





SYDNEY CONSTRUCTION MATERIALS

Trading name for Newnes Kaolin Pty Ltd
ABN: 71 065 564 794

SUPPLEMENTARY INFORMATION

- ***Enhanced Quarry Plan***
- ***Revised Noise Impact Assessment***
- ***Clarification of Flora and Fauna Study***
- ***Surface Water Management Plan***
- ***Response to NPWS Comments on the Archaeological Assessment***
- ***Conservation, Restoration, and Enhancement Project***
- ***Supplementary Visual Impacts Assessment***
- ***Hydrogeological Impact Report***
- ***Comprehensive Soil and Water Management Plan***
- ***Additional Supplementary Information***

April 2005

Executive Summary

Sydney Construction Materials (SCM) is seeking approval for the development of a construction sand, specialty sand, and Kaolin extraction operation at Newnes Junction, near Lithgow.

In May 2003, after over 10 years of extensive scientific and market research and development, SCM submitted a Development Application (DA) and accompanying Environmental Impact Statement (EIS) to the Department of Infrastructure, Planning, and Natural Resources (DIPNR) for assessment. Following the public display period, SCM received 10 government agency submissions and 28 public submissions on the EIS, addressing a range of issues, and requesting additional information.

One particular area in which additional information was sought was that of hydrogeology. DIPNR requested that further studies be conducted, and in the period during which those investigations were being arranged, approved, and conducted, SCM took the opportunity to make some amendments and enhancements to its original proposal, including:

- development of an Enhanced Quarry Plan,
- revision of the Noise Impact Assessment following quarry plan alterations,
- clarification of Flora and Fauna Study,
- upgrade and enhancement of the Surface Water Management Plan,
- response to NPWS comments on the Archaeological Assessment,
- development of the Newnes Junction Conservation, Restoration, and Enhancement Project, developed under the emerging NSW environmental offsets policy,
- augmentation of the Visual Impacts Assessment,
- preparation of a Hydrogeological Impact Report (as requested by DIPNR), and
- production of a Comprehensive Soil and Water Management Plan.

This paper provides a summary of, and forms a consolidated volume of the above reports.

List of Reports in Supplementary Submission

Following is a list of documents submitted to DIPNR following government agency and public submissions to the Sydney Construction Materials EIS received during the public display period.

A. ***Quarry Plan*** (MineConsult Pty Ltd, May 2004) – **[Document A]**

B. ***Noise Impact Assessment*** (Atkins Acoustics and Associates Pty Ltd, May 2004) – **[Document B]**

C. ***Flora and Fauna Issues*** (Gunninah Consultants, May 2004) – includes revised Section 5A Assessments of Significance, information additional to that in the EIS – **[Document C]** – includes:

   C-a. ***Supplementary Vegetation and Flora Survey*** (HWR Pty Ltd – Andrew Carty, Geoff Winning, and John-Paul King) – **[Appendix A, Document C]**

   C-b. ***Supplementary Survey for the Blue Mountains Water Skink*** (Biosphere Environmental Consultants Pty Ltd – Dr Arthur White) – **[Appendix B, Document C]**

D. ***Surface Water Management Plan*** (Hughes Trueman Pty Ltd, May 2004) – **[Document D]**

E. ***Response to NPWS Comments on the Archaeological Assessment*** (Mills Archaeological and Heritage Services Pty Ltd, August 2003) – **[Document E]**

F. ***Conservation, Restoration, and Enhancement Project***, compiled under the State Government's developing Green Offsets policy (Sydney Construction Materials, November 2004) – **[Document F]**

G. ***Supplementary Visual Impacts Assessment*** (Sydney Construction Materials, December 2004) – **[Document G]**

H. ***Hydrogeological Impact report*** (Kalf and Associates Pty Ltd, December 2004) – **[Document H]**

I. ***Soil and Water Management Plan*** (GSS Environmental, October 2004) – **[Document I]**

J. ***Additional Supplementary Information*** (Sydney Construction Materials, March 2004) – **[Document J]**

Documents A-E were submitted to DIPNR on 26th May 2004. Documents F-I were submitted to DIPNR on 11th January 2005. Document J was submitted to DIPNR on 14th April 2005.

Overview

This section provides an overview of the documents contained in this Supplementary Information Submission.

1. Revised Quarry Plan and Quarrying Method

Following advice by DIPNR for this project to meet the noise assessment criteria at all residential receptors at all stages of the operation, Sydney Construction Materials (SCM) has developed an innovative extraction process that is now included as part of the development proposal (**Document A**).

The method involves the use of a surface miner as the primary extraction unit and scrapers to deliver the material to the stockpiling area, rather than dozers, front-end loaders and trucks. This approach will reduce both noise and dust emissions, and will reduce the potential for erosion impacts. A description of the method is contained in the report by MineConsult and photographs of the Surface Miner are attached (Figure 9).

Technical information on the operation of the surface miner was provided by Wirtgen Australia Pty Ltd. Extraction planning and scheduling was reviewed by Don Reed and Associates (DRA).

As shown on the mine plan (Figures 2 to 7), the sequence of the benches remains largely unchanged but the starting point will be at the western end and will move progressively to the east and south. Additionally, the size of each bench will be larger given that it will be worked at the same level throughout. As the excavation expands, final slope batters and berms will be formed and progressively rehabilitated in the same way as previously proposed.

SCM have also included a minor alteration to the mine footprint to protect an area of swampy vegetation in a watercourse in the south-eastern part of the site. This was a result of the additional flora surveys (**Document C**), which addressed *inter alia* the presence or otherwise of the Newnes Plateau Shrub Swamp (NPSS). This community was not recorded on the site but the swampy vegetation in the south-east has some affinities with NPSS, and will therefore be excluded from the mine plan with an additional buffer.

The overall footprint of the extraction area will consequently be slightly smaller than shown in the EIS. The new final footprint is provided in Figure 1.

The following table summarises the primary differences between the quarry plan proposed in the 2003 EIS and that presented in the MineConsult report.

Table 1: Comparison of Current and 2003 EIS Quarry Plan

Item	2003 EIS Quarry Plan	2004 Quarry Plan
Area of quarry	25.4 ha	25 ha
Rock reserves	23.7 Mt	20.6 Mt
Quarry life	21 years	20 years
Pit base	970 mRL	990 mRL
Quarrying sequence	North to south direction in stacked benches	Top to bottom with open, wide benches
Rock fragmentation method	Rip and doze	Surface Miner
Loading	Front-end loader	Self loading scrapers
Pit haulage	Rear dump trucks	Self loading scrapers
Crushing	Jaw Crusher	None required
Surface water management	1 in 50 year design capacity	1 in 100 year design capacity
Marginal swamp vegetation	Some disturbance	No disturbance
Noise mitigation	Rock mound / mound wall	Acoustic barrier

2. Revised Noise Impact Assessment

Atkins Acoustics was engaged by Sydney Construction Materials to conduct noise modelling and prepare a noise impact assessment for the Newnes Junction Project. Atkins Acoustics Report No. 33.5058.R1.Rev03:CF57, dated March 2003, identified noise exceedances during extraction activities under the original mine plan.

A revised study (**Document B**) was commissioned following a redesign of the mine plan, and a modification of the proposed mining method in order to meet project specific noise levels at the referenced residential premises.

The main aims of the study were to:

- review and comment on the existing ambient background noise levels prevailing in the vicinity of the site;
- establish noise assessment goals in accordance with the Department of Environment and Conservation (DEC) Industrial Noise Policy (INP);
- establish noise assessment goals in accordance with the Department of Environment and Conservation (DEC) Environmental Noise Control Manual (ENCM);
- identify and quantify the main noise sources associated with the proposal;

- predict and evaluate the likely range of noise emissions during site establishment phases and extraction;
- assess potential noise impacts; and
- recommend ameliorative noise control measures.

Noise modelling of activities associated with construction has shown that the recommended assessment goals for site preparation, infrastructure development and pollution control can generally be achieved at all reference residential locations. Noise modelling for acoustic barrier construction has confirmed that exceedances of up to 13dB(A) at some reference locations (R1-R3) may occur for an expected duration of two (2) weeks from initial clearing by dozer.

During the initial stages of the mine development, an acoustic/visual barrier will be constructed along the western, south-western, and southern limits of the pit. The barrier will assist in reducing noise emission from infrastructure development, site preparation, pollution control and mining operations.

The findings of the noise modelling for the proposal have shown that with appropriate selection of equipment, effective noise controls, and management procedures, noise during normal mining operations and train loading can be controlled to satisfy the project specific assessment goals under calm and west wind meteorological conditions for all stages at all reference residential assessment locations.

With respect to the Blue Mountains National Park, the assessment has shown under mining operations, the recommended noise goal of 50dB(A) can be satisfied within one hundred and fifty (150) metres of the park boundary.

The assessment also found the predicted noise levels associated with rail movements on the main western rail line satisfy the recommended L_{Amax} 85dB(A) and $L_{Aeq\ 24hour}$ 60dB(A) assessment goals.

Irrespective of being able to meet INP requirements, the Company will honour its commitment to enter into sale and compensation agreements with residents of Newnes Junction.

3. Clarification of Flora and Fauna Study

Sydney Construction Materials engaged three additional consultants to undertake further flora and fauna surveys on the site (**Document C**). The results of these assessments confirm the findings of the EIS.

No threatened flora species were detected on the site despite intense targeted searches. Additionally, areas considered by others to be potential Newnes Plateau Shrub Swamp do not satisfy the criteria for that community as they do not contain the necessary structure, floristics, or key swamp species. These areas were described in the EIS and the same conclusions drawn.

Irrespective of this finding, we have proposed to exclude from the mine plan an area of swampy vegetation (with some affinities to Newnes Plateau Shrub Swamp) in the south-east of the site. In addition, the plan includes a buffer and has adopted the additional mitigation measures proposed by Gunninah Consultants, namely, the diversion of clean water from above the mine into the wet area, and additional ongoing vegetation monitoring and management.

4. Enhanced Surface Water Management

As a result of the change in the mining method, the extraction area under the new plan will now expand more quickly. To accommodate this, SCM has modified the timing of construction of the water management controls (**Document D**). These water management controls have also been increased in size to accommodate the 100 year ARI 72 hour storm. However, these structures will still discharge back into the mine void as previously proposed in the EIS.

The new mining method will also allow for the construction of a series of "in-pit" absorption banks to reduce the potential for erosion of the pit floor. The banks will also reduce the time of concentration of water flows, which in turn increases the ability to contain the coarser sand fraction before the water enters the main sediment control structures. This is an added benefit of the proposed mining method, and will increase the efficiency of the water treatment plant.

The original water pollution control system as described in the EIS remains substantially unchanged. It is still proposed to contain the "in-pit" water on site in a series of water retention ponds, and then pass the water through an on-site treatment plant to produce water of ANZECC Code quality, suitable for discharge. In addition it is now proposed that this water be utilised in an on-site nursery, to be developed in conjunction with local residents and the Lithgow Community Nursery, as well as for re-establishment of reservoir water supply to the residents of Newnes Junction.

5. Archaeological Assessment

Submissions to the EIS suggested that the Aboriginal Archaeological Assessment was insufficient. Sydney Construction Materials requested clarification from Mills Archaeological and Heritage Services (**Document E**). The clarification states:

> "Two experienced archaeologists and an experienced field officer from the Bathurst LALC conducted the survey of the Kaolin Mine. It is the professional opinion of the consultants and the LALC representative, that there are no "*heritage values*" located "*on the development area*". This assessment is based on the survey of 38 ha of the Kaolin development area of which, taking an average 30% visibility across the site into account, an estimated 30.8% or 11.6 ha were effectively surveyed."

The clarification paper provides details of how this determination was made.

6. Conservation, Restoration, and Enhancement Project

Consistent with emerging NSW environmental offsets policy, Sydney Construction Materials has prepared a report (**Document F**) to provide the basis for ensuring that the net environmental result of the development is positive.

The project involves the adoption of nine offset objectives, designed with the NSW Government's developing offsets policy in mind. This will provide a framework for the execution of the projects described in this paper, and will enable relevant government authorities to gauge the success of this strategy.

Sydney Construction Materials intends to work with these government authorities to ensure the final result of this operation is a net gain for the community and the environment.

Sydney Construction Materials intends to mitigate the impact of the Newnes Junction development through the provision of both on-site and off-site offsets. On-site offsets include innovative rehabilitation and final landform design techniques that will be employed to create an area that is aesthetically appealing and consistent with the surrounding landscape. Off-site, three separate offset projects will be undertaken:

1. The first project involves the rehabilitation of a nearby area of Newnes Plateau Shrub Swamp, an important plant community in the region, and a potential habitat for endangered fauna species.
2. The second project involves the rehabilitation and on-going management of a scenic and historically significant area of vacant Crown land – the Dargan's Creek Reserve.
3. The third project involves the establishment of a native plant nursery to provide plant stock for the extractive operation's rehabilitation, and to supply the local community with a variety of native flora.

Sydney Construction Materials will provide upfront funding for these offsets, and will continue to fund them for the duration of the development. It is proposed that the Hawkesbury-Nepean Catchment Management Authority (HNCMA) become the Scheme Manager, holding and disbursing the funds, and using its standard project reporting process to report to the Company, DIPNR, NSW EPA, and other relevant stakeholders.

The implementation of this strategy will provide a benchmark for environmentally friendly extractive operations that are capable of delivering significant environmental, economic, and social gains to the wider community.

7. Supplementary Visual Impacts Assessment

Section 5.5 of the Sydney Construction Materials EIS (2004) dealt with the visual implications of the proposed development. Sydney Construction Materials compiled a paper (**Document G**) to supplement that section of the EIS.

Measures taken to mitigate the potential visual impact in relation to this development include:

- the use of environmentally consistent colour schemes for all visible infrastructure (site office, water treatment facility, conveyor, and train loading system),
- the use of progressive clearing, minimising the total area of land cleared at any given time,
- the use of progressive rehabilitation, further minimising the total area of land cleared ant any given time,
- the use of terraced landscaping, which will ensure that there will be no more than 3 vertical metres of exposed rock wall at any given time, and

- a final landform design inspired by a nearby natural feature, known as "Gooches Crater".

These design features will allow the development to be rapidly integrated into the surrounding landscape both during and after operations.

Sydney Construction Materials engaged MineConsult to prepare visual transects of the proposed development from the areas identified in Section 5.5 of the EIS. These transects provide an understanding of how the development will look at the end of operations from nearby selected vantage points. They demonstrate that the visual impact from those locations will be minimal.

A review of formed bushwalking tracks in the area was also conducted. It revealed that there are no formed bushwalking tracks with a clear view of the development within 5km, indicating that the chance of a recreational bushwalker being visually impacted by the development is minimal.

Due to the mining and rehabilitation methods proposed to be employed by Sydney Construction Materials, the visual impact from the Newnes Junction development will be minimal at all times.

8. Hydrogeological Impact report

The main conclusions drawn from the Hydrogeological Impact report (**Document H**) are:

1. The drilling and testing of three sets of observation bore piezometers around the periphery of the proposed mine pit has indicated low permeability sandstone, validating a previous assessment. Bulk permeability is likely to be in the range of 0.02 – 0.05 m/day, with 0.02 m/day the most likely.
2. Numerical model simulation of the proposed mining over a 20-year period indicates that two years or so after mining stops, the groundwater system would reach equilibrium. The final land form at that time will only influence the water table locally, but will still allow the majority of deeper groundwater flow to reach the river drainage system.
3. Mining at the site will have no influence on the groundwater system at the Clarence Village as this groundwater is well beyond the drawdown influence of the proposed development.
4. Inflow to the pit is unlikely to exceed 0.8 ML/day, with much less inflow likely during operation.
5. Some years after mining ceases the pit will behave as a flow-through system and become an elevated wetland zone of good quality water.
6. The Rocla quarry, which was established in the 1970s, indicates that watertable drawdown around the pit has not influenced vegetation species surrounding the pit as these plants rely mainly on soil moisture conditions for survival. The same conditions would apply to the proposed development and therefore no influence on vegetation surrounding the development would be expected.
7. The development's construction will not measurably influence surface runoff or baseflow in the Wollangambe River system because of the

relatively small area of the total catchment affected. Seepage and surface flow from the area will in time be re-established to the catchment.

8. Once operations commence, water level measurements should be conducted initially on a monthly basis in each hole over time to establish seasonal trends, and then measured approximately every three months. This consideration is suggested to allow the drawdown estimates provided in the report to be verified.

9. Soil and Water Management Plan

Sydney Construction Materials commissioned GSS Environmental to develop a comprehensive Soil and Water Management Plan (**Document I**) to address in detail all aspects of:

- soil disturbance,
- erosion prevention,
- soil storage and movement,
- retention of any mobilised sediments, and
- soil-related aspects of water management on and off the site.

The plan is intrinsically related to the *Surface Water Management Plan* for the development, prepared by Hughes Trueman Pty Ltd (**Document D**).

In addition, the report sets out to address the specific requirements identified by the various government agencies, and as outlined in the Director General's Requirements provided by DIPNR, including specific requirements by (the former) NPWS, now part of DEC.

This SWMP has been formulated by GSS Environmental in accordance with the NSW Department of Housing's "*Managing Urban Stormwater: Soils and Construction Manual*" (2004), or the "Blue Book" as it is known in government circles.

10. Additional Supplementary Information

Following a meeting with DIPNR on 23rd February 2005, Sydney Construction Materials prepared a document containing responses to all outstanding issues and requests for information. It includes responses on:

1. Noise Impact Assessment
2. Visual Impact of Acoustic Barrier
3. Flora and Fauna Assessment
4. Impacts of Vegetation Clearing
5. Surface Water Impacts
6. Final Void
7. Groundwater Assessment
8. Iron Factor
9. Justification of Kaolin Extraction

10. Interactions with Zig-Zag Railway
11. Flora and Fauna Assessment
12. Aboriginal Heritage Assessment
13. Potential Air Quality Impacts
14. Potential Noise Impacts
15. Groundwater Assessment

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT A

Quarry Plan

MineConsult

May 2004

SYDNEY CONSTRUCTION MATERIALS

NEWNES JUNCTION SAND AND KAOLIN EXTRACTION PROJECT

QUARRY PLAN

MineConsult
mine management consultants

May, 2004
Job No. 1864

CONFIDENTIALITY
AND
USE OF INTELLECTUAL PROPERTY

The information contained in this document is solely for the use of the client identified on the cover sheet for the purpose for which it has been prepared.

This document, comprising figures, tables, appendices or any other inclusions, remains the intellectual property of MineConsult Pty Ltd (MineConsult).
No party or individual shall copy, modify, or publish the aforesaid material, or any part thereof, without written authorisation from MineConsult and full and proper acknowledgment of MineConsult's contribution.

TABLE OF CONTENTS

Page No.

1. INTRODUCTION 1

1.1 Study Background and Scope 1
1.2 Approach 1

2. QUARRY PLAN 3

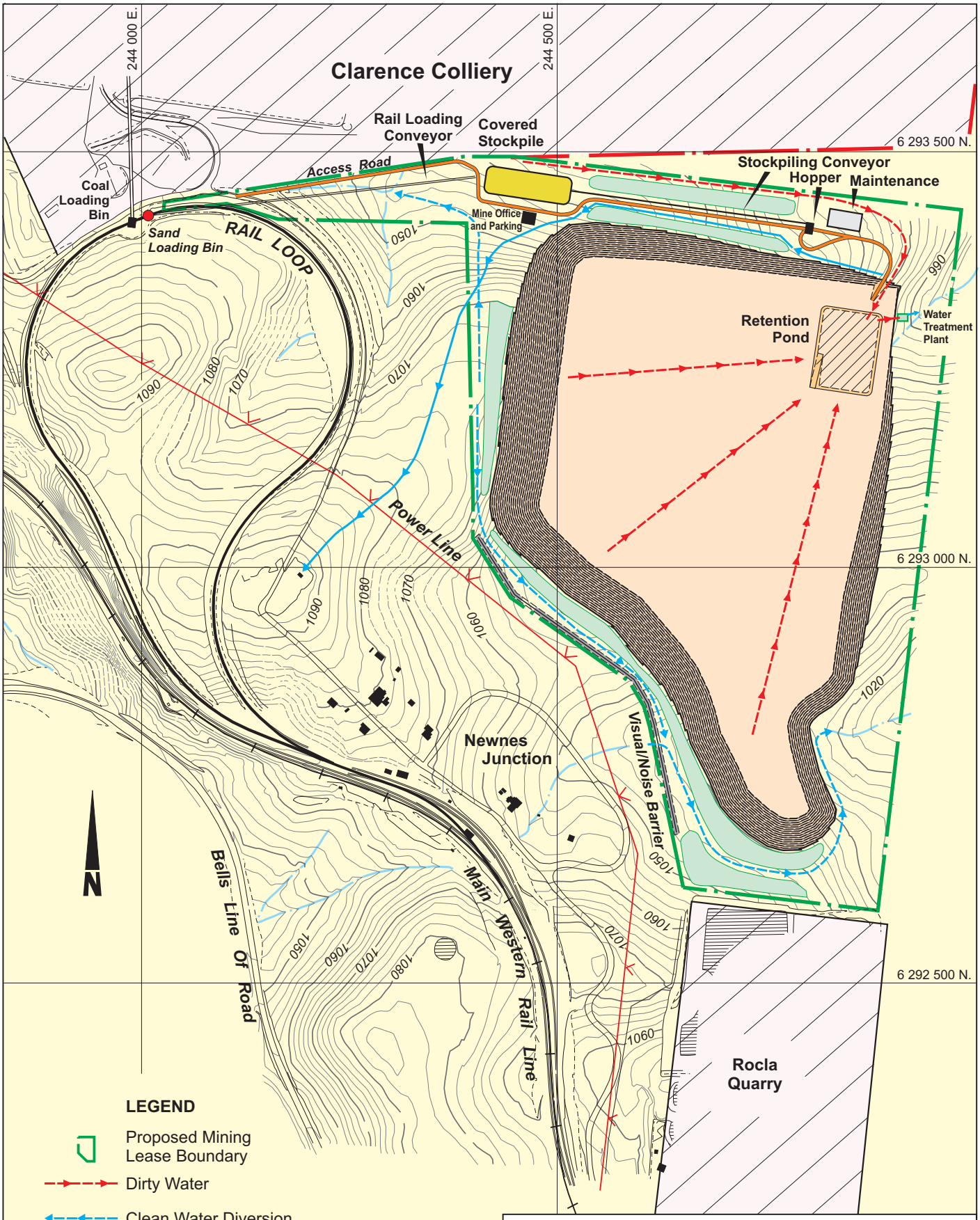
2.1 Introduction 3
2.2 Comparison of Current Quarry Plan with 2003 EIS Quarry Plan 3
2.3 Quarry Design 3
2.4 Quarry Product Quantities 4
2.5 Site Development 4
2.5.1 Site Preparation and Construction Stage 4
2.5.2 Quarry Development and Operations 5
2.5.3 Final Rehabilitation 6
2.6 Quarrying Method 6
2.7 On Site Materials Handling 7
2.8 Major Excavation Equipment 7
2.9 Fixed Plant and Infrastructure 8
2.10 Project Schedule and Hours of Operation 8
2.10.1 Construction Schedule 8
2.10.2 Operations Schedule 8
2.11 Workforce 8
2.11.1 Construction 8
2.11.2 Operation 9
2.12 Water Management 9

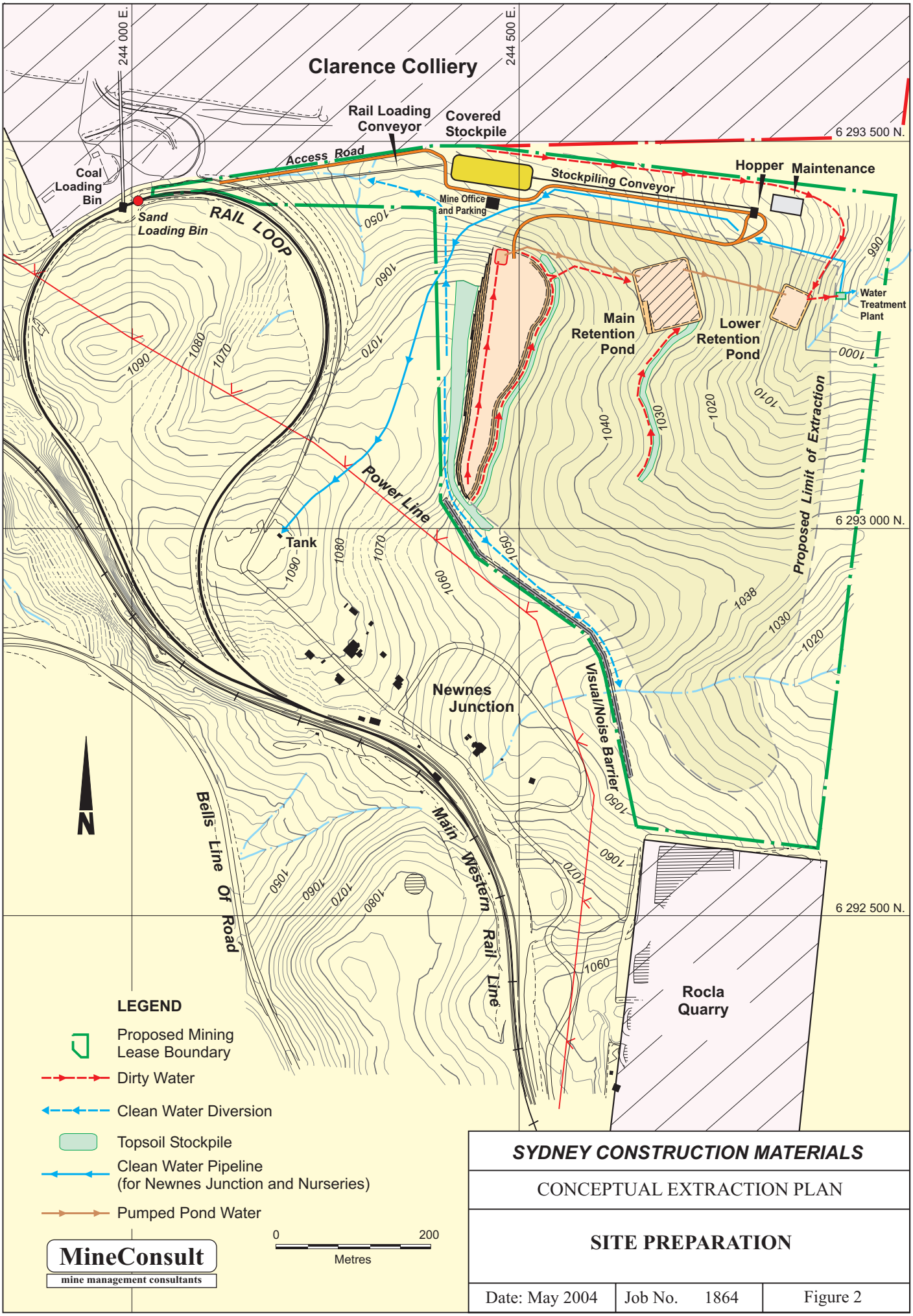
LIST OF TABLES

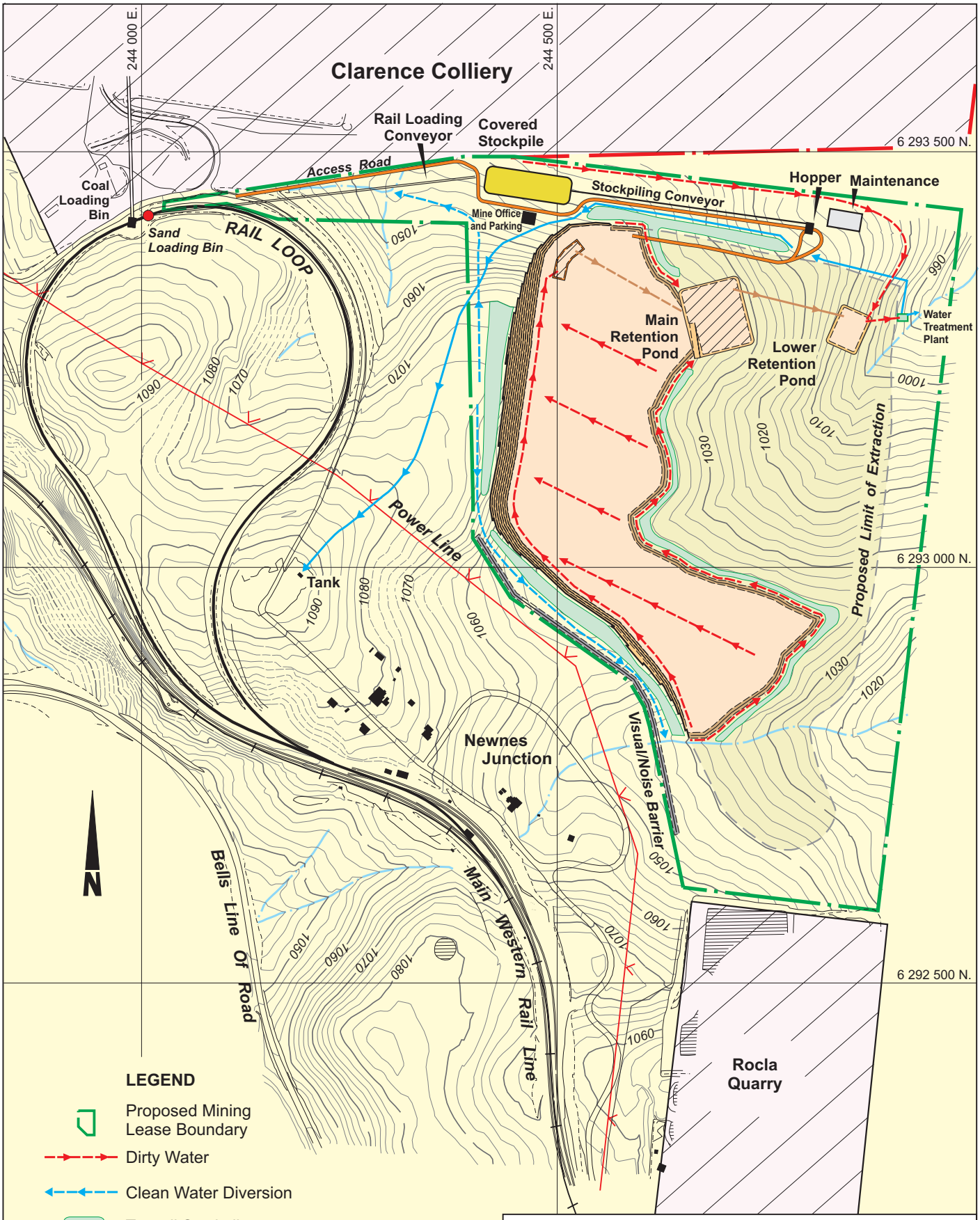
Table No.	Description	Page No
Table 2.1	Comparison of Current and EIS Quarry Plan	3
Table 2.2	Quarry Production	4

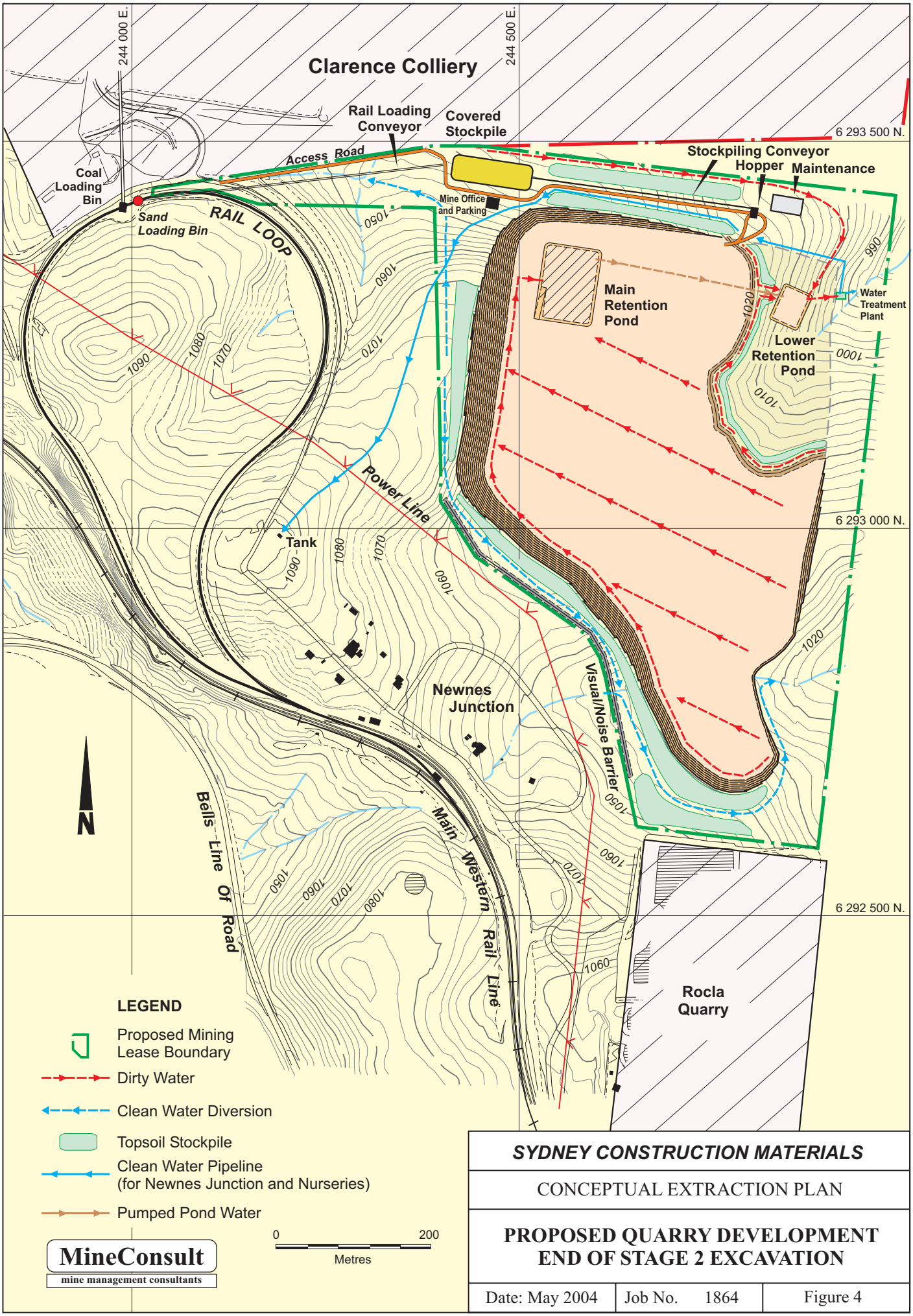
LIST OF FIGURES

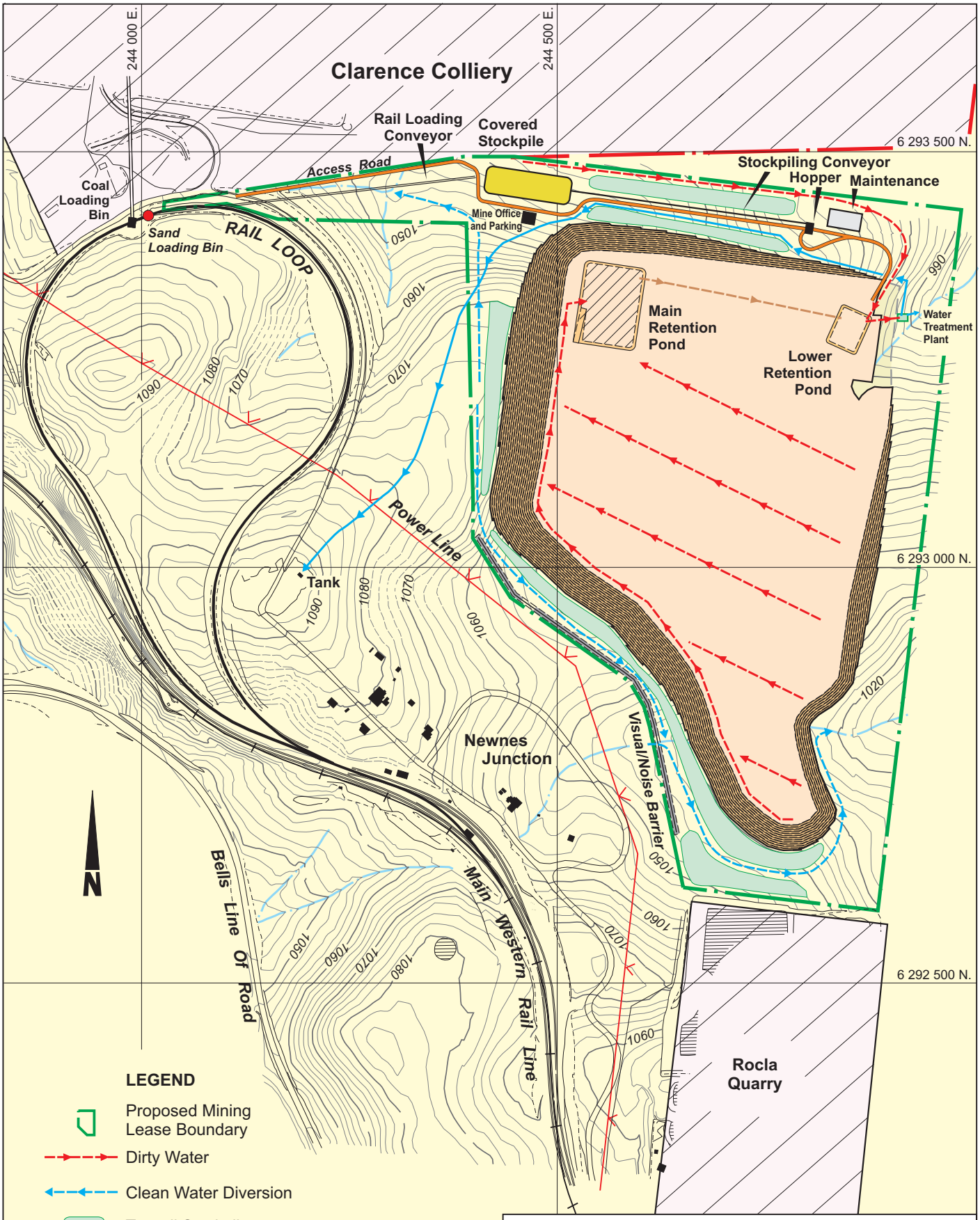
Figure No.	Description
1	Final Pit Development and Infrastructure Layout
2	Site Preparation
3	End of Stage 1 of Extraction
4	End of Stage 2 of Extraction
5	End of Stage 3 of Extraction
6	End of Stage 4 of Extraction
7	Timing of Extraction Stages
8	Final Rehabilitation
9	Final Rehabilitation 3D Perspective
10	Surface Miner

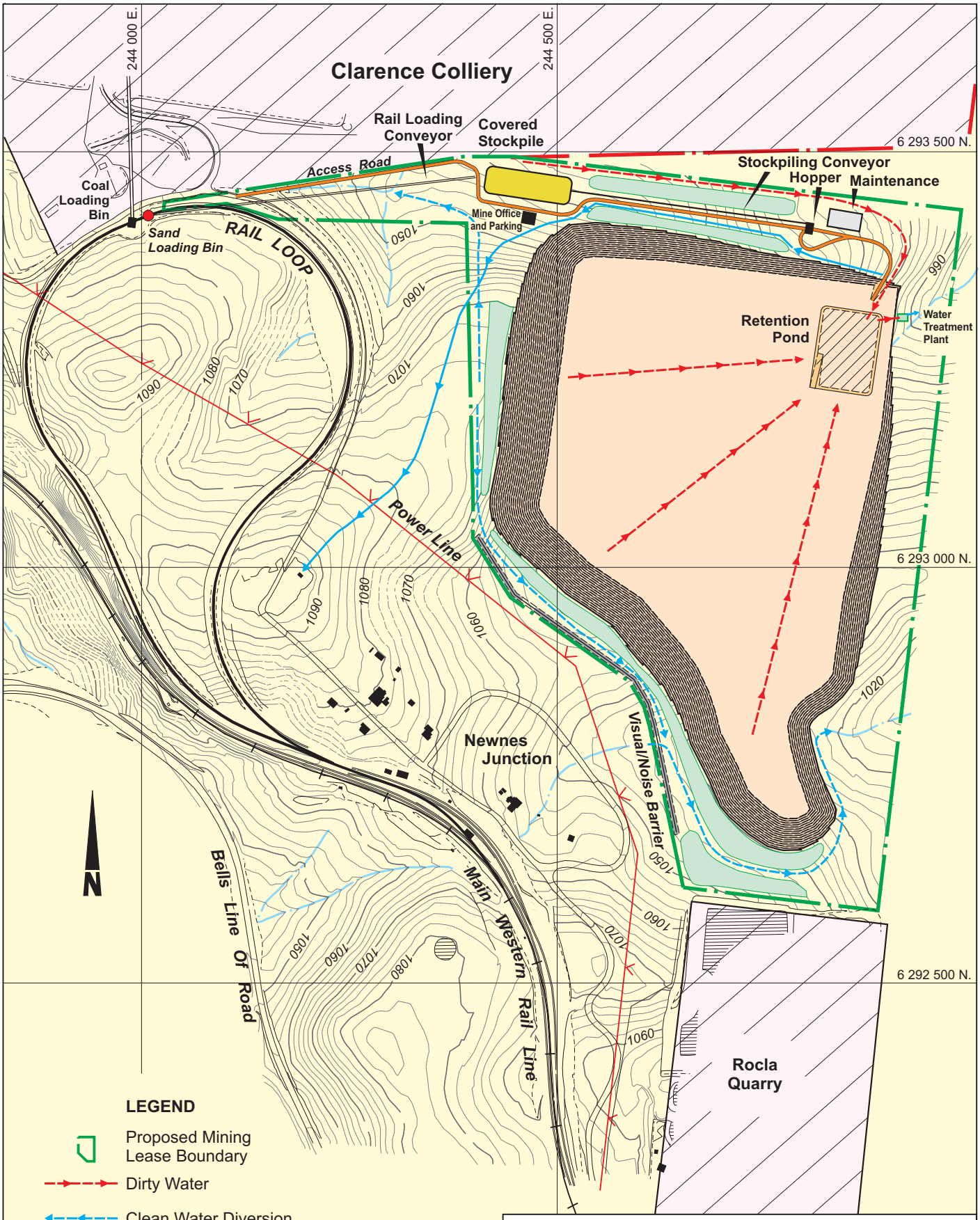

Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Stockpiling Conveyor Hopper
Maintenance
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Mine Office and Parking
Retention Pond
Water Treatment Plant
Power Line
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
FINAL QUARRY DEVELOPMENT AND INFRASTRUCTURE LAYOUT
Date: May 2004
Job No. 1864
Figure 1

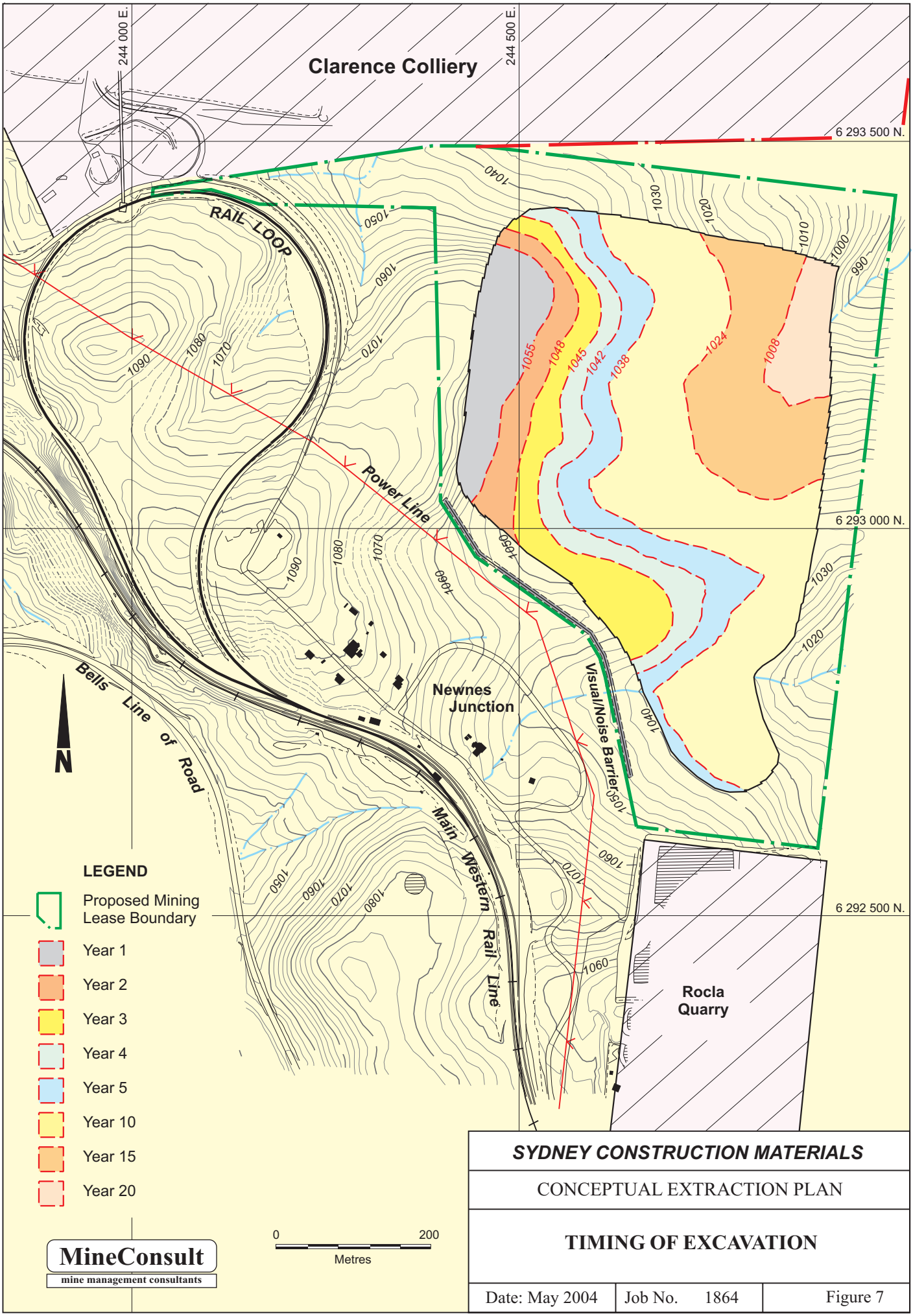

Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Stockpiling Conveyor
Hopper
Maintenance
Mine Office and Parking
Water Treatment Plant
Main Retention Pond
Lower Retention Pond
Proposed Limit of Extraction
Power Line
Tank
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
Pumped Pond Water
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
SITE PREPARATION
Date: May 2004
Job No. 1864
Figure 2

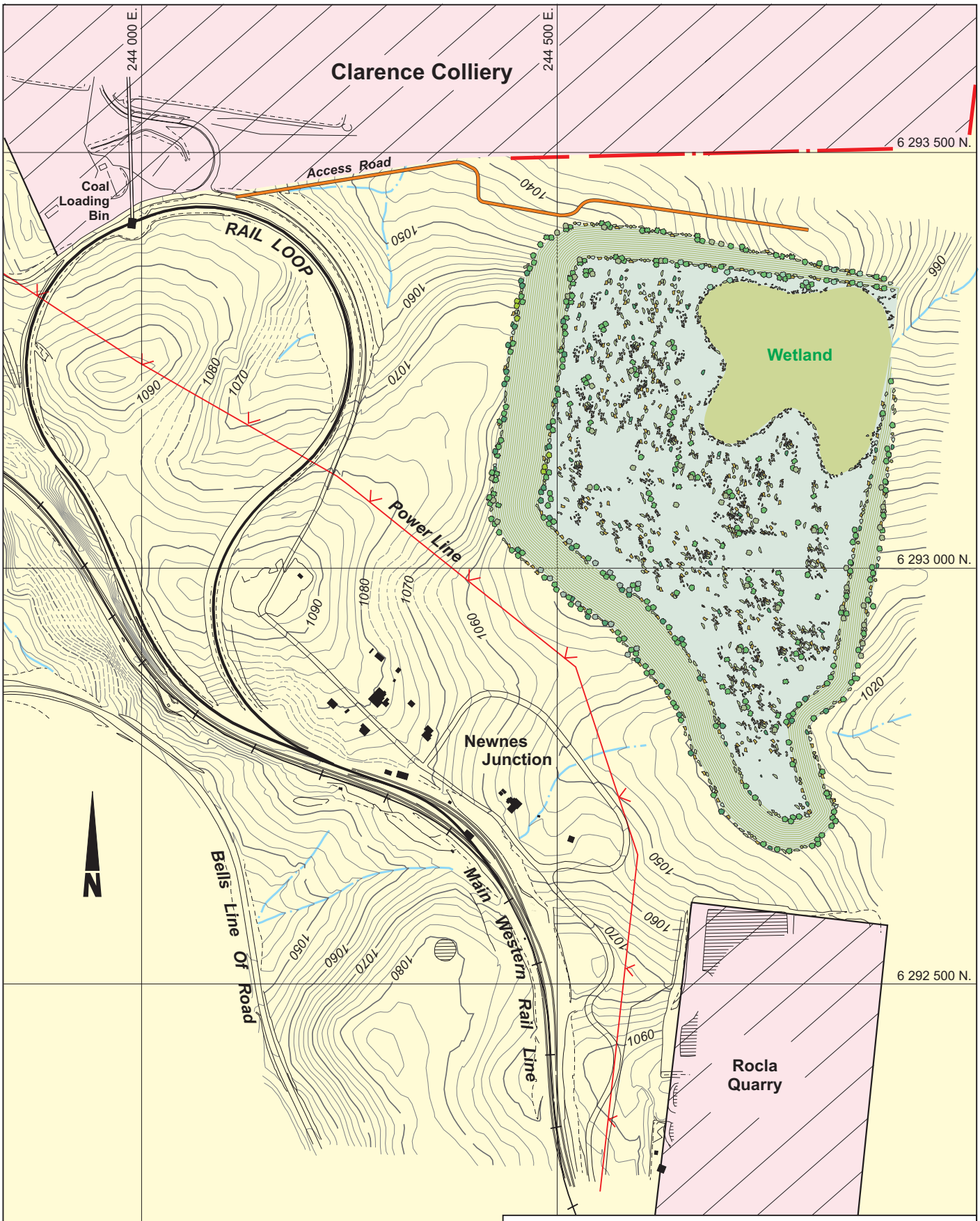

Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Stockpiling Conveyor
Hopper
Maintenance
Mine Office and Parking
Main Retention Pond
Lower Retention Pond
Water Treatment Plant
Proposed Limit of Extraction
Power Line
Tank
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
Pumped Pond Water
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
PROPOSED QUARRY DEVELOPMENT
END OF STAGE 1 EXCAVATION
Date: Apr. 2004
Job No. 1864
Figure 3


Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Mine Office and Parking
Stockpiling Conveyor Hopper
Maintenance
Main Retention Pond
Water Treatment Plant
Lower Retention Pond
Power Line
Tank
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
Pumped Pond Water
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
PROPOSED QUARRY DEVELOPMENT
END OF STAGE 2 EXCAVATION
Date: May 2004
Job No. 1864
Figure 4


Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Mine Office and Parking
Stockpiling Conveyor Hopper
Maintenance
Main Retention Pond
Lower Retention Pond
Water Treatment Plant
Power Line
Tank
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
1090
1080
1070
1060
1050
1020
990
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
Pumped Pond Water
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
PROPOSED QUARRY DEVELOPMENT
END OF STAGE 3 EXCAVATION
Date: May 2004
Job No. 1864
Figure 5


Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
Rail Loading Conveyor
Covered Stockpile
Access Road
Stockpiling Conveyor Hopper
Maintenance
Coal Loading Bin
Sand Loading Bin
RAIL LOOP
Mine Office and Parking
Retention Pond
Water Treatment Plant
Power Line
Newnes Junction
Visual/Noise Barrier
Bells Line Of Road
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Dirty Water
Clean Water Diversion
Topsoil Stockpile
Clean Water Pipeline (for Newnes Junction and Nurseries)
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
PROPOSED QUARRY DEVELOPMENT
END OF STAGE 4 EXCAVATION
Date: May 2004
Job No. 1864
Figure 6


Clarence Colliery
244 000 E.
244 500 E.
6 293 500 N.
6 293 000 N.
6 292 500 N.
RAIL LOOP
Power Line
Bells Line of Road
Newnes Junction
Visual/Noise Barrier
Main Western Rail Line
Rocla Quarry
N
LEGEND
Proposed Mining Lease Boundary
Year 1
Year 2
Year 3
Year 4
Year 5
Year 10
Year 15
Year 20
0
200
Metres
MineConsult
mine management consultants
SYDNEY CONSTRUCTION MATERIALS
CONCEPTUAL EXTRACTION PLAN
TIMING OF EXCAVATION
Date: May 2004
Job No. 1864
Figure 7



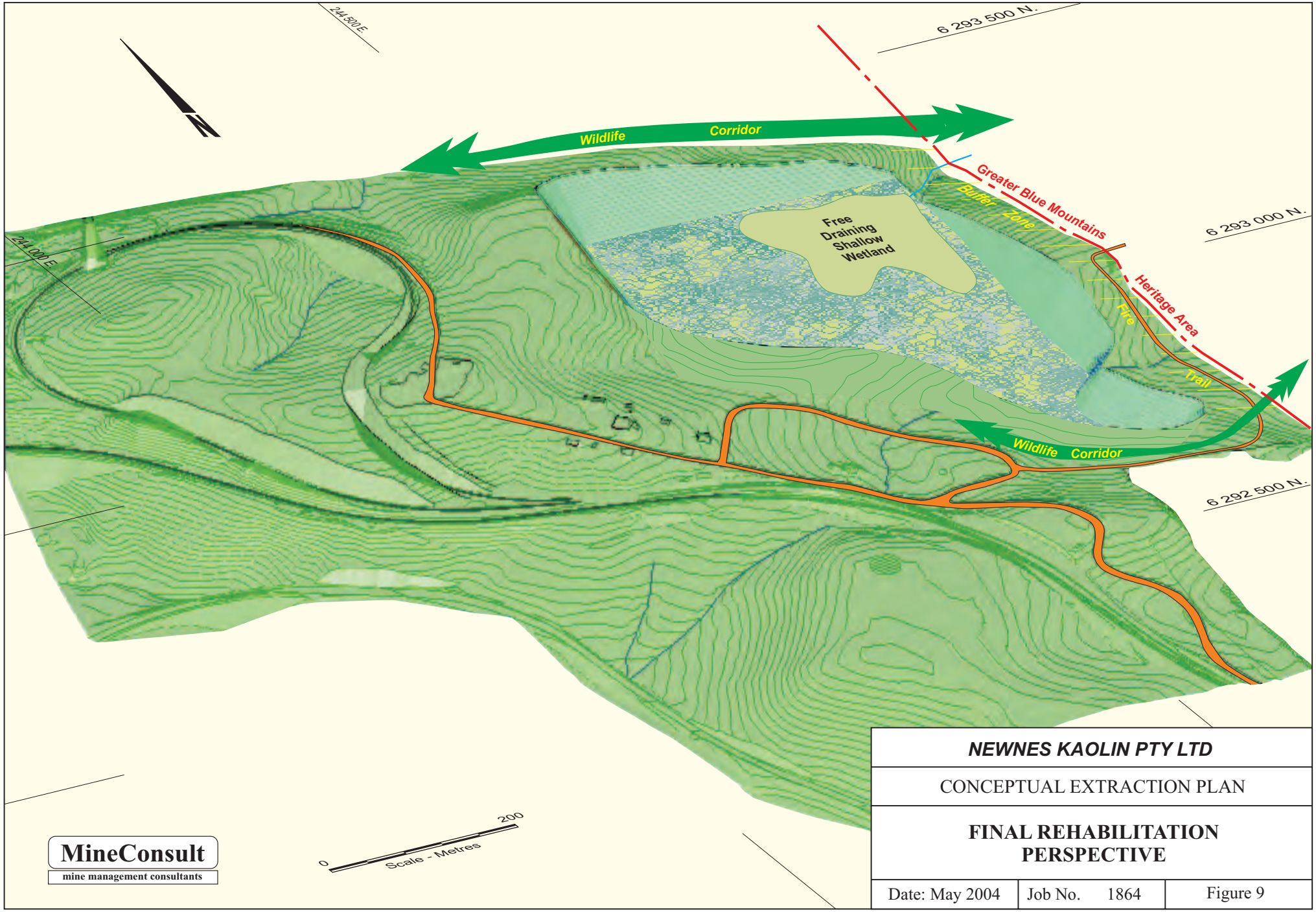
MineConsult
mine management consultants

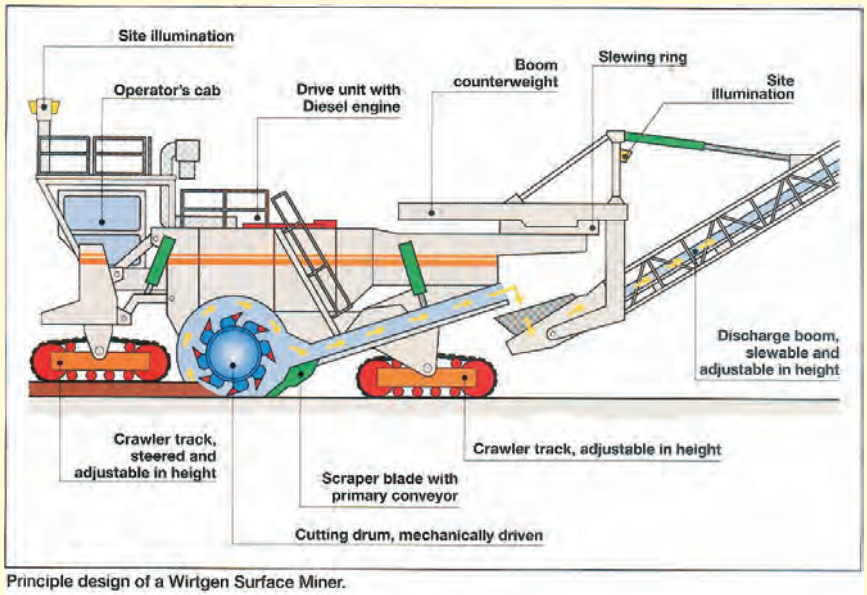
SYDNEY CONSTRUCTION MATERIALS

CONCEPTUAL EXTRACTION PLAN

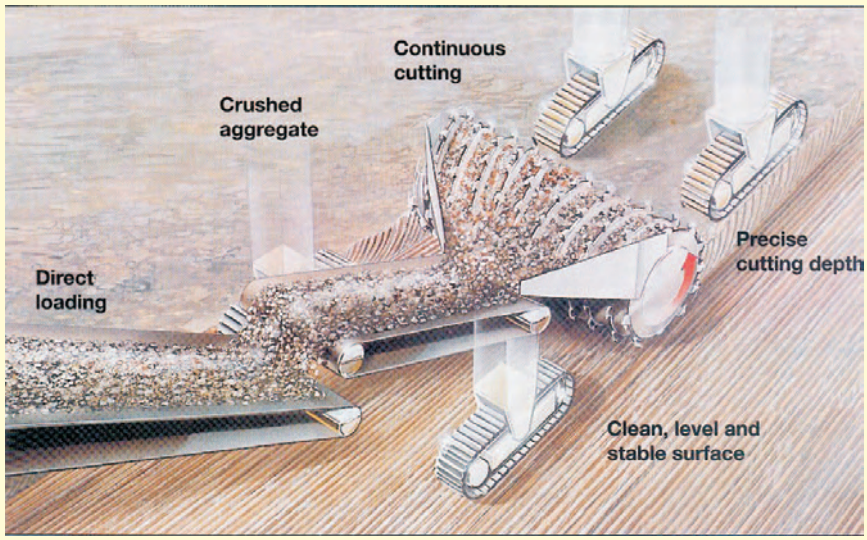
FINAL REHABILITATION

Date: May 2004	Job No. 1864	Figure 8


244 500 E.
6 293 500 N.
Wildlife Corridor
Greater Blue Mountains
Buffer Zone
Free Draining Shallow Wetland
6 293 000 N.
244 000 E.
Heritage Area
Fire Trail
Wildlife Corridor
6 292 500 N.
0
200
Scale - Metres
MineConsult
mine management consultants
NEWNES KAOLIN PTY LTD
CONCEPTUAL EXTRACTION PLAN
FINAL REHABILITATION PERSPECTIVE
Date: May 2004
Job No. 1864
Figure 9



Principle design of a Wirtgen Surface Miner.





NEWNES KAOLIN PTY LTD

CONCEPTUAL EXTRACTION PLAN

SURFACE MINER

CONVEYOR DISCHARGE WILL NOT APPLY

MineConsult
mine management consultants

Date: May 2004	Job No. 1864	Figure 10

1. INTRODUCTION

1.1 Study Background and Scope

Sydney Construction Materials (SCM) proposes to develop an open pit operation to quarry friable sandstone from a mining lease application within EL4192, near Newnes Junction, NSW. The development is limited to extracting the sandstone resource at a location bounded on three sides by existing sand extraction and coal mining operations and associated infrastructure. There is no proposal for any onsite processing of extracted material as all is to be railed to Sydney for off-site processing. The off-site processing will produce kaolin and sand products.

A quarry plan was prepared by MineConsult Pty Ltd (MineConsult) in 2001 that involved developing the quarry in stacked benches progressing from north to south. The extraction method involved:

- rip and doze by large dozer to fragment and heap the rock
- loading by front-end loader into rear dump haul trucks,
- haulage and dumping onto grizzly and crusher, and
- crushing and placement of material on a stockpile prior to being conveyed and loaded onto trains for transport.

The quarry plan was incorporated into the proposed development's Environmental Impact Statement (EIS) which was submitted to NSW Department of Infrastructure, Planning and Natural Resources (DIPNR) in May, 2003.

Feedback to the EIS from the statutory authorities suggested that the proposed quarry development required additional planning to further mitigate impacts on the surrounding environment.

In response, SCM commissioned MineConsult to improve the quarry plan and review environmental issues across all aspects but with a particular focus on the areas of:

- noise mitigation
- surface water management, and
- flora and fauna impact mitigation.

MineConsult only considered those aspects directly relevant to the quarrying operation and incorporated measures to mitigate the environmental impact based on feedback from the other consulting specialists, including Atkins Acoustics Pty Ltd and Hughes Trueman Pty Ltd.

The purpose of this report is to support SCM's modified Development Application to the DIPNR.

1.2 Approach

MineConsult initiated research into alternative extraction methods and noise reduction technology to enable noise criteria to be met. Further modifications were made to the quarry

design to incorporate feed back from consulting specialists in the areas of flora and fauna management and water management.

All other relevant environmental aspects were reviewed in the course of modifying the quarry plan to ensure impacts from the quarrying operation were mitigated for the surrounding environment and nearby residents.

The work has been completed to a level of detail considered appropriate for review of the quarry plan. Further work is recommended following development approval to confirm the requirements of the quarry operation.

Technical information on the operation of the surface miner was provided by Wirtgen Australia Pty Ltd who also provided information to SCM. MineConsult understands that SCM has completed their own assessment of the economic viability of the proposed mining method.

Extraction planning and scheduling was reviewed by Don Reed and Associates (DRA) in consultation with SCM.

2. QUARRY PLAN

2.1 Introduction

A full description of the site, its surrounds and the geological resource is provided in the 2003 EIS. The following description primarily focuses on areas in which the quarry plan has been modified from that presented in the 2003 EIS. The reader is referred back to the 2003 EIS for a more detailed description of aspects outside of that covered below.

2.2 Comparison of Current Quarry Plan with 2003 EIS Quarry Plan

The following table summarises the primary differences between the quarry plan proposed in the 2003 EIS and that presented in this report.

Table 2.1
Comparison of Current and 2003 EIS Quarry Plan

Item	2003 EIS Quarry Plan	2004 Quarry Plan
Area of quarry	25.4 ha	25
Rock reserves	23.7 Mt	20.6 Mt
Quarry life	21 years	20 years
Pit base	970 mRL	990 mRL
Quarrying sequence	North to south direction in stacked benches	Top to bottom with open, wide benches
Rock fragmentation method	Rip and doze	Surface Miner
Loading	Front-end loader	Self loading scrapers
Pit haulage	Rear dump trucks	Self loading scrapers
Crushing	Jaw Crusher	None required
Surface water management	1 in 50 year design capacity	1 in 100 year design capacity
Marginal swamp vegetation	Some disturbance	Minimal disturbance
Noise mitigation	Rock mound / mound wall	Acoustic barrier

All other aspects of the proposed development are largely unchanged, including:

- construction period
- hours of operation
- materials handling and stockpiling, and
- method of off-site product transport.

2.3 Quarry Design

The open cut quarry design and infrastructure layout is shown in **Figure 1**. The design is based on maintaining substantial buffers to the Newnes Junction residents and National Park, reducing disturbance to the marginal Newnes Plateau swamp vegetation in the southwest and having sufficient area for the required infrastructure. The pit depth is variable as it is located on the side of a hill and ranges from 80m on its western wall to only a few metres in the east. The maximum pit dimensions are 750 m in length north-south by 460 m in width. The final

wall slope has a 2m wide berm every 3 m in vertical height providing regular terraces for planting of vegetation as part of the progressive rehabilitation and eventual screening of walls.

The changes to the quarry design from that presented in the 2003 EIS are as follows:

- southeast crest modified to reduce disturbance to swamp vegetation
- construction of internal drainage within the pit to ensure zero discharge from the disturbed area runoff catchment in conditions of up to a 1 in 100 year storm event;
- pit base raised to prevent a large lake formation as proposed in the final rehabilitation plan of the 2003 EIS,
- pit base drainage modified to ensure final rehabilitation has a free-draining surface as recommended by DIPNR, and
- modifications to the quarry design has reduced the rock reserves from 23.7 Mt to 20.6 Mt..

The road design and location is largely unchanged to that presented in the 2003 EIS.

2.4 Quarry Product Quantities

The products obtained from the friable sandstone following processing include kaolin and high quality sands, as shown in **Table 2.2**.

Table 2.2
Quarry Production

	% of Product	Total Production (Mt)	Average Annual Production (Mt)	Max. Annual Production (Mt)
Kaolin	8.5%	1.8	0.1	0.1
Construction Sand	82.4%	17.0	0.8	1.2
Specialty Sand	9.1%	1.9	0.1	0.1
Total Production	100.00%	20.6	1.0	1.4

The quarry life is scheduled at 20 years with production targets slightly less in the earlier years to account for lower productivity in order to comply with the noise restrictions. Production commences at 300 kt in the first year, and gradually increases to 1.4 Mt by Year 12.

2.5 Site Development

The site development will take place in three stages: site preparation and construction stage; quarry development / operations stage; and final rehabilitation stage. The main activities of each are described below.

2.5.1 Site Preparation and Construction Stage

The site preparation stage involves:

- construction of acoustic barrier
- construction of infrastructure, and

- preparation of flat area for efficient surface miner operation.

The construction period is unchanged from the 2003 EIS except that an acoustic barrier will be constructed on commencement to mitigate the noise impact on nearby residences for this and subsequent development. Also, no construction of a crusher is required as crushing rock will no longer be necessary with the new mining method.

The site preparation for surface miner use involves establishing an area of sufficient width and length to allow the surface miner to operate efficiently. Wirtgen recommend for standard applications in soft material that the minimum cutting length be nominally 300 m. The surface miner working bench will be established by ripping and dozing with a small dozer and removal of material by scrapers. The excavated friable sandstone will be required for test work in commissioning the process plant; incorporated in site infrastructure activities or stockpiled and railed from site for processing. Topsoil stripped will be placed adjacent to the acoustic barrier to allow a visual screen of native trees to be established and further shield the barrier and quarry operation from the residents.

The layout of the quarry following site preparation is shown in **Figure 2**.

2.5.2 Quarry Development and Operations

Plans have been prepared to show quarry development over the project life as shown in **Figures 3** to **6.** As shown, the quarrying method involves extracting the material in horizontal layers from the upper most quarry bench to its base over the full width and length of each successive bench. This method meets the requirements of the surface miner, which prefers to operate over large, relatively flat areas for maximum efficiency. As the excavation expands, final slope batters and berms are formed and progressively rehabilitated. Also, residences will be increasingly shielded from the development by the final pit walls.

The working benches will have a slight grade to direct surface run-off away from the pit crest to the northwest area of the excavation. Quarrying below 1002 mRL will involve maintaining a minimum 2 m high wall on the western side to prevent outflow of water into the National Park and significantly increase the void's water storage capacity (refer Section 2.12). The pit base is approximately 990 mRL.

An important characteristic of the quarry development will be the early and progressive rehabilitation of the open cut berms. As the bench height is only 3 m, the wall will form a series of small terraces relative to typical quarry operations. Vegetation growth will hence shield the walls with the intention of screening the open cut void and reducing the visual impact ("terrace landscaping"). As described in the 2003 EIS, rehabilitation will involve:

- surface preparation of the area by light ripping;
- placement of topsoil on an area 2 m wide around the edge of the pit; and
- planting of native shrubs and trees on the topsoiled bench.

The site topography will allow for continued access to all benches.

The timing of the extraction stages is shown in **Figure 7**.

2.5.3 Final Rehabilitation

The final quarry void contains a large number of small benches forming a terraced, vegetated landscape. The base of the pit will be graded to be free-draining with all disturbed areas to be topsoiled and re-vegetated. A small wetland will result in the area occupied by the final retention pond (refer **Figures 8** and **9**).

The quarry design enables all water flows at completion of quarrying to be contained within the quarry void. When the final rehabilitation is complete, and vegetation well established and the landform stable, it will be possible to place a channel from the near quarry floor to the small creek channel in the north (refer **Figure 8**) and re-establish flows directly to the water course. Previously, no direct flows other than those discharged by the water treatment plant would have taken place.

Also on completion of quarrying, as described in the 2003 EIS, all buildings, infrastructure and stockpiles will be removed from the pit and processing areas leaving them to be shaped and re-vegetated.

2.6 Quarrying Method

Prior to cutting of friable sandstone by the surface miner, the area immediately downslope of the working bench will require clearing of vegetation and topsoil stripping. The topsoil management procedures are unchanged from the 2003 EIS. In brief, topsoil will be stripped by dozer and heaped for transport by scraper to stockpiles. Stockpiles will be located adjacent to the pit crest or placed directly on berms available for rehabilitation.

The friable sandstone will be excavated in small lifts of 0.3 m to allow greater quality control over the different grades of sandstone. After cutting, the fragmented rock drops onto the bench behind the cutting drum and, as the surface miner advances, metal plates heap the rock into long windrows (refer **Figure 10**). A water tank on the rear of the surface miner will provide dust suppression.

Self-loading scrapers are then used to pick up the windrowed material and haul it out of the pit and dump it onto a grizzly. As the surface miner breaks up the rock, no crushing is required.

An important aspect of this quarrying method compared to most other quarry methods is that the dig, load and haul activities are largely independent operations. Typically, as with the mining method in the 2003 EIS, loaders and trucks must work together to remove material from the quarry while dozers rip and doze rock in advance. With the surface miner method, the surface miner can independently dig, fragment and heap the material while the scrapers are not working. Similarly, the scrapers can operate on the windrowed heaps with the surface miner parked up. Hence, this provides a lot of flexibility for reducing peak noise emissions by reducing the quantity of equipment operating at any one time.

Quarrying from the more exposed upper benches, may require at times for the surface miner to operate independently from the scrapers to meet the noise criteria. Similarly, a scraper may need to operate at times with the surface miner parked up. As the working bench lowers and greater shielding by the quarry walls is achieved, equipment can commence to work simultaneously more regularly.

2.7 On Site Materials Handling

The following details on on-site materials handling is extracted from the 2003 EIS and is based on work completed by Roger Smith and Associates. It is briefly presented below for completeness of the description of site activities.

Excavated sandstone will be delivered by scrapers and discharged through a grizzly screen to a surge bin below the dump point. The grizzly will be a hydraulically operated, tipping, SimbaGrid type that allows oversize to be tipped off to the side as and when necessary. The small amount of oversize expected would be periodically run over by the dozer and crushed to below 200 mm then picked up by a scraper and again discharged onto the grizzly.

A light duty apron feeder will be located under the surge bin to ensure a steady controlled feed to the rest of the stockpiling conveyor taking rock to the main stockpile. The capacity of the main crushed sandstone stockpile will be 12,000 t.

Product will be reclaimed by gravity feed through a reclaim tunnel, then conveyed to the rail loading facility adjacent to the existing Clarence Coal loading facility.

This sizing, handling, stockpiling and reclaim process is common to that used by other mines and quarries.

2.8 Major Excavation Equipment

Mobile plant used to win, load and haul friable sandstone from the proposed quarry will typically consist of:

- 1 x Wirtgen 2200SM surface miner (or equivalent);
- between 1 and 3 x 50 t scrapers (or equivalent).

The major equipment will be supported by, on an as-required basis, a D6 or D7 sized Cat dozer, small watercart, long reach backhoe excavator and small dump truck. The dozer will primarily be used to prepare areas for excavation by clearing vegetation and stripping topsoil. The watercart will be used for dust suppression on disturbed quarry areas, such as haulage roads and benches, and on excavated sandstone windrows.

The surface miner is not commonly used in mining in Australia though it is used in soft rock quarries and mines throughout the world. Surface miner variants are however used in Australia for road construction due to its high level of control and accuracy in forming a flat surface. For example, it has recently been used in the expansion of the F3 Freeway north of Sydney, and reported as cutting through sandstone considerably harder than that located at the Newnes Junction site.

The surface miner is a track mounted machine and has a central cutting drum and cutting picks of similar appearance to underground continuous miners (refer **Figure 10**). When cutting, the central drum is lowered and the machine crawls forward at a low speed (<3 km/hr) cutting to a depth of approximately 300 mm into the friable sandstone. The surface miner proposed for

this development will not have the conveyor attachment, but rather cut sandstone will be placed directly on the ground with guide plates heaping it into windrows as it passes out the back of the machine. The cutting action of the surface miner crushes the sandstone and negates the need for any primary crushing on site.

2.9 Fixed Plant and Infrastructure

The fixed plant and infrastructure is unchanged from that presented in the 2003 EIS except that no crusher will be required.

2.10 Project Schedule and Hours of Operation

2.10.1 Construction Schedule

The project schedule is unchanged from that presented in the 2003 EIS. It is anticipated that the proposed extractive operation could be in commercial production within 26 weeks of development consent being granted. Exact scheduling of the development will however, depend upon the time of receipt of development approval and necessary licences and permits, in particular for the processing site in the Greater Sydney region (subject of a separate 2003 EIS).

2.10.2 Operations Schedule

Hours of operation are unchanged from the 2003 EIS. Normal hours of operation for development and operational activities will be as follows:

- ***pit development*** will occur in daylight hours only, nominally 7.00 am to 6:00 pm Monday to Saturday;

- ***train loading dispatch*** will occur during daylight hours wherever possible, 6 days per week, the operation will need to be available 24 hours a day, 7 days a week to provide flexibility for transportation requirements. ; and

- ***plant maintenance*** - will be undertaken during normal pit operational hours. In the event that this is not possible, maintenance will occur after hours with limited overtime. Breakdown maintenance may be required up to 24 hours per day during stoppages, as per normal industry practice.

2.11 Workforce

2.11.1 Construction

The construction workforce is unchanged from that presented in the 2003 EIS.

2.11.2 Operation

The number of people employed at the operation on a day to day basis is anticipated to fluctuate between 7 and 10, depending on production. The single shift workforce will typically require up to 8 people, including:

- 1 x pit manager;
- 1 x bulldozer / support equipment operator;
- 1 x surface miner operator;
- 2 x scraper drivers
- 2 x support staff / train loader / general support; and
- 1 x maintenance / general hand.

2.12 Water Management

The water management plan is discussed in greater detail in the "Revised Water Management Plan" (Hughes Trueman, 2004). The following discussion primarily focuses on the quarrying aspects. Key features of the water management plan are illustrated in **Figures 2** to **6**. The proposed system will be capable of retaining all runoff from storms in excess of the 100 year average recurrence interval (ARI), 72 hour storm. There will be no uncontrolled discharge from the site during operational and rehabilitation phases of the project and any discharge will only be by means of controlled flow from the water treatment plant. Hydrological modelling by Hughes Trueman has confirmed the plan will allow the site to store sufficient water to meet all on-site water needs throughout the life of the project, primarily for dust suppression and watering of newly established rehabilitation plantings.

Surface-runoff will be retained within the quarry excavation as benches will be formed with a nominal 1 in 100 gradient towards the northeast corner of the void. At commencement of the project, the main water retention pond will be required to be located down slope from the excavation and surface runoff will flow directly into the pond. Water will be transferred to the main retention pond by pumping.

As the quarry expands, the main retention pond will be relocated to the northeast corner of the void.

The cutting method of the surface miner allows for accurate control of bench gradient and will prove more efficient in forming and maintaining benches than traditional quarrying methods. The surface miner will also be used to form a "safety" windrow at the crest of the excavation to further prevent uncontrolled run-off from the workings.

A critical phase in the water management plan will be as the quarry approaches final depths. A change in the bench gradient is required to relocate the low point from the northwest to the northeast corner in order establish a free-draining surface as part of the final rehabilitation plan. At 1002 mRL, the bench gradient continues to slope up to the northeast with the main retention pond in the northwest at a depth of 5 m. As the working bench is lowered below this elevation, the extraction method will be modified to maintain a 2 m high wall between the crest and base. With each successive lift down to 998 mRL, the bench gradient will reduce until the pit base is flat and large retention pond will be developed in the northeast corner.

Below 998mRL, the gradient will gradually be modified until the bench adequately slopes towards the new retention pond in the northeast corner of the pit.

During the life of the project, run-off from stockpile, material handling and infrastructure areas will be channelled to a second retention pond adjacent to the water treatment plant. This pond will serve as a balancing storage for the transfer of water from the main retention pond for dust suppression purposes or treatment prior to discharge.

All water discharge from site will be treated.

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT B

Noise Impact Assessment

Atkins Acoustics and Associates

May 2004

ATKINS ACOUSTICS

Postal Address
P.O. Box 432
Gladesville
N.S.W. 1675
AUSTRALIA
A.C.N. 068 727 195
A.B.N. 19 068 727 195
Telephone: 02 9879 4544
Fax: 02 9879 4810
Email: AtkinsAcoustics@bigpond.com.au

Atkins Acoustics and Associates Pty Ltd.
Consulting Acoustical & Vibration Engineers

NOISE IMPACT ASSESSMENT

KAOLIN MINE

NEWNES JUNCTION

34.5058.R2:CFCD1
Rev 02

Prepared for: Newnes Kaolin Pty Ltd
Suite 504 37 Bligh Street
SYDNEY NSW 2000

Prepared by: Atkins Acoustics and Associates Pty Ltd.
8-10 Wharf Road
GLADESVILLE NSW 2111

May 2004

CONTENTS

	Page No
1.0 INTRODUCTION	1
2.0 SITE DESCRIPTION AND PROPOSAL	2
2.1 The Site	2
2.2 Description of Proposal	2
2.3 Site Development	4
2.3.1 Site Preparation, Infrastructure Development and Pollution Control	4
2.4 Mine Development	7
2.4.1 Mining	7
2.4.2 Material Transportation	7
2.4.3 Off-site Transfer	7
2.5 Mobile Plant and Equipment Schedules	8
2.5.1 Pit/ROM	8
2.5.2 Stationary Mine/Infrastructure	8
2.6 Hours of Operation	8
3.0 EXISTING AMBIENT NOISE LEVELS	9
3.1 Ambient Noise Measurements	9
3.2 Meteorology	10
3.3 Results	10
3.4 Audit Noise Measurements	14
4.0 NOISE ASSESSMENT GOALS	16
4.1 Construction	16
4.2 Mining Operations	17
4.3 Rail Activities	20
4.4 Recommended Goals	20
5.0 SITE PLANT AND EQUIPMENT	22
5.1 Site Establishment	22
5.2 Mine Operations	23
5.3 Train Loading Operations	23
6.0 SITE NOISE MODELLING	25
6.1 Construction	26
6.2 Mine Operations	27
6.3 Train Loading Operations	33
6.4 Train Movements	34
6.5 Assessment	35

CONTENTS (Cont.)

7.0 FINDINGS AND RECOMMENDATIONS 36
7.1 Noise Control Recommendations 37

8.0 CONCLUSION 39

LIST OF FIGURES

Figure 1: Site Location 6
Figure 2: Reference Noise Assessment Locations 19

LIST OF TABLES

Table 1: Construction Schedule 5
Table 2: Measured RBL and L_{Aeq} Noise Levels 10
Table 3: Predominant Wind Direction and Percentage Occurrence 13
Table 4: Audit Train Measurements at 5 Sandham Road 15
Table 5: INP Noise Policy Amenity Criteria 18
Table 6: Assessment RBL and Ambient L_{Aeq} Noise Levels 18
Table 7: Recommended Noise Goals 20
Table 8: Construction Plant & Equipment Sound Power Levels 22
Table 9: Mine Plant Sound Power Levels 23
Table 10: Train Loading Sound Power Levels 24
Table 11: Predicted Construction Noise Levels 26
Table 12: Predicted Noise Levels: Extraction 29
Table 13: Predicted Noise Levels: Train Loading 33
Table 14: Predicted Train Passby Noise Levels (Class 81 Locomotive) 34
Table 15: Predicted Train Noise Levels ($L_{Aeq,24hour}$) 34

APPENDICES

APPENDIX 1: Ambient Noise Levels
APPENDIX 2: Meteorology
APPENDIX 3: Stage Plans
APPENDIX 4: Stage 1B – Noise Contour Plot - Extraction (Calm)
APPENDIX 5: Stage 2B – Noise Contour Plot - Extraction (Calm)
APPENDIX 6: Stage 3B – Noise Contour Plot - Extraction (Calm)
APPENDIX 7: Bush Walking Tracks

1.0 INTRODUCTION

Atkins Acoustics was engaged Newnes Kaolin Pty Ltd to conduct noise modelling and prepare a noise impact assessment for a proposed friable sandstone extraction project at Newnes Junction. A previous mine plan and extraction methodology was presented in Atkins Acoustics Report No. 33.5058.R1.Rev03:CF57 dated March 2003 and identified noise exceedances during extraction activities. This study was commissioned following a redesign of the mine plan, review of plant and equipment schedules in order to meet project specific noise levels at the referenced residential premises.

This report presents the results, findings and recommendations of the noise assessment. The main aims of the study were to:

- review and comment on the existing ambient background noise levels prevailing in the vicinity of the site;
- establish noise assessment goals in accordance with the Department of Environment and Conservation (DEC), Industrial Noise Policy (INP);
- establish noise assessment goals in accordance with the Department of Environment and Conservation (DEC), Environmental Noise Control Manual (ENCM);
- identify and quantify the main noise sources associated with the proposal;
- predict and evaluate the likely range of noise emissions during site establishment phases and extraction
- assess potential noise impacts; and,
- recommend ameliorative noise control measures.

The information presented in this report has been prepared for the particular investigation described herein, and should not be used in any other context or for any other purposes.

2.0 SITE DESCRIPTION AND PROPOSAL

2.1 The Site

The Newnes site is located north of Newnes Junction, between Bell and Lithgow along the Bells Line of Road (Chifley Road) (*Figure 1*). The site is bounded by the Clarence Colliery to the north-west and north, Blue Mountains National Park to the east, Rocla Quarry and the Main Western Rail Line to the south. A number of isolated residences are located to the south and south-west.

Potential noise sensitive areas in the vicinity of the site and considered in this assessment are isolated residential dwellings to the south and south-west and the Blue Mountains National Park to the east.

2.2 Description of Proposal

It is proposed to mine an area of approximately 25 hectares. It has been estimated that the project will produce approximately 119000 tpa of kaolinite to supply ceramic, paper coating and related industrial markets. A by-product of the separation of kaolin from its ore is high quality sand suitable for glass manufacture and high grade construction purposes. Up to 1.281 million tonnes per annum of high grade sand will be produced. Average annual extraction rate at the mine will be 1.1 million tonnes.

The expected lifespan of the mine is twenty-one (21) years, with a total estimated reserve of 23.7Mt.

To assist in minimising noise and visual impacts from the development, it is proposed to construct an acoustic/visual barrier to a height of approximate five (5) metres high along the lease boundary to the west, south-west and south.

A number of options were investigated in order to determine what was feasible, reasonable and practical to minimise noise emissions. Options included:

1. *No acoustic/visual barrier* – this option was rejected as it provides no acoustic or visual benefits are made.
2. *Acoustic/Visual Bund* – this option has a number of disadvantages including: large footprint, potential for increased soil erosion, requires large dozer/s for an extended duration (>8 weeks) to construct bund resulting in non-compliance noise levels over an extended period of time.
3. *Additional secondary noise controls on plant* – the plant and equipment selected has modified secondary engineered noise controls, the measures proposed are best practice and at the cutting edge of current technology. Further noise reductions could impact on performance, efficiency, exhaust emissions and cooling.
4. *Acoustic barrier/wall construction* – utilising a small dozer (CAT D6 or equivalent) to clear a path for the proposed barrier. Use of a D6 dozer would reduce the level of noise at the residential receivers during the clearing for the barrier, however the duration of the activities would extend for up to six to eight (6-8) weeks.
5. *Acoustic barrier/wall construction* – utilising a medium to large dozer (CAT D8/9) to clear path. Although the use of a larger dozer will result in higher noise levels at the residential receivers, the duration of the activities would be significantly reduced, approximately two (2) weeks.

After reviewing the above options in terms of potential noise impacts, plant selections, duration of activities, and achievable net noise reductions, Option 5 was adopted as the preferred option.

2.3 Site Development

With the site infrastructure, acoustic/visual barrier and site preparation completed, a surface miner will mill and deposit the ore into windrows. Scrapers (35-50t) will be utilised to collect the ore from the windrows and transfer the material to the stockpile ROM area and conveyed to a surge bin adjacent to the railway line for outloading into trains.

The main stationary mine infrastructure including conveyor (train loading), covered stockpile and maintenance facilities are located along the northern portion of the site.

2.3.1 Site Preparation, Infrastructure Development and Pollution Control

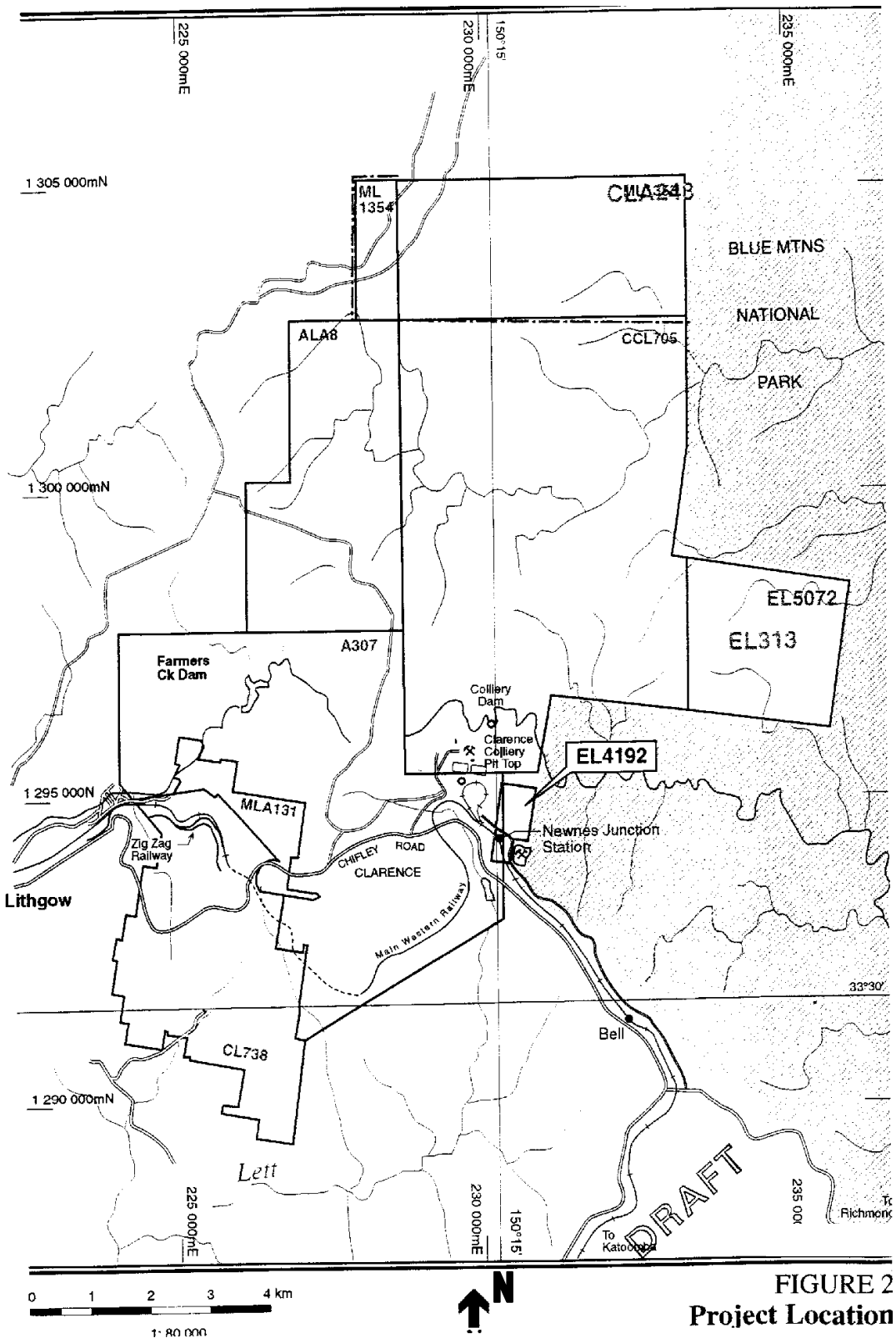
Prior to the commencement of continuous mining operations, the site will be cleared site access road and internal roads constructed, acoustic/visual barrier erected, materials handling system installed, storm water runoff ponds constructed, servicing, maintenance and administration facilities established.

The site establishment and construction works will be performed in two (2) stages with total estimated duration of not more than six (6) months (26 weeks). A summary of the envisaged construction stages, description and typical plant and equipment is presented in *Table 1*.

Table 1: Construction Schedule

Construction Stage	Description of Activities	Typical Plant & Equipment
Stage 1 (2-4 weeks)	- Access road - Internal roads - Clearing of path for barrier - Erection of barrier - Excavation of pond/sump - Preparation for siting of buildings - Preparation of footings for conveyor	- Dozer - Excavator - Front End Loader - Trucks - Truck Mounted Auger - Water Cart - Grader
Stage 2 (20–22 weeks)	- Building erection & fitout - Installation of stationary plant & equipment - Erection of conveyor systems - Commissioning of plant & equipment - Clearing and levelling of site in preparation of mining	- Crane - Trucks - Dozer - Scrapers - General Hand Tools

Figure 1: Site Location



2.4 Mine Development

Newnes Kaolin Pty Ltd has developed mine plans, identified ROM dump areas, stockpile and conveyor routes for the Newnes proposal. A key feature of the mine is shallow stripping technique and mining along contour (RL) lines with progressive deepening of the mine. The basic mining stages are as follows:

2.4.1 Mining

The winning of the material will be achieved by utilisation of an acoustically treated surface miner (Wirtgen 2200M) which will mill and deposit material into windrows. It is proposed to operate the surface miner generally in a west to east direction with strips running north/south following the prepared ground contours.

As the material is extracted the surface area of the pit will expand and deepen. New areas will be cleared and prepared with a D6 dozer or equivalent prior to the continuation of the surface miner.

2.4.2 Material Transportation

The extracted material will be deposited as windrows adjacent to the surface miner. Scrapers (35-50t) will be utilised to pick up the material and transfer it to the ROM stockpile on the northern portion of the site. No crushing or further on-site processing is proposed.

2.4.3 Off-site Transfer

The stockpiled material will be loaded onto the conveyor by an automated reclaim feeder and/or front-end loader. The material will be conveyed to the surge bin located at the train loading facility. The material will be loaded and transported by rail to an off-site processing facility yet to be determined.

2.5 Mobile Plant and Equipment Schedules

Plant and equipment to win, load, and transport the material will typically comprise:

2.5.1 Pit/ROM

- 1 x surface miner (Wirtgen 2200M) or equivalent
- 1-3 x 50 tonne scrapers (CAT 631) or equivalent
- Dozer (D6) or equivalent
- FEL (Volvo L150C) or equivalent

2.5.2 Stationary Mine / Infrastructure

- conveyor (200kW)
- train loader (surge bin)

2.6 Hours of Operation

The operation of the mine will be principally governed by market demand for raw material and the site's ability to meet that demand.

The proposed hours of operation would be 7.00am to 6.00pm Monday to Saturday. Loading of trains will be dependant on State Rail schedules and timetables. However it is anticipated that all loading would be undertaken during daytime hours.

3.0 EXISTING AMBIENT NOISE LEVELS

3.1 Ambient Noise Measurements

For the purposes of assessing noise impacts, the existing ambient background noise levels were measured and recorded from Thursday 16 March 2000 to Tuesday 18 April 2000.

The reference locations (Figure 1) selected to acquire ambient noise levels that are representative of those experienced by the residences identified in Section 2.1 were:

Measurement Location 1: 5 Sandham Road

Representing the residences (Reference Locations R2-R5) at the north-western portion of the Newnes 'village' on Sandham Road. The residences are exposed to noise from rail traffic and distant road traffic noise from Bells Line of Road (Chifley Road) the Clarence Colliery.

Measurement Location 2: Sandham Road (opp. Newnes Junction Railway Station)

Representing the residence (Reference Location R1) at the south-eastern potion of Newnes 'village' on Sandham Road. The residence is exposed to noise from rail traffic, Rocla Quarry and distant (shielded) road traffic from Bells Line of Road.

The instrumentation selected for the measurements consisted of two (2) RTA Technology Environmental Noise Loggers. The reference level of each instrument was checked prior to and after the measurements with a NATA calibrated (Certificate No. 3630) Bruel & Kjaer Sound Level Calibrator Type 4230, Serial No. 623590, with no significant drift recorded. The sound logging meters were set to A-weighting, fast response and fifteen (15) minute sampling period.

The ambient noise levels were measured and assessed as percentile A-weighted sound levels. The parameters regarded as being the most important amongst these, are the "L_{A90}", the level exceeded for 90% of the sample period and referenced as the

"background or average minimum noise level", and the "L_{Aeq}", which is the A-weighted energy equivalent continuous (constant) sound level.

3.2 Meteorology

Meteorological conditions including wind speed, wind direction, temperature, humidity and rainfall were recorded during the noise measurement period using a Davis Instruments – Weather Monitor II and Weatherlink data logger. The weather station was installed at the rear of the property identified as 5 Sandham Road and adjacent to noise Measurement Location 1.

3.3 Results

From the procedures recommended in the 'Industrial Noise Policy' (INP), the Rating Background Level (RBL) and ambient L_{Aeq} noise levels were assessed to establish noise assessment goals for the project. The RBL is the median of the tenth percentile background levels for each assessment period over the measurement period. The L_{Aeq} level represents the energy averaged noise level for each assessment period. *Table 2* presents a summary of the existing ambient noise levels for the daytime, evening and night-time hours, and the calculated RBL and L_{Aeq} levels.

Table 2: Measured RBL and L_{Aeq} Noise Levels
dB(A) re: 20 x 10^{-6} Pa

Date	Assessment Background Level L_{A90}			Equivalent Continuous Level L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Location 1: 5 Sandham Road						
Thu 16.3.00		32	29		57	51
Fri 17.3.00	32	32	29	56	58	50
Sat 18.3.00	37	31	30	51	49	52
Sun 19.3.00	31	32	31	54	50	51
Mon 20.3.00	38	37	34	57	58	54
Tue 21.3.00	42	39	36	56	59	54
Wed 22.3.00	42	37	33	57	58	55
Thu 23.3.00	34	33	31	56	56	54
Fri 24.3.00	33	32	29	55	51	50
Sat 25.3.00	32	29	28	50	46	45
Sun 26.3.00	30	29	28	48	48	49

Table 2: Measured RBL and L_{Aeq} Noise Levels (cont.)

dB(A) re: 20 x 10^{-6} Pa

Date	Assessment Background Level L_{A90}			Equivalent Continuous Level L_{Aeq}		
	Day	**Evening**	**Night**	**Day**	**Evening**	**Night**
Location 1: 5 Sandham Road (cont.)						
Mon 27.3.00	31	31	30	53	52	54
Tue 28.3.00	34	33	38	53	53	54
Wed 29.3.00	31	31	30	52	56	52
Thu 30.3.00	32	29	30	54	56	53
Fri 31.3.00	39	34	34	55	55	54
Sat 1.4.00	34	29	29	49	40	47
Sun 2.4.00	33	30	30	48	45	51
Mon 3.4.00	36	33	31	52	57	53
Tue 4.4.00	32	29	30	53	56	51
Wed 5.4.00	43	39	39	54	58	54
Thu 6.4.00	36	32	30	56	58	52
Fri 7.4.00	33	31	28	52	54	51
Sat 8.4.00	32	31	29	51	51	50
Sun 9.4.00	30	29	28	49	46	51
Mon 10.4.00	34	33	28	50	53	49
Tue 11.4.00	31	30	28	50	55	51
Wed 12.4.00	31	31	29	53	55	50
Thu 13.4.00	31	30	31	53	56	52
Fri 14.4.00	36	34	30	52	55	50
Sat 15.4.00	36	28	28	51	54	46
Sun 16.4.00	38	29	35	49	48	52
Mon 17.4.00	35	29		50	54	
RBL	**33**	**31**	**30**			
Ambient L_{Aeq}				**53**	**55**	**52**
Location 2: Sandham Road						
Thu 16.3.00		28	28		47	36
Fri 17.3.00	32	29	29	49	47	36
Sat 18.3.00	33	28	28	46	49	40
Sun 19.3.00	31	28	29	54	43	41
Mon 20.3.00	42	34	31	53	50	45
Tue 21.3.00	40	38	33	50	50	45
Wed 22.3.00	41	37	31	50	46	42
Thu 23.3.00	34	32	30	51	46	41
Fri 24.3.00	31	31	29	47	44	41
Sat 25.3.00	30	28	28	47	37	37
Sun 26.3.00	29	28	28	48	41	40
Mon 27.3.00	30	29	32	50	56	46
Tue 28.3.00	40	41	33	51	57	45
Wed 29.3.00	34	29	28	53	48	42
Thu 30.3.00	31	29	32	48	46	45
Fri 31.3.00	38	34	30	49	45	45
Sat 1.4.00	31	28	28	47	32	43
Sun 2.4.00	29	29	30	47	35	45

Table 2: Measured RBL and L_{Aeq} Noise Levels (cont.)
dB(A) re: 20 x 10^{-6} Pa

Date	Assessment Background Level L_{A90}			Equivalent Continuous Level L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night
Location 2: Sandham Road (cont.)						
Mon 3.4.00	34	36	31	52	55	44
Tue 4.4.00	30	28	29	48	45	46
Wed 5.4.00	38	36	38	48	50	50
Thu 6.4.00	34	31	30	52	47	43
Fri 7.4.00	30	30	28	47	42	40
Sat 8.4.00	30	30	28	49	36	38
Sun 9.4.00	29	27	27	44	32	41
Mon 10.4.00	40	40	27	49	45	44
Tue 11.4.00	30	29	27	48	45	42
Wed 12.4.00	29	30	28	45	44	37
Thu 13.4.00	31	29	32	49	45	43
Fri 14.4.00	34	33	29	46	44	42
Sat 15.4.00	36	27	27	67	43	40
Sun 16.4.00	32	27	32	47	42	45
Mon 17.4.00	30	28	28	47	45	44
RBL	**32**	**29**	**29**			
Ambient L_{Aeq}				**54**	**48**	**43**

NOTE: Daytime : (7.00am to 6.00pm)
Evening : (6.00pm to 10.00pm)
Night-time : (10.00pm to 7.00am)

Meteorological conditions experienced during the noise measurement period were typified by generally low wind speeds (<2m/s) and temperatures ranging from 7°C at night to 30°C during the day. Rainfall data recorded during the measurement period was reviewed and not considered to have significantly altered the noise measurement results. Appendix 2 presents a summary of the meteorological conditions recorded during the survey period (Thursday 16 March 2000 to Tuesday 18 April 2000).

Additional meteorological information (Appendix 2) supplied by Holmes Air Sciences (HAS) provided annual and seasonal data for wind speed and direction at the closest meteorological stations of Mount Piper and Lithgow. A review of the data for the purpose of noise modelling identified the predominant wind directions and percentage occurrence for Mount Piper and Lithgow (*Table 3*). The data confirmed that west winds are predominant and should be considered for the noise modelling. In

terms of source to receiver winds, a review of the windrose data (Appendix 2), considering the sum of winds (0.1-3m/s) in the quadrants 45º either side of direct source to receiver wind (north and north-east), has shown that wind in the direction of the referenced receivers does not occur for more than 30% of the time in any season. Accordingly, in accordance with the INP procedures source to receiver winds conditions have not been considered for the noise modelling.

The HAS data (Appendix 2) identified that E and F Stability Class conditions at wind speeds of less than 3m/s occur for less than 30% of the time. Accordingly, as the INP recommends that adverse meteorological condition need only be assessed when wind speeds of 3m/s or below occur for 30% or more of the time, the effects of temperature inversions have not been considered in the noise modelling.

Table 3: Predominant Wind Direction and Percentage Occurrence
Holmes Air Sciences

Meteorological Station	Time Period	Wind Direction	Percentage Occurrence (%)
Mount Piper	Winter 1997	SW WSW Calm	16 15 10.3
	Autumn 1997	SW WSW Calm	13 10 8.8
	Spring 1997	SW WSW Calm	13 15 6.5
	Summer 1997	ESE Calm	11 4.6
	Annual 1997	SW WSW Calm	13 13 7.9

Table 3: Predominant Wind Direction and Percentage Occurrence (cont.)
Holmes Air Sciences

Meteorological Station	Time Period	Wind Direction	Percentage Occurrence (%)
Lithgow	Winter 1997	W	31
		SW	17
		Calm	17.4
	Autumn 1997	W	20
		SW	11
		SE	18
		Calm	17.8
	Spring 1997	W	30
		SW	13
		NW	19
		Calm	10.5
	Summer 1997	W	15
		SE	18
		E	15
		NW	15
		Calm	15.2
	Annual 1997	W	24
		SW	12
		SE	15
		NW	15
		Calm	15.3

3.4 Audit Noise Measurements

Site attended audit measurements of noise generated by existing rail activities were conducted to assist in assessing potential noise impact associated with increased rail movements as a result of the proposal. Measurements were conducted at the rear of the residence identified as 5 Sandham Road on the 7 March 2000 and 18 March 2000. A summary of the L_{Amax} noise level and sound exposure level (SEL) recorded are presented in *Table 4*. The location was approximately sixty (60) metres from the main western rail line, and partially shielded by existing cuttings.

Table 4: Audit Train Measurements at 5 Sandham Road (rear-60m from rail line)

dB(A) re: 20 x 10^{-6} Pa

Date	Train Type	Speed	Duration	Direction	SEL dB(A)	Sound Pressure Level L_{Amax} dB(A)
7.4.00	Silver commuter	fast	15s	W	79.7	70
	Silver commuter	fast	15s	E	82.1	71
	Goods train	med	38s	W	87.6	72
	Silver commuter	fast	13s	W	79.9	70
18.4.00	Silver commuter	med	15s	E	82.6	72
	Silver commuter	slow	20s	W	78.7	68
	Silver commuter	fast	22s	E	81.4	70

4.0 NOISE ASSESSMENT GOALS

In accordance with the INP and Environmental Noise Control Manual (ENCM), the following goals have been considered for assessing noise associated with the proposed developement.

4.1 Construction

The ENCM construction noise guidelines have been considered and adopted for this assessment.

These guidelines consider the L_{A10} noise level (the noise level exceeded for 10% of the time) from construction activities and provide assessment goals depending on the construction period. These are:

Short Term – 4 weeks or less. The L_{A10} level of construction noise should not exceed the L_{A90} background noise level by more than 20dB(A).

Medium Term – greater than 4 weeks but less than 26 weeks. The L_{A10} level of construction noise should not exceed the L_{A90} background noise by more than 10dB(A).

Long Term – greater than 26 weeks. The L_{A10} level of construction noise should not exceed the L_{A90} background noise by more than 5dB(A).

In setting these goals, the DEC recognise that the recommended levels will not always be achieved. Accordingly, where there is a technical exceedance of the assessment goals, it is generally recommended that the construction activities be restricted to daytime hours and a ‘Noise Management Plan’ be prepared.

Noise emissions from construction activities were assessed to five (5) reference residential premises (*Figure 2*) identified as:

Location 1: Sandham Road (R1) – south-east of village
Location 2: Sandham Road (R2) – central northern house in village
Location 3: Sandham Road (R3) – north-western house in village
Location 4: Sandham Road (R4) – central southern house in village
Location 5: 5 Sandham Road (R5) – western southern house in village

Considering the scheduled duration of the construction activities is less than 26 weeks, the recommended goal for assessing noise during this period is background L_{A90} +10dB(A).

4.2 Mining Operations

The INP assessment procedure for operational noise has two (2) components:

(1) controlling intrusive noise; and
(2) maintaining noise amenity.

The intrusiveness of a noise is considered to be acceptable if the $L_{Aeq,\ 15\ minute}$ noise level does not exceed the RBL by more than 5dB(A) when assessed at a sensitive noise receiver location. In order to determine the amenity noise goal, the ambient L_{Aeq} noise levels should not normally exceed the recommended acceptable noise levels (*Table 5*). Where existing L_{Aeq} noise levels approach or exceed acceptable noise levels, design assessment goals are set below the existing L_{Aeq} in order to limit any further increase or "creep" in the ambient levels.

Table 5: INP Noise Policy Amenity Criteria
dB(A) re: 20 x 10 $^{-6}$ Pa

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended Maximum
Residence	Suburban	Day Evening Night	55 45 40	60 50 45
Area specifically reserved for passive recreation	All	When in use	50	55

To the west of the Newnes site is the Blue Mountains National Park. The INP provides recommended noise assessment goals for areas identified as National Parks. (*Table 5*).

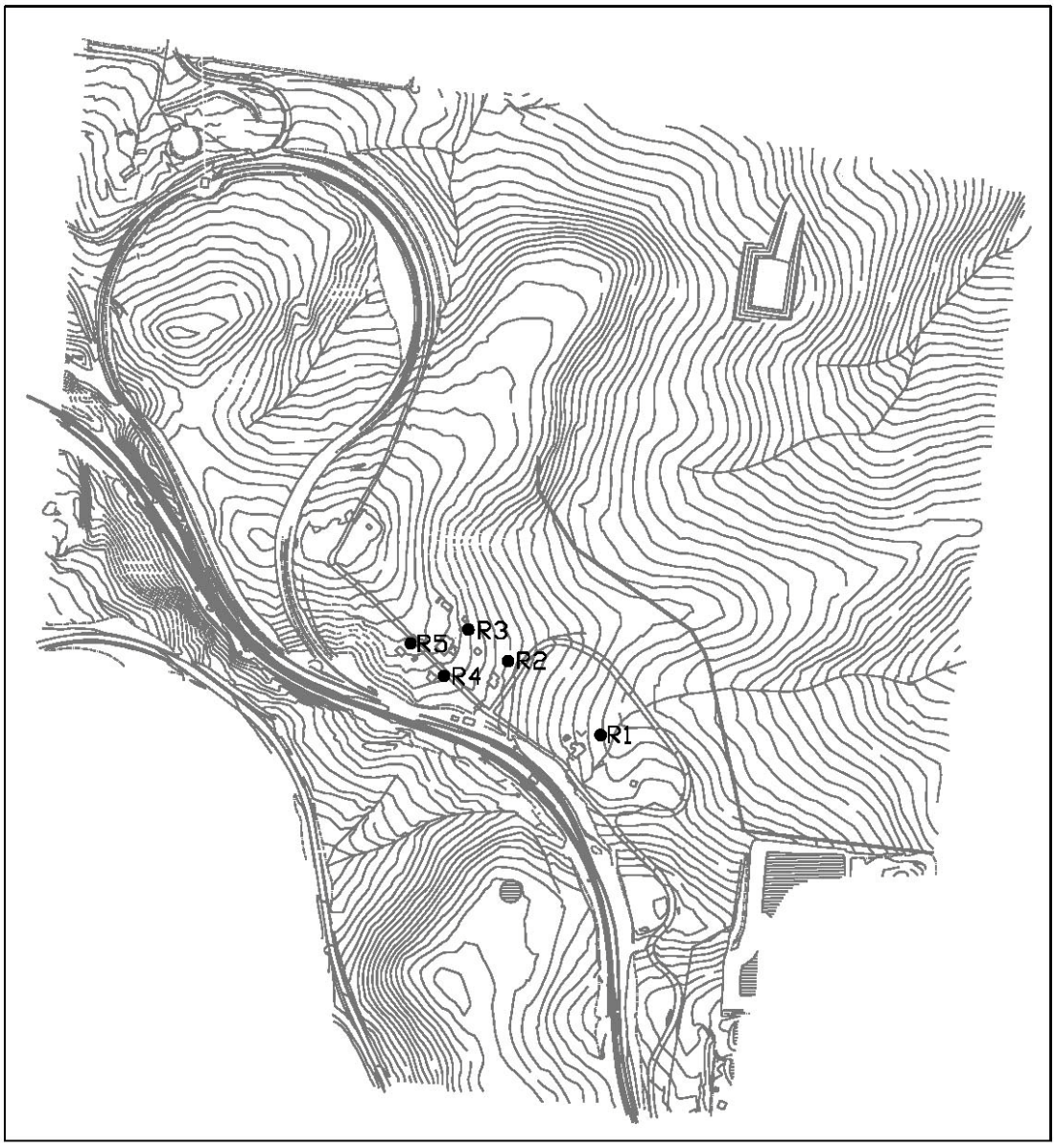
Considering the measured ambient noise levels and the INP guidelines, *Table 6* presents a summary of the RBL's, the L_{Aeq} noise levels, the intrusive and amenity noise assessment goals.

Table 6: Assessment RBL and Ambient L_{Aeq} Noise Levels
dB(A) re: 20 x 10^{-6} Pa

Period[(1)]	Recommended Noise Level L_{Aeq}	Existing RBL L_{A90}	Existing L_{Aeq}	Intrusive Criterion L_{Aeq}	Amenity Criterion L_{Aeq}
Location 1:	**Main Village (R2-R5)**				
Day	55	33	53	38	43
Location 2:	**Sandham Road (R1)**				
Day	55	32	54	37	44
Location 3:	**Blue Mountains National Park**				
Day	50-55[(2)]	-	-	-	50-55[(2)]

(1) Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays
(2) Recommended maximum level of 55dB(A)

Figure 2: Reference Noise Assessment Locations



4.3 Rail Activities

In accordance with the DEC, ENCM [Chapter 163] the recommended goals for assessing rail noise at the residential building facades are $L_{Aeq,24hour}$ 60dB(A) and L_{Amax} 85dB(A).

4.4 Recommended Goals

Having regard to the measured ambient noise levels and the DEC guidelines, the goals recommended for assessing noise from the Newnes proposal are tabulated below:

Table 7: Recommended Noise Goals
dB(A) re: 20 x 10^{-6} Pa

Noise Goals	Sound Pressure Levels dB(A)
	Day 7.00am–6.00pm
Sandham Road (R1) – opposite railway station	
Construction (L_{A10})	42
Mining Operations (L_{Aeq})	37
Train Loading (L_{Aeq})	37
Train Passby ($L_{Aeq,24hour}$)	60
Train Passby (L_{Amax})	85
Main Village - Sandham Road (R2-R5)	
Construction (L_{A10})	43
Mining Operations (L_{Aeq})	38
Train Loading (L_{Aeq})	38
Train Passby ($L_{Aeq,24hour}$)	60
Train Passby (L_{Amax})	85
Blue Mountains National Park	
Mining Operations (L_{Aeq})	50-55

For the purpose of assessing noise impacts at residences, the noise is normally assessed at the most affected point on or within the residential property boundary or, if this is more than 30m from the residence, at the most affected point within 30m of the residence (INP [Section 2.2.1]).

Discussions with DEC have confirmed that noise emissions from the proposal when assessed to National Parks and Wilderness Areas shall be predicted at the closest

point of any defined walking trails or authorised camping area as documented by the National Parks & Wildlife Service or Land & Property Information. Investigations (Newnes Kaolin Pty Ltd) have established that the closest walking trails are located greater than two (2) kilometres from the site (Appendix 6). Albeit, the noise modelling has assessed the noise at two hundred (200) metres from the southern pit boundary.

5.0 SITE PLANT AND EQUIPMENT

Site noise emissions have been modelled and assessed in terms of continuous noise from the fixed and mobile plant, truck and/or scraper movements, conveyors and train loading operations. In addition noise from construction activities associated with noise mitigation control works, site preparation, access road construction, buildings and conveyor erection has been assessed.

5.1 Site Establishment

The main plant and equipment of acoustical significance associated with envisaged site establishment works consists of a dozer, excavator, front end loaders, grader, truck mounted boring machine, trucks, water cart, crane, concrete trucks, generator, grader, and compressor. For modelling noise emissions from the plant and equipment, the following schedule and sound power level data have been established from site attended audit measurements, published data, AS2436-1981 and discussions with Metford Laboratories. It is not anticipated that all plant would be located on-site and/or operated simultaneously, therefore the noise modelling has considered typical (staged) activities.

Table 8: Construction Plant & Equipment Sound Power Levels
dB(A) re: 10^{-12} Watts

Plant Description	Number of Items	Sound Power Level dB(A)
STAGE 1		
Dozer (D8-D10)	1	110
Excavator	1	106
Front End Loader	1	104
Truck Mounted Auger	1	99
Truck Mounted Crane	1	100
Truck	2	105
Grader*	1	99
STAGE 2		
Dozer (D6*)	1	100
Crane	1	108
Truck	2	105
Scraper*	1-2	105

* acoustically treated plant

5.2 Mine Operations

The main site plant and equipment of acoustical significance consists of a dozer (topsoil and overburden removal), surface miner (winning of material) and scraper/s. For the modelling noise emissions from this plant, the following sound power levels (*Table 9*) have been provided by Metford Laboratories.

Table 9: Mine Plant Sound Power Levels
dB(A) re: 10^{-12} Watts

Plant Description	Sound Power Level dB(A)								
	dB(A)	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Dozer (CAT D6)	**100***	99	103	100	99	95	90	84	80
Surface Miner (Wirtgen 2200M)	**100-105****	106	110	102	102	100	98	92	83
35-50t Scraper (CAT 651)	**102-105***	106	110	102	102	100	98	92	83

* Acoustically treated unit by Metford Laboratories.
** Acoustically treated unit be Metford Laboratories and reduction in engine speed for additional noise reductions.

5.3 Train Loading Operations

It is expected that normal train-loading operations would have a duration of forty-five (45) minutes to one (1) hour. For the purpose of modelling noise from train loading operations, the sound power levels of typical equipment have been established from site attended audit measurements and published data (*Table 10*). Train loading operations involving the use of a front end loader, conveyors, surge bin and Class 81 locomotives.

In terms of train movements on the main rail line, the train noise was assessed in terms of a maximum passby noise level, and a $L_{Aeq,24hour}$ taking into account existing train activities and additional train activities as a result of the proposal. Information available at the time of the assessment projected a maximum of two (2) trains being loading within any twenty four (24) hour period, with a maximum of seven (7) trains per week. However, it is considered unlikely that more than one (1) train would be loaded on any one day within the first nine (9) years of extraction.

Table 10: Train Loading Sound Power Levels
dB(A) re: 10^{-12} Watts

Item Description	Sound Power Level dB(A) re: 10^{-12} Watts								
	dBA	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Surge Bin	**112**	98	100	104	102	104	108	105	92
Class 81 Locomotive*	**114**	106	99	99	105	107	110	106	100
Conveyor Drive – 200kW	**93**	77	82	84	87	90	85	79	66
Conveyor Belt – 400m	**104**	89	94	96	98	101	97	93	78
FEL (Volvo L150C)	**105**	115	109	106	100	96	99	90	81

* at Notch 3 power setting

Information provided by FreightCorp identified that between two (2) and three (3) Class 81 (3000hp – diesel/electric) locomotives would be utilised for rail transportation of the ore. It is understood that a train may be loaded with two (2) locomotives operating at a power setting of Notch 2 or 3. The noise modelling predictions for train loading has assumed this operational situation.

Previous studies (James Heddle Acoustical Consultants) of Class 81 Locomotives have been conducted and recorded train noise levels. These measurements were utilised and adjusted to account for a power setting of Notch 3 for the locomotives and sixty (60) wagons providing an SEL of Lw 111dB(A).

6.0 SITE NOISE MODELLING

Noise from the site operations was modelled with the DEC approved Environmental Noise Model (ENM) computer model. The model considers attenuation factors such as distance, shielding from working faces, ground coverage, atmospheric absorption, topographical features of the area and shielding from structures.

The noise model input data for the Newnes Kaolin Mine has been based on noise measurements at similar sites, manufacturers specifications, digital ground contours plotted from aerial survey (MineConsult Pty Ltd), ground contour intervals of two (2) metres, digital mine plans (MineConsult Pty Ltd).

The INP(Section 5.3.1) guidelines for noise assessment under varying wind conditions recommend that wind effects be assessed when wind speeds of 3m/s or below occur for 30 percent of the time or more in any assessment period or season. Considering the meteorological and seasonal wind data from Holmes Air Sciences (Section 3.2Table 2), calm conditions and westerly winds have been considered for the noise modelling. The meteorological scenarios modelled are outlined below:

- Calm: no wind, relative humidity of 60%, and air temperature of 18°C;
- West wind: 3m/sec west wind (270°), relative humidity of 60%, and air temperature of 18°C;

Records reported by Holmes Air Sciences show that the occurrence of temperature inversion is less than 30%, therefore in accordance with the EPA, INP (Appendix C) assessment procedures, inversion effects have not been considered in the noise modelling.

6.1 Site Establishment

Noise from the envisaged site establishment activities was predicted considering the plant noise data presented in *Table 8*, calm meteorological conditions, 60% humidity and air temperature of 18°C.

The results of the modelling are summarised in *Table 11*. For assessment purposes the stages modelled are as follows:

Stage 1a: Plant and equipment at infrastructure area excavation of sump, preliminary levelling (excavator, trucks x 2, front end loader) and clearing of path for acoustic barrier (dozer D8-10 and grader).

Stage 1b: Plant and equipment at infrastructure area excavation of sump, preliminary levelling (excavator, trucks x 2, front end loader) and boring of holes and erection of panels for acoustic barrier (truck mounted auger, truck mounted crane).

Stage 1c: Acoustic barrier constructed. Plant and equipment at infrastructure area excavation of sump, preliminary levelling (excavator, trucks x 2, front end loader).

Stage 2: Acoustic barrier constructed. Site preparation involving clearing and levelling of site in preparation for mining activities approx. RL1056 (dozer D6 and scraper – 1 to 2 movements/15min – Lw105 OR 2 to 4 movements/15min – Lw102).

Table 11: Predicted Construction Noise Levels
L_{A10} dB(A) re: 20 x 10^{-6} Pa

Reference Location	Assessment Goal	Predicted Noise Level dB(A)			
		Stage 1a	Stage 1b	Stage 1c	Stage 2
R1 – south-east	42	43-55	34-44	31	33-35
R2 – central northern	43	48-54	39-43	40	41-44
R3 – north-western	43	47-54	39-44	41	34-38
R4 – central southern	43	40-46	35-36	34	30-33
R5 – western	43	38-46	30-35	30	30-34

A range of noise levels are presented (*Table 11*) for Stage 1a & 1b works, representing activities along the western, central and eastern portions of the proposed acoustic/visual barrier alignment. The results of the noise predictions associated with the clearing of the path for the acoustic/visual barrier (Stage1a) show that noise levels exceed the recommended noise goals for medium term construction (<26 weeks). Albeit, the exceedances relate to noise mitigation works and the duration of the activities is anticipated to be less than two (2) weeks. Accordingly the short term exceedances would normally be considered as acceptable as the acoustic/visual barrier is being constructed to ensure both acoustic and visual amelioration to the existing residential premises. To minimise noise impacts, a Noise Management Plan would be developed.

During Stage 2, a range of noise levels are presented accounting for dozer and scrapers within the northern or southern portion of the area being cleared. A noise exceedance of 1dB(A) above the recommended noise goal is considered marginally acceptable, albeit a reduction to one scraper (Lw105) movement/15min or 'parking up' of the dozer and two scraper (Lw105) movements/15min would remove the technical exceedance of 1dB(A). Alternatively, a modified scraper with a Lw103 could be utilised allowing three scraper movements/15min without an exceedance.

6.2 Mine Operations

For the modelling of noise from the mining operations, sources were located at the most exposed locations to the referenced receivers to represent a conservative assessment. At other source locations within the mine, noise levels at the reference receivers would be lower.

The noise modelling has identified noise compliant operating scenarios and site operating restrictions. Accordingly site operation will involve restrictions for the surface miner and/or dozer and/or one to three (1-3) scraper movements/15min. With

a reduction to the base sound power level of the scraper (Lw105) to Lw102, the number of movements/15min for the referenced scenarios could be doubled. The mining stages (Appendix 3) considered to represent the life of the mine and presented in this report included:

Stage 1:
- **A** commencement at RL1056, scraper/s at RL1056 to RL1015 ROM
- **B** commencement at RL1048, scraper/s at RL1056 to RL1015 ROM
- **C** commencement at RL1044, scraper/s at RL1056 to RL1015 ROM
- **D** completion at RL1038, scraper/s at RL1056 to RL1015 ROM

Stage 2:
- **A** commencement at RL1034, scraper/s at RL1034 to RL1015 ROM
- **B** commencement at RL1030, scraper/s at RL1030 to RL1015 ROM
- **C** commencement at RL1026, scraper/s at RL1026 to RL1015 ROM
- **D** completion at RL1020, scraper/s at RL1020 to RL1015 ROM

Stage 3:
- **A** commencement at RL1018, scraper/s at RL1018 to RL1015 ROM
- **B** commencement at RL1012, scraper/s at RL1012 to RL1015 ROM
- **C** commencement at RL1002, scraper/s at RL1002 to RL1015 ROM

The above scenarios generally cover the envisaged situations throughout the life of the mine. They were selected to present the range of activities, situations and noise levels likely to be emitted from the site.

The noise levels predicted for each reference location are presented in *Table 12* together with the operating scenario required to achieve compliance for the various stages of the mine development.

Table 12: Predicted Noise Levels: Extraction

$L_{Aeq,15min}$ dB(A) re: 20 x 10^{-6} Pa

Meteorological Condition	Reference Receiver				
	R1	**R2**	**R3**	**R4**	**R5**
STAGE 1 A – RL1056					
Dozer (Lw100dB(A)) or Surface Miner (Lw100)					
Calm	28	38	31	27	23
West Wind	28	35	29	25	22
OR					
1 scraper movement/15min ONLY					
Calm	28	37	29	25	26
West Wind	28	35	26	23	24
STAGE 1 B – RL1048					
Dozer (Lw100dB(A)) & Surface Miner (Lw100) OR Surface Miner (Lw103)					
Calm	28	36	37	30	32
West Wind	28	34	34	28	28
OR					
1 scraper movement/15min					
Calm	26	37	34	29	26
West Wind	26	34	31	26	23
STAGE 1 C – RL1044					
Surface Miner (Lw105)					
Calm	32	33	36	31	28
West Wind	30	29	31	27	25
OR					
2 scraper movement/15min					
Calm	28	38	37	31	32
West Wind	27	35	34	29	27
OR					
Surface Miner (Lw102) & 1 scraper movement/15min					
Calm	28	38	38	31	32
West Wind	27	35	35	29	28
STAGE 1 D – RL1038					
Surface Miner (Lw105)					
Calm	25	35	38	27	35
West Wind	24	31	33	25	29
OR					
2 scraper movement/15min					
Calm	31	37	38	32	30
West Wind	29	33	33	29	28
OR					
Surface Miner (Lw103) & 1 scraper movement/15min					
Calm	30	36	38	30	34
West Wind	27	33	34	28	29

Table 12: Predicted Noise Levels: Extraction (cont.)

$L_{Aeq,15min}$ dB(A) re: 20 x 10^{-6} Pa

Meteorological Condition	Reference Receiver				
	R1	**R2**	**R3**	**R4**	**R5**
STAGE 2 A – RL1034					
Surface Miner (Lw105)					
Calm	24	35	37	26	31
West Wind	22	31	33	23	29
OR					
3 scraper movement/15min					
Calm	30	37	38	32	31
West Wind	28	34	34	29	28
OR					
Surface Miner (Lw101) OR Dozer (Lw101) & 2 scraper movement/15min					
Calm	29	36	37	31	31
West Wind	27	33	34	28	28
OR					
Surface Miner (Lw105) & 1 scraper movement/15min					
Calm	27	37	38	30	32
West Wind	26	33	35	27	30
STAGE 2 B – RL1030					
Surface Miner (Lw105)					
Calm	23	32	36	26	33
West Wind	21	28	31	23	27
OR					
3 scraper movement/15min					
Calm	28	37	37	32	31
West Wind	26	33	33	29	28
OR					
Surface Miner (Lw105) OR Dozer & 1 scraper movement/15min					
Calm	26	35	37	29	34
West Wind	24	31	33	26	29
STAGE 2 C – RL1026					
Surface Miner (Lw105) OR Dozer & 3 scraper movement/15min					
Calm	29	37	38	32	32
West Wind	27	33	34	29	29
OR					
3 scraper movement/15min					
Calm	28	36	36	31	30
West Wind	26	32	32	28	27

Table 12: Predicted Noise Levels: Extraction (cont.)

$L_{Aeq,15min}$ dB(A) re: 20 x 10^{-6} Pa

Meteorological Condition	Reference Receiver				
	R1	**R2**	**R3**	**R4**	**R5**
STAGE 2 D – RL1020					
Surface Miner (Lw105) & Dozer (Lw100) & 3 scraper movement/15min					
Calm	29	36	36	32	31
West Wind	27	32	32	29	28
OR					
3 scraper movement/15min					
Calm	27	35	35	30	29
West Wind	25	31	31	28	27
OR					
6 scraper movement/15min					
Calm	30	38	38	33	32
West Wind	28	34	34	31	30
STAGE 3 A – RL1018					
Surface Miner (Lw105) & Dozer (Lw100) & 3 scraper movement/15min					
Calm	28	35	36	31	31
West Wind	26	32	32	28	28
OR					
3 scraper movement/15min					
Calm	26	35	35	30	29
West Wind	25	31	31	27	27
OR					
6 scraper movement/15min					
Calm	29	38	38	33	32
West Wind	28	34	34	30	30
STAGE 3 B – RL1012					
Surface Miner (Lw105) & Dozer (Lw100) & 3 scraper movement/15min					
Calm	27	35	35	30	30
West Wind	26	31	31	27	28
OR					
3 scraper movement/15min					
Calm	26	34	34	29	28
West Wind	24	30	30	26	26
OR					
6 scraper movement/15min					
Calm	29	37	37	32	31
West Wind	27	33	33	29	29

Table 12: Predicted Noise Levels: Extraction (cont.)
$L_{Aeq,15min}$ dB(A) re: 20 x 10^{-6} Pa

Meteorological Condition	Reference Receiver				
	R1	**R2**	**R3**	**R4**	**R5**
STAGE 3 C – RL1002					
Surface Miner (Lw105) & Dozer (Lw100) & 3 scraper movement/15min					
Calm	26	34	34	29	28
West Wind	34	30	30	26	26
OR					
3 scraper movement/15min					
Calm	25	33	33	28	26
West Wind	23	29	29	25	25
OR					
6 scraper movement/15min					
Calm	28	36	36	31	29
West Wind	26	32	32	28	28

The noise predictions presented in *Table 12* show extraction activities during both calm and west wind meteorological conditions satisfy the recommended project specific noise goals at all reference residential receiver locations under the operating scenarios referenced.

In terms of the Blue Mountains National Park, a review of the mining and lease boundaries has found that at its closest point plant and equipment would be located approximately fifty (50) metres from the lease boundary. A review of available literature and discussions with the National Parks and Wildlife Service (Appendix 7) have confirmed that the closest formalised walking track is more than two (2) kilometres from the lease boundary. At a distance of two hundred (200) metres from the pit boundary the predicted noise levels within the Blue Mountains National Park are less than L_{Aeq} 50dB(A). At the closest identified walking track (2 kilometres) into the Blue Mountains National Park noise from the mining operations would be significantly less than 50dB(A).

The results of the noise modelling for Stage 1B, 2B and 3B during calm meteorological conditions are presented as noise contours in Appendices 4-6. It is noted that the noise contours plots are for presented for graphic purposes only, *Table 12* should be referred to for more detailed noise predictions.

6.3 Train Loading Operations

Train loading operations have been considered as a separate operation and without normal mine extraction activities. This scenario has been modelled considering the short duration of the loading activities (45min to 1 hour). A summary of the predicted noise levels during under varying meteorological conditions is presented in *Table 13*.

Table 13: Predicted Noise Levels: Train Loading
$L_{Aeq,15min}$ dB(A) re: 20 x 10^{-6} Pa

Meteorological Condition	Reference Receiver				
	R1	R2	R3	R4	R5
Calm	27	29	34	31	29
West Wind	33	35	38	34	31

The results of the noise predictions for train loading activities show that the recommended project specific noise levels can be achieved at all reference residential locations.

In terms of cumulative noise from mining activities and train loading, exceedances (1-3dB(A)) of the project goal (37-38dB(A)) may occur at some reference receiver locations located at the western end of Newnes village (Reference Locations R2-R5).

The main source of the noise from train loading activities is associated with the locomotive. Considering the locomotive is located outside the mine lease area, its operations should be considered as a separate entity and accordingly not assessed as the cumulative operations with the mine.

6.4 Train Movements

Passby noise levels from trains (Notch 3 power setting) on the main western rail line and at the entrance to the rail loop have been assessed for the most exposed receivers identified as Sandham Road – southeast (R1) and 5 Sandham Road (R5). A summary of the predicted passby noise levels is presented in *Table 14*.

Table 14: Predicted Train Passby Noise Levels (Class 81 Locomotive)
L_{Amax} dB(A) re: 20 x 10^{-6} Pa

Reference Location	Predicted Noise Level dB(A)
Sandham Road (R1)	78
5 Sandham Road (R5)	77

Taking account of the existing and projected two (2) train movements in a twenty four (24) hour period (Section 5.2) and the measured SEL noise levels of train passbys (*Table 4*), *Table 15* provides a summary of the existing and projected train movements, and the calculated existing and projected $L_{Aeq, 24hour}$ noise levels.

Table 15: Predicted Train Noise Levels ($L_{Aeq,24hour}$)
dB(A) re: 20 x 10^{-6} Pa

Reference Location	Existing Daily Rail Movements	Projected Daily Rail Movements (max.)	Existing $L_{Aeq,24hour}$	Projected $L_{Aeq,24hour}$	Increase dB(A)
Sandham Road (R1)	$25^{(C)}$ $20^{(F)}$	$25^{(C)}$ $22^{(F)}$	55.6	56.0	+0.4
5 Sandham Road (R5)	$25^{(C)}$ $20^{(F)}$	$25^{(C)}$ $22^{(F)}$	54.9	55.4	+0.5

NOTE: (F) Freight Train – indicative provided by RailAccess Corporation
(C) Commuter Train – provided by CityRail

The calculated noise levels for the existing and additional train movements projected for the main western rail line satisfy the DEC recommended goal of $L_{Aeq, 24hour}$ 60dB(A).

6.5 Assessment

The results of the noise modelling for the site establishment including infrastructure development, and pollution control ainstallations has shown that the recommended noise goals are generally satisfied at the reference residential assessment locations during both Stage 1 and Stage 2 construction/preparation works. Albeit, noise exceedance has been identified during site preparation for the erection of the acoustic barrier.

The noise modelling and assessment has shown that noise from mine extraction operations considered under calm and west wind conditions satisfy the recommended project specific noise levels for all mining stages (Stage 1-3) at all reference residential assessment locations under the operating scenarios presented.

The assessment of train loading activities has shown that the project specific noise levels can be satisfied at the reference residential assessment.

Noise levels associated with rail movements on the main western rail line are predicted to satisfy the recommended L_{Amax} noise level of 85dB(A) and the $L_{Aeq\ 24hour}$ noise goal of 60dB(A).

With respect to noise impacts on the Blue Mountains National Park, the assessment has shown (Section 6.2 and Appendices 3-5) that the recommended noise goal of 50-55dB(A) can be satisfied within one hundred and fifty (150) metres of the park boundary.

7.0 FINDINGS AND RECOMMENDATIONS

Noise modelling has shown that during site preparation, infrastructure development and pollution control installation the recommended medium term goal for construction (L_{A90} +10dB(A)) can generally be satisfied at the reference residential locations. Noise modelling for barrier construction has confirmed that the recommended construction noise goal for the total construction and site preparation works (26 weeks – 42/43dB(A)) may be exceeded by up to 13dB(A) at some reference locations (R1-R3) for an expected duration of two (2) weeks from initial clearing by dozer. To minimise noise impacts, a noise management plan would be prepared.

Noise modelling for mining operations during calm and west wind meteorological conditions has shown that the recommended project specific noise goals (L_{Aeq} 37-38) are satisfied for all stages at the reference residential receivers subject to compliance with the operating scenarios presented.

With respect to the Blue Mountains National Park, the assessment has shown during normal mining operations, the recommended noise goal of 50dB(A) can be satisfied within one hundred and fifty (150) metres of the park boundary.

The results of the noise predictions for train loading activities has shown that the recommended project specific noise levels can be satisfied at all reference residential locations.

The assessment has shown that predicted noise levels associated with the additional rail movements on the main western rail line satisfy the recommended L_{Amax} 85dB(A) and $L_{Aeq\ 24hour}$ 60dB(A) noise levels.

7.1 Noise Control Recommendations

- to control noise impacts during site preparation, infrastructure development and pollution control, it is recommended that a 'Construction Noise Management Plan' (CNMP), be prepared to identify procedures and methods of controlling noise;

- the proposed acoustic/visual barrier shall be constructed of precast concrete panels, Hebel or equivalent and erected to a height of five (5) metres above the existing ground level adjacent the western, south-western and southern pit boundaries prior to any major site works;

- all site preparation, infrastructure development and pollution control installations shall be undertaken between the hours of 7.00am – 6.00pm Monday to Friday, and 7.00am-1.00pm Saturday;

- all construction plant and equipment shall selected and maintained to satisfy the acoustic performance referenced in *Table 8*;

- all loading conveyor systems shall be belt type conveyors;

- all permanent site plant and equipment shall selected and maintained to atisfy the acoustic performance referenced in *Table 9*;

- mining to be conducted in accordance with the operating scenarios presented in *Table 12*; and;

- as part of the Mine EMP a "Noise Management Plan" (NMP) shall be developed and implemented with noise monitoring being conducted during initial stages of mine development to confirm noise levels and where required assess the practicability of additional noise controls. Subsequent annual noise audits should be undertaken if considered necessary to ensure that all noise control measures are installed and maintained, and that the environmental noise levels (criteria) are satisfied. The program shall incorporate a complaint management protocol that facilitates investigation and actioning of noise related complaints.

8.0 CONCLUSION

It is proposed to establish a kaolin ore mine with an area of approximately twenty-three (23) hectares at a greenfield site at Newnes Junction. The mine proposal is located north of Newnes Junction, between Bell and Lithgow along Bells Line Road (*Figure 1*).

The results of ambient noise monitoring and environmental noise audits conducted in the area have confirmed that the existing ambient noise is influenced by road traffic on the Bells Line of Road (Chifley Road), rail traffic, local domestic, existing colliery and Rocla quarry operations and natural elements such as wind, birds, animals, etc.

Noise modelling of activities associated with construction has shown with appropriate selection of plant and equipment the recommended assessment goals for site preparation, infrastructure development and pollution control can generally be achieved at all reference residential locations. Albeit, noise modelling for acoustic barrier construction has confirmed that exceedances of up to 13dB(A) at some reference locations (R1-R3) may occur for an expected duration of two (2) weeks from initial clearing by dozer.

During the initial stages of the mine development an acoustic/visual barrier will be constructed along the western, south-western and southern limits of the pit. The barrier will assist in reducing noise emission from infrastructure development, site preparation, pollution control and mining operations.

The findings of the noise modelling for the proposal have shown that with appropriate selection of equipment, effective noise controls and management procedures, noise during normal mining operations and train loading can be controlled to satisfy the

project specific assessment goals under calm and west wind meteorological conditions for all stages at all reference residential assessment locations.

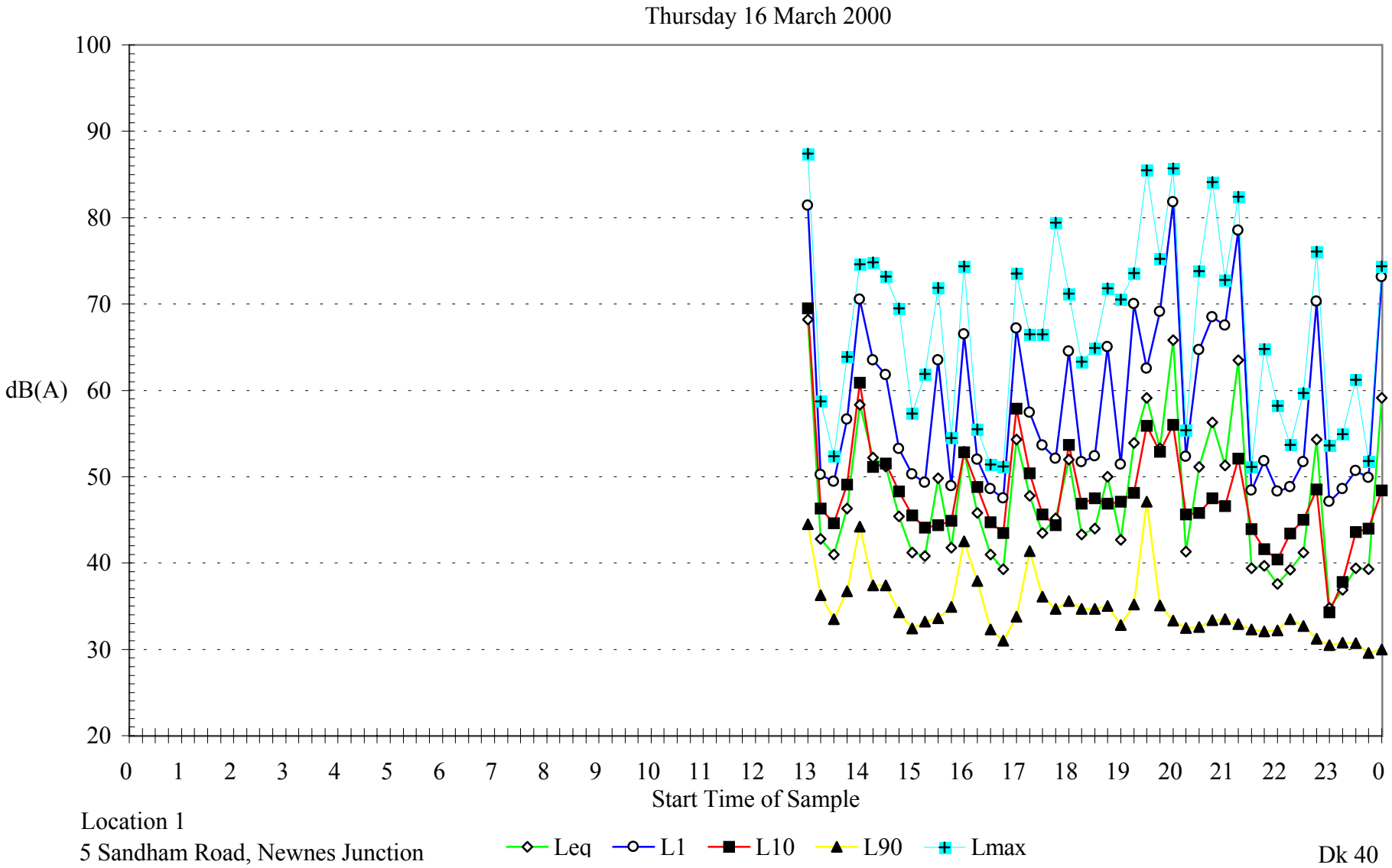
With respect to the Blue Mountains National Park, the assessment has shown under mining operations, the recommended noise goal of 50dB(A) can be satisfied within one hundred and fifty (150) metres of the park boundary.

The assessment also found the predicted noise levels associated with rail movements on the main western rail line satisfy the recommended L_{Amax} 85dB(A) and $L_{Aeq\ 24hour}$ 60dB(A) assessment goals.

Based on the findings of the assessment and as part of the Noise Management Plan for the proposal it is recommended that noise monitoring be conducted during initial stages of mine development to confirm the above findings and establish the practicability of additional noise controls where required.

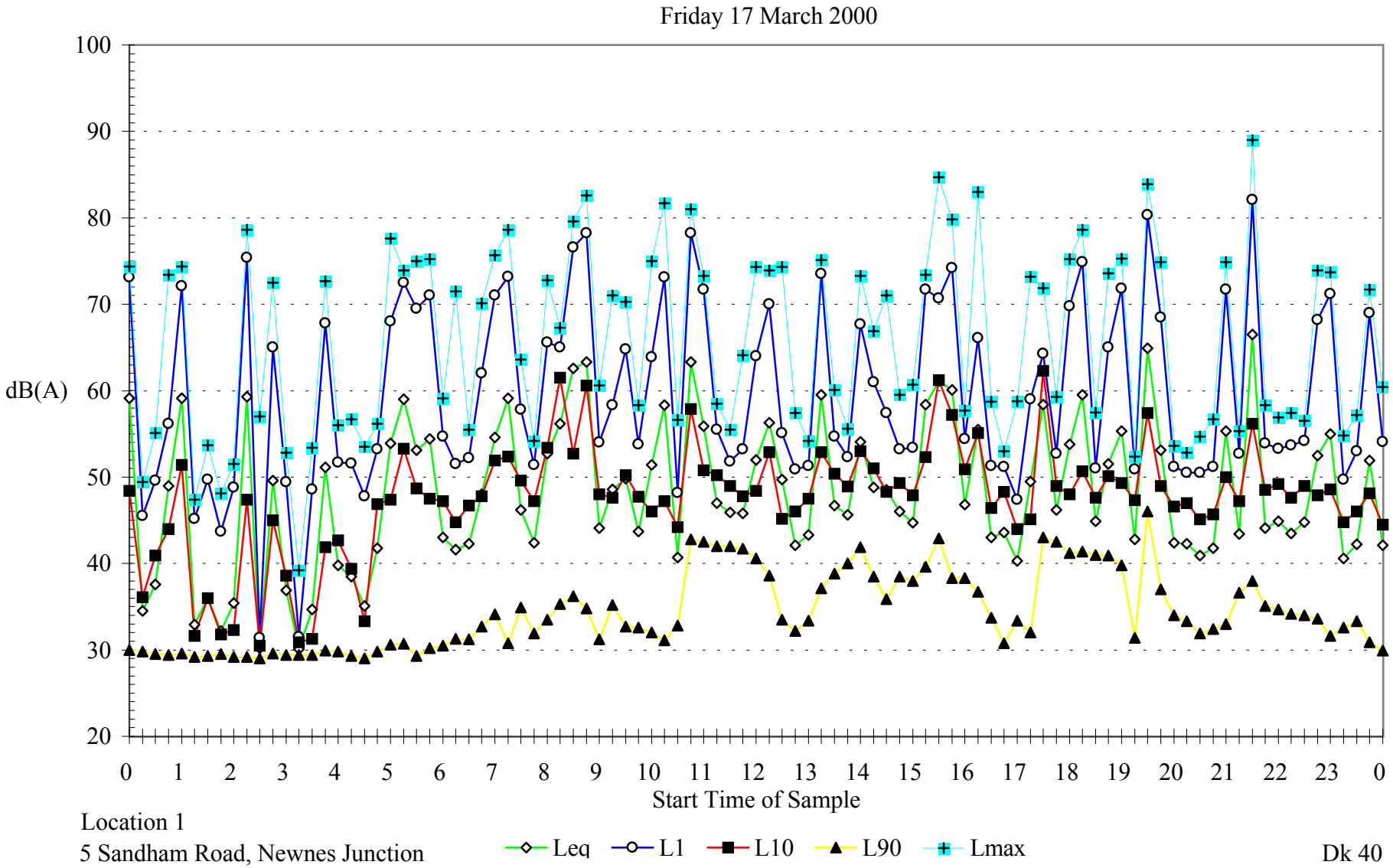
APPENDIX 1: AMBIENT NOISE LEVELS

Ambient Sound Pressure Levels



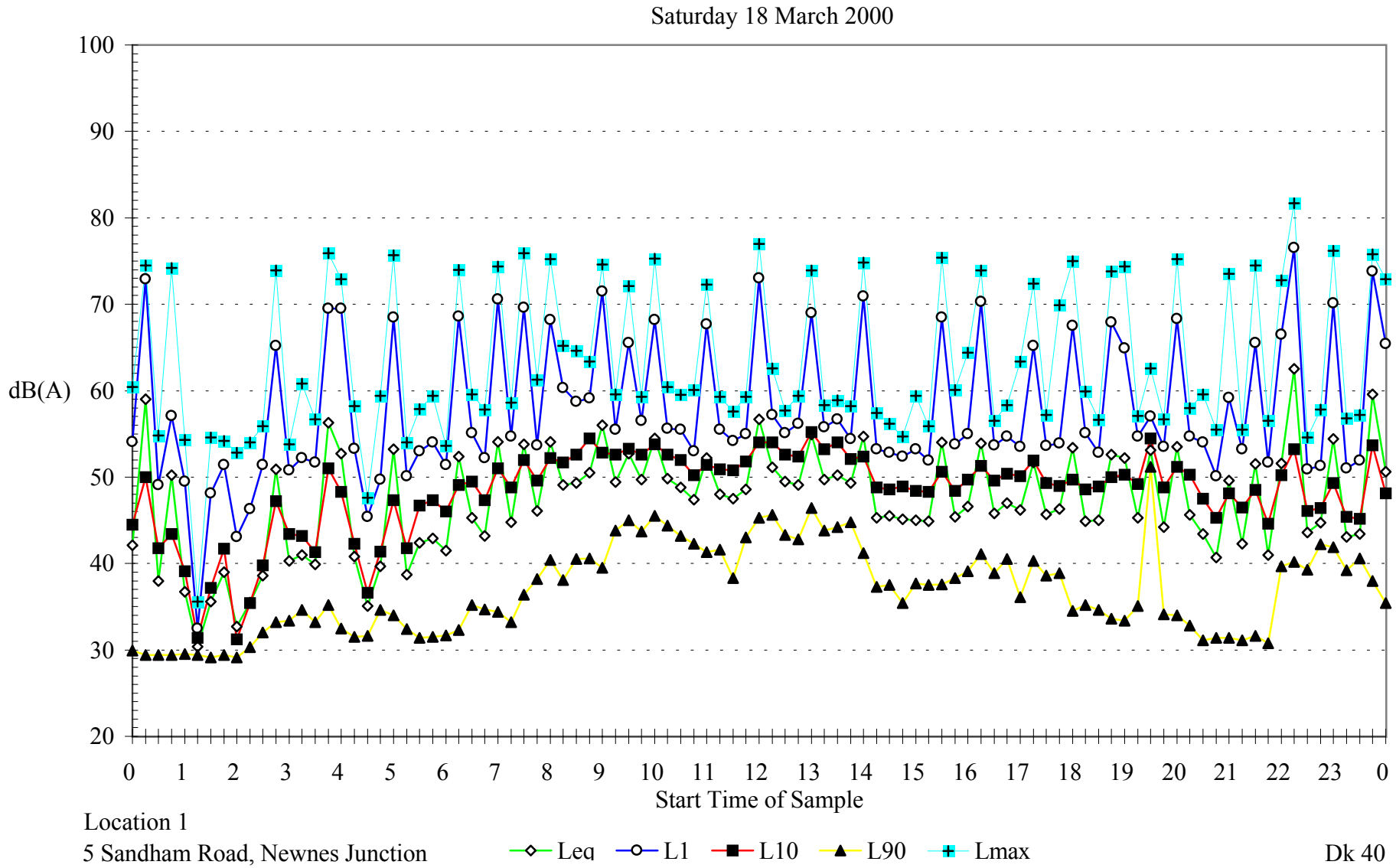
5058R1AA.XLS

Ambient Sound Pressure Levels



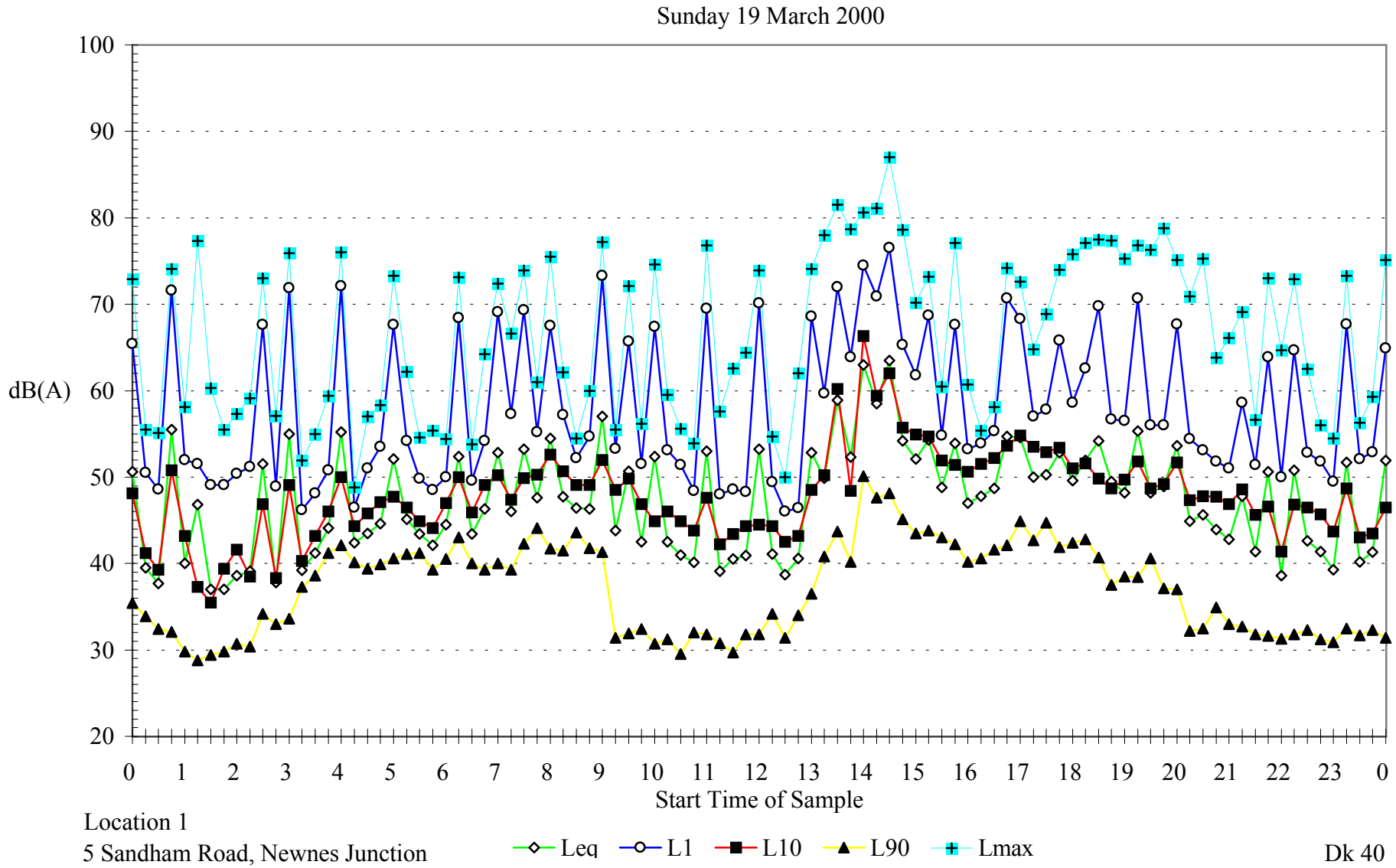
5058R1AA.XLS

Ambient Sound Pressure Levels



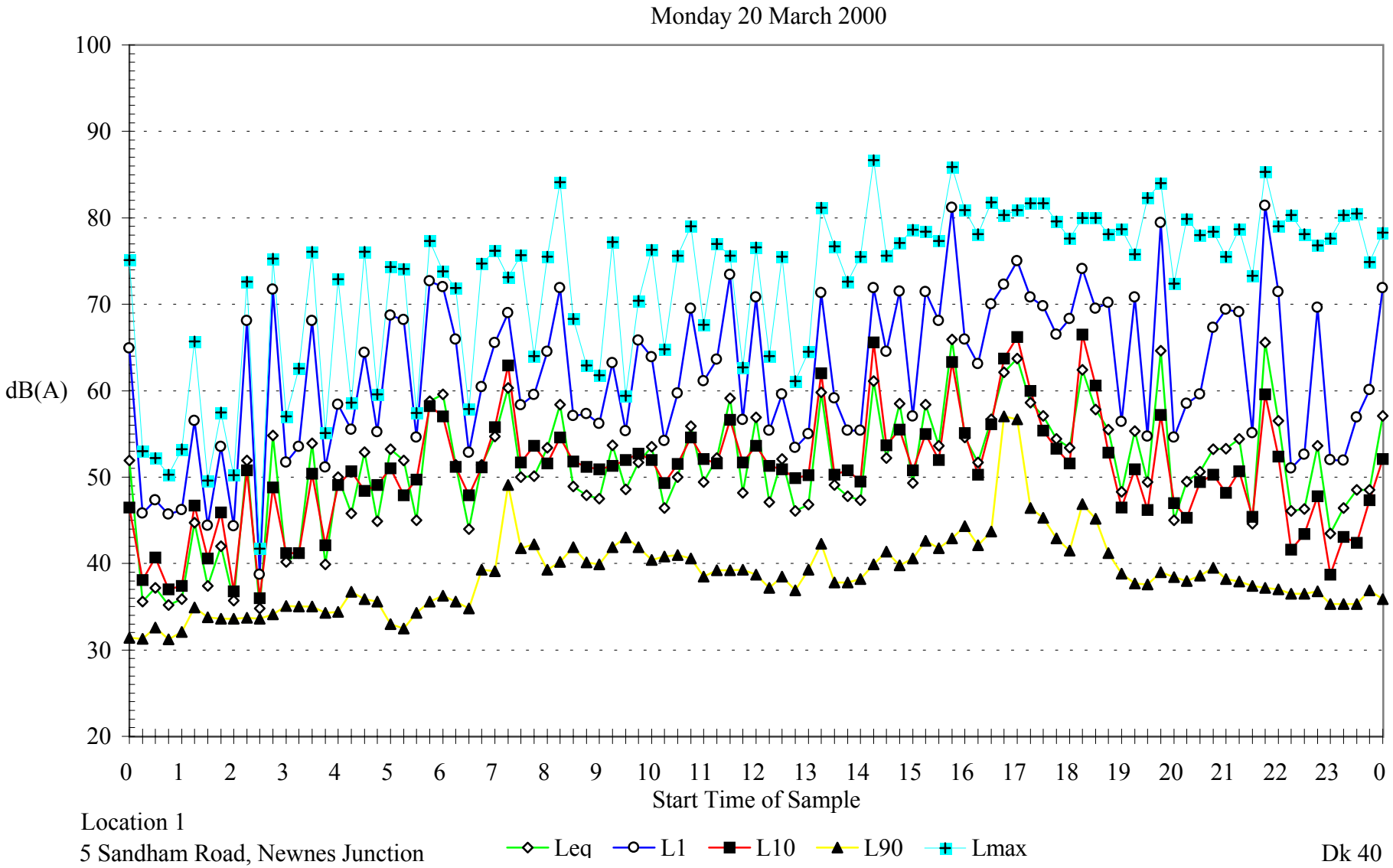
5058R1AA.XLS

Ambient Sound Pressure Levels



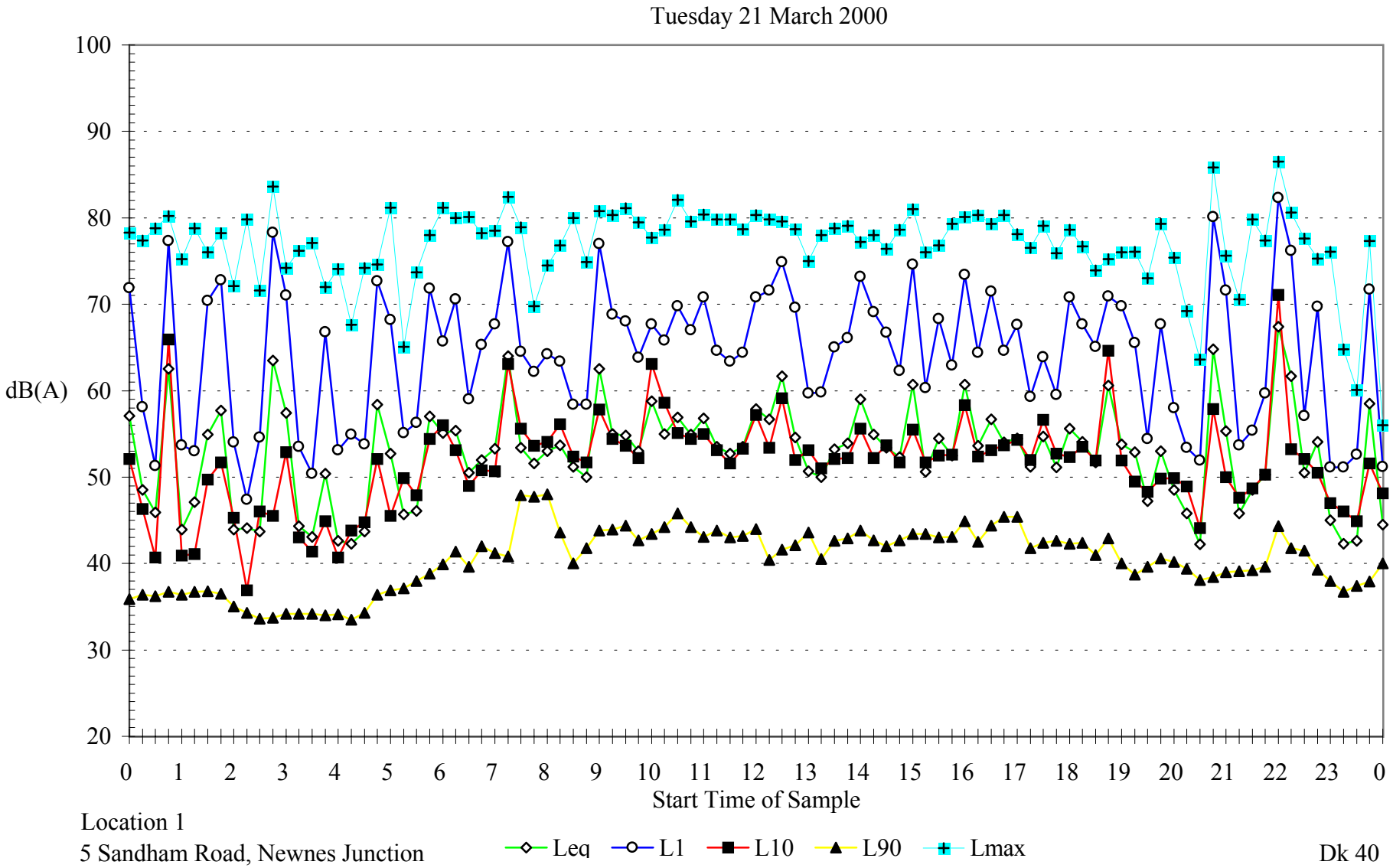
5058R1AA.XLS

Ambient Sound Pressure Levels



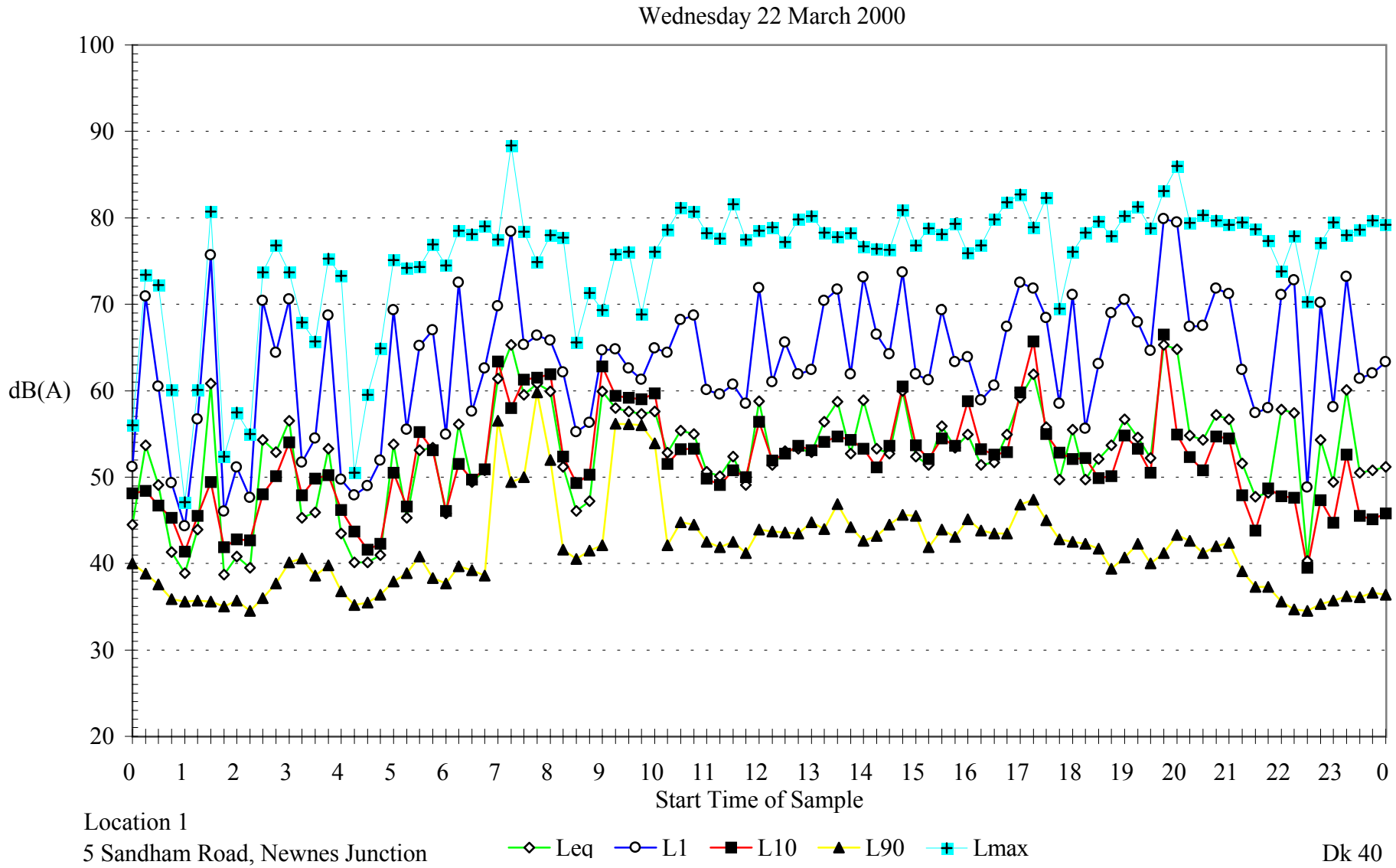
5058R1AA.XLS

Ambient Sound Pressure Levels



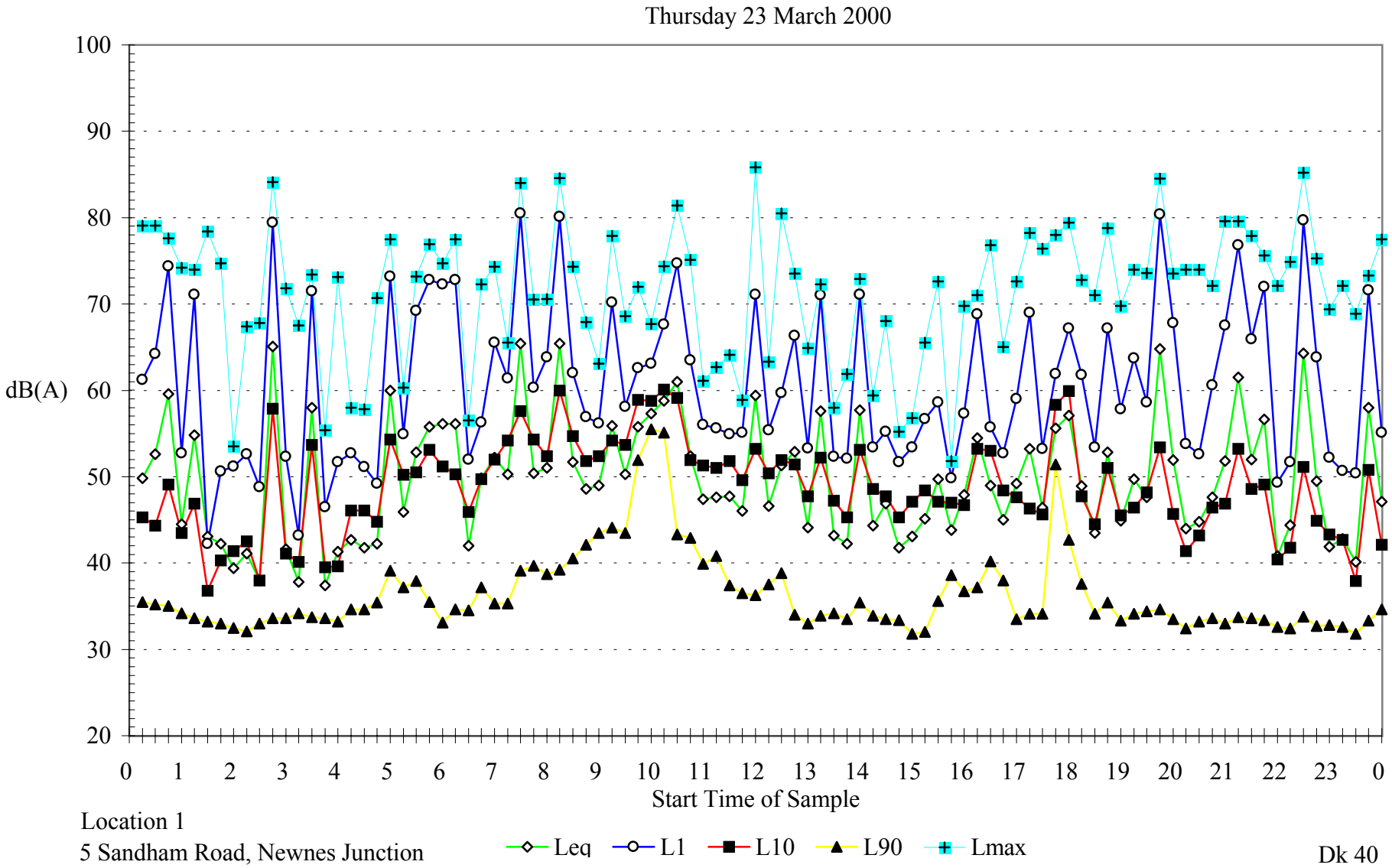
5058R1AA.XLS

Ambient Sound Pressure Levels



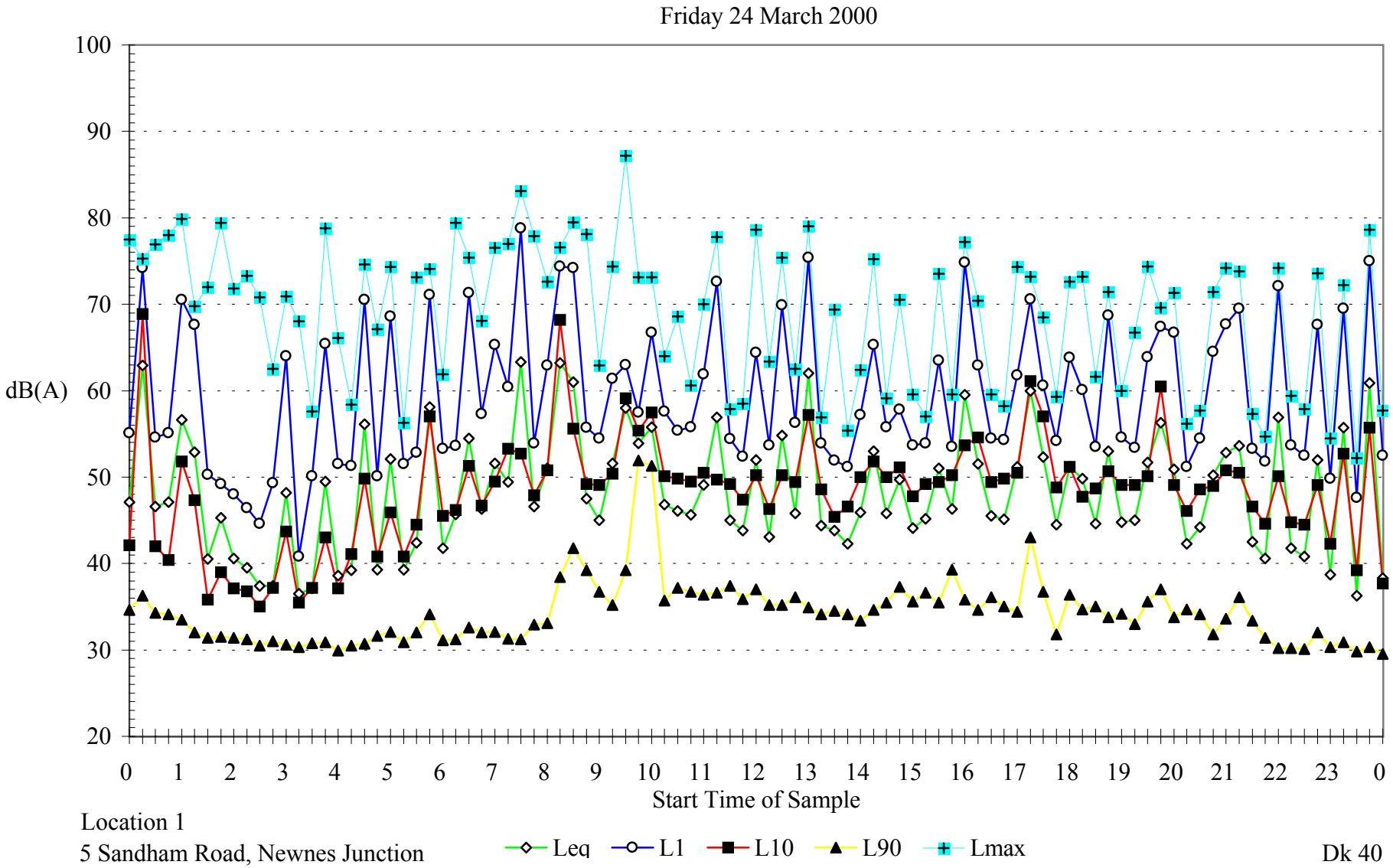
5058R1AA.XLS

Ambient Sound Pressure Levels



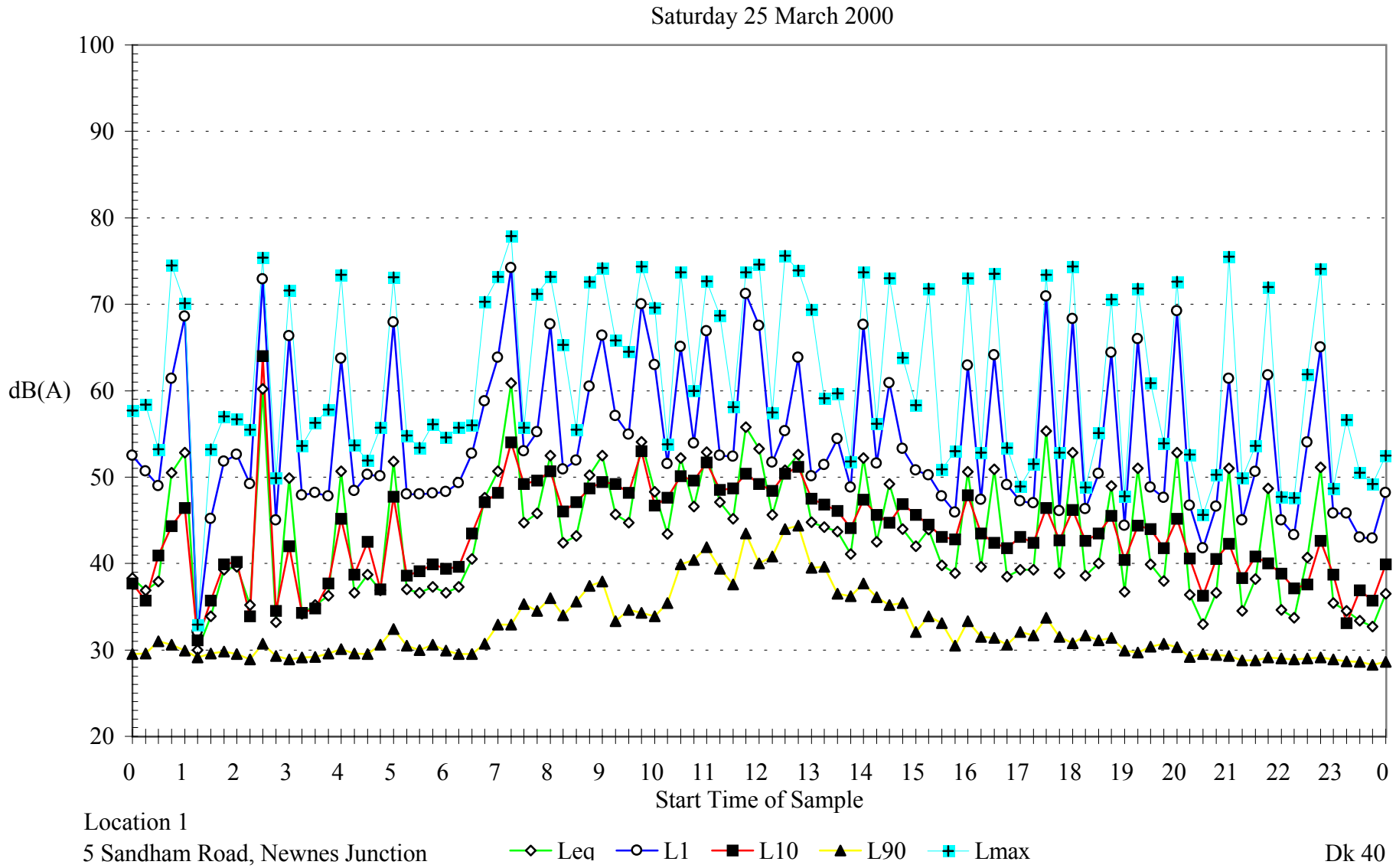
5058R1BA.XLS

Ambient Sound Pressure Levels



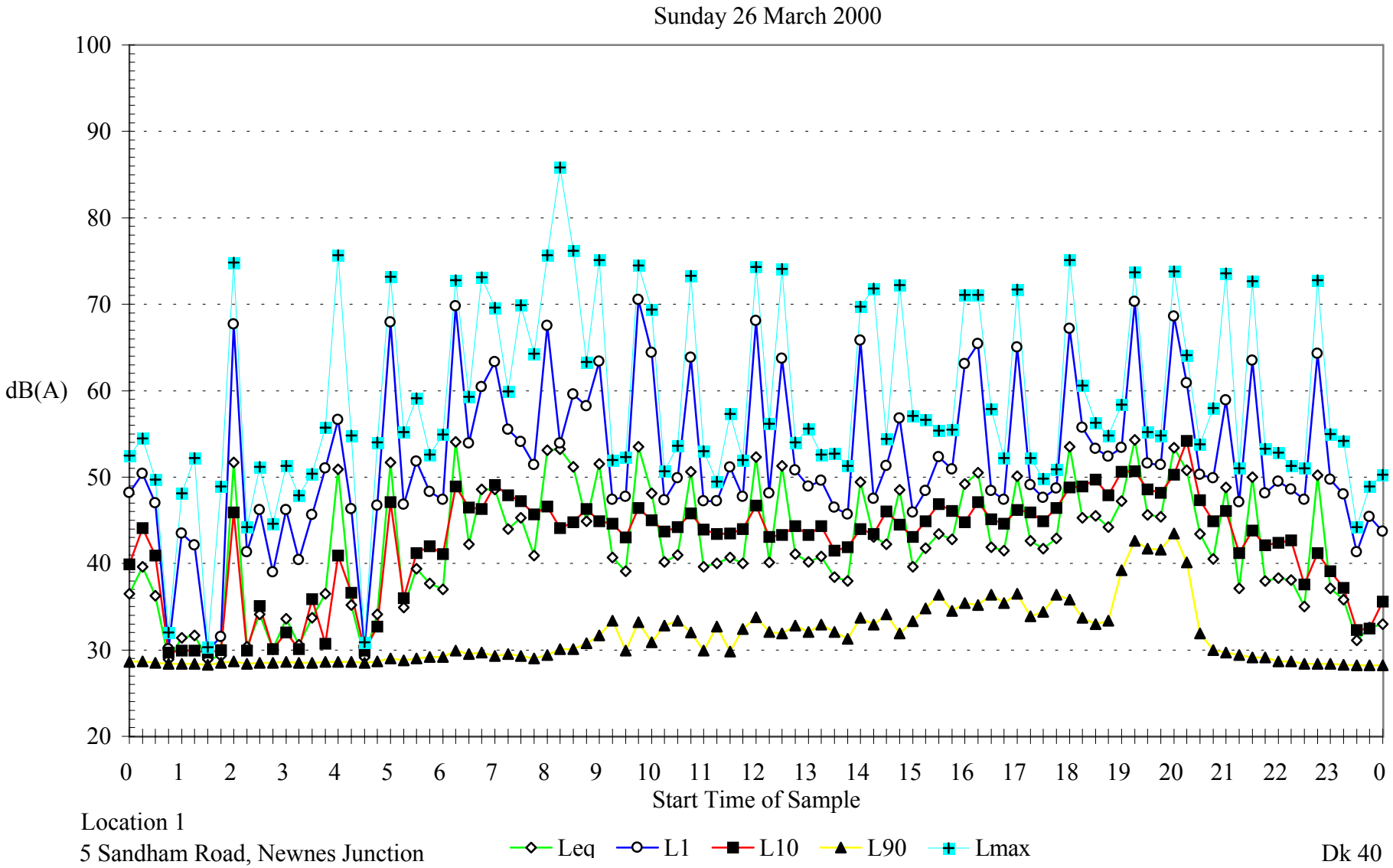
5058R1BA.XLS

Ambient Sound Pressure Levels



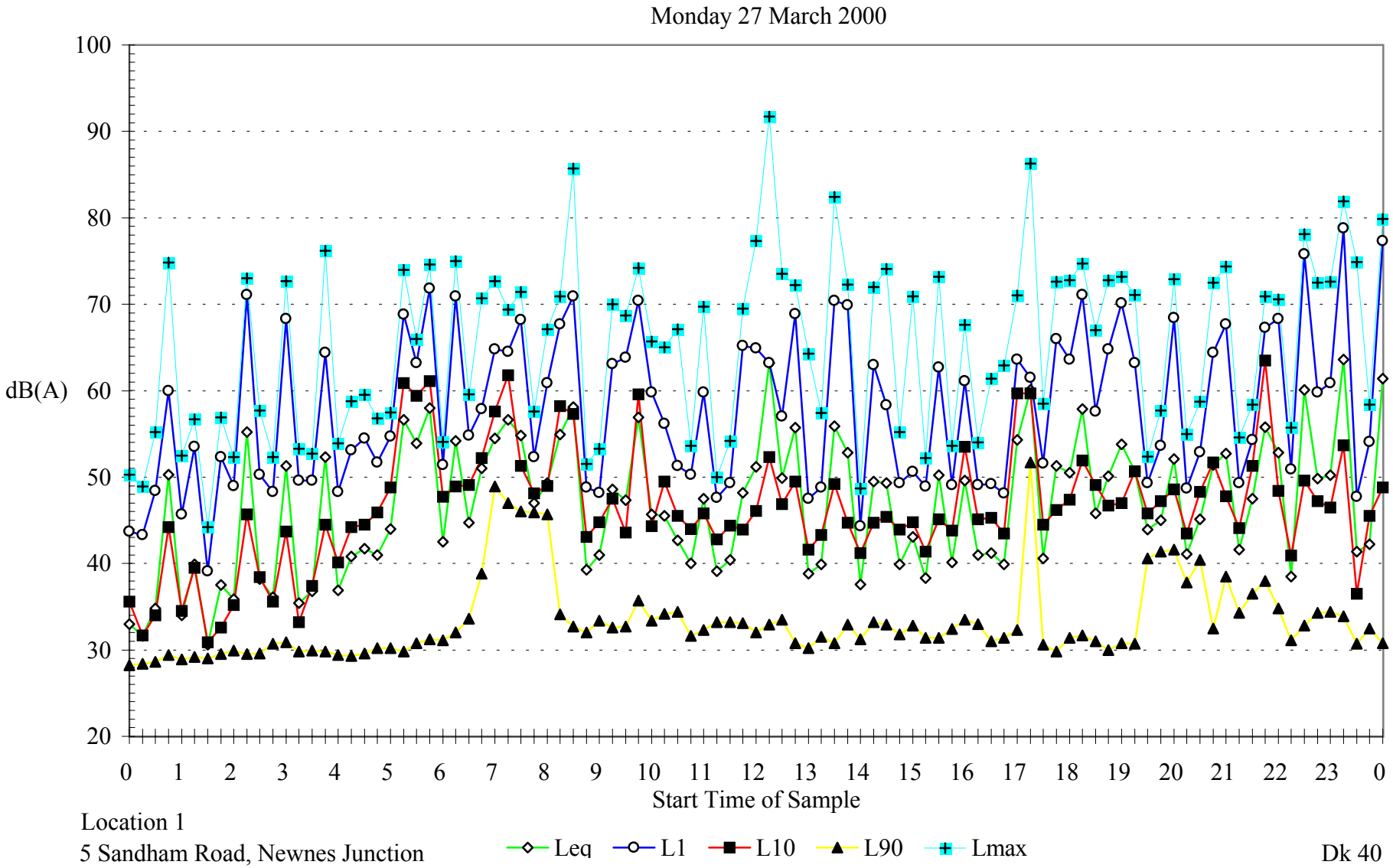
5058R1BA.XLS

Ambient Sound Pressure Levels



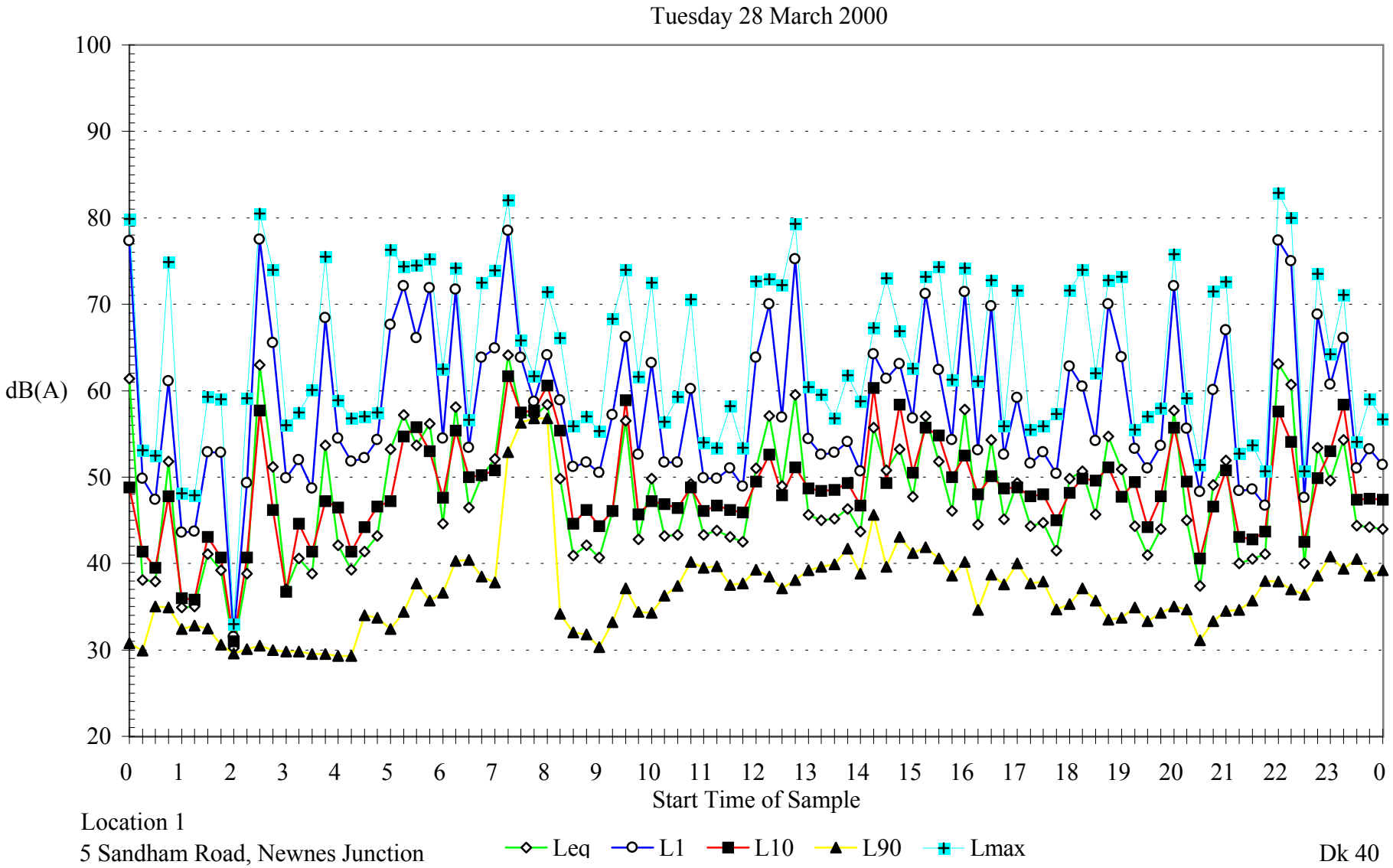
5058R1BA.XLS

Ambient Sound Pressure Levels



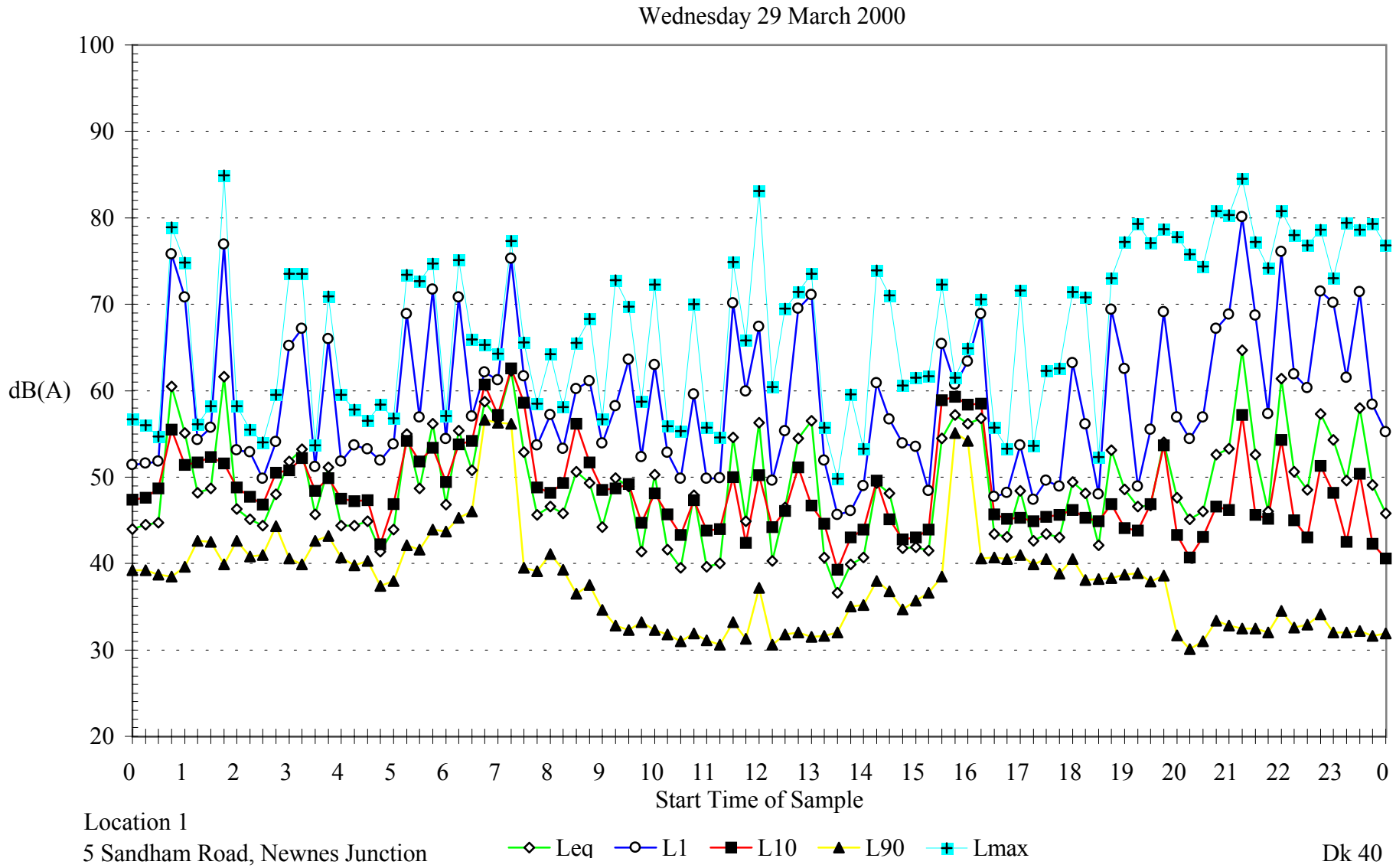
5058R1BA.XLS

Ambient Sound Pressure Levels



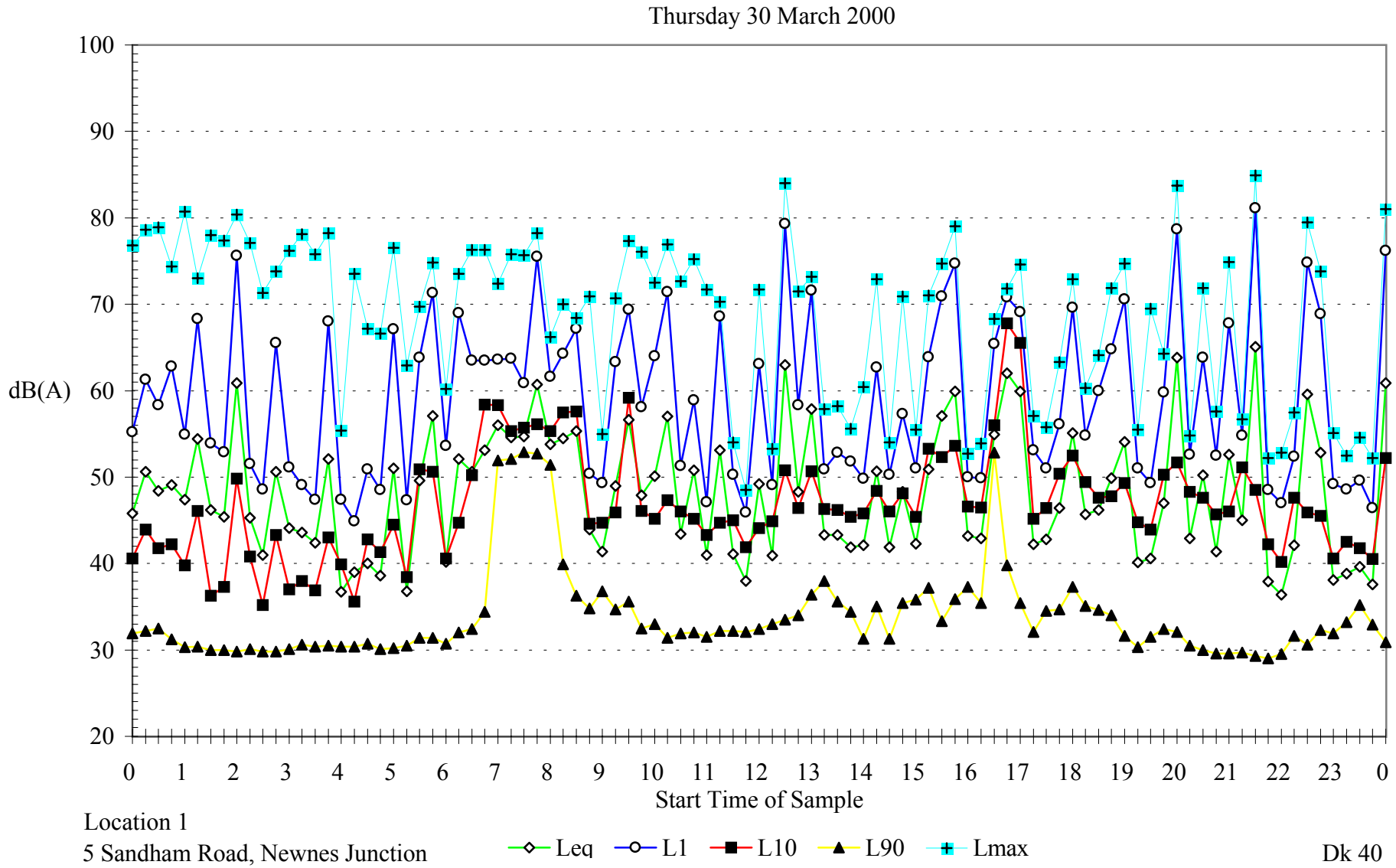
5058R1BA.XLS

Ambient Sound Pressure Levels



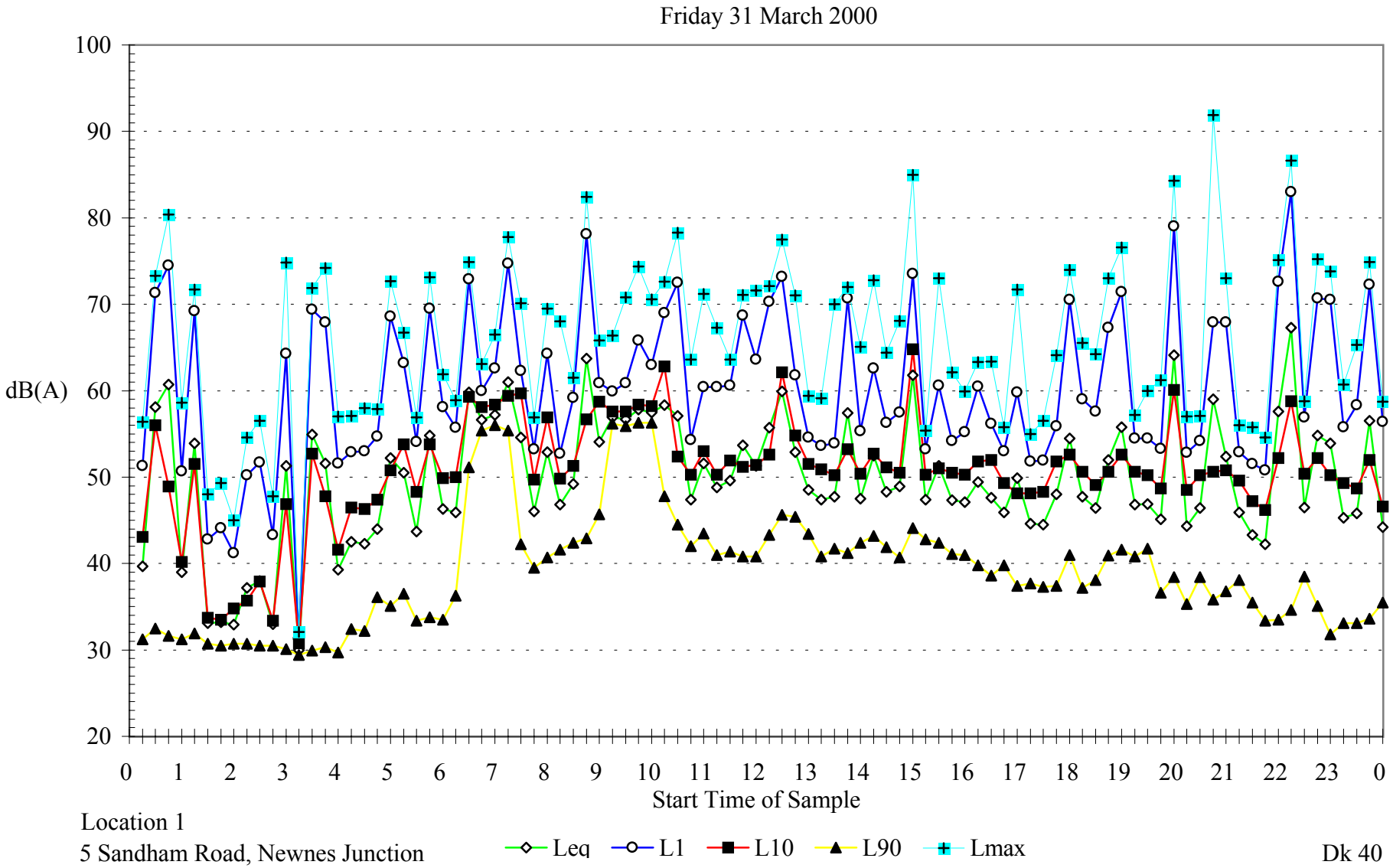
5058R1BA.XLS

Ambient Sound Pressure Levels



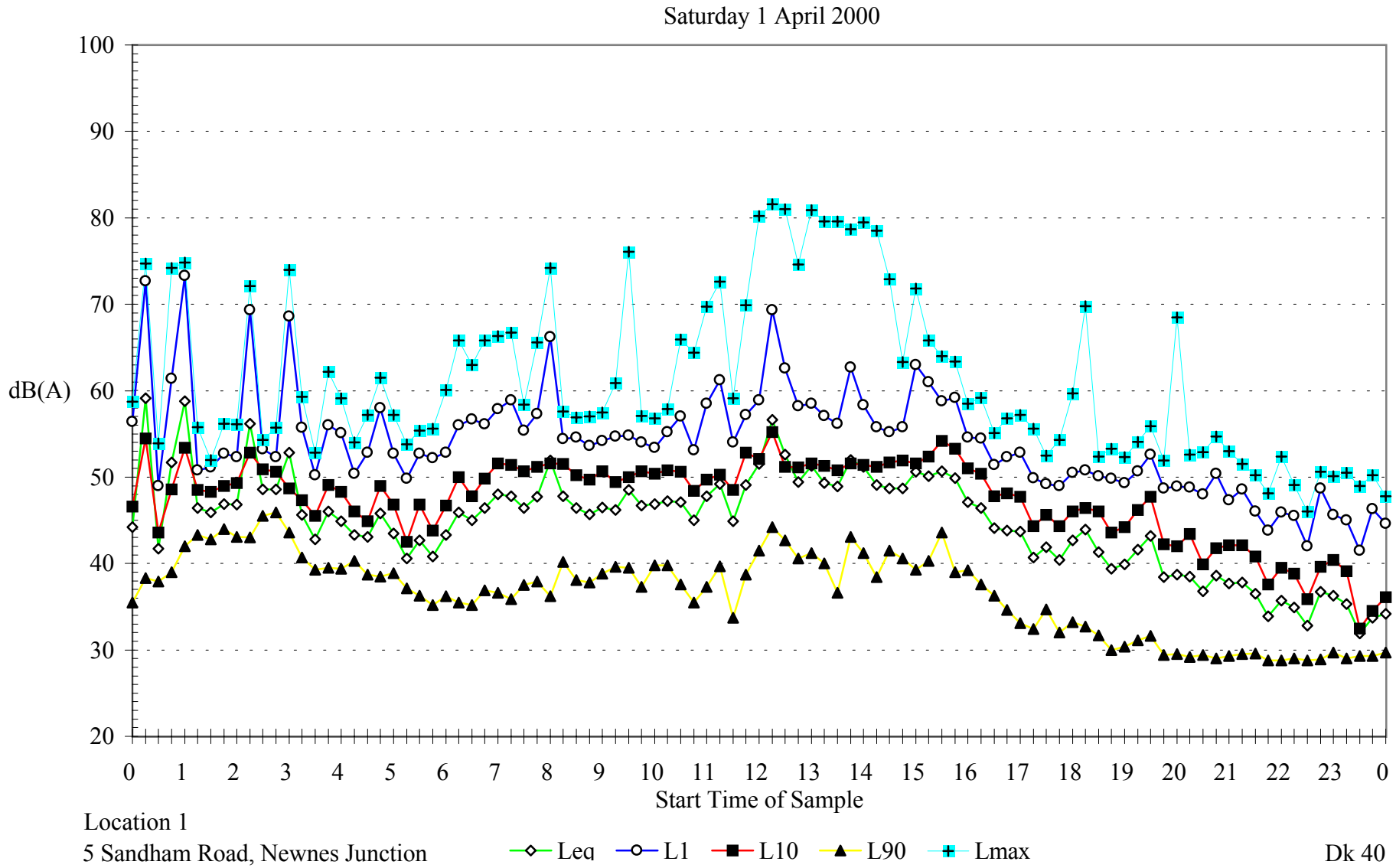
5058R1BA.XLS

Ambient Sound Pressure Levels



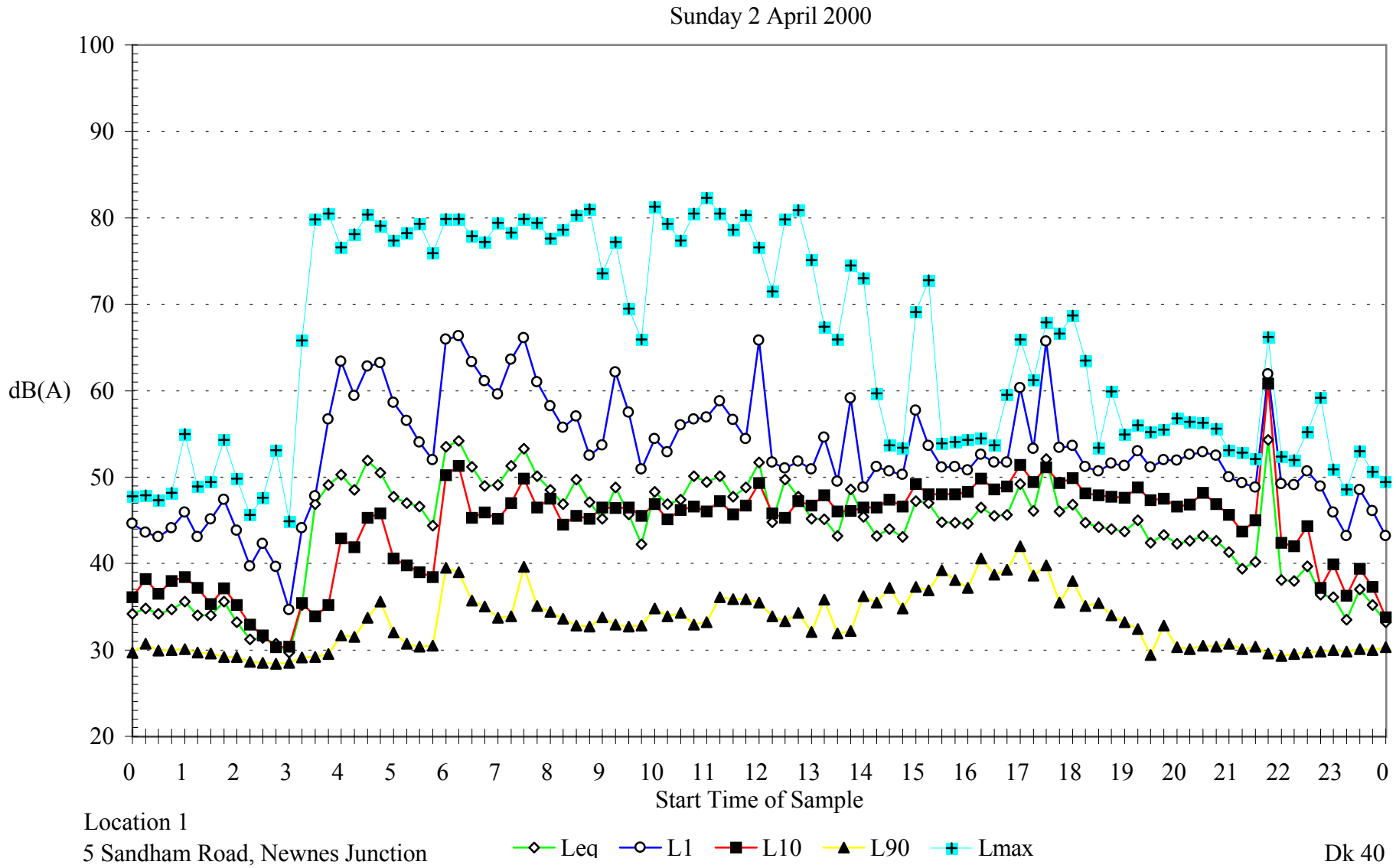
5058R1CA.XLS

Ambient Sound Pressure Levels



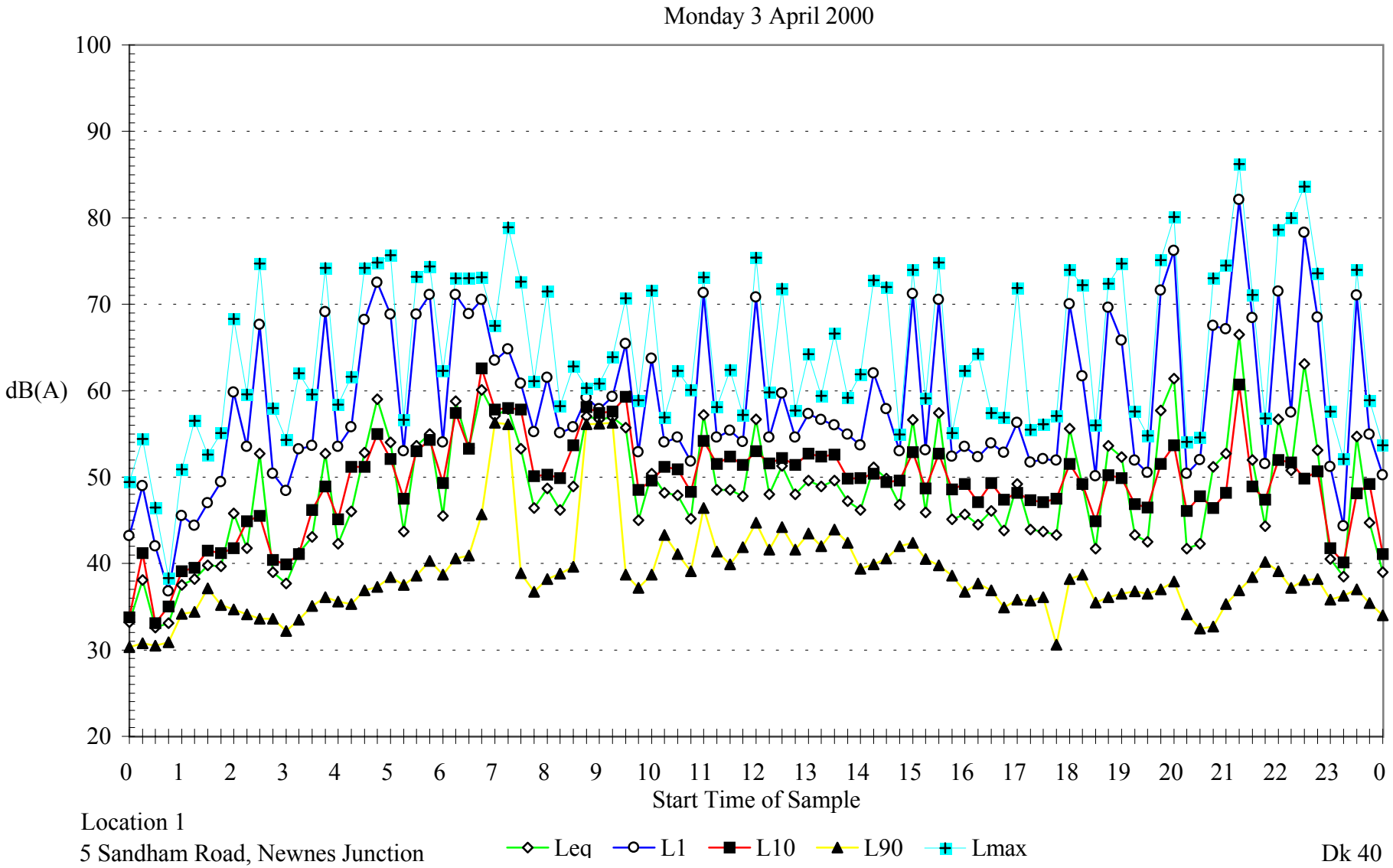
5058R1CA.XLS

Ambient Sound Pressure Levels



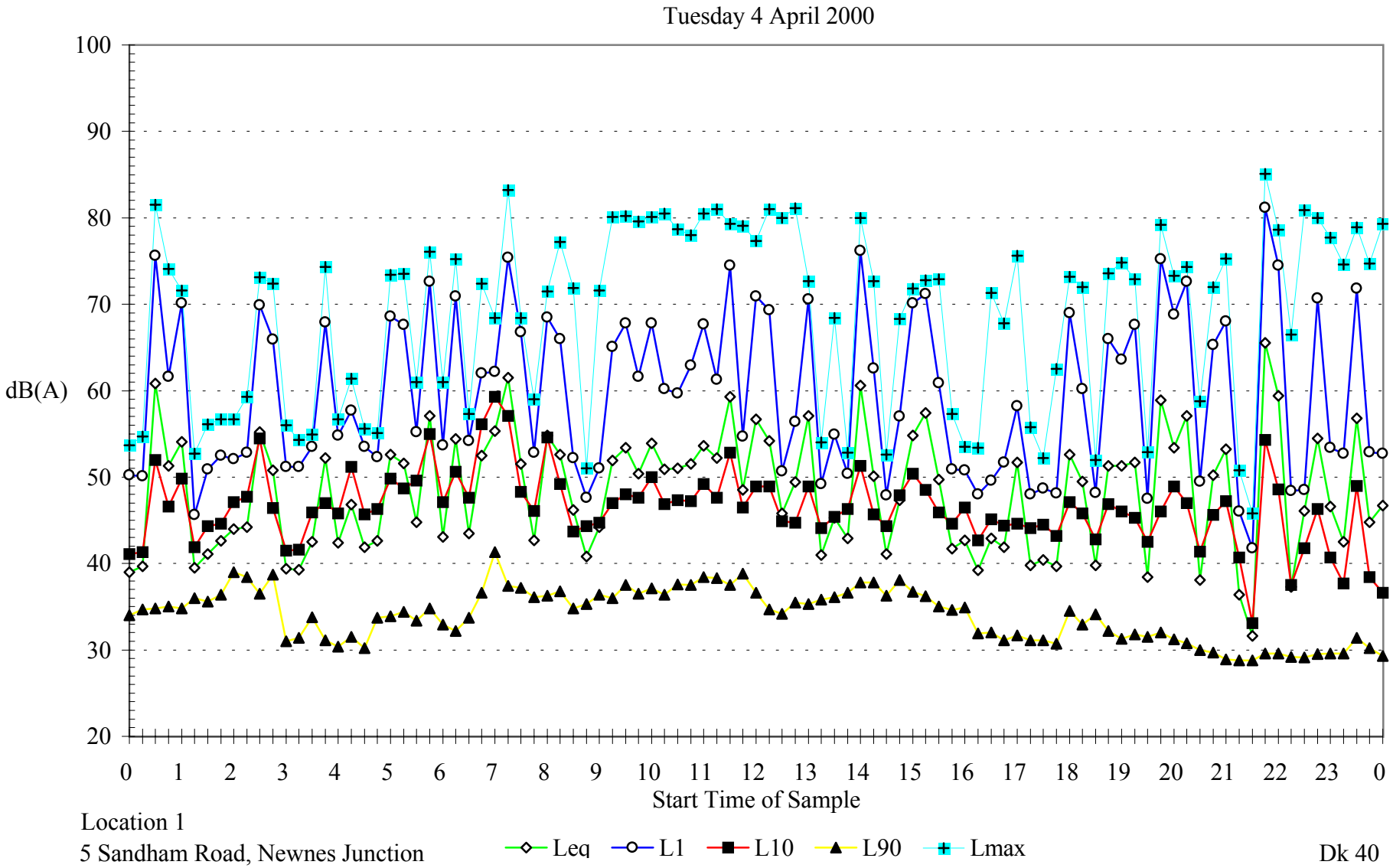
5058R1CA.XLS

Ambient Sound Pressure Levels



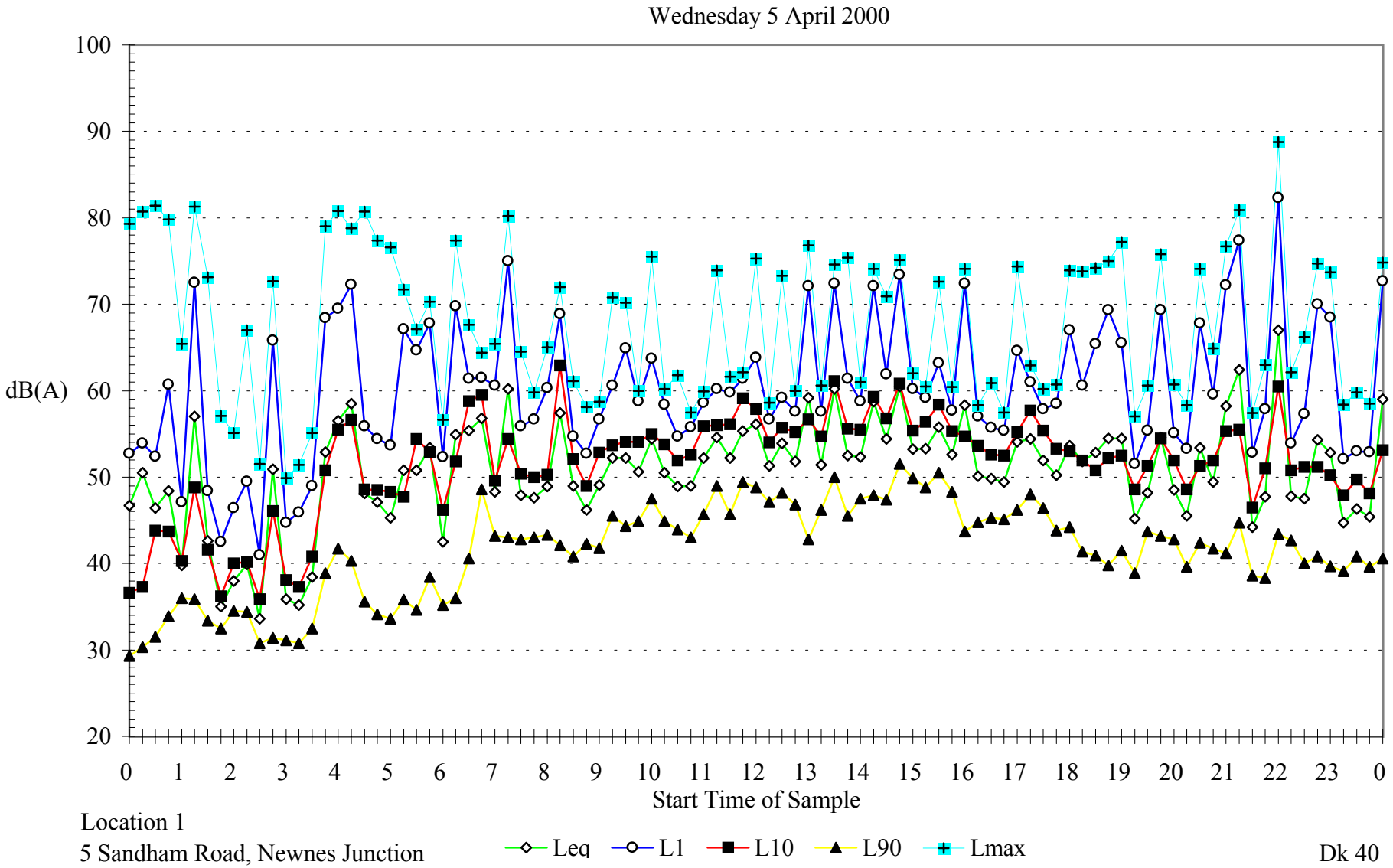
5058R1CA.XLS

Ambient Sound Pressure Levels



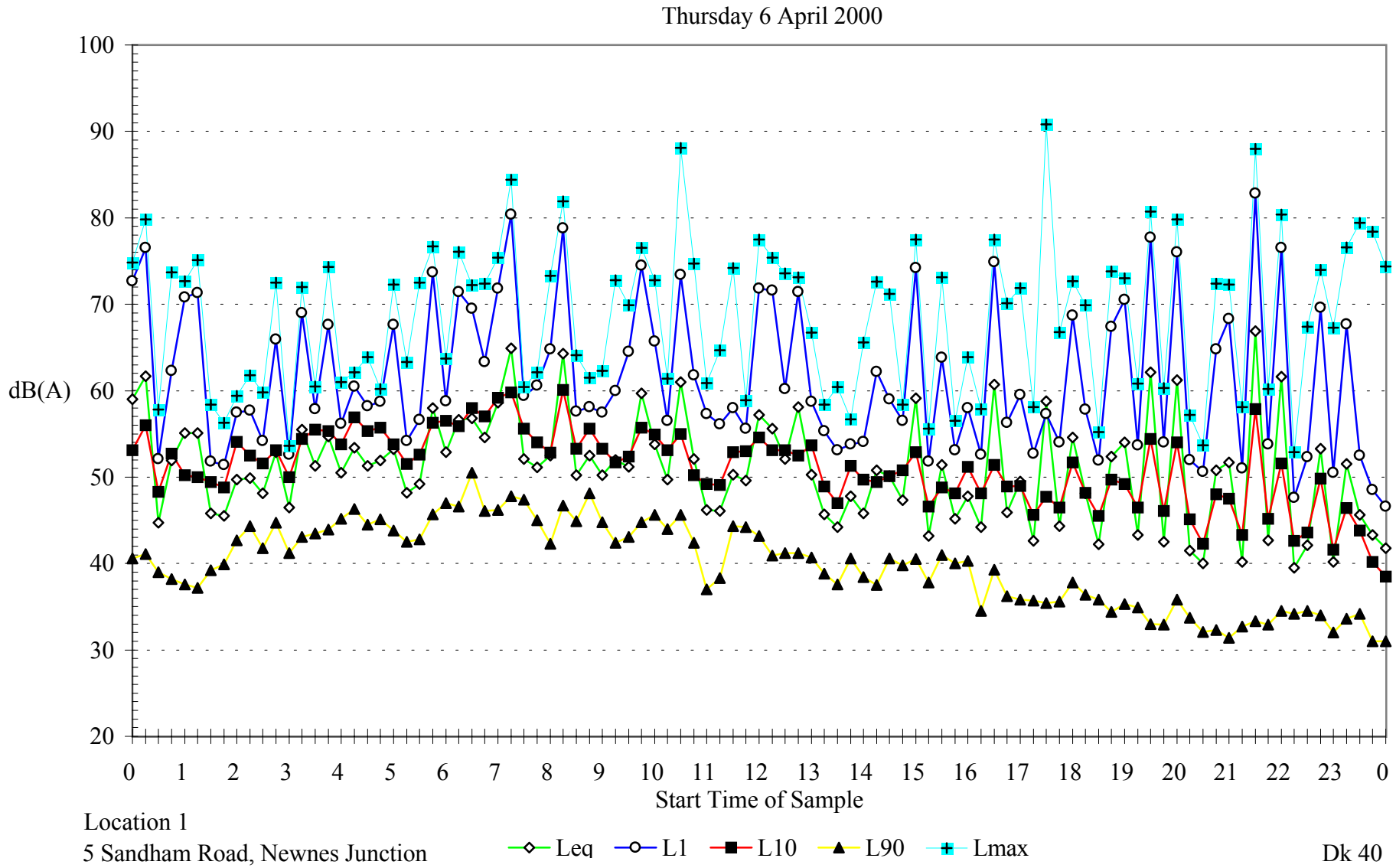
5058R1CA.XLS

Ambient Sound Pressure Levels



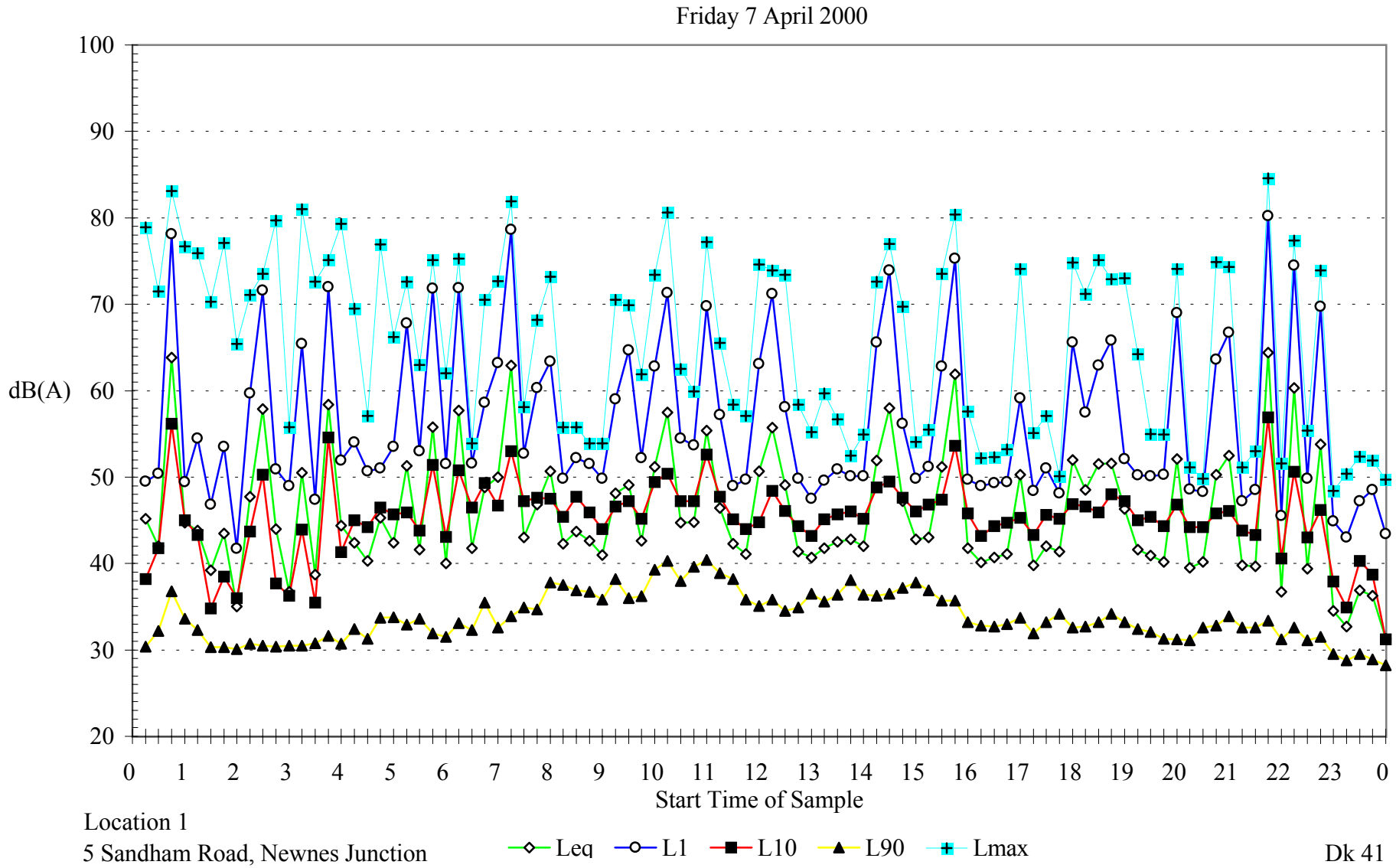
5058R1CA.XLS

Ambient Sound Pressure Levels



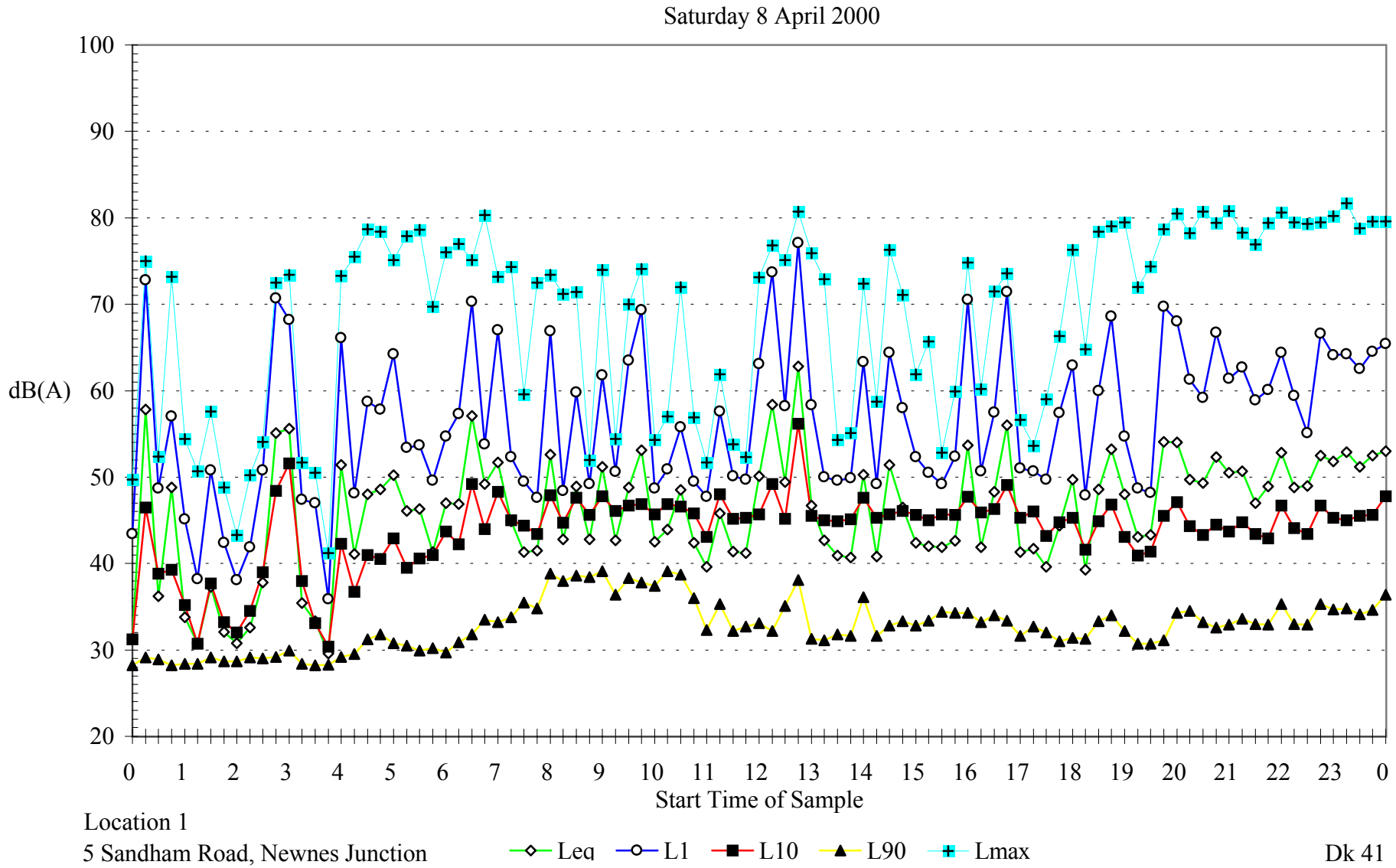
5058R1CA.XLS

Ambient Sound Pressure Levels



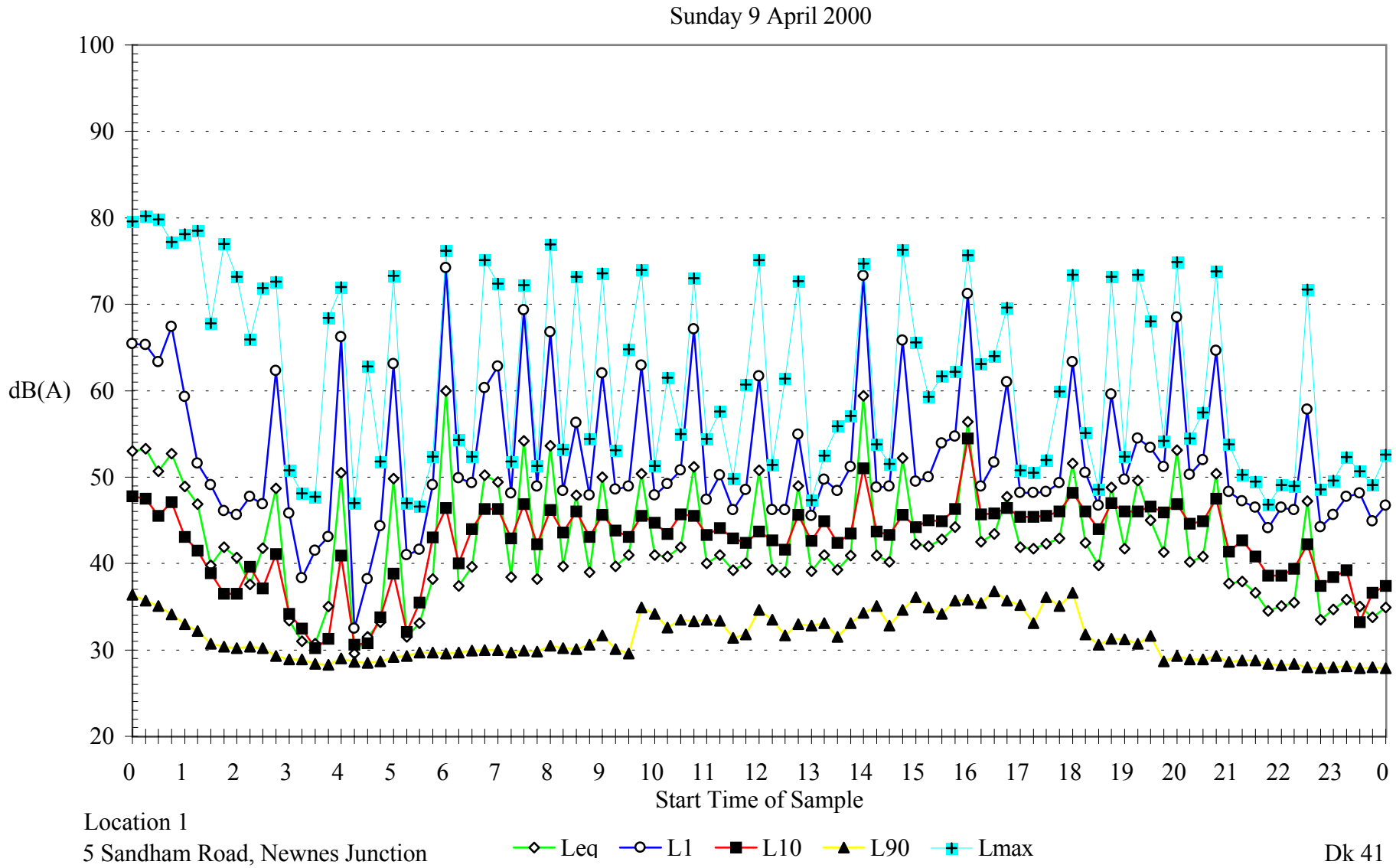
5058R1DA.XLS

Ambient Sound Pressure Levels



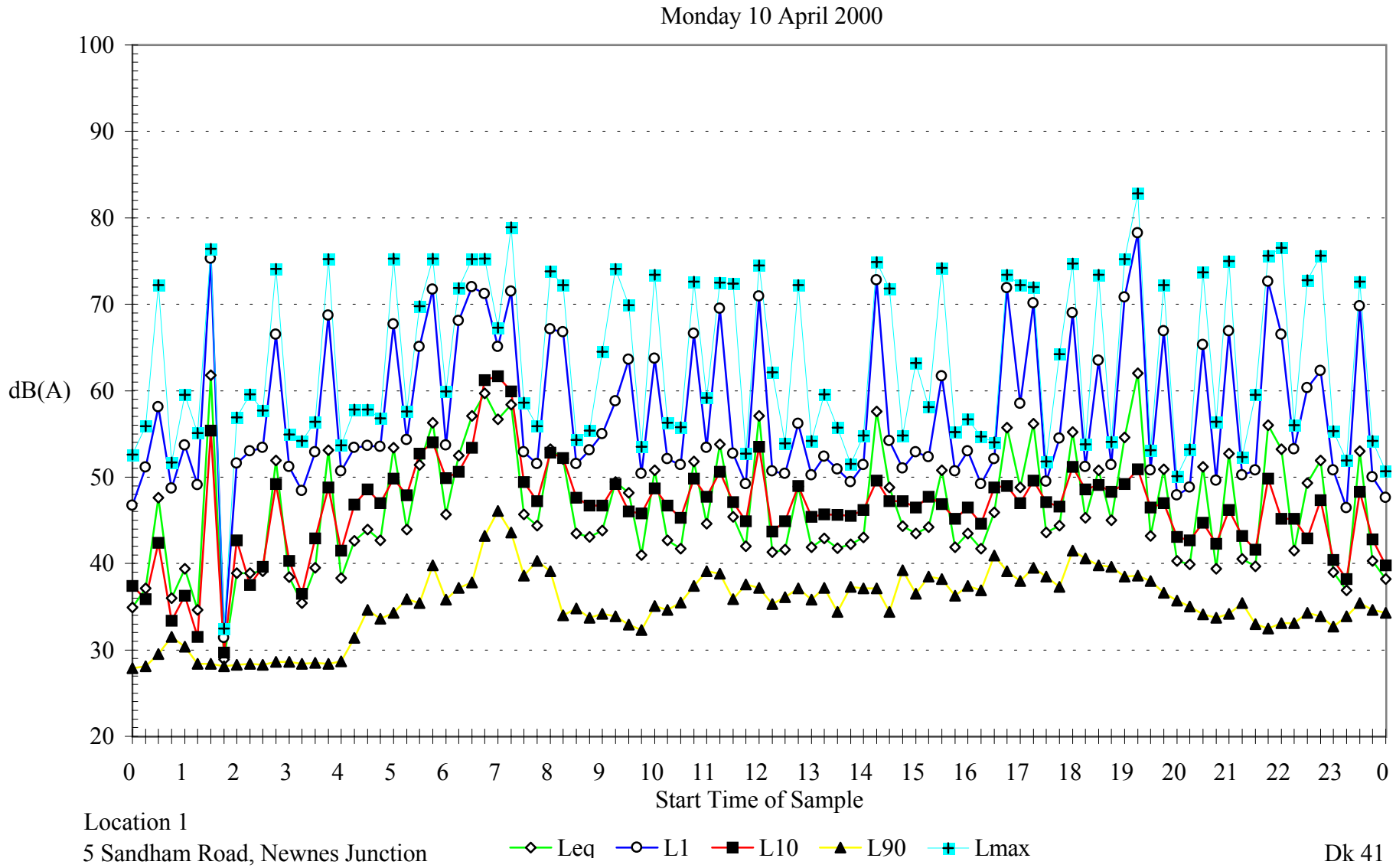
5058R1DA.XLS

Ambient Sound Pressure Levels



5058R1DA.XLS

Ambient Sound Pressure Levels



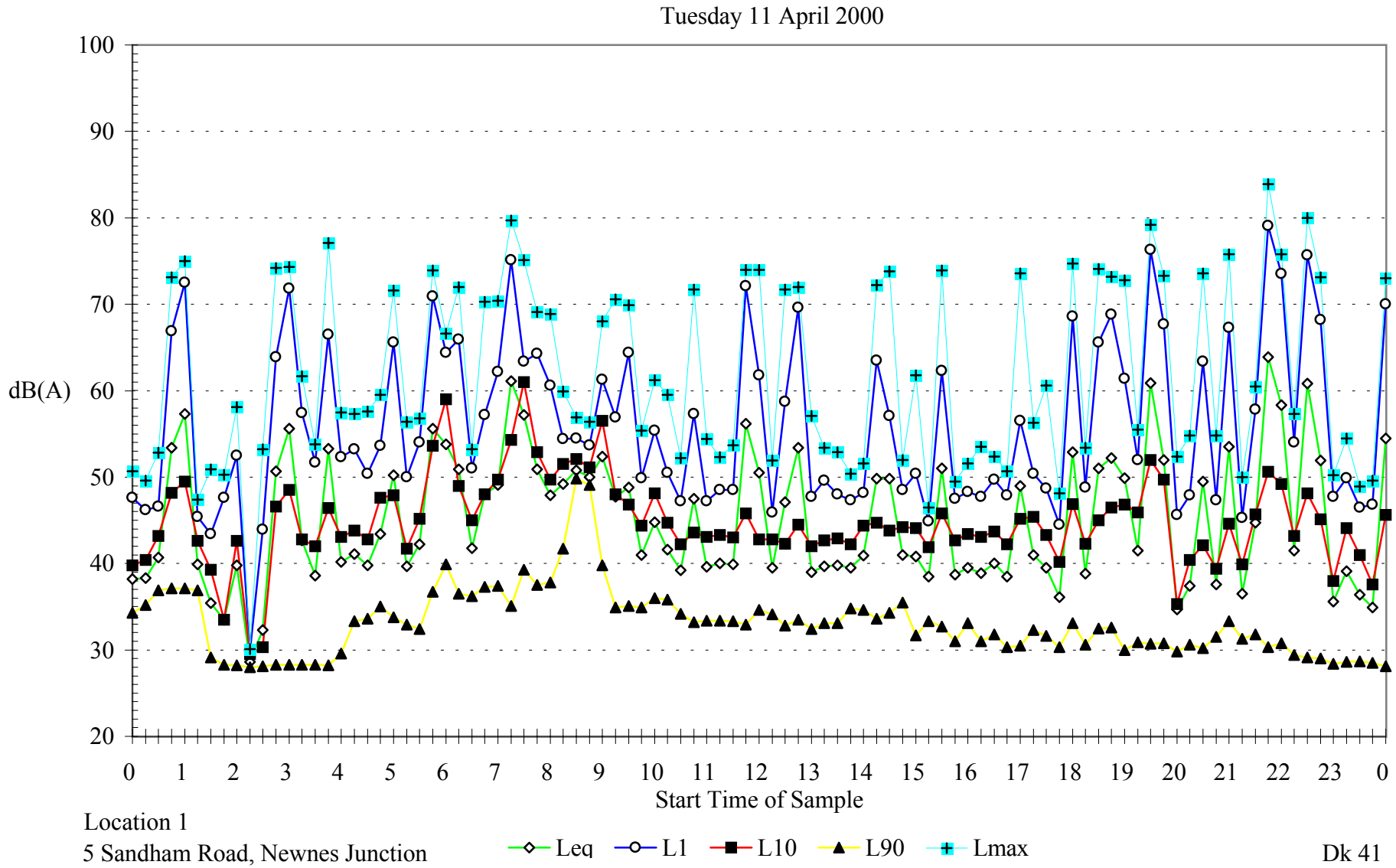
Location 1

5 Sandham Road, Newnes Junction

Dk 41

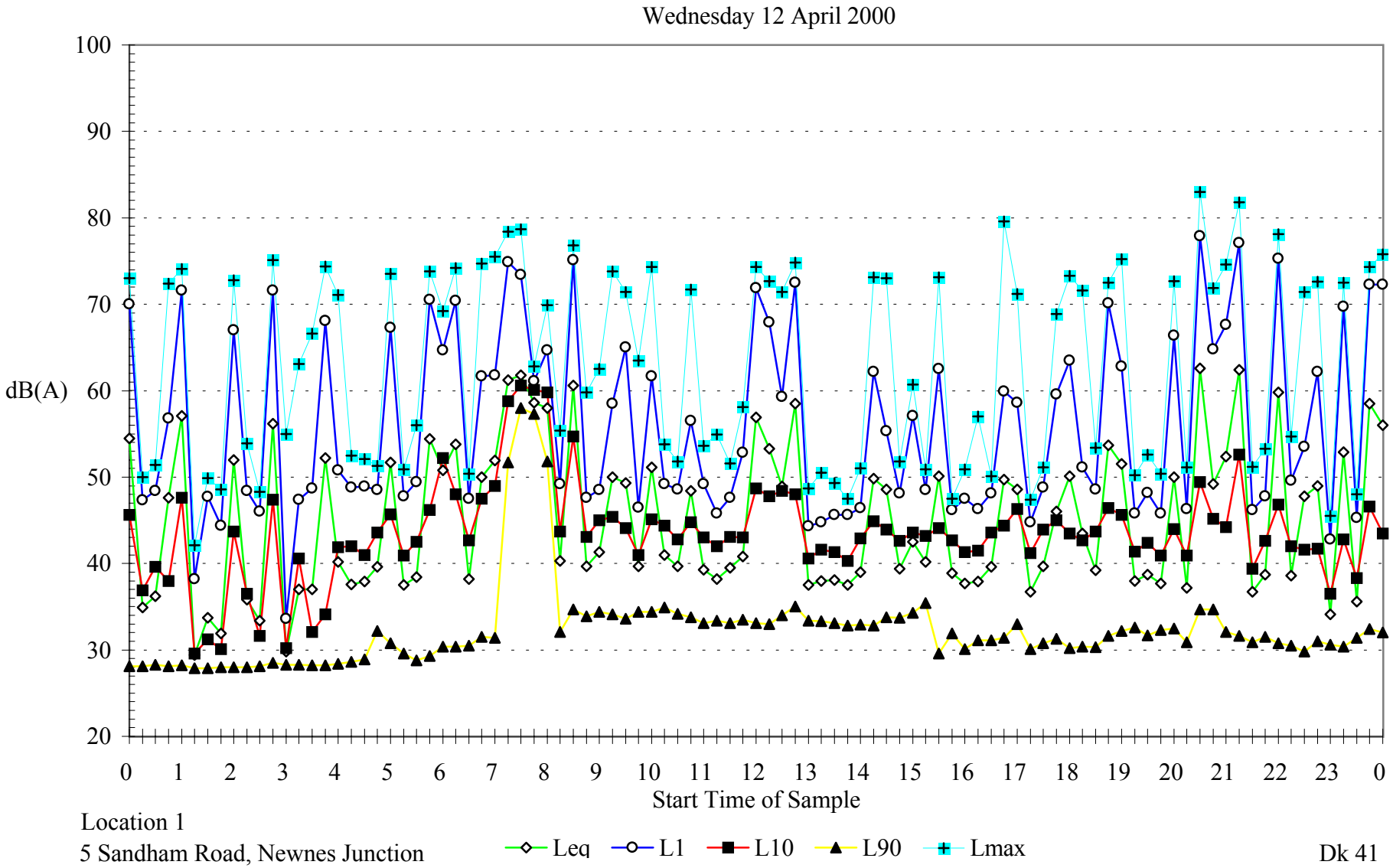
5058R1DA.XLS

Ambient Sound Pressure Levels



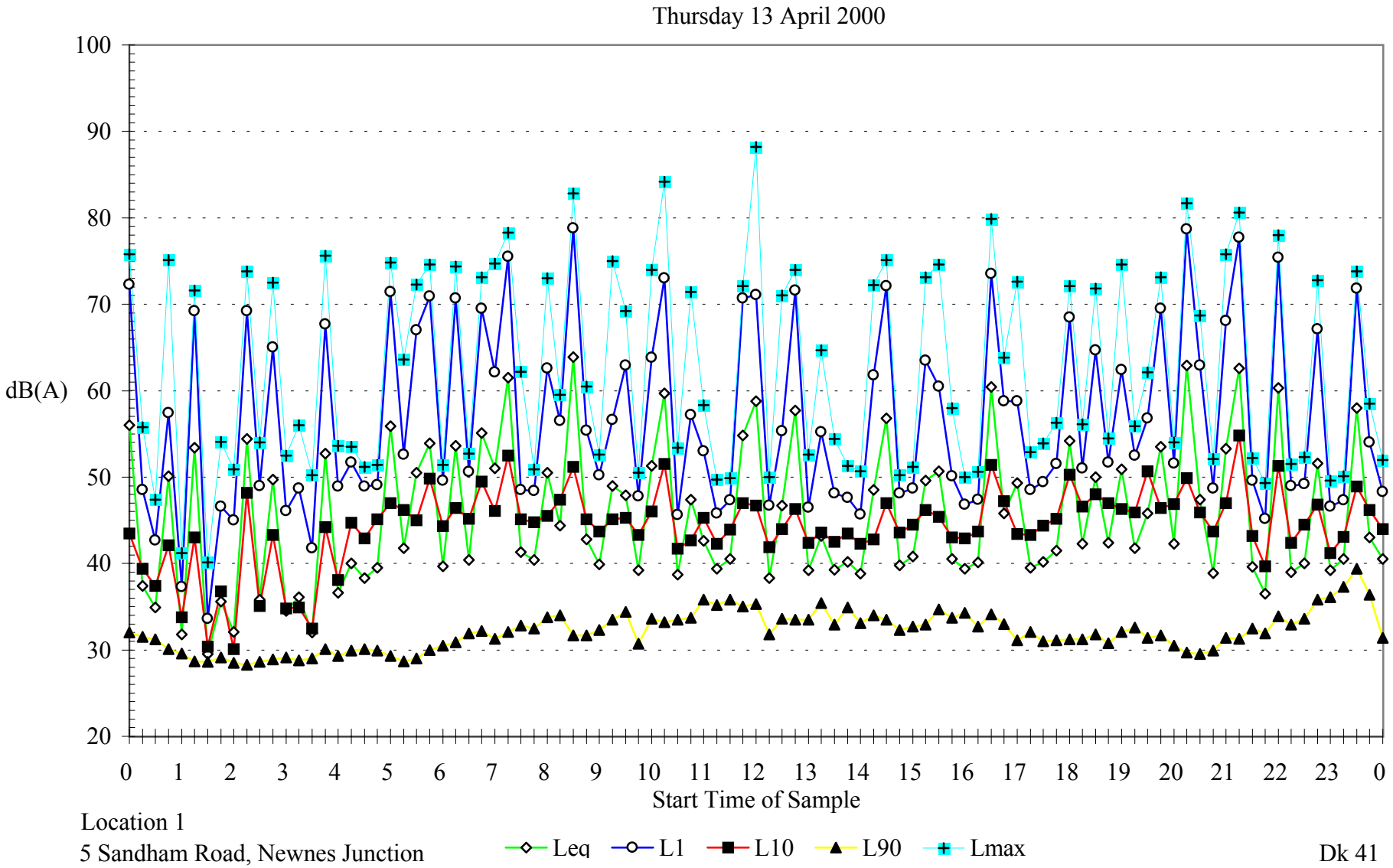
5058R1DA.XLS

Ambient Sound Pressure Levels



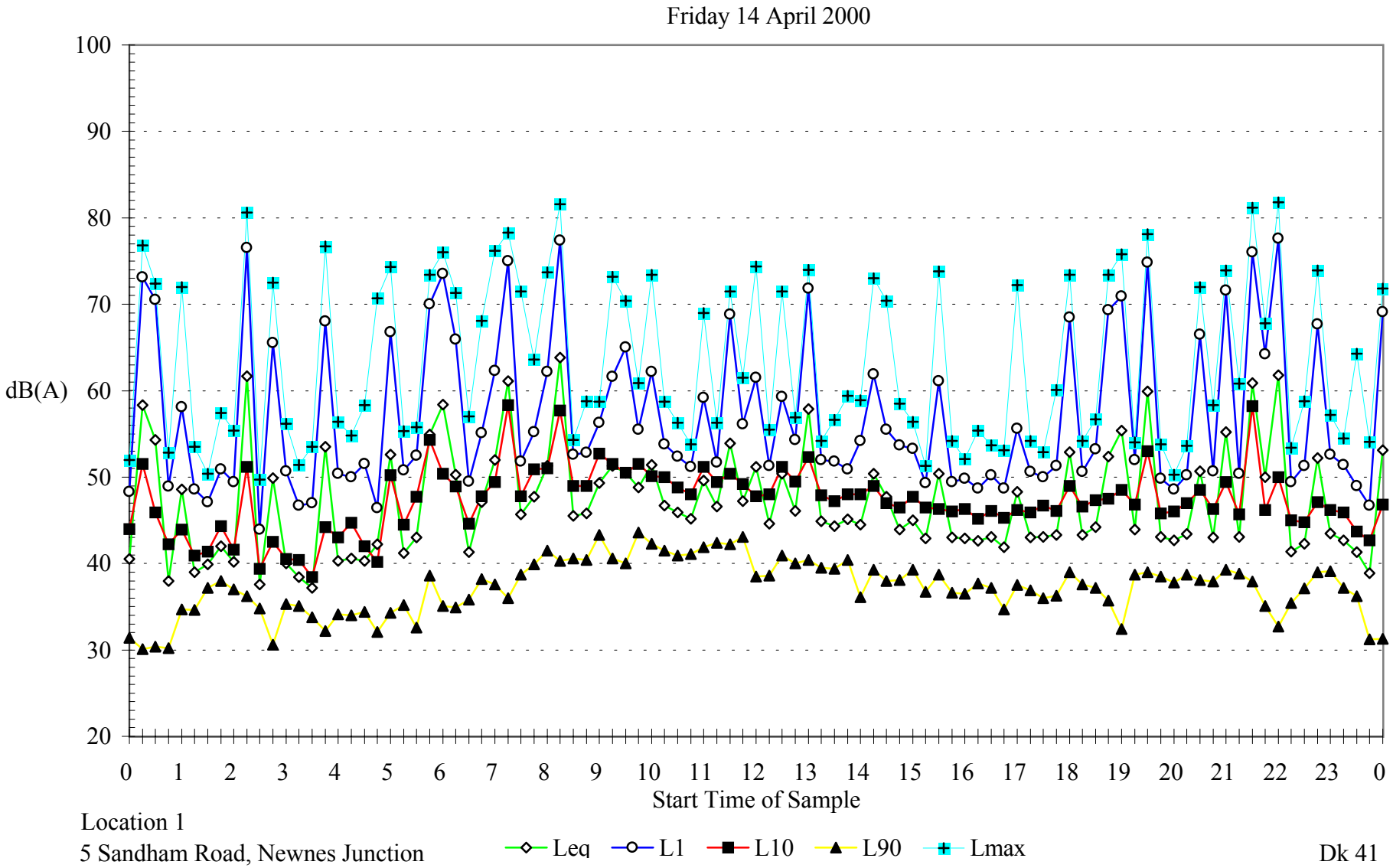
5058R1DA.XLS

Ambient Sound Pressure Levels



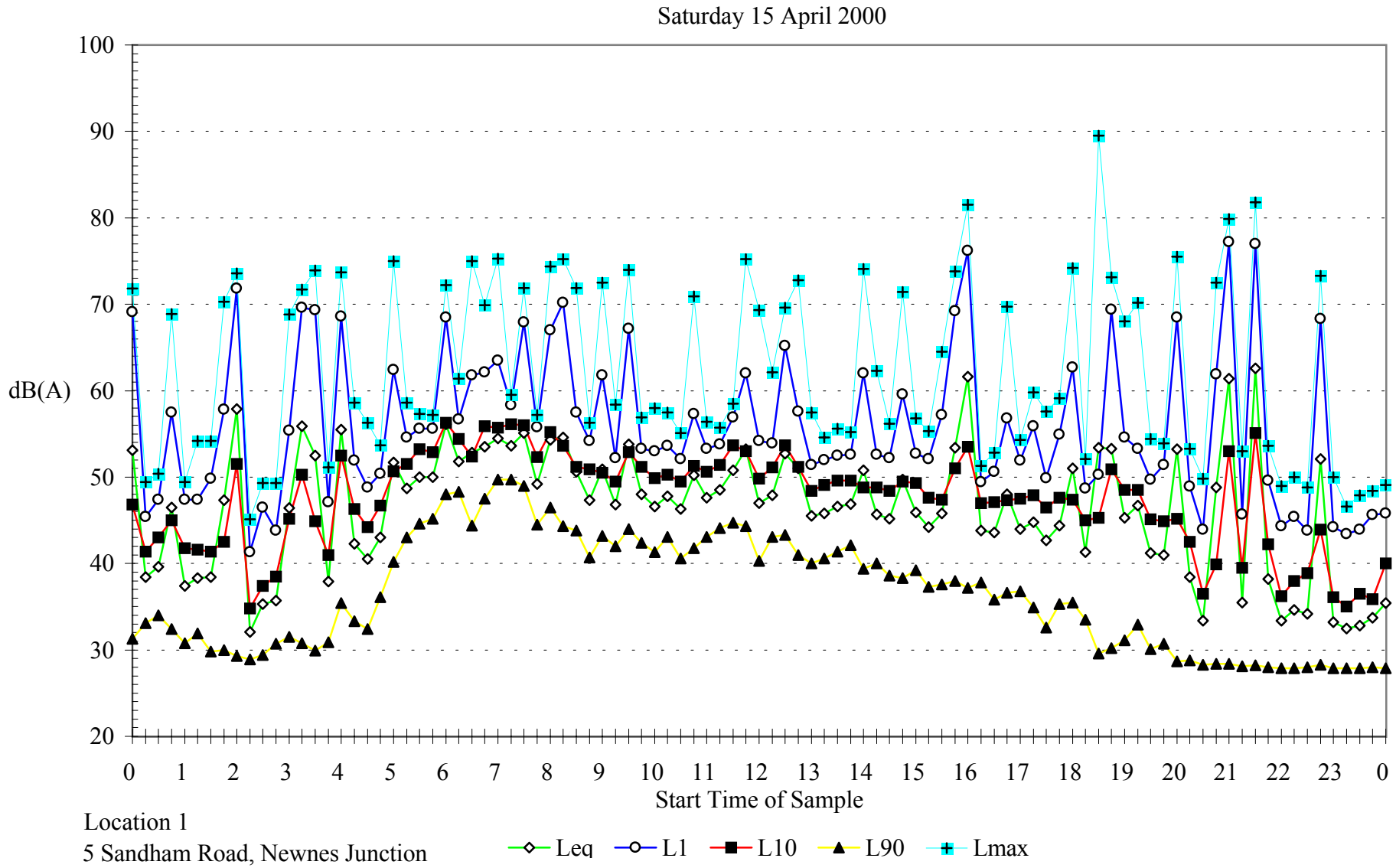
5058R1DA.XLS

Ambient Sound Pressure Levels



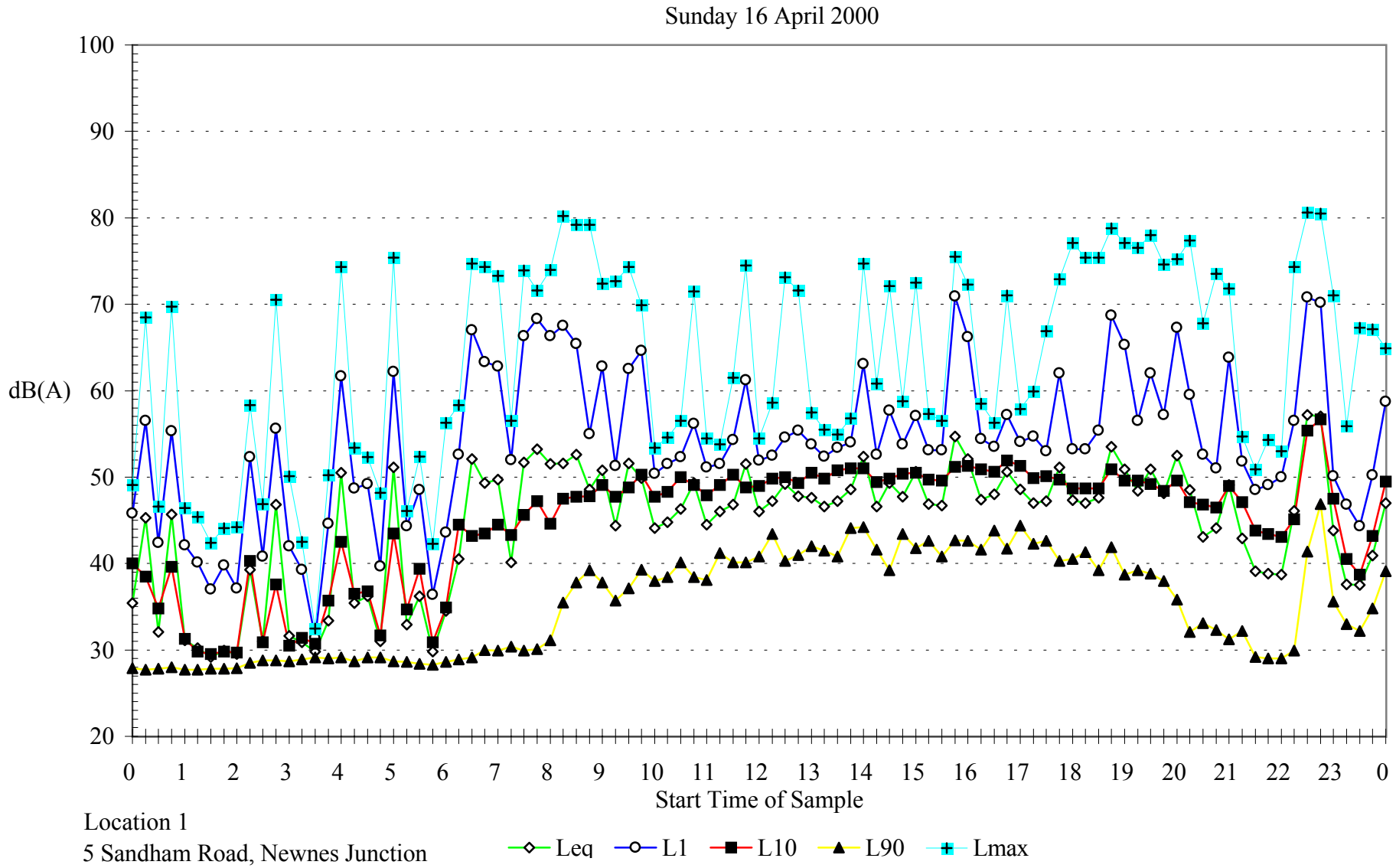
5058R1DA.XLS

Ambient Sound Pressure Levels



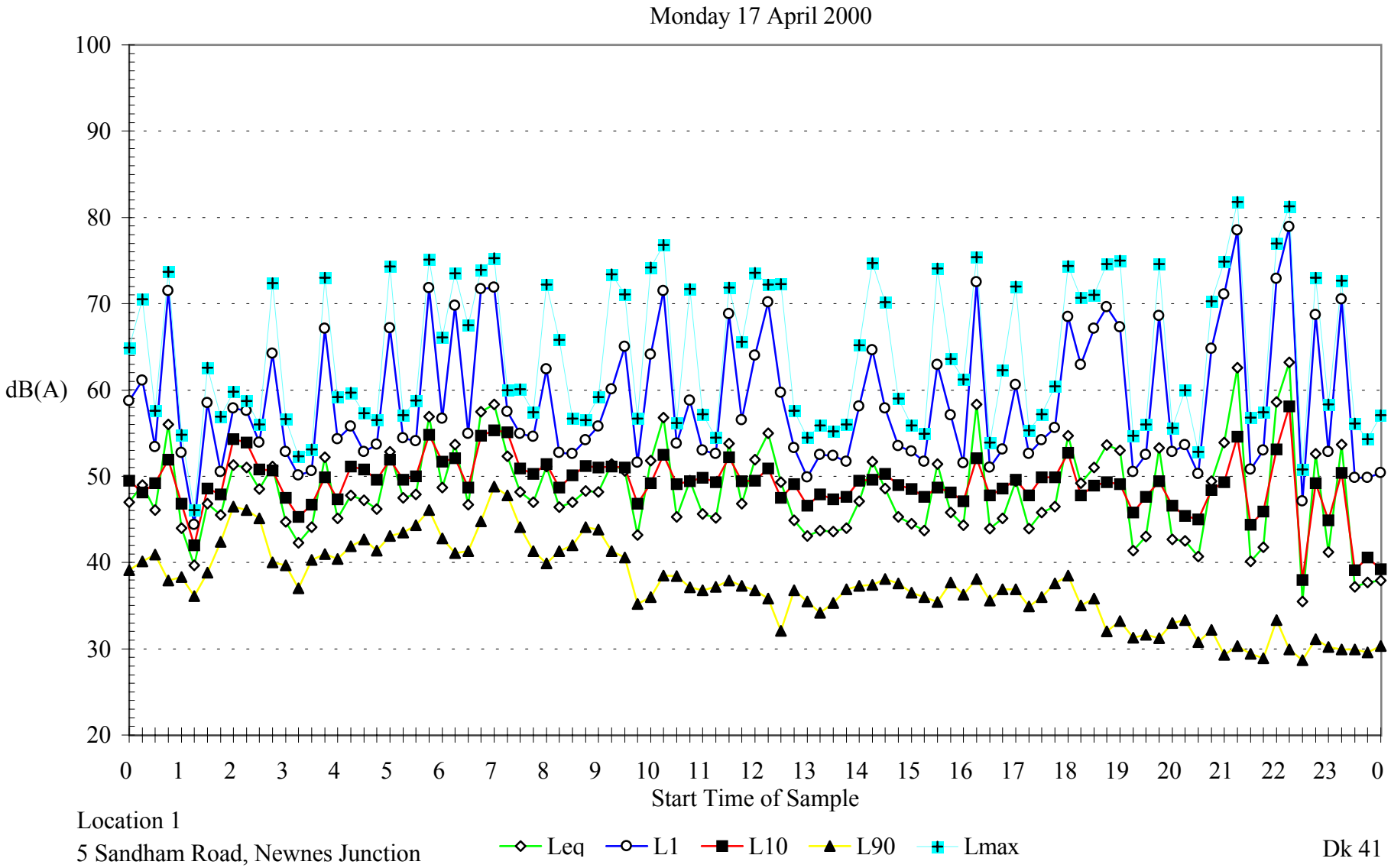
5058R1DA.XLS

Ambient Sound Pressure Levels



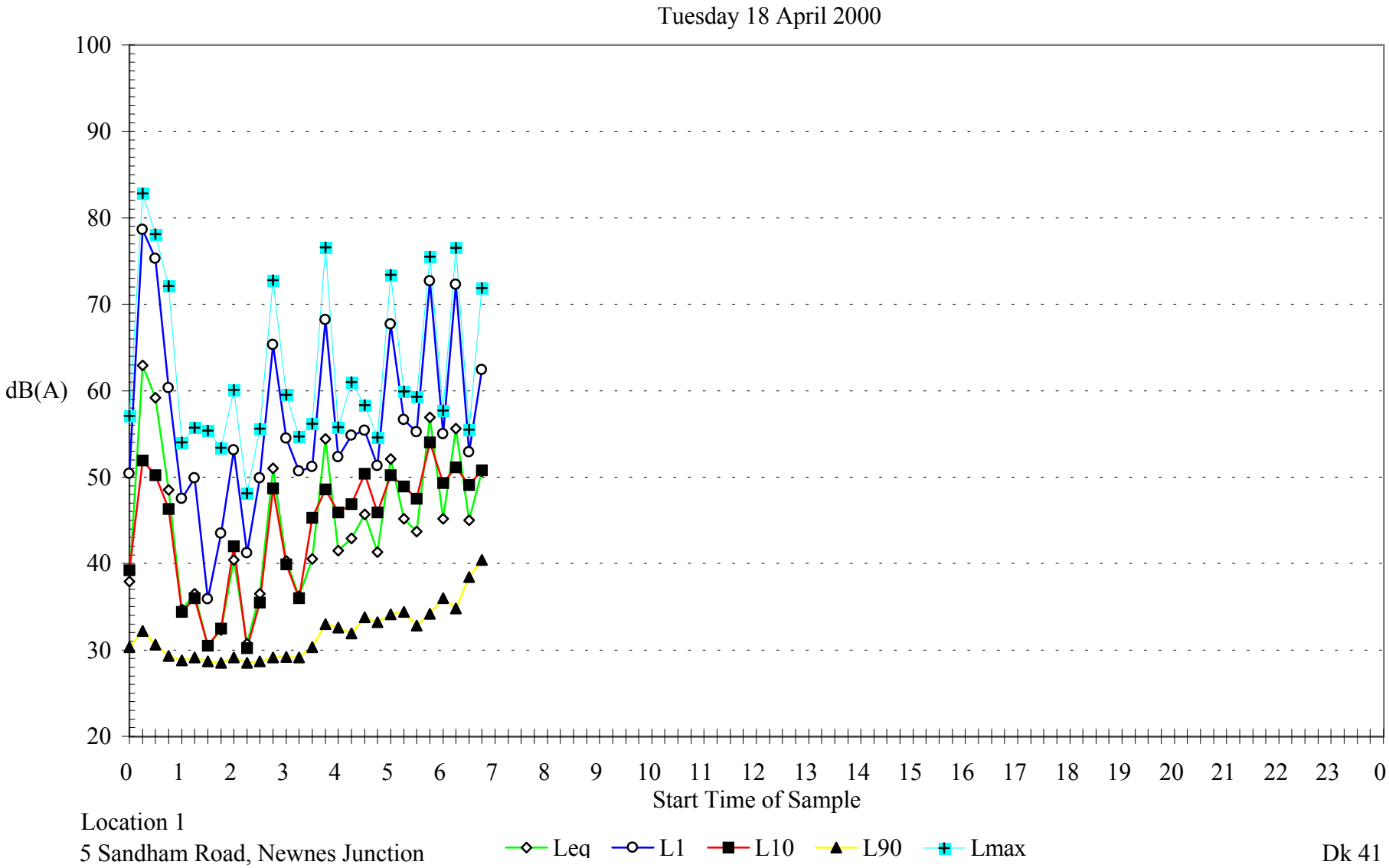
5058R1DA.XLS

Ambient Sound Pressure Levels



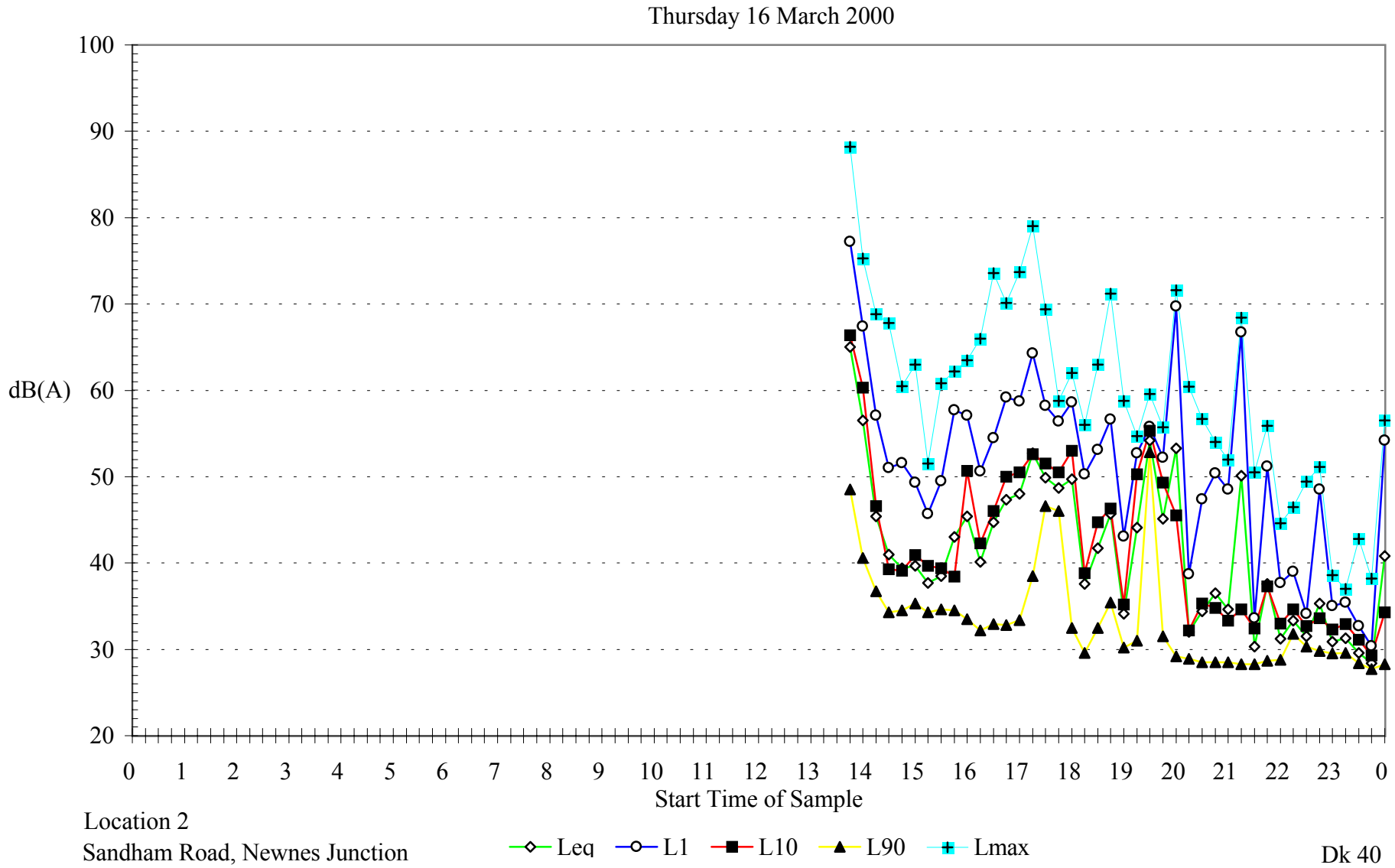
5058R1DA.XLS

Ambient Sound Pressure Levels



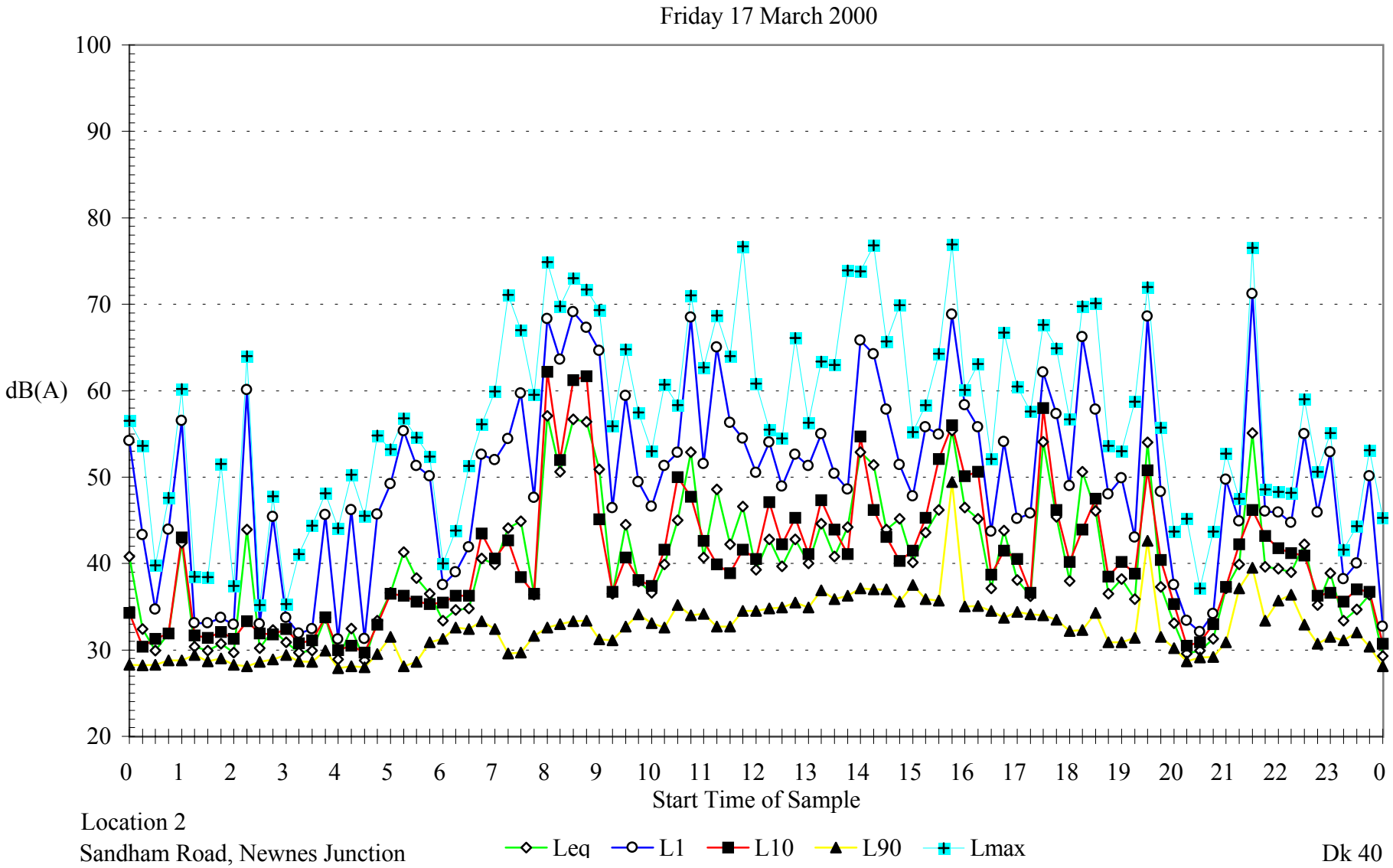
5058R1DA.XLS

Ambient Sound Pressure Levels



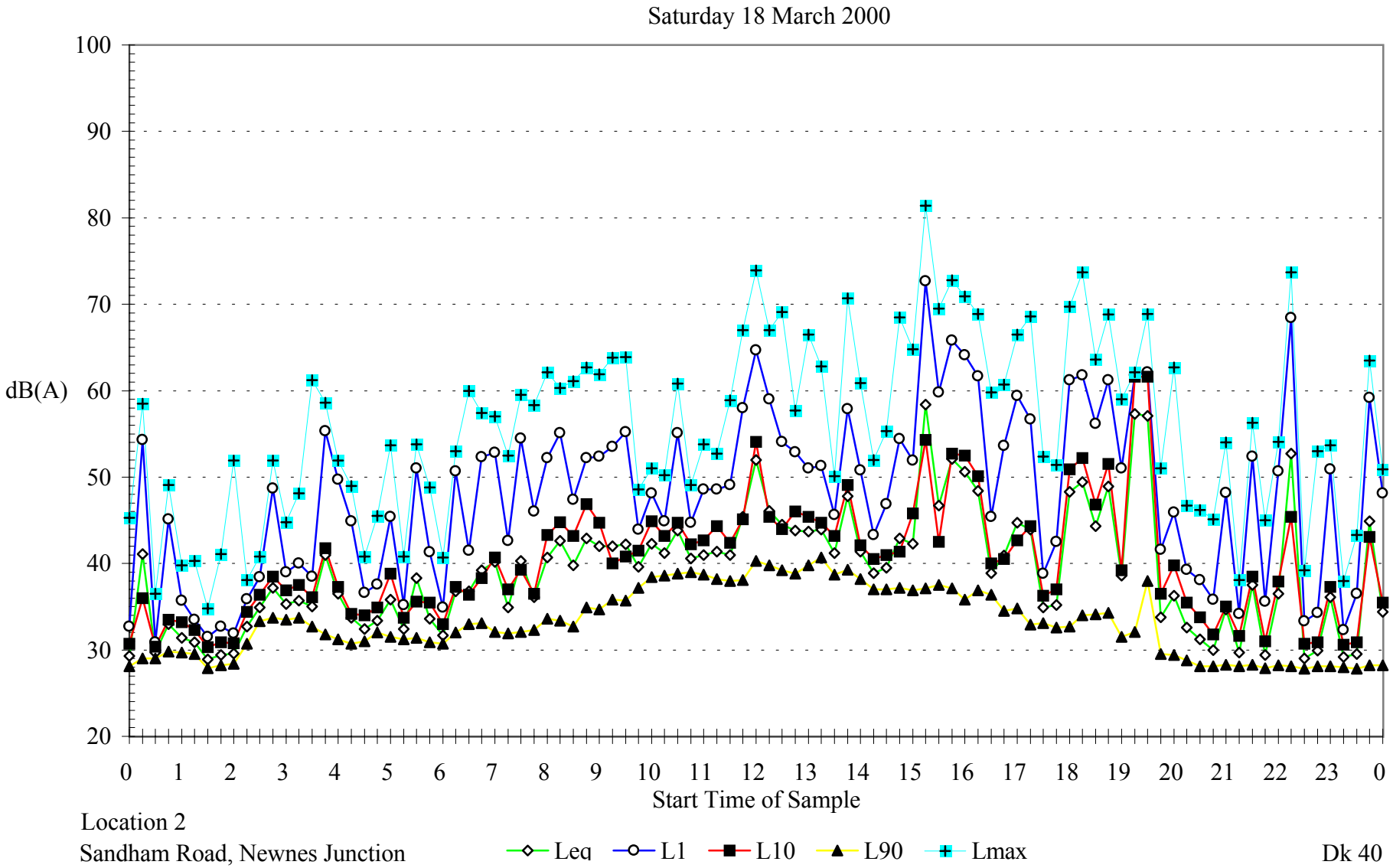
5058R2AA.XLS

Ambient Sound Pressure Levels



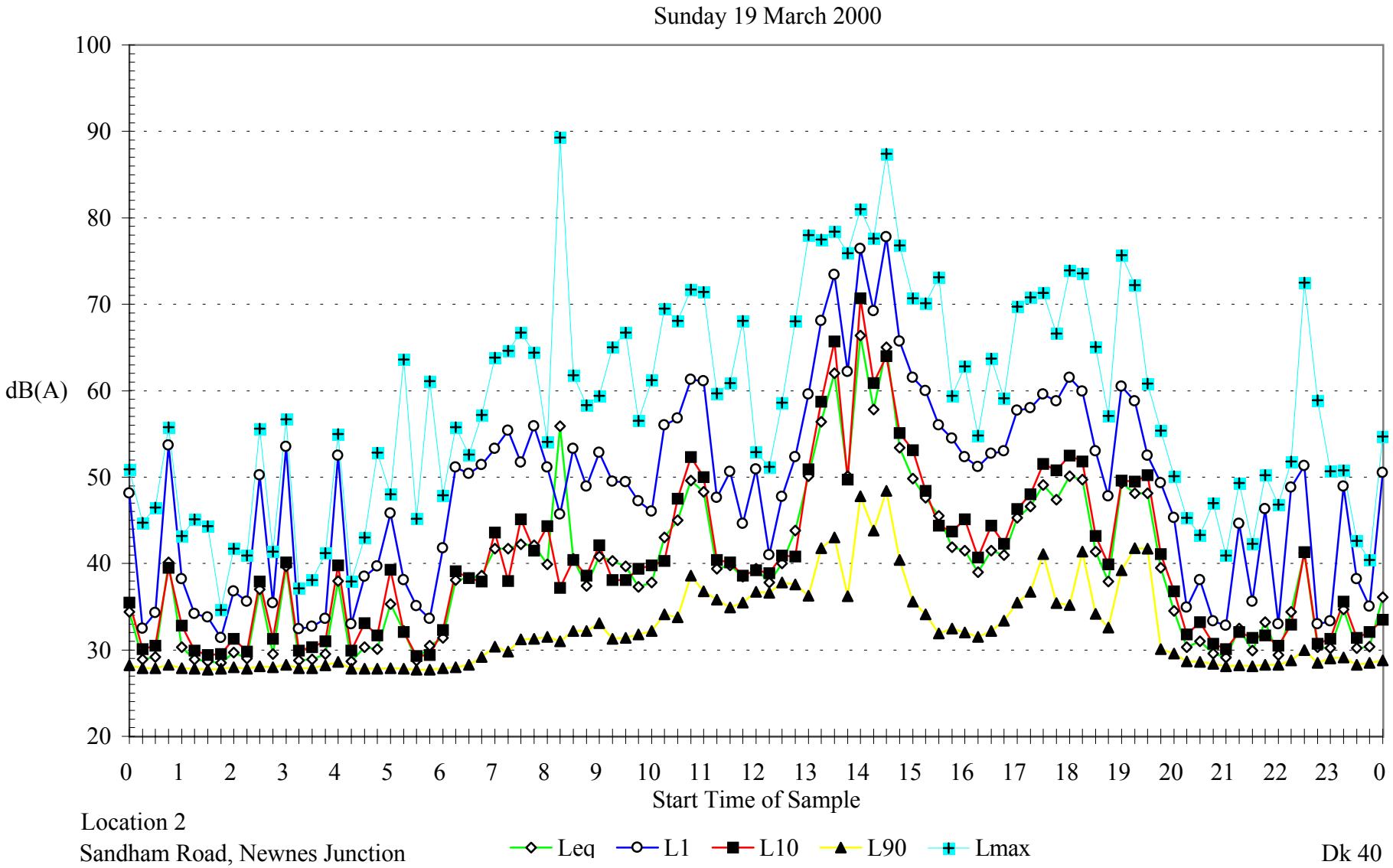
5058R2AA.XLS

Ambient Sound Pressure Levels



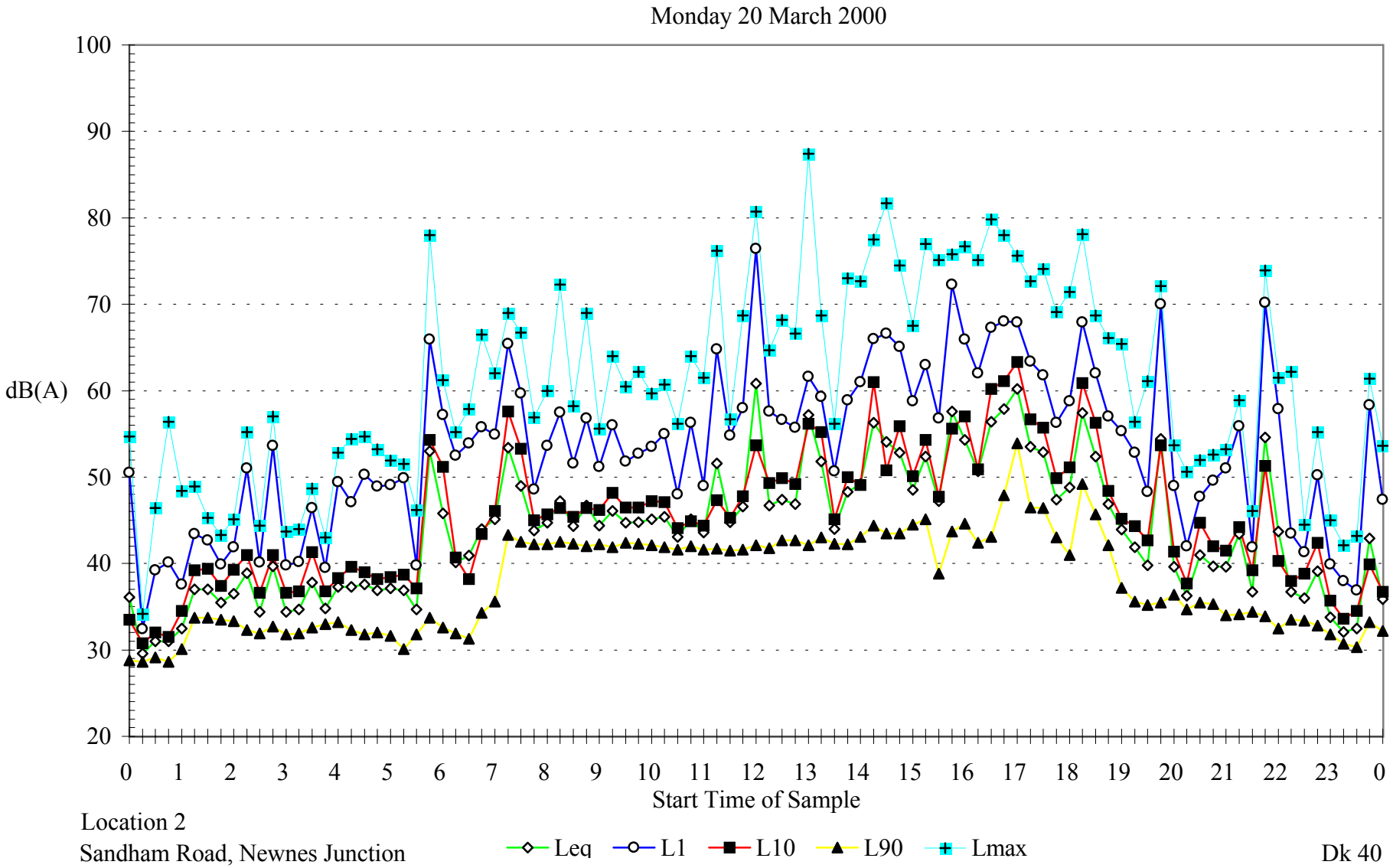
5058R2AA.XLS

Ambient Sound Pressure Levels



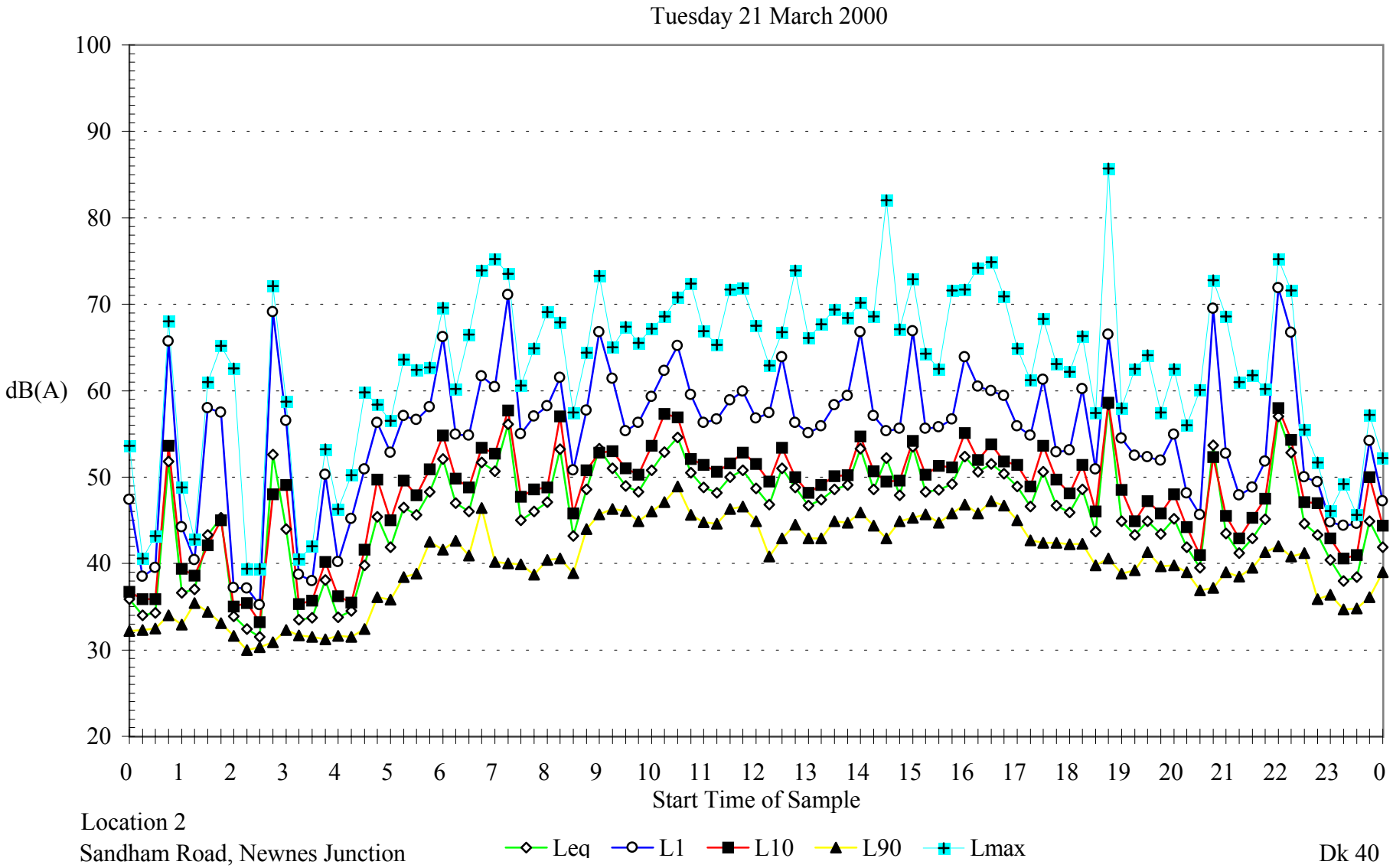
5058R2AA.XLS

Ambient Sound Pressure Levels



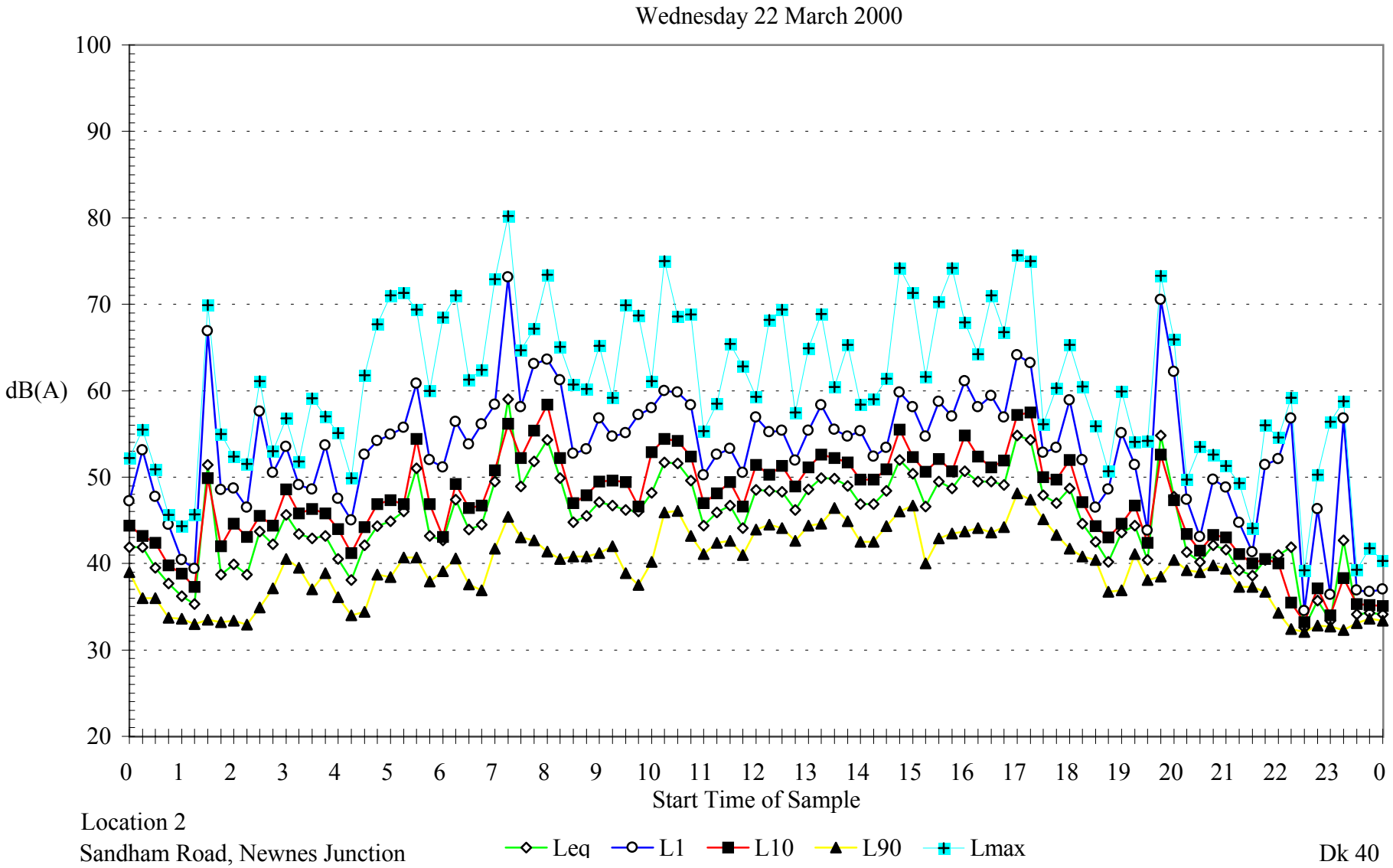
5058R2AA.XLS

Ambient Sound Pressure Levels



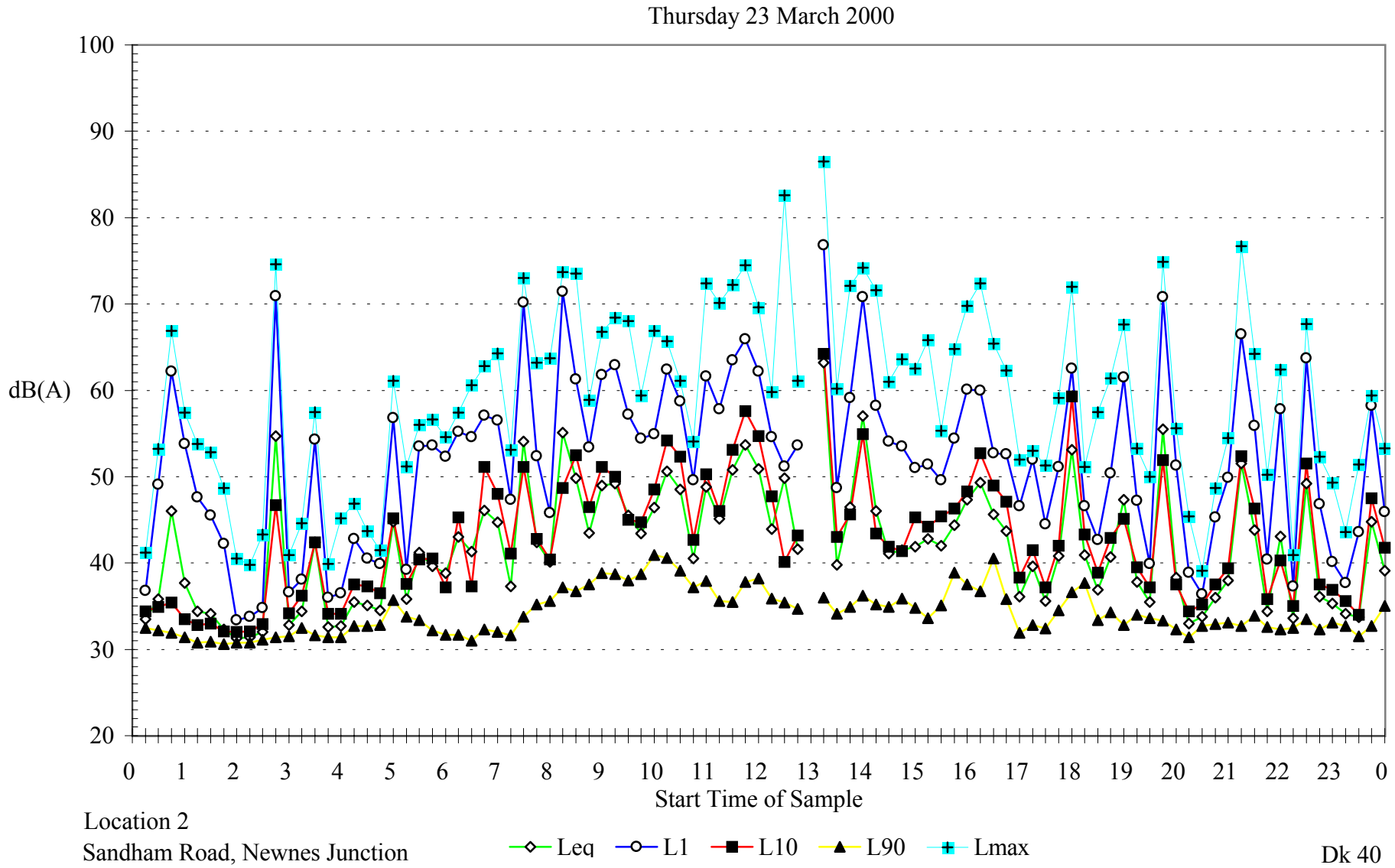
5058R2AA.XLS

Ambient Sound Pressure Levels



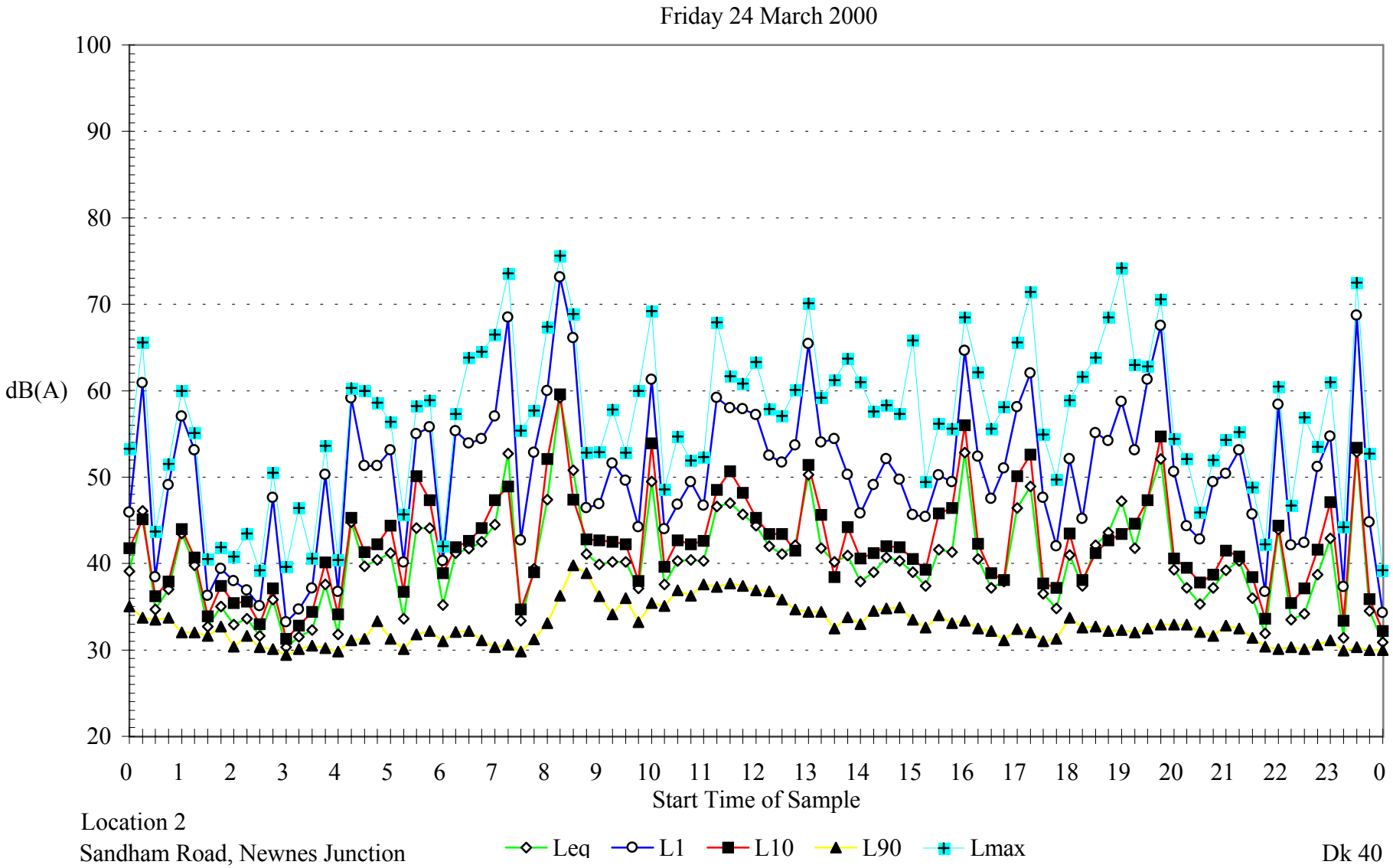
5058R2AA.XLS

Ambient Sound Pressure Levels



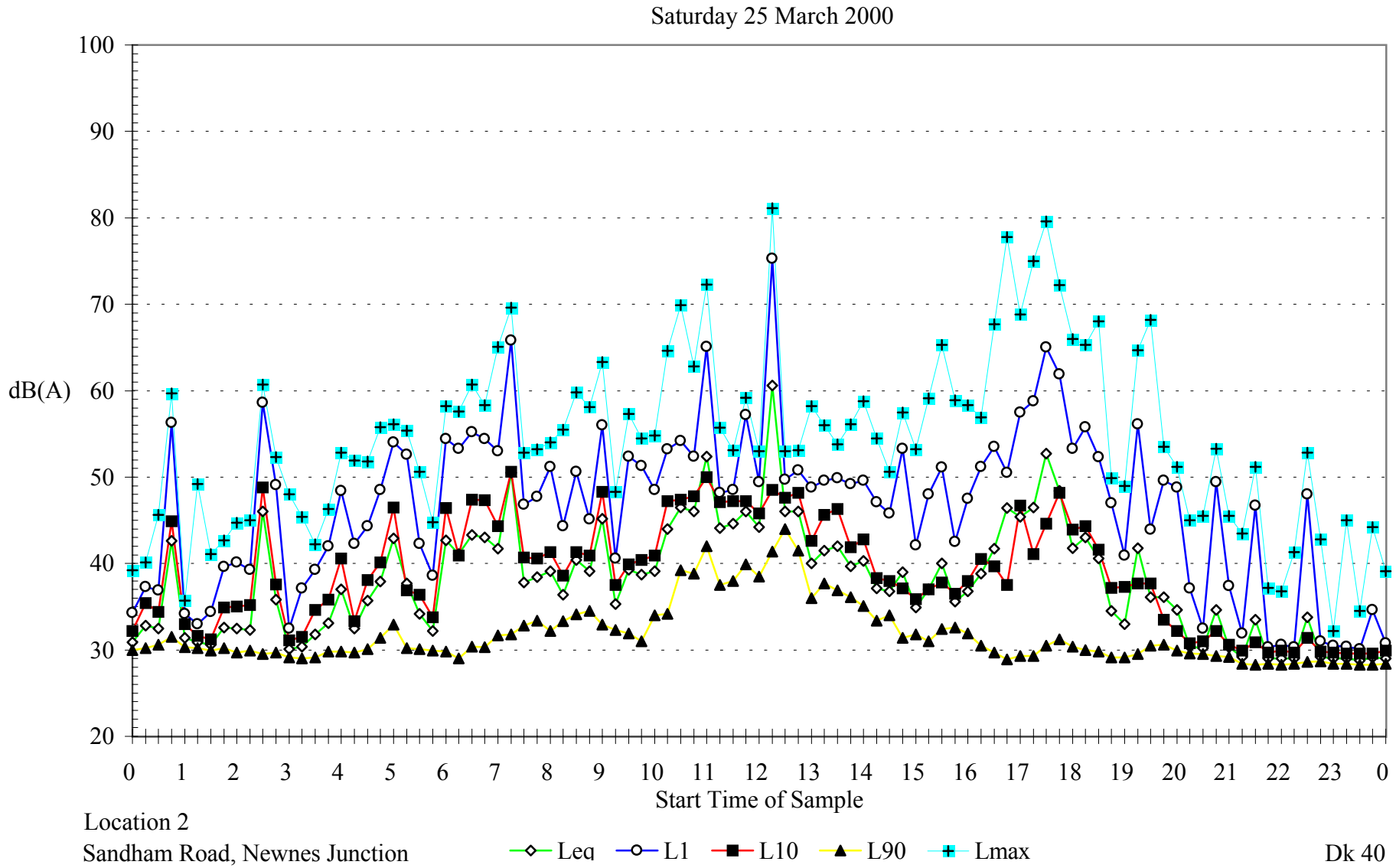
5058R2BA.XLS

Ambient Sound Pressure Levels



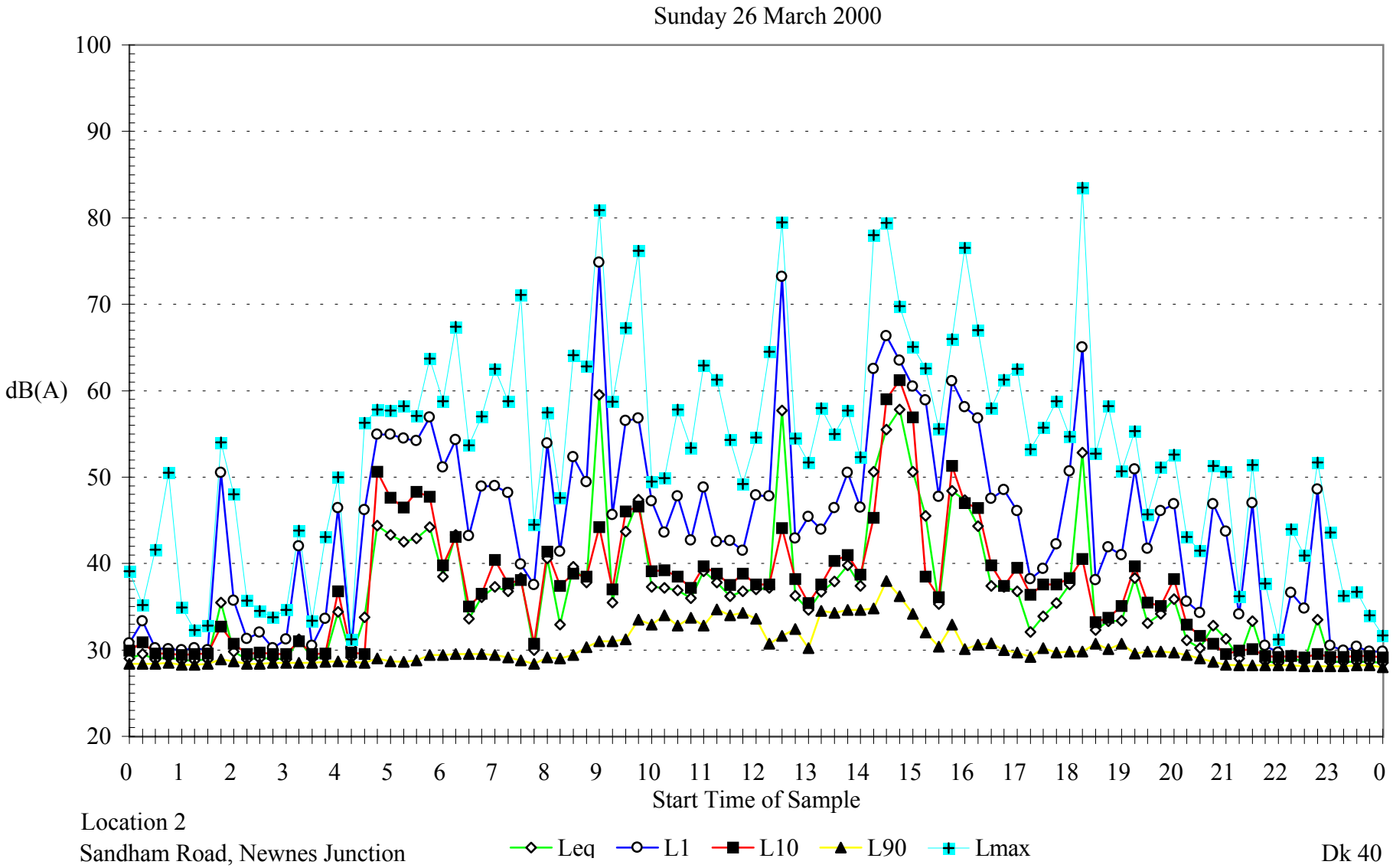
5058R2BA.XLS

Ambient Sound Pressure Levels



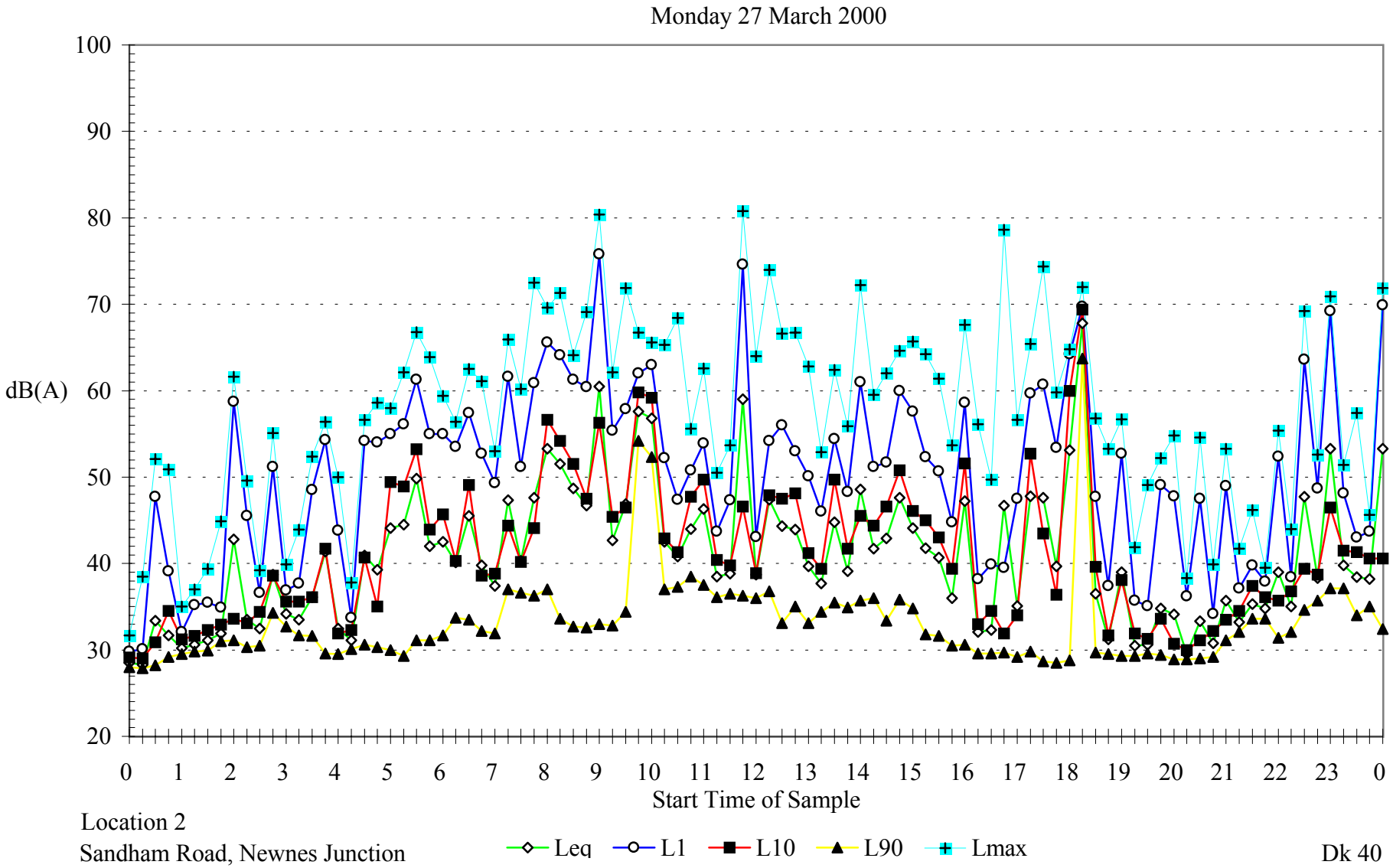
5058R2BA.XLS

Ambient Sound Pressure Levels



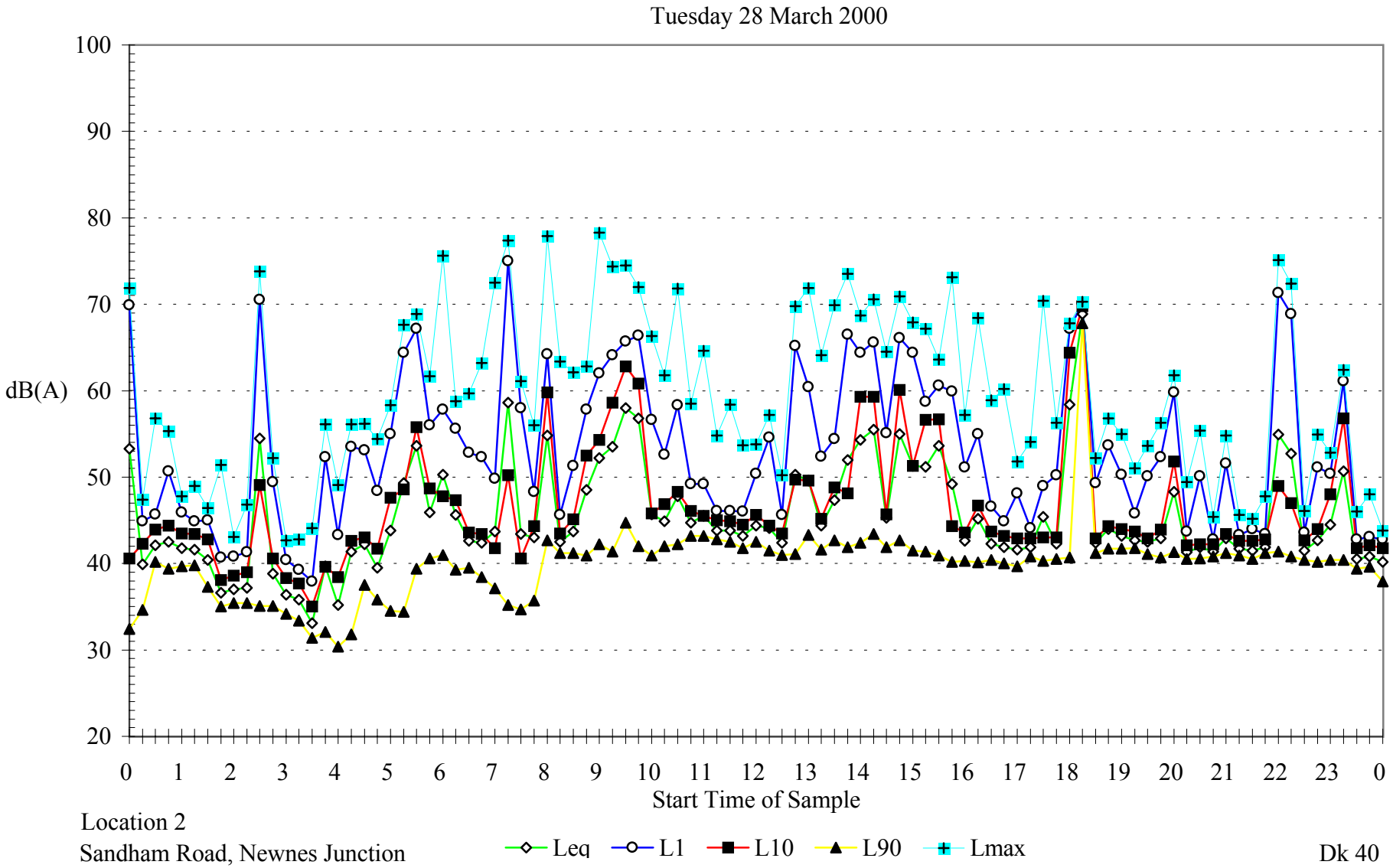
5058R2BA.XLS

Ambient Sound Pressure Levels



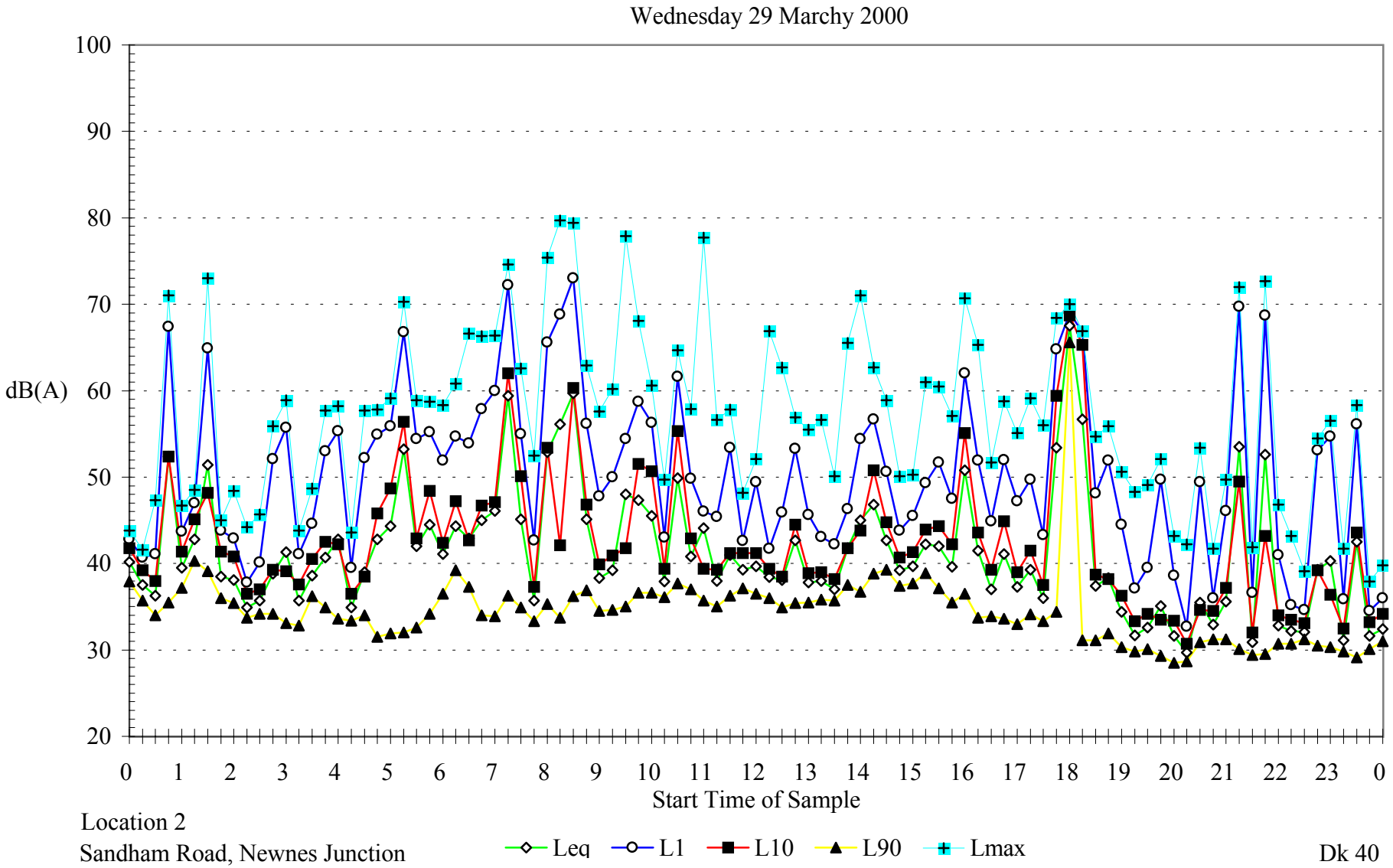
5058R2BA.XLS

Ambient Sound Pressure Levels



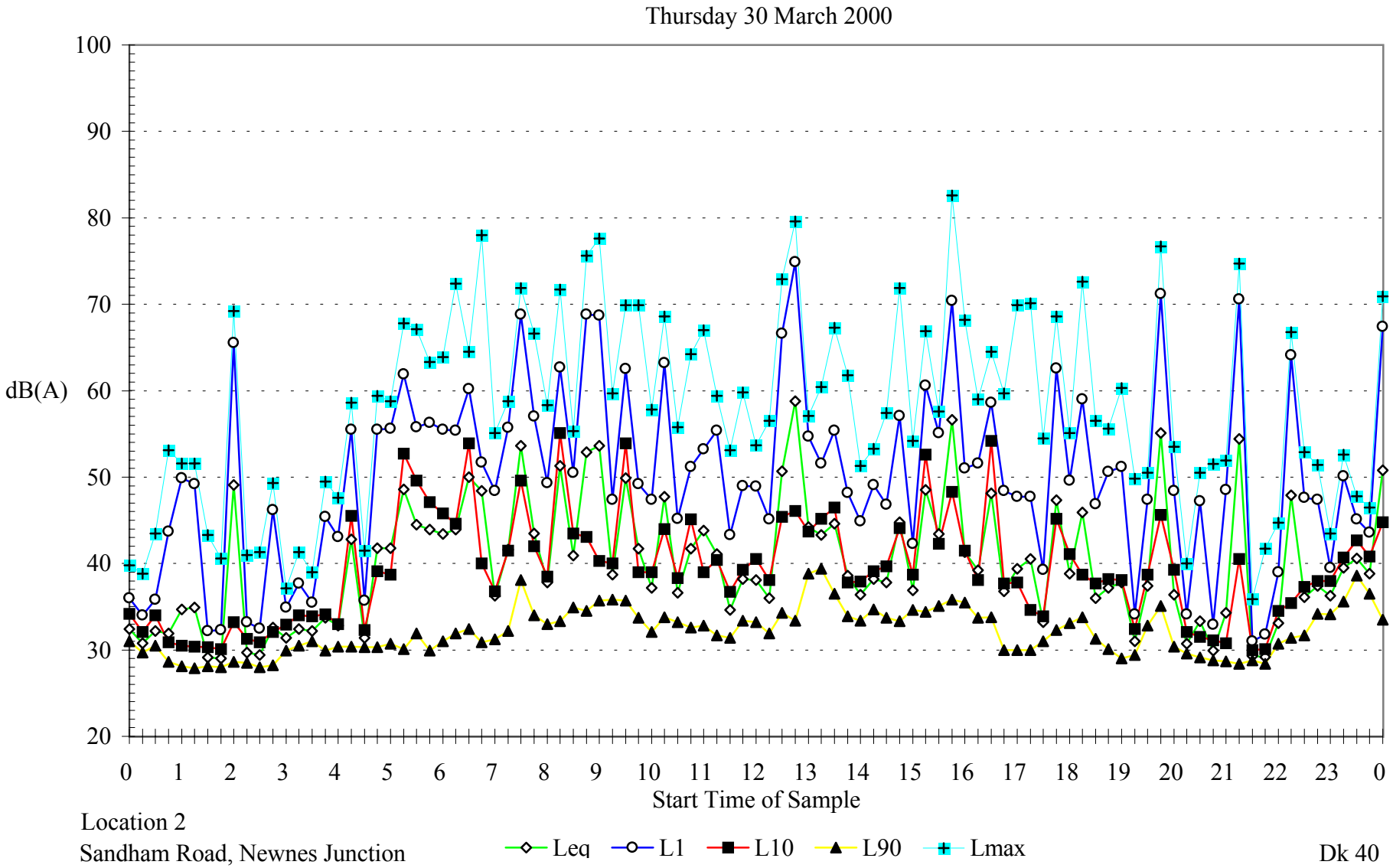
5058R2BA.XLS

Ambient Sound Pressure Levels



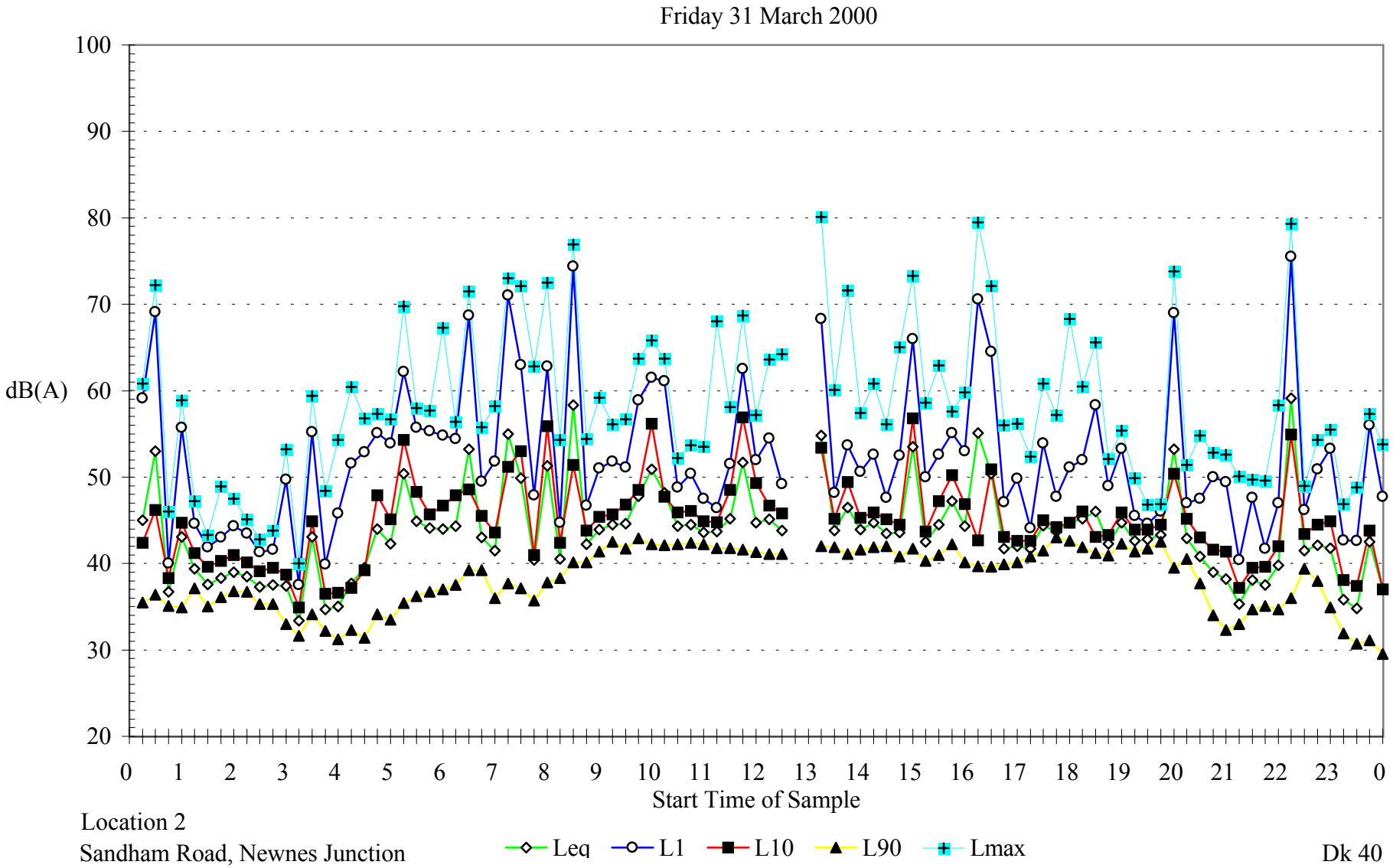
5058R2BA.XLS

Ambient Sound Pressure Levels



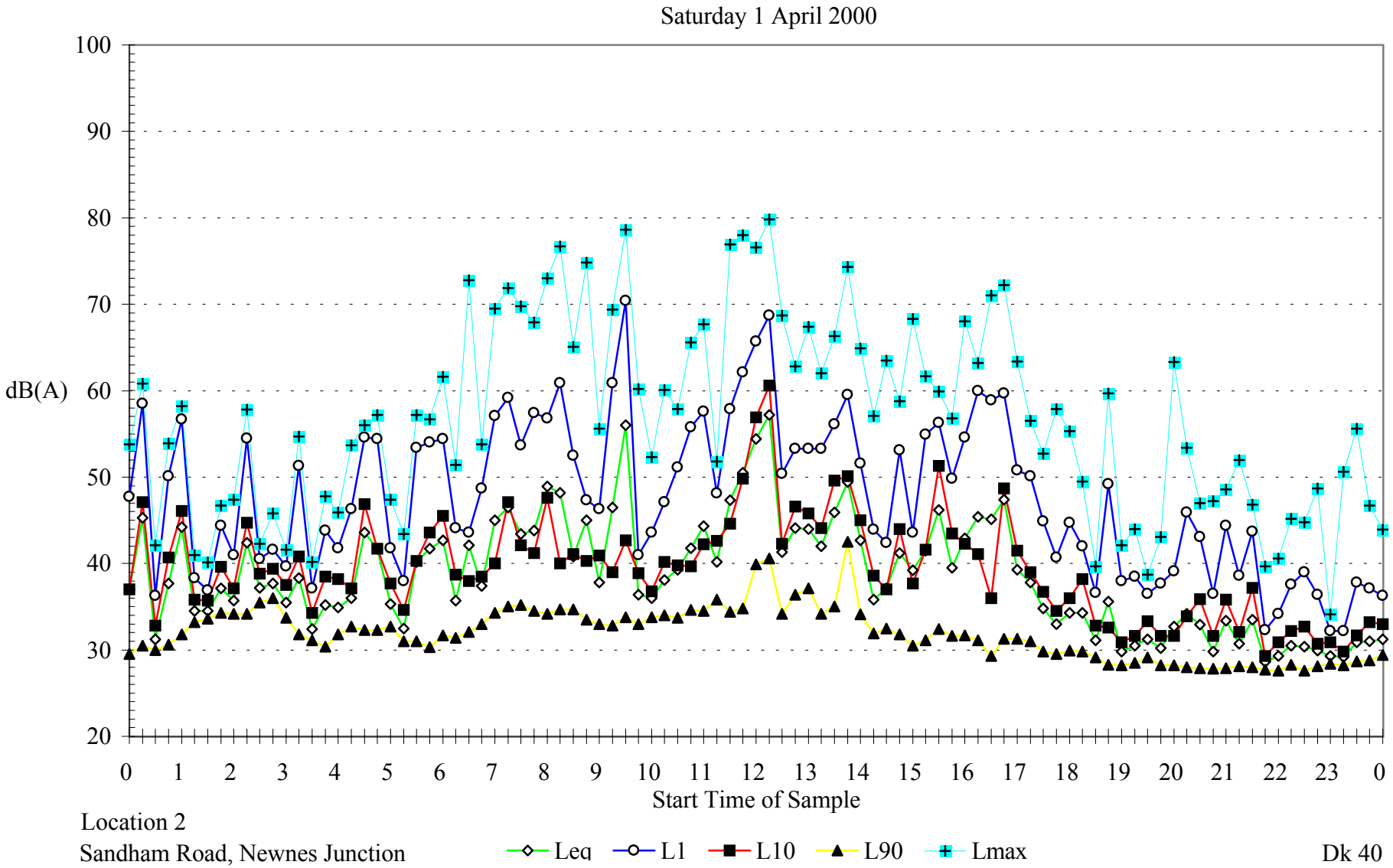
5058R2BA.XLS

Ambient Sound Pressure Levels



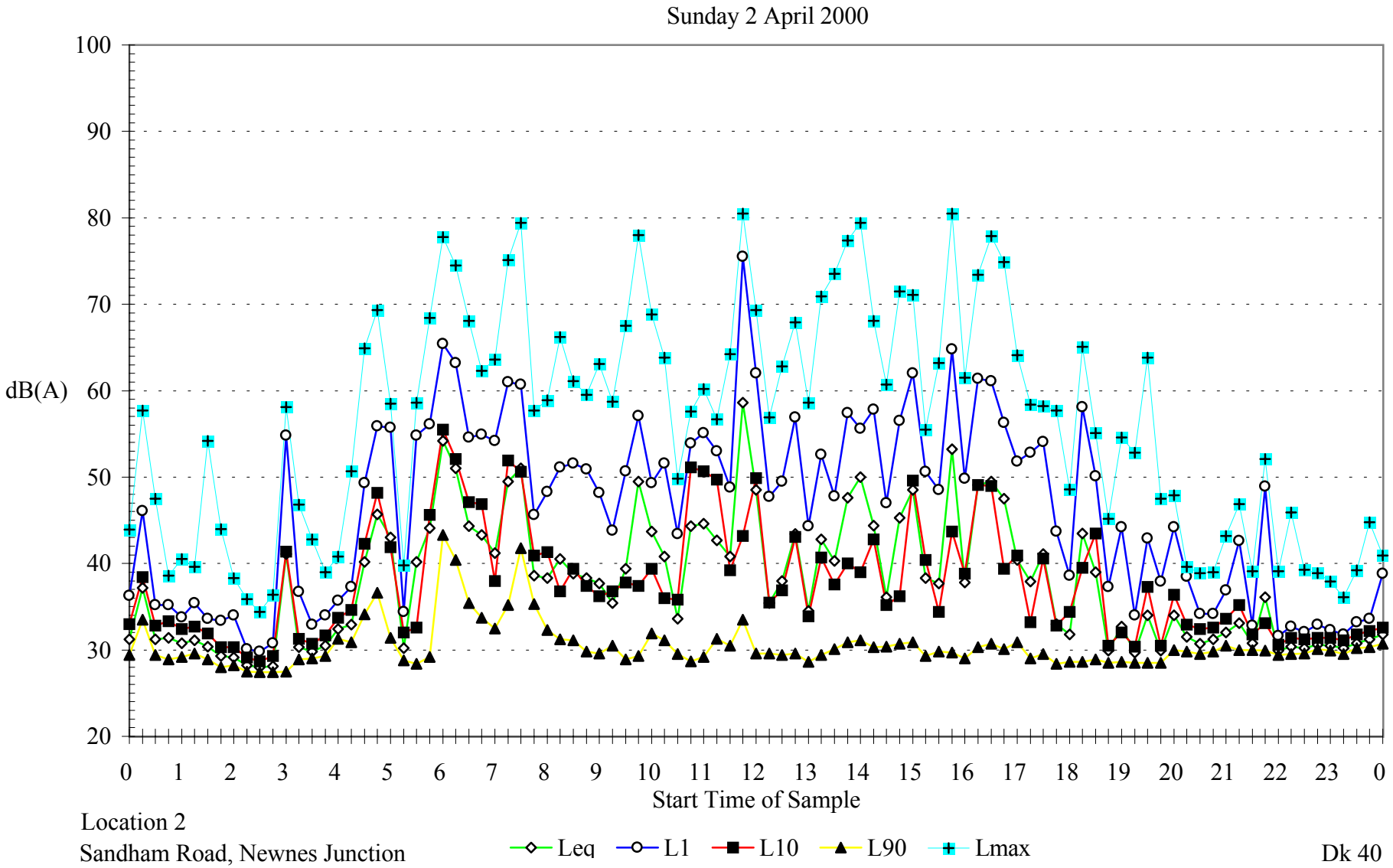
5058R2CA.XLS

Ambient Sound Pressure Levels



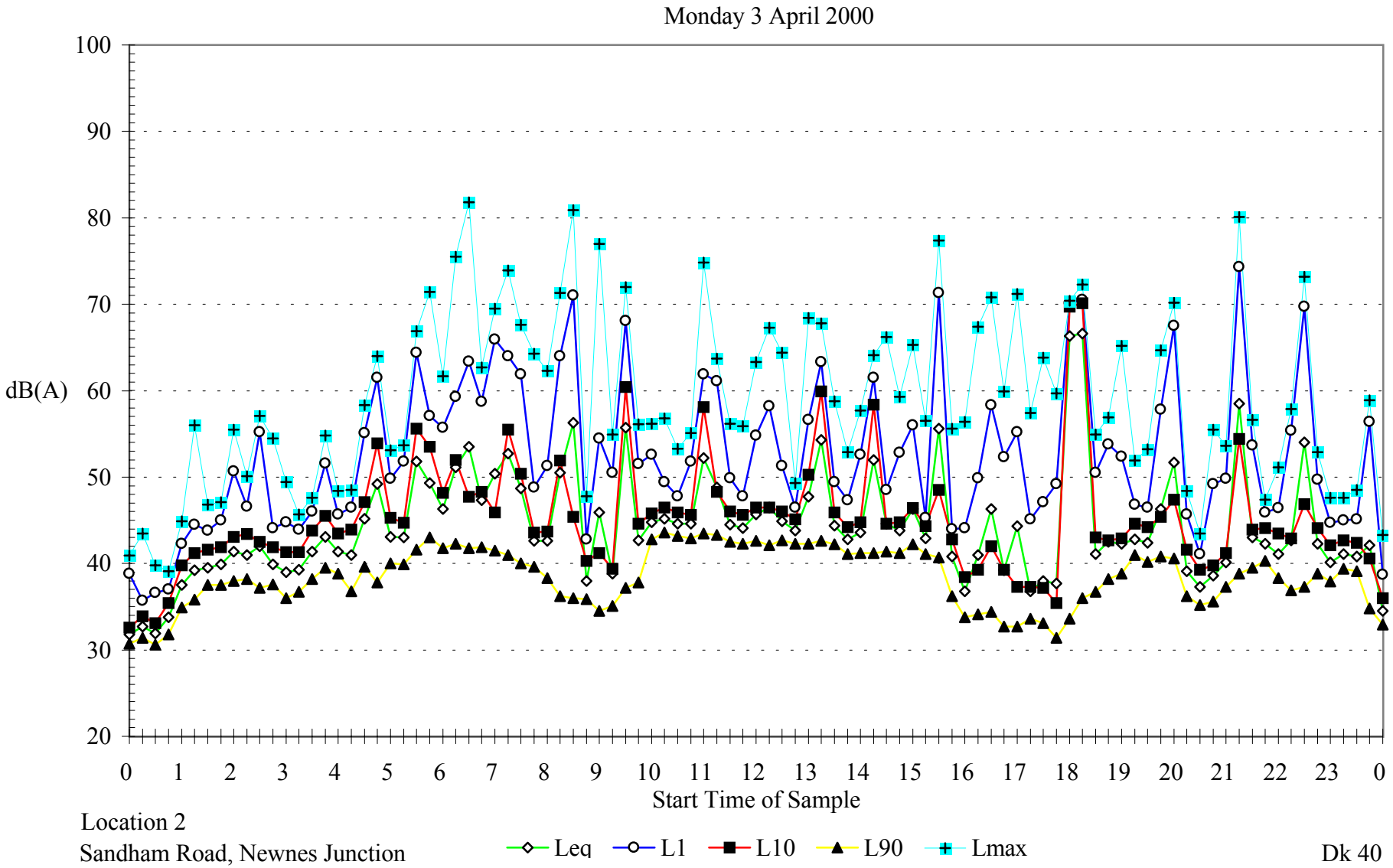
5058R2CA.XLS

Ambient Sound Pressure Levels



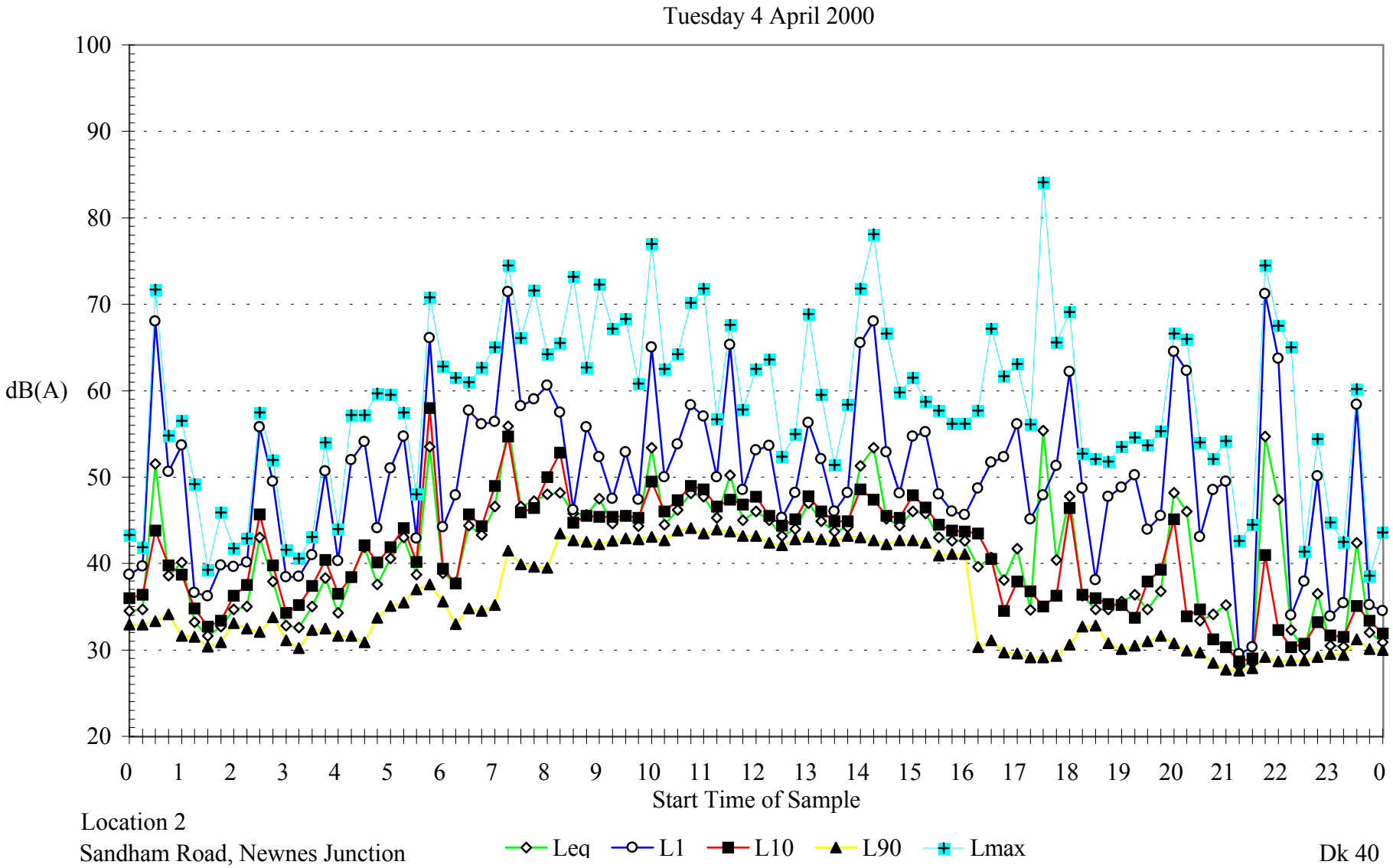
5058R2CA.XLS

Ambient Sound Pressure Levels



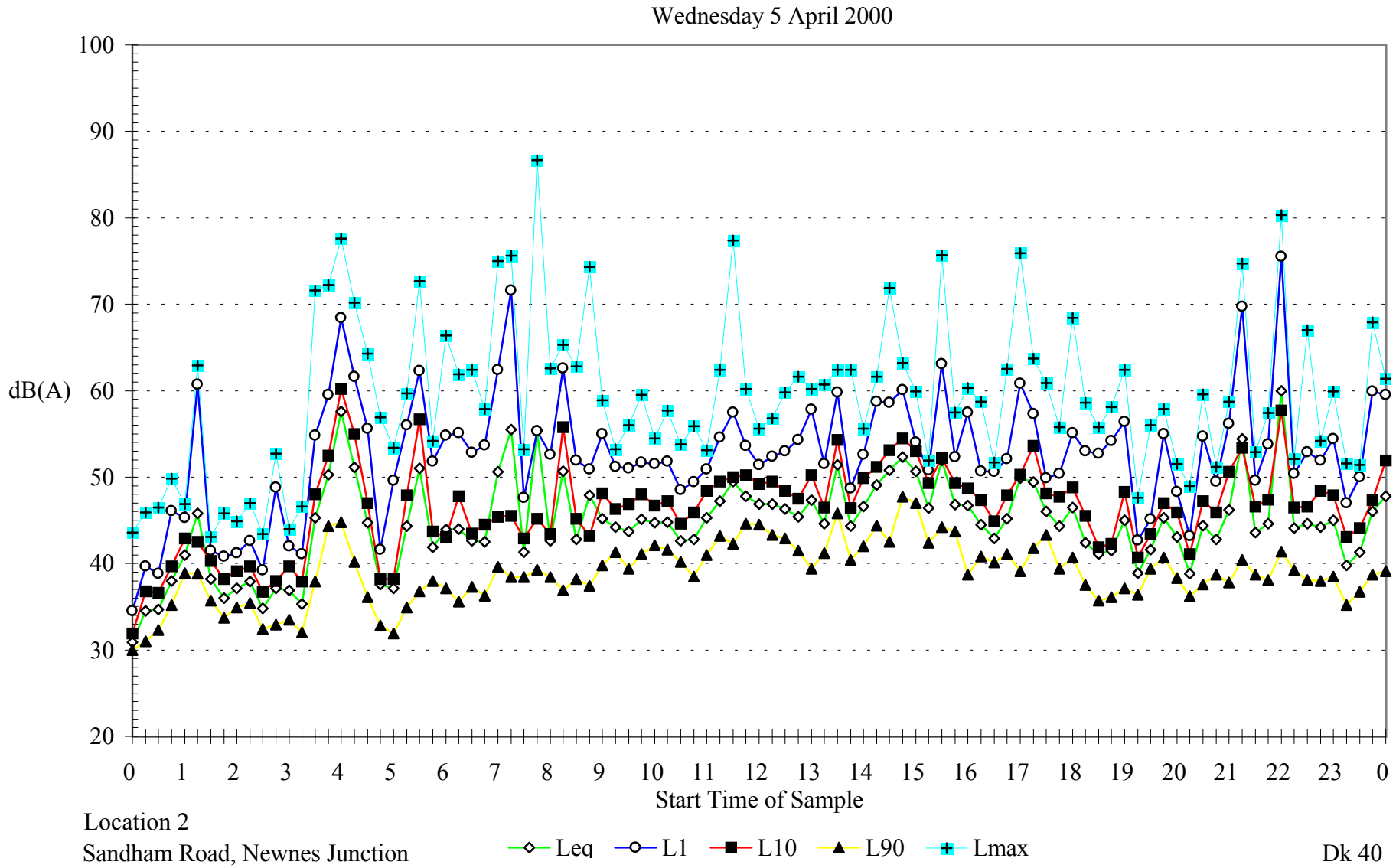
5058R2CA.XLS

Ambient Sound Pressure Levels



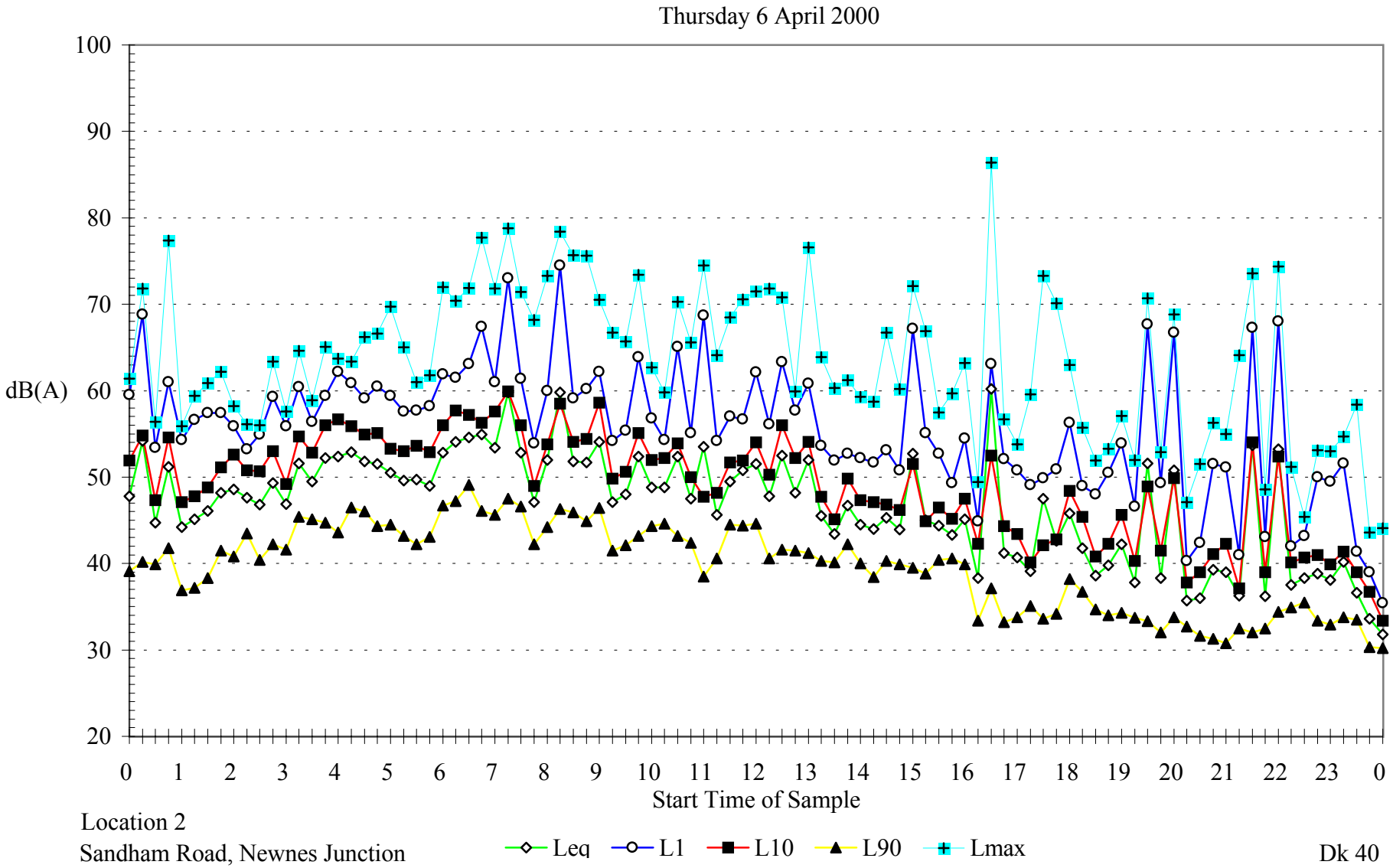
5058R2CA.XLS

Ambient Sound Pressure Levels



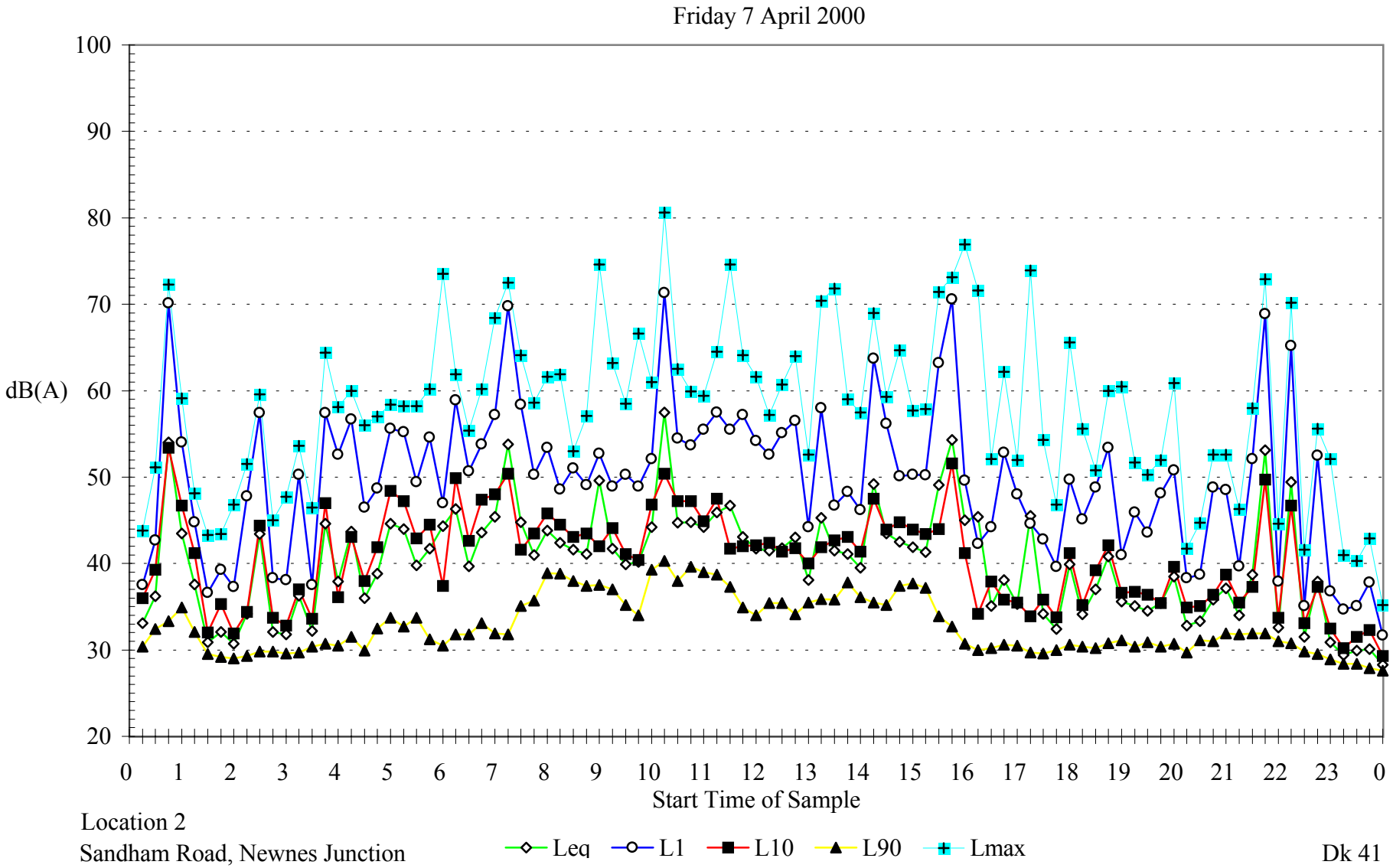
5058R2CA.XLS

Ambient Sound Pressure Levels



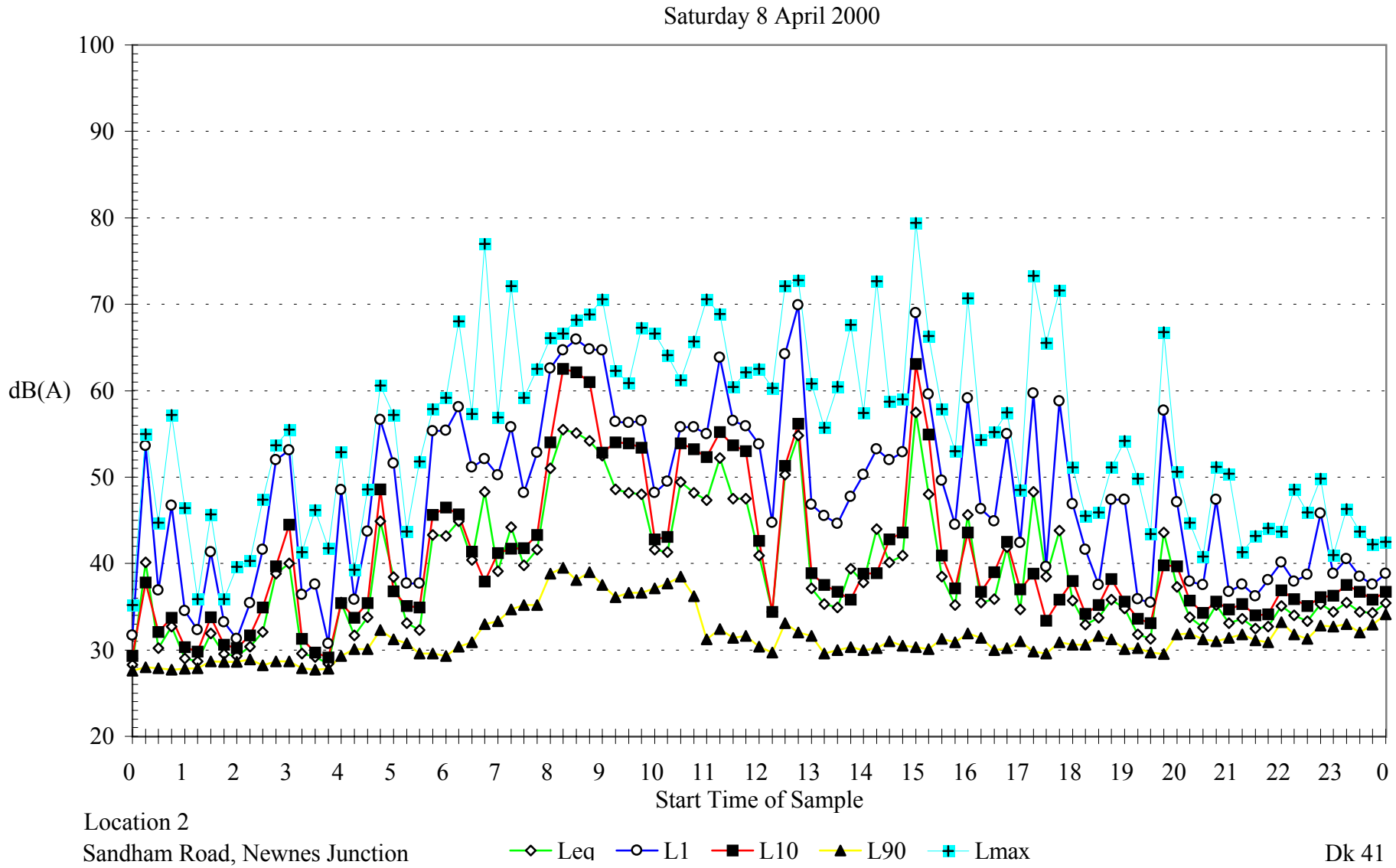
5058R2CA.XLS

Ambient Sound Pressure Levels



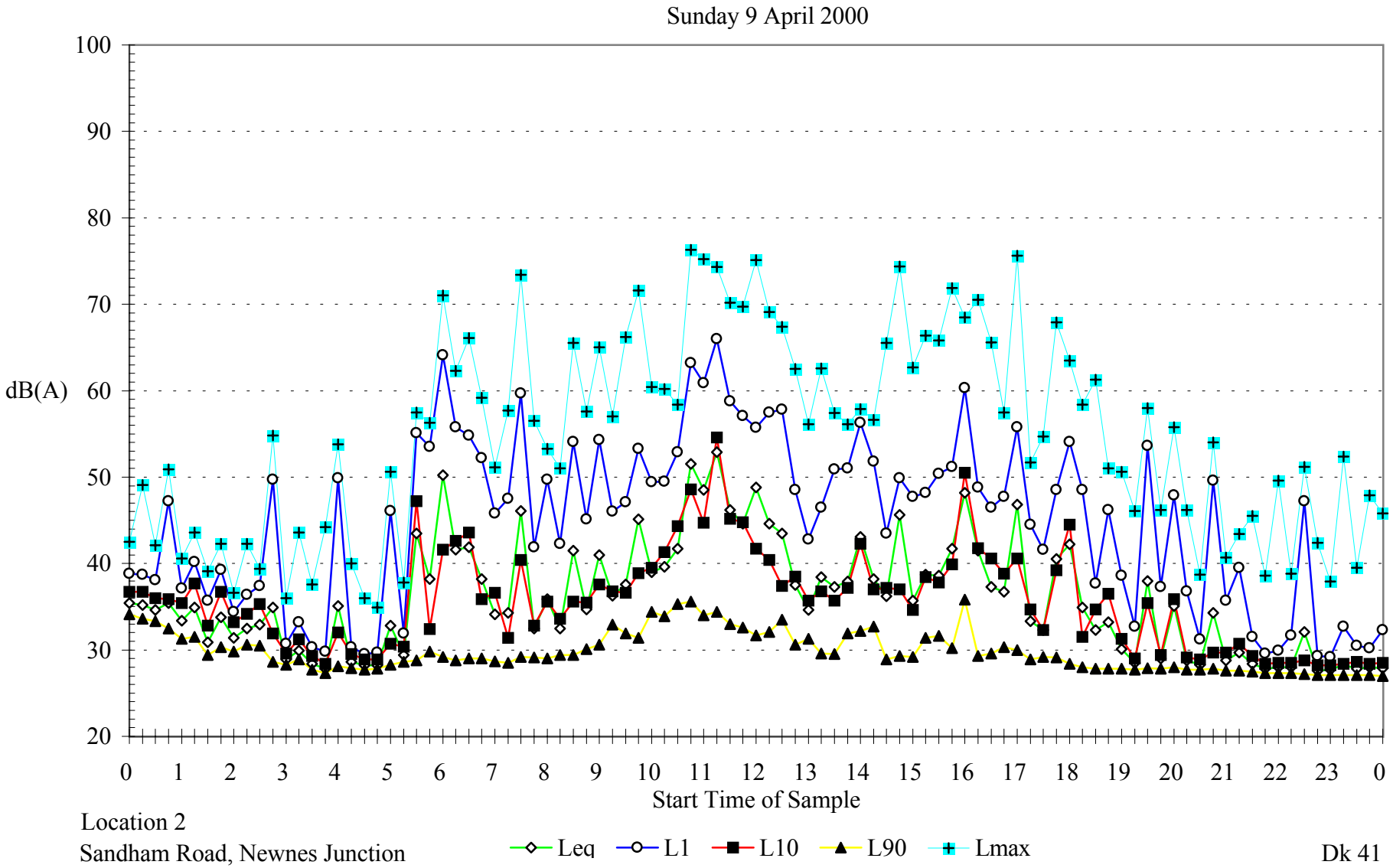
5058R2DA.XLS

Ambient Sound Pressure Levels



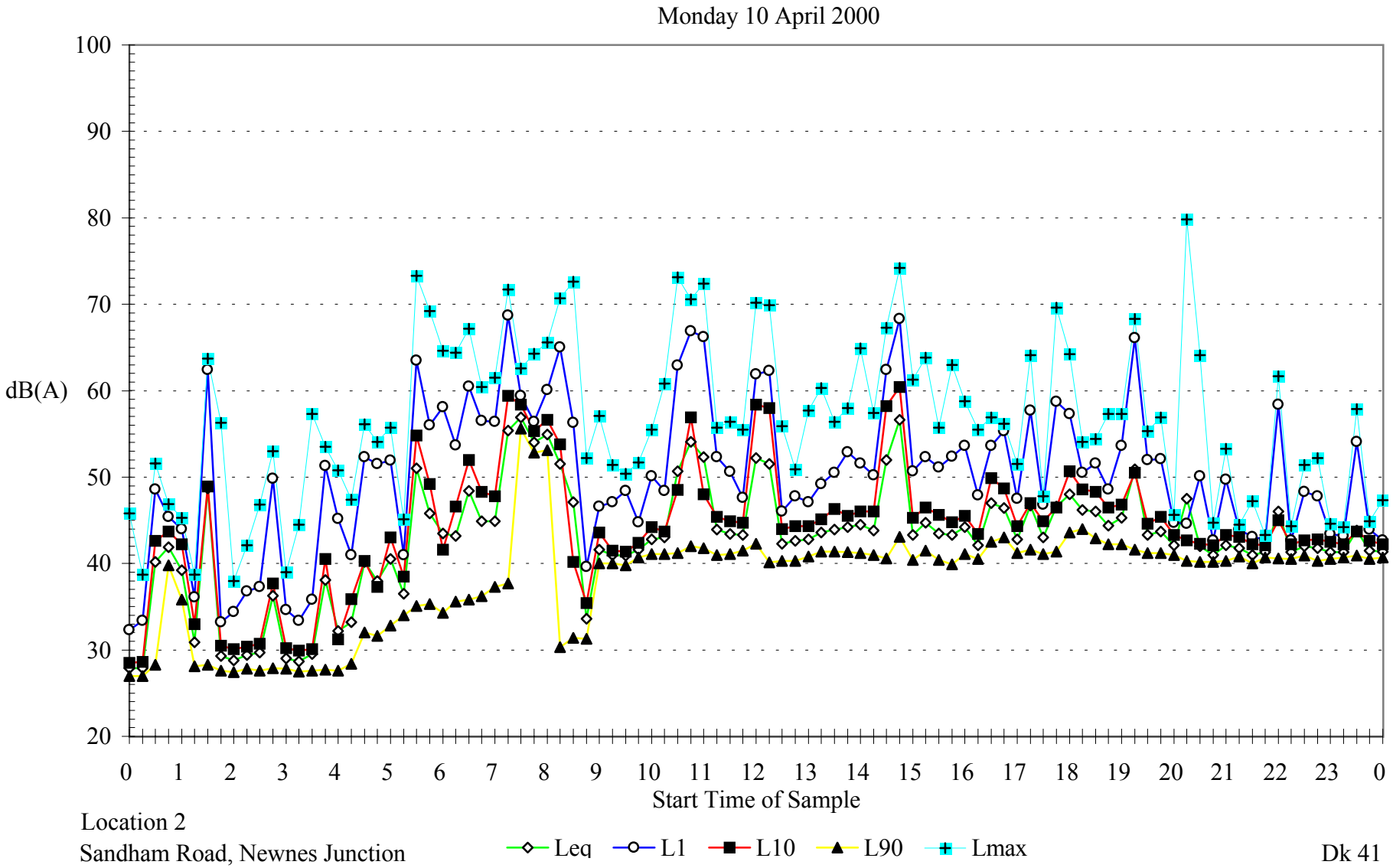
5058R2DA.XLS

Ambient Sound Pressure Levels



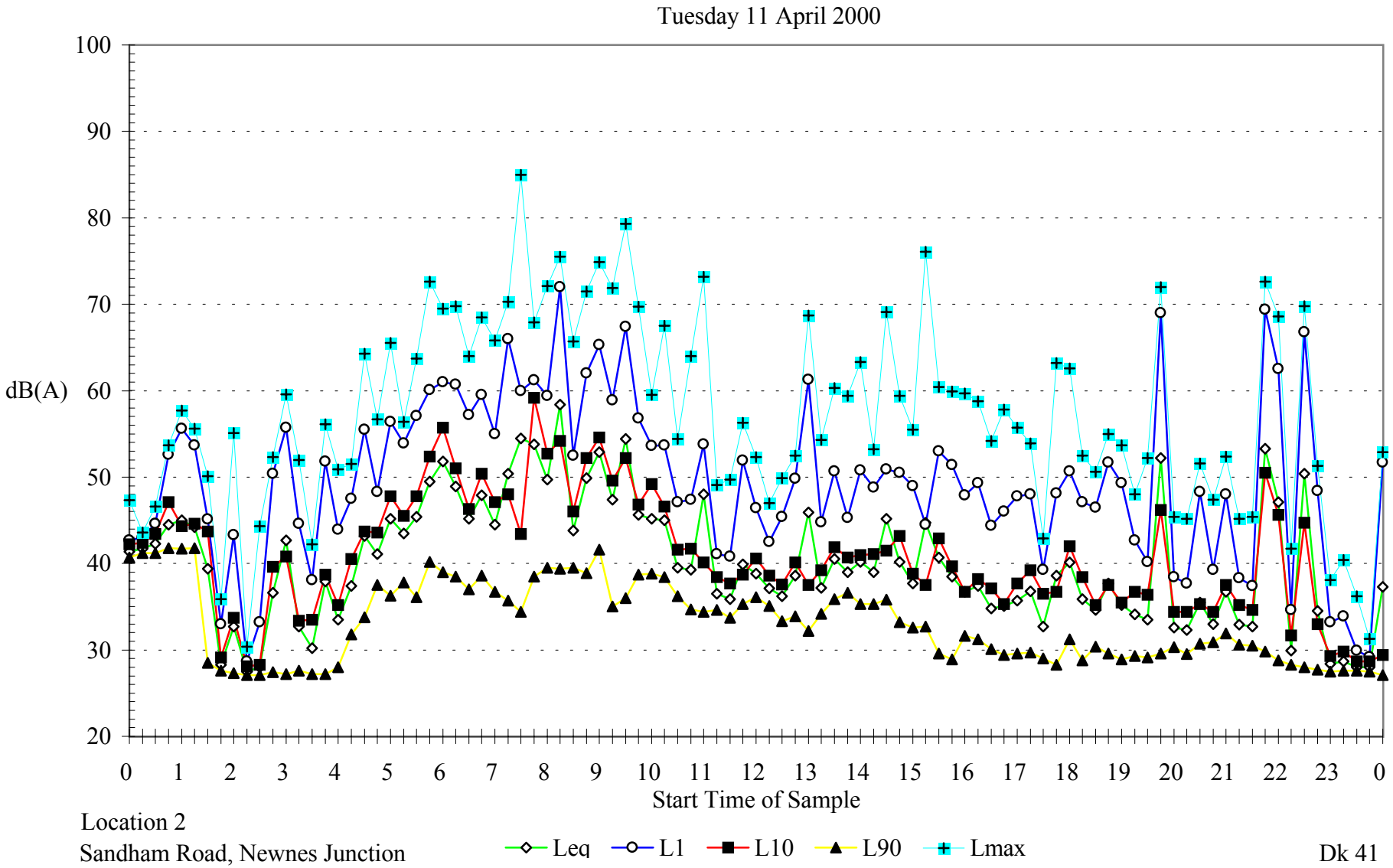
5058R2DA.XLS

Ambient Sound Pressure Levels



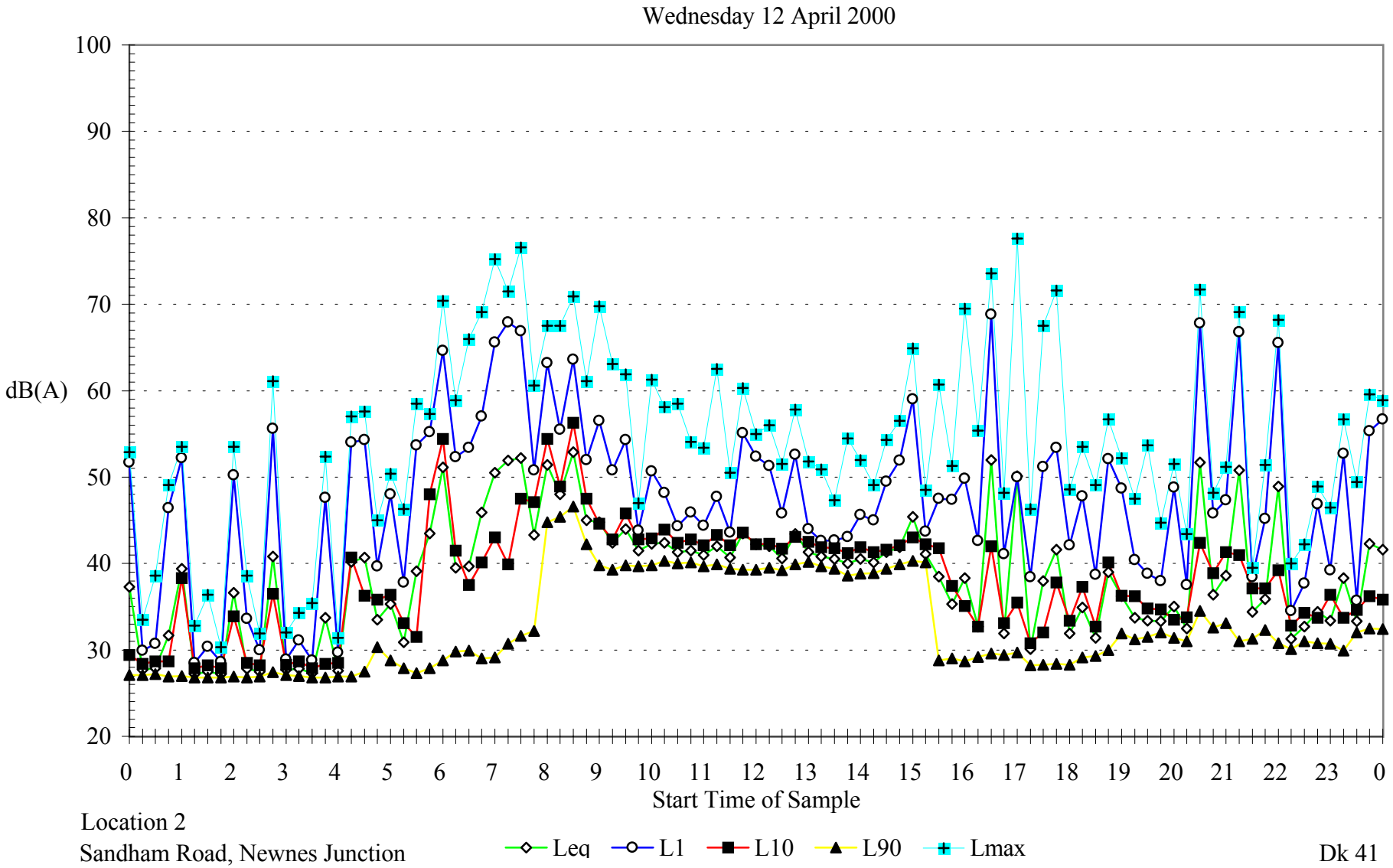
5058R2DA.XLS

Ambient Sound Pressure Levels



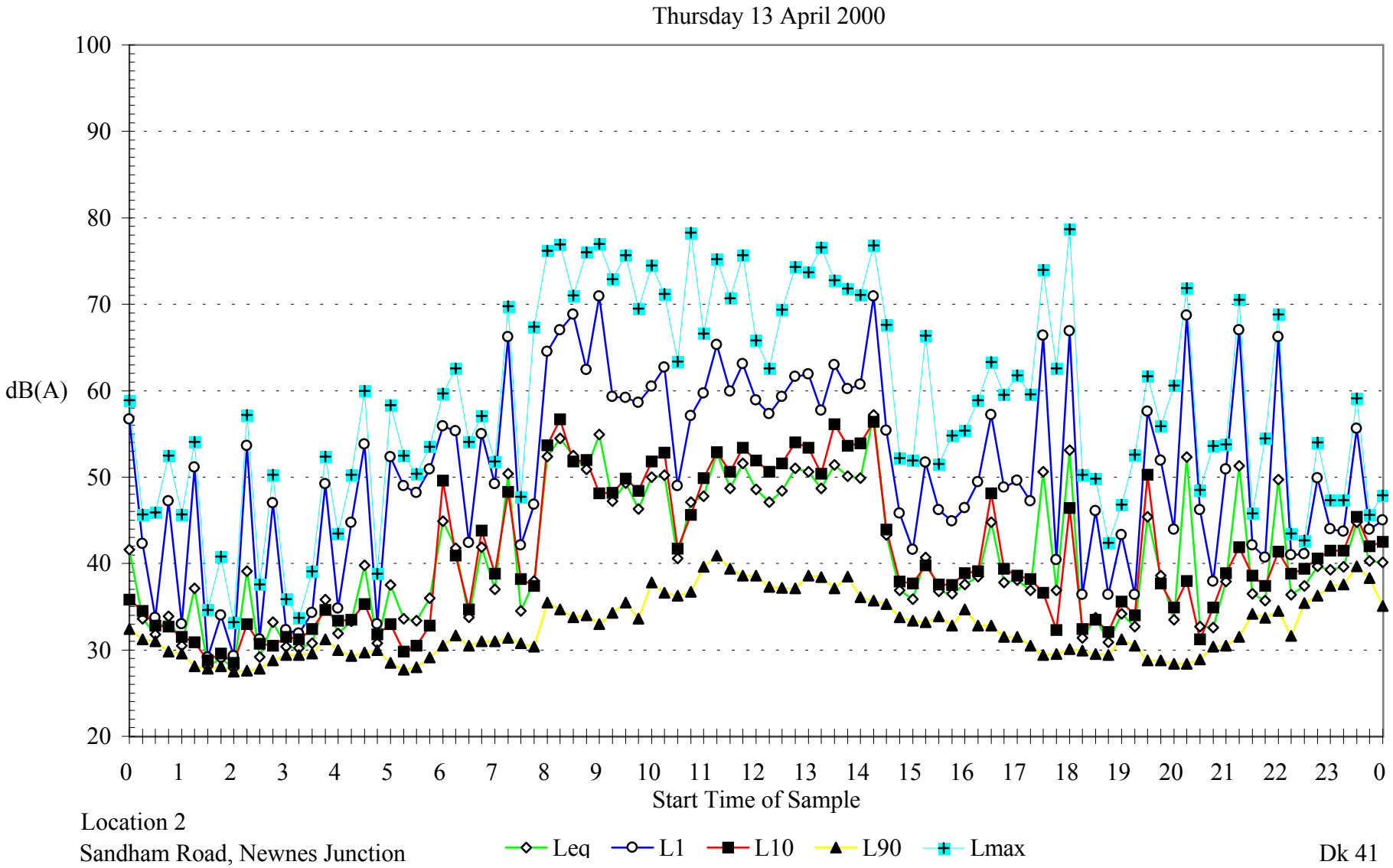
5058R2DA.XLS

Ambient Sound Pressure Levels



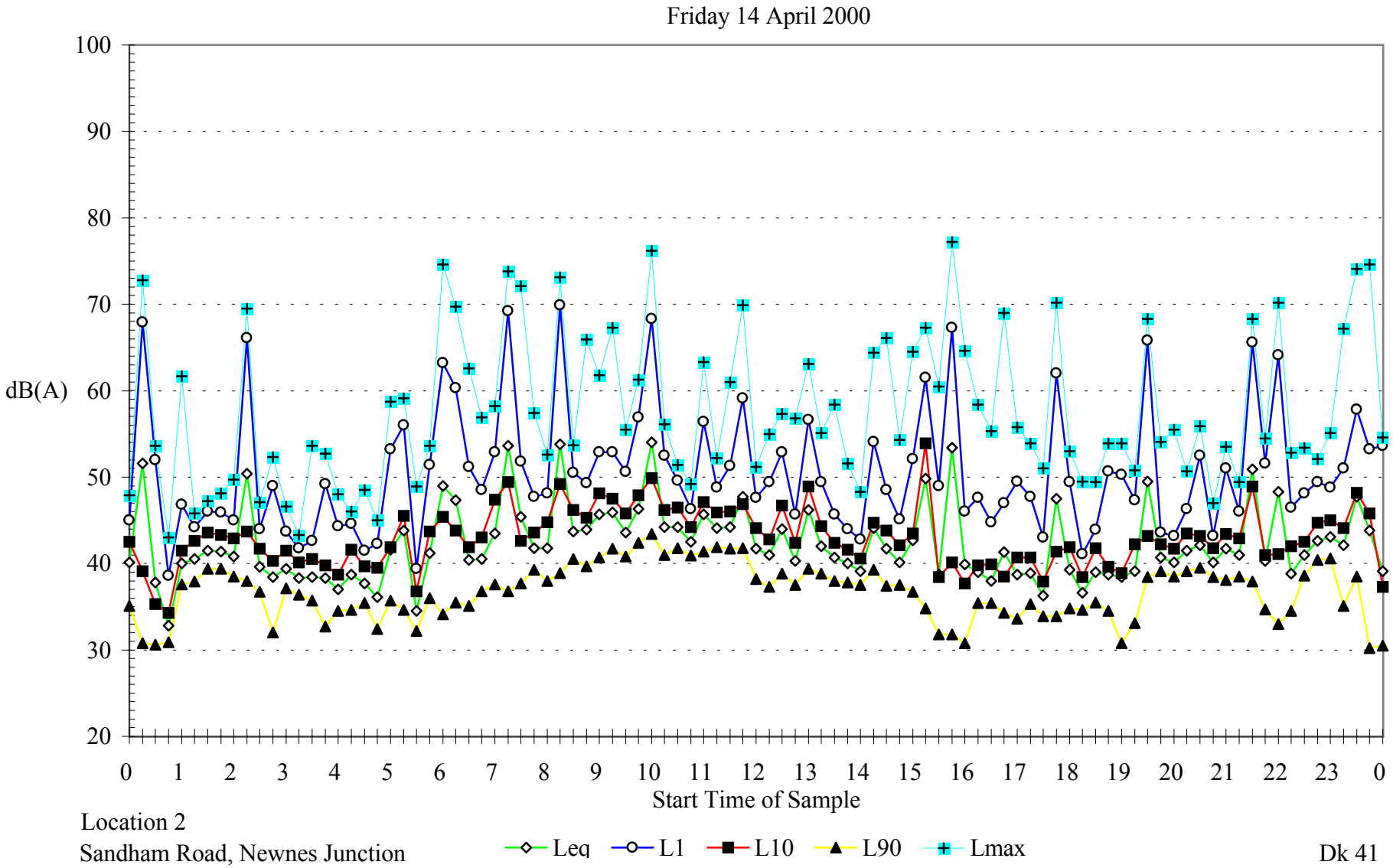
5058R2DA.XLS

Ambient Sound Pressure Levels



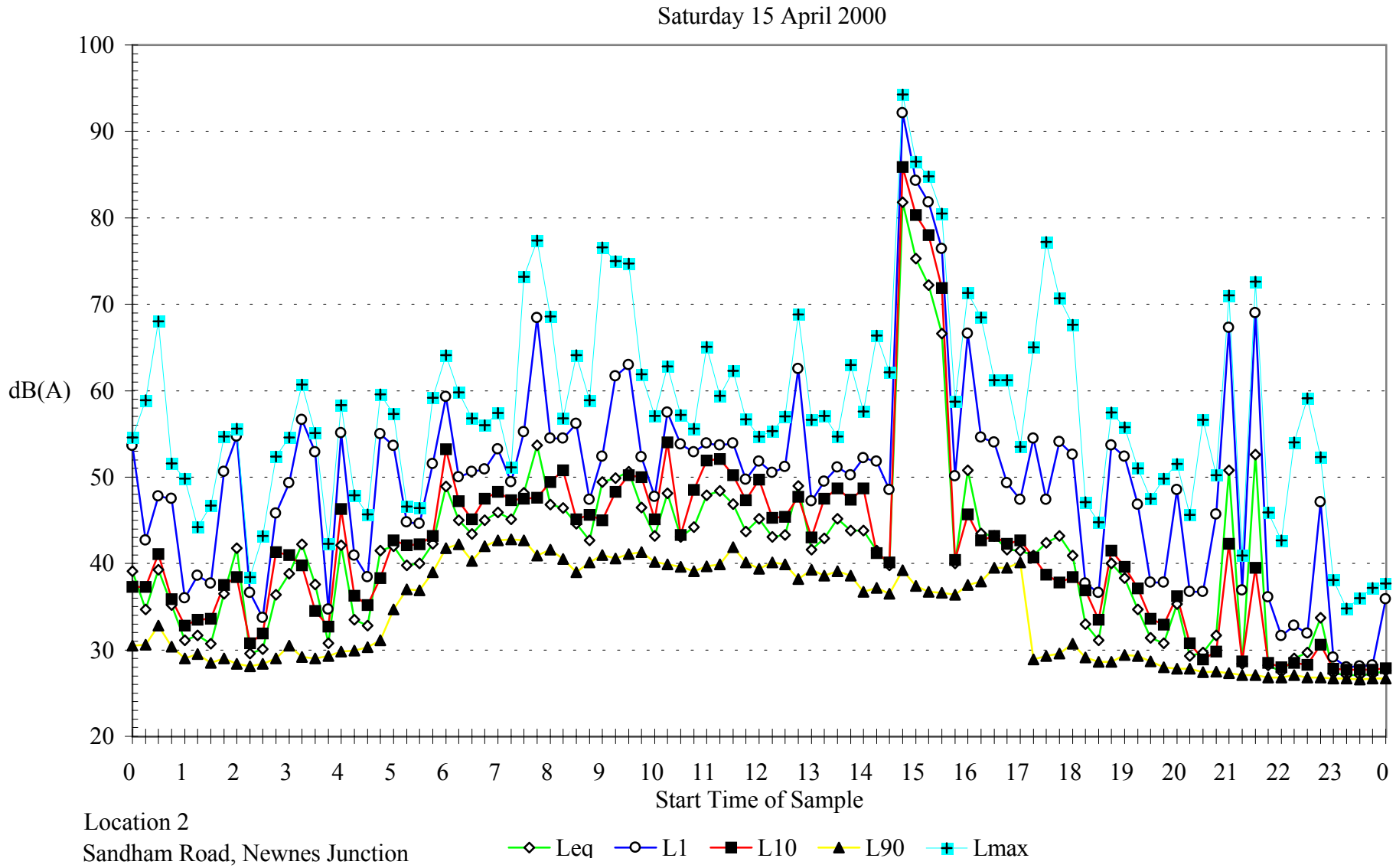
5058R2DA.XLS

Ambient Sound Pressure Levels



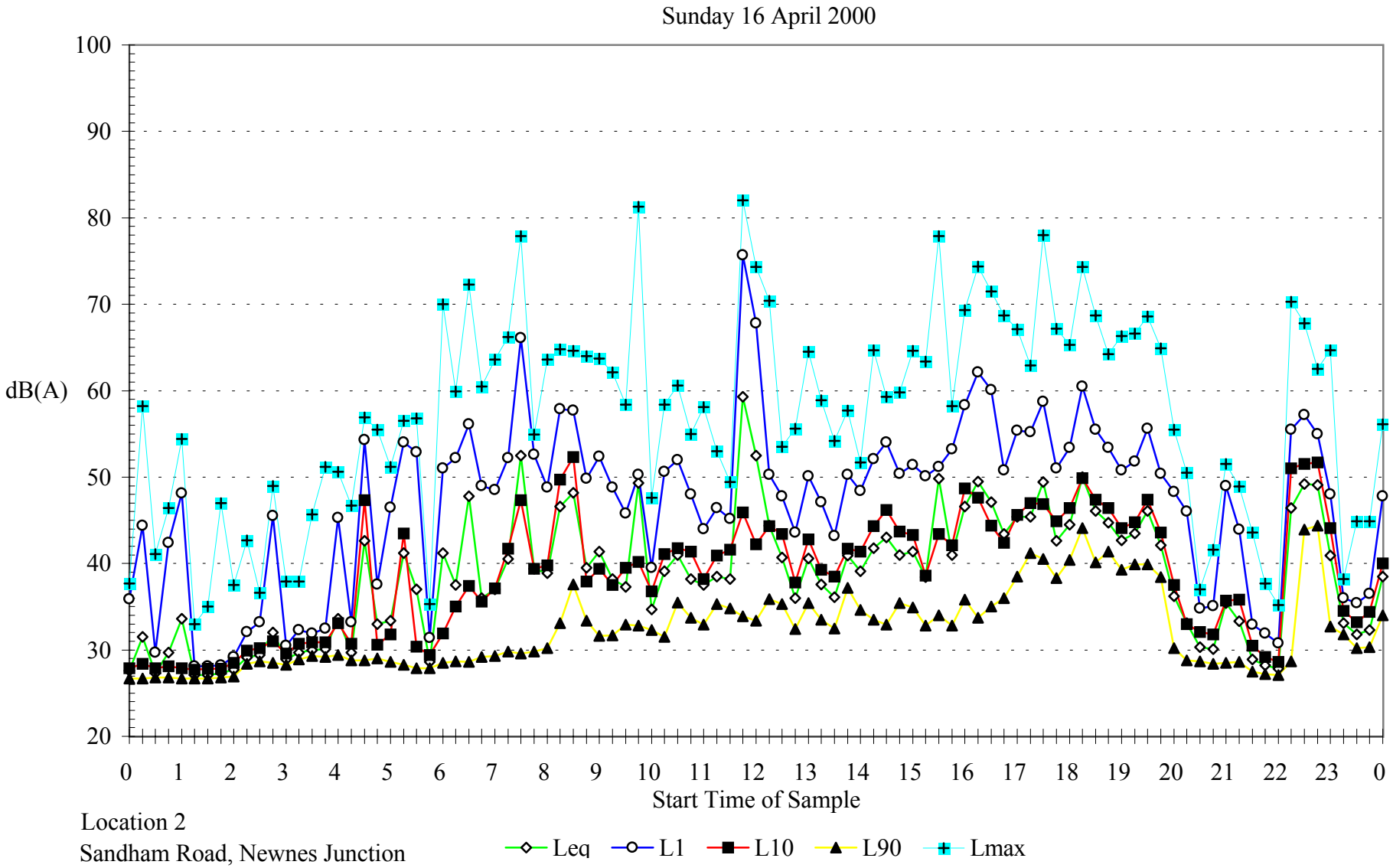
5058R2DA.XLS

Ambient Sound Pressure Levels



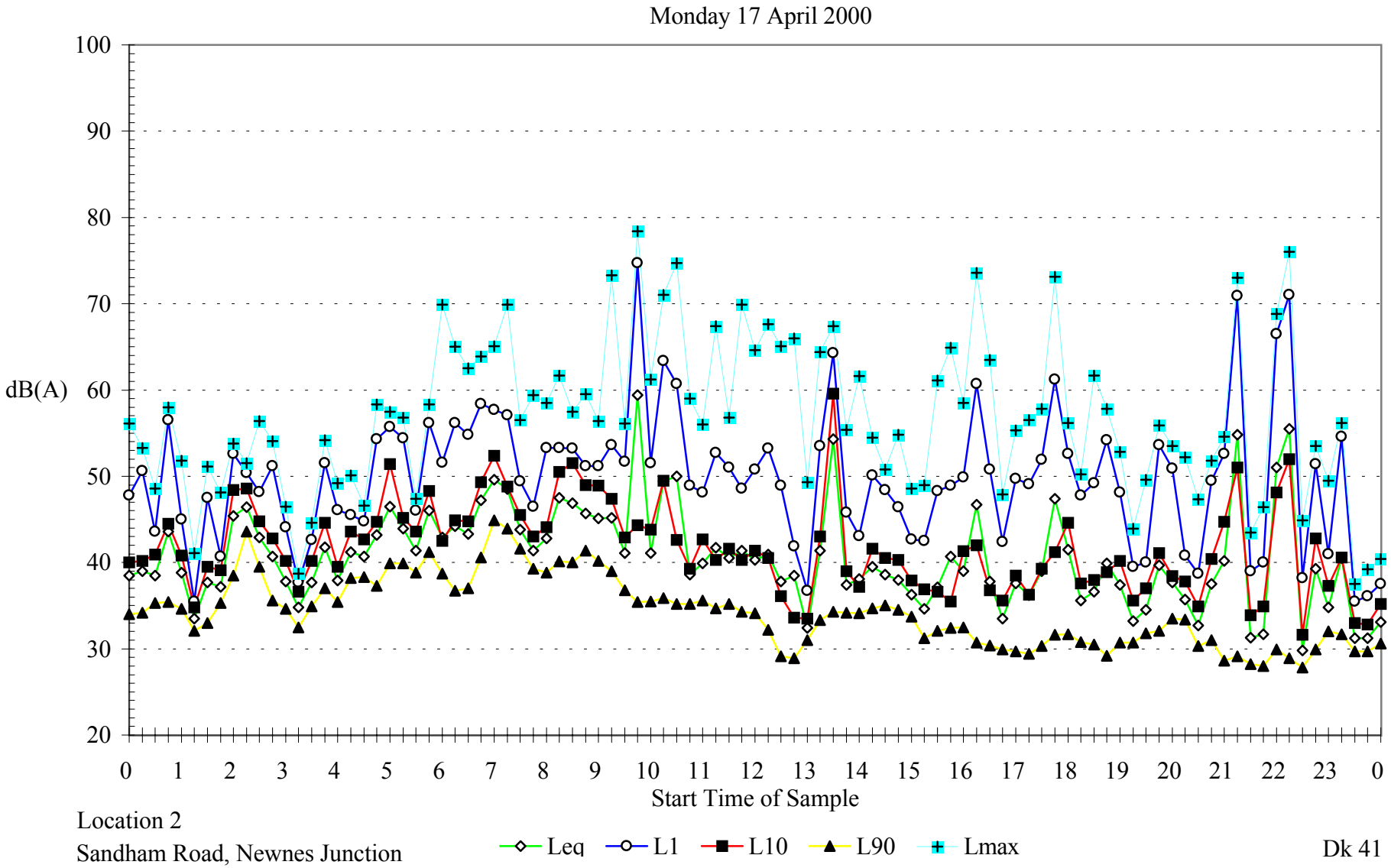
5058R2DA.XLS

Ambient Sound Pressure Levels



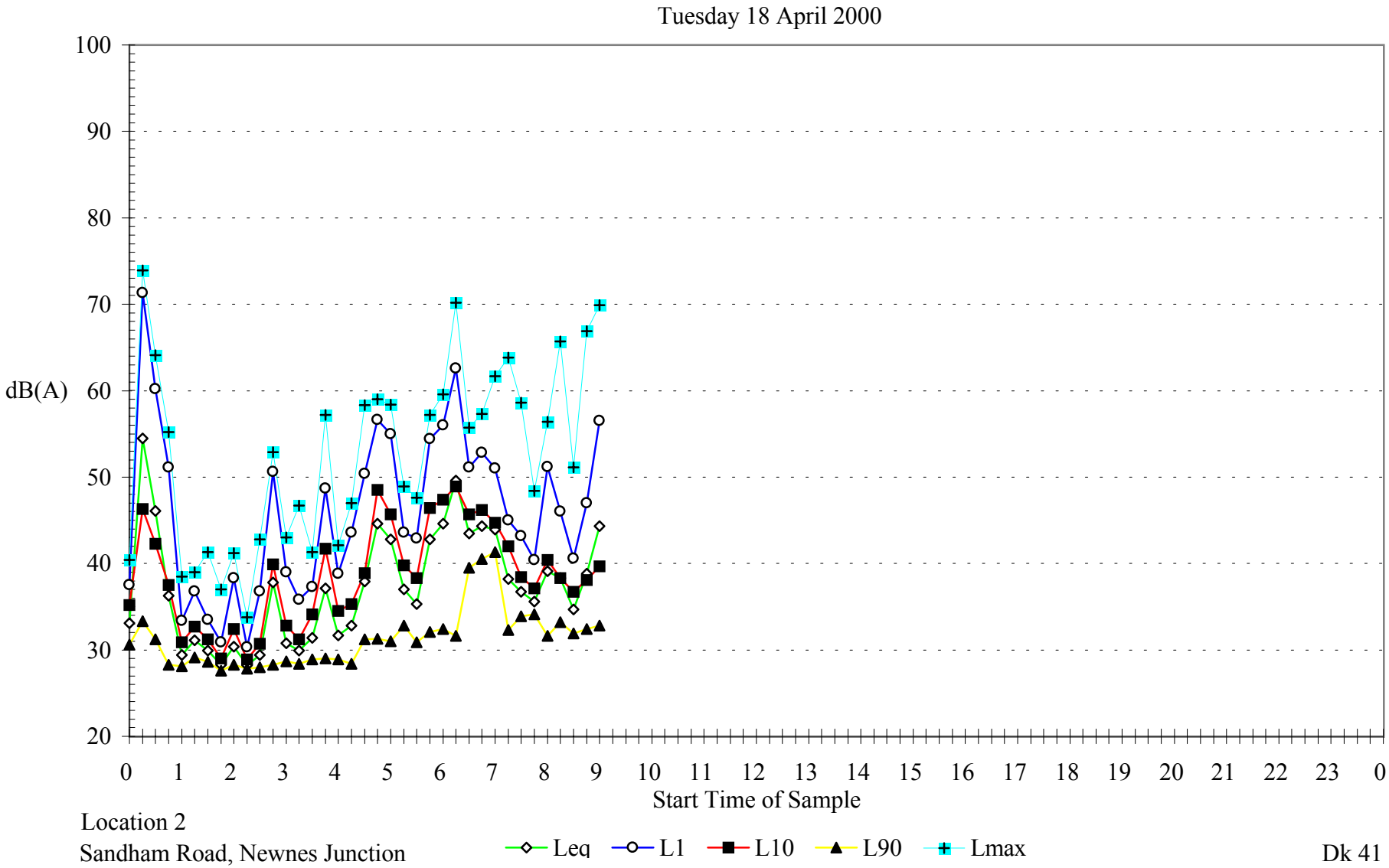
5058R2DA.XLS

Ambient Sound Pressure Levels



5058R2DA.XLS

Ambient Sound Pressure Levels



5058R2DA.XLS

APPENDIX 2: METEOROLOGY

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/16/00	2:30p	23.8	23.8	24.3	23.5	0	1.3	SW	1.4	897.6	60
3/16/00	2:45p	23.2	23.2	23.6	22.8	0.4	1.3	N	0.4	897.6	62
3/16/00	3:00p	22.9	22.9	23	22.7	0.9	1.3	N	0	897.5	62
3/16/00	3:15p	22.7	22.7	22.9	22.5	0.9	1.8	N	0	897.3	62
3/16/00	3:30p	22.7	22.7	22.9	22	0.9	2.2	N	0	897.4	63
3/16/00	3:45p	21.6	21.6	22	21.1	0.9	2.7	N	0	897.5	63
3/16/00	4:00p	20.8	20.8	21.1	20.7	0.4	2.2	N	0	897.4	63
3/16/00	4:15p	21.1	21.1	21.8	20.7	0.4	0.9	N	0	897.3	64
3/16/00	4:30p	21.2	21.2	21.7	20.9	0.4	0.9	N	0	897.2	65
3/16/00	4:45p	20.6	20.6	20.9	20.4	0.4	0.9	N	0	897.1	65
3/16/00	5:00p	20.1	20.1	20.4	19.7	0	0.9	N	0.6	897.3	64
3/16/00	5:15p	19.4	19.4	19.7	19.3	0.4	0.9	N	0.4	897.2	64
3/16/00	5:30p	19.2	19.2	19.4	19	0.4	1.3	NNW	0.6	897.3	65
3/16/00	5:45p	18.8	18.8	19	18.7	0.4	1.3	N	0	897.3	66
3/16/00	6:00p	18.6	18.6	18.7	18.5	0	0.4	N	0	897.4	66
3/16/00	6:15p	18.4	18.4	18.5	18.4	0.4	0.9	N	0	897.6	67
3/16/00	6:30p	18.6	18.6	18.6	18.4	0	0.9	N	0.2	897.9	67
3/16/00	6:45p	18.6	18.6	18.7	18.6	0	0	---	0.4	898	68
3/16/00	7:00p	18.6	18.6	18.6	18.5	0	0.4	N	0	898.2	68
3/16/00	7:15p	18.5	18.5	18.6	18.5	0	0.9	N	0	898.4	68
3/16/00	7:30p	18.5	18.5	18.6	18.4	0	6.7	N	0	898.5	69
3/16/00	7:45p	18.4	18.4	18.5	18.4	0.4	0.9	N	0	898.5	69
3/16/00	8:00p	18.5	18.5	18.5	18.4	0	0.4	N	0	898.5	69
3/16/00	8:15p	18.4	18.4	18.5	18.4	0	0.4	N	0	899	69
3/16/00	8:30p	18.4	18.4	18.4	18.4	0	0.4	N	0	899.5	70
3/16/00	8:45p	18.3	18.3	18.4	18.3	0	0.9	N	0.2	899.4	70
3/16/00	9:00p	18.4	18.4	18.4	18.3	0	0.9	N	0	899.2	70
3/16/00	9:15p	18.4	18.4	18.4	18.4	0.4	0.9	N	0	899.3	71
3/16/00	9:30p	18.4	18.4	18.4	18.4	0	0.9	N	0	899.4	71
3/16/00	9:45p	18.4	18.4	18.4	18.3	0	0.9	N	0	899.4	71
3/16/00	10:00p	18.3	18.3	18.3	18.2	0	0.4	N	0	899.5	71
3/16/00	10:15p	18.2	18.2	18.3	18.1	0	0.9	N	0	899.6	71
3/16/00	10:30p	18.3	18.3	18.3	18.2	0	0.4	N	0	899.4	71
3/16/00	10:45p	18.3	18.3	18.3	18.3	0	0.9	N	0	899.4	72
3/16/00	11:00p	18.4	18.4	18.4	18.3	0.4	0.9	N	0	899.4	72
3/16/00	11:15p	18.3	18.3	18.4	18.2	0	0.9	N	0	899.3	72
3/16/00	11:30p	18.1	18.1	18.2	18	0	0	---	0	899.4	72
3/16/00	11:45p	18	18	18.1	17.9	0	0	---	0	899.4	72
3/17/00	12:00a	18.1	18.1	18.2	18.1	0	0.9	N	0	899.4	72
3/17/00	12:15a	18.2	18.2	18.2	18.2	0	0.9	N	0	899.4	73
3/17/00	12:30a	18.3	18.3	18.3	18.2	0	0.9	N	0	899.4	73
3/17/00	12:45a	18.3	18.3	18.3	18.3	0	0.9	N	0	899.4	73
3/17/00	1:00a	18.3	18.3	18.3	18.3	0	1.3	N	0	899.4	73
3/17/00	1:15a	18.2	18.2	18.3	18.2	0	0.9	N	0	899.2	74
3/17/00	1:30a	18.2	18.2	18.2	18.2	0	1.3	N	0	899.1	74
3/17/00	1:45a	18.1	18.1	18.2	18.1	0	0.9	N	0	898.9	74
3/17/00	2:00a	18.1	18.1	18.1	18.1	0	0.4	N	0	898.9	74

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/17/00	2:15a	18.1	18.1	18.1	18.1	0	0.9	N	0	898.9	74
3/17/00	2:30a	18.1	18.1	18.1	18	0	0.9	N	0	898.6	74
3/17/00	2:45a	18	18	18	17.9	0.4	1.3	N	0	898.5	74
3/17/00	3:00a	17.9	17.9	18	17.9	0.4	1.3	N	0	898.5	75
3/17/00	3:15a	17.9	17.9	17.9	17.9	0	0.4	NNE	0	898.6	75
3/17/00	3:30a	17.9	17.9	17.9	17.8	0	0.9	N	0	898.4	75
3/17/00	3:45a	17.6	17.6	17.8	17.4	0	0	---	0	898.4	75
3/17/00	4:00a	17.3	17.3	17.4	17.2	0	0	---	0	898.5	75
3/17/00	4:15a	17.4	17.4	17.4	17.3	0	0.4	---	0	898.5	75
3/17/00	4:30a	17.2	17.2	17.3	17.1	0	0	---	0	898.5	75
3/17/00	4:45a	17	17	17.1	16.9	0	0	---	0	898.5	75
3/17/00	5:00a	16.9	16.9	16.9	16.8	0	0	---	0	898.7	75
3/17/00	5:15a	16.8	16.8	16.9	16.7	0	0	---	0	898.7	75
3/17/00	5:30a	16.9	16.9	17	16.8	0	0	---	0	898.8	75
3/17/00	5:45a	16.9	16.9	17	16.8	0	0	---	0	898.9	75
3/17/00	6:00a	17.1	17.1	17.1	17	0	0	---	0	898.9	75
3/17/00	6:15a	16.9	16.9	17.1	16.9	0	0	---	0	899	75
3/17/00	6:30a	16.9	16.9	17	16.9	0	0	---	0	899.1	76
3/17/00	6:45a	16.8	16.8	16.9	16.8	0	0	---	0	899.1	75
3/17/00	7:00a	16.8	16.8	16.8	16.8	0	0	---	0	899.5	75
3/17/00	7:15a	16.8	16.8	16.8	16.7	0	0	---	0	899.6	75
3/17/00	7:30a	16.7	16.7	16.7	16.7	0	0	---	0	899.6	75
3/17/00	7:45a	16.9	16.9	17	16.7	0	0	---	0	899.8	76
3/17/00	8:00a	17.6	17.6	18.1	17	0	0	---	0	899.7	76
3/17/00	8:15a	18.3	18.3	18.5	18.1	0	0	---	0	899.9	77
3/17/00	8:30a	18.6	18.6	19	18.4	0	1.3	NNE	0	899.9	78
3/17/00	8:45a	19.3	19.3	19.4	19.1	0	0.9	NNE	0	899.9	78
3/17/00	9:00a	19.3	19.3	19.5	19.2	0	0	---	0	900	78
3/17/00	9:15a	19.5	19.5	19.8	19.4	0	0.4	NNE	0	900	77
3/17/00	9:30a	20.3	20.3	20.6	19.8	0	0.4	NNE	0	899.9	78
3/17/00	9:45a	21.1	21.1	21.5	20.6	0	0.9	NNE	0	899.9	79
3/17/00	10:00a	21.8	21.8	22.1	21.5	0	0.9	NNE	0	899.9	80
3/17/00	10:15a	21.6	21.6	22.1	21.4	0	0.9	N	0	899.9	79
3/17/00	10:30a	22	22	22.7	21.4	0.4	1.8	N	0	899.7	79
3/17/00	10:45a	21.3	21.3	21.4	21.2	0	1.3	NNW	0	899.6	77
3/17/00	11:00a	22.2	22.2	23.7	21.3	0	0.9	ESE	0	899.6	79
3/17/00	11:15a	21.2	21.2	21.5	20.9	0	0.4	ESE	0	899.6	77
3/17/00	11:30a	23	23	26.2	20.9	0	0.9	ESE	0	899.4	80
3/17/00	11:45a	26.1	26.1	27.6	23.9	0	1.8	N	0	899.3	85
3/17/00	12:00p	25.1	25.1	25.9	23.9	0.4	1.8	N	0	899.1	80
3/17/00	12:15p	23	23	23.9	22.7	0.4	1.8	N	0	899.1	74
3/17/00	12:30p	23.2	23.2	24.1	22.8	0	0.9	N	0	898.9	72
3/17/00	12:45p	24.7	24.7	26.2	23.4	0	0.9	N	0	898.7	74
3/17/00	1:00p	23.4	23.4	24.1	23.2	0	0	---	0	898.5	72
3/17/00	1:15p	23.8	23.8	25.1	22.8	0.4	1.8	SSW	0	898.4	72
3/17/00	1:30p	22.9	22.9	24.1	22.7	1.3	2.2	SSW	0	898.3	71
3/17/00	1:45p	24.9	24.9	25.4	24.1	0.9	2.2	SSW	0	898.2	73

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/17/00	2:00p	25.2	25.2	25.8	24.3	0.9	2.2	SSW	0	898.1	73
3/17/00	2:15p	24.3	24.3	25.2	23.7	0.4	1.8	SSW	0	898.1	71
3/17/00	2:30p	23.8	23.8	23.9	23.7	0	0.9	SSW	0	897.8	70
3/17/00	2:45p	23.6	23.6	24	23.2	0.4	1.3	SSW	0	897.7	70
3/17/00	3:00p	23.4	23.4	24	22.8	0	0.9	SSW	0	897.8	70
3/17/00	3:15p	22.4	22.4	22.7	22.2	0	0	---	0	898	70
3/17/00	3:30p	22.8	22.8	22.8	22.7	0.4	2.2	SSW	0	897.9	70
3/17/00	3:45p	22.7	22.7	22.8	22.6	0	0	---	0	898	71
3/17/00	4:00p	22.6	22.6	22.8	22.4	0	0	---	0	897.8	71
3/17/00	4:15p	22.9	22.9	23.2	22.7	0	0	---	0	897.9	72
3/17/00	4:30p	23.1	23.1	23.3	23	0	0	---	0	897.9	72
3/17/00	4:45p	23.1	23.1	23.3	22.9	0	0.9	ESE	0	897.6	72
3/17/00	5:00p	22.7	22.7	22.9	22.3	0.9	1.8	N	0	897.5	72
3/17/00	5:15p	22.3	22.3	22.7	22.1	0.4	1.3	N	0	897.5	72
3/17/00	5:30p	22.1	22.1	22.2	21.9	0	0.9	N	0	897.6	71
3/17/00	5:45p	22.1	22.1	22.2	21.8	0	0.9	N	0	897.6	72
3/17/00	6:00p	21.6	21.6	21.8	21.4	0.4	1.3	N	0	897.7	72
3/17/00	6:15p	21.3	21.3	21.4	21.3	0	0.9	N	0	897.8	72
3/17/00	6:30p	21.3	21.3	21.3	21.1	0	0.9	N	0	898	72
3/17/00	6:45p	21.1	21.1	21.2	20.9	0	0.4	N	0.2	898.1	72
3/17/00	7:00p	20.8	20.8	20.9	20.8	0	0	---	0	898.2	73
3/17/00	7:15p	20.7	20.7	20.8	20.5	0	0	---	0	898	73
3/17/00	7:30p	20.3	20.3	20.5	20.2	0	0	---	0	897.9	73
3/17/00	7:45p	20.1	20.1	20.2	20	0	0	---	0	898.2	73
3/17/00	8:00p	20.1	20.1	20.1	19.9	0	0.9	N	0	898.5	74
3/17/00	8:15p	20.1	20.1	20.2	20.1	0	0.9	N	0	898.9	74
3/17/00	8:30p	20.2	20.2	20.2	20.1	0	0.9	N	0	898.9	75
3/17/00	8:45p	19.9	19.9	20.1	19.8	0	0	---	0	898.9	75
3/17/00	9:00p	19.7	19.7	19.8	19.7	0	0	---	0	898.9	75
3/17/00	9:15p	19.7	19.7	19.7	19.7	0	0	---	0	898.8	75
3/17/00	9:30p	19.6	19.6	19.7	19.3	0	0	---	0	898.8	75
3/17/00	9:45p	19.2	19.2	19.3	19.1	0	0	---	0	898.8	75
3/17/00	10:00p	19	19	19.1	18.9	0	0	---	0	898.8	75
3/17/00	10:15p	18.9	18.9	19.1	18.8	0	0	---	0	898.8	75
3/17/00	10:30p	19.1	19.1	19.1	19	0.4	0.9	N	0	898.6	76
3/17/00	10:45p	18.8	18.8	19	18.7	0	1.3	N	0	898.8	76
3/17/00	11:00p	18.7	18.7	18.7	18.6	0	0	---	0	898.9	76
3/17/00	11:15p	18.7	18.7	18.8	18.7	0	0.4	---	0	898.8	76
3/17/00	11:30p	19	19	19.2	18.8	0	0.4	N	0	898.8	76
3/17/00	11:45p	18.9	18.9	19.2	18.8	0	0.9	N	0	898.9	76
3/18/00	12:00a	18.8	18.8	18.8	18.8	0.4	0.9	N	0	898.8	77
3/18/00	12:15a	18.8	18.8	18.8	18.7	0	0	---	0	898.9	77
3/18/00	12:30a	18.6	18.6	18.7	18.6	0	0	---	0	898.8	77
3/18/00	12:45a	18.6	18.6	18.6	18.6	0	0	---	0	898.6	77
3/18/00	1:00a	18.7	18.7	18.8	18.6	0	0	---	0	898.5	77
3/18/00	1:15a	18.8	18.8	18.9	18.6	0	0.9	N	0	898.6	77
3/18/00	1:30a	18.7	18.7	18.8	18.6	0	0.4	N	0	898.5	77

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/18/00	1:45a	18.8	18.8	18.9	18.6	0	0	---	0	898.4	77
3/18/00	2:00a	18.3	18.3	18.6	18.2	0	0	---	0	898.4	77
3/18/00	2:15a	18.2	18.2	18.2	18.2	0	0	---	0	898.4	77
3/18/00	2:30a	18.1	18.1	18.2	18	0	0	---	0	898.2	77
3/18/00	2:45a	18.2	18.2	18.3	18.1	0	0	---	0	897.9	77
3/18/00	3:00a	18.7	18.7	18.9	18.3	0.4	0.9	WNW	0	897.8	78
3/18/00	3:15a	19.1	19.1	19.1	18.9	0.9	1.3	WSW	0	897.7	79
3/18/00	3:30a	19.1	19.1	19.1	19	0.9	1.3	WSW	0	897.6	79
3/18/00	3:45a	19.1	19.1	19.2	19.1	0.4	1.3	WSW	0	897.7	79
3/18/00	4:00a	19	19	19.1	18.9	0	0.9	SW	0	897.6	79
3/18/00	4:15a	18.7	18.7	18.9	18.6	0	0	---	0	897.7	79
3/18/00	4:30a	18.7	18.7	18.7	18.6	0.4	1.3	SW	0	897.6	80
3/18/00	4:45a	18.7	18.7	18.7	18.6	0.9	1.8	SW	0	897.6	80
3/18/00	5:00a	18.7	18.7	18.7	18.6	0.9	1.3	SSW	0	897.5	80
3/18/00	5:15a	18.6	18.6	18.6	18.4	0.9	1.3	SSW	0	897.6	81
3/18/00	5:30a	18.4	18.4	18.5	18.3	0.4	0.9	SSW	0	897.7	80
3/18/00	5:45a	18.1	18.1	18.3	17.9	0	0	---	0	897.5	80
3/18/00	6:00a	17.8	17.8	17.9	17.6	0	0	---	0	897.5	80
3/18/00	6:15a	17.8	17.8	17.8	17.8	0	0	---	0	897.6	80
3/18/00	6:30a	17.9	17.9	17.9	17.8	0.4	1.3	SSW	0	897.6	81
3/18/00	6:45a	17.9	17.9	17.9	17.9	0.9	1.3	SSW	0	897.8	81
3/18/00	7:00a	17.9	17.9	17.9	17.8	0.9	1.3	SSW	0	897.9	81
3/18/00	7:15a	17.8	17.8	17.8	17.8	0.9	1.3	SSW	0	897.9	82
3/18/00	7:30a	17.9	17.9	18.1	17.8	1.3	1.8	SSW	0	897.9	82
3/18/00	7:45a	18.2	18.2	18.3	18.1	1.3	1.8	SSW	0	898	83
3/18/00	8:00a	18.6	18.6	18.7	18.3	1.3	2.2	SSW	0	898.1	84
3/18/00	8:15a	18.9	18.9	19.2	18.7	0.9	1.8	SSW	0	898.2	84
3/18/00	8:30a	19.2	19.2	19.2	19.1	0.9	2.2	SSW	0	898.4	84
3/18/00	8:45a	19.4	19.4	19.7	19.2	0.9	1.3	SSW	0	898.4	84
3/18/00	9:00a	20	20	20.2	19.7	1.3	2.7	SSW	0	898.5	85
3/18/00	9:15a	20.3	20.3	20.5	20.2	1.8	3.1	SSW	0	898.5	85
3/18/00	9:30a	20.7	20.7	21.1	20.4	1.8	4.5	SSW	0	898.4	85
3/18/00	9:45a	21.7	21.7	22.6	21.1	1.8	3.6	SSW	0	898.5	85
3/18/00	10:00a	22	21.4	22.6	21.7	2.2	4	SW	0	898.5	86
3/18/00	10:15a	22.1	22.1	22.3	21.8	1.8	3.6	SW	0	898.7	85
3/18/00	10:30a	22.8	22.8	23.5	22.3	1.3	2.2	SW	0	898.8	85
3/18/00	10:45a	24.6	24.6	25.1	23.6	1.3	2.7	SSW	0	898.6	87
3/18/00	11:00a	25.9	25.9	26.4	25.2	1.3	3.1	SW	0	898.5	88
3/18/00	11:15a	26.2	26.2	26.9	25.8	1.3	3.6	SSW	0	898.6	83
3/18/00	11:30a	27.1	27.1	27.8	25.9	1.3	2.2	SSW	0	898.7	80
3/18/00	11:45a	26.6	26.6	27.2	25.7	1.8	3.6	SSW	0	898.6	74
3/18/00	12:00p	26.9	26.6	27.4	26.2	2.2	4.5	SSW	0	898.6	70
3/18/00	12:15p	26.9	26.6	27.3	26.7	2.2	4	SSW	0	898.5	66
3/18/00	12:30p	27.2	26.9	27.5	26.8	2.2	3.6	SSW	0	898.5	63
3/18/00	12:45p	27.3	27.3	28.2	26.9	1.8	3.6	SSW	0	898.4	60
3/18/00	1:00p	26.7	26.3	27.2	26.1	2.2	4	SSW	0	898.3	56
3/18/00	1:15p	27.1	26.7	27.9	26.4	2.2	4	SSW	0	898.3	54

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/18/00	1:30p	27.8	27.6	28.3	27.2	2.2	4	SSW	0	898	54
3/18/00	1:45p	27.7	27.7	28.3	27.2	1.8	3.6	SSW	0	898	52
3/18/00	2:00p	28.6	28.6	29.4	26.9	1.3	3.1	SSW	0	897.7	51
3/18/00	2:15p	26.4	26.4	26.9	26.2	0.9	2.2	SSW	0	897.6	50
3/18/00	2:30p	26.3	26.3	26.4	26.1	1.3	2.7	SSW	0	897.2	51
3/18/00	2:45p	26.1	26.1	26.4	25.8	0.9	2.2	SSW	0	897	53
3/18/00	3:00p	25.9	25.9	26.1	25.6	0.9	1.8	S	0	896.9	54
3/18/00	3:15p	25.4	25.4	25.7	25.3	0.9	1.3	SW	0	896.7	55
3/18/00	3:30p	25.8	25.8	26.1	25.6	0.9	2.2	SSW	0	896.8	56
3/18/00	3:45p	25.7	25.7	26.4	25.1	1.3	2.7	SSW	0	896.8	56
3/18/00	4:00p	25.6	25.6	26.1	25.1	1.3	2.2	SSW	0	896.8	56
3/18/00	4:15p	26.3	26.3	26.4	26.1	1.8	2.7	SSW	0	896.8	57
3/18/00	4:30p	25.9	25.9	26.2	25.7	1.3	2.7	SSW	0	896.8	57
3/18/00	4:45p	26.8	26.8	27.5	25.9	0.9	1.8	SW	0	896.7	57
3/18/00	5:00p	26.1	26.1	27.4	25.2	0.9	2.2	SSW	0	896.7	56
3/18/00	5:15p	25.3	25.3	25.4	25	1.3	2.2	SSW	0	896.8	56
3/18/00	5:30p	25.2	25.2	25.3	25.1	1.3	2.2	SSW	0	897	56
3/18/00	5:45p	24.6	24.6	25.1	24.2	0.9	2.2	S	0	897.2	56
3/18/00	6:00p	24.2	24.2	24.5	24.1	0.9	1.8	SSW	0	897.2	57
3/18/00	6:15p	24.4	24.4	24.5	24.3	0.9	2.2	SSW	0	897.2	58
3/18/00	6:30p	23.8	23.8	24.3	23.4	0.9	1.8	SSW	0	897.3	58
3/18/00	6:45p	23.1	23.1	23.3	22.7	0.9	1.3	SSW	0	897.4	58
3/18/00	7:00p	22.4	22.4	22.7	22.1	0.9	0.9	SSW	0	897.4	58
3/18/00	7:15p	21.6	21.6	22.1	21.2	0.9	1.3	SSW	0	897.5	58
3/18/00	7:30p	21	21	21.2	20.9	1.3	1.3	SSW	0	897.6	59
3/18/00	7:45p	20.8	20.8	20.9	20.7	1.3	1.3	SSW	0	897.9	60
3/18/00	8:00p	20.8	20.8	20.9	20.8	0.9	1.3	SSW	0	897.8	61
3/18/00	8:15p	20.8	20.8	20.8	20.7	0.9	1.3	SSW	0	898.1	61
3/18/00	8:30p	20.7	20.7	20.7	20.7	0.9	1.3	SSW	0	898.1	62
3/18/00	8:45p	20.6	20.6	20.7	20.6	0.4	0.9	SSW	0	898.1	62
3/18/00	9:00p	20.4	20.4	20.6	20.2	0.4	0.9	SSW	0	898.3	63
3/18/00	9:15p	20.1	20.1	20.2	20.1	0.4	0.9	SSW	0	898.4	63
3/18/00	9:30p	20	20	20.1	19.9	0.4	0.9	SSW	0	898.4	63
3/18/00	9:45p	19.9	19.9	20	19.9	0.4	0.9	SSW	0	898.5	64
3/18/00	10:00p	19.8	19.8	19.9	19.7	0.4	0.9	SSW	0	898.5	64
3/18/00	10:15p	19.7	19.7	19.8	19.7	0.9	1.3	SSW	0	898.6	64
3/18/00	10:30p	19.8	19.8	19.9	19.8	0.4	0.9	SSW	0	898.7	65
3/18/00	10:45p	19.7	19.7	19.8	19.6	0.4	0.9	SSW	0	898.8	65
3/18/00	11:00p	19.6	19.6	19.6	19.6	0	0	---	0	898.8	65
3/18/00	11:15p	19.6	19.6	19.6	19.4	0	0	---	0	898.7	65
3/18/00	11:30p	19.3	19.3	19.4	19.3	0	0	---	0	898.8	65
3/18/00	11:45p	19.4	19.4	19.6	19.3	0	0	---	0	898.8	66
3/19/00	12:00a	19.5	19.5	19.5	19.4	0	0	---	0	898.7	66
3/19/00	12:15a	19.3	19.3	19.4	19.1	0	0	---	0	898.8	66
3/19/00	12:30a	19	19	19.1	18.9	0	0	---	0	898.6	66
3/19/00	12:45a	19.2	19.2	19.4	19	0	0	---	0	898.6	67
3/19/00	1:00a	19.2	19.2	19.4	19	0	0	---	0	898.4	67

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/19/00	1:15a	19	19	19.1	18.9	0	0	---	0	898.4	68
3/19/00	1:30a	18.8	18.8	19	18.7	0	0	---	0	898.3	68
3/19/00	1:45a	18.9	18.9	19	18.8	0	0	---	0	898.1	68
3/19/00	2:00a	18.8	18.8	19	18.7	0	0	---	0	898.1	68
3/19/00	2:15a	18.7	18.7	18.8	18.7	0	0	---	0	898	68
3/19/00	2:30a	18.8	18.8	18.9	18.7	0	0	---	0	897.8	69
3/19/00	2:45a	18.8	18.8	18.9	18.8	0	0	---	0	897.7	69
3/19/00	3:00a	19	19	19	18.9	0	0	---	0	897.6	69
3/19/00	3:15a	19.1	19.1	19.2	19	0	0	---	0	897.7	69
3/19/00	3:30a	19.2	19.2	19.2	19.1	0	0	---	0	897.4	69
3/19/00	3:45a	19.1	19.1	19.2	19	0	0	---	0	897.3	70
3/19/00	4:00a	18.9	18.9	19	18.8	0	0	---	0	897.4	69
3/19/00	4:15a	18.7	18.7	18.8	18.6	0	0	---	0	897.4	70
3/19/00	4:30a	18.7	18.7	18.7	18.6	0	0	---	0	897.3	70
3/19/00	4:45a	18.5	18.5	18.6	18.4	0	0	---	0	897.3	69
3/19/00	5:00a	18.3	18.3	18.4	18.3	0	0	---	0	897.4	70
3/19/00	5:15a	18.2	18.2	18.2	18.1	0	0	---	0	897.4	70
3/19/00	5:30a	18.3	18.3	18.4	18.2	0	0	---	0	897.5	70
3/19/00	5:45a	18.5	18.5	18.5	18.4	0	0	---	0	897.7	70
3/19/00	6:00a	18.1	18.1	18.4	17.9	0	0	---	0	897.8	70
3/19/00	6:15a	18.1	18.1	18.2	18	0	0	---	0	897.8	70
3/19/00	6:30a	18.1	18.1	18.2	18	0	0	---	0	897.8	71
3/19/00	6:45a	17.9	17.9	18.1	17.9	0	0	---	0	897.8	71
3/19/00	7:00a	18.2	18.2	18.3	18.1	0	0	---	0	898	71
3/19/00	7:15a	18.2	18.2	18.3	18.2	0	0	---	0	898.1	71
3/19/00	7:30a	18.2	18.2	18.3	18.1	0	0	---	0	898.3	71
3/19/00	7:45a	18.3	18.3	18.4	18.3	0	0	---	0	898.4	72
3/19/00	8:00a	18.6	18.6	18.7	18.4	0	0	---	0	898.5	72
3/19/00	8:15a	18.9	18.9	19.1	18.7	0	0	---	0	898.7	72
3/19/00	8:30a	19.3	19.3	19.6	19.1	0	0	---	0	898.6	72
3/19/00	8:45a	20.2	20.2	20.9	19.6	0	0	---	0	898.6	73
3/19/00	9:00a	21.2	21.2	21.3	21	0	0	---	0	898.6	75
3/19/00	9:15a	21.3	21.3	21.4	21.2	0	0	---	0	898.6	74
3/19/00	9:30a	21.6	21.6	22	21.4	0	0	---	0	898.6	73
3/19/00	9:45a	22.9	22.9	23.3	22.1	0.4	1.3	E	0	898.5	74
3/19/00	10:00a	23.5	23.5	24	23.2	0.4	1.3	E	0	898.6	74
3/19/00	10:15a	23.4	23.4	23.9	22.9	0.4	1.3	NNW	0	898.7	74
3/19/00	10:30a	23.1	23.1	23.4	22.7	0	1.3	E	0	898.6	73
3/19/00	10:45a	24.7	24.7	25.9	23.5	0.4	1.3	E	0	898.5	75
3/19/00	11:00a	25.3	25.3	25.8	24.9	0.4	1.3	N	0	898.4	75
3/19/00	11:15a	27.4	27.4	28.3	26.1	0.9	2.2	N	0	898.4	75
3/19/00	11:30a	28.3	28.3	29	27.1	0.9	2.7	N	0	898.5	73
3/19/00	11:45a	28.8	28.8	29.8	28.1	0.4	2.2	N	0	898.5	70
3/19/00	12:00p	29.9	29.9	30.6	29.2	0.9	2.2	N	0	898.4	67
3/19/00	12:15p	28.9	28.9	29.6	27.6	0.9	2.2	N	0	898.4	63
3/19/00	12:30p	29.2	29.2	30.1	28.1	0.4	1.8	N	0	898.1	61
3/19/00	12:45p	28.2	28.2	30	25.6	0.9	2.7	N	0	897.8	58

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/19/00	1:00p	24.6	24.6	25.6	22.9	0.4	1.8	N	0.4	897.6	54
3/19/00	1:15p	21.6	21.6	22.8	21.1	0.4	1.3	N	3.6	897.4	52
3/19/00	1:30p	20.8	20.8	21.1	20.7	0.4	1.3	NNE	2.6	896.9	55
3/19/00	1:45p	20.9	20.9	20.9	20.7	0	1.8	SW	1	896.8	59
3/19/00	2:00p	19.2	19.2	20.5	18.2	0.4	1.8	SE	8.2	896.8	60
3/19/00	2:15p	18.2	18.2	18.3	18.1	0	0.4	---	0.6	897	62
3/19/00	2:30p	18.3	18.3	18.5	18.2	0	0	---	0.8	896.9	64
3/19/00	2:45p	18	18	18.2	17.9	0	0	---	0	897	65
3/19/00	3:00p	17.7	17.7	18	17.3	0	0	---	0	896.9	66
3/19/00	3:15p	17.3	17.3	17.4	17.3	0	0	---	0	897	67
3/19/00	3:30p	17.4	17.4	17.8	17.3	0	0	---	0	896.5	68
3/19/00	3:45p	18.1	18.1	18.1	17.8	0	0	---	0	896.3	69
3/19/00	4:00p	18.2	18.2	18.3	18.1	0	0	---	0	896.4	69
3/19/00	4:15p	18.4	18.4	18.6	18.3	0	0	---	0.2	896.6	70
3/19/00	4:30p	18.4	18.4	18.7	17.9	0.4	1.8	SSE	0	896.8	71
3/19/00	4:45p	17.7	17.7	17.9	17.2	0.9	2.2	SSE	0	896.9	72
3/19/00	5:00p	17.1	17.1	17.3	16.9	1.3	3.1	S	0	896.8	73
3/19/00	5:15p	16.9	16.9	17.1	16.9	0.4	1.3	SSE	0.2	896.9	73
3/19/00	5:30p	17.1	17.1	17.1	17	0.4	0.9	SSE	0.6	897	74
3/19/00	5:45p	17.1	17.1	17.1	17	0	0	---	0	897	74
3/19/00	6:00p	17.2	17.2	17.2	17.1	0	0	---	0.8	897.4	74
3/19/00	6:15p	17.2	17.2	17.3	17.2	0	0	---	0.4	897.4	74
3/19/00	6:30p	17.2	17.2	17.3	17.2	0	0	---	0	897.5	75
3/19/00	6:45p	17.2	17.2	17.3	17.2	0	0.9	SSE	0	897.4	75
3/19/00	7:00p	17.2	17.2	17.2	17.2	0	0.9	SSE	0.6	897.4	75
3/19/00	7:15p	17.3	17.3	17.3	17.2	0	0	---	0.4	897.1	75
3/19/00	7:30p	17.2	17.2	17.3	17.2	0	0.4	SSE	0	897.4	75
3/19/00	7:45p	17.2	17.2	17.2	17.2	0	0.9	SSE	0	897.5	76
3/19/00	8:00p	17.2	17.2	17.2	17.2	0	0.9	SSE	0	897.3	76
3/19/00	8:15p	17.2	17.2	17.2	17.2	0	0	---	0	897.2	76
3/19/00	8:30p	17.2	17.2	17.2	17.2	0	0	---	0	897.5	76
3/19/00	8:45p	17.2	17.2	17.2	17.2	0	0	---	0	897.3	76
3/19/00	9:00p	17.2	17.2	17.2	17.2	0	0	---	0	897.4	76
3/19/00	9:15p	17.1	17.1	17.2	17.1	0	0	---	0	897.4	76
3/19/00	9:30p	17.1	17.1	17.2	17.1	0	0	---	0	897.4	76
3/19/00	9:45p	17.2	17.2	17.3	17.1	0	0	---	0	897.5	76
3/19/00	10:00p	17.2	17.2	17.3	17.2	0	0	---	0	897.6	76
3/19/00	10:15p	17.2	17.2	17.3	17.2	0	0	---	0	897.5	76
3/19/00	10:30p	17.1	17.1	17.2	17	0	0	---	0.2	897.3	77
3/19/00	10:45p	16.9	16.9	17.1	16.9	0	0.9	SSE	0	897.1	77
3/19/00	11:00p	16.8	16.8	16.9	16.7	0	0.9	SSE	0	897	77
3/19/00	11:15p	16.6	16.6	16.7	16.6	0	0.4	SSE	0	896.8	77
3/19/00	11:30p	16.6	16.6	16.7	16.6	0	0.9	SSE	0	896.6	77
3/19/00	11:45p	16.7	16.7	16.7	16.6	0.4	1.8	SSE	0	896.6	78
3/20/00	12:00a	16.6	16.6	16.7	16.6	0.4	1.3	SSE	0	896.4	78
3/20/00	12:15a	16.6	16.6	16.6	16.6	0.4	1.3	S	0	896.1	79
3/20/00	12:30a	16.5	16.5	16.6	16.4	0	0.4	S	0	895.9	78

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/20/00	12:45a	16.6	16.6	16.6	16.4	0	0.9	S	0	895.9	79
3/20/00	1:00a	16.6	16.6	16.7	16.6	0	0.9	S	0	895.7	79
3/20/00	1:15a	16.4	16.4	16.6	16.3	0.4	0.9	S	0	895.6	79
3/20/00	1:30a	16.2	16.2	16.3	16	0	0	---	0	895.5	79
3/20/00	1:45a	15.9	15.9	16	15.9	0	0	---	0	895.4	79
3/20/00	2:00a	15.8	15.8	15.9	15.7	0	0	---	0	895.2	79
3/20/00	2:15a	15.7	15.7	15.7	15.7	0	0	---	0	895.2	80
3/20/00	2:30a	15.8	15.8	15.9	15.7	0	0	---	0	895	80
3/20/00	2:45a	15.9	15.9	15.9	15.9	0	1.3	S	0	895	81
3/20/00	3:00a	16	16	16	15.9	0.9	1.3	S	0	894.8	81
3/20/00	3:15a	16	16	16.1	16	0.9	1.3	SSW	0	894.7	81
3/20/00	3:30a	15.9	15.9	16	15.9	0.9	1.3	SSW	0	894.6	82
3/20/00	3:45a	15.9	15.9	16	15.9	0.9	1.3	SSW	0	894.4	82
3/20/00	4:00a	15.9	15.9	16	15.9	0.9	1.3	SSW	0	894.4	82
3/20/00	4:15a	15.9	15.9	16	15.9	0.9	1.8	SSW	0	894.4	82
3/20/00	4:30a	16	16	16	15.9	1.3	1.8	SSW	0	894.4	82
3/20/00	4:45a	16.1	16.1	16.1	16	1.3	1.8	SSW	0	894.4	83
3/20/00	5:00a	16	16	16.1	16	0.9	1.3	SSW	0	894.4	83
3/20/00	5:15a	16	16	16.1	16	0.9	1.8	SSW	0	894.5	83
3/20/00	5:30a	16.2	16.2	16.3	16.1	1.3	1.8	SSW	0	894.7	83
3/20/00	5:45a	16.2	16.2	16.2	16.2	0.9	1.8	SSW	0	894.5	83
3/20/00	6:00a	16.2	16.2	16.2	16.1	0.9	1.3	SSW	0	894.6	83
3/20/00	6:15a	16.2	16.2	16.3	16.1	0.9	1.3	SSW	0	894.5	84
3/20/00	6:30a	16.3	16.3	16.4	16.3	0.9	1.3	SSW	0	894.7	84
3/20/00	6:45a	16.4	16.4	16.5	16.4	1.3	2.2	SSW	0	894.7	84
3/20/00	7:00a	16.6	16.6	16.7	16.5	1.8	2.7	SSW	0	894.7	85
3/20/00	7:15a	16.7	15.8	16.8	16.7	2.2	3.1	SSW	0	894.8	85
3/20/00	7:30a	16.8	15.9	16.9	16.7	2.2	3.6	SSW	0	895	86
3/20/00	7:45a	16.9	16.9	16.9	16.9	1.8	3.6	SSW	0	895	86
3/20/00	8:00a	16.9	16.9	16.9	16.8	1.8	2.7	SSW	0	895.2	86
3/20/00	8:15a	17	17	17.2	16.9	1.8	3.1	SSW	0	895.3	86
3/20/00	8:30a	17.2	17.2	17.2	17.2	1.8	2.7	SSW	0	895.4	87
3/20/00	8:45a	17.3	17.3	17.4	17.3	1.3	2.7	SSW	0	895.3	87
3/20/00	9:00a	17.6	17.6	17.8	17.3	1.8	2.2	SSW	0	895.4	87
3/20/00	9:15a	17.9	17.9	17.9	17.8	1.8	3.1	SSW	0	895.6	88
3/20/00	9:30a	17.5	17.5	17.8	17.2	1.8	2.2	SSW	0	895.6	87
3/20/00	9:45a	17.1	17.1	17.2	17	1.8	2.7	SSW	0	895.5	87
3/20/00	10:00a	17.4	17.4	17.5	17.3	1.8	2.7	SSW	0	895.3	87
3/20/00	10:15a	17.7	17.7	17.8	17.4	1.8	2.7	SSW	0	895.3	88
3/20/00	10:30a	17.9	17.9	17.9	17.8	1.3	2.2	SSW	0	895.2	88
3/20/00	10:45a	18.1	18.1	18.5	17.8	1.3	2.7	SSW	0	895.3	88
3/20/00	11:00a	18.9	18.9	19.1	18.6	0.9	1.8	SSW	0	895.4	89
3/20/00	11:15a	18.6	18.6	19.1	18.3	1.3	2.7	SSW	0	895.4	89
3/20/00	11:30a	18.3	18.3	18.4	18.3	1.3	2.7	SSW	0	895.5	88
3/20/00	11:45a	18.6	18.6	18.7	18.4	1.3	3.6	SSW	0	895.5	88
3/20/00	12:00p	18.4	18.4	18.5	18.3	1.3	2.2	SSW	0	895.4	87
3/20/00	12:15p	18.3	18.3	18.4	18.3	0.4	1.8	SSW	0	895.4	87

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/20/00	12:30p	18	18	18.2	17.8	0.9	1.8	SSW	0	895.2	86
3/20/00	12:45p	17.8	17.8	18	17.6	0.9	1.8	SSW	0	895.2	86
3/20/00	1:00p	17.8	17.8	18.1	17.6	0.9	1.8	SSW	0	895.2	87
3/20/00	1:15p	17.6	17.6	17.7	17.5	0.4	1.8	SSW	0.8	894.7	87
3/20/00	1:30p	17.7	17.7	17.8	17.6	0.9	1.3	SSW	0	894.7	87
3/20/00	1:45p	17.9	17.9	18	17.8	0.9	1.8	SSW	0	894.6	87
3/20/00	2:00p	17.9	17.9	17.9	17.8	0.4	1.3	SSW	0	894.6	88
3/20/00	2:15p	17.7	17.7	17.8	17.6	0.9	1.8	SSW	0.2	894.7	88
3/20/00	2:30p	17.7	17.7	17.7	17.6	0.4	0.9	SSW	0	894.5	88
3/20/00	2:45p	17.7	17.7	17.8	17.4	0	0.9	SSW	0.2	894.3	88
3/20/00	3:00p	17.4	17.4	17.5	17.4	0	0	---	0.6	894.3	88
3/20/00	3:15p	17.4	17.4	17.5	17.4	0	0	---	0.4	894.2	88
3/20/00	3:30p	17.3	17.3	17.4	17.2	0	1.3	SSW	0.4	894.3	88
3/20/00	3:45p	17.2	17.2	17.2	17.1	0	0.9	SSW	1	894.2	87
3/20/00	4:00p	17.1	17.1	17.1	17	0	0	---	1	893.9	87
3/20/00	4:15p	17.1	17.1	17.1	17.1	0	0.4	SSW	0.4	894.1	88
3/20/00	4:30p	17	17	17.1	16.8	0.4	1.8	SSW	1.8	894.2	88
3/20/00	4:45p	16.8	16.8	16.9	16.7	0.4	2.2	S	2.2	894.3	88
3/20/00	5:00p	16.4	16.4	16.7	16.3	0.9	1.8	SSW	2.2	894.6	88
3/20/00	5:15p	15.5	15.5	16.4	14.6	0.4	1.8	ENE	1.8	894.9	87
3/20/00	5:30p	14.3	14.3	14.6	14.2	0.4	1.8	ESE	1.6	894.8	85
3/20/00	5:45p	14.1	14.1	14.2	14.1	0.4	1.8	NW	0.4	895.2	85
3/20/00	6:00p	14	14	14.1	13.9	0.4	1.3	ENE	3	895.3	86
3/20/00	6:15p	13.9	13.9	14	13.9	0	1.3	N	1.6	895.7	86
3/20/00	6:30p	13.8	13.8	13.9	13.7	0.9	3.6	N	0.6	895.2	87
3/20/00	6:45p	13.7	13.7	13.7	13.6	0.4	1.3	NNW	0.2	895.7	87
3/20/00	7:00p	13.7	13.7	13.8	13.6	0.4	1.8	N	0	895.8	87
3/20/00	7:15p	13.6	13.6	13.7	13.6	0.4	1.8	ENE	0.2	896	88
3/20/00	7:30p	13.5	13.5	13.6	13.4	0.9	2.2	N	0	896.4	88
3/20/00	7:45p	13.5	13.5	13.5	13.4	0.9	1.8	ESE	0	896.8	88
3/20/00	8:00p	13.2	13.2	13.4	13.1	0.9	1.3	ESE	0	896.8	88
3/20/00	8:15p	12.9	12.9	13.1	12.8	0.4	2.2	E	0.2	896.8	88
3/20/00	8:30p	12.6	12.6	12.8	12.4	1.3	3.1	N	0	896.2	88
3/20/00	8:45p	12.4	12.4	12.6	12.3	0.9	4	E	0	896.7	88
3/20/00	9:00p	12.3	12.3	12.3	12.2	0.9	2.2	SE	0	897.7	88
3/20/00	9:15p	12.2	12.2	12.3	12.2	1.3	3.1	E	0	897.8	88
3/20/00	9:30p	12.2	12.2	12.2	12.2	0.4	1.8	ESE	0	897.8	89
3/20/00	9:45p	12.2	12.2	12.2	12.1	0	1.3	ESE	0	898.1	89
3/20/00	10:00p	12.2	12.2	12.3	12.2	0	0.4	ESE	0	898	89
3/20/00	10:15p	12.1	12.1	12.2	12.1	0.4	1.8	N	0.2	897.5	89
3/20/00	10:30p	12.1	12.1	12.1	12	0.9	1.8	E	0	897.9	89
3/20/00	10:45p	11.9	11.9	12.1	11.9	0.9	1.8	ENE	0	897.9	89
3/20/00	11:00p	11.9	11.9	12.1	11.9	0.4	1.3	ENE	0	897.5	89
3/20/00	11:15p	11.8	11.8	11.9	11.8	0.4	3.1	NW	0	897.7	89
3/20/00	11:30p	11.8	11.8	11.9	11.8	0.4	2.2	ENE	0	897.7	89
3/20/00	11:45p	11.7	11.7	11.8	11.7	0.9	2.2	ENE	0	897.9	89
3/21/00	12:00a	11.7	11.7	11.8	11.6	0.4	1.3	ENE	0	897.7	89

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/21/00	12:15a	11.6	11.6	11.6	11.5	0.4	1.8	E	0	897.9	89
3/21/00	12:30a	11.5	11.5	11.6	11.4	0.4	1.8	E	0	897.4	89
3/21/00	12:45a	11.4	11.4	11.4	11.3	0.9	1.8	E	0	897.6	89
3/21/00	1:00a	11.4	11.4	11.4	11.4	0.9	1.8	SE	0	897.9	89
3/21/00	1:15a	11.4	11.4	11.4	11.3	0.4	1.8	ENE	0.2	897.1	90
3/21/00	1:30a	11.3	11.3	11.4	11.3	0.9	2.2	ESE	0	897.6	90
3/21/00	1:45a	11.3	11.3	11.3	11.3	0.4	1.8	E	0	896.6	90
3/21/00	2:00a	11.3	11.3	11.4	11.2	0.4	1.3	SE	0	897.5	90
3/21/00	2:15a	11.3	11.3	11.3	11.2	0.4	1.3	SE	0	896.8	90
3/21/00	2:30a	11.2	11.2	11.3	11.2	0.4	1.3	NE	0	897.3	90
3/21/00	2:45a	11.2	11.2	11.3	11.2	0.4	1.3	ENE	0	897.4	90
3/21/00	3:00a	11.1	11.1	11.2	10.9	0.9	1.8	E	0	897.1	90
3/21/00	3:15a	10.9	10.9	10.9	10.8	0.9	2.2	E	0	897.2	90
3/21/00	3:30a	10.8	10.8	10.8	10.7	0.9	1.8	ESE	0	897.3	90
3/21/00	3:45a	10.8	10.8	10.8	10.7	0.9	1.8	E	0	897.5	90
3/21/00	4:00a	10.7	10.7	10.7	10.7	0.9	1.8	SE	0	897.2	90
3/21/00	4:15a	10.7	10.7	10.7	10.7	0.4	1.3	E	0	897.1	90
3/21/00	4:30a	10.8	10.8	10.9	10.7	0.4	1.8	E	0	897.1	90
3/21/00	4:45a	10.9	10.9	10.9	10.8	0.9	2.2	ESE	0	897.1	90
3/21/00	5:00a	10.9	10.9	10.9	10.9	0.9	1.8	E	0.2	897.3	91
3/21/00	5:15a	11	11	11	10.9	0.9	1.8	ESE	0	897.4	91
3/21/00	5:30a	10.9	10.9	11	10.9	1.3	3.6	ESE	0	897.4	91
3/21/00	5:45a	10.9	10.9	10.9	10.8	0.9	2.2	SE	0.4	897.4	91
3/21/00	6:00a	10.8	10.8	10.8	10.8	0.4	1.8	E	0.6	897.5	91
3/21/00	6:15a	10.7	10.7	10.8	10.7	0.9	2.2	E	0.2	897.5	91
3/21/00	6:30a	10.7	10.7	10.7	10.6	0	1.8	E	0.4	897.7	91
3/21/00	6:45a	10.6	10.6	10.6	10.5	0.9	1.8	ESE	0.6	897.9	91
3/21/00	7:00a	10.6	10.6	10.7	10.5	0.9	1.8	E	0	898	91
3/21/00	7:15a	10.7	10.7	10.8	10.7	0.9	1.8	ESE	0	898.3	91
3/21/00	7:30a	10.7	10.7	10.8	10.6	0.9	1.8	SE	0	898.3	91
3/21/00	7:45a	10.6	10.6	10.7	10.6	1.3	2.2	SSE	0.2	898.5	91
3/21/00	8:00a	10.8	10.8	10.8	10.7	0.9	1.8	SSE	0	898.6	91
3/21/00	8:15a	10.8	10.8	10.9	10.8	0.4	1.8	SSE	0	898.8	91
3/21/00	8:30a	10.9	10.9	10.9	10.8	0.9	1.8	SE	0.2	898.7	92
3/21/00	8:45a	11.1	11.1	11.2	10.9	1.3	3.1	ESE	0.4	898.9	92
3/21/00	9:00a	11.2	11.2	11.2	11.1	1.3	2.7	ESE	0.6	899	92
3/21/00	9:15a	11.2	11.2	11.2	11.1	1.3	4.9	ESE	0.6	899.1	92
3/21/00	9:30a	11.2	11.2	11.3	11.2	1.3	4	SE	0.4	899.3	92
3/21/00	9:45a	11.2	11.2	11.3	11.2	1.8	4.5	SSE	0.4	899.5	92
3/21/00	10:00a	11.2	11.2	11.3	11.2	1.8	3.1	SE	0.4	899.6	92
3/21/00	10:15a	11.2	11.2	11.3	11.2	1.3	3.1	SE	1	899.7	92
3/21/00	10:30a	11.3	11.3	11.3	11.2	1.3	2.7	SE	1	900	92
3/21/00	10:45a	11.3	11.3	11.3	11.3	1.3	2.7	SE	0.4	900	93
3/21/00	11:00a	11.4	11.4	11.4	11.3	1.3	3.1	SE	0.6	899.9	93
3/21/00	11:15a	11.4	11.4	11.5	11.4	1.3	2.2	SSE	0.4	900.1	93
3/21/00	11:30a	11.5	11.5	11.6	11.5	1.3	2.2	ESE	0.6	899.9	93
3/21/00	11:45a	11.6	11.6	11.7	11.6	1.3	2.7	SE	0.4	900	93

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/21/00	12:00p	11.6	11.6	11.6	11.5	1.3	2.7	ESE	0.4	900.1	93
3/21/00	12:15p	11.6	11.6	11.7	11.6	1.3	2.2	ESE	0.2	900	93
3/21/00	12:30p	11.7	11.7	11.8	11.7	0.9	2.2	SE	0.4	899.7	93
3/21/00	12:45p	11.9	11.9	11.9	11.8	0.4	1.3	E	0.4	899.7	93
3/21/00	1:00p	11.9	11.9	12.1	11.9	0.9	1.3	E	0.2	899.4	93
3/21/00	1:15p	11.9	11.9	12.1	11.8	0.9	2.2	SE	0.6	899.5	93
3/21/00	1:30p	11.9	11.9	12	11.8	0.4	1.3	ESE	0.8	899.6	93
3/21/00	1:45p	11.8	11.8	12	11.7	1.3	3.1	ESE	0.4	899.6	93
3/21/00	2:00p	11.6	11.6	11.7	11.6	0.9	2.2	E	0.2	899.5	93
3/21/00	2:15p	11.5	11.5	11.6	11.4	0.9	1.8	E	0.4	899.5	93
3/21/00	2:30p	11.4	11.4	11.5	11.4	0.9	2.7	ENE	0.2	899.5	93
3/21/00	2:45p	11.4	11.4	11.5	11.4	0.9	1.8	E	0.6	899.2	93
3/21/00	3:00p	11.6	11.6	11.7	11.5	0.9	2.2	E	0.4	899.2	93
3/21/00	3:15p	11.5	11.5	11.6	11.4	1.3	2.2	ENE	0.4	899.2	93
3/21/00	3:30p	11.4	11.4	11.5	11.4	0.9	2.2	E	0.4	899.2	93
3/21/00	3:45p	11.4	11.4	11.5	11.3	0.9	2.7	E	0.4	899.4	93
3/21/00	4:00p	11.2	11.2	11.3	11.2	1.3	2.7	E	0.2	899.2	93
3/21/00	4:15p	11.2	11.2	11.3	11.2	0.9	1.8	E	0.4	899.4	93
3/21/00	4:30p	11.2	11.2	11.3	11.1	1.3	2.7	E	0.6	899.4	93
3/21/00	4:45p	10.8	10.8	11.1	10.6	1.3	4	E	0.4	899.7	93
3/21/00	5:00p	10.4	10.4	10.6	10.2	1.3	4	ENE	0	899.8	92
3/21/00	5:15p	10.2	10.2	10.3	10.2	1.3	3.1	ENE	0.2	899.9	92
3/21/00	5:30p	10.2	10.2	10.2	10.1	0.9	3.1	ENE	0.2	900	92
3/21/00	5:45p	10.2	10.2	10.2	10.2	1.3	4	E	0	900.1	92
3/21/00	6:00p	10.2	10.2	10.2	10.2	1.3	4.5	E	0.2	900.3	93
3/21/00	6:15p	10.1	10.1	10.2	10	1.3	4	ENE	0	900.5	93
3/21/00	6:30p	10	10	10.1	10	1.3	3.1	E	0.2	900.5	93
3/21/00	6:45p	9.9	9.9	9.9	9.8	1.3	3.1	ENE	0	900.7	93
3/21/00	7:00p	9.8	9.8	9.8	9.7	0.9	2.7	ENE	0	900.7	93
3/21/00	7:15p	9.7	9.7	9.7	9.6	0.9	3.6	E	0.2	900.7	92
3/21/00	7:30p	9.7	9.7	9.7	9.7	0.9	2.7	ENE	0.2	900.8	93
3/21/00	7:45p	9.7	9.7	9.7	9.6	0.9	3.1	ENE	0	901	93
3/21/00	8:00p	9.4	9.4	9.6	9.3	0.9	2.2	E	0	901.1	93
3/21/00	8:15p	9.3	9.3	9.3	9.2	0.9	3.1	ENE	0.2	901.1	92
3/21/00	8:30p	9.3	9.3	9.4	9.2	0.9	3.1	N	0	901.1	92
3/21/00	8:45p	9.5	9.5	9.6	9.4	0.9	2.7	E	0	901.1	93
3/21/00	9:00p	9.6	9.6	9.6	9.6	0.9	2.7	ENE	0.2	901.1	93
3/21/00	9:15p	9.6	9.6	9.7	9.6	0.9	2.7	NE	0	901.1	93
3/21/00	9:30p	9.7	9.7	9.7	9.7	0.9	2.7	ENE	0.2	901.3	93
3/21/00	9:45p	9.7	9.7	9.8	9.7	1.3	3.6	ENE	0.2	901.5	94
3/21/00	10:00p	9.7	9.7	9.7	9.7	0.9	3.1	ENE	0	901.5	94
3/21/00	10:15p	9.7	9.7	9.7	9.6	0.9	3.1	ENE	0.2	901.4	94
3/21/00	10:30p	9.7	9.7	9.7	9.7	1.3	3.6	ENE	0	901.5	94
3/21/00	10:45p	9.7	9.7	9.7	9.6	0.9	3.6	ENE	0	901.3	94
3/21/00	11:00p	9.5	9.5	9.6	9.4	0.9	3.6	E	0	901.4	94
3/21/00	11:15p	9.4	9.4	9.5	9.4	0.9	2.2	E	0	901.3	94
3/21/00	11:30p	9.4	9.4	9.4	9.4	0.9	2.7	ENE	0	901.2	94

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/21/00	11:45p	9.4	9.4	9.5	9.4	0.9	2.7	ENE	0	901	94
3/22/00	12:00a	9.5	9.5	9.5	9.4	1.3	3.1	E	0	900.9	94
3/22/00	12:15a	9.4	9.4	9.5	9.3	1.3	2.2	E	0	900.5	94
3/22/00	12:30a	9.3	9.3	9.4	9.3	0.9	2.7	ENE	0	900.5	94
3/22/00	12:45a	9.3	9.3	9.3	9.3	0.9	2.7	ENE	0	900.2	94
3/22/00	1:00a	9.3	9.3	9.3	9.2	0.9	2.2	E	0	900.1	94
3/22/00	1:15a	9.3	9.3	9.3	9.2	0.9	2.2	E	0	900	93
3/22/00	1:30a	9.3	9.3	9.3	9.3	0.4	2.2	W	0	899.9	94
3/22/00	1:45a	9.3	9.3	9.3	9.3	0.9	2.2	ENE	0	899.7	94
3/22/00	2:00a	9.4	9.4	9.4	9.3	0.9	4.5	N	0	899.7	94
3/22/00	2:15a	9.4	9.4	9.4	9.4	0.9	2.7	E	0	899.6	94
3/22/00	2:30a	9.4	9.4	9.5	9.4	0.9	3.1	ENE	0	899.4	94
3/22/00	2:45a	9.6	9.6	9.6	9.6	1.3	4	ENE	0	899.1	94
3/22/00	3:00a	9.7	9.7	9.7	9.6	1.3	3.6	ENE	0	899.1	94
3/22/00	3:15a	9.7	9.7	9.7	9.6	1.3	2.7	ENE	0	899.1	94
3/22/00	3:30a	9.5	9.5	9.6	9.4	1.3	4.5	ENE	0.2	899	94
3/22/00	3:45a	9.4	9.4	9.4	9.4	1.3	4.5	E	0	898.9	94
3/22/00	4:00a	9.3	9.3	9.4	9.2	0.9	2.7	ENE	0	898.7	94
3/22/00	4:15a	9.2	9.2	9.2	9.2	0.9	3.6	E	0	898.5	94
3/22/00	4:30a	9.1	9.1	9.2	9	0.9	2.2	ENE	0	898.5	94
3/22/00	4:45a	9	9	9.1	8.9	0.9	1.8	ENE	0	898.3	94
3/22/00	5:00a	8.9	8.9	8.9	8.8	1.3	2.2	E	0.2	898.2	94
3/22/00	5:15a	8.9	8.9	8.9	8.8	1.3	2.7	E	0	898.1	94
3/22/00	5:30a	9	9	9.1	8.9	0.9	2.2	E	0.2	898.2	94
3/22/00	5:45a	9	9	9	9	0.9	2.7	E	0	898.2	94
3/22/00	6:00a	9	9	9	9	0.9	2.2	ENE	0	898	94
3/22/00	6:15a	9.1	9.1	9.1	9	1.3	3.1	E	0.2	897.9	94
3/22/00	6:30a	9.1	9.1	9.1	9.1	1.3	2.2	E	0	898	94
3/22/00	6:45a	9.2	9.2	9.3	9.1	0.9	2.7	E	0	898	94
3/22/00	7:00a	9.4	9.4	9.6	9.3	1.3	2.2	E	0.2	897.8	94
3/22/00	7:15a	9.7	9.7	9.8	9.6	1.3	2.7	E	0.2	897.8	95
3/22/00	7:30a	9.7	9.7	9.8	9.7	1.3	2.7	E	0	897.9	95
3/22/00	7:45a	9.8	9.8	9.8	9.7	1.3	2.2	E	0	897.8	95
3/22/00	8:00a	9.9	9.9	9.9	9.8	1.3	2.7	E	0.2	897.7	95
3/22/00	8:15a	10	10	10.1	9.9	1.3	2.2	E	0	897.7	95
3/22/00	8:30a	10.1	10.1	10.2	10.1	1.3	2.2	ESE	0	897.7	95
3/22/00	8:45a	10.2	10.2	10.3	10.1	1.3	2.2	E	0	897.7	95
3/22/00	9:00a	10.3	10.3	10.4	10.3	1.3	2.2	E	0	897.7	95
3/22/00	9:15a	10.4	10.4	10.6	10.4	1.3	2.2	E	0	897.5	95
3/22/00	9:30a	10.6	10.6	10.7	10.6	1.3	2.2	E	0	897.5	96
3/22/00	9:45a	10.8	10.8	10.9	10.7	1.3	2.7	E	0	897.5	96
3/22/00	10:00a	10.9	10.9	11	10.9	0.9	2.2	E	0.2	897.6	96
3/22/00	10:15a	11.1	11.1	11.1	11	0.9	2.2	ENE	1	897.5	96
3/22/00	10:30a	11.2	11.2	11.2	11.1	0.9	2.2	ENE	1	897.4	96
3/22/00	10:45a	11.4	11.4	11.6	11.3	0.9	2.2	E	0.4	897.3	96
3/22/00	11:00a	11.6	11.6	11.6	11.5	1.3	2.7	E	0	897.2	96
3/22/00	11:15a	11.7	11.7	11.8	11.6	0.9	1.8	ENE	0.4	897.2	96

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/22/00	11:30a	11.9	11.9	12.1	11.8	0.9	2.7	ENE	0	897	96
3/22/00	11:45a	12.1	12.1	12.2	12	1.3	3.1	ENE	0.2	896.8	96
3/22/00	12:00p	12.3	12.3	12.3	12.1	1.3	4	N	0	896.6	96
3/22/00	12:15p	12.4	12.4	12.5	12.3	1.3	3.1	N	0	896.5	96
3/22/00	12:30p	12.6	12.6	12.8	12.5	0.9	3.1	NE	0.2	896.1	97
3/22/00	12:45p	12.7	12.7	12.7	12.6	1.8	4.9	NNE	0	896	97
3/22/00	1:00p	12.6	12.6	12.8	12.6	1.3	3.6	E	0	895.8	96
3/22/00	1:15p	12.6	12.6	12.7	12.4	1.8	3.6	E	0.2	895.5	96
3/22/00	1:30p	12.5	12.5	12.6	12.4	1.3	3.6	ENE	0	895.3	96
3/22/00	1:45p	12.4	12.4	12.6	12.3	1.8	4	ENE	0	895	96
3/22/00	2:00p	12.6	12.6	12.7	12.4	1.3	2.7	E	0	894.5	96
3/22/00	2:15p	12.7	12.7	12.7	12.6	1.3	3.1	ENE	0.2	894.2	96
3/22/00	2:30p	12.7	12.7	12.8	12.6	1.3	4	E	0	894	96
3/22/00	2:45p	12.8	12.8	12.8	12.7	1.3	4	ENE	0.2	893.9	96
3/22/00	3:00p	12.8	12.8	12.9	12.8	1.3	4	E	0.2	893.7	96
3/22/00	3:15p	12.9	12.9	12.9	12.8	1.3	3.6	E	0.2	893.6	96
3/22/00	3:30p	13.1	13.1	13.2	12.9	1.8	3.6	E	0.2	893.5	96
3/22/00	3:45p	13.2	13.2	13.2	13.1	1.3	4	E	0.2	893.2	96
3/22/00	4:00p	13.2	13.2	13.2	13.1	1.8	4	E	0	893	97
3/22/00	4:15p	13.2	13.2	13.3	13.1	1.3	4.5	NE	0	892.8	96
3/22/00	4:30p	13.1	13.1	13.2	13	1.3	3.6	ENE	0.2	892.6	96
3/22/00	4:45p	12.9	12.9	13	12.9	0.9	2.7	E	1	892.5	96
3/22/00	5:00p	13	13	13	13	0.9	3.6	ENE	3	892.5	96
3/22/00	5:15p	13.1	13.1	13.1	13	0.9	2.2	N	1	892.5	96
3/22/00	5:30p	13.1	13.1	13.2	13.1	1.3	4	N	0.2	892.4	96
3/22/00	5:45p	13	13	13.1	12.9	1.3	4	NNE	0	892.4	96
3/22/00	6:00p	13	13	13	12.9	1.3	3.1	N	0	892.2	96
3/22/00	6:15p	12.9	12.9	12.9	12.8	1.3	3.6	N	0	892.1	96
3/22/00	6:30p	12.8	12.8	12.9	12.8	0.9	2.2	N	0.2	892	96
3/22/00	6:45p	12.9	12.9	12.9	12.8	0.9	2.2	N	0	891.9	96
3/22/00	7:00p	12.8	12.8	12.9	12.7	1.3	2.7	NNE	0.2	891.8	96
3/22/00	7:15p	12.6	12.6	12.7	12.6	1.3	4	N	0	891.9	96
3/22/00	7:30p	12.6	12.6	12.7	12.6	0.9	2.2	N	0.2	892.1	96
3/22/00	7:45p	12.7	12.7	12.7	12.7	0.9	2.7	N	0.2	892	96
3/22/00	8:00p	12.6	12.6	12.7	12.6	1.3	2.7	N	0	891.9	96
3/22/00	8:15p	12.6	12.6	12.6	12.5	0.9	2.2	N	0.2	891.9	96
3/22/00	8:30p	12.6	12.6	12.6	12.6	0.4	1.8	N	0.4	891.9	96
3/22/00	8:45p	12.6	12.6	12.6	12.5	0.9	1.8	NNW	0.4	892	96
3/22/00	9:00p	12.5	12.5	12.5	12.5	0.9	2.2	N	0.2	892.1	96
3/22/00	9:15p	12.5	12.5	12.5	12.5	0.4	1.3	N	0	892.2	96
3/22/00	9:30p	12.5	12.5	12.5	12.4	0.4	2.2	N	0.2	892.1	96
3/22/00	9:45p	12.2	12.2	12.4	12	0.9	2.7	N	0	892.2	96
3/22/00	10:00p	11.9	11.9	11.9	11.8	0.4	1.3	N	0	892.2	96
3/22/00	10:15p	11.9	11.9	11.9	11.8	0	1.3	NNE	0	892.1	96
3/22/00	10:30p	11.9	11.9	12	11.9	0.4	1.3	NNW	0	891.9	96
3/22/00	10:45p	12.1	12.1	12.1	12	0.4	2.2	N	0	891.8	96
3/22/00	11:00p	12.2	12.2	12.2	12.1	0.4	1.3	NNW	0	891.6	96

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/22/00	11:15p	12.2	12.2	12.3	12.2	0.4	0.9	N	0	891.4	96
3/22/00	11:30p	12.3	12.3	12.3	12.3	0.4	1.3	N	0	891.3	96
3/22/00	11:45p	12.3	12.3	12.4	12.3	0.4	1.8	N	0	891	97
3/23/00	12:00a	12.4	12.4	12.4	12.3	0.4	1.3	N	0	890.9	97
3/23/00	12:15a	12.4	12.4	12.4	12.4	0	1.3	N	0	890.7	97
3/23/00	12:30a	12.4	12.4	12.4	12.4	0	1.3	N	0	890.4	97
3/23/00	12:45a	12.4	12.4	12.4	12.4	0	0.9	N	0	890.4	97
3/23/00	1:00a	12.3	12.3	12.4	12.3	0	0.9	N	0	890.5	97
3/23/00	1:15a	12.4	12.4	12.4	12.4	0	0	---	0	890.3	97
3/23/00	1:30a	12.4	12.4	12.4	12.3	0	0	---	0	890	97
3/23/00	1:45a	12.2	12.2	12.3	12.2	0	0	---	0	890	96
3/23/00	2:00a	12.2	12.2	12.2	12.2	0	0	---	0	889.9	96
3/23/00	2:15a	12.2	12.2	12.2	12.1	0	0.4	N	0	889.7	96
3/23/00	2:30a	12.1	12.1	12.2	12.1	0	0.4	N	0	889.5	96
3/23/00	2:45a	12.1	12.1	12.1	12.1	0	0	---	0	889.2	96
3/23/00	3:00a	12.1	12.1	12.2	12.1	0	0	---	0	889	96
3/23/00	3:15a	12.2	12.2	12.2	12.1	0.9	1.8	SSW	0	889	97
3/23/00	3:30a	12.1	12.1	12.2	12.1	0.9	1.3	SSW	0	888.7	97
3/23/00	3:45a	12.1	12.1	12.1	12.1	0.4	1.3	SSW	0	888.7	97
3/23/00	4:00a	12	12	12.1	12	0.4	1.3	SSW	0	888.6	97
3/23/00	4:15a	12.1	12.1	12.2	12.1	0.9	2.2	SSW	0	888.6	97
3/23/00	4:30a	12.3	12.3	12.3	12.2	0.9	2.2	SSW	0	889	97
3/23/00	4:45a	12.3	12.3	12.3	12.3	1.3	1.8	SSW	0	889	97
3/23/00	5:00a	12.3	12.3	12.3	12.2	1.3	2.7	SSW	0	889	97
3/23/00	5:15a	12.2	12.2	12.2	12.2	0.9	1.8	SSW	0	889.1	97
3/23/00	5:30a	12.2	12.2	12.3	12.2	0.9	1.8	SSW	0	889.1	97
3/23/00	5:45a	12.3	12.3	12.3	12.3	0.9	1.3	SSW	0	889.2	97
3/23/00	6:00a	12.3	12.3	12.3	12.2	0.9	1.8	SSW	0	889.3	97
3/23/00	6:15a	12.3	12.3	12.3	12.2	0.9	1.8	SSW	0	889.4	97
3/23/00	6:30a	12.3	12.3	12.3	12.3	0.9	1.8	SSW	0	889.5	97
3/23/00	6:45a	12.3	12.3	12.4	12.3	1.3	1.8	SSW	0	889.6	97
3/23/00	7:00a	12.4	12.4	12.4	12.4	0.9	1.8	SSW	0	889.7	97
3/23/00	7:15a	12.4	12.4	12.4	12.4	0.9	1.8	SSW	0	889.8	98
3/23/00	7:30a	12.4	12.4	12.4	12.4	1.3	1.8	SSW	0	889.8	97
3/23/00	7:45a	12.5	12.5	12.5	12.4	1.3	2.2	SSW	0	889.8	98
3/23/00	8:00a	12.6	12.6	12.6	12.5	0.9	1.8	SSW	0	889.9	98
3/23/00	8:15a	12.7	12.7	12.7	12.6	0.9	2.2	SSW	0	890.2	98
3/23/00	8:30a	12.8	12.8	13	12.7	0.9	2.7	SSW	0	890.3	98
3/23/00	8:45a	13.1	13.1	13.1	13	1.3	3.1	SSW	0	890.2	98
3/23/00	9:00a	13.3	13.3	13.7	13.1	1.8	2.7	SSW	0	890.2	98
3/23/00	9:15a	13.8	13.8	13.8	13.7	1.8	3.6	SSW	0	890.5	99
3/23/00	9:30a	13.8	13.8	14	13.7	1.8	3.1	SSW	0	890.5	99
3/23/00	9:45a	13.9	13.9	14	13.9	1.8	3.1	SSW	0	890.6	99
3/23/00	10:00a	13.8	12.8	13.9	13.7	2.2	3.1	SSW	0	890.8	99
3/23/00	10:15a	13.7	13.7	13.8	13.7	1.8	3.1	SSW	0	890.9	99
3/23/00	10:30a	13.9	13.9	14.3	13.7	1.8	2.7	SSW	0	890.7	98
3/23/00	10:45a	15.7	15.7	17.3	14.4	1.3	3.1	SSW	0	890.6	100

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/23/00	11:00a	16.4	16.4	17.1	15.7	1.3	2.7	SSW	0	890.6	100
3/23/00	11:15a	15.8	15.8	15.9	15.7	0.9	1.8	SSW	0	890.8	100
3/23/00	11:30a	15.7	15.7	16.1	15.4	1.3	2.2	SSW	0	890.9	100
3/23/00	11:45a	16.2	16.2	16.5	15.9	0.9	2.7	SSW	0	890.8	99
3/23/00	12:00p	16.6	16.6	16.9	16.1	0.9	1.8	SSW	0	890.9	99
3/23/00	12:15p	16.6	16.6	16.9	16.3	0.9	1.8	SSW	0	891	99
3/23/00	12:30p	16.3	16.3	16.9	16.2	0.9	1.8	SSW	0.2	891.1	97
3/23/00	12:45p	17.2	17.2	17.3	17.1	0.4	1.3	SSW	0	891.2	84
3/23/00	1:00p	16.7	16.7	17.1	16.6	0.9	1.8	SSW	0	891.3	90
3/23/00	1:15p	16.8	16.8	17.3	16.5	0.4	1.8	S	0	891.2	91
3/23/00	1:30p	16.8	16.8	17.2	16.4	0.9	1.3	S	0	891	90
3/23/00	1:45p	17.7	17.7	17.9	17	0.4	1.8	S	0	890.9	91
3/23/00	2:00p	17.4	17.4	17.8	17.2	0.4	1.3	S	0	890.8	90
3/23/00	2:15p	17.5	17.5	17.9	17.3	0.4	2.2	SE	0	890.7	89
3/23/00	2:30p	18.3	18.3	18.4	17.9	0	0.9	SSE	0	890.6	89
3/23/00	2:45p	18.6	18.6	18.8	18.4	0.4	1.3	SSE	0	890.5	90
3/23/00	3:00p	18	18	18.4	17.6	0.4	2.2	SSE	0	890.6	88
3/23/00	3:15p	17.3	17.3	17.5	17.2	0.9	1.8	SE	0	890.7	86
3/23/00	3:30p	16.3	16.3	17.2	15	0.9	3.1	NE	0	891	85
3/23/00	3:45p	14.7	14.7	14.9	14.4	0.9	2.7	E	0	891.2	83
3/23/00	4:00p	14.3	14.3	14.4	14.1	0.9	2.2	N	0.2	891.4	83
3/23/00	4:15p	13.9	13.9	14.1	13.6	0.4	3.1	N	0	891.5	83
3/23/00	4:30p	12.8	12.8	13.5	12.3	1.3	3.6	ENE	0	891.8	83
3/23/00	4:45p	12.1	12.1	12.3	11.9	0.9	3.1	E	0	892.1	83
3/23/00	5:00p	12	12	12.1	11.8	0.9	2.2	E	0	892.3	84
3/23/00	5:15p	11.8	11.8	11.9	11.8	0.9	1.8	E	0	892.6	86
3/23/00	5:30p	11.8	11.8	11.8	11.6	0.9	2.2	N	0.2	892.7	86
3/23/00	5:45p	11.4	11.4	11.6	11.3	0.9	2.7	NE	0	892.9	87
3/23/00	6:00p	11.2	11.2	11.3	11.1	1.3	3.1	ENE	0	893.1	87
3/23/00	6:15p	11.1	11.1	11.1	11	0.9	3.6	E	0	893.4	87
3/23/00	6:30p	11	11	11.1	10.9	0.9	3.1	E	0	893.6	88
3/23/00	6:45p	10.8	10.8	10.9	10.7	0.9	2.2	E	0	893.9	88
3/23/00	7:00p	10.7	10.7	10.8	10.6	0.9	2.2	ENE	0	894.2	88
3/23/00	7:15p	10.5	10.5	10.6	10.3	0.9	2.7	E	0	894.3	89
3/23/00	7:30p	10.2	10.2	10.3	10.2	0.9	3.1	ENE	0	894.7	89
3/23/00	7:45p	10.1	10.1	10.2	10	0.4	2.2	E	0	894.9	89
3/23/00	8:00p	9.9	9.9	10	9.9	0.4	1.8	ENE	0	895.1	89
3/23/00	8:15p	9.9	9.9	9.9	9.8	0.4	1.8	N	0	895.4	89
3/23/00	8:30p	9.8	9.8	9.8	9.7	0.9	2.2	E	0	895.7	89
3/23/00	8:45p	9.8	9.8	9.8	9.7	0.4	1.3	E	0	895.8	90
3/23/00	9:00p	9.7	9.7	9.7	9.7	0.4	1.8	E	0	896.1	90
3/23/00	9:15p	9.8	9.8	9.8	9.7	0.4	1.8	E	0.2	896.3	90
3/23/00	9:30p	9.8	9.8	9.8	9.7	0.4	1.3	E	0	896.3	90
3/23/00	9:45p	9.7	9.7	9.7	9.7	0	1.3	NE	0	896.5	90
3/23/00	10:00p	9.7	9.7	9.7	9.6	0.4	1.3	ENE	0	896.7	91
3/23/00	10:15p	9.7	9.7	9.7	9.6	0.4	1.3	ENE	0	896.7	91
3/23/00	10:30p	9.7	9.7	9.7	9.6	0.4	1.3	ENE	0	896.6	91

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/23/00	10:45p	9.6	9.6	9.6	9.6	0.4	1.3	ENE	0	896.8	91
3/23/00	11:00p	9.6	9.6	9.6	9.5	0.4	1.3	ENE	0.2	896.6	91
3/23/00	11:15p	9.6	9.6	9.6	9.5	0	1.3	NW	0	896.7	91
3/23/00	11:30p	9.6	9.6	9.6	9.6	0.4	0.9	N	0	896.9	91
3/23/00	11:45p	9.4	9.4	9.6	9.3	0.9	1.8	E	0.2	896.9	91
3/24/00	12:00a	9.2	9.2	9.3	9.1	0.9	1.8	E	0	896.8	91
3/24/00	12:15a	9.2	9.2	9.2	9.1	0.9	2.2	E	0.2	896.8	91
3/24/00	12:30a	9.1	9.1	9.2	9.1	0.9	1.8	E	0	896.8	91
3/24/00	12:45a	9.1	9.1	9.1	9.1	0.4	1.3	E	0	896.8	91
3/24/00	1:00a	9.1	9.1	9.2	9.1	0.4	1.3	E	0	896.8	92
3/24/00	1:15a	9.1	9.1	9.2	9	0.4	1.3	E	0	896.8	92
3/24/00	1:30a	9	9	9.1	8.9	0.4	1.3	E	0	896.7	92
3/24/00	1:45a	8.8	8.8	8.9	8.7	0.9	1.8	ENE	0	896.7	92
3/24/00	2:00a	8.7	8.7	8.8	8.6	0.4	1.8	ENE	0	896.8	92
3/24/00	2:15a	8.5	8.5	8.6	8.4	0.4	1.3	ENE	0	896.7	92
3/24/00	2:30a	8.4	8.4	8.5	8.4	0.4	1.3	ENE	0	896.8	92
3/24/00	2:45a	8.4	8.4	8.4	8.3	0.4	0.9	NE	0	896.7	92
3/24/00	3:00a	8.4	8.4	8.4	8.3	0.4	0.9	N	0	896.7	92
3/24/00	3:15a	8.3	8.3	8.4	8.3	0.9	1.8	ENE	0	896.7	92
3/24/00	3:30a	8.3	8.3	8.4	8.3	0.9	1.3	ENE	0	896.8	92
3/24/00	3:45a	8.3	8.3	8.4	8.2	0.9	1.8	ESE	0	896.6	92
3/24/00	4:00a	8.3	8.3	8.3	8.2	0.9	1.8	SE	0	896.7	92
3/24/00	4:15a	8.3	8.3	8.4	8.2	0.9	1.8	ESE	0	896.7	92
3/24/00	4:30a	8.3	8.3	8.4	8.1	0.9	1.8	ESE	0	896.7	92
3/24/00	4:45a	8.1	8.1	8.2	7.9	0.9	2.2	SE	0	896.8	92
3/24/00	5:00a	7.9	7.9	8	7.7	0.9	2.2	SSE	0	896.8	92
3/24/00	5:15a	7.7	7.7	7.8	7.7	0.9	1.8	SE	0	896.8	92
3/24/00	5:30a	7.7	7.7	7.8	7.7	0.9	2.7	SE	0	897	92
3/24/00	5:45a	7.7	7.7	7.8	7.7	0.9	1.8	SE	0.2	897	92
3/24/00	6:00a	7.7	7.7	7.8	7.7	0.9	1.8	SE	0	897.2	92
3/24/00	6:15a	7.7	7.7	7.8	7.6	0.4	1.3	SE	0	897.4	93
3/24/00	6:30a	7.6	7.6	7.7	7.6	0.9	1.3	SE	0	897.4	93
3/24/00	6:45a	7.7	7.7	7.8	7.6	0.4	0.9	SE	0	897.6	93
3/24/00	7:00a	7.7	7.7	7.8	7.6	0.4	1.3	SE	0	897.8	93
3/24/00	7:15a	7.6	7.6	7.6	7.6	0.4	1.3	SE	0	897.9	93
3/24/00	7:30a	7.6	7.6	7.6	7.5	0.4	0.9	SE	0	897.9	93
3/24/00	7:45a	7.7	7.7	7.7	7.6	0.4	1.3	SE	0	898.1	93
3/24/00	8:00a	7.7	7.7	7.7	7.6	0.4	1.3	SE	0	898.2	93
3/24/00	8:15a	7.7	7.7	7.8	7.6	0.4	1.3	SE	0	898.5	93
3/24/00	8:30a	7.7	7.7	7.8	7.6	0.9	1.8	SE	0	898.7	93
3/24/00	8:45a	7.7	7.7	7.8	7.6	0.9	1.8	SE	0	898.7	93
3/24/00	9:00a	7.8	7.8	7.9	7.7	0.9	1.8	SE	0	898.8	93
3/24/00	9:15a	8.1	8.1	8.2	7.9	0.9	2.2	SE	0	898.9	94
3/24/00	9:30a	8.2	8.2	8.3	8.1	0.9	2.2	SE	0	898.9	94
3/24/00	9:45a	8.3	8.3	8.4	8.2	0.9	1.8	SE	0	898.9	94
3/24/00	10:00a	8.5	8.5	8.8	8.3	0.9	2.2	SE	0	899	94
3/24/00	10:15a	8.8	8.8	9.1	8.6	0.9	2.7	SE	0	899	94

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/24/00	10:30a	9.2	9.2	9.4	9	0.9	2.2	SE	0	898.8	95
3/24/00	10:45a	9.4	9.4	9.6	9.3	0.9	1.8	SE	0	898.7	95
3/24/00	11:00a	10	10	10.3	9.6	0.9	1.8	ESE	0	898.5	95
3/24/00	11:15a	10.1	10.1	10.1	9.9	1.3	2.2	ESE	0	898.6	95
3/24/00	11:30a	10.2	10.2	10.3	10.1	0.9	2.2	ESE	0	898.4	95
3/24/00	11:45a	10.6	10.6	10.7	10.4	0.9	1.8	E	0	898.5	95
3/24/00	12:00p	10.6	10.6	10.7	10.4	0.9	1.8	SE	0	898.5	95
3/24/00	12:15p	10.7	10.7	10.8	10.4	0.9	2.2	ESE	0	898.3	95
3/24/00	12:30p	10.9	10.9	11.2	10.7	0.4	1.8	ESE	0	898.3	95
3/24/00	12:45p	11.1	11.1	11.2	10.9	0.4	1.3	ESE	0	898.1	94
3/24/00	1:00p	10.9	10.9	11	10.8	0.4	1.3	ESE	0	897.9	94
3/24/00	1:15p	10.9	10.9	11.1	10.8	0	0.9	ESE	0	897.8	94
3/24/00	1:30p	10.7	10.7	11	10.5	0.4	1.8	N	0	897.7	93
3/24/00	1:45p	10.7	10.7	10.8	10.6	0.4	1.3	ENE	0	897.7	93
3/24/00	2:00p	10.7	10.7	10.8	10.6	0	1.3	SE	0	897.7	93
3/24/00	2:15p	10.3	10.3	10.6	10.1	0.9	1.3	SE	0	897.7	92
3/24/00	2:30p	10.2	10.2	10.3	10.1	0.9	1.8	SE	0	897.6	92
3/24/00	2:45p	10.2	10.2	10.3	10.1	0.9	1.8	SE	0	897.8	92
3/24/00	3:00p	10.3	10.3	10.3	10.2	0.4	1.3	ESE	0	897.6	92
3/24/00	3:15p	10.3	10.3	10.4	10.2	0.4	1.3	SE	0	897.7	92
3/24/00	3:30p	10.2	10.2	10.4	10.1	0.4	1.8	E	0	897.7	92
3/24/00	3:45p	10.2	10.2	10.2	10.1	0.4	1.3	SE	0	897.5	92
3/24/00	4:00p	10.2	10.2	10.3	10.2	0.9	1.3	SE	0	897.6	92
3/24/00	4:15p	10.1	10.1	10.2	10	0.9	1.8	SE	0	897.6	92
3/24/00	4:30p	9.9	9.9	10	9.8	0.4	1.3	SE	0	897.5	92
3/24/00	4:45p	9.8	9.8	9.8	9.7	0.4	1.3	ESE	0	897.7	92
3/24/00	5:00p	9.7	9.7	9.8	9.6	0.4	1.3	E	0	897.6	92
3/24/00	5:15p	9.7	9.7	9.7	9.7	0.4	1.3	E	0	897.8	92
3/24/00	5:30p	9.7	9.7	9.8	9.7	0.4	0.9	E	0	897.8	92
3/24/00	5:45p	9.7	9.7	9.8	9.7	0.4	0.9	E	0	898	92
3/24/00	6:00p	9.5	9.5	9.7	9.4	0.4	1.3	NE	0	898.1	93
3/24/00	6:15p	9.3	9.3	9.4	9.2	0.4	1.8	E	0	898.2	92
3/24/00	6:30p	9.2	9.2	9.3	9.1	0.4	1.3	E	0	898.3	92
3/24/00	6:45p	9.1	9.1	9.1	9	0.4	1.8	E	0	898.5	92
3/24/00	7:00p	8.9	8.9	9	8.8	0.4	0.9	E	0	898.5	92
3/24/00	7:15p	8.9	8.9	8.9	8.8	0	0.9	E	0	898.7	92
3/24/00	7:30p	8.9	8.9	9	8.9	0	0.9	E	0	898.8	92
3/24/00	7:45p	9	9	9	9	0.4	0.9	E	0	898.9	92
3/24/00	8:00p	9.1	9.1	9.1	9	0	0.9	ENE	0	899	92
3/24/00	8:15p	9.1	9.1	9.1	9	0.4	1.3	ENE	0	899.2	93
3/24/00	8:30p	9	9	9	9	0.4	1.3	E	0	899.3	93
3/24/00	8:45p	9	9	9	9	0	0	---	0	899.4	93
3/24/00	9:00p	9	9	9.1	9	0.4	1.3	E	0	899.6	93
3/24/00	9:15p	9	9	9.1	8.8	0.4	1.8	E	0	899.7	93
3/24/00	9:30p	8.8	8.8	8.9	8.8	0.4	1.3	E	0	899.8	93
3/24/00	9:45p	8.8	8.8	8.8	8.7	0	0.9	E	0	899.7	93
3/24/00	10:00p	8.8	8.8	8.8	8.7	0	0	---	0	899.6	93

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/24/00	10:15p	8.6	8.6	8.6	8.6	0	0	---	0	899.5	93
3/24/00	10:30p	8.6	8.6	8.6	8.6	0	0.9	E	0	899.5	93
3/24/00	10:45p	8.7	8.7	8.7	8.6	0	0.9	E	0	899.6	93
3/24/00	11:00p	8.8	8.8	8.8	8.7	0.4	1.3	E	0	899.5	93
3/24/00	11:15p	8.8	8.8	8.8	8.8	0	0.9	E	0	899.5	93
3/24/00	11:30p	8.8	8.8	8.8	8.7	0	0.9	E	0	899.3	94
3/24/00	11:45p	8.7	8.7	8.8	8.7	0.4	0.9	E	0	899.3	94
3/25/00	12:00a	8.7	8.7	8.8	8.7	0.4	1.3	ESE	0	899	94
3/25/00	12:15a	8.7	8.7	8.8	8.6	0.9	1.8	SE	0	898.9	94
3/25/00	12:30a	8.6	8.6	8.6	8.5	0.4	1.8	SE	0	898.8	94
3/25/00	12:45a	8.6	8.6	8.6	8.5	0.9	1.8	ESE	0	898.7	94
3/25/00	1:00a	8.6	8.6	8.6	8.6	0.9	1.8	SE	0	898.5	94
3/25/00	1:15a	8.7	8.7	8.7	8.6	0.4	1.3	ESE	0	898.6	94
3/25/00	1:30a	8.6	8.6	8.7	8.6	0.4	1.8	SE	0	898.6	94
3/25/00	1:45a	8.6	8.6	8.6	8.5	0.9	1.3	SE	0	898.6	94
3/25/00	2:00a	8.6	8.6	8.6	8.6	0	1.3	SE	0	898.4	94
3/25/00	2:15a	8.5	8.5	8.6	8.4	0	0.4	SE	0	898.4	94
3/25/00	2:30a	8.6	8.6	8.6	8.6	0	0	---	0	898.4	94
3/25/00	2:45a	8.6	8.6	8.7	8.6	0.4	1.3	SE	0	898.3	94
3/25/00	3:00a	8.7	8.7	8.7	8.7	0.4	0.9	SE	0	898	94
3/25/00	3:15a	8.7	8.7	8.7	8.7	0.4	1.3	SE	0	897.9	94
3/25/00	3:30a	8.7	8.7	8.7	8.7	0.4	1.3	SE	0	897.8	94
3/25/00	3:45a	8.6	8.6	8.7	8.6	0.4	2.2	E	0	897.7	94
3/25/00	4:00a	8.6	8.6	8.6	8.6	0.4	0.9	E	0	897.7	94
3/25/00	4:15a	8.6	8.6	8.6	8.6	0	0.4	---	0	897.7	94
3/25/00	4:30a	8.6	8.6	8.6	8.5	0.4	1.3	ENE	0	897.7	94
3/25/00	4:45a	8.5	8.5	8.5	8.4	0	0.9	ENE	0	897.8	94
3/25/00	5:00a	8.4	8.4	8.5	8.4	0	1.3	ENE	0	897.7	94
3/25/00	5:15a	8.4	8.4	8.4	8.4	0	1.3	ENE	0	897.6	94
3/25/00	5:30a	8.4	8.4	8.4	8.3	0	0.9	ENE	0	897.7	94
3/25/00	5:45a	8.4	8.4	8.4	8.3	0	1.3	ENE	0	897.8	94
3/25/00	6:00a	8.4	8.4	8.4	8.4	0.4	1.3	ENE	0	897.8	94
3/25/00	6:15a	8.4	8.4	8.4	8.4	0	0	---	0	897.9	94
3/25/00	6:30a	8.4	8.4	8.5	8.4	0	0	---	0	898	94
3/25/00	6:45a	8.6	8.6	8.6	8.5	0	0	---	0	898.1	94
3/25/00	7:00a	8.6	8.6	8.6	8.6	0.4	1.8	ENE	0	898.2	94
3/25/00	7:15a	8.6	8.6	8.6	8.6	0.4	1.3	ENE	0	898.4	94
3/25/00	7:30a	8.7	8.7	8.7	8.6	0.4	1.3	ENE	0	898.6	94
3/25/00	7:45a	8.7	8.7	8.8	8.7	0.4	1.8	E	0	898.6	95
3/25/00	8:00a	8.9	8.9	9	8.8	0.4	1.3	E	0	898.6	95
3/25/00	8:15a	9.1	9.1	9.2	9	0.4	1.3	E	0	898.8	95
3/25/00	8:30a	9.4	9.4	9.6	9.2	0	0.9	E	0	898.8	95
3/25/00	8:45a	9.7	9.7	9.8	9.6	0.4	1.3	ENE	0	898.7	95
3/25/00	9:00a	9.9	9.9	10.2	9.8	0.4	1.3	E	0	898.8	95
3/25/00	9:15a	10.3	10.3	10.4	10.2	0.4	1.3	E	0	899	96
3/25/00	9:30a	10.5	10.5	10.8	10.2	0.4	1.8	ENE	0	898.9	96
3/25/00	9:45a	10.9	10.9	11.1	10.8	0.4	1.3	ENE	0	899	96

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/25/00	10:00a	10.8	10.8	10.9	10.7	0.4	1.3	ENE	0	899.2	96
3/25/00	10:15a	10.7	10.7	10.8	10.6	0.4	1.3	E	0	899.1	96
3/25/00	10:30a	11	11	11.2	10.8	0.4	0.9	NE	0	899.1	96
3/25/00	10:45a	11.3	11.3	11.6	11.1	0.4	1.3	ENE	0	899.1	96
3/25/00	11:00a	11.8	11.8	11.9	11.6	0.4	1.8	E	0	899	96
3/25/00	11:15a	12	12	12.3	11.8	0	1.3	NNW	0	899	96
3/25/00	11:30a	12.4	12.4	12.8	12.1	0.4	1.3	N	0	899	96
3/25/00	11:45a	12.8	12.8	13.1	12.6	0.4	1.8	E	0	898.7	97
3/25/00	12:00p	12.8	12.8	12.9	12.7	0.4	1.3	ENE	0	898.5	96
3/25/00	12:15p	13.1	13.1	13.3	12.7	0	1.8	NW	0	898.5	96
3/25/00	12:30p	13.5	13.5	13.7	13.1	0.4	1.3	NNE	0	898.3	96
3/25/00	12:45p	13.9	13.9	14.2	13.7	0.4	1.8	N	0	898.2	96
3/25/00	1:00p	13.7	13.7	13.9	13.6	0.4	1.3	N	0	898.1	95
3/25/00	1:15p	13.8	13.8	14.1	13.6	0.4	1.3	N	0	897.9	95
3/25/00	1:30p	13.7	13.7	13.9	13.5	0.4	1.3	N	0	897.9	94
3/25/00	1:45p	13.7	13.7	13.8	13.6	0.4	2.2	N	0	897.7	94
3/25/00	2:00p	14.2	14.2	14.4	13.9	0	0.9	N	0	897.5	94
3/25/00	2:15p	14.3	14.3	14.4	14.2	0.4	1.8	NNE	0	897.3	94
3/25/00	2:30p	14.6	14.6	14.8	14.3	0.4	1.3	N	0	897.2	94
3/25/00	2:45p	14.5	14.5	14.8	14.3	0	1.3	N	0	897.1	94
3/25/00	3:00p	14.6	14.6	14.8	14.4	0.4	1.3	NW	0	896.7	93
3/25/00	3:15p	14.6	14.6	14.9	14.3	0.4	1.8	N	0	896.7	93
3/25/00	3:30p	14.8	14.8	15	14.6	0.4	1.8	N	0	896.7	93
3/25/00	3:45p	15.1	15.1	15.2	14.9	0.4	1.3	N	0	896.7	93
3/25/00	4:00p	15.1	15.1	15.3	14.8	0.4	2.2	NNW	0	896.7	92
3/25/00	4:15p	14.6	14.6	14.8	14.5	0.4	1.3	NNW	0	896.6	92
3/25/00	4:30p	14.6	14.6	15.1	14.4	0.4	1.8	N	0	896.5	91
3/25/00	4:45p	14.3	14.3	14.8	14	0.4	1.3	N	0	896.4	90
3/25/00	5:00p	14.3	14.3	14.7	14	0.4	1.3	N	0	896.5	89
3/25/00	5:15p	14.4	14.4	15.1	14.2	0.4	1.8	NW	0	896.4	89
3/25/00	5:30p	14.1	14.1	14.3	13.8	0.4	1.8	N	0	896.4	89
3/25/00	5:45p	13.8	13.8	14.1	13.5	0.4	1.3	N	0	896.5	89
3/25/00	6:00p	13.4	13.4	13.5	13.2	0.4	1.8	N	0	896.6	89
3/25/00	6:15p	12.9	12.9	13.2	12.7	0.4	1.8	N	0	896.7	88
3/25/00	6:30p	12.6	12.6	12.7	12.5	0.4	1.8	N	0	896.7	88
3/25/00	6:45p	12.4	12.4	12.5	12.3	0.4	1.8	N	0	896.9	89
3/25/00	7:00p	12.3	12.3	12.3	12.1	0	1.3	N	0	896.8	89
3/25/00	7:15p	12	12	12.1	11.9	0.4	1.3	NNW	0	896.8	89
3/25/00	7:30p	11.8	11.8	11.9	11.8	0	1.3	N	0	897	89
3/25/00	7:45p	11.8	11.8	11.8	11.8	0	1.3	N	0	897.1	90
3/25/00	8:00p	11.8	11.8	11.8	11.8	0	1.3	N	0	897.3	90
3/25/00	8:15p	11.8	11.8	11.8	11.7	0	1.3	N	0	897.3	90
3/25/00	8:30p	11.7	11.7	11.8	11.7	0	1.3	N	0	897.6	91
3/25/00	8:45p	11.6	11.6	11.7	11.6	0.4	1.3	N	0	897.5	91
3/25/00	9:00p	11.6	11.6	11.6	11.6	0.4	1.8	NNW	0	897.6	91
3/25/00	9:15p	11.6	11.6	11.6	11.6	0	0.9	NNW	0	897.8	91
3/25/00	9:30p	11.6	11.6	11.6	11.5	0.4	1.3	N	0	897.9	91

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/25/00	9:45p	11.5	11.5	11.6	11.5	0	0.9	NNW	0	897.9	91
3/25/00	10:00p	11.5	11.5	11.6	11.5	0.4	1.3	NNW	0	897.9	91
3/25/00	10:15p	11.5	11.5	11.5	11.4	0	1.3	N	0	898	92
3/25/00	10:30p	11.4	11.4	11.5	11.4	0	0	---	0	897.9	91
3/25/00	10:45p	11.3	11.3	11.4	11.2	0	0	---	0	897.8	91
3/25/00	11:00p	11.2	11.2	11.3	11.2	0	0	---	0	897.7	92
3/25/00	11:15p	11.2	11.2	11.2	11.2	0	0	---	0	897.7	92
3/25/00	11:30p	11.2	11.2	11.2	11.2	0	0.9	N	0	897.7	92
3/25/00	11:45p	11.2	11.2	11.2	11.1	0	0.9	N	0	897.5	92
3/26/00	12:00a	11.2	11.2	11.2	11.1	0	0.4	---	0	897.7	92
3/26/00	12:15a	11.2	11.2	11.2	11.1	0	0	---	0	897.5	92
3/26/00	12:30a	11.1	11.1	11.2	11.1	0	0	---	0	897.5	92
3/26/00	12:45a	11	11	11.1	10.8	0	0	---	0	897.3	92
3/26/00	1:00a	10.7	10.7	10.8	10.5	0	0	---	0	897.2	92
3/26/00	1:15a	10.3	10.3	10.4	10.2	0	0	---	0	897.1	91
3/26/00	1:30a	10	10	10.1	9.8	0	0	---	0	896.9	91
3/26/00	1:45a	9.7	9.7	9.8	9.7	0	0	---	0	897	91
3/26/00	2:00a	9.8	9.8	10.1	9.6	0	0	---	0	896.8	91
3/26/00	2:15a	10.1	10.1	10.2	10	0	0	---	0	896.7	91
3/26/00	2:30a	9.6	9.6	10	9.2	0	0	---	0	896.7	91
3/26/00	2:45a	8.8	8.8	9.2	8.7	0	0	---	0	896.5	91
3/26/00	3:00a	8.6	8.6	8.7	8.5	0	0	---	0	896.4	90
3/26/00	3:15a	8.4	8.4	8.5	8.3	0	0	---	0	896.2	90
3/26/00	3:30a	8.4	8.4	8.5	8.3	0	0	---	0	896.2	90
3/26/00	3:45a	8.3	8.3	8.3	8.3	0	0	---	0	896.2	91
3/26/00	4:00a	8.3	8.3	8.4	8.3	0	0	---	0	896.2	91
3/26/00	4:15a	8.3	8.3	8.3	8.3	0	0	---	0	896.1	91
3/26/00	4:30a	8.1	8.1	8.3	7.8	0	0	---	0	896.2	91
3/26/00	4:45a	7.8	7.8	7.8	7.7	0	0	---	0	896.1	91
3/26/00	5:00a	7.7	7.7	7.7	7.6	0	0	---	0	896.2	91
3/26/00	5:15a	7.6	7.6	7.7	7.5	0	0	---	0	896.1	91
3/26/00	5:30a	7.7	7.7	7.7	7.6	0	0	---	0	896.1	91
3/26/00	5:45a	7.9	7.9	8	7.7	0	0	---	0	896.2	91
3/26/00	6:00a	7.9	7.9	8	7.9	0	0	---	0	896.2	92
3/26/00	6:15a	7.8	7.8	7.9	7.7	0	0	---	0	896.4	92
3/26/00	6:30a	7.7	7.7	7.9	7.5	0	0	---	0	896.6	92
3/26/00	6:45a	7.7	7.7	8.1	7.3	0	0	---	0	896.7	92
3/26/00	7:00a	7.3	7.3	7.5	7.2	0	0	---	0	896.8	92
3/26/00	7:15a	7.4	7.4	7.5	7.4	0	0	---	0	896.8	92
3/26/00	7:30a	7.6	7.6	7.7	7.5	0	0	---	0	897	92
3/26/00	7:45a	8.1	8.1	8.4	7.7	0	0	---	0	897	92
3/26/00	8:00a	8.6	8.6	9	8.4	0	0	---	0	897	93
3/26/00	8:15a	9.8	9.8	10.7	9	0	1.3	N	0	897	94
3/26/00	8:30a	11	11	11.4	10.7	0	0.9	N	0	897	95
3/26/00	8:45a	11.6	11.6	11.8	11.4	0	0.4	N	0	897	96
3/26/00	9:00a	11.9	11.9	12.1	11.8	0.4	1.3	NNW	0	897	96
3/26/00	9:15a	12.2	12.2	12.3	12	0.4	1.3	N	0	897	96

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/26/00	9:30a	12.5	12.5	12.8	12.3	0.4	1.3	N	0	897	96
3/26/00	9:45a	12.8	12.8	12.9	12.7	0.4	1.8	N	0	897	96
3/26/00	10:00a	13.1	13.1	13.2	12.9	0.4	1.8	N	0	897.1	96
3/26/00	10:15a	13.3	13.3	13.6	13.2	0.4	1.3	N	0	897.1	96
3/26/00	10:30a	13.5	13.5	13.9	13.3	0.4	1.3	N	0	897	96
3/26/00	10:45a	14.2	14.2	14.4	14	0.4	1.8	N	0	896.8	96
3/26/00	11:00a	14.3	14.3	14.7	14	0.4	2.2	N	0	896.7	96
3/26/00	11:15a	15.2	15.2	16.4	14.3	0.9	1.8	N	0	896.7	97
3/26/00	11:30a	16.1	16.1	18.7	14.6	0.4	2.2	N	0	896.5	97
3/26/00	11:45a	16.3	16.3	18.7	15.4	0.4	1.8	N	0	896.5	98
3/26/00	12:00p	18.4	18.4	20.8	15.8	0.4	2.2	N	0	896.2	99
3/26/00	12:15p	18.3	18.3	20	17.2	0.4	1.8	N	0	896.1	96
3/26/00	12:30p	19.3	19.3	21.5	16.8	0.4	1.8	N	0	895.6	93
3/26/00	12:45p	20.8	20.8	22.4	19.6	0.4	2.7	NNW	0	895.6	91
3/26/00	1:00p	19.6	19.6	20.6	18.7	0.9	2.2	E	0	895.5	81
3/26/00	1:15p	18.2	18.2	20.2	17.3	0.4	1.8	N	0	895.3	71
3/26/00	1:30p	18.2	18.2	19.3	17.2	0.4	2.2	N	0	895.1	71
3/26/00	1:45p	17.6	17.6	18.7	16.7	0.4	1.8	NNW	0	895	70
3/26/00	2:00p	16.7	16.7	16.9	16.5	0	1.3	N	0	894.9	70
3/26/00	2:15p	17.2	17.2	17.4	16.9	0.4	2.2	N	0	894.6	73
3/26/00	2:30p	17.3	17.3	17.7	17.2	0.9	1.8	N	0	894.5	76
3/26/00	2:45p	17.3	17.3	17.7	17	0.9	2.2	N	0	894.5	77
3/26/00	3:00p	17.2	17.2	17.4	17	0.9	1.8	N	0	894.4	78
3/26/00	3:15p	17.6	17.6	17.7	17.3	0.9	2.2	ENE	0	894.3	79
3/26/00	3:30p	17.7	17.7	17.9	17.2	0	1.3	N	0	894.4	79
3/26/00	3:45p	16.9	16.9	17.3	16.6	0	1.3	ENE	0	894.3	80
3/26/00	4:00p	17.5	17.5	17.9	17.2	0.4	1.8	N	0	894.1	79
3/26/00	4:15p	17.6	17.6	18.3	16.8	0	1.3	ENE	0	894.1	79
3/26/00	4:30p	16.7	16.7	18.1	16.2	0	1.3	E	0	894.1	78
3/26/00	4:45p	17.8	17.8	18.3	17.6	0.9	2.7	N	0	894.1	79
3/26/00	5:00p	17.4	17.4	17.8	17.2	0.4	1.8	N	0	894.1	79
3/26/00	5:15p	18.4	18.4	19.8	17.1	0.4	2.2	N	0	894	77
3/26/00	5:30p	16.4	16.4	17.1	16.1	0.4	1.8	N	0	894.2	73
3/26/00	5:45p	15.8	15.8	16.3	15.5	0.4	1.8	N	0	894.3	73
3/26/00	6:00p	15.3	15.3	15.5	15.1	0	0.9	NW	0	894.3	73
3/26/00	6:15p	14.9	14.9	15.1	14.8	0	1.3	N	0	894.5	74
3/26/00	6:30p	14.6	14.6	14.8	14.4	0.4	1.3	NNW	0	894.6	75
3/26/00	6:45p	14.2	14.2	14.4	13.8	0	1.3	N	0	894.7	76
3/26/00	7:00p	13.7	13.7	13.8	13.4	0	0.4	N	0	894.9	76
3/26/00	7:15p	13.3	13.3	13.4	13.2	0	0.4	N	0	894.8	77
3/26/00	7:30p	12.9	12.9	13.2	12.8	0	0.4	N	0	894.8	77
3/26/00	7:45p	12.8	12.8	12.8	12.7	0	0.4	N	0	895	78
3/26/00	8:00p	12.6	12.6	12.7	12.4	0	0	---	0	895.1	78
3/26/00	8:15p	12.3	12.3	12.5	12.1	0	0	---	0	895.4	79
3/26/00	8:30p	11.8	11.8	12	11.6	0	0	---	0	895.6	79
3/26/00	8:45p	11.6	11.6	11.7	11.5	0	0	---	0	895.5	79
3/26/00	9:00p	11.7	11.7	11.9	11.7	0	0	---	0	895.6	79

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/26/00	9:15p	11.8	11.8	12	11.6	0	0.9	N	0	895.6	80
3/26/00	9:30p	12	12	12.1	11.9	0	0.9	N	0	895.9	80
3/26/00	9:45p	12.3	12.3	12.3	12.2	0	0.9	N	0	895.9	81
3/26/00	10:00p	12.2	12.2	12.3	12.1	0	0.9	N	0	895.8	82
3/26/00	10:15p	12	12	12.1	11.9	0	0.9	N	0	895.8	82
3/26/00	10:30p	12.1	12.1	12.2	12	0	0.4	---	0	895.8	82
3/26/00	10:45p	12.2	12.2	12.2	12.2	0	0.9	N	0	895.6	82
3/26/00	11:00p	12.2	12.2	12.2	12.1	0	0.9	N	0	895.6	82
3/26/00	11:15p	11.9	11.9	12.1	11.8	0	1.3	N	0	895.5	82
3/26/00	11:30p	11.8	11.8	11.9	11.8	0	0.9	N	0	895.4	82
3/26/00	11:45p	11.7	11.7	11.8	11.6	0	0	---	0	895.3	82
3/27/00	12:00a	11.7	11.7	11.7	11.6	0	0	---	0	895.2	82
3/27/00	12:15a	11.8	11.8	11.8	11.7	0	0	---	0	895.3	83
3/27/00	12:30a	11.8	11.8	11.8	11.7	0	0.9	N	0	895.2	83
3/27/00	12:45a	11.7	11.7	11.8	11.7	0	0.4	N	0	895.3	83
3/27/00	1:00a	11.8	11.8	11.8	11.7	0	0	---	0	895.1	83
3/27/00	1:15a	11.6	11.6	11.8	11.2	0	0	---	0	894.9	83
3/27/00	1:30a	11	11	11.2	10.7	0	0	---	0	895	82
3/27/00	1:45a	10.8	10.8	10.8	10.7	0	0.4	---	0	894.8	82
3/27/00	2:00a	10.8	10.8	10.8	10.7	0	0	---	0	894.6	82
3/27/00	2:15a	10.6	10.6	10.8	10.4	0	0	---	0	894.6	82
3/27/00	2:30a	10.3	10.3	10.4	10.3	0	0	---	0	894.5	82
3/27/00	2:45a	10.2	10.2	10.3	10	0	0	---	0	894.4	82
3/27/00	3:00a	9.7	9.7	10.1	9.5	0	0	---	0	894.1	82
3/27/00	3:15a	9.8	9.8	10	9.5	0	0	---	0	894.1	82
3/27/00	3:30a	10.1	10.1	10.3	9.7	0	0.4	N	0	893.9	83
3/27/00	3:45a	10.2	10.2	10.3	10.1	0	0.4	---	0	893.9	83
3/27/00	4:00a	10	10	10.1	9.9	0	0	---	0	893.8	83
3/27/00	4:15a	9.9	9.9	10.1	9.8	0	0	---	0	893.8	83
3/27/00	4:30a	10.3	10.3	10.7	10.1	0.4	1.3	N	0	893.6	84
3/27/00	4:45a	10.6	10.6	10.7	10.4	0	0.4	N	0	893.7	84
3/27/00	5:00a	10.4	10.4	10.4	10.3	0	0.9	N	0	893.7	84
3/27/00	5:15a	10.3	10.3	10.4	10.2	0	0	---	0	893.8	84
3/27/00	5:30a	10.1	10.1	10.3	9.9	0	0	---	0	893.9	84
3/27/00	5:45a	10.2	10.2	10.3	10.1	0	0.4	---	0	894.2	84
3/27/00	6:00a	10.1	10.1	10.1	9.9	0	0	---	0	894.1	84
3/27/00	6:15a	10	10	10.3	9.9	0	0	---	0	894	84
3/27/00	6:30a	10.4	10.4	10.4	10.3	0	0.4	N	0	894	85
3/27/00	6:45a	10.4	10.4	10.5	10.2	0	0	---	0	894.2	85
3/27/00	7:00a	10	10	10.2	9.8	0	0	---	0	894.6	84
3/27/00	7:15a	9.7	9.7	9.8	9.7	0	0	---	0	894.7	84
3/27/00	7:30a	9.7	9.7	9.8	9.7	0	0	---	0	894.8	84
3/27/00	7:45a	9.8	9.8	10	9.8	0	0	---	0	894.9	85
3/27/00	8:00a	10.2	10.2	10.4	10	0	0	---	0	894.8	85
3/27/00	8:15a	11	11	11.5	10.5	0	0.4	N	0	894.8	86
3/27/00	8:30a	11.6	11.6	11.9	11.6	0	0.4	N	0	895.2	87
3/27/00	8:45a	12.5	12.5	12.8	11.9	0	0.9	N	0	895.1	88

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/27/00	9:00a	12.2	12.2	12.4	12.1	0	0.9	N	0	895.1	88
3/27/00	9:15a	12.2	12.2	12.6	11.9	0.4	1.8	N	0	895.1	87
3/27/00	9:30a	12.6	12.6	12.8	12.4	0.4	2.2	N	0	895	87
3/27/00	9:45a	13.2	13.2	13.8	12.6	0.4	2.7	NNE	0	895.1	87
3/27/00	10:00a	14.2	14.2	14.7	13.7	0.4	1.8	N	0	895	88
3/27/00	10:15a	15.1	15.1	15.5	14.5	0.4	1.3	N	0	894.9	89
3/27/00	10:30a	15.8	15.8	16.6	15.2	0.9	1.8	NNE	0	894.8	89
3/27/00	10:45a	17.6	17.6	19.2	16.2	0.4	2.2	N	0	894.6	92
3/27/00	11:00a	19.2	19.2	20.1	18.4	0.4	1.8	N	0	894.3	94
3/27/00	11:15a	18.8	18.8	20.1	16.8	0.4	2.2	N	0	894.3	87
3/27/00	11:30a	20.4	20.4	21.9	19	0.4	1.8	N	0	894.2	86
3/27/00	11:45a	21.2	21.2	21.9	20.6	0.4	1.8	NNE	0	894.3	82
3/27/00	12:00p	21.6	21.6	22.3	20.9	0.4	2.7	N	0	894.2	77
3/27/00	12:15p	22.5	22.5	23.1	21.8	0.4	1.8	N	0	894.1	73
3/27/00	12:30p	22.8	22.8	23.8	21.7	0.4	2.2	N	0	894.1	68
3/27/00	12:45p	22.1	22.1	22.8	21.3	0.4	2.2	NW	0	894.2	63
3/27/00	1:00p	21.8	21.8	22.5	20.3	0.4	2.2	N	0	893.9	59
3/27/00	1:15p	21.5	21.5	22.8	20.6	0	1.3	N	0	893.7	58
3/27/00	1:30p	19.5	19.5	20.9	18.6	0.4	1.8	N	0	893.5	56
3/27/00	1:45p	20	20	21.5	19.1	0.4	1.8	N	0	893.3	58
3/27/00	2:00p	19.4	19.4	19.8	18.9	0	0.9	ENE	0	893	58
3/27/00	2:15p	18.9	18.9	19.2	18.7	0.4	1.3	ENE	0	892.9	59
3/27/00	2:30p	18.9	18.9	19.2	18.6	0.4	1.8	N	0	892.8	62
3/27/00	2:45p	18.6	18.6	19	18.3	0.4	1.8	N	0	892.7	63
3/27/00	3:00p	18.5	18.5	18.7	18.3	0.4	1.8	N	0	892.7	64
3/27/00	3:15p	18.3	18.3	18.5	18.2	0.4	1.3	NNW	0	892.7	65
3/27/00	3:30p	18	18	18.2	17.9	0.4	1.3	N	0	892.6	65
3/27/00	3:45p	18.6	18.6	18.8	18.2	0.9	2.7	N	0	892.5	67
3/27/00	4:00p	18.7	18.7	19.1	18.3	0.9	1.8	N	0	892.4	67
3/27/00	4:15p	17.9	17.9	18.3	17.6	0.4	1.3	N	0	892.5	66
3/27/00	4:30p	18.2	18.2	19.1	17.7	0.4	1.8	N	0	892.4	66
3/27/00	4:45p	18.6	18.6	19.3	18.2	0.9	2.2	N	0	892.3	67
3/27/00	5:00p	18.1	18.1	18.6	17.6	0.4	2.2	N	0	892.2	67
3/27/00	5:15p	17.3	17.3	17.6	17.1	0.4	1.8	NNW	0	892.4	66
3/27/00	5:30p	17.2	17.2	17.3	17.1	0.4	1.8	NNW	0	892.5	66
3/27/00	5:45p	16.8	16.8	17.2	16.6	0	1.3	N	0	892.7	66
3/27/00	6:00p	16.3	16.3	16.6	16.1	0.4	1.3	NNW	0	892.8	66
3/27/00	6:15p	15.9	15.9	16.1	15.9	0	0.9	N	0	892.9	66
3/27/00	6:30p	15.7	15.7	16	15.5	0	0.9	N	0	893.2	67
3/27/00	6:45p	15.3	15.3	15.4	15	0	0	---	0	893.4	67
3/27/00	7:00p	14.9	14.9	15	14.8	0	0	---	0	893.5	68
3/27/00	7:15p	14.6	14.6	14.7	14.4	0	0	---	0	893.5	68
3/27/00	7:30p	14.4	14.4	14.4	14.3	0	0	---	0	893.8	68
3/27/00	7:45p	14.2	14.2	14.3	14	0	0	---	0	893.8	69
3/27/00	8:00p	13.9	13.9	14.1	13.9	0	0	---	0	893.9	69
3/27/00	8:15p	13.9	13.9	14	13.8	0	0	---	0	893.9	70
3/27/00	8:30p	13.8	13.8	13.8	13.7	0	0	---	0	894.1	70

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/27/00	8:45p	13.8	13.8	13.8	13.7	0	0	---	0	894.1	71
3/27/00	9:00p	13.7	13.7	13.7	13.6	0	0	---	0	894.2	71
3/27/00	9:15p	13.6	13.6	13.7	13.6	0	0	---	0	894.3	71
3/27/00	9:30p	13.6	13.6	13.7	13.6	0	0	---	0	894.3	71
3/27/00	9:45p	13.5	13.5	13.6	13.4	0	0	---	0	894.4	72
3/27/00	10:00p	13.4	13.4	13.5	13.3	0	0	---	0	894.3	72
3/27/00	10:15p	13.3	13.3	13.4	13.3	0	0	---	0	894.4	72
3/27/00	10:30p	13.2	13.2	13.4	13.1	0	0	---	0	894.4	72
3/27/00	10:45p	13.3	13.3	13.3	13.2	0	0	---	0	894.6	72
3/27/00	11:00p	13.4	13.4	13.5	13.3	0	0	---	0	894.8	73
3/27/00	11:15p	13.3	13.3	13.5	13.2	0	0	---	0	894.7	73
3/27/00	11:30p	13.3	13.3	13.3	13.2	0	0	---	0	894.6	73
3/27/00	11:45p	13.2	13.2	13.3	13.1	0	0	---	0	894.3	74
3/28/00	12:00a	12.9	12.9	13.1	12.7	0	0	---	0	894.3	73
3/28/00	12:15a	12.7	12.7	12.8	12.6	0	0	---	0	894.3	73
3/28/00	12:30a	12.7	12.7	12.9	12.4	0	0	---	0	894.2	74
3/28/00	12:45a	12.3	12.3	12.4	12.3	0	0	---	0	894.2	74
3/28/00	1:00a	12.4	12.4	12.5	12.4	0	0	---	0	894	74
3/28/00	1:15a	12.4	12.4	12.4	12.4	0	0	---	0	893.9	74
3/28/00	1:30a	12.2	12.2	12.4	12	0	0	---	0	893.9	74
3/28/00	1:45a	12	12	12.2	11.9	0	0	---	0	894.1	75
3/28/00	2:00a	12.2	12.2	12.2	12.1	0	0	---	0	893.8	75
3/28/00	2:15a	11.9	11.9	12.1	11.7	0	0	---	0	893.9	75
3/28/00	2:30a	11.7	11.7	11.8	11.7	0	0	---	0	894	75
3/28/00	2:45a	11.7	11.7	11.7	11.7	0	0	---	0	894.1	75
3/28/00	3:00a	11.7	11.7	11.8	11.7	0	0	---	0	893.9	76
3/28/00	3:15a	11.8	11.8	11.8	11.7	0	0	---	0	893.9	76
3/28/00	3:30a	11.8	11.8	11.8	11.7	0	0	---	0	893.9	76
3/28/00	3:45a	11.9	11.9	12.1	11.8	0	0	---	0	893.9	77
3/28/00	4:00a	12	12	12.1	12	0	0	---	0	893.8	77
3/28/00	4:15a	12.2	12.2	12.2	12.1	0	0	---	0	893.8	77
3/28/00	4:30a	12.1	12.1	12.2	12	0	0	---	0	893.7	77
3/28/00	4:45a	12	12	12.1	12	0	0	---	0	893.6	77
3/28/00	5:00a	12.1	12.1	12.2	12	0	0	---	0	893.6	77
3/28/00	5:15a	11.9	11.9	12	11.8	0	0	---	0	893.7	77
3/28/00	5:30a	11.7	11.7	11.8	11.6	0	0	---	0	893.8	77
3/28/00	5:45a	11.6	11.6	11.7	11.6	0	0	---	0	894.1	77
3/28/00	6:00a	11.7	11.7	11.8	11.6	0	0	---	0	894.1	77
3/28/00	6:15a	11.5	11.5	11.8	11.3	0	0	---	0	894	77
3/28/00	6:30a	11.1	11.1	11.3	11.1	0	0	---	0	894	77
3/28/00	6:45a	11.3	11.3	11.4	11.1	0	0	---	0	894.1	78
3/28/00	7:00a	11.5	11.5	11.6	11.4	0	0	---	0	894.2	78
3/28/00	7:15a	11.7	11.7	11.8	11.6	0	0	---	0	894.1	78
3/28/00	7:30a	11.8	11.8	12.1	11.6	0	0	---	0	894.2	79
3/28/00	7:45a	12.3	12.3	12.4	12.1	0	0	---	0	894.3	79
3/28/00	8:00a	12.7	12.7	12.9	12.4	0	0	---	0	894.5	79
3/28/00	8:15a	13.3	13.3	13.8	12.9	0	0	---	0	894.5	80

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/28/00	8:30a	14.2	14.2	14.6	13.8	0	0	---	0	894.5	81
3/28/00	8:45a	15.7	15.7	16.6	14.6	0	0	---	0	894.7	83
3/28/00	9:00a	16.6	16.6	16.8	16.4	0	0	---	0	894.6	85
3/28/00	9:15a	16.8	16.8	17.1	16.7	0	0	---	0	894.7	84
3/28/00	9:30a	17.2	17.2	17.8	16.9	0	0	---	0	894.8	82
3/28/00	9:45a	18.1	18.1	18.3	17.9	0	0	---	0	894.8	82
3/28/00	10:00a	18.7	18.7	18.8	18.4	0	0	---	0	894.8	82
3/28/00	10:15a	18.9	18.9	19.6	18.6	0	0	---	0	894.6	82
3/28/00	10:30a	20.3	20.3	21.1	19.5	0	1.3	SW	0	894.7	81
3/28/00	10:45a	20.9	20.9	22.1	20.1	0.4	1.3	SW	0	894.5	80
3/28/00	11:00a	23.7	23.7	24.4	22.1	0.4	1.3	SW	0	894.4	82
3/28/00	11:15a	24.4	24.4	25.1	23.8	0.9	2.2	SSW	0	894.4	75
3/28/00	11:30a	25.3	25.3	26.2	24.4	0.4	2.7	SSW	0	894.4	70
3/28/00	11:45a	24.4	24.4	24.8	23.7	0.9	2.2	SW	0	894.3	65
3/28/00	12:00p	24.9	24.9	25.6	24.1	0.4	1.8	SW	0	894.2	61
3/28/00	12:15p	24.5	24.5	24.9	23.9	0.9	2.2	SSW	0	894.4	57
3/28/00	12:30p	24.2	24.2	24.8	23.6	0.9	1.8	SW	0	894.2	53
3/28/00	12:45p	24.5	24.5	25	23.9	0.9	1.8	SW	0	894	51
3/28/00	1:00p	22.8	22.8	24.4	21.4	1.3	2.7	SW	0	893.9	47
3/28/00	1:15p	20.9	20.9	21.4	20.5	0.9	2.2	SSW	0	893.7	45
3/28/00	1:30p	20.8	20.8	20.9	20.6	0.9	2.2	SSW	0	893.3	47
3/28/00	1:45p	20.9	20.9	21	20.8	0.9	2.7	SSW	0	893.1	48
3/28/00	2:00p	20.9	20.9	21.2	20.7	1.3	2.7	SSW	0	893.1	49
3/28/00	2:15p	20.8	20.8	21	20.4	1.3	2.7	SSW	0	893	49
3/28/00	2:30p	20.6	20.6	20.8	20.3	1.3	3.1	SW	0	893	50
3/28/00	2:45p	20.4	20.4	20.5	20.3	0.9	1.8	SW	0	892.8	51
3/28/00	3:00p	20.7	20.7	21.4	20.4	1.3	2.7	SW	0	892.7	52
3/28/00	3:15p	20.9	20.9	21.4	20.7	1.3	3.1	SSW	0	892.8	53
3/28/00	3:30p	20.9	20.9	21.1	20.7	1.3	2.7	SSW	0	892.7	53
3/28/00	3:45p	21	21	21.3	20.9	1.8	3.1	SSW	0	892.6	54
3/28/00	4:00p	21.4	21.4	21.9	21.2	1.3	2.7	SSW	0	892.5	53
3/28/00	4:15p	20.8	20.8	21.2	20.5	1.3	2.2	SSW	0	892.5	53
3/28/00	4:30p	20.3	20.3	20.8	19.8	1.3	2.7	SSW	0	892.4	54
3/28/00	4:45p	19.9	19.9	20.1	19.7	1.3	2.7	SSW	0	892.4	54
3/28/00	5:00p	19.5	19.5	20	19.2	1.3	3.1	SSW	0	892.5	55
3/28/00	5:15p	19.5	19.5	19.7	19.3	0.9	2.2	SSW	0	892.5	55
3/28/00	5:30p	19.6	19.6	20	19.4	0.9	1.8	SW	0	892.6	56
3/28/00	5:45p	20.2	20.2	20.4	20	0.9	2.2	SW	0	892.6	57
3/28/00	6:00p	19.3	19.3	20	19.1	1.3	2.2	SW	0	892.6	57
3/28/00	6:15p	19.1	19.1	19.2	18.8	1.3	3.6	SSW	0	892.6	57
3/28/00	6:30p	18.6	18.6	18.8	18.6	1.3	1.8	SSW	0	892.7	58
3/28/00	6:45p	18.3	18.3	18.6	18	0.9	1.8	SSW	0	892.9	58
3/28/00	7:00p	17.8	17.8	18	17.6	0.9	1.8	SSW	0	893.1	58
3/28/00	7:15p	17.4	17.4	17.6	17.2	0.4	1.3	SSW	0	893.3	59
3/28/00	7:30p	17.1	17.1	17.2	17.1	0	0.9	SSW	0	893.5	59
3/28/00	7:45p	17.1	17.1	17.1	17	0	0	---	0	893.6	60
3/28/00	8:00p	16.8	16.8	17	16.6	0.4	1.3	SSW	0	893.7	61

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/28/00	8:15p	16.6	16.6	16.6	16.5	0.9	1.3	SSW	0	893.9	62
3/28/00	8:30p	16.4	16.4	16.5	16.3	0.9	1.3	SSW	0	893.9	62
3/28/00	8:45p	16.3	16.3	16.4	16.2	0.9	1.8	SSW	0	894	63
3/28/00	9:00p	16.3	16.3	16.4	16.1	0.9	1.3	SSW	0	894.1	64
3/28/00	9:15p	16.1	16.1	16.1	16.1	0.9	1.3	SSW	0	894.1	65
3/28/00	9:30p	16	16	16.2	15.9	0.9	2.2	SSW	0	894.1	66
3/28/00	9:45p	16.2	16.2	16.3	16.1	1.3	1.8	SSW	0	894.1	67
3/28/00	10:00p	16.2	16.2	16.3	16.1	1.3	1.8	SSW	0	894.1	67
3/28/00	10:15p	16.4	16.4	16.4	16.3	1.3	1.8	SSW	0	894.1	68
3/28/00	10:30p	16.4	16.4	16.4	16.4	1.8	2.2	SSW	0	894.1	68
3/28/00	10:45p	16.5	16.5	16.5	16.4	1.8	2.7	SSW	0	894	69
3/28/00	11:00p	16.5	16.5	16.6	16.4	1.8	3.1	SSW	0	894	69
3/28/00	11:15p	16.6	16.6	16.6	16.4	1.8	2.7	SSW	0	893.9	69
3/28/00	11:30p	16.6	16.6	16.6	16.5	1.8	2.7	SSW	0	893.8	69
3/28/00	11:45p	16.6	16.6	16.7	16.5	1.8	2.7	SSW	0	893.5	69
3/29/00	12:00a	16.7	16.7	16.7	16.7	1.8	3.1	SSW	0	893.5	69
3/29/00	12:15a	16.8	16.8	16.9	16.7	1.8	3.1	SSW	0	893.4	69
3/29/00	12:30a	16.9	16.9	16.9	16.8	1.8	3.1	SSW	0	893.5	69
3/29/00	12:45a	16.7	16.7	16.8	16.7	1.8	3.1	SSW	0	893.5	69
3/29/00	1:00a	16.6	15.7	16.7	16.6	2.2	3.1	SSW	0	893.6	69
3/29/00	1:15a	16.4	16.4	16.5	16.3	1.8	3.6	SSW	0	893.8	69
3/29/00	1:30a	16.1	16.1	16.3	15.8	1.8	3.1	SSW	0	894	70
3/29/00	1:45a	15.7	15.7	15.8	15.4	1.8	3.1	SSW	0	893.9	70
3/29/00	2:00a	15.2	14.3	15.4	15.1	2.2	4	SSW	0	893.9	70
3/29/00	2:15a	14.8	13.1	15.1	14.6	2.7	4.5	SSW	0	893.9	71
3/29/00	2:30a	14.4	13.4	14.6	14.3	2.2	4	SSW	0	893.8	72
3/29/00	2:45a	14.1	13	14.3	13.9	2.2	3.1	SSW	0	893.8	73
3/29/00	3:00a	14	12.9	14.1	13.9	2.2	4.5	SSW	0	893.6	74
3/29/00	3:15a	13.8	13.8	13.9	13.7	1.8	2.7	SSW	0	893.4	75
3/29/00	3:30a	13.6	13.6	13.6	13.6	1.8	3.1	SSW	0	893.4	76
3/29/00	3:45a	13.6	13.6	13.6	13.4	1.8	3.1	SSW	0	893.2	77
3/29/00	4:00a	13.5	13.5	13.6	13.4	1.8	2.7	SSW	0	893.1	78
3/29/00	4:15a	13.5	12.4	13.6	13.4	2.2	4	SSW	0	893.1	78
3/29/00	4:30a	13.6	12.6	13.7	13.6	2.2	3.1	SSW	0	893.1	78
3/29/00	4:45a	13.6	12.5	13.6	13.5	2.2	3.1	SSW	0	893.2	79
3/29/00	5:00a	13.4	13.4	13.6	13.3	1.8	2.7	SSW	0	893.3	79
3/29/00	5:15a	13.2	13.2	13.3	13.1	1.8	2.7	SSW	0	893.4	79
3/29/00	5:30a	12.9	12.9	13.1	12.8	1.8	3.1	SSW	0	893.7	80
3/29/00	5:45a	12.6	12.6	12.8	12.5	1.3	2.2	SSW	0	894	80
3/29/00	6:00a	12.4	12.4	12.5	12.4	1.8	2.2	SSW	0	894.1	81
3/29/00	6:15a	12.3	12.3	12.4	12.2	0.4	1.8	SSW	0	894.6	80
3/29/00	6:30a	12	12	12.2	11.9	0.9	1.3	SSW	0	894.5	80
3/29/00	6:45a	11.9	11.9	12	11.9	1.3	2.2	SSW	0	894.7	81
3/29/00	7:00a	12	10.8	12.1	12	2.2	2.7	SSW	0	894.6	82
3/29/00	7:15a	12.1	10.9	12.1	12.1	2.2	3.1	SSW	0	894.8	83
3/29/00	7:30a	12.2	12.2	12.3	12.1	1.3	2.7	SSW	0	895.1	83
3/29/00	7:45a	12.4	12.4	12.4	12.3	0.9	1.3	SSW	0	895.4	83

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/29/00	8:00a	12.6	12.6	13.1	12.4	0.4	1.3	SSW	0	895.6	83
3/29/00	8:15a	13	13	13.1	12.9	0.4	1.3	SSW	0	895.7	84
3/29/00	8:30a	13.3	13.3	13.4	13.2	0.9	1.8	SSW	0	895.8	84
3/29/00	8:45a	14.1	14.1	14.7	13.4	0.9	1.8	SSW	0	895.8	86
3/29/00	9:00a	14.2	14.2	14.5	14.1	1.3	2.2	SSW	0	896	87
3/29/00	9:15a	14.3	14.3	14.5	14.2	1.3	2.2	SSW	0	896.2	86
3/29/00	9:30a	14.8	14.8	14.9	14.5	1.3	2.7	SSW	0	896.5	84
3/29/00	9:45a	15.2	15.2	15.6	14.8	0.9	2.2	SSW	0	896.7	84
3/29/00	10:00a	15.7	15.7	16	15.5	0.9	2.2	SE	0	896.8	83
3/29/00	10:15a	16.7	16.7	17.3	16.1	0.4	1.8	S	0	896.7	83
3/29/00	10:30a	17.3	17.3	17.8	16.9	0.9	1.8	SE	0	896.7	83
3/29/00	10:45a	19.4	19.4	20.6	17.8	0.4	1.8	SE	0	896.6	87
3/29/00	11:00a	20.5	20.5	20.7	20.2	0.9	2.2	SE	0	896.7	85
3/29/00	11:15a	21.8	21.8	22.4	20.6	0.4	1.3	SE	0	896.6	81
3/29/00	11:30a	22.7	22.7	23.6	22.1	0.4	1.8	SE	0	896.7	76
3/29/00	11:45a	23.3	23.3	24.3	22.7	0.9	1.8	SE	0	896.8	71
3/29/00	12:00p	23.6	23.6	24.4	22.9	0.9	1.8	SSE	0	896.9	66
3/29/00	12:15p	24.6	24.6	26.1	23.7	0.4	1.8	SE	0	896.9	63
3/29/00	12:30p	24.6	24.6	25.4	23.7	0.9	2.7	SSE	0	896.9	58
3/29/00	12:45p	25.3	25.3	26.3	23.8	0.4	1.8	SSE	0	896.9	56
3/29/00	1:00p	22.8	22.8	23.7	21.4	0.9	1.8	S	0	896.7	49
3/29/00	1:15p	22.3	22.3	23.1	21.3	0.4	1.3	S	0	896.3	49
3/29/00	1:30p	21.4	21.4	22.1	20.8	0.9	2.2	SSE	0	896	48
3/29/00	1:45p	22.2	22.2	23.1	21.2	0.9	1.8	S	0	895.8	50
3/29/00	2:00p	20.8	20.8	21.3	20.4	0.4	1.3	NNW	0	895.6	51
3/29/00	2:15p	20.3	20.3	20.8	19.9	0.9	1.8	N	0	895.6	52
3/29/00	2:30p	20.4	20.4	20.8	20.2	0.9	2.2	N	0	895.5	53
3/29/00	2:45p	19.6	19.6	20.3	19.2	0.9	2.7	NNW	0	895.6	54
3/29/00	3:00p	19.6	19.6	20.1	18.8	0.9	2.2	N	0	895.6	55
3/29/00	3:15p	18.9	18.9	19.2	18.7	0.9	2.2	N	0	895.6	56
3/29/00	3:30p	18.6	18.6	18.8	18.2	0.9	2.2	N	0	895.5	56
3/29/00	3:45p	18.5	18.5	19.1	18.1	0.9	2.7	N	0	895.4	58
3/29/00	4:00p	19.1	19.1	19.5	18.2	0.9	2.7	N	0	895.5	58
3/29/00	4:15p	18.5	18.5	18.8	18.2	0.9	3.6	NNW	0	895.5	59
3/29/00	4:30p	17.9	17.9	18.5	17.5	0.9	2.7	N	0	895.6	59
3/29/00	4:45p	18	18	18.3	17.4	0.9	1.8	N	0	895.7	59
3/29/00	5:00p	17.6	17.6	18.3	17.1	0.9	2.2	N	0	895.8	60
3/29/00	5:15p	17.1	17.1	17.3	16.8	0.9	2.2	N	0	895.8	61
3/29/00	5:30p	16.8	16.8	16.9	16.6	0.9	2.2	N	0	895.8	61
3/29/00	5:45p	16.2	16.2	16.6	15.8	0.9	2.7	N	0	896	62
3/29/00	6:00p	15.8	15.8	15.9	15.7	0.9	2.7	N	0	896.1	62
3/29/00	6:15p	15.5	15.5	15.8	15.2	0.9	2.7	NNW	0	896.3	63
3/29/00	6:30p	15	15	15.2	14.8	0.9	2.2	N	0	896.6	64
3/29/00	6:45p	14.6	14.6	14.8	14.4	0.9	2.2	NNE	0	896.9	65
3/29/00	7:00p	14.3	14.3	14.4	14.2	0.4	1.8	N	0	896.9	65
3/29/00	7:15p	14.1	14.1	14.2	13.9	0.4	2.2	N	0	897.1	66
3/29/00	7:30p	13.7	13.7	13.9	13.6	0.9	2.2	ENE	0	897.2	67

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/29/00	7:45p	13.4	13.4	13.6	13.3	0.4	2.2	NE	0	897.4	67
3/29/00	8:00p	13.3	13.3	13.3	13.2	0.4	2.7	E	0	897.6	68
3/29/00	8:15p	13.2	13.2	13.3	13.2	0.4	1.3	NNW	0	897.7	69
3/29/00	8:30p	13.1	13.1	13.2	13.1	0.4	2.2	E	0	898	69
3/29/00	8:45p	13.1	13.1	13.1	12.9	0.4	1.8	N	0	898.1	70
3/29/00	9:00p	13	13	13	12.9	0.4	1.8	NNW	0	898.3	70
3/29/00	9:15p	13	13	13	12.9	0.4	1.3	N	0	898.3	70
3/29/00	9:30p	12.9	12.9	12.9	12.8	0.4	2.2	N	0	898.3	71
3/29/00	9:45p	12.8	12.8	12.8	12.7	0.4	1.8	N	0	898.4	71
3/29/00	10:00p	12.6	12.6	12.7	12.6	0.4	2.7	N	0	898.4	72
3/29/00	10:15p	12.5	12.5	12.6	12.5	0.4	1.8	N	0	898.4	72
3/29/00	10:30p	12.5	12.5	12.6	12.4	0.4	2.7	NNW	0	898.3	72
3/29/00	10:45p	12.5	12.5	12.5	12.4	0.4	1.8	N	0	898.4	73
3/29/00	11:00p	12.4	12.4	12.5	12.4	0.4	1.8	N	0	898.4	73
3/29/00	11:15p	12.5	12.5	12.6	12.5	0.4	1.3	N	0	898.2	74
3/29/00	11:30p	12.5	12.5	12.6	12.4	0.4	1.8	N	0	898	74
3/29/00	11:45p	12.5	12.5	12.6	12.4	0.4	1.8	N	0	898.1	74
3/30/00	12:00a	12.5	12.5	12.6	12.5	0.4	2.2	N	0	897.9	75
3/30/00	12:15a	12.5	12.5	12.5	12.4	0.4	1.8	N	0	897.7	75
3/30/00	12:30a	12.5	12.5	12.5	12.4	0	0.9	NNW	0	897.5	75
3/30/00	12:45a	12.5	12.5	12.5	12.4	0.4	1.8	N	0	897.5	75
3/30/00	1:00a	12.4	12.4	12.5	12.4	0.4	1.8	N	0	897.4	75
3/30/00	1:15a	12.4	12.4	12.4	12.2	0.4	1.3	N	0	897.4	76
3/30/00	1:30a	11.9	11.9	12.2	11.8	0.4	1.8	N	0	897.4	76
3/30/00	1:45a	11.8	11.8	11.9	11.8	0.4	1.8	N	0	897.5	75
3/30/00	2:00a	11.8	11.8	11.9	11.8	0	0.9	NNW	0	897.4	75
3/30/00	2:15a	11.9	11.9	11.9	11.8	0.4	1.3	N	0	897.4	76
3/30/00	2:30a	11.9	11.9	11.9	11.9	0.4	1.3	N	0	897.1	76
3/30/00	2:45a	11.9	11.9	12	11.9	0	1.3	N	0	897	76
3/30/00	3:00a	11.9	11.9	12	11.9	0.4	1.8	N	0	896.9	77
3/30/00	3:15a	11.9	11.9	12	11.9	0.4	1.3	N	0	896.8	77
3/30/00	3:30a	11.9	11.9	11.9	11.9	0	0.9	N	0	896.8	77
3/30/00	3:45a	11.9	11.9	11.9	11.9	0.4	1.3	N	0	896.6	77
3/30/00	4:00a	11.9	11.9	11.9	11.8	0.4	2.2	N	0	896.4	77
3/30/00	4:15a	11.9	11.9	11.9	11.8	0.4	1.3	N	0	896.6	78
3/30/00	4:30a	11.8	11.8	11.9	11.8	0.4	1.8	N	0	896.4	78
3/30/00	4:45a	11.8	11.8	11.9	11.8	0.4	1.8	N	0	896.4	78
3/30/00	5:00a	11.9	11.9	11.9	11.8	0.4	1.3	N	0	896.6	78
3/30/00	5:15a	11.9	11.9	11.9	11.9	0.4	2.2	N	0	896.5	78
3/30/00	5:30a	11.9	11.9	11.9	11.9	0.4	1.3	N	0	896.6	79
3/30/00	5:45a	11.9	11.9	12	11.9	0.4	0.9	N	0	896.8	79
3/30/00	6:00a	11.9	11.9	12	11.9	0.4	1.3	N	0	896.9	79
3/30/00	6:15a	12	12	12	11.9	0.4	1.3	N	0	897	79
3/30/00	6:30a	12	12	12.1	12	0.4	1.3	N	0	897.2	79
3/30/00	6:45a	12.1	12.1	12.1	12	0.4	1.3	N	0	897.3	79
3/30/00	7:00a	12.1	12.1	12.1	12.1	0.4	1.3	N	0	897.1	79
3/30/00	7:15a	12.2	12.2	12.2	12.1	0.4	1.8	N	0	897.1	80

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/30/00	7:30a	12.2	12.2	12.2	12.2	0.4	2.2	N	0	897.3	80
3/30/00	7:45a	12.2	12.2	12.3	12.2	0.4	1.3	N	0	897.5	80
3/30/00	8:00a	12.2	12.2	12.2	12.2	0.4	2.2	N	0	897.6	80
3/30/00	8:15a	12.2	12.2	12.3	12.2	0	0.9	N	0	897.6	80
3/30/00	8:30a	12.3	12.3	12.3	12.3	0.4	1.3	N	0	897.6	80
3/30/00	8:45a	12.4	12.4	12.4	12.3	0.4	1.3	N	0	897.7	81
3/30/00	9:00a	12.6	12.6	12.6	12.4	0	1.3	N	0	897.6	81
3/30/00	9:15a	12.6	12.6	12.7	12.6	0.4	1.8	N	0	897.8	81
3/30/00	9:30a	12.7	12.7	12.7	12.7	0.9	2.2	NNE	0	897.7	82
3/30/00	9:45a	12.8	12.8	12.9	12.7	0.9	2.7	N	0	897.5	82
3/30/00	10:00a	12.9	12.9	13.1	12.9	0.9	2.2	N	0	897.6	82
3/30/00	10:15a	13.1	13.1	13.2	13	0.4	1.8	N	0	897.6	82
3/30/00	10:30a	13.2	13.2	13.2	13.1	0.9	2.7	N	0	897.5	83
3/30/00	10:45a	13.3	13.3	13.4	13.2	0.4	1.8	N	0	897.5	83
3/30/00	11:00a	13.4	13.4	13.6	13.3	0.4	1.8	N	0	897.4	83
3/30/00	11:15a	13.7	13.7	13.8	13.6	0.4	1.8	N	0	897.2	83
3/30/00	11:30a	13.9	13.9	14.1	13.7	0.4	1.8	N	0	897.1	83
3/30/00	11:45a	14.1	14.1	14.2	13.9	0.4	1.8	N	0	897.1	83
3/30/00	12:00p	14.1	14.1	14.3	13.9	0.4	1.8	NNW	0	896.9	83
3/30/00	12:15p	14.1	14.1	14.2	14	0.4	1.3	N	0	896.7	83
3/30/00	12:30p	14.2	14.2	14.4	14.1	0	1.8	N	0	896.7	83
3/30/00	12:45p	14.8	14.8	15.7	14.4	0	1.3	N	0	896.4	83
3/30/00	1:00p	15.4	15.4	15.6	15.3	0	1.3	N	0	896.3	84
3/30/00	1:15p	15.7	15.7	16.2	15.3	0.4	1.3	N	0	896.1	84
3/30/00	1:30p	16.9	16.9	17.4	16.1	0	0	---	0	895.9	85
3/30/00	1:45p	17.4	17.4	17.9	17.1	0	0.9	N	0	895.7	85
3/30/00	2:00p	18.1	18.1	18.4	17.9	0.4	1.8	SSW	0	895.1	84
3/30/00	2:15p	18.4	18.4	18.6	18.3	0.4	1.3	SSW	0	895	84
3/30/00	2:30p	18.8	18.8	18.9	18.6	0.4	1.8	SW	0	894.8	84
3/30/00	2:45p	18.8	18.8	18.9	18.7	0	0.9	SW	0	894.4	83
3/30/00	3:00p	19	19	19.1	18.9	0	1.3	SW	0	894.4	83
3/30/00	3:15p	19.1	19.1	19.2	18.9	0	1.3	SSW	0	894.3	82
3/30/00	3:30p	19.3	19.3	19.6	19	0.4	1.8	SSW	0	894.3	82
3/30/00	3:45p	19.6	19.6	20	19.3	0	1.3	SSW	0	894.3	81
3/30/00	4:00p	19.6	19.6	20.1	18.9	0	0.4	SSW	0	894.2	80
3/30/00	4:15p	19.2	19.2	19.9	18.9	0	0	---	0	894.2	79
3/30/00	4:30p	19.8	19.8	20.2	19.3	0	0.9	SSW	0	894.2	80
3/30/00	4:45p	19.2	19.2	19.3	19.1	0	0	---	0	894.2	79
3/30/00	5:00p	19.4	19.4	20.5	19.1	0	0	---	0	894.2	78
3/30/00	5:15p	20.4	20.4	20.9	19.8	0	1.3	SSW	0	894	78
3/30/00	5:30p	19.1	19.1	19.8	18.5	0	0	---	0	894.2	77
3/30/00	5:45p	18.9	18.9	19.6	18.3	0	0	---	0	894.3	76
3/30/00	6:00p	18.4	18.4	18.7	18.2	0	0	---	0	894.4	76
3/30/00	6:15p	18	18	18.2	17.8	0	0	---	0	894.3	76
3/30/00	6:30p	17.4	17.4	17.8	17.1	0	0	---	0	894.5	76
3/30/00	6:45p	16.7	16.7	17.1	16.3	0	0	---	0	894.8	75
3/30/00	7:00p	15.9	15.9	16.2	15.6	0	0	---	0	894.8	75

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/30/00	7:15p	15.4	15.4	15.6	14.9	0	0	---	0	894.9	75
3/30/00	7:30p	14.8	14.8	15	14.6	0	0	---	0	895	75
3/30/00	7:45p	14.4	14.4	14.6	14.1	0	0	---	0	895.2	75
3/30/00	8:00p	14	14	14.1	13.8	0	0	---	0	895.2	76
3/30/00	8:15p	13.6	13.6	13.8	13.3	0	0	---	0	895.3	76
3/30/00	8:30p	13.1	13.1	13.3	13.1	0	0	---	0	895.5	76
3/30/00	8:45p	12.9	12.9	13.2	12.7	0	0	---	0	895.6	76
3/30/00	9:00p	13.5	13.5	14.3	12.6	0	0	---	0	895.5	77
3/30/00	9:15p	13.9	13.9	14.4	13.2	0	0	---	0	895.5	78
3/30/00	9:30p	13.8	13.8	14.3	13.4	0	0	---	0	895.4	78
3/30/00	9:45p	13.9	13.9	14.5	13.6	0	0	---	0	895.4	78
3/30/00	10:00p	13.8	13.8	13.9	13.8	0	0	---	0	895.5	79
3/30/00	10:15p	14.1	14.1	14.4	13.8	0	0	---	0	895.4	79
3/30/00	10:30p	14.4	14.4	14.6	14.4	0	0	---	0	895.4	79
3/30/00	10:45p	14.4	14.4	14.6	14.3	0	0.4	ESE	0	895.2	79
3/30/00	11:00p	14.4	14.4	14.6	14.3	0	0	---	0	895	79
3/30/00	11:15p	14.4	14.4	14.5	14.2	0	0.9	ESE	0	895	79
3/30/00	11:30p	14.4	14.4	14.5	14.3	0	0.9	E	0	894.9	79
3/30/00	11:45p	14.3	14.3	14.4	14.2	0	0	---	0	894.9	80
3/31/00	12:00a	14.1	14.1	14.2	14	0	0	---	0	894.8	79
3/31/00	12:15a	13.8	13.8	13.9	13.5	0	0	---	0	894.5	79
3/31/00	12:30a	13.3	13.3	13.5	13.2	0	0	---	0	894.5	79
3/31/00	12:45a	13.1	13.1	13.2	13.1	0	0	---	0	894.4	79
3/31/00	1:00a	12.9	12.9	13.1	12.7	0	0	---	0	894.4	79
3/31/00	1:15a	12.7	12.7	12.8	12.5	0	0	---	0	894.2	78
3/31/00	1:30a	12.4	12.4	12.5	12.3	0	0	---	0	894	79
3/31/00	1:45a	12.2	12.2	12.4	12.1	0	0	---	0	894	79
3/31/00	2:00a	11.9	11.9	12.1	11.8	0	0	---	0	893.9	79
3/31/00	2:15a	11.7	11.7	11.7	11.6	0	0	---	0	893.9	79
3/31/00	2:30a	11.3	11.3	11.5	11.2	0	0	---	0	893.9	79
3/31/00	2:45a	11.3	11.3	11.3	11.2	0	0	---	0	893.9	79
3/31/00	3:00a	11.2	11.2	11.2	11.1	0	0	---	0	893.8	80
3/31/00	3:15a	11	11	11.1	10.8	0	0	---	0	893.8	80
3/31/00	3:30a	10.7	10.7	10.8	10.7	0	0	---	0	893.6	80
3/31/00	3:45a	10.7	10.7	10.7	10.7	0	0	---	0	893.7	80
3/31/00	4:00a	11	11	11.2	10.7	0	0	---	0	893.4	80
3/31/00	4:15a	11.2	11.2	11.2	11.1	0	0	---	0	893.4	81
3/31/00	4:30a	10.9	10.9	11.2	10.7	0	0	---	0	893.4	81
3/31/00	4:45a	10.8	10.8	10.9	10.7	0	0	---	0	893.4	81
3/31/00	5:00a	10.9	10.9	10.9	10.8	0	0	---	0	893.4	82
3/31/00	5:15a	10.7	10.7	10.7	10.7	0	0	---	0	893.5	82
3/31/00	5:30a	10.6	10.6	10.7	10.6	0	0	---	0	893.5	83
3/31/00	5:45a	10.5	10.5	10.6	10.4	0.9	1.3	SE	0	893.7	83
3/31/00	6:00a	10.5	10.5	10.6	10.4	0.9	1.3	SSE	0	893.7	84
3/31/00	6:15a	10.5	10.5	10.6	10.4	0.9	0.9	SSE	0	893.8	83
3/31/00	6:30a	10.4	10.4	10.4	10.3	0.4	0.9	SSE	0	893.9	83
3/31/00	6:45a	10.2	10.2	10.3	10.1	0.4	0.9	SSE	0	893.8	83

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/31/00	7:00a	9.9	9.9	10.1	9.9	0.9	1.3	SSE	0	893.9	83
3/31/00	7:15a	9.9	9.9	10.1	9.9	0.9	1.3	S	0	894	84
3/31/00	7:30a	10.2	10.2	10.3	10.1	0.9	1.3	S	0	894	84
3/31/00	7:45a	10.3	10.3	10.6	10.2	0.9	1.3	S	0	894.2	84
3/31/00	8:00a	11.3	11.3	12.3	10.6	0.9	1.3	S	0	894.2	85
3/31/00	8:15a	12.2	12.2	12.4	12.1	1.3	1.3	SSW	0	894.3	85
3/31/00	8:30a	12.7	12.7	13.1	12.3	1.3	1.8	SSW	0	894.5	87
3/31/00	8:45a	13.6	13.6	13.8	13.1	1.3	2.2	SSW	0	894.5	91
3/31/00	9:00a	14.1	14.1	14.2	13.8	1.8	2.7	SSW	0	894.3	88
3/31/00	9:15a	14.4	14.4	14.6	14.2	1.8	3.1	SSW	0	894.2	85
3/31/00	9:30a	14.8	13.8	15.1	14.6	2.2	3.1	SSW	0	894.3	83
3/31/00	9:45a	15.4	14.4	15.6	15.1	2.2	3.1	SW	0	894.3	81
3/31/00	10:00a	16.2	16.2	16.6	15.6	1.8	3.1	SSW	0	894.3	80
3/31/00	10:15a	17	16.1	17.5	16.5	2.2	4	SSW	0	894.3	79
3/31/00	10:30a	18.2	18.2	18.7	17.6	1.8	4	SW	0	894.2	78
3/31/00	10:45a	19.7	19	20.4	18.8	2.2	3.1	SSW	0	894.1	75
3/31/00	11:00a	20.6	19.9	20.9	20.2	2.2	4	SSW	0	894	69
3/31/00	11:15a	20.9	20.3	21.4	20.7	2.2	3.6	SSW	0	894.1	62
3/31/00	11:30a	21.8	21.8	23.1	20.9	1.8	4	SSW	0	894.1	59
3/31/00	11:45a	22.5	22.5	22.8	22.1	1.8	2.7	SSW	0	894.1	56
3/31/00	12:00p	22.6	22.6	23.3	22	1.8	3.6	SSW	0	894.2	53
3/31/00	12:15p	23.8	23.8	24.2	23.3	1.3	3.1	SW	0	894.2	50
3/31/00	12:30p	23.9	23.9	24.8	23.3	1.8	3.1	SSW	0	894.1	46
3/31/00	12:45p	23.3	23.3	24	21.6	1.8	3.6	SSW	0	894	41
3/31/00	1:00p	20.8	20.8	21.4	20.6	1.8	3.6	SSW	0	893.8	36
3/31/00	1:15p	20.6	20.6	20.9	20.4	1.8	3.1	SSW	0	893.4	36
3/31/00	1:45p	21.1	21.1	21.3	20.9	1.8	3.1	SW	0	893.2	36
3/31/00	2:00p	20.8	20.8	20.9	20.7	1.8	4	SSW	0	893.1	37
3/31/00	2:15p	21	21	21.2	20.8	1.8	3.1	SW	0	892.8	39
3/31/00	2:30p	21	21	21.1	20.9	1.8	3.1	SSW	0	892.8	40
3/31/00	2:45p	20.9	20.9	21.1	20.8	1.3	3.6	SSW	0	892.9	41
3/31/00	3:00p	21.1	21.1	21.3	20.9	1.8	4	SSW	0	892.8	41
3/31/00	3:15p	21	21	21.2	20.8	1.8	3.1	SSW	0	892.7	42
3/31/00	3:30p	21.1	21.1	21.2	20.9	1.3	2.7	SSW	0	892.8	43
3/31/00	3:45p	21.4	21.4	22.3	21	1.3	3.6	SSW	0	892.6	43
3/31/00	4:00p	21.9	21.9	22.3	21.4	1.8	3.6	SSW	0	892.8	43
3/31/00	4:15p	21.3	21.3	21.4	21.2	1.3	2.7	SSW	0	892.7	44
3/31/00	4:30p	21.4	21.4	21.6	21.2	1.3	2.7	SW	0	892.6	44
3/31/00	4:45p	21.3	21.3	21.6	21.2	0.9	2.2	SW	0	892.7	44
3/31/00	5:00p	21.1	21.1	21.4	20.9	1.3	2.7	SSW	0	892.7	44
3/31/00	5:15p	21.4	21.4	21.7	21	0.9	2.2	SSW	0	892.7	44
3/31/00	5:30p	20.7	20.7	21	20.5	0.9	1.8	SW	0	892.9	44
3/31/00	5:45p	20.7	20.7	21.1	20.3	0.9	1.3	SW	0	892.9	45
3/31/00	6:00p	20.1	20.1	20.3	19.8	0.4	1.8	SW	0	893.1	45
3/31/00	6:15p	19.5	19.5	19.8	19.3	0.4	0.9	SW	0	893.2	45
3/31/00	6:30p	18.5	18.5	19.3	17.8	0	0.4	SW	0	893.3	45
3/31/00	6:45p	17.3	17.3	17.8	16.9	0	0	---	0	893.4	45

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
3/31/00	7:00p	16.8	16.8	17	16.3	0	0.9	SW	0	893.7	45
3/31/00	7:15p	15.9	15.9	16.3	15.6	0	0.4	SW	0	893.9	46
3/31/00	7:30p	15.4	15.4	15.6	15	0	0	---	0	893.9	46
3/31/00	7:45p	14.7	14.7	14.9	14.4	0	0	---	0	894.2	47
3/31/00	8:00p	14.3	14.3	14.4	14.2	0	0	---	0	894.4	47
3/31/00	8:15p	14.1	14.1	14.2	13.9	0	0	---	0	894.7	47
3/31/00	8:30p	13.9	13.9	14	13.9	0	0	---	0	894.8	48
3/31/00	8:45p	13.6	13.6	13.9	13.3	0	0	---	0	894.9	49
3/31/00	9:00p	13.2	13.2	13.3	13.1	0	0	---	0	894.9	49
3/31/00	9:15p	13.1	13.1	13.1	13	0	0	---	0	895.1	50
3/31/00	9:30p	13.1	13.1	13.2	13.1	0	0	---	0	895.2	51
3/31/00	9:45p	13.1	13.1	13.2	13	0	0	---	0	895.2	51
3/31/00	10:00p	12.9	12.9	13	12.9	0	0	---	0	895.2	51
3/31/00	10:15p	12.7	12.7	12.8	12.7	0	0.4	SW	0	895.2	52
3/31/00	10:30p	12.7	12.7	12.8	12.3	0.4	0.9	SW	0	895.2	53
3/31/00	10:45p	12.3	12.3	12.3	12.2	0	0.9	SW	0	895.2	52
3/31/00	11:00p	12.3	12.3	12.4	12.1	0	0	---	0	895.1	54
3/31/00	11:15p	12.1	12.1	12.3	12	0	0	---	0	895	54
3/31/00	11:30p	11.8	11.8	12.2	11.6	0.4	0.9	SW	0	895	54
3/31/00	11:45p	11.7	11.7	11.8	11.6	0	0	---	0	894.9	55
4/01/00	12:00a	12.2	12.2	12.5	11.8	0	0	---	0	894.9	56
4/01/00	12:15a	12.8	12.8	13	12.6	0	0	---	0	894.6	56
4/01/00	12:30a	13.2	13.2	13.4	13	0	0	---	0	894.7	57
4/01/00	12:45a	13.6	13.6	13.7	13.4	0.9	1.3	SW	0	894.4	57
4/01/00	1:00a	13.9	13.9	14	13.7	1.3	1.8	SW	0	894.1	58
4/01/00	1:15a	14.1	14.1	14.2	14	1.3	2.2	SW	0	894.2	58
4/01/00	1:30a	14.3	14.3	14.4	14.2	1.3	1.8	SSW	0	894.2	58
4/01/00	1:45a	14.4	14.4	14.5	14.4	1.8	2.2	SSW	0	894.1	58
4/01/00	2:00a	14.6	14.6	14.7	14.5	1.8	2.7	SSW	0	894.1	58
4/01/00	2:15a	14.8	14.8	14.8	14.7	1.8	2.7	SSW	0	894	58
4/01/00	2:30a	14.7	14.7	14.8	14.6	1.8	2.7	SSW	0	893.7	58
4/01/00	2:45a	14.6	14.6	14.6	14.6	1.8	2.7	SSW	0	893.8	58
4/01/00	3:00a	14.7	14.7	14.8	14.6	1.8	2.7	SSW	0	893.7	58
4/01/00	3:15a	14.7	13.7	14.8	14.7	2.2	2.7	SSW	0	893.6	58
4/01/00	3:30a	14.9	13.9	15.1	14.8	2.2	3.1	SSW	0	893.7	58
4/01/00	3:45a	15	14	15.1	14.9	2.2	2.7	SSW	0	893.5	58
4/01/00	4:00a	14.8	14.8	14.9	14.6	1.8	2.7	SSW	0	893.5	58
4/01/00	4:15a	14.5	14.5	14.6	14.4	1.8	2.2	SW	0	893.6	57
4/01/00	4:30a	14.3	14.3	14.4	14.2	1.8	2.2	SW	0	893.5	57
4/01/00	4:45a	14.2	14.2	14.2	14.1	1.8	2.2	SSW	0	893.7	58
4/01/00	5:00a	14.2	14.2	14.3	14.1	1.8	2.7	SSW	0	893.8	58
4/01/00	5:15a	14.2	14.2	14.3	14.2	1.8	2.7	SSW	0	894	58
4/01/00	5:30a	14.1	14.1	14.2	14	1.8	2.2	SSW	0	894.1	58
4/01/00	5:45a	13.9	13.9	14	13.8	1.8	2.2	SSW	0	894.3	58
4/01/00	6:00a	13.8	13.8	13.9	13.8	1.8	2.7	SSW	0	894.4	58
4/01/00	6:15a	13.7	13.7	13.8	13.6	1.8	2.2	SSW	0	894.7	58
4/01/00	6:30a	13.5	13.5	13.6	13.4	1.3	1.8	SSW	0	894.7	58

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/01/00	6:45a	13.3	13.3	13.4	13.3	1.3	1.8	SSW	0	895.1	58
4/01/00	7:00a	13.2	13.2	13.3	13.2	1.3	1.8	SSW	0	895.2	58
4/01/00	7:15a	13.2	13.2	13.2	13.1	1.3	1.8	SSW	0	895.2	58
4/01/00	7:30a	13.2	13.2	13.3	13.1	1.3	1.8	SSW	0	895.4	59
4/01/00	7:45a	13.4	13.4	13.6	13.3	1.3	1.8	SSW	0	895.7	59
4/01/00	8:00a	13.7	13.7	14.1	13.6	1.3	1.8	SSW	0	895.9	59
4/01/00	8:15a	14.1	14.1	14.4	14.1	1.3	1.3	SSW	0	896	60
4/01/00	8:30a	15.1	15.1	15.9	14.4	1.3	1.3	SSW	0	896.1	61
4/01/00	8:45a	16.6	16.6	17.1	16.1	0.9	1.8	SSW	0	896.1	63
4/01/00	9:00a	16.7	16.7	16.8	16.6	1.3	2.2	SSW	0	896.2	63
4/01/00	9:15a	16.8	16.8	16.9	16.8	1.3	1.8	SSW	0	896.2	62
4/01/00	9:30a	16.7	16.7	16.8	16.7	0.9	1.8	SSW	0	896.4	60
4/01/00	9:45a	16.8	16.8	16.8	16.7	0.9	1.3	SSW	0	896.6	60
4/01/00	10:00a	17.1	17.1	17.4	16.8	0.9	1.8	SSW	0	896.5	60
4/01/00	10:15a	17.9	17.9	18.3	17.4	1.3	1.8	SSW	0	896.5	60
4/01/00	10:30a	17.9	17.9	18.1	17.8	1.3	2.2	SSW	0	896.4	59
4/01/00	10:45a	18.6	18.6	19	18.2	1.3	2.7	SSW	0	896.6	59
4/01/00	11:00a	18.7	18.7	18.9	18.6	0.9	1.8	SSW	0	896.3	59
4/01/00	11:15a	18.9	18.9	19.3	18.8	0.9	1.8	SSW	0	896.3	59
4/01/00	11:30a	19.7	19.7	19.9	19.4	0.4	1.8	SSW	0	896.3	58
4/01/00	11:45a	19.8	19.8	20.2	19.7	0.4	1.3	SSW	0	896.3	58
4/01/00	12:00p	21.2	21.2	22.6	20.2	0.4	1.8	SSW	0	896.3	59
4/01/00	12:15p	22	22	22.6	21.2	0.4	1.3	SSW	0	896.2	59
4/01/00	12:30p	20.1	20.1	21.2	19.3	0.9	1.3	SSE	0	896.2	56
4/01/00	12:45p	17.8	17.8	19.3	15.8	0.4	1.3	SSE	0.4	896.3	52
4/01/00	1:00p	14.9	14.9	15.8	14.4	0.4	1.3	SSE	0.8	896.4	51
4/01/00	1:15p	14.4	14.4	14.7	14.3	0.9	1.3	S	0.8	896.5	53
4/01/00	1:30p	14.7	14.7	14.8	14.6	0.4	1.3	S	0	896.8	56
4/01/00	1:45p	14.3	14.3	14.6	14	0.4	1.3	S	0.2	896.3	58
4/01/00	2:00p	13.9	13.9	14.1	13.8	0.4	0.9	S	0	896.3	59
4/01/00	2:15p	14.1	14.1	14.1	13.9	0	0.4	S	0.2	896	60
4/01/00	2:30p	14.1	14.1	14.2	14.1	0.4	1.3	S	0.4	896.5	61
4/01/00	2:45p	13.7	13.7	14	13.5	0	0.9	S	0.4	896.1	62
4/01/00	3:00p	13.9	13.9	14	13.7	0.4	0.9	S	0	896	63
4/01/00	3:15p	13.8	13.8	13.8	13.7	0	0	---	0	896.2	63
4/01/00	3:30p	13.7	13.7	13.7	13.6	0.4	0.9	SSW	0	896.1	64
4/01/00	3:45p	13.8	13.8	14	13.7	0	0.4	SSW	0	896.2	65
4/01/00	4:00p	14	14	14.1	13.9	0	0	---	0	896.1	66
4/01/00	4:15p	14.1	14.1	14.1	14	0	1.3	SSW	0	896.1	66
4/01/00	4:30p	14.3	14.3	14.4	14.1	0.9	1.3	SSW	0	895.9	67
4/01/00	4:45p	14.3	14.3	14.3	14.2	0.4	1.3	SSW	0	896	68
4/01/00	5:00p	13.9	13.9	14.2	13.7	0	0	---	0	896.5	68
4/01/00	5:15p	13.7	13.7	13.7	13.6	0	0	---	0	896.8	68
4/01/00	5:30p	13.6	13.6	13.7	13.6	0	0	---	0	896.7	68
4/01/00	5:45p	13.6	13.6	13.6	13.6	0	0	---	0	897.1	69
4/01/00	6:00p	13.4	13.4	13.6	13.3	0	1.3	ESE	0	897.1	69
4/01/00	6:15p	13.2	13.2	13.3	13.1	0	0	---	0	897.1	70

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/01/00	6:30p	12.9	12.9	13.1	12.7	0	0.9	N	0	897.1	70
4/01/00	6:45p	12.6	12.6	12.7	12.4	0	0	---	0	897.4	69
4/01/00	7:00p	12.3	12.3	12.4	12.3	0	0	---	0	897.5	70
4/01/00	7:15p	12.2	12.2	12.3	12.2	0	0	---	0	897.7	70
4/01/00	7:30p	12.2	12.2	12.3	12.2	0	0	---	0	898.1	70
4/01/00	7:45p	12.2	12.2	12.2	12.2	0	0	---	0	898.4	70
4/01/00	8:00p	12.2	12.2	12.2	12.2	0	0	---	0	898.3	70
4/01/00	8:15p	12.1	12.1	12.2	12.1	0	0	---	0	898.5	70
4/01/00	8:30p	12	12	12.1	11.9	0	0	---	0	898.6	71
4/01/00	8:45p	11.9	11.9	12	11.9	0	0	---	0	898.9	71
4/01/00	9:00p	11.9	11.9	12	11.9	0	0	---	0	899	71
4/01/00	9:15p	11.9	11.9	11.9	11.9	0	0	---	0	899.1	71
4/01/00	9:30p	11.9	11.9	11.9	11.8	0	0	---	0	899.2	71
4/01/00	9:45p	11.9	11.9	11.9	11.8	0	0	---	0	899.2	71
4/01/00	10:00p	12.1	12.1	12.2	11.9	0	0.4	N	0	899.2	72
4/01/00	10:15p	12.3	12.3	12.3	12.2	0	0.4	---	0	899.3	72
4/01/00	10:30p	12.3	12.3	12.3	12.3	0	0	---	0	899.4	72
4/01/00	10:45p	12.3	12.3	12.4	12.3	0	0	---	0	899.5	72
4/01/00	11:00p	12.4	12.4	12.4	12.4	0	0	---	0	899.4	73
4/01/00	11:15p	12.4	12.4	12.4	12.3	0	0	---	0	899.3	73
4/01/00	11:30p	12.3	12.3	12.3	12.3	0	0	---	0	899.2	73
4/01/00	11:45p	12.4	12.4	12.4	12.3	0.4	1.3	NW	0	899.1	73
4/02/00	12:00a	12.4	12.4	12.5	12.4	0	1.3	N	0	899.2	73
4/02/00	12:15a	12.5	12.5	12.5	12.4	0	1.3	N	0	899.2	74
4/02/00	12:30a	12.4	12.4	12.5	12.4	0	1.3	N	0	899.1	74
4/02/00	12:45a	12.5	12.5	12.6	12.4	0.4	0.9	N	0	898.9	74
4/02/00	1:00a	12.6	12.6	12.6	12.6	0.4	2.2	N	0.2	898.9	75
4/02/00	1:15a	12.6	12.6	12.6	12.6	0.4	1.8	N	0	899	75
4/02/00	1:30a	12.6	12.6	12.7	12.6	0.9	2.2	N	0	898.8	75
4/02/00	1:45a	12.6	12.6	12.6	12.6	0.9	2.2	NNW	0	898.6	75
4/02/00	2:00a	12.6	12.6	12.6	12.6	0.9	2.2	N	0	898.5	76
4/02/00	2:15a	12.6	12.6	12.6	12.5	0.4	1.8	N	0	898.4	76
4/02/00	2:30a	12.4	12.4	12.5	12.4	0.4	1.3	NE	0	898.6	76
4/02/00	2:45a	12.4	12.4	12.4	12.4	0.4	1.8	E	0	898.6	76
4/02/00	3:00a	12.4	12.4	12.4	12.3	0.4	1.8	NNE	0	898.5	76
4/02/00	3:15a	12.4	12.4	12.4	12.4	0	1.3	N	0	898.7	76
4/02/00	3:30a	12.4	12.4	12.4	12.4	0	0.9	NE	0	898.4	76
4/02/00	3:45a	12.4	12.4	12.4	12.4	0	0.4	N	0	898.1	76
4/02/00	4:00a	12.5	12.5	12.5	12.4	0	0.9	N	0	898.2	77
4/02/00	4:15a	12.5	12.5	12.6	12.5	0	0.9	N	0	898.2	77
4/02/00	4:30a	12.6	12.6	12.6	12.6	0	0.9	N	0	898.2	77
4/02/00	4:45a	12.7	12.7	12.8	12.6	0.4	1.8	WNW	0	898.1	77
4/02/00	5:00a	12.8	12.8	12.9	12.8	0.4	1.8	N	0	898.4	78
4/02/00	5:15a	12.9	12.9	12.9	12.9	0.4	1.8	N	0.2	898.1	78
4/02/00	5:30a	12.9	12.9	12.9	12.8	0.9	3.1	N	0.2	898.2	78
4/02/00	5:45a	12.8	12.8	12.8	12.8	0.4	1.8	N	0.2	898.1	79
4/02/00	6:00a	12.8	12.8	12.8	12.8	0	1.3	NNW	0	898.6	78

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/02/00	6:15a	12.8	12.8	12.8	12.8	0	0.9	N	0	899	78
4/02/00	6:30a	12.8	12.8	12.8	12.8	0.4	2.2	N	0	899.1	79
4/02/00	6:45a	12.8	12.8	12.8	12.8	0	0.4	---	0.6	899.6	79
4/02/00	7:00a	12.8	12.8	12.8	12.8	0.4	1.3	N	0.8	899.4	79
4/02/00	7:15a	12.8	12.8	12.8	12.8	0	0.9	NNW	0.2	899.3	79
4/02/00	7:30a	12.7	12.7	12.8	12.7	0.4	1.3	NNW	0.2	899.5	79
4/02/00	7:45a	12.7	12.7	12.8	12.7	0.4	1.8	N	0	899.5	79
4/02/00	8:00a	12.7	12.7	12.8	12.7	0.4	1.3	N	0.2	899.5	79
4/02/00	8:15a	12.8	12.8	12.8	12.8	0	1.3	N	0.8	899.9	79
4/02/00	8:30a	12.8	12.8	12.8	12.8	0	0.4	N	0.2	900.2	79
4/02/00	8:45a	12.8	12.8	12.9	12.8	0.4	0.9	N	0.2	900.2	79
4/02/00	9:00a	12.9	12.9	12.9	12.9	0.4	1.3	N	0	900.5	80
4/02/00	9:15a	12.9	12.9	13	12.9	0.4	1.8	N	0	900.4	80
4/02/00	9:30a	13.1	13.1	13.1	13	0.4	1.3	NNW	0	900.3	80
4/02/00	9:45a	13.1	13.1	13.1	13.1	0.4	1.3	NNW	0	900.5	80
4/02/00	10:00a	13.1	13.1	13.1	12.9	0.4	1.3	N	0	900.4	81
4/02/00	10:15a	13	13	13.1	13	0.4	2.2	N	0	900.6	81
4/02/00	10:30a	13.1	13.1	13.1	13	0	0.9	N	0	900.6	81
4/02/00	10:45a	13.1	13.1	13.1	13	0.4	1.3	NNW	0.2	900.5	81
4/02/00	11:00a	13.1	13.1	13.1	13.1	0.4	1.8	NNW	0	900	81
4/02/00	11:15a	13.1	13.1	13.1	13.1	0.4	1.3	N	0	900.2	81
4/02/00	11:30a	13.1	13.1	13.2	13.1	0	0.9	N	0	900.3	81
4/02/00	11:45a	13.2	13.2	13.3	13.1	0.4	1.3	NNW	0	900	81
4/02/00	12:00p	13.2	13.2	13.3	13.2	0.4	2.2	NNW	0	899.6	82
4/02/00	12:15p	13.3	13.3	13.3	13.3	0.4	1.8	NNW	0	899.4	82
4/02/00	12:30p	13.4	13.4	13.4	13.3	0.9	1.8	N	0	899.1	82
4/02/00	12:45p	13.6	13.6	13.7	13.4	0	1.3	N	0.2	899.6	82
4/02/00	1:00p	13.4	13.4	13.4	13.4	0.4	1.3	N	0	899.5	82
4/02/00	1:15p	13.5	13.5	13.6	13.4	0.4	1.8	NNW	0	899.1	82
4/02/00	1:30p	13.6	13.6	13.7	13.5	0.4	1.8	NNE	0	898.7	82
4/02/00	1:45p	13.6	13.6	13.7	13.6	0	0.9	N	0	898.8	82
4/02/00	2:00p	13.8	13.8	14	13.6	0	1.3	N	0	898.6	82
4/02/00	2:15p	14.1	14.1	14.3	13.9	0	0.9	N	0	898.5	82
4/02/00	2:30p	14.4	14.4	14.6	14.2	0.4	1.3	N	0	898.3	83
4/02/00	2:45p	14.6	14.6	14.7	14.4	0.4	0.9	N	0	898.1	83
4/02/00	3:00p	14.8	14.8	14.9	14.7	0.4	1.8	N	0	898	83
4/02/00	3:15p	14.7	14.7	14.9	14.6	0.4	1.3	N	0	897.8	83
4/02/00	3:30p	15.2	15.2	15.4	14.9	0.4	1.3	N	0	897.7	83
4/02/00	3:45p	15.2	15.2	15.2	15.2	0	1.8	NNE	0	897.7	83
4/02/00	4:00p	15.4	15.4	15.4	15.2	0	1.3	N	0	897.7	83
4/02/00	4:15p	15.2	15.2	15.3	15.1	0.4	1.3	N	0	897.6	83
4/02/00	4:30p	15.2	15.2	15.3	15.1	0	0.9	NNE	0	897.4	83
4/02/00	4:45p	15.1	15.1	15.1	15	0	0	---	0	897.3	83
4/02/00	5:00p	14.9	14.9	15	14.9	0	0.9	NNE	0	897.4	82
4/02/00	5:15p	15.1	15.1	15.2	15.1	0	0	---	0	897.4	82
4/02/00	5:30p	15.1	15.1	15.2	15	0	0	---	0	897.3	82
4/02/00	5:45p	14.8	14.8	15	14.6	0	0.4	NNW	0	897.3	83

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/02/00	6:00p	14.5	14.5	14.6	14.4	0	0	---	0	897.2	82
4/02/00	6:15p	14.3	14.3	14.4	14.2	0	0	---	0	897.4	82
4/02/00	6:30p	14.1	14.1	14.2	14	0	0	---	0	897	82
4/02/00	6:45p	13.9	13.9	14	13.8	0	0	---	0	897.4	82
4/02/00	7:00p	13.7	13.7	13.8	13.6	0	0	---	0	897.5	82
4/02/00	7:15p	13.5	13.5	13.6	13.4	0	0	---	0	897.8	82
4/02/00	7:30p	13.3	13.3	13.4	13.2	0	0	---	0	897.8	82
4/02/00	7:45p	13.2	13.2	13.2	13.1	0	0.4	NNW	0	898	82
4/02/00	8:00p	13	13	13.1	12.9	0	0	---	0	898.1	82
4/02/00	8:15p	12.8	12.8	12.9	12.6	0	0	---	0	898.1	82
4/02/00	8:30p	12.6	12.6	12.6	12.6	0	0	---	0	898.2	82
4/02/00	8:45p	12.4	12.4	12.6	12.3	0	0	---	0	898.2	82
4/02/00	9:00p	12.2	12.2	12.3	12.2	0	0	---	0	898.2	82
4/02/00	9:15p	12.2	12.2	12.2	12.1	0	0	---	0	898.3	82
4/02/00	9:30p	12.1	12.1	12.2	12.1	0	0	---	0	898.2	82
4/02/00	9:45p	12.1	12.1	12.1	12.1	0	0	---	0	898.4	82
4/02/00	10:00p	12.2	12.2	12.2	12.1	0	0	---	0	898.3	82
4/02/00	10:15p	12.6	12.6	12.8	12.2	0	0.4	---	0	898.4	83
4/02/00	10:30p	12.6	12.6	12.7	12.4	0	0	---	0	898.4	83
4/02/00	10:45p	12.4	12.4	12.6	12.4	0	0.9	N	0	898.3	83
4/02/00	11:00p	12.5	12.5	12.7	12.3	0	0.4	N	0	898.5	83
4/02/00	11:15p	12.5	12.5	12.8	12.4	0	1.3	N	0	898.3	83
4/02/00	11:30p	12.7	12.7	12.8	12.6	0	0.9	N	0	898.3	83
4/02/00	11:45p	12.6	12.6	12.9	12.5	0	2.2	NE	0	897.9	83
4/03/00	12:00a	12.8	12.8	12.9	12.8	0	1.3	N	0	897.8	83
4/03/00	12:15a	12.7	12.7	12.9	12.5	0	2.2	N	0	897.9	84
4/03/00	12:30a	12.7	12.7	12.8	12.6	0.4	1.8	NNE	0	897.8	84
4/03/00	12:45a	12.6	12.6	12.7	12.5	0.4	1.8	NNE	0	897.7	84
4/03/00	1:00a	12.7	12.7	12.8	12.6	0.4	1.3	N	0	897.6	84
4/03/00	1:15a	12.8	12.8	12.8	12.7	0.4	1.3	N	0	897.5	84
4/03/00	1:30a	12.6	12.6	12.8	12.5	0.4	1.8	N	0	897.5	84
4/03/00	1:45a	12.4	12.4	12.6	12.3	0.4	1.8	N	0	897.2	84
4/03/00	2:00a	12.3	12.3	12.4	12.2	0.4	1.8	N	0	897.2	84
4/03/00	2:15a	12.2	12.2	12.3	12.1	0	0.4	N	0	897	84
4/03/00	2:30a	12.2	12.2	12.3	12.2	0	0	---	0	897	84
4/03/00	2:45a	12.2	12.2	12.3	12.2	0	0.4	---	0	896.8	84
4/03/00	3:00a	12.4	12.4	12.6	12.3	0	0.4	---	0	896.6	84
4/03/00	3:15a	12.6	12.6	12.7	12.6	0	0.4	N	0	896.5	84
4/03/00	3:30a	12.7	12.7	12.8	12.7	0	0.9	N	0	896.3	84
4/03/00	3:45a	12.4	12.4	12.7	12.1	0.4	0.9	N	0	896.2	84
4/03/00	4:00a	12	12	12.1	11.9	0.4	1.3	W	0	896.3	84
4/03/00	4:15a	11.9	11.9	12	11.9	0.4	0.9	W	0	896	84
4/03/00	4:30a	12	12	12	11.9	0.4	0.9	W	0	896	84
4/03/00	4:45a	12	12	12.1	11.9	0.9	0.9	W	0	896	85
4/03/00	5:00a	12.2	12.2	12.3	12.1	0.9	0.9	W	0	896.1	85
4/03/00	5:15a	12.4	12.4	12.4	12.3	0.9	0.9	W	0	896.2	85
4/03/00	5:30a	12.4	12.4	12.4	12.3	0.9	1.3	W	0	896.2	86

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/03/00	5:45a	12.4	12.4	12.4	12.4	0.9	1.3	W	0	896.2	86
4/03/00	6:00a	12.4	12.4	12.5	12.3	0.9	1.3	WSW	0	896.3	86
4/03/00	6:15a	12.6	12.6	12.7	12.5	0.9	1.3	WSW	0	896.3	86
4/03/00	6:30a	12.9	12.9	13.1	12.7	0.9	1.3	WSW	0	896.4	86
4/03/00	6:45a	13.2	13.2	13.3	13.1	0.9	1.3	WSW	0	896.5	86
4/03/00	7:00a	13.3	13.3	13.4	13.3	0.9	1.3	WSW	0	896.6	86
4/03/00	7:15a	13.3	13.3	13.4	13.2	0.9	1.3	WSW	0	896.7	86
4/03/00	7:30a	13.5	13.5	13.6	13.3	0.9	1.3	WSW	0	896.7	86
4/03/00	7:45a	13.4	13.4	13.6	13.3	0.9	1.3	WSW	0	896.8	86
4/03/00	8:00a	13.7	13.7	14	13.5	0.9	1.3	WSW	0	896.8	87
4/03/00	8:15a	14.2	14.2	14.7	13.9	0.9	1.3	SW	0	896.9	87
4/03/00	8:30a	17.1	17.1	18	14.7	0.9	1.3	SW	0	897	92
4/03/00	8:45a	17.7	17.7	18	17	0.9	1.3	SW	0	897	96
4/03/00	9:00a	16.7	16.7	17	16.6	0.4	1.3	SW	0	897	93
4/03/00	9:15a	16.6	16.6	16.7	16.5	0.9	1.8	SW	0	897	90
4/03/00	9:30a	17	17	17.2	16.7	0.9	1.8	SSW	0	897.1	88
4/03/00	9:45a	17.5	17.5	17.8	17.2	0.9	1.8	SW	0	897.3	88
4/03/00	10:00a	18.2	18.2	18.7	17.8	0.9	1.8	SSW	0	897.1	87
4/03/00	10:15a	19.3	19.3	19.8	18.8	0.9	1.8	SSW	0	897.2	88
4/03/00	10:30a	20.2	20.2	20.7	19.9	0.9	2.2	SSW	0	897.1	89
4/03/00	10:45a	21.6	21.6	22.2	20.7	1.3	2.2	SSW	0	896.7	90
4/03/00	11:00a	22.4	22.4	23.1	21.2	0.9	2.7	SW	0	896.7	87
4/03/00	11:15a	22.6	22.6	22.9	22.2	1.8	3.1	SW	0	896.5	81
4/03/00	11:30a	22.5	22.5	23.4	21.8	1.3	2.2	SW	0	896.5	77
4/03/00	11:45a	22.8	22.8	23.7	20.6	1.3	3.1	SSW	0	896.7	73
4/03/00	12:00p	21.3	21.3	21.9	20.2	1.8	2.7	SW	0	896.5	68
4/03/00	12:15p	22.3	22.3	22.9	21.3	1.8	3.1	SSW	0	896.4	66
4/03/00	12:30p	21.2	21.2	22.2	20.2	1.8	3.6	SW	0	896.3	62
4/03/00	12:45p	20.4	20.4	20.7	20	1.8	3.6	SW	0	896.1	60
4/03/00	1:00p	19.9	19.9	20.3	19.8	1.3	3.1	SSW	0	895.7	60
4/03/00	1:15p	20.2	20.2	20.4	19.8	1.8	2.7	SW	0	895.6	61
4/03/00	1:30p	20	20	20.2	19.8	1.8	3.1	SW	0	895.4	62
4/03/00	1:45p	20.3	20.3	20.7	19.9	1.8	3.1	SW	0	895.2	64
4/03/00	2:00p	20.7	20.7	20.9	20.6	1.8	4	SW	0	894.9	64
4/03/00	2:15p	21	21	21.2	20.7	1.8	3.1	SSW	0	894.8	65
4/03/00	2:30p	20.8	20.8	21.2	20.6	1.3	3.1	SW	0	894.8	65
4/03/00	2:45p	20.6	20.6	20.8	20.4	1.3	2.7	SW	0	894.8	65
4/03/00	3:00p	20.4	20.4	20.6	20.2	1.3	2.7	SW	0	894.8	65
4/03/00	3:15p	20.2	20.2	20.3	20.2	1.3	2.2	SSW	0	894.9	65
4/03/00	3:30p	20.6	20.6	20.8	20.3	1.3	2.2	SSW	0	894.7	66
4/03/00	3:45p	20.9	20.9	21.4	20.6	1.3	2.2	SW	0	894.6	66
4/03/00	4:00p	21.4	21.4	21.7	21.1	1.3	2.2	SW	0	894.6	66
4/03/00	4:15p	20.7	20.7	21	20.6	1.3	2.7	SW	0	894.4	66
4/03/00	4:30p	20.8	20.8	21	20.7	0.9	2.2	SW	0	894.2	66
4/03/00	4:45p	20.7	20.7	20.9	20.5	1.3	2.2	SSW	0	894.4	66
4/03/00	5:00p	20.1	20.1	20.5	20	0.9	1.8	SW	0	894.4	66
4/03/00	5:15p	20.2	20.2	20.3	19.9	0.9	2.2	SW	0	894.3	66

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/03/00	5:30p	19.6	19.6	19.9	19.4	0.9	1.8	SW	0	894.4	66
4/03/00	5:45p	19.3	19.3	19.5	19	0.9	1.3	SW	0	894.4	66
4/03/00	6:00p	19.1	19.1	19.2	18.9	0.9	1.8	SW	0	894.6	66
4/03/00	6:15p	19.1	19.1	19.2	18.9	0.9	1.3	SW	0	894.6	67
4/03/00	6:30p	18.6	18.6	18.9	18.3	0.4	1.8	SW	0	894.8	67
4/03/00	6:45p	18	18	18.3	17.8	0	1.3	SW	0	895.1	67
4/03/00	7:00p	17.5	17.5	17.7	17.3	0	0	---	0	895.1	67
4/03/00	7:15p	17.2	17.2	17.3	16.9	0	0	---	0	895.4	67
4/03/00	7:30p	16.8	16.8	16.9	16.7	0	0	---	0	895.6	67
4/03/00	7:45p	16.6	16.6	16.7	16.5	0	0	---	0	895.7	68
4/03/00	8:00p	16.4	16.4	16.5	16.2	0	0	---	0	895.8	68
4/03/00	8:15p	16.1	16.1	16.2	15.9	0	0	---	0	896	68
4/03/00	8:30p	15.9	15.9	15.9	15.8	0	0	---	0	896	69
4/03/00	8:45p	16	16	16.1	15.9	0	0	---	0	896.2	69
4/03/00	9:00p	16.1	16.1	16.1	16	0	0	---	0	896.4	70
4/03/00	9:15p	15.9	15.9	16	15.8	0	0	---	0	896.3	70
4/03/00	9:30p	15.8	15.8	15.9	15.8	0	0	---	0	896.3	70
4/03/00	9:45p	15.9	15.9	15.9	15.8	0	0	---	0	896.3	70
4/03/00	10:00p	15.7	15.7	15.8	15.6	0	0	---	0	896.3	71
4/03/00	10:15p	15.8	15.8	15.9	15.7	0	0	---	0	896.4	72
4/03/00	10:30p	16.1	16.1	16.2	15.9	0.4	1.8	SW	0	896.4	73
4/03/00	10:45p	16.2	16.2	16.3	16.2	0.9	1.8	SW	0	896.3	74
4/03/00	11:00p	16.2	16.2	16.3	16.1	0.9	1.3	SW	0	896.1	74
4/03/00	11:15p	16.2	16.2	16.2	16.1	0.9	1.3	SW	0	895.8	75
4/03/00	11:30p	16.3	16.3	16.3	16.2	0.9	1.8	SW	0	896.2	76
4/03/00	11:45p	16.1	16.1	16.2	16	0.9	1.3	SW	0	896.2	76
4/04/00	12:00a	16	16	16.1	16	0.9	1.3	SW	0	896	77
4/04/00	12:15a	16.2	16.2	16.2	16.1	0.9	1.3	SW	0	896.2	78
4/04/00	12:30a	16.1	16.1	16.1	16.1	1.3	1.8	SW	0	896.1	78
4/04/00	12:45a	16.2	16.2	16.2	16.1	0.9	1.3	SW	0	896	79
4/04/00	1:00a	16.2	16.2	16.3	16.2	0.9	1.3	SW	0	896	79
4/04/00	1:15a	16.2	16.2	16.2	16.1	0.9	1.3	SW	0	895.9	79
4/04/00	1:30a	16.1	16.1	16.1	16	0.9	1.8	SW	0	895.9	79
4/04/00	1:45a	15.9	15.9	16	15.8	1.3	1.8	SW	0	895.8	80
4/04/00	2:00a	15.7	15.7	15.8	15.6	1.3	1.8	SW	0	895.7	80
4/04/00	2:15a	15.7	15.7	15.7	15.7	1.8	2.2	SW	0	895.6	80
4/04/00	2:30a	15.7	15.7	15.7	15.6	1.3	2.2	SSW	0	895.3	80
4/04/00	2:45a	15.7	15.7	15.7	15.6	1.8	2.7	SSW	0	895.1	80
4/04/00	3:00a	15.6	15.6	15.7	15.4	1.8	2.2	SSW	0	894.9	80
4/04/00	3:15a	15.3	15.3	15.4	15.3	1.8	2.2	SSW	0	895	80
4/04/00	3:30a	15.2	15.2	15.3	15.2	1.8	2.2	SW	0	894.7	80
4/04/00	3:45a	15.2	15.2	15.2	15.2	1.3	2.2	SSW	0	894.7	80
4/04/00	4:00a	14.9	14.9	15.2	14.7	1.3	1.8	SSW	0	894.6	80
4/04/00	4:15a	14.7	14.7	14.7	14.6	1.3	1.8	SSW	0	894.6	80
4/04/00	4:30a	14.6	14.6	14.7	14.5	1.3	1.8	SSW	0	894.6	81
4/04/00	4:45a	14.6	14.6	14.7	14.3	0.9	1.3	SSW	0	894.5	81
4/04/00	5:00a	14.2	14.2	14.3	14.1	0.4	0.9	SSW	0	894.7	80

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/04/00	5:15a	14.2	14.2	14.2	14.1	0.4	0.9	SSW	0	894.6	80
4/04/00	5:30a	13.8	13.8	14.2	13.6	0.4	0.9	SSW	0	894.6	80
4/04/00	5:45a	13.4	13.4	13.6	13.2	0	0.9	SSW	0	894.8	80
4/04/00	6:00a	13	13	13.2	12.9	0.4	0.9	SSW	0	894.8	80
4/04/00	6:15a	13	13	13.1	13	0.4	0.9	SSW	0	895	80
4/04/00	6:30a	13.2	13.2	13.4	13.1	0.4	0.9	SSW	0	895.2	81
4/04/00	6:45a	13.5	13.5	13.6	13.3	0.4	0.9	SSW	0	895.4	81
4/04/00	7:00a	13.4	13.4	13.4	13.3	0	0	---	0	895.4	81
4/04/00	7:15a	13.6	13.6	13.9	13.3	0	0.4	SSW	0	895.6	81
4/04/00	7:30a	13.9	13.9	14.1	13.6	0	0.4	SSW	0	895.7	81
4/04/00	7:45a	13.9	13.9	14.2	13.6	0	0	---	0	895.7	82
4/04/00	8:00a	14	14	14.4	13.8	0	0.9	NW	0	896	82
4/04/00	8:15a	14.5	14.5	15	14.2	0.4	1.3	NNW	0	896.2	82
4/04/00	8:30a	16.6	16.6	17.2	15.1	0.9	1.8	NNW	0	896.1	88
4/04/00	8:45a	16.6	16.6	16.9	16	0.4	1.3	N	0	896.2	91
4/04/00	9:00a	15.1	15.1	15.9	14.6	0.9	1.8	N	0	896.4	86
4/04/00	9:15a	14.4	14.4	14.6	14.3	0.4	1.3	N	0	896.4	83
4/04/00	9:30a	14.3	14.3	14.4	14.2	0.4	1.3	NNW	0	896.7	81
4/04/00	9:45a	14.3	14.3	14.3	14.2	0.4	1.8	NNW	0	896.5	81
4/04/00	10:00a	14.3	14.3	14.3	14.2	0.4	1.8	N	0	897	81
4/04/00	10:15a	14.3	14.3	14.4	14.2	0	1.3	NNW	0	897	82
4/04/00	10:30a	14.4	14.4	14.4	14.4	0.4	1.3	NNW	0	896.9	82
4/04/00	10:45a	14.4	14.4	14.5	14.4	0.4	1.3	NNW	0	897.2	82
4/04/00	11:00a	14.4	14.4	14.5	14.3	0.4	1.3	NNE	0	897.1	82
4/04/00	11:15a	14.4	14.4	14.5	14.3	0.4	1.3	N	0	896.9	83
4/04/00	11:30a	14.5	14.5	14.6	14.4	0.4	1.3	NNW	0.4	897.1	83
4/04/00	11:45a	14.6	14.6	14.7	14.3	0.4	0.9	NNW	0	897.2	83
4/04/00	12:00p	14.4	14.4	14.6	14.3	0.4	2.2	NNW	0.2	897	83
4/04/00	12:15p	14.6	14.6	14.8	14.5	0.4	1.8	NNE	0	896.6	83
4/04/00	12:30p	14.6	14.6	14.7	14.4	0.4	1.3	N	0	896.3	83
4/04/00	12:45p	14.5	14.5	14.6	14.4	0.4	1.8	N	0.2	896.5	83
4/04/00	1:00p	14.3	14.3	14.4	14.2	0.9	1.3	N	0	896.3	83
4/04/00	1:15p	14.4	14.4	14.6	14.3	0.4	1.8	N	0	896.2	83
4/04/00	1:30p	14.7	14.7	14.9	14.5	0.4	1.8	N	0	895.9	83
4/04/00	1:45p	14.9	14.9	15.1	14.7	0.4	1.3	N	0	895.6	84
4/04/00	2:00p	15.1	15.1	15.3	14.9	0.4	1.8	N	0	895.2	84
4/04/00	2:15p	15.4	15.4	15.7	15.2	0.4	1.3	N	0	895.2	84
4/04/00	2:30p	15.8	15.8	16.1	15.6	0.4	1.8	NNW	0	895.2	85
4/04/00	2:45p	16.4	16.4	16.6	15.9	0	1.3	N	0	894.9	85
4/04/00	3:00p	16.3	16.3	16.6	16.1	0	2.2	NNE	0	894.6	85
4/04/00	3:15p	16.4	16.4	16.6	16.2	0	1.3	NNE	0	894.7	85
4/04/00	3:30p	16.1	16.1	16.4	15.9	0.4	1.3	NNE	0	894.4	84
4/04/00	3:45p	16.1	16.1	16.3	15.8	0.4	1.8	NE	0	894	84
4/04/00	4:00p	16.1	16.1	16.3	15.9	0.4	2.2	NNW	0	894.1	84
4/04/00	4:15p	16.2	16.2	16.2	16.1	0.4	2.7	NE	0	894	84
4/04/00	4:30p	16	16	16.1	15.9	0.4	1.3	NNE	0	894	83
4/04/00	4:45p	16.2	16.2	16.3	16.1	0.4	2.2	NNE	0	893.5	83

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/04/00	5:00p	16.3	16.3	16.3	16.2	0	1.3	N	0	893.4	84
4/04/00	5:15p	16.1	16.1	16.3	15.8	0.4	1.3	N	0	893.3	83
4/04/00	5:30p	15.7	15.7	15.8	15.6	0.4	1.3	NNE	0	893.5	83
4/04/00	5:45p	15.5	15.5	15.6	15.4	0.4	0.9	N	0	893.3	83
4/04/00	6:00p	15.3	15.3	15.4	15.2	0.4	1.3	N	0	893.4	83
4/04/00	6:15p	15.1	15.1	15.2	15.1	0	0.4	N	0	893.6	83
4/04/00	6:30p	14.9	14.9	15.1	14.7	0.4	1.3	N	0	893.6	83
4/04/00	6:45p	14.6	14.6	14.7	14.6	0	1.3	N	0	893.9	83
4/04/00	7:00p	14.6	14.6	14.6	14.5	0.4	1.8	N	0	893.6	83
4/04/00	7:15p	14.4	14.4	14.5	14.4	0.4	1.3	N	0	893.4	83
4/04/00	7:30p	14.3	14.3	14.4	14.3	0.4	1.3	N	0	893.8	83
4/04/00	7:45p	14.2	14.2	14.3	14.2	0	1.3	N	0	893.8	83
4/04/00	8:00p	14.1	14.1	14.2	14.1	0.4	1.3	N	0	893.8	83
4/04/00	8:15p	14.1	14.1	14.1	14.1	0.4	1.3	N	0	893.7	83
4/04/00	8:30p	14.1	14.1	14.1	14	0.4	1.3	N	0	893.7	84
4/04/00	8:45p	13.9	13.9	14	13.9	0	0.9	N	0	893.4	84
4/04/00	9:00p	13.9	13.9	13.9	13.9	0	1.8	N	0	893.5	84
4/04/00	9:15p	14	14	14.1	13.9	0	1.3	N	0	893.5	84
4/04/00	9:30p	14.1	14.1	14.1	14.1	0	0.9	NNE	0	893.6	84
4/04/00	9:45p	14.1	14.1	14.1	14.1	0	0.4	---	0	893.8	84
4/04/00	10:00p	14.1	14.1	14.2	14.1	0	0.4	---	0	893.8	84
4/04/00	10:15p	14.1	14.1	14.2	14.1	0	0.9	NNE	0	893.9	84
4/04/00	10:30p	14.2	14.2	14.2	14.1	0	0.9	N	0	893.8	85
4/04/00	10:45p	14.2	14.2	14.2	14.2	0	0.9	N	0	893.7	85
4/04/00	11:00p	14.2	14.2	14.2	14.2	0	0.4	N	0	893.6	85
4/04/00	11:15p	14.2	14.2	14.2	14.2	0	0.9	N	0	893.5	85
4/04/00	11:30p	14.2	14.2	14.2	14.2	0	0.9	N	0	893.3	85
4/04/00	11:45p	14.2	14.2	14.2	14.2	0	0.9	N	0.2	893.3	85
4/05/00	12:00a	14.2	14.2	14.2	14.2	0	1.3	N	0	892.9	85
4/05/00	12:15a	14.2	14.2	14.2	14.2	0	0.4	N	0	892.7	85
4/05/00	12:30a	14.2	14.2	14.3	14.2	0	1.3	N	0	892.5	85
4/05/00	12:45a	14.2	14.2	14.3	14.2	0	1.3	NNE	0	892.2	85
4/05/00	1:00a	14.3	14.3	14.3	14.2	0	0.4	N	0	892.2	85
4/05/00	1:15a	14.3	14.3	14.4	14.3	0	1.3	NNE	0	891.8	86
4/05/00	1:30a	14.4	14.4	14.4	14.4	0	1.8	NNE	0	891.5	86
4/05/00	1:45a	14.5	14.5	14.6	14.4	0	1.3	NE	0	891.6	86
4/05/00	2:00a	14.6	14.6	14.6	14.5	0	0	---	0	891.3	86
4/05/00	2:15a	14.6	14.6	14.6	14.6	0	0	---	0	891	86
4/05/00	2:30a	14.6	14.6	14.6	14.6	0	0	---	0	890.8	86
4/05/00	2:45a	14.6	14.6	14.6	14.6	0	0	---	0	890.4	86
4/05/00	3:00a	14.6	14.6	14.6	14.6	0	1.3	SE	0	890.3	86
4/05/00	3:15a	14.6	14.6	14.6	14.6	0	0.9	S	0	889.8	86
4/05/00	3:30a	14.6	14.6	14.6	14.6	0	0	---	0	889.2	86
4/05/00	3:45a	14.6	14.6	14.6	14.6	0	0	---	0	889	86
4/05/00	4:00a	14.6	14.6	14.6	14.6	0	0	---	0	889	86
4/05/00	4:15a	14.6	14.6	14.6	14.6	0	0	---	0.2	888.6	87
4/05/00	4:30a	14.6	14.6	14.6	14.6	0.9	1.8	SSW	0	888.9	87

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/05/00	4:45a	14.6	14.6	14.6	14.6	0.4	1.3	SSW	1.4	888.6	87
4/05/00	5:00a	14.5	14.5	14.6	14.5	0.9	1.3	SSW	0.6	888.8	87
4/05/00	5:15a	14.5	14.5	14.6	14.5	0.4	1.3	SSW	0.2	888.3	87
4/05/00	5:30a	14.5	14.5	14.5	14.4	0	0.9	SSW	0	888.2	87
4/05/00	5:45a	14.6	14.6	14.6	14.5	0.4	1.3	SSW	0	888.3	87
4/05/00	6:00a	14.6	14.6	14.6	14.6	0.4	1.8	SSW	0	888	88
4/05/00	6:15a	14.6	14.6	14.6	14.6	0.9	1.8	SW	0	888.2	88
4/05/00	6:30a	14.6	14.6	14.6	14.6	0.4	1.3	SW	0	888.4	88
4/05/00	6:45a	14.6	14.6	14.6	14.6	0.4	1.3	SW	0	888.3	88
4/05/00	7:00a	14.7	14.7	14.7	14.6	0.4	1.3	SW	0	888.2	88
4/05/00	7:15a	14.7	14.7	14.7	14.7	0.4	1.3	SW	0	888.1	88
4/05/00	7:30a	14.7	14.7	14.7	14.6	0	0.9	SW	0	887.7	88
4/05/00	7:45a	14.7	14.7	14.7	14.6	0	0.9	SSW	0	887.9	88
4/05/00	8:00a	14.7	14.7	14.8	14.7	0.9	2.2	SW	0	887.8	89
4/05/00	8:15a	14.9	14.9	14.9	14.8	0.9	2.2	SW	0	887.8	89
4/05/00	8:30a	14.9	14.9	15	14.9	0.9	1.8	SSW	0	887.8	89
4/05/00	8:45a	15.1	15.1	15.2	15	0.9	2.2	SW	0	887.6	90
4/05/00	9:00a	15.3	15.3	15.4	15.2	0.9	1.8	SSW	0	887.7	90
4/05/00	9:15a	15.4	15.4	15.4	15.4	0.9	1.8	SSW	0	887.8	90
4/05/00	9:30a	15.6	15.6	15.7	15.4	1.3	2.2	SSW	0	887.7	90
4/05/00	9:45a	15.9	15.9	16.1	15.7	0.9	2.2	SSW	0	887.1	90
4/05/00	10:00a	16.3	16.3	16.7	16.1	1.3	2.7	SW	0	887.4	91
4/05/00	10:15a	16.7	16.7	16.7	16.6	1.8	3.6	SW	0	887.3	92
4/05/00	10:30a	16.9	16.9	17.2	16.7	1.8	3.1	SW	0	887.3	92
4/05/00	10:45a	17.2	17.2	17.7	16.8	1.8	3.6	SW	0	887.2	92
4/05/00	11:00a	17.7	17.7	18.3	17.3	1.8	3.1	SW	0	886.9	93
4/05/00	11:15a	17.7	17.7	18	17.1	1.8	2.7	SW	0	886.9	92
4/05/00	11:30a	17.4	17.4	17.8	17	1.8	3.6	SW	0	886.8	91
4/05/00	11:45a	17	17	17.3	16.8	1.8	3.6	SW	0	887	88
4/05/00	12:00p	17.4	16.6	17.9	16.7	2.2	4.5	SW	0	887	88
4/05/00	12:15p	16.7	15.8	17.8	15.8	2.2	4.5	SSW	0	886.9	87
4/05/00	12:30p	17.1	15.7	18.2	16.3	2.7	4.9	SSW	0	886.6	86
4/05/00	12:45p	15.9	14.4	16.3	15.7	2.7	4.5	SSW	0	886.5	83
4/05/00	1:00p	15.4	13.8	15.7	15.1	2.7	4.5	SSW	0	886.5	81
4/05/00	1:15p	15.4	13.8	15.6	15.2	2.7	4.5	SSW	0	886.6	81
4/05/00	1:30p	15.4	14.4	15.5	15.1	2.2	4.9	SSW	0	886.4	81
4/05/00	1:45p	15.4	14.4	15.6	15.1	2.2	3.6	SSW	0	886.2	81
4/05/00	2:00p	15.2	14.2	15.4	15.1	2.2	4	SW	0	886.2	80
4/05/00	2:15p	15	13.3	15.4	14.3	2.7	5.4	SSW	0	886.4	79
4/05/00	2:30p	14.3	12.6	14.5	14	2.7	5.8	SSW	0	886.5	77
4/05/00	2:45p	13.7	12.7	13.9	13.4	2.2	4	SSW	0	886.5	77
4/05/00	3:00p	13.7	11.9	13.9	13.4	2.7	5.8	SSW	0	886.4	77
4/05/00	3:15p	14.3	12.6	14.7	13.8	2.7	4.5	SSW	0	886.3	78
4/05/00	3:30p	14.3	11.9	14.8	14.1	3.1	5.8	SSW	0	886.4	77
4/05/00	3:45p	14.4	12	14.7	14.1	3.1	4.9	SSW	0	886.6	76
4/05/00	4:00p	14.2	11.7	14.6	13.5	3.1	5.4	SSW	0	886.8	75
4/05/00	4:15p	13.6	11.1	13.8	13.3	3.1	5.4	SSW	0	887	74

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/05/00	4:30p	13.7	11.2	14.1	13.2	3.1	4.9	S	0	887.2	73
4/05/00	4:45p	12.9	11.1	13.2	12.8	2.7	4	SSW	0	887.4	72
4/05/00	5:00p	12.9	11.8	13	12.8	2.2	4.9	S	0	887.7	72
4/05/00	5:15p	12.7	11.6	12.8	12.7	2.2	4	S	0	887.8	72
4/05/00	5:30p	12.7	10.8	12.9	12.5	2.7	4.5	SSW	0	888	71
4/05/00	5:45p	12.3	10.4	12.5	12.3	2.7	4.9	SSW	0	888.2	71
4/05/00	6:00p	12.1	10.1	12.3	11.9	2.7	4.5	SSW	0	888.3	71
4/05/00	6:15p	11.7	9	11.9	11.6	3.1	4.9	SSW	0	888.5	70
4/05/00	6:30p	11.4	10.2	11.6	11.2	2.2	3.6	SSW	0	888.9	70
4/05/00	6:45p	11.1	9.9	11.3	10.9	2.2	4	S	0	889.3	70
4/05/00	7:00p	10.8	10.8	10.9	10.7	1.8	3.6	SSW	0	889.6	71
4/05/00	7:15p	10.7	10.7	10.8	10.6	1.8	3.6	SSW	0	889.8	71
4/05/00	7:30p	10.5	10.5	10.6	10.3	1.8	2.7	S	0	890.1	72
4/05/00	7:45p	10.3	10.3	10.4	10.2	1.8	3.1	S	0	890.4	72
4/05/00	8:00p	10.2	10.2	10.3	10	1.8	3.1	S	0	890.7	72
4/05/00	8:15p	10	10	10.1	9.9	1.8	3.1	S	0	891	73
4/05/00	8:30p	10.1	8.8	10.2	10	2.2	3.1	S	0	891.1	73
4/05/00	8:45p	10.1	10.1	10.2	10.1	1.8	4	S	0	891.5	74
4/05/00	9:00p	10.3	10.3	10.3	10.2	1.8	4	SSE	0	891.8	74
4/05/00	9:15p	10.3	9.1	10.3	10.2	2.2	4.9	SSE	0	891.9	74
4/05/00	9:30p	10.2	8.9	10.3	10.1	2.2	4.9	SSE	0	892.4	75
4/05/00	9:45p	10	8.7	10.1	9.9	2.2	4.5	SSE	0	892.6	75
4/05/00	10:00p	9.9	8.6	9.9	9.8	2.2	4.5	SSE	0	892.9	75
4/05/00	10:15p	9.8	8.6	9.9	9.8	2.2	5.4	SE	0	893.1	76
4/05/00	10:30p	9.7	9.7	9.8	9.7	1.8	4	SE	0	893	76
4/05/00	10:45p	9.7	8.4	9.7	9.7	2.2	5.4	SE	0	893.1	77
4/05/00	11:00p	9.7	7.6	9.8	9.7	2.7	5.4	SSE	0	893.2	78
4/05/00	11:15p	9.7	8.4	9.8	9.7	2.2	5.4	SSE	0	893.4	78
4/05/00	11:30p	9.8	8.5	9.8	9.8	2.2	4.5	SE	0	893.4	78
4/05/00	11:45p	9.8	8.6	9.9	9.8	2.2	4.5	SE	0	893.5	79
4/06/00	12:00a	9.9	9.9	9.9	9.8	1.8	4	SE	0	893.3	79
4/06/00	12:15a	9.9	8.6	9.9	9.9	2.2	4	SE	0	893.5	79
4/06/00	12:30a	9.9	9.9	9.9	9.9	1.8	4.5	SE	0	893.6	80
4/06/00	12:45a	9.9	9.9	9.9	9.8	1.8	3.6	SSE	0	893.6	80
4/06/00	1:00a	9.9	8.6	9.9	9.8	2.2	4	SE	0	893.4	80
4/06/00	1:15a	9.9	9.9	9.9	9.9	1.8	4.5	SE	0	893.7	81
4/06/00	1:30a	9.9	9.9	10	9.9	1.8	3.6	SE	0	893.7	81
4/06/00	1:45a	9.9	9.9	9.9	9.9	1.8	3.1	SE	0	893.6	81
4/06/00	2:00a	9.8	9.8	9.9	9.6	1.8	4	SE	0	893.7	82
4/06/00	2:15a	9.4	9.4	9.5	9.3	1.8	4.5	SE	0	893.9	82
4/06/00	2:30a	9.3	8	9.3	9.2	2.2	4	SE	0	894.1	83
4/06/00	2:45a	9.1	7.8	9.2	9.1	2.2	4.9	SE	0	894.2	83
4/06/00	3:00a	8.9	6.7	9.1	8.8	2.7	5.4	SE	0	894.2	84
4/06/00	3:15a	8.8	7.5	8.8	8.8	2.2	5.8	SE	0	894.2	84
4/06/00	3:30a	8.8	6.6	8.8	8.7	2.7	4.9	SE	0	894.3	85
4/06/00	3:45a	8.8	6.6	8.8	8.7	2.7	4.9	SE	0	894.3	85
4/06/00	4:00a	8.7	7.4	8.8	8.7	2.2	5.4	SE	0	894.5	86

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/06/00	4:15a	8.8	6.6	8.8	8.7	2.7	4.9	ESE	0	894.5	86
4/06/00	4:30a	8.8	6.6	8.8	8.7	2.7	5.4	ESE	0.2	894.7	87
4/06/00	4:45a	8.8	6.6	8.8	8.7	2.7	5.4	ESE	0	895	87
4/06/00	5:00a	8.8	7.5	8.9	8.8	2.2	4.9	ESE	0	895.1	87
4/06/00	5:15a	8.8	7.5	8.9	8.8	2.2	5.4	ESE	0	895.2	88
4/06/00	5:30a	8.8	7.5	8.8	8.8	2.2	4.5	ESE	0	895.5	88
4/06/00	5:45a	8.7	6.5	8.8	8.7	2.7	4.5	ESE	0	895.8	88
4/06/00	6:00a	8.6	7.3	8.7	8.5	2.2	3.6	ESE	0	896.1	88
4/06/00	6:15a	8.4	8.4	8.5	8.4	1.8	3.6	ESE	0.2	896.4	88
4/06/00	6:30a	8.3	7	8.4	8.3	2.2	4	ESE	0	896.4	88
4/06/00	6:45a	8.3	6.1	8.3	8.3	2.7	4.9	ESE	0	896.7	89
4/06/00	7:00a	8.3	6	8.3	8.2	2.7	4.9	ESE	0	897.1	89
4/06/00	7:15a	8.1	5.8	8.2	8.1	2.7	4.9	ESE	0	897.4	89
4/06/00	7:30a	8	5.7	8.1	7.9	2.7	5.8	ESE	0	897.5	89
4/06/00	7:45a	7.9	6.6	8	7.9	2.2	5.4	ESE	0	897.9	89
4/06/00	8:00a	7.9	6.6	7.9	7.9	2.2	4.9	ESE	0	898.2	89
4/06/00	8:15a	8	6.6	8.1	7.9	2.2	3.6	ESE	0	898.3	89
4/06/00	8:30a	8.2	6.8	8.3	8	2.2	4	ESE	0	898.7	89
4/06/00	8:45a	8.3	7	8.4	8.2	2.2	5.4	SE	0	898.7	89
4/06/00	9:00a	8.7	7.4	8.8	8.4	2.2	4.9	ESE	0	899	90
4/06/00	9:15a	8.6	7.3	8.7	8.4	2.2	4.9	ESE	0	899.2	90
4/06/00	9:30a	8.9	6.7	9	8.7	2.7	4.9	ESE	0	899.2	90
4/06/00	9:45a	9.2	7	9.3	8.8	2.7	4.5	ESE	0	899.4	89
4/06/00	10:00a	9.2	7.9	9.3	9.1	2.2	4	ESE	0	899.5	90
4/06/00	10:15a	8.9	7.6	9.3	8.7	2.2	3.6	SE	0	899.8	89
4/06/00	10:30a	8.6	7.2	8.7	8.5	2.2	4.5	ESE	0	899.8	88
4/06/00	10:45a	8.6	7.2	8.7	8.4	2.2	4.9	SE	0	900.1	88
4/06/00	11:00a	8.5	7.2	8.6	8.4	2.2	4.9	ESE	0	900.3	88
4/06/00	11:15a	9.1	7.8	10.4	8.6	2.2	3.6	ESE	0	900.1	89
4/06/00	11:30a	10.3	10.3	10.9	9.9	1.8	3.6	ESE	0	900.1	92
4/06/00	11:45a	10.1	10.1	10.6	9.9	1.8	3.6	ESE	0	899.9	91
4/06/00	12:00p	10.5	10.5	10.7	10.4	1.3	3.1	ESE	0	899.9	90
4/06/00	12:15p	10.7	10.7	10.9	10.2	1.3	3.1	E	0	899.9	89
4/06/00	12:30p	9.6	9.6	10.2	9.3	1.8	3.6	E	0	900.2	87
4/06/00	12:45p	9.4	9.4	9.6	9.2	1.8	3.6	E	0	900.2	86
4/06/00	1:00p	9.5	9.5	9.6	9.4	1.8	2.7	ESE	0	900.1	86
4/06/00	1:15p	9.8	9.8	9.9	9.4	1.8	3.6	E	0	900.1	87
4/06/00	1:30p	9.9	9.9	10.1	9.7	1.3	2.7	E	0	900	87
4/06/00	1:45p	9.4	9.4	9.6	9.3	1.3	3.6	E	0	900.2	87
4/06/00	2:00p	8.9	8.9	9.2	8.8	1.8	3.1	ESE	0	900.1	86
4/06/00	2:15p	9.6	9.6	10.2	9.1	1.3	2.7	ESE	0	899.8	86
4/06/00	2:30p	10.6	10.6	11.1	10.2	1.3	2.7	E	0	899.6	87
4/06/00	2:45p	10.9	10.9	11.2	10.7	1.3	3.1	E	0	899.4	88
4/06/00	3:00p	11.2	11.2	11.4	11.1	1.3	3.1	ESE	0	899.4	88
4/06/00	3:15p	11.2	11.2	11.5	10.7	0.9	3.1	E	0	899.6	88
4/06/00	3:30p	10.4	10.4	10.7	10.3	1.3	2.2	E	0	899.5	87
4/06/00	3:45p	10.7	10.7	10.9	10.4	1.3	2.7	E	0	899.7	86

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/06/00	4:00p	10.7	10.7	11.1	10.4	0.9	2.7	E	0	899.5	86
4/06/00	4:15p	11.1	11.1	11.2	10.9	0.9	3.1	E	0	899.5	86
4/06/00	4:30p	11	11	11.3	10.6	1.3	3.1	E	0	899.6	86
4/06/00	4:45p	10.3	10.3	10.6	10.1	1.3	4.5	E	0	900	85
4/06/00	5:00p	9.9	9.9	10.1	9.8	0.9	3.1	ENE	0	900.1	84
4/06/00	5:15p	10.1	10.1	10.3	9.9	0.9	2.7	E	0	900.2	84
4/06/00	5:30p	10.1	10.1	10.2	9.9	0.9	2.7	ENE	0	900.2	84
4/06/00	5:45p	9.9	9.9	10	9.8	0.9	2.2	ENE	0	900.4	84
4/06/00	6:00p	9.9	9.9	10.1	9.6	0.9	2.2	ENE	0	900.5	85
4/06/00	6:15p	9.6	9.6	9.6	9.5	0.9	2.7	ENE	0	900.5	84
4/06/00	6:30p	9.3	9.3	9.5	9.2	1.3	2.7	E	0	900.8	85
4/06/00	6:45p	9.1	9.1	9.2	8.9	0.9	2.2	E	0	901	85
4/06/00	7:00p	8.8	8.8	8.9	8.7	0.9	3.1	E	0	901.3	85
4/06/00	7:15p	8.7	8.7	8.7	8.7	0.9	2.7	E	0	901.3	85
4/06/00	7:30p	8.7	8.7	8.7	8.7	0.9	2.2	E	0	901.6	85
4/06/00	7:45p	8.7	8.7	8.7	8.6	0.9	2.2	E	0	901.6	85
4/06/00	8:00p	8.6	8.6	8.7	8.6	0.9	1.8	E	0	901.8	85
4/06/00	8:15p	8.7	8.7	8.7	8.7	0.9	2.2	E	0	902	86
4/06/00	8:30p	8.7	8.7	8.7	8.7	0.9	1.8	ENE	0	902.1	86
4/06/00	8:45p	8.7	8.7	8.7	8.7	0.9	1.3	E	0	902.2	86
4/06/00	9:00p	8.7	8.7	8.7	8.6	0.9	1.8	E	0	902.2	86
4/06/00	9:15p	8.6	8.6	8.6	8.6	0.9	1.8	ENE	0	902.3	86
4/06/00	9:30p	8.6	8.6	8.6	8.6	0.9	2.2	ENE	0	902.3	86
4/06/00	9:45p	8.7	8.7	8.7	8.6	0.4	1.8	ENE	0	902.4	87
4/06/00	10:00p	8.6	8.6	8.7	8.6	0.4	2.2	ENE	0	902.4	86
4/06/00	10:15p	8.5	8.5	8.6	8.4	0.9	2.2	E	0	902.5	87
4/06/00	10:30p	8.4	8.4	8.5	8.4	0.9	1.8	ENE	0	902.4	87
4/06/00	10:45p	8.5	8.5	8.5	8.4	0.9	1.8	E	0	902.3	87
4/06/00	11:00p	8.4	8.4	8.5	8.4	0.9	1.8	E	0	902.3	87
4/06/00	11:15p	8.4	8.4	8.4	8.3	0.9	2.7	E	0	902.4	87
4/06/00	11:30p	8.3	8.3	8.3	8.2	0.9	2.7	E	0	902.4	87
4/06/00	11:45p	8.3	8.3	8.3	8.2	0.9	2.2	E	0	902.4	87
4/07/00	12:00a	8.3	8.3	8.4	8.3	0.9	3.1	E	0	902.4	87
4/07/00	12:15a	8.4	8.4	8.4	8.3	0.9	2.7	E	0.2	902.2	88
4/07/00	12:30a	8.3	8.3	8.4	8.3	0.4	1.8	NE	0	902.4	88
4/07/00	12:45a	8.3	8.3	8.3	8.3	0.4	2.2	ENE	0	902.4	88
4/07/00	1:00a	8.3	8.3	8.3	8.3	0.9	2.2	ENE	0	902.3	88
4/07/00	1:15a	8.3	8.3	8.3	8.2	0.9	2.2	ENE	0	902.5	88
4/07/00	1:30a	8.2	8.2	8.2	8.1	0.9	1.8	ENE	0	902.2	88
4/07/00	1:45a	8.1	8.1	8.1	8.1	0.9	2.2	ENE	0	902.3	88
4/07/00	2:00a	7.9	7.9	8.1	7.9	0.9	3.1	ENE	0	902.3	88
4/07/00	2:15a	7.8	7.8	7.9	7.8	0.4	2.7	E	0	902.3	88
4/07/00	2:30a	7.8	7.8	7.9	7.8	0.4	1.8	E	0	902.4	88
4/07/00	2:45a	7.8	7.8	7.8	7.8	0.4	1.3	E	0	902.4	88
4/07/00	3:00a	7.8	7.8	7.9	7.8	0.4	1.3	ENE	0	902.2	88
4/07/00	3:15a	7.9	7.9	7.9	7.9	0.4	1.3	ENE	0	902.1	88
4/07/00	3:30a	7.9	7.9	7.9	7.9	0.4	1.3	E	0	902.1	88

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/07/00	3:45a	7.8	7.8	7.9	7.8	0.4	1.8	ENE	0	902	88
4/07/00	4:00a	7.8	7.8	7.8	7.8	0.4	1.8	E	0	901.9	88
4/07/00	4:15a	7.7	7.7	7.8	7.7	0.9	1.8	E	0	901.9	88
4/07/00	4:30a	7.6	7.6	7.7	7.6	0.4	1.8	E	0	901.9	88
4/07/00	4:45a	7.7	7.7	7.8	7.7	0.4	0.9	NNE	0	902	88
4/07/00	5:00a	7.9	7.9	7.9	7.8	0.4	2.2	E	0	901.8	89
4/07/00	5:15a	7.8	7.8	7.9	7.8	0.4	1.3	E	0	901.9	89
4/07/00	5:30a	7.8	7.8	7.8	7.7	0.4	1.3	N	0	901.9	89
4/07/00	5:45a	7.7	7.7	7.8	7.7	0	0.9	N	0	902.1	89
4/07/00	6:00a	7.9	7.9	8	7.8	0.4	1.3	NNW	0	902.1	89
4/07/00	6:15a	8.1	8.1	8.1	7.9	0.4	1.8	N	0	902.2	89
4/07/00	6:30a	8.1	8.1	8.2	8.1	0.4	1.8	E	0	902.3	89
4/07/00	6:45a	8.2	8.2	8.2	8.1	0.4	2.2	E	0	902.4	89
4/07/00	7:00a	8.2	8.2	8.2	8.1	0.4	1.8	E	0	902.5	89
4/07/00	7:15a	8.1	8.1	8.2	8.1	0.4	1.3	NW	0	902.6	89
4/07/00	7:30a	8	8	8.1	7.9	0.4	2.2	E	0	902.9	89
4/07/00	7:45a	7.9	7.9	7.9	7.9	0.4	1.8	E	0	903	89
4/07/00	8:00a	8.1	8.1	8.3	7.9	0	1.3	NNW	0	903	89
4/07/00	8:15a	8.7	8.7	8.8	8.3	0.4	2.7	NNW	0	903.1	89
4/07/00	8:30a	8.9	8.9	9	8.8	0.4	2.2	E	0	903.5	90
4/07/00	8:45a	9.1	9.1	9.3	9	0.4	2.7	E	0	903.5	90
4/07/00	9:00a	9.2	9.2	9.4	9.1	0.9	1.8	ENE	0	903.7	91
4/07/00	9:15a	9.3	9.3	9.4	9.2	0.9	1.8	E	0	903.9	91
4/07/00	9:30a	9.4	9.4	9.6	9.3	0.9	1.8	E	0	903.9	90
4/07/00	9:45a	9.7	9.7	9.9	9.6	0.9	2.2	E	0	904.1	90
4/07/00	10:00a	9.9	9.9	10.1	9.8	0.9	2.7	E	0	904	90
4/07/00	10:15a	10.3	10.3	10.8	10.1	0.9	2.2	N	0	903.8	91
4/07/00	10:30a	10.9	10.9	11.1	10.7	0.9	2.2	E	0	903.9	91
4/07/00	10:45a	10.9	10.9	11.1	10.7	0.9	2.2	NNW	0	904	91
4/07/00	11:00a	11.2	11.2	11.3	11	0.4	2.2	N	0	903.8	91
4/07/00	11:15a	11	11	11.2	10.9	0.9	2.2	E	0	903.9	90
4/07/00	11:30a	11	11	11.1	10.8	0.4	1.8	N	0	904	90
4/07/00	11:45a	10.7	10.7	10.8	10.6	0.9	3.1	N	0	903.9	89
4/07/00	12:00p	10.7	10.7	10.8	10.4	0.9	2.7	N	0	904	87
4/07/00	12:15p	10.6	10.6	10.7	10.4	0.9	2.2	N	0	904	87
4/07/00	12:30p	10.3	10.3	10.6	10.1	0.9	2.2	N	0	904	87
4/07/00	12:45p	10.3	10.3	10.7	10.2	0.4	1.8	N	0	904.1	87
4/07/00	1:00p	10.7	10.7	10.8	10.5	0.4	1.8	N	0	903.9	88
4/07/00	1:15p	10.9	10.9	11.3	10.5	0.9	2.2	E	0	903.8	88
4/07/00	1:30p	11.5	11.5	11.7	11.2	0.4	3.1	NNW	0	903.5	89
4/07/00	1:45p	11.1	11.1	11.2	11	0.9	2.2	E	0	903.2	88
4/07/00	2:00p	11.6	11.6	12.3	11.1	0.9	1.8	N	0	902.9	88
4/07/00	2:15p	12	12	12.2	11.7	0.9	3.1	N	0	902.7	89
4/07/00	2:30p	11.6	11.6	11.8	11.2	0.4	1.8	E	0	902.6	88
4/07/00	2:45p	11.3	11.3	11.7	11.2	0.4	1.8	NNE	0	902.5	87
4/07/00	3:00p	11.8	11.8	12.1	11.6	0.9	2.7	E	0	902.4	87
4/07/00	3:15p	12.2	12.2	12.7	12	0.4	2.2	NE	0	902.2	88

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/07/00	3:30p	11.9	11.9	12.5	11.4	0.4	2.2	E	0	902.3	87
4/07/00	3:45p	11.3	11.3	11.4	11.1	0.4	2.7	E	0	902.3	86
4/07/00	4:00p	11.1	11.1	11.2	11.1	0.4	1.8	E	0	902.4	86
4/07/00	4:15p	11.1	11.1	11.1	11	0.4	1.8	ENE	0	902.5	86
4/07/00	4:30p	11.1	11.1	11.1	11	0.4	1.8	NNW	0	902.6	86
4/07/00	4:45p	10.9	10.9	11	10.8	0.4	1.8	E	0	902.6	86
4/07/00	5:00p	10.8	10.8	10.9	10.7	0.4	1.8	N	0	902.5	86
4/07/00	5:15p	10.7	10.7	10.9	10.7	0.4	2.7	N	0	902.6	86
4/07/00	5:30p	10.6	10.6	10.7	10.4	0.4	1.8	N	0	902.6	86
4/07/00	5:45p	10.3	10.3	10.4	10.2	0.4	1.3	N	0	902.5	86
4/07/00	6:00p	10.2	10.2	10.3	10.2	0.4	2.7	NW	0	902.7	86
4/07/00	6:15p	10.1	10.1	10.2	10.1	0	2.2	N	0	902.7	86
4/07/00	6:30p	10	10	10.1	9.9	0	0.9	NNW	0	902.9	86
4/07/00	6:45p	9.9	9.9	9.9	9.8	0	0.9	NNW	0	903	86
4/07/00	7:00p	9.9	9.9	9.9	9.8	0	1.3	NNW	0	903.1	86
4/07/00	7:15p	9.9	9.9	9.9	9.8	0	0.9	N	0	903.2	86
4/07/00	7:30p	9.8	9.8	9.9	9.8	0.4	1.3	N	0	903.2	86
4/07/00	7:45p	9.8	9.8	9.8	9.7	0	1.3	NNW	0	903.2	86
4/07/00	8:00p	9.8	9.8	9.8	9.8	0.4	1.3	N	0	903.4	86
4/07/00	8:15p	9.8	9.8	9.8	9.8	0	0.9	ENE	0	903.4	87
4/07/00	8:30p	9.8	9.8	9.8	9.8	0	1.3	ENE	0	903.8	87
4/07/00	8:45p	9.8	9.8	9.8	9.7	0.4	1.3	E	0	903.9	87
4/07/00	9:00p	9.7	9.7	9.8	9.7	0.4	1.8	N	0	904	87
4/07/00	9:15p	9.7	9.7	9.7	9.7	0	1.8	NW	0	903.9	87
4/07/00	9:30p	9.7	9.7	9.7	9.6	0.9	3.1	NNW	0	903.8	87
4/07/00	9:45p	9.6	9.6	9.6	9.6	0.4	2.2	N	0	904.1	87
4/07/00	10:00p	9.6	9.6	9.6	9.5	0.9	2.2	N	0	904.1	87
4/07/00	10:15p	9.5	9.5	9.6	9.4	0.9	2.2	N	0	904.2	87
4/07/00	10:30p	9.4	9.4	9.4	9.3	0.9	1.8	N	0	904.4	87
4/07/00	10:45p	9.3	9.3	9.4	9.3	0.9	2.2	NNW	0	904.3	87
4/07/00	11:00p	9.3	9.3	9.3	9.2	0.4	2.2	N	0	904.2	87
4/07/00	11:15p	9.2	9.2	9.2	9.2	0.4	2.7	N	0	904.3	87
4/07/00	11:30p	9.2	9.2	9.2	9.1	0.4	1.8	N	0	904.2	87
4/07/00	11:45p	9.1	9.1	9.1	9.1	0.4	1.3	NNW	0	904.3	87
4/08/00	12:00a	9.1	9.1	9.1	9	0.4	0.9	N	0	904.1	87
4/08/00	12:15a	9.1	9.1	9.1	9	0	1.3	N	0	904	87
4/08/00	12:30a	9	9	9.1	8.9	0.4	1.3	N	0	903.7	87
4/08/00	12:45a	8.8	8.8	8.9	8.7	0	0.9	NNW	0	903.7	87
4/08/00	1:00a	8.6	8.6	8.7	8.5	0	0.9	NNW	0	903.6	87
4/08/00	1:15a	8.3	8.3	8.4	8.2	0	0	---	0	903.6	87
4/08/00	1:30a	8.1	8.1	8.2	8	0	0	---	0	903.3	87
4/08/00	1:45a	7.9	7.9	8.1	7.8	0	0	---	0	903.2	86
4/08/00	2:00a	7.8	7.8	7.8	7.7	0	0	---	0	903.2	86
4/08/00	2:15a	7.8	7.8	7.9	7.7	0.4	1.3	NNW	0	903	86
4/08/00	2:30a	8	8	8.1	7.9	0	0.9	E	0	903	87
4/08/00	2:45a	8.2	8.2	8.2	8.1	0.4	2.2	NNW	0	902.8	87
4/08/00	3:00a	8.2	8.2	8.3	8.1	0.4	1.8	E	0	902.7	87

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/08/00	3:15a	8.3	8.3	8.3	8.3	0.4	1.8	E	0	902.6	88
4/08/00	3:30a	8.2	8.2	8.3	8.2	0.4	1.8	E	0	902.5	88
4/08/00	3:45a	8.3	8.3	8.3	8.3	0.4	1.3	NW	0	902.4	88
4/08/00	4:00a	8.3	8.3	8.4	8.3	0	1.3	NNW	0	902.2	88
4/08/00	4:15a	8.4	8.4	8.4	8.3	0.4	1.3	NNW	0	902.3	88
4/08/00	4:30a	8.4	8.4	8.5	8.4	0	1.3	NNW	0	902.2	88
4/08/00	4:45a	8.5	8.5	8.6	8.5	0	1.3	NNW	0	902.2	88
4/08/00	5:00a	8.6	8.6	8.7	8.5	0	0	---	0	902.2	88
4/08/00	5:15a	8.7	8.7	8.7	8.7	0	1.3	NNW	0	902.1	88
4/08/00	5:30a	8.7	8.7	8.7	8.7	0.4	1.3	NW	0	902.3	88
4/08/00	5:45a	8.7	8.7	8.7	8.7	0	0.9	N	0	902.3	88
4/08/00	6:00a	8.7	8.7	8.7	8.7	0	0.4	N	0.2	902.4	88
4/08/00	6:15a	8.7	8.7	8.7	8.7	0	1.3	ENE	0	902.3	88
4/08/00	6:30a	8.7	8.7	8.7	8.7	0.4	1.3	N	0	902.4	88
4/08/00	6:45a	8.7	8.7	8.7	8.6	0.4	0.9	N	0	902.4	88
4/08/00	7:00a	8.8	8.8	8.8	8.7	0.4	0.9	N	0	902.4	88
4/08/00	7:15a	8.9	8.9	8.9	8.8	0.4	1.8	N	0	902.4	88
4/08/00	7:30a	8.9	8.9	9	8.9	0.4	1.3	N	0	902.5	89
4/08/00	7:45a	9	9	9.1	8.9	0.4	0.9	N	0	902.5	89
4/08/00	8:00a	9.1	9.1	9.1	9	0.4	1.8	ENE	0	902.6	89
4/08/00	8:15a	9.1	9.1	9.2	9.1	0.4	1.3	ENE	0	902.7	89
4/08/00	8:30a	9.2	9.2	9.2	9.1	0.4	1.8	NW	0	902.9	89
4/08/00	8:45a	9.3	9.3	9.3	9.2	0.4	1.3	N	0	903.1	89
4/08/00	9:00a	9.2	9.2	9.3	9.2	0.9	2.2	N	0	903.1	89
4/08/00	9:15a	9.4	9.4	9.4	9.3	0.9	3.1	NNE	0	903.3	89
4/08/00	9:30a	9.4	9.4	9.5	9.4	0.9	2.7	NNE	0	903.3	89
4/08/00	9:45a	9.7	9.7	9.9	9.4	0.4	2.7	NNE	0	903.3	89
4/08/00	10:00a	10.1	10.1	10.2	9.9	0.9	2.7	N	0	903.3	90
4/08/00	10:15a	9.9	9.9	10.2	9.8	0.9	2.7	NNE	0	903.4	90
4/08/00	10:30a	9.9	9.9	9.9	9.8	0.9	2.2	N	0	903.5	90
4/08/00	10:45a	10.1	10.1	10.3	9.9	0.9	1.8	N	0	903.5	90
4/08/00	11:00a	10.3	10.3	10.4	10.2	0.9	2.2	N	0	903.5	90
4/08/00	11:15a	10.2	10.2	10.4	10.1	0.9	2.2	NNW	0	903.4	90
4/08/00	11:30a	10.4	10.4	10.6	10.2	0.9	2.7	N	0	903.3	90
4/08/00	11:45a	10.6	10.6	10.8	10.2	0.9	2.2	ENE	0	903.1	90
4/08/00	12:00p	10.7	10.7	10.8	10.4	0.4	1.8	N	0	903.1	90
4/08/00	12:15p	10.4	10.4	10.7	10.3	0.9	2.2	N	0	902.8	90
4/08/00	12:30p	10.9	10.9	11.3	10.7	0.4	2.7	E	0	902.7	90
4/08/00	12:45p	11.2	11.2	11.4	10.9	0.4	1.3	ENE	0	902.5	90
4/08/00	1:00p	10.7	10.7	10.9	10.6	0.4	1.8	ENE	0	902.4	90
4/08/00	1:15p	10.7	10.7	10.8	10.6	0.4	1.8	N	0	902.3	89
4/08/00	1:30p	10.7	10.7	11.1	10.6	0.4	2.2	E	0	902	89
4/08/00	1:45p	11.3	11.3	11.7	11.1	0	1.3	E	0	901.9	89
4/08/00	2:00p	11.6	11.6	11.7	11.4	0.4	2.2	E	0	901.7	90
4/08/00	2:15p	11.3	11.3	11.3	11.2	0.4	1.3	E	0	901.6	89
4/08/00	2:30p	10.9	10.9	11.2	10.8	0	1.8	N	0	901.5	89
4/08/00	2:45p	10.9	10.9	10.9	10.8	0	1.3	E	0	901.4	88

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/08/00	3:00p	10.7	10.7	10.9	10.5	0	1.3	E	0	901.6	88
4/08/00	3:15p	10.3	10.3	10.5	10.3	0.4	1.3	ENE	0	901.4	88
4/08/00	3:30p	10.2	10.2	10.2	10.1	0.4	1.8	ENE	0	901.6	87
4/08/00	3:45p	10.2	10.2	10.2	10.1	0	2.2	NNW	0	901.4	88
4/08/00	4:00p	10.2	10.2	10.2	10.1	0.4	1.8	ENE	0	901.5	88
4/08/00	4:15p	10.1	10.1	10.2	10.1	0.4	2.2	N	0	901.6	88
4/08/00	4:30p	10	10	10.1	9.9	0.4	1.8	E	0	901.6	88
4/08/00	4:45p	9.9	9.9	10	9.9	0.4	1.8	N	0	901.6	88
4/08/00	5:00p	9.9	9.9	9.9	9.9	0.4	1.8	E	0	901.5	88
4/08/00	5:15p	10	10	10	9.9	0.4	1.3	ENE	0	901.6	88
4/08/00	5:30p	10	10	10	9.9	0.4	1.3	NE	0	901.6	88
4/08/00	5:45p	10	10	10.1	9.9	0.4	0.9	NNE	0	901.5	88
4/08/00	6:00p	9.9	9.9	9.9	9.8	0.4	2.2	E	0	901.6	88
4/08/00	6:15p	9.8	9.8	9.8	9.8	0.4	1.3	E	0	901.7	88
4/08/00	6:30p	9.8	9.8	9.8	9.7	0.4	1.8	N	0	901.8	89
4/08/00	6:45p	9.7	9.7	9.8	9.7	0.4	1.8	ENE	0	902	88
4/08/00	7:00p	9.7	9.7	9.8	9.7	0.4	1.8	NNW	0	901.9	89
4/08/00	7:15p	9.7	9.7	9.7	9.7	0.9	2.7	NNW	0	902.1	89
4/08/00	7:30p	9.7	9.7	9.7	9.7	0.4	2.2	N	0	902.1	89
4/08/00	7:45p	9.7	9.7	9.7	9.6	0.9	2.7	N	0	902.2	89
4/08/00	8:00p	9.7	9.7	9.7	9.7	0.4	1.8	N	0	902.3	89
4/08/00	8:15p	9.7	9.7	9.7	9.6	0.4	1.8	NNW	0	902.2	89
4/08/00	8:30p	9.7	9.7	9.7	9.7	0.4	1.3	N	0	902.4	89
4/08/00	8:45p	9.7	9.7	9.7	9.7	0.4	1.8	N	0	902.4	89
4/08/00	9:00p	9.7	9.7	9.7	9.6	0.9	2.2	N	0	902.7	90
4/08/00	9:15p	9.6	9.6	9.6	9.6	0.9	1.8	NNW	0	902.6	90
4/08/00	9:30p	9.6	9.6	9.6	9.6	0.9	1.8	NNW	0	902.5	90
4/08/00	9:45p	9.6	9.6	9.7	9.6	0.4	1.8	N	0	902.6	90
4/08/00	10:00p	9.7	9.7	9.7	9.7	0.4	2.2	N	0	902.5	90
4/08/00	10:15p	9.7	9.7	9.8	9.7	0.4	1.8	N	0	902.5	90
4/08/00	10:30p	9.8	9.8	9.8	9.7	0.4	1.8	N	0.2	902.6	90
4/08/00	10:45p	9.8	9.8	9.8	9.8	0.4	1.8	N	0	902.6	90
4/08/00	11:00p	9.8	9.8	9.8	9.8	0.4	2.7	N	0	902.4	90
4/08/00	11:15p	9.8	9.8	9.8	9.8	0.4	1.8	N	0	902.3	90
4/08/00	11:30p	9.8	9.8	9.8	9.8	0.9	2.7	N	0	902.2	90
4/08/00	11:45p	9.8	9.8	9.9	9.8	0.9	2.7	N	0	902.2	90
4/09/00	12:00a	9.9	9.9	9.9	9.8	0.4	2.2	NNW	0.2	902.1	90
4/09/00	12:15a	9.9	9.9	9.9	9.9	0.9	2.7	N	0	902.1	90
4/09/00	12:30a	9.8	9.8	9.8	9.8	0.4	1.8	N	0	902	90
4/09/00	12:45a	9.8	9.8	9.8	9.8	0	1.8	N	0	901.9	90
4/09/00	1:00a	9.8	9.8	9.8	9.8	0.4	1.3	N	0.2	901.8	90
4/09/00	1:15a	9.8	9.8	9.8	9.8	0.4	1.8	N	0	901.8	90
4/09/00	1:30a	9.8	9.8	9.9	9.8	0.4	2.2	N	0.2	901.8	90
4/09/00	1:45a	9.9	9.9	9.9	9.8	0.4	1.3	NNE	0	901.6	90
4/09/00	2:00a	9.9	9.9	9.9	9.9	0.4	2.2	N	0	901.5	90
4/09/00	2:15a	9.9	9.9	10	9.9	0.4	1.3	N	0	901.3	91
4/09/00	2:30a	10	10	10.1	10	0.4	1.8	N	0	901.3	91

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/09/00	2:45a	10.1	10.1	10.1	10	0.4	1.3	N	0	901.1	91
4/09/00	3:00a	10	10	10	9.9	0.4	2.7	N	0	901	91
4/09/00	3:15a	9.9	9.9	10	9.9	0.4	1.3	N	0	901	91
4/09/00	3:30a	9.8	9.8	9.9	9.8	0.4	1.8	NNE	0	900.7	91
4/09/00	3:45a	9.7	9.7	9.8	9.7	0.4	1.8	N	0	900.7	91
4/09/00	4:00a	9.7	9.7	9.7	9.7	0.4	1.3	N	0	900.9	91
4/09/00	4:15a	9.8	9.8	9.8	9.7	0.4	1.8	NNE	0	900.8	91
4/09/00	4:30a	9.8	9.8	9.8	9.7	0	1.3	NNE	0	900.7	91
4/09/00	4:45a	9.7	9.7	9.7	9.7	0.4	1.3	NNE	0	900.8	91
4/09/00	5:00a	9.6	9.6	9.7	9.6	0.4	1.3	N	0	900.6	91
4/09/00	5:15a	9.6	9.6	9.6	9.5	0.4	1.8	N	0	900.9	91
4/09/00	5:30a	9.6	9.6	9.7	9.6	0.4	1.3	N	0	901	91
4/09/00	5:45a	9.6	9.6	9.7	9.6	0.4	1.3	N	0	901.1	91
4/09/00	6:00a	9.6	9.6	9.7	9.6	0	1.3	N	0	901.1	91
4/09/00	6:15a	9.5	9.5	9.6	9.4	0.4	1.8	NNE	0	901.2	91
4/09/00	6:30a	9.5	9.5	9.6	9.5	0.4	2.2	N	0	901.3	91
4/09/00	6:45a	9.4	9.4	9.5	9.3	0.4	1.3	NNE	0	901.4	91
4/09/00	7:00a	9.2	9.2	9.3	9.1	0	1.3	NNW	0	901.4	91
4/09/00	7:15a	9.2	9.2	9.2	9.1	0	0	---	0	901.3	91
4/09/00	7:30a	9.2	9.2	9.3	9.2	0.4	1.3	N	0	901.4	91
4/09/00	7:45a	9.4	9.4	9.5	9.3	0.4	1.3	NNE	0	901.6	91
4/09/00	8:00a	9.4	9.4	9.6	9.4	0	0.9	N	0	901.6	91
4/09/00	8:15a	9.6	9.6	9.8	9.4	0.4	1.3	N	0	901.9	91
4/09/00	8:30a	9.9	9.9	10.1	9.8	0.4	1.3	N	0	902	92
4/09/00	8:45a	10.2	10.2	10.4	10.1	0.4	1.3	N	0	902	92
4/09/00	9:00a	10.7	10.7	11.2	10.4	0.4	1.3	NNE	0	902	92
4/09/00	9:15a	11.6	11.6	11.9	11.2	0.4	1.8	NNE	0	902	93
4/09/00	9:30a	12.1	12.1	12.4	11.8	0.4	2.2	N	0	902.1	94
4/09/00	9:45a	12.6	12.6	13	12.3	0.9	2.2	N	0	902.1	94
4/09/00	10:00a	13.4	13.4	13.8	13.1	0.9	1.8	N	0	902.2	95
4/09/00	10:15a	13.3	13.3	13.7	12.9	0.4	1.3	N	0	902.2	95
4/09/00	10:30a	13.1	13.1	14.4	12.7	0.4	2.7	N	0	902.2	94
4/09/00	10:45a	14.3	14.3	16	13.3	0.9	2.7	N	0	902	96
4/09/00	11:00a	15.8	15.8	17.2	14.8	0.9	2.7	N	0	901.7	100
4/09/00	11:15a	17.2	17.2	18.2	16	0.4	2.2	N	0	901.8	100
4/09/00	11:30a	17.4	17.4	18.3	16.4	0.9	2.2	N	0	901.7	98
4/09/00	11:45a	16.7	16.7	17.4	15.8	0.4	2.2	N	0	901.7	92
4/09/00	12:00p	15.9	15.9	16.6	15.4	0.4	2.2	N	0	901.6	85
4/09/00	12:15p	17.9	17.9	19.7	16.3	0.4	2.7	N	0	901.3	86
4/09/00	12:30p	18.9	18.9	19.6	18.1	0.4	2.2	N	0	901.1	87
4/09/00	12:45p	18.2	18.2	20.2	16.6	0.4	1.8	N	0	901	80
4/09/00	1:00p	15.7	15.7	16.6	15.3	0.4	2.2	NNE	0	900.7	73
4/09/00	1:15p	15.8	15.8	16.1	15.6	0.4	1.8	N	0	900.5	74
4/09/00	1:30p	16.1	16.1	16.4	15.6	0.9	1.8	N	0	900.3	76
4/09/00	1:45p	15.6	15.6	15.7	15.5	0.4	1.8	N	0	900.3	78
4/09/00	2:00p	15.4	15.4	15.7	15.3	0.4	1.8	N	0	900.4	79
4/09/00	2:15p	15.3	15.3	15.4	15.3	0.4	1.3	NNW	0	900.1	80

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/09/00	2:30p	15.3	15.3	15.6	15.2	0.4	1.3	N	0	900.1	81
4/09/00	2:45p	15.5	15.5	15.6	15.3	0.9	1.8	N	0	899.9	82
4/09/00	3:00p	15.6	15.6	15.8	15.4	0.4	2.7	N	0	900.1	82
4/09/00	3:15p	15.6	15.6	15.7	15.2	0.4	1.3	N	0	900.1	82
4/09/00	3:30p	15.5	15.5	15.8	15.2	0.9	1.8	N	0	900	82
4/09/00	3:45p	15.7	15.7	15.9	15.5	0.4	2.2	NNE	0	900	83
4/09/00	4:00p	15.5	15.5	15.6	15.4	0.4	1.3	N	0	900	83
4/09/00	4:15p	15.6	15.6	15.6	15.4	0.4	1.3	N	0	899.9	83
4/09/00	4:30p	15.2	15.2	15.5	15	0.9	2.2	N	0	900.1	83
4/09/00	4:45p	14.8	14.8	15.1	14.7	0.4	1.8	N	0	900.1	83
4/09/00	5:00p	14.5	14.5	14.7	14.4	0.4	0.9	NNW	0	900.2	82
4/09/00	5:15p	14.2	14.2	14.4	14.1	0.4	1.3	N	0	900	82
4/09/00	5:30p	14.1	14.1	14.2	14.1	0.4	1.8	N	0	900.1	82
4/09/00	5:45p	14.2	14.2	14.2	14.1	0.9	2.2	N	0	900.2	82
4/09/00	6:00p	13.9	13.9	14.1	13.7	0.4	1.3	NW	0	900.3	82
4/09/00	6:15p	13.7	13.7	13.7	13.6	0	0.9	NW	0	900.5	82
4/09/00	6:30p	13.6	13.6	13.7	13.3	0.4	1.3	N	0	900.7	82
4/09/00	6:45p	13.2	13.2	13.3	13.1	0	0.4	N	0	901	82
4/09/00	7:00p	12.9	12.9	13.1	12.8	0	0.4	N	0	901.1	82
4/09/00	7:15p	12.7	12.7	12.8	12.7	0	0.9	N	0	901.2	82
4/09/00	7:30p	12.5	12.5	12.6	12.3	0	0.4	N	0	901.5	82
4/09/00	7:45p	12.2	12.2	12.3	12.1	0	0	---	0	901.4	82
4/09/00	8:00p	12	12	12.1	11.9	0	0	---	0	901.6	82
4/09/00	8:15p	11.9	11.9	11.9	11.8	0	0	---	0	901.7	83
4/09/00	8:30p	11.8	11.8	11.9	11.8	0	0	---	0	901.8	83
4/09/00	8:45p	11.8	11.8	11.8	11.7	0	0	---	0	901.8	83
4/09/00	9:00p	11.9	11.9	12	11.7	0	0	---	0	902	83
4/09/00	9:15p	11.8	11.8	11.9	11.6	0	0	---	0	902.1	84
4/09/00	9:30p	11.6	11.6	11.6	11.5	0	0	---	0	902.3	84
4/09/00	9:45p	11.8	11.8	11.8	11.6	0	0	---	0	902.4	84
4/09/00	10:00p	11.9	11.9	11.9	11.8	0	0	---	0	902.3	84
4/09/00	10:15p	11.9	11.9	11.9	11.9	0	0	---	0	902.4	85
4/09/00	10:30p	11.8	11.8	11.9	11.8	0	0	---	0	902.5	85
4/09/00	10:45p	11.8	11.8	11.9	11.8	0	0	---	0	902.5	85
4/09/00	11:00p	11.9	11.9	11.9	11.9	0	0	---	0	902.5	85
4/09/00	11:15p	11.9	11.9	11.9	11.9	0	0	---	0	902.6	85
4/09/00	11:30p	11.9	11.9	11.9	11.8	0	0	---	0	902.4	85
4/09/00	11:45p	11.8	11.8	11.9	11.8	0	0	---	0	902.5	85
4/10/00	12:00a	11.8	11.8	11.9	11.8	0	0	---	0	902.4	85
4/10/00	12:15a	11.7	11.7	11.8	11.7	0	0	---	0	902.5	85
4/10/00	12:30a	11.7	11.7	11.7	11.6	0	0	---	0	902.5	85
4/10/00	12:45a	11.4	11.4	11.6	11.3	0	0	---	0	902.5	85
4/10/00	1:00a	11.1	11.1	11.3	10.9	0	0	---	0	902.5	85
4/10/00	1:15a	10.9	10.9	10.9	10.7	0	0	---	0	902.5	84
4/10/00	1:30a	10.6	10.6	10.7	10.4	0	0	---	0	902.6	84
4/10/00	1:45a	10.3	10.3	10.4	10.3	0	0	---	0	902.6	84
4/10/00	2:00a	10.2	10.2	10.3	10	0	0	---	0	902.4	84

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/10/00	2:15a	10	10	10	10	0	0	---	0	902.3	84
4/10/00	2:30a	10	10	10	9.9	0	0	---	0	902.4	84
4/10/00	2:45a	9.9	9.9	10	9.8	0	0	---	0	902.4	84
4/10/00	3:00a	9.7	9.7	9.8	9.5	0	0	---	0	902.4	84
4/10/00	3:15a	9.4	9.4	9.4	9.3	0	0	---	0	902.5	84
4/10/00	3:30a	9.2	9.2	9.3	9.2	0	0	---	0	902.5	84
4/10/00	3:45a	9.3	9.3	9.3	9.2	0	0	---	0	902.6	84
4/10/00	4:00a	9.2	9.2	9.3	9.2	0	0	---	0	902.4	85
4/10/00	4:15a	9.1	9.1	9.2	8.9	0	0	---	0	902.6	85
4/10/00	4:30a	8.9	8.9	9	8.8	0	0	---	0	902.6	85
4/10/00	4:45a	8.9	8.9	8.9	8.8	0	0	---	0	902.9	85
4/10/00	5:00a	8.9	8.9	8.9	8.8	0	0	---	0	903	85
4/10/00	5:15a	8.9	8.9	8.9	8.8	0	0	---	0	903.2	85
4/10/00	5:30a	8.9	8.9	9	8.9	0	0	---	0	903.2	85
4/10/00	5:45a	9	9	9.1	8.9	0	0	---	0	903.3	86
4/10/00	6:00a	9	9	9.1	8.9	0	0	---	0	903.3	86
4/10/00	6:15a	8.9	8.9	9	8.9	0	0	---	0	903.5	86
4/10/00	6:30a	8.9	8.9	9	8.8	0	0	---	0	903.7	86
4/10/00	6:45a	8.8	8.8	8.8	8.8	0	0	---	0	903.7	86
4/10/00	7:00a	9	9	9.1	8.8	0	0	---	0	903.9	86
4/10/00	7:15a	9.2	9.2	9.3	9.1	0	0	---	0	903.9	86
4/10/00	7:30a	9.2	9.2	9.2	9.1	0	0	---	0	903.9	86
4/10/00	7:45a	9.4	9.4	9.5	9.3	0	0	---	0	904.3	86
4/10/00	8:00a	9.4	9.4	9.5	9.3	0	0	---	0	904.5	87
4/10/00	8:15a	9.8	9.8	10.2	9.5	0	0	---	0	904.6	87
4/10/00	8:30a	11.3	11.3	12.1	10.2	0	0	---	0	904.7	91
4/10/00	8:45a	11.8	11.8	11.9	11.8	0	0	---	0	904.8	94
4/10/00	9:00a	12.1	12.1	12.4	11.8	0	0	---	0	904.9	92
4/10/00	9:15a	12.7	12.7	13.2	12.4	0	0	---	0	904.9	91
4/10/00	9:30a	13.4	13.4	13.6	13.2	0	0	---	0	905	91
4/10/00	9:45a	13.9	13.9	14.3	13.6	0	0	---	0	904.9	91
4/10/00	10:00a	14.4	14.4	14.9	14.3	0	0	---	0	904.9	91
4/10/00	10:15a	15.4	15.4	15.9	14.9	0	0	---	0	904.8	92
4/10/00	10:30a	17	17	17.7	16	0	0	---	0	904.8	95
4/10/00	10:45a	18.2	18.2	18.6	17.7	0	0	---	0	904.7	96
4/10/00	11:00a	18.7	18.7	19.9	18.1	0	0	---	0	904.6	92
4/10/00	11:15a	19.3	19.3	20.6	17.7	0.4	1.3	SSE	0	904.5	88
4/10/00	11:30a	17.4	17.4	19.4	16.2	0	1.3	SSE	0	904.6	81
4/10/00	11:45a	17.1	17.1	19.2	16.2	0.4	1.3	ESE	0	904.6	77
4/10/00	12:00p	17.9	17.9	19.3	16.1	0	0	---	0	904.5	77
4/10/00	12:15p	18.4	18.4	19.5	17.1	0.4	1.8	SE	0	904.3	76
4/10/00	12:30p	19.4	19.4	20.6	18.3	0.4	2.2	SE	0	904.3	75
4/10/00	12:45p	18.5	18.5	19.9	17.4	0.4	2.2	E	0	904.1	70
4/10/00	1:00p	17.1	17.1	17.4	16.9	0.9	2.7	E	0	904	67
4/10/00	1:15p	17.2	17.2	17.5	16.8	0.4	1.8	ENE	0	903.9	67
4/10/00	1:30p	16.9	16.9	17.3	16.6	0.4	1.8	E	0	903.6	68
4/10/00	1:45p	16.4	16.4	16.9	16.2	0.4	1.8	ESE	0	903.5	68

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/10/00	2:00p	16.2	16.2	16.6	15.8	0.9	1.8	SE	0	903.4	68
4/10/00	2:15p	16.4	16.4	16.8	16.3	0.9	1.8	E	0	903.3	69
4/10/00	2:30p	16.7	16.7	16.9	16.4	0.9	2.2	SE	0	903.3	70
4/10/00	2:45p	16.1	16.1	16.3	15.8	0.4	1.3	ENE	0	903.3	70
4/10/00	3:00p	16.2	16.2	16.3	15.8	0.4	1.8	ENE	0	903.3	70
4/10/00	3:15p	15.7	15.7	16.1	15.4	0.4	1.3	ENE	0	903.2	70
4/10/00	3:30p	16.1	16.1	16.7	15.5	0.4	1.8	SE	0	903.1	70
4/10/00	3:45p	15.7	15.7	16.7	15	0.4	1.3	ENE	0	903.2	71
4/10/00	4:00p	15.7	15.7	16.4	15	0.9	2.2	ESE	0	903.2	70
4/10/00	4:15p	15.7	15.7	16.3	15.1	0.9	2.2	E	0	903.3	71
4/10/00	4:30p	15	15	15.2	14.9	0.4	1.8	E	0	903.3	71
4/10/00	4:45p	15.7	15.7	16	15.2	0.4	2.2	NW	0	903.3	71
4/10/00	5:00p	15.1	15.1	15.8	14.5	0.4	1.8	E	0	903.3	72
4/10/00	5:15p	14.7	14.7	14.9	14.4	0.4	3.6	NNE	0	903.3	71
4/10/00	5:30p	14.4	14.4	14.8	13.9	0.9	2.2	N	0	903.5	71
4/10/00	5:45p	13.6	13.6	13.9	13.4	0.4	1.8	ENE	0	903.5	71
4/10/00	6:00p	13.4	13.4	13.4	13.3	0.4	1.8	NNW	0	903.8	71
4/10/00	6:15p	13.3	13.3	13.4	13.3	0	1.3	N	0	903.9	72
4/10/00	6:30p	13.2	13.2	13.3	13.2	0.4	1.8	NW	0	904	72
4/10/00	6:45p	13.2	13.2	13.2	13.2	0.4	1.8	N	0	904.2	73
4/10/00	7:00p	13.1	13.1	13.2	13	0.9	3.1	N	0	904.4	73
4/10/00	7:15p	12.8	12.8	13	12.7	0.9	1.8	E	0	904.5	73
4/10/00	7:30p	12.4	12.4	12.7	12.3	0.4	3.1	N	0	904.8	73
4/10/00	7:45p	12.2	12.2	12.3	12.1	0.4	1.8	E	0	904.9	74
4/10/00	8:00p	12	12	12.1	11.9	0.4	1.8	ENE	0	905.3	74
4/10/00	8:15p	11.9	11.9	11.9	11.8	0.4	1.8	E	0	905.4	74
4/10/00	8:30p	11.7	11.7	11.8	11.7	0	0.9	E	0	905.5	74
4/10/00	8:45p	11.6	11.6	11.7	11.6	0.4	1.3	E	0	905.6	75
4/10/00	9:00p	11.4	11.4	11.6	11.4	0	0.9	E	0	905.6	75
4/10/00	9:15p	11.3	11.3	11.4	11.2	0	0.9	E	0	905.6	75
4/10/00	9:30p	11.2	11.2	11.3	11.2	0	0	---	0	905.9	75
4/10/00	9:45p	11.3	11.3	11.3	11.2	0	0.9	NW	0	906	75
4/10/00	10:00p	11	11	11.2	10.8	0	0.4	NNE	0	906	76
4/10/00	10:15p	10.8	10.8	10.8	10.7	0	0.9	NE	0	906.1	75
4/10/00	10:30p	10.7	10.7	10.7	10.6	0	0	---	0	906.1	75
4/10/00	10:45p	10.6	10.6	10.7	10.6	0	0	---	0	906.2	76
4/10/00	11:00p	10.6	10.6	10.7	10.6	0	0	---	0	906.3	76
4/10/00	11:15p	10.6	10.6	10.6	10.6	0	0	---	0	906.1	76
4/10/00	11:30p	10.6	10.6	10.6	10.6	0	0	---	0	906	76
4/10/00	11:45p	10.5	10.5	10.6	10.4	0	0	---	0	905.9	76
4/11/00	12:00a	10.3	10.3	10.4	10.3	0	0.9	NE	0	905.7	76
4/11/00	12:15a	10.2	10.2	10.3	10.2	0	0.9	NE	0	905.6	76
4/11/00	12:30a	10.2	10.2	10.2	10.1	0.4	0.9	NE	0	905.5	77
4/11/00	12:45a	10.1	10.1	10.1	9.9	0	0.9	ENE	0	905.4	77
4/11/00	1:00a	9.9	9.9	9.9	9.9	0	0	---	0	905.5	77
4/11/00	1:15a	9.8	9.8	9.9	9.8	0	0.9	ENE	0	905.2	77
4/11/00	1:30a	9.9	9.9	9.9	9.9	0.4	0.9	ENE	0	905.3	78

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/11/00	1:45a	9.9	9.9	10	9.8	0.9	1.3	ESE	0	905.4	78
4/11/00	2:00a	9.7	9.7	9.8	9.7	0.4	0.9	ESE	0	905.2	78
4/11/00	2:15a	9.7	9.7	9.7	9.7	0.4	0.9	ESE	0	905.2	78
4/11/00	2:30a	9.7	9.7	9.7	9.7	0.4	0.9	ESE	0	905.2	78
4/11/00	2:45a	9.6	9.6	9.7	9.2	0	0.9	ESE	0	905.3	78
4/11/00	3:00a	8.9	8.9	9.2	8.7	0	0	---	0	905.1	78
4/11/00	3:15a	8.8	8.8	9.1	8.6	0	0	---	0	905	78
4/11/00	3:30a	8.8	8.8	9.2	8.6	0	0	---	0	905	78
4/11/00	3:45a	8.5	8.5	8.6	8.4	0	0	---	0	905	78
4/11/00	4:00a	8.6	8.6	8.8	8.4	0	0.4	---	0	904.9	78
4/11/00	4:15a	8.6	8.6	8.8	8.3	0	0.4	ESE	0	905	78
4/11/00	4:30a	8.7	8.7	9	8.3	0	1.3	ESE	0	905	79
4/11/00	4:45a	9.1	9.1	9.2	9.1	0.4	0.9	ESE	0	905	79
4/11/00	5:00a	9.2	9.2	9.3	9.1	0	0.9	ESE	0	905.1	80
4/11/00	5:15a	9.3	9.3	9.4	9	0	0	---	0	905.2	80
4/11/00	5:30a	9.3	9.3	9.4	9.3	0.4	0.9	ESE	0	905	80
4/11/00	5:45a	9.2	9.2	9.2	9.1	0.4	1.3	ESE	0	905.1	80
4/11/00	6:00a	9	9	9.1	8.9	0.9	1.3	ESE	0	905.3	81
4/11/00	6:15a	9	9	9.1	8.9	0.9	1.3	SE	0	905.4	80
4/11/00	6:30a	9.1	9.1	9.1	9	0.9	1.3	SE	0	905.3	80
4/11/00	6:45a	9.1	9.1	9.1	8.9	0.9	2.2	SE	0	905.5	81
4/11/00	7:00a	8.8	8.8	9.1	8.7	0.9	1.3	SE	0	905.5	81
4/11/00	7:15a	8.7	8.7	8.7	8.6	0.4	0.9	SE	0	905.6	81
4/11/00	7:30a	8.6	8.6	8.7	8.5	0	1.3	SE	0	905.7	81
4/11/00	7:45a	8.4	8.4	8.6	8.2	0	0	---	0	905.8	81
4/11/00	8:00a	8.8	8.8	9.7	8.2	0	0	---	0	906.2	81
4/11/00	8:15a	11.5	11.5	12.9	9.8	0	0.4	SE	0	906.4	84
4/11/00	8:30a	13	13	13.4	12.7	0	0.9	SE	0	906.3	94
4/11/00	8:45a	12.4	12.4	12.9	11.8	0.4	1.3	SE	0	906.3	94
4/11/00	9:00a	11.4	11.4	12	11	0.9	1.8	E	0	906.3	87
4/11/00	9:15a	11.1	11.1	11.6	10.9	0	0	---	0	906.4	83
4/11/00	9:30a	11.7	11.7	12.3	11.4	0.4	1.8	ESE	0	906.2	82
4/11/00	9:45a	12.6	12.6	13	12.1	0.9	2.2	ESE	0	906.2	83
4/11/00	10:00a	12.8	12.8	13.7	12.2	0.4	2.7	ENE	0	906.3	82
4/11/00	10:15a	14.7	14.7	15.4	13.7	0.9	1.8	ENE	0	906.3	87
4/11/00	10:30a	15.1	15.1	16.2	13.9	0.9	2.2	E	0	906	87
4/11/00	10:45a	15.4	15.4	16.6	13.8	0.9	1.8	E	0	905.9	83
4/11/00	11:00a	13.7	13.7	14.2	13.3	0.4	1.3	E	0	905.9	78
4/11/00	11:15a	14.9	14.9	16.2	13.7	0.9	2.2	E	0	905.8	77
4/11/00	11:30a	15.3	15.3	16.1	14.6	0.4	3.6	E	0	905.8	77
4/11/00	11:45a	16.1	16.1	16.9	15.2	0.9	2.2	E	0	905.7	76
4/11/00	12:00p	18.4	18.4	19.5	15.8	0.9	3.1	N	0	905.5	79
4/11/00	12:15p	17.8	17.8	19.3	15.8	0.9	2.7	N	0	905.3	75
4/11/00	12:30p	17.3	17.3	18.4	15.5	0.9	2.7	N	0	905.2	70
4/11/00	12:45p	16.4	16.4	18.1	15.3	0.9	3.6	N	0	905	63
4/11/00	1:00p	15.5	15.5	15.8	15.2	0.9	2.7	N	0	904.8	62
4/11/00	1:15p	15.4	15.4	15.6	15.1	0.9	3.1	N	0	904.7	63

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/11/00	1:30p	15.2	15.2	15.8	14.9	0.9	2.7	E	0	904.4	64
4/11/00	1:45p	15.1	15.1	15.8	14.5	0.4	1.3	N	0	904.4	66
4/11/00	2:00p	14.8	14.8	15.2	14.4	0.4	1.8	N	0	904.2	67
4/11/00	2:15p	15.1	15.1	15.4	14.4	0.4	1.8	E	0	904	68
4/11/00	2:30p	14.5	14.5	14.9	14.2	0.9	2.2	E	0	904	68
4/11/00	2:45p	15.1	15.1	15.5	14.9	0.9	3.1	ENE	0	903.9	69
4/11/00	3:00p	15.7	15.7	16.1	15.3	0.9	3.1	N	0	903.8	70
4/11/00	3:15p	15.3	15.3	15.6	15.2	0.9	2.2	N	0	903.6	70
4/11/00	3:30p	15.6	15.6	15.8	15.2	0.9	2.7	N	0	903.4	70
4/11/00	3:45p	14.5	14.5	15.1	14.1	0.4	1.8	N	0	903.3	69
4/11/00	4:00p	14.8	14.8	15.2	14.7	0.9	2.2	N	0	903.3	70
4/11/00	4:15p	15.1	15.1	15.3	14.6	0.9	2.7	N	0	903.1	70
4/11/00	4:30p	13.9	13.9	14.6	13.6	0.4	1.3	E	0	903.2	69
4/11/00	4:45p	14.2	14.2	14.4	13.8	0.4	1.8	N	0	903.2	70
4/11/00	5:00p	13.9	13.9	14.2	13.6	0.9	2.2	E	0	903.2	70
4/11/00	5:15p	13.3	13.3	13.5	13.1	0.4	1.3	E	0	903.2	70
4/11/00	5:30p	13.2	13.2	13.2	13.1	0.4	1.3	NW	0	903.2	70
4/11/00	5:45p	13.2	13.2	13.2	13.1	0.4	1.3	N	0	903.4	70
4/11/00	6:00p	13.1	13.1	13.2	13	0	1.3	N	0	903.3	70
4/11/00	6:15p	13.1	13.1	13.2	12.8	0.4	1.8	N	0	903.5	71
4/11/00	6:30p	12.6	12.6	12.8	12.4	0.4	1.8	NNW	0	903.6	71
4/11/00	6:45p	12.4	12.4	12.4	12.4	0.4	1.3	NNW	0	903.7	71
4/11/00	7:00p	12.4	12.4	12.4	12.4	0.4	1.3	ENE	0	903.9	72
4/11/00	7:15p	12.4	12.4	12.4	12.4	0.4	1.3	N	0	904.1	72
4/11/00	7:30p	12.3	12.3	12.4	12.2	0.4	2.2	N	0	904.3	72
4/11/00	7:45p	12.1	12.1	12.2	12.1	0.4	1.3	NNW	0	904.6	73
4/11/00	8:00p	12.2	12.2	12.2	12.1	0.4	1.3	NNW	0	904.7	73
4/11/00	8:15p	12.1	12.1	12.2	12.1	0.4	2.7	N	0	904.8	74
4/11/00	8:30p	12.1	12.1	12.1	12	0	1.3	NNW	0	904.9	74
4/11/00	8:45p	11.9	11.9	12	11.8	0.4	2.2	NNW	0	904.8	74
4/11/00	9:00p	11.8	11.8	11.8	11.8	0.4	1.8	E	0	904.8	74
4/11/00	9:15p	11.7	11.7	11.7	11.7	0.4	2.2	ENE	0	904.7	75
4/11/00	9:30p	11.6	11.6	11.7	11.6	0.4	1.8	NE	0	904.8	75
4/11/00	9:45p	11.4	11.4	11.6	11.3	0.9	3.1	N	0	904.6	75
4/11/00	10:00p	11.3	11.3	11.3	11.2	0.9	2.7	NNE	0	904.7	75
4/11/00	10:15p	11.1	11.1	11.2	10.9	0.9	2.2	N	0	904.6	75
4/11/00	10:30p	10.9	10.9	10.9	10.9	0.9	2.2	N	0	904.6	75
4/11/00	10:45p	10.7	10.7	10.9	10.7	0.9	1.3	N	0	904.6	76
4/11/00	11:00p	10.5	10.5	10.7	10.3	0.4	1.8	NNW	0	904.7	76
4/11/00	11:15p	10.2	10.2	10.3	10.1	0.4	1.3	N	0	904.8	75
4/11/00	11:30p	10.1	10.1	10.1	10	0	0.9	N	0	904.7	75
4/11/00	11:45p	10.1	10.1	10.1	10	0	0.9	N	0	904.4	76
4/12/00	12:00a	9.9	9.9	10	9.7	0	0.9	N	0	904.3	76
4/12/00	12:15a	9.7	9.7	9.8	9.7	0	0.4	N	0	904.4	76
4/12/00	12:30a	9.7	9.7	9.8	9.7	0	0.4	N	0	904.4	76
4/12/00	12:45a	9.9	9.9	9.9	9.8	0	0.9	N	0	904.5	76
4/12/00	1:00a	9.9	9.9	10	9.9	0	0.4	N	0	904.3	77

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/12/00	1:15a	9.9	9.9	9.9	9.9	0	0.4	N	0	904.3	77
4/12/00	1:30a	9.8	9.8	9.9	9.8	0	0.4	N	0	904.4	77
4/12/00	1:45a	9.7	9.7	9.8	9.6	0	0.4	N	0	904.3	77
4/12/00	2:00a	9.5	9.5	9.6	9.5	0	0.4	---	0	904	77
4/12/00	2:15a	9.7	9.7	9.9	9.6	0	0	---	0	903.9	77
4/12/00	2:30a	9.8	9.8	9.9	9.8	0	0	---	0	903.8	77
4/12/00	2:45a	9.9	9.9	9.9	9.8	0	0	---	0	903.7	77
4/12/00	3:00a	9.8	9.8	9.8	9.7	0	0.4	N	0	903.5	77
4/12/00	3:15a	9.8	9.8	9.8	9.7	0	0.4	N	0	903.3	78
4/12/00	3:30a	9.7	9.7	9.8	9.7	0.4	1.3	NNW	0	903.1	78
4/12/00	3:45a	9.7	9.7	9.7	9.7	0.4	1.3	NNW	0	902.9	78
4/12/00	4:00a	9.7	9.7	9.7	9.7	0.4	1.8	NW	0	902.8	78
4/12/00	4:15a	9.7	9.7	9.8	9.7	0	0.4	NW	0	903	78
4/12/00	4:30a	9.7	9.7	9.7	9.7	0	0.9	NW	0	902.9	78
4/12/00	4:45a	9.7	9.7	9.8	9.7	0	0.9	NW	0	903.1	78
4/12/00	5:00a	9.7	9.7	9.7	9.7	0.4	0.9	NW	0	903	78
4/12/00	5:15a	9.5	9.5	9.7	9.3	0	0.9	NW	0	903.1	78
4/12/00	5:30a	9.2	9.2	9.3	9.1	0.4	1.3	NW	0	903.1	78
4/12/00	5:45a	9.3	9.3	9.3	9.2	0.4	1.3	N	0	903.2	78
4/12/00	6:00a	9.2	9.2	9.3	9.2	0.4	0.9	N	0	903.4	78
4/12/00	6:15a	9.4	9.4	9.4	9.3	0.4	2.2	N	0	903.6	78
4/12/00	6:30a	9.4	9.4	9.4	9.4	0	0.9	NNW	0	903.8	79
4/12/00	6:45a	9.4	9.4	9.4	9.3	0	0.9	NNW	0	903.9	79
4/12/00	7:00a	9.3	9.3	9.4	9.2	0	0.4	NNW	0	903.9	79
4/12/00	7:15a	9.2	9.2	9.2	9.1	0	0.4	NNW	0	904	79
4/12/00	7:30a	9.1	9.1	9.2	9.1	0	0	---	0	904.3	79
4/12/00	7:45a	9.2	9.2	9.2	9.2	0	0	---	0	904.4	79
4/12/00	8:00a	9.2	9.2	9.3	9.2	0	0	---	0	904.4	79
4/12/00	8:15a	9.4	9.4	9.5	9.3	0	0	---	0	904.4	79
4/12/00	8:30a	9.7	9.7	9.9	9.5	0.4	0.9	NNW	0	904.5	79
4/12/00	8:45a	10.4	10.4	10.7	9.9	0	0.9	NNW	0	904.4	81
4/12/00	9:00a	10.7	10.7	10.8	10.6	0.4	0.9	N	0	904.6	82
4/12/00	9:15a	10.7	10.7	10.8	10.5	0.9	1.8	N	0	904.5	81
4/12/00	9:30a	10.6	10.6	10.7	10.4	0.9	2.2	N	0	904.4	81
4/12/00	9:45a	10.8	10.8	11.2	10.6	0.9	1.8	N	0	904.3	81
4/12/00	10:00a	11.5	11.5	11.9	11.2	0.9	3.1	N	0	904.2	81
4/12/00	10:15a	12.6	12.6	13.4	11.8	0.4	2.7	N	0	904.2	83
4/12/00	10:30a	12.7	12.7	13.1	12.4	0.9	2.2	N	0	904.1	84
4/12/00	10:45a	12.6	12.6	12.9	12.3	0.9	2.2	N	0	903.9	82
4/12/00	11:00a	12.8	12.8	13.3	12.5	0.9	2.7	N	0	903.8	82
4/12/00	11:15a	12.5	12.5	12.7	12.3	0.4	1.8	N	0	904	80
4/12/00	11:30a	12.3	12.3	12.4	12.2	0.4	1.8	NNW	0	903.9	79
4/12/00	11:45a	12.5	12.5	12.8	12.3	0.4	1.8	N	0	903.8	79
4/12/00	12:00p	12.9	12.9	13.2	12.6	0.4	1.3	N	0	903.8	79
4/12/00	12:15p	12.6	12.6	12.9	12.3	0.4	1.8	N	0	903.6	79
4/12/00	12:30p	12.8	12.8	13	12.4	0.4	1.3	N	0	903.3	79
4/12/00	12:45p	12.8	12.8	13	12.7	0.4	1.3	NW	0	903.3	79

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/12/00	1:00p	13.4	13.4	14.1	12.8	0.4	1.8	N	0	902.8	79
4/12/00	1:15p	13.4	13.4	13.8	13	0.4	1.8	NNE	0	902.8	80
4/12/00	1:30p	12.9	12.9	13.2	12.7	0.4	2.2	N	0	902.6	79
4/12/00	1:45p	13.2	13.2	13.9	12.8	0.4	1.8	N	0	902.5	79
4/12/00	2:00p	14.1	14.1	14.5	13.8	0.4	2.2	N	0	902.4	80
4/12/00	2:15p	13.8	13.8	14.2	13.4	0.9	2.2	N	0	902.1	80
4/12/00	2:30p	13.7	13.7	13.8	13.5	0.9	2.2	N	0	902	79
4/12/00	2:45p	13.7	13.7	13.9	13.5	0.4	2.2	N	0	901.8	79
4/12/00	3:00p	13.6	13.6	13.8	13.4	0	1.3	N	0	901.8	78
4/12/00	3:15p	13.7	13.7	13.8	13.6	0.4	1.3	N	0	901.7	78
4/12/00	3:30p	13.8	13.8	13.9	13.7	0	0.9	NNE	0	901.6	78
4/12/00	3:45p	13.8	13.8	14	13.6	0.4	1.8	N	0	901.5	78
4/12/00	4:00p	13.5	13.5	13.7	13.2	0.4	2.2	NW	0	901.4	78
4/12/00	4:15p	13.2	13.2	13.3	13.1	0	0.9	N	0	901.3	78
4/12/00	4:30p	12.9	12.9	13.1	12.9	0.4	1.3	N	0	901.2	78
4/12/00	4:45p	12.7	12.7	12.9	12.6	0.4	1.3	N	0	901.2	77
4/12/00	5:00p	12.5	12.5	12.6	12.3	0.4	1.3	N	0	901.1	77
4/12/00	5:15p	12.3	12.3	12.3	12.2	0.4	1.3	N	0	901.1	77
4/12/00	5:30p	12.2	12.2	12.2	12.2	0.4	1.3	N	0	901.2	77
4/12/00	5:45p	12.1	12.1	12.2	12.1	0.4	1.8	N	0	901.2	78
4/12/00	6:00p	12	12	12.1	11.9	0	1.3	NNW	0	901.3	78
4/12/00	6:15p	11.9	11.9	11.9	11.8	0	1.3	N	0	901.3	78
4/12/00	6:30p	11.8	11.8	11.8	11.8	0	0.9	NNW	0	901.3	78
4/12/00	6:45p	11.7	11.7	11.8	11.6	0	1.3	NNW	0	901.5	78
4/12/00	7:00p	11.6	11.6	11.6	11.6	0	0.4	NNW	0	901.4	79
4/12/00	7:15p	11.5	11.5	11.6	11.4	0	1.3	N	0	901.4	79
4/12/00	7:30p	11.4	11.4	11.5	11.4	0	1.3	N	0	901.5	79
4/12/00	7:45p	11.5	11.5	11.5	11.4	0.4	1.8	N	0	901.4	79
4/12/00	8:00p	11.4	11.4	11.5	11.4	0.4	1.8	N	0	901.5	80
4/12/00	8:15p	11.3	11.3	11.4	11.3	0.4	1.8	N	0	901.6	80
4/12/00	8:30p	11.3	11.3	11.3	11.2	0.4	1.8	N	0	901.6	80
4/12/00	8:45p	11.2	11.2	11.3	11.2	0.9	1.8	N	0	901.6	80
4/12/00	9:00p	11.2	11.2	11.3	11.2	0.9	2.7	N	0	901.5	80
4/12/00	9:15p	11.3	11.3	11.4	11.3	0.9	2.7	N	0	901.5	80
4/12/00	9:30p	11.4	11.4	11.4	11.3	0.9	2.7	N	0	901.5	81
4/12/00	9:45p	11.2	11.2	11.3	11.2	0.9	2.7	NNE	0	901.5	81
4/12/00	10:00p	11.1	11.1	11.2	11	0.4	1.8	N	0	901.6	81
4/12/00	10:15p	11	11	11	10.9	0.4	2.2	N	0	901.6	81
4/12/00	10:30p	11	11	11	10.9	0.4	2.2	NW	0	901.6	81
4/12/00	10:45p	10.9	10.9	10.9	10.9	0.4	1.8	N	0	901.7	81
4/12/00	11:00p	10.9	10.9	10.9	10.8	0.4	2.2	N	0	901.7	81
4/12/00	11:15p	10.8	10.8	10.8	10.8	0.4	1.3	N	0	901.5	81
4/12/00	11:30p	10.8	10.8	10.8	10.7	0.4	1.3	N	0	901.4	82
4/12/00	11:45p	10.6	10.6	10.7	10.5	0.4	1.8	N	0	901.1	81
4/13/00	12:00a	10.4	10.4	10.5	10.4	0.4	1.3	NNE	0	901.2	81
4/13/00	12:15a	10.4	10.4	10.4	10.4	0	0.9	N	0	901.1	81
4/13/00	12:30a	10.4	10.4	10.4	10.4	0.4	2.2	N	0	901.1	82

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/13/00	12:45a	10.4	10.4	10.4	10.4	0.4	1.3	N	0	901.1	82
4/13/00	1:00a	10.4	10.4	10.4	10.3	0.4	1.8	N	0	900.9	82
4/13/00	1:15a	10.3	10.3	10.3	10.2	0.9	1.3	N	0	900.7	82
4/13/00	1:30a	10.1	10.1	10.2	10.1	0.9	1.8	N	0	900.6	82
4/13/00	1:45a	10.1	10.1	10.1	10	0.4	2.2	N	0	900.4	82
4/13/00	2:00a	9.9	9.9	10	9.8	0.4	1.3	NNW	0	900.4	82
4/13/00	2:15a	9.8	9.8	9.8	9.7	0	0.9	N	0	900.3	82
4/13/00	2:30a	9.8	9.8	9.8	9.7	0	0.9	N	0	900.2	82
4/13/00	2:45a	9.8	9.8	9.9	9.8	0	0.4	N	0	900.3	82
4/13/00	3:00a	9.8	9.8	9.8	9.7	0	0	---	0	900.1	82
4/13/00	3:15a	9.6	9.6	9.7	9.6	0	0	---	0	900	82
4/13/00	3:30a	9.6	9.6	9.6	9.6	0	0	---	0	899.9	82
4/13/00	3:45a	9.5	9.5	9.6	9.4	0	0	---	0	899.8	82
4/13/00	4:00a	9.5	9.5	9.5	9.4	0	0.4	N	0	899.8	82
4/13/00	4:15a	9.6	9.6	9.6	9.5	0	0	---	0	899.8	82
4/13/00	4:30a	9.7	9.7	9.7	9.6	0	0.4	N	0	899.7	82
4/13/00	4:45a	9.7	9.7	9.7	9.6	0	0.4	N	0	899.7	83
4/13/00	5:00a	9.5	9.5	9.6	9.4	0	0	---	0	899.7	83
4/13/00	5:15a	9.6	9.6	9.7	9.4	0	0	---	0	899.7	83
4/13/00	5:30a	9.7	9.7	9.7	9.6	0	0	---	0	899.7	83
4/13/00	5:45a	9.6	9.6	9.7	9.6	0	0	---	0	899.7	83
4/13/00	6:00a	9.6	9.6	9.7	9.6	0	0	---	0	899.7	83
4/13/00	6:15a	9.7	9.7	9.7	9.6	0	0	---	0	899.9	83
4/13/00	6:30a	9.6	9.6	9.8	9.5	0	0.4	N	0	899.9	83
4/13/00	6:45a	9.7	9.7	9.7	9.7	0	0.4	N	0	900	83
4/13/00	7:00a	9.6	9.6	9.7	9.5	0	0	---	0	900	83
4/13/00	7:15a	9.7	9.7	9.8	9.6	0	0	---	0	900	83
4/13/00	7:30a	9.6	9.6	9.8	9.6	0	0	---	0	900.1	83
4/13/00	7:45a	9.9	9.9	10.1	9.8	0	0.9	N	0	900.2	83
4/13/00	8:00a	10.1	10.1	10.2	10	0	0	---	0	900.3	83
4/13/00	8:15a	10.6	10.6	10.9	10.2	0	0	---	0	900.4	84
4/13/00	8:30a	11.2	11.2	11.3	11	0	1.3	N	0	900.5	85
4/13/00	8:45a	11.4	11.4	11.5	11.3	0.4	1.3	N	0	900.7	85
4/13/00	9:00a	11.6	11.6	11.7	11.5	0.4	1.3	N	0	900.7	85
4/13/00	9:15a	11.8	11.8	11.9	11.7	0.4	0.9	N	0	900.7	85
4/13/00	9:30a	12.1	12.1	12.3	11.9	0	0.9	N	0	900.7	85
4/13/00	9:45a	12.6	12.6	12.9	12.3	0	1.3	N	0	900.7	85
4/13/00	10:00a	13.4	13.4	14.2	12.9	0	1.3	N	0	900.6	86
4/13/00	10:15a	14.2	14.2	14.4	14.1	0.4	2.2	NNE	0	900.5	87
4/13/00	10:30a	14.9	14.9	15.1	14.4	0	1.3	NNE	0	900.3	87
4/13/00	10:45a	15.1	15.1	16.2	14.8	0	1.3	NNE	0	900.1	86
4/13/00	11:00a	17.7	17.7	18.6	16.4	0.4	2.7	NNE	0	899.7	91
4/13/00	11:15a	19.2	19.2	19.8	18.2	0.4	1.8	N	0	899.5	92
4/13/00	11:30a	20.8	20.8	22.2	19.6	0.4	2.2	N	0	899.4	90
4/13/00	11:45a	21.3	21.3	21.9	20.6	0.4	2.2	N	0	899.3	84
4/13/00	12:00p	21.9	21.9	22.9	20.5	0.4	2.2	NNE	0	899.1	78
4/13/00	12:15p	22.8	22.8	23.6	21.1	0.4	3.1	NNE	0	899	73

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/13/00	12:30p	21.3	21.3	22.1	20.3	0.9	3.6	NNE	0	898.9	65
4/13/00	12:45p	19	19	20.3	18.6	0.4	2.2	N	0	898.5	58
4/13/00	1:00p	18.5	18.5	18.8	18.1	0.4	3.1	N	0	898.1	58
4/13/00	1:15p	18.4	18.4	18.8	18.1	0.4	2.7	N	0	897.7	61
4/13/00	1:30p	18.1	18.1	18.8	17.6	0.9	2.7	NNE	0	897.6	62
4/13/00	1:45p	17.9	17.9	18.2	17.6	0.9	2.7	NNE	0	897.2	64
4/13/00	2:00p	18.1	18.1	18.4	17.8	0.9	2.2	N	0	897.1	65
4/13/00	2:15p	18	18	18.3	17.4	0.4	1.8	NNE	0	896.8	66
4/13/00	2:30p	18.1	18.1	18.4	17.9	0.4	2.2	NNE	0	896.9	66
4/13/00	2:45p	17.7	17.7	17.9	17.4	0.9	2.7	N	0	896.8	66
4/13/00	3:00p	17.7	17.7	17.9	17.5	0.4	2.2	N	0	896.7	67
4/13/00	3:15p	17.8	17.8	18	17.6	0.4	2.2	N	0	896.7	67
4/13/00	3:30p	17.5	17.5	17.7	17.3	0.4	2.2	N	0	896.7	67
4/13/00	3:45p	17.6	17.6	17.7	17.4	0.4	1.3	NNE	0	896.6	67
4/13/00	4:00p	17.5	17.5	17.7	17.2	0.4	2.2	N	0	896.6	67
4/13/00	4:15p	17	17	17.2	16.9	0	1.8	NNE	0	896.5	67
4/13/00	4:30p	17.1	17.1	17.3	16.7	0.4	2.7	N	0	896.5	67
4/13/00	4:45p	16.3	16.3	16.7	16.1	0.4	1.3	N	0	896.6	67
4/13/00	5:00p	16.4	16.4	16.5	16.4	0.9	1.8	N	0	896.5	67
4/13/00	5:15p	16.3	16.3	16.4	16.2	0.4	1.8	N	0	896.4	67
4/13/00	5:30p	16	16	16.2	15.8	0.4	1.8	NNE	0	896.6	67
4/13/00	5:45p	15.7	15.7	15.9	15.5	0.4	1.3	N	0	896.8	67
4/13/00	6:00p	15.4	15.4	15.6	15.1	0.9	2.7	N	0	896.8	67
4/13/00	6:15p	14.8	14.8	15.1	14.6	0.4	2.2	N	0	896.9	67
4/13/00	6:30p	14.4	14.4	14.6	14.2	0	1.3	N	0	897.1	67
4/13/00	6:45p	14	14	14.2	13.7	0	0	---	0	897.1	67
4/13/00	7:00p	13.6	13.6	13.7	13.4	0	0	---	0	897.1	67
4/13/00	7:15p	13.3	13.3	13.4	13.2	0	0	---	0	897.2	67
4/13/00	7:30p	13.1	13.1	13.2	13	0	0	---	0	897.4	68
4/13/00	7:45p	13.3	13.3	13.5	13.1	0	0	---	0	897.5	68
4/13/00	8:00p	13.3	13.3	13.4	13.2	0	0	---	0	897.5	69
4/13/00	8:15p	12.9	12.9	13.2	12.7	0	0	---	0	897.5	69
4/13/00	8:30p	12.6	12.6	12.7	12.5	0	0	---	0	897.6	69
4/13/00	8:45p	12.7	12.7	12.8	12.4	0	0	---	0	897.7	69
4/13/00	9:00p	12.7	12.7	12.8	12.4	0	0	---	0	897.7	70
4/13/00	9:15p	12.2	12.2	12.4	12.1	0	0	---	0	897.8	70
4/13/00	9:30p	12.1	12.1	12.3	12	0	0	---	0	897.9	70
4/13/00	9:45p	12.1	12.1	12.2	11.9	0	0	---	0	897.9	70
4/13/00	10:00p	12.1	12.1	12.1	11.9	0	0	---	0	897.7	70
4/13/00	10:15p	12	12	12.1	11.9	0	0	---	0	898	71
4/13/00	10:30p	11.9	11.9	11.9	11.8	0	0	---	0	898	71
4/13/00	10:45p	11.7	11.7	11.8	11.7	0	0	---	0	897.9	71
4/13/00	11:00p	11.8	11.8	11.9	11.8	0	0	---	0	897.7	71
4/13/00	11:15p	11.8	11.8	11.8	11.7	0	0	---	0	897.5	72
4/13/00	11:30p	11.7	11.7	11.8	11.6	0	0	---	0	897.4	72
4/13/00	11:45p	11.7	11.7	11.7	11.6	0	0	---	0	897.2	72
4/14/00	12:00a	11.4	11.4	11.6	11.3	0	0	---	0	897.1	72

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/14/00	12:15a	11.4	11.4	11.5	11.3	0	0	---	0	897	72
4/14/00	12:30a	11.5	11.5	11.6	11.4	0	0.4	NNE	0	897	72
4/14/00	12:45a	11.4	11.4	11.6	11.3	0	0	---	0	896.9	73
4/14/00	1:00a	11.4	11.4	11.4	11.3	0	0	---	0	896.9	73
4/14/00	1:15a	11.4	11.4	11.4	11.3	0	0	---	0	896.9	73
4/14/00	1:30a	11.4	11.4	11.4	11.4	0	0	---	0	896.7	73
4/14/00	1:45a	11.4	11.4	11.4	11.3	0	0	---	0	896.8	74
4/14/00	2:00a	11.2	11.2	11.3	11.2	0	0	---	0	896.7	74
4/14/00	2:15a	11.1	11.1	11.2	11	0	0	---	0	896.5	73
4/14/00	2:30a	10.9	10.9	11	10.9	0	0	---	0	896.7	73
4/14/00	2:45a	10.9	10.9	10.9	10.8	0	0	---	0	896.4	73
4/14/00	3:00a	10.8	10.8	10.8	10.8	0	0	---	0	896.1	73
4/14/00	3:15a	10.9	10.9	10.9	10.8	0	0	---	0	896.1	74
4/14/00	3:30a	10.9	10.9	10.9	10.8	0	0	---	0	896.1	74
4/14/00	3:45a	11	11	11.1	10.9	0	0	---	0	896	74
4/14/00	4:00a	11.1	11.1	11.3	11.1	0	0	---	0	896	74
4/14/00	4:15a	11.3	11.3	11.4	11.3	0	0	---	0	895.9	74
4/14/00	4:30a	11.4	11.4	11.4	11.4	0	0	---	0	895.8	75
4/14/00	4:45a	11.4	11.4	11.4	11.4	0	0	---	0	895.9	75
4/14/00	5:00a	11.6	11.6	11.7	11.4	0	0	---	0	895.8	75
4/14/00	5:15a	11.8	11.8	11.9	11.7	0	0	---	0	895.9	75
4/14/00	5:30a	12	12	12.2	11.9	0	0	---	0	895.9	75
4/14/00	5:45a	12.3	12.3	12.6	12.2	0	0	---	0	895.9	76
4/14/00	6:00a	12.5	12.5	12.6	12.4	0	0.9	SW	0	896	76
4/14/00	6:15a	12.4	12.4	12.4	12.3	0	0.9	SW	0	895.8	76
4/14/00	6:30a	12.3	12.3	12.3	12.2	0	0.9	SW	0	895.8	76
4/14/00	6:45a	12.4	12.4	12.4	12.3	0	0	---	0	895.8	76
4/14/00	7:00a	12.3	12.3	12.4	12.2	0.4	1.3	SW	0	895.7	77
4/14/00	7:15a	12.3	12.3	12.4	12.2	0.4	1.8	SW	0	895.9	77
4/14/00	7:30a	12.4	12.4	12.4	12.3	0.9	1.8	SW	0	896	77
4/14/00	7:45a	12.4	12.4	12.6	12.4	0.9	1.3	SSW	0	896	78
4/14/00	8:00a	12.7	12.7	13.2	12.6	0.9	1.8	SW	0	896.1	78
4/14/00	8:15a	14.7	14.7	16.1	13.3	0.9	1.8	SSW	0	896.1	79
4/14/00	8:30a	16.4	16.4	16.9	15.3	0.9	1.8	SW	0	896	86
4/14/00	8:45a	15.1	15.1	15.3	15.1	1.3	2.2	SW	0	896.1	86
4/14/00	9:00a	14.8	14.8	15.1	14.4	1.3	2.7	SW	0	896.1	82
4/14/00	9:15a	14.4	14.4	14.6	14.3	0.9	2.2	SW	0	896.2	79
4/14/00	9:30a	14.6	14.6	14.8	14.4	0.9	2.2	SW	0	896.3	78
4/14/00	9:45a	15	15	15.4	14.4	0.9	2.2	SW	0	896.2	78
4/14/00	10:00a	15.9	15.9	16.7	15.5	1.3	2.2	SW	0	896.2	80
4/14/00	10:15a	18.3	18.3	19.3	16.8	0.9	2.2	SW	0	895.9	85
4/14/00	10:30a	19.5	19.5	20	19	1.3	3.1	SSW	0	895.7	81
4/14/00	10:45a	18.7	18.7	19.6	17.7	1.3	2.7	SW	0	895.6	75
4/14/00	11:00a	19.9	19.9	21.1	18.8	0.9	2.7	SSW	0	895.4	73
4/14/00	11:15a	21.4	21.4	22.3	20.6	0.9	2.2	SW	0	895.4	70
4/14/00	11:30a	21.4	21.4	22.2	20.8	0.9	1.8	SW	0	895.1	67
4/14/00	11:45a	20.6	20.6	21.3	19.8	0.9	2.2	SSW	0	895	63

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/14/00	12:00p	20.9	20.9	22	19.3	0.9	2.7	SW	0	894.9	61
4/14/00	12:15p	20.1	20.1	20.7	19.4	0.4	1.8	SW	0	894.8	59
4/14/00	12:30p	18.2	18.2	19.6	17.4	0.4	1.8	SW	0	894.7	56
4/14/00	12:45p	17.3	17.3	17.6	17.1	0.4	1.8	SSW	0	894.4	55
4/14/00	1:00p	17.1	17.1	17.4	16.9	0.4	1.3	SSW	0	894.2	56
4/14/00	1:15p	17.7	17.7	17.9	17.3	0.9	2.7	SSW	0	894	59
4/14/00	1:30p	17.9	17.9	18.1	17.7	0.9	2.2	SW	0	893.8	60
4/14/00	1:45p	17.9	17.9	18.1	17.7	0.9	2.7	SW	0	893.7	61
4/14/00	2:00p	18.2	18.2	18.4	17.8	0.4	1.8	SSW	0	893.3	62
4/14/00	2:15p	18.4	18.4	18.7	18.1	0.4	1.3	SW	0	893	62
4/14/00	2:30p	18.4	18.4	18.8	17.8	0.4	1.3	SW	0	893	63
4/14/00	2:45p	17.6	17.6	17.8	17.4	0.4	1.3	SSW	0	893.1	62
4/14/00	3:00p	17.3	17.3	17.4	17.1	0	0	---	0	893.1	62
4/14/00	3:15p	16.6	16.6	17.1	16.4	0	0	---	0	893.1	62
4/14/00	3:30p	16.2	16.2	16.4	16.1	0	0	---	0	892.9	62
4/14/00	3:45p	16.2	16.2	16.2	16.1	0	0	---	0	892.8	63
4/14/00	4:00p	16.1	16.1	16.1	16	0	0	---	0	892.8	63
4/14/00	4:15p	15.7	15.7	16	15.6	0	0	---	0	892.7	64
4/14/00	4:30p	15.6	15.6	15.6	15.5	0	0.9	NE	0	892.6	64
4/14/00	4:45p	15.5	15.5	15.6	15.4	0	0	---	0	892.6	64
4/14/00	5:00p	15.4	15.4	15.6	15.3	0	2.2	NNE	0	892.7	65
4/14/00	5:15p	15.2	15.2	15.3	15.1	0	0	---	0	892.6	65
4/14/00	5:30p	15.2	15.2	15.2	15.1	0	0.9	NNE	0	892.7	65
4/14/00	5:45p	15.2	15.2	15.3	15.1	0	0.9	NNE	0	892.7	66
4/14/00	6:00p	14.9	14.9	15.1	14.8	0	0	---	0	892.7	66
4/14/00	6:15p	14.7	14.7	14.8	14.5	0	2.2	NNE	0	892.7	66
4/14/00	6:30p	14.4	14.4	14.5	14.3	0	0	---	0	892.8	66
4/14/00	6:45p	14.2	14.2	14.3	14	0	0	---	0	893	66
4/14/00	7:00p	13.9	13.9	14	13.9	0	0	---	0	892.9	66
4/14/00	7:15p	13.9	13.9	13.9	13.9	0	0	---	0	892.9	67
4/14/00	7:30p	13.9	13.9	14	13.8	0	0	---	0	893	67
4/14/00	7:45p	13.8	13.8	13.9	13.8	0	0	---	0	893.1	68
4/14/00	8:00p	13.7	13.7	13.8	13.7	0	0	---	0	893.1	68
4/14/00	8:15p	13.7	13.7	13.7	13.6	0	0	---	0	893.1	68
4/14/00	8:30p	13.6	13.6	13.7	13.6	0	0	---	0	893.3	69
4/14/00	8:45p	13.6	13.6	13.6	13.5	0	0	---	0	893.4	69
4/14/00	9:00p	13.6	13.6	13.7	13.6	0	0	---	0	893.4	69
4/14/00	9:15p	13.6	13.6	13.7	13.6	0	0	---	0	893.6	70
4/14/00	9:30p	13.6	13.6	13.7	13.5	0	0	---	0	893.4	70
4/14/00	9:45p	13.3	13.3	13.4	13.2	0	0	---	0	893.4	70
4/14/00	10:00p	13.2	13.2	13.3	13.2	0	1.3	NE	0	893.2	70
4/14/00	10:15p	13.2	13.2	13.3	13.2	0	0.9	NE	0	893.2	70
4/14/00	10:30p	13.3	13.3	13.3	13.2	0	0.9	S	0	893.3	71
4/14/00	10:45p	13.3	13.3	13.4	13.3	0	0.4	---	0	893.4	71
4/14/00	11:00p	13.3	13.3	13.4	13.3	0	0	---	0	893.3	71
4/14/00	11:15p	13.4	13.4	13.5	13.3	0	0	---	0	893.2	72
4/14/00	11:30p	13.6	13.6	13.6	13.5	0	0	---	0	893.2	72

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/14/00	11:45p	13.6	13.6	13.7	13.6	0	0	---	0	893.2	72
4/15/00	12:00a	13.7	13.7	13.7	13.6	0.9	1.8	SW	0	893.2	74
4/15/00	12:15a	13.3	13.3	13.5	13	0.9	1.8	SW	0	892.9	74
4/15/00	12:30a	12.8	12.8	13	12.7	0.4	1.3	WSW	0.2	892.5	74
4/15/00	12:45a	12.6	12.6	12.7	12.4	0.4	1.3	SW	0	892.6	74
4/15/00	1:00a	12.4	12.4	12.4	12.4	0	0	---	0	892.5	75
4/15/00	1:15a	12.5	12.5	12.6	12.4	0	0	---	0	892.4	76
4/15/00	1:30a	12.6	12.6	12.6	12.6	0.4	1.8	SW	0	892.4	77
4/15/00	1:45a	12.5	12.5	12.6	12.5	0.4	1.3	SSW	0	892.1	77
4/15/00	2:00a	12.4	12.4	12.5	12.4	0.9	1.3	SSW	0	892.3	78
4/15/00	2:15a	12.6	12.6	12.7	12.6	0	0.9	SSW	0	892.3	79
4/15/00	2:30a	12.7	12.7	12.8	12.7	0.4	1.8	SSW	0	892.2	79
4/15/00	2:45a	12.8	12.8	12.9	12.8	0.4	1.3	SSW	0	892.2	80
4/15/00	3:00a	12.9	12.9	12.9	12.9	0	0.9	SW	0	892	80
4/15/00	3:15a	12.9	12.9	12.9	12.9	0	0.9	SW	0	891.8	80
4/15/00	3:30a	12.9	12.9	13	12.9	0.4	1.3	SW	0	891.7	80
4/15/00	3:45a	13	13	13	12.9	0.9	1.3	SW	0	891.5	81
4/15/00	4:00a	12.9	12.9	12.9	12.9	0.4	1.3	SW	0	891.7	81
4/15/00	4:15a	12.8	12.8	12.9	12.8	0	0	---	0	891.7	81
4/15/00	4:30a	12.8	12.8	12.8	12.7	0	1.3	SSW	0	891.7	81
4/15/00	4:45a	12.6	12.6	12.7	12.6	0.9	1.8	SSW	0	891.7	82
4/15/00	5:00a	12.6	12.6	12.7	12.6	1.3	2.7	SSW	0	891.7	82
4/15/00	5:15a	12.6	12.6	12.6	12.6	1.3	1.8	SSW	0	891.6	83
4/15/00	5:30a	12.7	12.7	12.7	12.6	1.3	1.8	SSW	0	891.6	83
4/15/00	5:45a	12.7	12.7	12.7	12.7	1.3	2.2	SSW	0	891.8	84
4/15/00	6:00a	12.7	12.7	12.7	12.7	1.8	3.1	SSW	0	891.7	84
4/15/00	6:15a	12.6	12.6	12.7	12.5	1.8	3.1	SSW	0	891.5	85
4/15/00	6:30a	12.5	12.5	12.6	12.4	1.8	2.7	SW	0	891.6	85
4/15/00	6:45a	12.4	11.3	12.5	12.4	2.2	3.1	SW	0	891.5	86
4/15/00	7:00a	12.5	11.4	12.5	12.4	2.2	3.6	SW	0	891.7	86
4/15/00	7:15a	12.6	11.5	12.7	12.5	2.2	3.1	SW	0	892	87
4/15/00	7:30a	12.7	12.7	12.7	12.6	1.8	3.1	SW	0	892	87
4/15/00	7:45a	12.8	11.7	13	12.7	2.2	3.6	SW	0	892.2	87
4/15/00	8:00a	13.3	11.6	14.1	13	2.7	3.6	SW	0	892.4	88
4/15/00	8:15a	14.9	13.3	15.2	14.2	2.7	4	SW	0	892.7	88
4/15/00	8:30a	15.3	14.4	15.7	14.7	2.2	4	SW	0	893	93
4/15/00	8:45a	14.4	13.4	14.7	14.3	2.2	4	SSW	0	893	94
4/15/00	9:00a	13.9	12.1	14.3	13.7	2.7	4.5	SSW	0	893.2	90
4/15/00	9:15a	14.1	13.1	14.5	13.7	2.2	3.1	SSW	0	893.4	87
4/15/00	9:30a	14.8	14.8	15.3	14.5	1.8	3.6	SSW	0	893.5	87
4/15/00	9:45a	15.3	15.3	15.6	15.1	1.8	3.1	SSW	0	893.4	87
4/15/00	10:00a	15.6	15.6	16.3	15.1	1.8	3.6	SSW	0	893.5	88
4/15/00	10:15a	16.9	16.9	17.7	16.4	1.8	4	SSW	0	893.6	89
4/15/00	10:30a	17.3	16.5	17.7	16.7	2.2	4	SSW	0	893.5	84
4/15/00	10:45a	18.1	18.1	19.7	17.1	1.3	3.6	SSW	0	893.5	81
4/15/00	11:00a	19.1	19.1	19.8	18.3	1.8	3.1	SSW	0	893.5	77
4/15/00	11:15a	19.3	19.3	20.6	18.2	1.8	2.7	SW	0	893.3	72

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/15/00	11:30a	19.8	19.8	20.6	18.2	1.8	3.1	SSW	0	893.4	68
4/15/00	11:45a	17.6	17.6	18.7	16.4	1.8	3.1	SSW	0	893.6	62
4/15/00	12:00p	18.7	18.7	19.8	17.6	1.3	2.7	SSW	0	893.4	61
4/15/00	12:15p	19.7	19	20.5	19.2	2.2	4.5	SSW	0	893.4	60
4/15/00	12:30p	19.3	19.3	19.8	18	1.8	4	SW	0	893.3	55
4/15/00	12:45p	17.2	17.2	17.9	17	1.3	2.7	SW	0	893.2	50
4/15/00	1:00p	16.9	16.9	17.1	16.8	1.8	3.1	SSW	0	893.1	50
4/15/00	1:15p	17	17	17.3	16.8	1.8	3.6	SSW	0	892.9	52
4/15/00	1:30p	17	16.1	17.3	16.8	2.2	4.5	SSW	0	893	53
4/15/00	1:45p	17.3	17.3	17.5	17.1	1.3	4.5	SW	0	892.8	54
4/15/00	2:00p	17.7	17.7	17.8	17.4	1.3	2.7	SSW	0	892.8	55
4/15/00	2:15p	17.9	17.9	18	17.8	1.3	2.2	SSW	0	892.6	56
4/15/00	2:30p	17.7	17.7	18	17.4	1.8	3.1	SSW	0	892.6	56
4/15/00	2:45p	17.2	17.2	17.6	16.9	1.3	2.7	SSW	0	892.6	56
4/15/00	3:00p	16.9	16.9	17	16.8	1.3	2.2	SSW	0	892.7	57
4/15/00	3:15p	17.2	17.2	17.3	17	1.3	3.1	S	0	892.7	58
4/15/00	3:30p	17.1	17.1	17.2	17	1.3	2.2	SSW	0	892.7	58
4/15/00	3:45p	17	17	17.1	16.9	1.3	2.2	SSW	0	892.7	59
4/15/00	4:00p	17.1	17.1	17.2	16.9	0.9	1.8	SSW	0	892.6	59
4/15/00	4:15p	17.1	17.1	17.2	16.8	0.9	1.3	SSW	0	892.5	60
4/15/00	4:30p	17.1	17.1	17.2	17.1	0.9	2.2	SSW	0	892.4	60
4/15/00	4:45p	17.1	17.1	17.2	17.1	0.9	1.8	SSW	0	892.4	60
4/15/00	5:00p	17.1	17.1	17.1	17	0.9	1.8	SSW	0	892.4	61
4/15/00	5:15p	16.9	16.9	17	16.7	0	0.9	SSW	0	892.4	60
4/15/00	5:30p	16.6	16.6	16.6	16.4	0.4	0.9	SSW	0	892.7	61
4/15/00	5:45p	16.1	16.1	16.4	15.9	0	0	---	0	892.7	61
4/15/00	6:00p	15.7	15.7	15.8	15.6	0	0.4	SSW	0	892.8	60
4/15/00	6:15p	15.2	15.2	15.6	14.9	0	0	---	0	893.1	60
4/15/00	6:30p	14.5	14.5	14.9	14.1	0	0	---	0	893.3	60
4/15/00	6:45p	13.6	13.6	14.1	13.4	0	0	---	0	893.4	60
4/15/00	7:00p	13.3	13.3	13.4	13.1	0	0	---	0	893.4	60
4/15/00	7:15p	12.8	12.8	13.1	12.5	0	0	---	0	893.6	61
4/15/00	7:30p	12.4	12.4	12.5	12.3	0	0	---	0	893.8	61
4/15/00	7:45p	12.1	12.1	12.3	11.9	0	0	---	0	894	62
4/15/00	8:00p	12	12	12.1	11.9	0	0	---	0	894.3	62
4/15/00	8:15p	12.1	12.1	12.2	12.1	0	0	---	0	894.6	63
4/15/00	8:30p	12.1	12.1	12.2	12.1	0	0	---	0	894.5	63
4/15/00	8:45p	12.6	12.6	12.9	12.2	0	0.9	NW	0	894.4	64
4/15/00	9:00p	12.8	12.8	12.9	12.7	0	0	---	0	894.5	64
4/15/00	9:15p	13.1	13.1	13.1	12.9	0	0.9	NNW	0	894.4	65
4/15/00	9:30p	13.1	13.1	13.1	13.1	0	1.3	NNW	0	894.5	65
4/15/00	9:45p	13.1	13.1	13.1	13.1	0	0.9	NW	0	894.5	66
4/15/00	10:00p	13.1	13.1	13.1	13	0	0.9	NW	0	894.4	66
4/15/00	10:15p	13	13	13.1	13	0	0	---	0	894.6	66
4/15/00	10:30p	13	13	13	12.9	0	0	---	0	894.8	66
4/15/00	10:45p	12.9	12.9	12.9	12.9	0	0	---	0	894.9	67
4/15/00	11:00p	13	13	13.1	12.9	0	0	---	0	894.8	67

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/15/00	11:15p	13.1	13.1	13.1	12.9	0	0	---	0	894.9	67
4/15/00	11:30p	12.8	12.8	12.9	12.8	0	0	---	0	894.8	67
4/15/00	11:45p	12.7	12.7	12.8	12.7	0	0	---	0	894.7	67
4/16/00	12:00a	12.7	12.7	12.7	12.7	0	0	---	0	894.5	67
4/16/00	12:15a	12.7	12.7	12.7	12.7	0	0	---	0	894.3	68
4/16/00	12:30a	12.7	12.7	12.7	12.7	0	0	---	0	894.2	68
4/16/00	12:45a	12.6	12.6	12.7	12.6	0	0	---	0	894	68
4/16/00	1:00a	12.6	12.6	12.6	12.6	0	0	---	0	893.8	68
4/16/00	1:15a	12.6	12.6	12.6	12.6	0	0	---	0	893.4	68
4/16/00	1:30a	12.5	12.5	12.6	12.4	0	0	---	0	893.5	69
4/16/00	1:45a	12.4	12.4	12.4	12.3	0	0	---	0	893.3	69
4/16/00	2:00a	12.3	12.3	12.4	12.3	0	0	---	0	893.2	69
4/16/00	2:15a	12.2	12.2	12.3	12.1	0	0	---	0	893	69
4/16/00	2:30a	11.9	11.9	12.1	11.9	0	0	---	0	893.1	69
4/16/00	2:45a	11.9	11.9	12	11.9	0	1.3	N	0	892.8	69
4/16/00	3:00a	11.8	11.8	11.9	11.7	0	0.4	N	0	892.7	69
4/16/00	3:15a	11.6	11.6	11.7	11.4	0	0.4	N	0	892.4	69
4/16/00	3:30a	11.5	11.5	11.6	11.4	0	0.4	N	0	892.2	70
4/16/00	3:45a	11.6	11.6	11.6	11.4	0	0	---	0	892.1	70
4/16/00	4:00a	11.6	11.6	11.7	11.5	0	0.4	N	0	892.1	70
4/16/00	4:15a	11.5	11.5	11.6	11.5	0	0	---	0	891.9	71
4/16/00	4:30a	11.5	11.5	11.6	11.4	0	0	---	0	891.6	71
4/16/00	4:45a	11.5	11.5	11.6	11.4	0	0	---	0	891.8	71
4/16/00	5:00a	11.6	11.6	11.7	11.6	0	0	---	0	891.8	71
4/16/00	5:15a	11.6	11.6	11.6	11.5	0	0	---	0	891.7	71
4/16/00	5:30a	11.6	11.6	11.8	11.6	0	0	---	0	891.9	72
4/16/00	5:45a	12	12	12.2	11.8	0	0	---	0	891.9	72
4/16/00	6:00a	12.4	12.4	12.6	12.2	0	0	---	0	892.1	72
4/16/00	6:15a	12.7	12.7	12.7	12.6	0	0	---	0	891.8	73
4/16/00	6:30a	12.9	12.9	13.1	12.7	0	0	---	0	891.8	73
4/16/00	6:45a	13.2	13.2	13.3	13.1	0	1.3	N	0	891.9	73
4/16/00	7:00a	13.4	13.4	13.4	13.3	0	0.9	N	0	891.8	74
4/16/00	7:15a	13.4	13.4	13.4	13.3	0	0.9	NNE	0	891.7	74
4/16/00	7:30a	13.4	13.4	13.4	13.4	0	0.4	NNE	0	891.6	74
4/16/00	7:45a	13.5	13.5	13.6	13.4	0	0	---	0	891.4	74
4/16/00	8:00a	13.7	13.7	13.8	13.6	0	1.3	NNE	0	891.7	74
4/16/00	8:15a	14.1	14.1	14.2	13.8	0	0.9	NNE	0	891.9	74
4/16/00	8:30a	14.4	14.4	14.5	14.3	0	0.4	NNE	0	891.9	75
4/16/00	8:45a	14.6	14.6	14.6	14.5	0	2.2	NNE	0	892.1	75
4/16/00	9:00a	14.6	14.6	14.7	14.4	0	0	---	0	892.3	75
4/16/00	9:15a	14.1	14.1	14.4	13.8	0	1.3	NE	1.6	892.1	75
4/16/00	9:30a	13.9	13.9	14	13.8	0	0.9	NNE	0.2	892	74
4/16/00	9:45a	14.1	14.1	14.1	14	0	0.9	NNE	0	892.3	75
4/16/00	10:00a	14.3	14.3	14.6	14.1	0.4	1.8	SSW	0	892.2	76
4/16/00	10:15a	15.6	15.6	16.3	14.7	0.9	1.8	SSW	0	892	81
4/16/00	10:30a	16.8	16.8	17	16.3	0.9	1.8	SW	0	891.7	85
4/16/00	10:45a	17.1	17.1	17.2	16.8	0.9	1.8	SW	0	891.7	84

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/16/00	11:00a	16.9	16.9	17.4	16.6	0.9	1.8	SSW	0	891.7	81
4/16/00	11:15a	17.3	17.3	17.4	17.1	0.9	2.2	SW	0	891.5	79
4/16/00	11:30a	17.3	17.3	17.6	17.2	0.9	2.2	SW	0	891.1	78
4/16/00	11:45a	18.4	18.4	19.1	17.6	0.4	1.3	SW	0	890.8	79
4/16/00	12:00p	19.4	19.4	19.9	19	0.9	2.2	SW	0	890.7	79
4/16/00	12:15p	18.7	18.7	19.2	18.3	0.9	2.2	SSW	0	890.6	75
4/16/00	12:30p	18.3	18.3	18.5	18	0.9	2.2	SW	0	890.5	72
4/16/00	12:45p	17.9	17.9	18	17.8	0.9	1.8	SW	0	890.4	71
4/16/00	1:00p	17.9	17.9	17.9	17.8	0.9	2.2	SSW	0	890	70
4/16/00	1:15p	17.8	17.8	17.9	17.7	0.9	1.8	SW	0	890	70
4/16/00	1:30p	17.7	17.7	17.8	17.7	0.9	1.8	SW	0	889.8	71
4/16/00	1:45p	17.7	17.7	17.8	17.4	0.9	1.8	SW	0	889.8	71
4/16/00	2:00p	17.2	17.2	17.3	17.1	1.3	1.8	SW	0	889.6	70
4/16/00	2:15p	17.1	17.1	17.3	16.9	0.9	1.8	SW	0	889.6	71
4/16/00	2:30p	17	17	17.2	16.9	1.3	2.7	SSW	0	889.3	71
4/16/00	2:45p	16.8	16.8	16.9	16.8	1.3	2.7	SW	0	889.3	71
4/16/00	3:00p	16.7	16.7	16.8	16.6	1.3	3.1	SSW	0	889.3	71
4/16/00	3:15p	16.6	16.6	16.6	16.5	0.9	2.2	SSW	0	889.2	71
4/16/00	3:30p	16.5	16.5	16.5	16.4	0.9	2.2	SSW	0	889.1	71
4/16/00	3:45p	16.3	16.3	16.4	16.1	1.3	2.7	SSW	0	889	71
4/16/00	4:00p	16	16	16.1	15.9	0.9	1.8	SW	0	889	70
4/16/00	4:15p	15.8	15.8	15.9	15.7	0.9	2.2	SW	0	889	70
4/16/00	4:30p	15.6	15.6	15.7	15.6	0.9	1.8	SSW	0	889	70
4/16/00	4:45p	15.4	15.4	15.6	15.3	0.9	1.8	SW	0	889	70
4/16/00	5:00p	15.2	15.2	15.3	15.2	0.9	1.8	SW	0.2	889.1	70
4/16/00	5:15p	15.1	15.1	15.2	14.9	0.9	1.8	SW	0	889.4	70
4/16/00	5:30p	14.8	14.8	14.9	14.7	1.3	2.7	SSW	0	889.5	71
4/16/00	5:45p	14.3	14.3	14.7	13.9	1.3	3.1	SSW	0	889.7	71
4/16/00	6:00p	13.4	13.4	13.9	13	1.3	2.2	SSW	0	889.8	72
4/16/00	6:15p	12.8	12.8	13	12.7	0.9	1.3	SSW	0	889.8	73
4/16/00	6:30p	12.6	12.6	12.7	12.6	0.9	1.3	SSW	0	890.1	74
4/16/00	6:45p	12.6	12.6	12.7	12.5	0.4	1.3	SSW	0.2	890.3	75
4/16/00	7:00p	12.4	12.4	12.5	12.3	0.4	1.3	SSW	0	890.3	75
4/16/00	7:15p	12.2	12.2	12.3	12.1	0.9	1.3	SSW	0.2	890.3	76
4/16/00	7:30p	12.1	12.1	12.1	12.1	0.9	1.8	SSW	0.2	890.2	77
4/16/00	7:45p	12.1	12.1	12.1	12	0.9	1.8	SSW	0	890	78
4/16/00	8:00p	12	12	12	12	0.9	1.8	SSW	0	890.3	79
4/16/00	8:15p	12	12	12	12	0.9	1.8	SSW	0.2	890.3	80
4/16/00	8:30p	11.9	11.9	12	11.9	0.9	1.3	SSW	0	889.9	80
4/16/00	8:45p	11.9	11.9	11.9	11.9	0.9	1.3	SSW	0	890.1	81
4/16/00	9:00p	11.8	11.8	11.9	11.8	0.4	0.9	SSW	0.2	890.2	81
4/16/00	9:15p	11.8	11.8	11.8	11.8	0.4	0.9	SSW	0	889.9	81
4/16/00	9:30p	11.9	11.9	11.9	11.8	0.4	0.9	SSW	0	890.1	82
4/16/00	9:45p	11.9	11.9	11.9	11.9	0	0	---	0	890	82
4/16/00	10:00p	11.9	11.9	12	11.9	0.4	0.9	SSW	0	889.8	82
4/16/00	10:15p	11.9	11.9	11.9	11.9	0.4	0.9	SSW	0	889.9	82
4/16/00	10:30p	12	12	12	11.9	0.4	0.9	SSW	0	890	82

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/16/00	10:45p	12.1	12.1	12.1	12	0	0	---	0	890	82
4/16/00	11:00p	12.1	12.1	12.1	12.1	0	0	---	0	889.9	82
4/16/00	11:15p	12.1	12.1	12.1	12.1	0	0	---	1.2	890	82
4/16/00	11:30p	11.9	11.9	12.1	11.3	0.9	3.1	SSW	0.8	890.3	83
4/16/00	11:45p	10.6	9.4	11.2	10.4	2.2	4	S	0.2	890.3	83
4/17/00	12:00a	10.4	10.4	10.4	10.3	1.3	2.2	S	0	890.3	83
4/17/00	12:15a	10.2	10.2	10.3	10.1	1.3	1.8	SSW	0	890.1	84
4/17/00	12:30a	9.9	9.9	10.1	9.8	1.3	2.2	SSW	0	890.3	84
4/17/00	12:45a	9.8	9.8	9.9	9.8	1.8	2.7	SSW	0	890.1	85
4/17/00	1:00a	9.8	8.6	9.9	9.8	2.2	3.1	SSW	0	890.2	85
4/17/00	1:15a	10	8.7	10.1	9.9	2.2	3.1	SSW	0	890.5	86
4/17/00	1:30a	10.1	10.1	10.1	10	1.8	2.7	SSW	0	890.5	87
4/17/00	1:45a	10	10	10.1	9.9	1.8	3.1	SSW	0	890.1	87
4/17/00	2:00a	9.7	9.7	9.9	9.6	1.8	2.7	SSW	0	889.8	87
4/17/00	2:15a	9.6	9.6	9.6	9.6	1.8	2.7	SSW	0	889.7	87
4/17/00	2:30a	9.6	8.3	9.6	9.5	2.2	2.7	SSW	0	889.4	88
4/17/00	2:45a	9.4	8.2	9.5	9.4	2.2	3.1	SSW	0	889.5	88
4/17/00	3:00a	9.4	6.4	9.4	9.4	3.1	4.5	SSW	0	889.6	89
4/17/00	3:15a	9.4	7.2	9.4	9.3	2.7	4.5	SSW	0	889.4	89
4/17/00	3:30a	9.3	7.2	9.4	9.3	2.7	4	SSW	0	889.7	89
4/17/00	3:45a	9.3	8.1	9.4	9.3	2.2	3.6	SSW	0	889.6	89
4/17/00	4:00a	9.2	7.9	9.3	9.2	2.2	3.1	SSW	0	889.6	90
4/17/00	4:15a	9.1	9.1	9.2	9	1.8	3.1	SSW	0	889.9	90
4/17/00	4:30a	9.2	7.9	9.3	9.1	2.2	3.1	SSW	0	890.1	90
4/17/00	4:45a	9.3	8	9.3	9.1	2.2	3.6	SSW	0	890.3	90
4/17/00	5:00a	8.9	7.6	9.1	8.8	2.2	3.1	SSW	0	890.5	90
4/17/00	5:15a	8.8	7.5	8.9	8.8	2.2	3.6	SSW	0	890.7	90
4/17/00	5:30a	8.8	7.4	8.9	8.7	2.2	3.1	SSW	0	890.9	90
4/17/00	5:45a	8.6	7.3	8.7	8.5	2.2	3.6	SSW	0	891.1	90
4/17/00	6:00a	8.6	7.3	8.7	8.5	2.2	4	SSW	0	891.4	90
4/17/00	6:15a	8.6	6.4	8.7	8.5	2.7	3.6	SSW	0	891.5	90
4/17/00	6:30a	8.4	6.2	8.6	8.4	2.7	3.6	SSW	0	891.4	90
4/17/00	6:45a	8.4	7.1	8.6	8.4	2.2	3.6	SSW	0	891.6	90
4/17/00	7:00a	8.4	7.1	8.5	8.4	2.2	3.1	SSW	0	891.8	90
4/17/00	7:15a	8.4	8.4	8.4	8.3	1.8	2.7	SSW	0	892.2	90
4/17/00	7:30a	8.4	7.1	8.4	8.3	2.2	3.1	SSW	0	892.2	90
4/17/00	7:45a	8.4	6.1	8.6	8.3	2.7	3.6	SSW	0	892.4	90
4/17/00	8:00a	9.2	6.1	10.5	8.6	3.1	4.9	SSW	0	892.6	91
4/17/00	8:15a	10.4	8.4	11.1	9.4	2.7	4	S	0	893.1	91
4/17/00	8:30a	10.9	9.7	11.8	9.4	2.2	4	S	0	893.2	92
4/17/00	8:45a	11.1	11.1	11.5	10.7	1.8	3.1	SSW	0	893.5	98
4/17/00	9:00a	10.6	10.6	11.2	10.3	1.8	3.6	SSW	0	893.8	96
4/17/00	9:15a	10.6	10.6	10.8	10.4	1.8	2.7	SSW	0	893.9	93
4/17/00	9:30a	10.7	9.4	10.8	10.6	2.2	4	S	0	893.9	91
4/17/00	9:45a	11.1	9.9	11.5	10.8	2.2	3.6	S	0	893.9	90
4/17/00	10:00a	12.2	11	13	11.6	2.2	3.6	SSW	0	893.8	92
4/17/00	10:15a	14	14	14.9	12.9	1.3	3.1	SSW	0	893.8	95

Newnes Meteorology

(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/17/00	10:30a	14.8	14.8	15.2	14.4	1.3	2.7	SSW	0	893.7	93
4/17/00	10:45a	15.4	15.4	16.6	14.4	0.9	1.8	SE	0	893.7	89
4/17/00	11:00a	16.9	16.9	18.3	15.7	0.4	1.8	SW	0	893.8	86
4/17/00	11:15a	17.4	17.4	18.8	16.3	0.9	1.8	S	0	893.7	81
4/17/00	11:30a	17.5	17.5	17.9	16.8	0.9	1.8	SSE	0	893.8	77
4/17/00	11:45a	17.7	17.7	18.5	17.3	0.9	2.2	SSE	0	893.9	74
4/17/00	12:00p	18.8	18.8	19.6	18.2	0.4	1.8	S	0	893.8	70
4/17/00	12:15p	18.8	18.8	19.3	18.1	0.9	2.2	SSW	0	893.8	66
4/17/00	12:30p	17.4	17.4	18.6	15.6	1.3	2.7	SSE	0	893.7	58
4/17/00	12:45p	14.8	14.8	15.4	14.5	0.4	1.8	SSW	0	893.6	54
4/17/00	1:00p	14.7	14.7	14.9	14.3	0.4	1.8	SSW	0	893.3	55
4/17/00	1:15p	14.1	14.1	14.5	14	0.9	1.8	S	0	893.3	57
4/17/00	1:30p	14.1	14.1	14.3	13.9	0.4	0.9	S	0	893.2	59
4/17/00	1:45p	14.3	14.3	14.5	14.2	0.4	1.3	S	0	893.1	61
4/17/00	2:00p	14.7	14.7	15.1	14.3	0.4	1.3	S	0	893	62
4/17/00	2:15p	14.9	14.9	15.1	14.7	0.9	1.8	SSE	0	893	63
4/17/00	2:30p	14.7	14.7	14.9	14.6	0.9	1.8	S	0	892.9	63
4/17/00	2:45p	14.9	14.9	15.2	14.7	0.9	1.8	S	0	893	63
4/17/00	3:00p	15.3	15.3	15.7	15.1	0.9	1.8	S	0	893.1	64
4/17/00	3:15p	15.1	15.1	15.3	14.9	1.3	2.2	SSE	0	893.1	63
4/17/00	3:30p	15.2	15.2	15.5	15	0.9	2.2	SSE	0	893.1	63
4/17/00	3:45p	15.2	15.2	15.3	15.1	0.9	1.8	S	0	893.2	63
4/17/00	4:00p	14.8	14.8	15.1	14.6	0.9	2.2	S	0	893.3	63
4/17/00	4:15p	14.6	14.6	14.7	14.4	0.9	1.8	S	0	893.5	62
4/17/00	4:30p	14.3	14.3	14.4	14.2	0.9	1.3	S	0	893.6	62
4/17/00	4:45p	14.2	14.2	14.2	14.1	0.9	1.3	S	0	893.7	62
4/17/00	5:00p	14	14	14.1	13.9	0.9	1.8	SSW	0	893.8	62
4/17/00	5:15p	13.9	13.9	13.9	13.8	0.9	1.8	SSW	0	893.8	62
4/17/00	5:30p	13.7	13.7	13.9	13.6	0.9	1.8	SSW	0	893.9	62
4/17/00	5:45p	13.5	13.5	13.6	13.4	0.9	1.3	SSW	0	893.9	62
4/17/00	6:00p	13.1	13.1	13.4	12.9	0.9	1.3	SSW	0	894.1	62
4/17/00	6:15p	12.6	12.6	12.9	12.3	0.9	1.3	SSW	0	894.1	62
4/17/00	6:30p	11.7	11.7	12.2	11.2	0.9	1.3	SSW	0	894.3	62
4/17/00	6:45p	11	11	11.2	10.7	0.9	1.3	SSW	0	894.4	62
4/17/00	7:00p	10.4	10.4	10.7	10.2	0.4	1.3	SSW	0	894.7	62
4/17/00	7:15p	10.1	10.1	10.2	9.8	0	0.9	SSW	0	894.9	63
4/17/00	7:30p	9.6	9.6	9.8	9.4	0	0	---	0	895.1	63
4/17/00	7:45p	9.2	9.2	9.4	9	0	0	---	0	895.4	63
4/17/00	8:00p	8.8	8.8	9	8.4	0	0.9	SSW	0	895.4	64
4/17/00	8:15p	8.4	8.4	8.5	8.3	0	0	---	0	895.7	64
4/17/00	8:30p	8.6	8.6	8.7	8.5	0	0	---	0	895.9	65
4/17/00	8:45p	8.4	8.4	8.6	8.4	0	0	---	0	895.9	66
4/17/00	9:00p	8.3	8.3	8.4	8.2	0	0	---	0	896	67
4/17/00	9:15p	8.1	8.1	8.2	8	0	0	---	0	896	67
4/17/00	9:30p	8.1	8.1	8.2	8.1	0	0	---	0	896.1	67
4/17/00	9:45p	8.1	8.1	8.1	8	0	0	---	0	896.5	68
4/17/00	10:00p	8.3	8.3	8.4	8.1	0	0	---	0	896.5	68

Newnes Meteorology

(16/3/00 to 18/4/00)

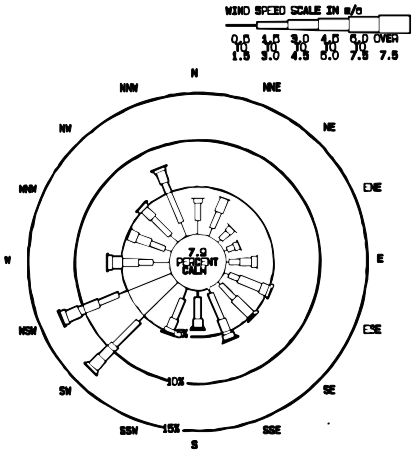
Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/17/00	10:15p	8.3	8.3	8.4	8.2	0	0	---	0	896.7	68
4/17/00	10:30p	8.2	8.2	8.2	8.1	0	0	---	0	896.8	68
4/17/00	10:45p	7.9	7.9	8.1	7.8	0	0	---	0	896.8	68
4/17/00	11:00p	7.6	7.6	7.7	7.4	0	0	---	0	896.8	68
4/17/00	11:15p	7.2	7.2	7.4	7.1	0	0	---	0	897.1	68
4/17/00	11:30p	7.1	7.1	7.1	7.1	0	0	---	0	897.1	69
4/17/00	11:45p	7	7	7.1	6.9	0	0	---	0	897	69
4/18/00	12:00a	7	7	7.1	6.9	0	0	---	0	896.9	70
4/18/00	12:15a	7.1	7.1	7.3	6.9	0	0	---	0	896.9	70
4/18/00	12:30a	7.2	7.2	7.3	7.2	0	0	---	0	896.8	71
4/18/00	12:45a	7.1	7.1	7.2	6.9	0	0	---	0	896.8	71
4/18/00	1:00a	6.9	6.9	6.9	6.8	0	0	---	0	896.8	71
4/18/00	1:15a	6.7	6.7	6.8	6.7	0	0	---	0	896.8	72
4/18/00	1:30a	6.8	6.8	6.9	6.8	0	0	---	0	896.9	72
4/18/00	1:45a	6.9	6.9	7	6.9	0	0	---	0	896.8	72
4/18/00	2:00a	7	7	7.1	6.9	0	0	---	0	896.8	72
4/18/00	2:15a	6.9	6.9	6.9	6.9	0	0	---	0	896.7	72
4/18/00	2:30a	7.1	7.1	7.3	6.9	0	0	---	0	896.7	72
4/18/00	2:45a	7.2	7.2	7.5	6.8	0	0	---	0	896.5	73
4/18/00	3:00a	6.8	6.8	6.8	6.8	0	0	---	0	896.3	73
4/18/00	3:15a	6.6	6.6	6.8	6.4	0	0	---	0	896.2	73
4/18/00	3:30a	6.2	6.2	6.4	6	0	0	---	0	896.4	73
4/18/00	3:45a	6	6	6.1	5.9	0	0	---	0	896.3	73
4/18/00	4:00a	6.1	6.1	6.2	6.1	0	0	---	0	896.3	73
4/18/00	4:15a	6.4	6.4	6.6	6.3	0	0	---	0	896.2	74
4/18/00	4:30a	6.7	6.7	6.9	6.6	0	0	---	0	896.2	75
4/18/00	4:45a	7.1	7.1	7.3	6.9	0	0	---	0	896.4	75
4/18/00	5:00a	7.3	7.3	7.5	7.3	0	0	---	0	896.3	75
4/18/00	5:15a	7.4	7.4	7.5	7.4	0.4	1.8	SSW	0	896.3	75
4/18/00	5:30a	7.3	7.3	7.3	7.2	1.3	1.3	SSW	0	896.1	75
4/18/00	5:45a	7.3	7.3	7.3	7.2	1.3	1.8	SSW	0	896.3	75
4/18/00	6:00a	7.4	7.4	7.6	7.3	1.3	1.8	SSW	0	896.3	75
4/18/00	6:15a	7.6	7.6	7.6	7.5	1.3	1.8	SSW	0	896.3	75
4/18/00	6:30a	7.4	7.4	7.5	7.3	1.3	1.8	SSW	0	896.4	75
4/18/00	6:45a	7.6	7.6	7.6	7.4	1.3	1.8	SSW	0	896.4	75
4/18/00	7:00a	7.6	7.6	7.7	7.5	1.3	1.8	SSW	0	896.5	75
4/18/00	7:15a	7.7	7.7	7.7	7.6	1.3	1.3	SSW	0	896.5	75
4/18/00	7:30a	7.7	7.7	7.7	7.6	0.9	1.3	SSW	0	896.6	75
4/18/00	7:45a	7.7	7.7	7.7	7.7	0.4	0.9	SSW	0	896.6	75
4/18/00	8:00a	7.9	7.9	8.1	7.7	0.4	0.9	SSW	0	896.9	75
4/18/00	8:15a	8.2	8.2	8.3	8	0.4	0.9	SSW	0	897	76
4/18/00	8:30a	8.4	8.4	8.4	8.3	0.4	0.9	SSW	0	897.1	76
4/18/00	8:45a	8.5	8.5	8.7	8.4	0.9	1.3	SSW	0	897.3	76
4/18/00	9:00a	8.8	8.8	8.9	8.7	0.9	1.3	SSW	0	897.4	76
4/18/00	9:15a	8.9	8.9	9.7	8.7	0.9	1.8	SSW	0	897.5	76
4/18/00	9:30a	9.6	9.6	10.1	9.5	0.9	1.8	SSW	0	897.6	77
4/18/00	9:45a	10.6	10.6	11.1	10.1	0.9	1.3	SSW	0	897.4	78

Newnes Meteorology

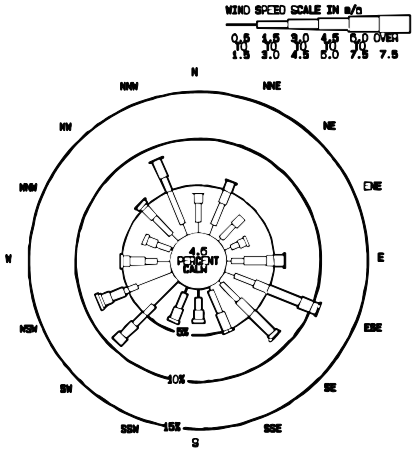
(16/3/00 to 18/4/00)

Date	Time	Temp. Out	Wind Chill	Hi Temp	Low Temp	Wind Speed (m/s)			Rain	Bar	Hum In
		C°	C°	C°	C°	Avg	Hi	Dir	mm	mB	%
4/18/00	10:00a	10.5	10.5	10.9	10.3	0.4	1.3	S	0	897.3	77
4/18/00	10:15a	11.5	11.5	12.1	10.9	0.4	1.8	S	0	897.2	77
4/18/00	10:30a	11	11	11.4	10.6	0.9	1.8	SSW	0	897.1	76
4/18/00	10:45a	10.9	10.9	11.1	10.6	0.4	1.8	SSW	0	897	74

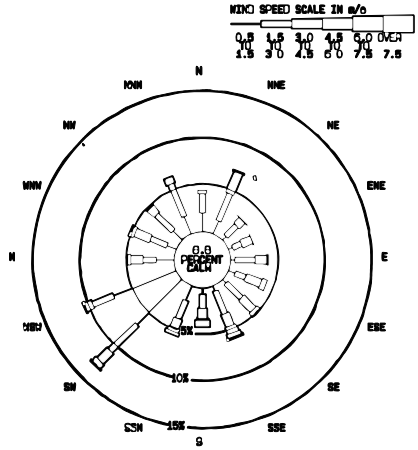
Annual and Seasonal Windroses for Mount Piper 1997



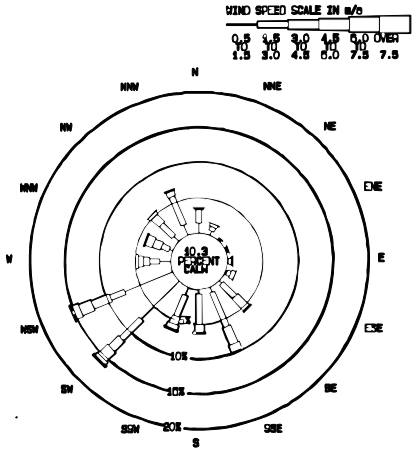
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Mount Piper - Annual 1997



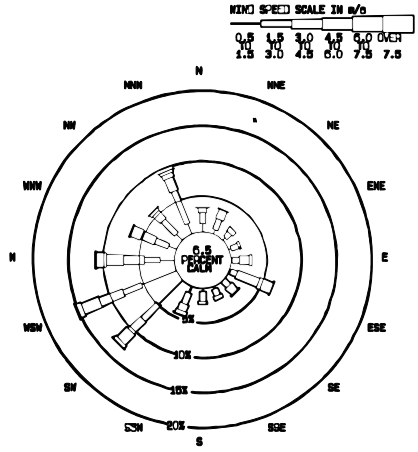
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Mount Piper - Summer 1997



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Mount Piper - Autumn 1997



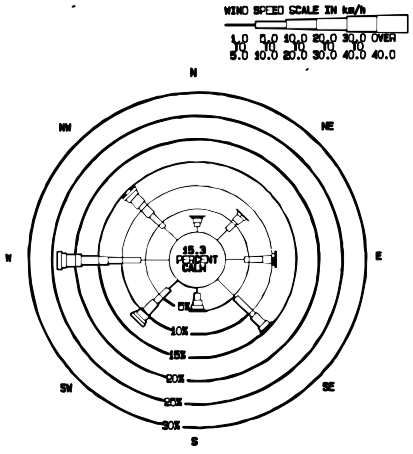
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Mount Piper - Winter 1997



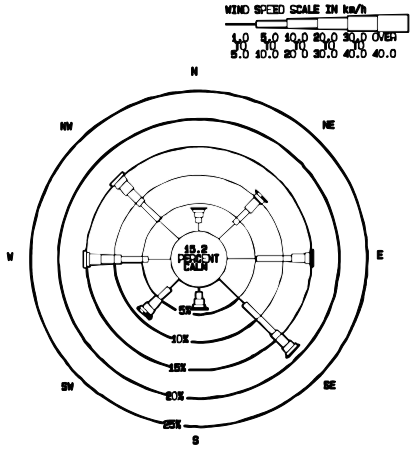
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Mount Piper - Spring 1997

FIGURE 4

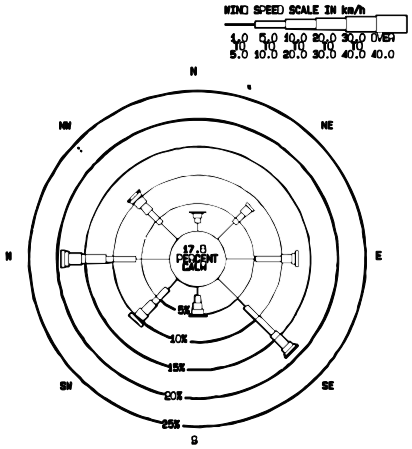
Annual and Seasonal Windroses for Lithgow (BoM) 9 am and 3 pm



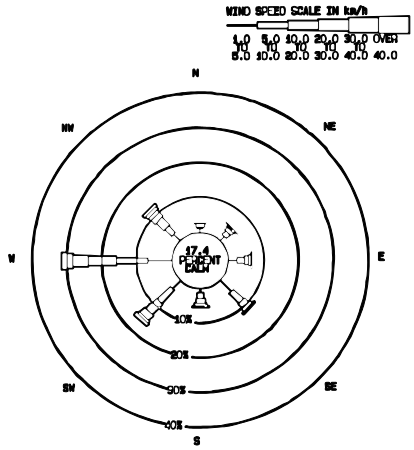
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Lithgow - Annual 9am & 3pm



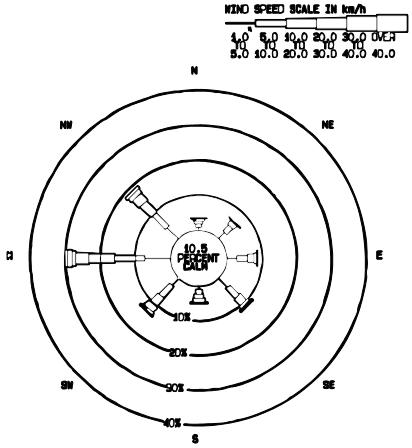
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Lithgow - Summer 9am & 3pm



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Lithgow - Autumn 9am & 3pm



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Lithgow - Winter 9am & 3pm



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Lithgow - Spring 9am & 3pm

FIGURE 5

FROM 97. 1. 3 TO 97.12.31

PASQUILL STABILITY CLASS "A"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.002869	.003142	.000820	.000000	.000000	.000000	.000000	.000000	.006831	1.91
NE	.001503	.003279	.000956	.000000	.000000	.000000	.000000	.000000	.005738	2.20
ENE	.001230	.001503	.001230	.000000	.000000	.000000	.000000	.000000	.003962	2.30
E	.001230	.002732	.000410	.000000	.000000	.000000	.000000	.000000	.004372	1.95
ESE	.001366	.001913	.000956	.000000	.000000	.000000	.000000	.000000	.004235	2.15
SE	.000410	.003415	.001776	.000000	.000000	.000000	.000000	.000000	.005601	2.53
SSE	.000683	.004645	.000956	.000000	.000000	.000000	.000000	.000000	.006284	2.35
S	.002596	.003689	.001093	.000000	.000000	.000000	.000000	.000000	.007377	2.11
SSW	.001913	.003415	.002186	.000000	.000000	.000000	.000000	.000000	.007514	2.36
SW	.000820	.003825	.001639	.000137	.000000	.000000	.000000	.000000	.006421	2.51
WSW	.001093	.002869	.002459	.000273	.000000	.000000	.000000	.000000	.006694	2.79
W	.001503	.004645	.003142	.000546	.000000	.000000	.000000	.000000	.009836	2.79
WNW	.000546	.004645	.002322	.000410	.000000	.000000	.000000	.000000	.007923	2.68
NW	.002732	.005328	.001639	.000000	.000000	.000000	.000000	.000000	.009699	2.13
NNW	.003689	.011612	.002869	.000000	.000000	.000000	.000000	.000000	.018169	2.24
N	.003142	.005738	.001639	.000000	.000000	.000000	.000000	.000000	.010519	2.10
CALM									.011749	
TOTAL	.027322	.066393	.026093	.001366	.000000	.000000	.000000	.000000	.132923	2.14

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

PASQUILL STABILITY CLASS "B"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.000683	.002596	.002186	.000000	.000000	.000000	.000000	.000000	.005464	2.66
NE	.000273	.001503	.001230	.000000	.000000	.000000	.000000	.000000	.003005	2.96
ENE	.000273	.000820	.001093	.000137	.000000	.000000	.000000	.000000	.002322	2.91
E	.000137	.000410	.000683	.000137	.000000	.000000	.000000	.000000	.001366	3.08
ESE	.000000	.001366	.001776	.000137	.000000	.000000	.000000	.000000	.003279	3.16
SE	.000137	.001503	.001093	.000000	.000000	.000000	.000000	.000000	.002732	2.90
SSE	.000137	.001776	.000956	.000137	.000000	.000000	.000000	.000000	.003005	2.95
S	.000137	.001093	.001913	.000000	.000000	.000000	.000000	.000000	.003142	3.00
SSW	.000137	.000546	.001230	.000273	.000000	.000000	.000000	.000000	.002186	3.30
SW	.000000	.001503	.002459	.000956	.000000	.000000	.000000	.000000	.004918	3.76
WSW	.000000	.000956	.003142	.001503	.000000	.000000	.000000	.000000	.005601	3.90
W	.000000	.001093	.002596	.001913	.000000	.000000	.000000	.000000	.005601	4.10
WNW	.000137	.001776	.004235	.001913	.000000	.000000	.000000	.000000	.008060	3.87
NW	.000410	.001366	.002732	.000410	.000000	.000000	.000000	.000000	.004918	3.18
NNW	.000273	.005328	.002732	.000137	.000000	.000000	.000000	.000000	.008470	2.81
N	.000956	.002869	.002049	.000000	.000000	.000000	.000000	.000000	.005874	2.57
CALM									.001366	
TOTAL	.003689	.026503	.032104	.007650	.000000	.000000	.000000	.000000	.071311	3.19

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

PASQUILL STABILITY CLASS "C"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.001093	.001230	.004098	.000546	.000000	.000000	.000000	.000000	.006967	3.18
NE	.000273	.000273	.001503	.000000	.000000	.000000	.000000	.000000	.002049	3.19
ENE	.000000	.000546	.000956	.000137	.000000	.000000	.000000	.000000	.001639	3.44
E	.000546	.001230	.002186	.000820	.000000	.000000	.000000	.000000	.004781	3.32
ESE	.000137	.001503	.003689	.001230	.000000	.000000	.000000	.000000	.006557	3.72
SE	.000000	.001913	.005874	.001230	.000000	.000000	.000000	.000000	.009016	3.68
SSE	.000000	.002869	.004372	.000410	.000000	.000000	.000000	.000000	.007650	3.42
S	.000000	.001366	.001230	.000137	.000000	.000000	.000000	.000000	.002732	3.08
SSW	.000137	.001503	.001913	.001503	.000000	.000000	.000000	.000000	.005055	3.59
SW	.000546	.001503	.005464	.004508	.000000	.000000	.000000	.000000	.012022	4.09
WSW	.000000	.000956	.003552	.005055	.000000	.000000	.000000	.000000	.009563	4.45
W	.000273	.000820	.004645	.005328	.000000	.000000	.000000	.000000	.011066	4.41
WNW	.000273	.001639	.003279	.005328	.000000	.000000	.000000	.000000	.010519	4.17
NW	.000137	.003279	.003825	.001776	.000000	.000000	.000000	.000000	.009016	3.60
NNW	.000273	.006421	.004235	.001230	.000000	.000000	.000000	.000000	.012158	3.07
N	.000546	.001913	.000410	.000137	.000000	.000000	.000000	.000000	.003005	2.45
CALM									.001639	
TOTAL	.004235	.028962	.051230	.029372	.000000	.000000	.000000	.000000	.115437	3.66

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

PASQUILL STABILITY CLASS "D"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.001776	.006557	.007514	.000273	.000000	.000000	.000000	.000000	.016120	2.95
NE	.000410	.002322	.001913	.000000	.000137	.000000	.000000	.000000	.004781	3.01
ENE	.000000	.001366	.001366	.000410	.000000	.000000	.000000	.000000	.003142	3.43
E	.000273	.005738	.008607	.004645	.000273	.000000	.000000	.000000	.019536	3.69
ESE	.000137	.004645	.017760	.009290	.000410	.000000	.000000	.000000	.032240	4.05
SE	.000000	.011066	.014754	.001913	.000137	.000000	.000000	.000000	.027869	3.32
SSE	.000273	.014071	.010109	.004918	.001366	.000410	.000000	.000000	.031148	3.51
S	.000410	.008470	.003415	.001093	.001639	.000000	.000000	.000000	.015027	3.33
SSW	.001776	.009563	.004508	.003279	.001503	.000000	.000000	.000000	.020628	3.27
SW	.019126	.015164	.006831	.007377	.002869	.000820	.000000	.000000	.052186	2.81
WSW	.015984	.008880	.012158	.007514	.004918	.001776	.000137	.000000	.051366	3.39
W	.000820	.005464	.005328	.003005	.004781	.000546	.000000	.000000	.019945	4.40
WNW	.000820	.004781	.004781	.001230	.001366	.000000	.000000	.000000	.012978	3.48
NW	.000683	.009016	.005464	.001230	.000683	.000000	.000000	.000000	.017077	3.08
NNW	.001366	.010383	.002869	.001230	.000956	.000273	.000000	.000000	.017077	3.00
N	.000683	.002049	.000956	.000273	.000137	.000000	.000000	.000000	.004098	2.82
CALM									.002869	
TOTAL	.044536	.119536	.108333	.047678	.021175	.003825	.000137	.000000	.348087	3.34

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

PASQUILL STABILITY CLASS "E"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.000410	.003279	.000820	.000000	.000000	.000000	.000000	.000000	.004508	2.46
NE	.000000	.001776	.000683	.000000	.000000	.000000	.000000	.000000	.002459	2.83
ENE	.000137	.002186	.000546	.000000	.000000	.000000	.000000	.000000	.002869	2.53
E	.000137	.000683	.000546	.000137	.000000	.000000	.000000	.000000	.001503	2.73
ESE	.000410	.001366	.000820	.000000	.000000	.000000	.000000	.000000	.002596	2.46
SE	.000410	.002596	.000683	.000000	.000000	.000000	.000000	.000000	.003689	2.53
SSE	.000410	.004645	.000273	.000000	.000000	.000000	.000000	.000000	.005328	2.28
S	.000546	.005464	.001093	.000273	.000000	.000000	.000000	.000000	.007377	2.46
SSW	.002596	.005328	.001230	.000000	.000000	.000000	.000000	.000000	.009153	2.07
SW	.018579	.011202	.002732	.000683	.000000	.000000	.000000	.000000	.033197	1.70
WSW	.017486	.006557	.000820	.000137	.000000	.000000	.000000	.000000	.025000	1.49
W	.003142	.002049	.000820	.000000	.000000	.000000	.000000	.000000	.006011	1.81
WNW	.001366	.001639	.000546	.000000	.000000	.000000	.000000	.000000	.003552	1.92
NW	.001366	.004372	.000000	.000000	.000000	.000000	.000000	.000000	.005738	1.85
NNW	.002596	.007377	.000137	.000000	.000000	.000000	.000000	.000000	.010109	1.82
N	.001913	.002186	.000137	.000000	.000000	.000000	.000000	.000000	.004235	1.73
CALM									.002322	
TOTAL	.051503	.062705	.011885	.001230	.000000	.000000	.000000	.000000	.129645	1.87

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

PASQUILL STABILITY CLASS "F"

WIND SPEED CLASS (MPS)

WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.002596	.001503	.000000	.000000	.000000	.000000	.000000	.000000	.004098	1.42
NE	.001913	.001366	.000000	.000000	.000000	.000000	.000000	.000000	.003279	1.53
ENE	.002186	.001503	.000000	.000000	.000000	.000000	.000000	.000000	.003689	1.47
E	.000683	.000820	.000000	.000000	.000000	.000000	.000000	.000000	.001503	1.53
ESE	.003415	.000683	.000000	.000000	.000000	.000000	.000000	.000000	.004098	1.19
SE	.002869	.000820	.000000	.000000	.000000	.000000	.000000	.000000	.003689	1.21
SSE	.004645	.001913	.000000	.000000	.000000	.000000	.000000	.000000	.006557	1.32
S	.004098	.002869	.000000	.000000	.000000	.000000	.000000	.000000	.006967	1.44
SSW	.005874	.002322	.000000	.000000	.000000	.000000	.000000	.000000	.008197	1.30
SW	.020082	.002049	.000000	.000000	.000000	.000000	.000000	.000000	.022131	1.10
WSW	.025956	.002459	.000000	.000000	.000000	.000000	.000000	.000000	.028415	.99
W	.011339	.001639	.000000	.000000	.000000	.000000	.000000	.000000	.012978	1.01
WNW	.004508	.002049	.000000	.000000	.000000	.000000	.000000	.000000	.006557	1.36
NW	.006011	.002186	.000000	.000000	.000000	.000000	.000000	.000000	.008197	1.29
NNW	.008060	.004508	.000000	.000000	.000000	.000000	.000000	.000000	.012568	1.39
N	.007240	.003825	.000000	.000000	.000000	.000000	.000000	.000000	.011066	1.38
CALM									.058607	
TOTAL	.111475	.032514	.000000	.000000	.000000	.000000	.000000	.000000	.202596	.94

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID STABILITY DEPENDENT OBSERVATIONS = 7320

ALL PASQUILL STABILITY CLASSES

WIND SPEED CLASS (MPS)

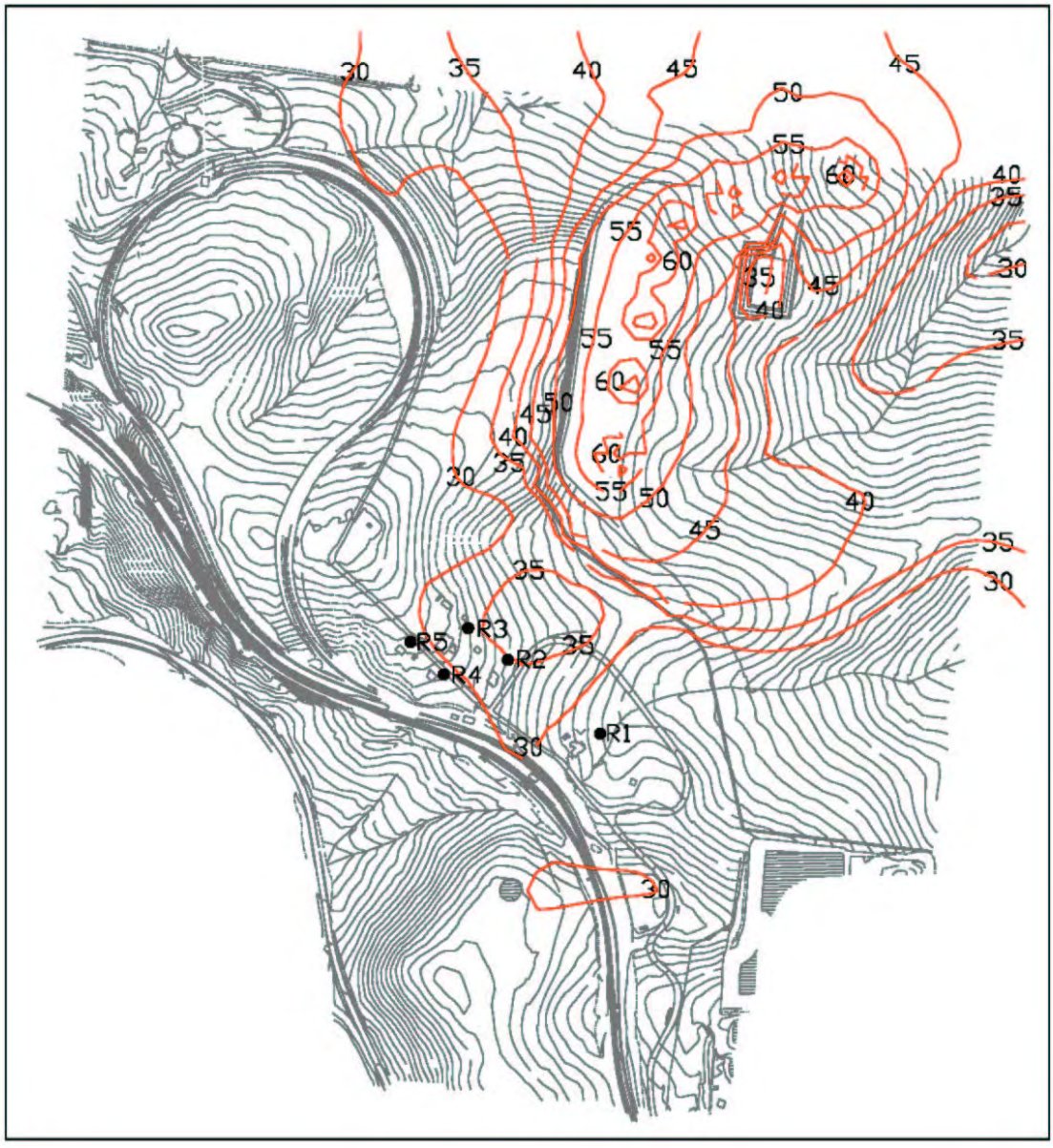
WIND SECTOR	.51 TO 1.50	1.51 TO 3.00	3.01 TO 4.50	4.51 TO 6.00	6.01 TO 7.50	7.51 TO 9.00	9.01 TO 10.50	GREATER THAN 10.50	TOTAL	MEAN SPEED
NNE	.009426	.018306	.015437	.000820	.000000	.000000	.000000	.000000	.043989	2.59
NE	.004372	.010519	.006284	.000000	.000137	.000000	.000000	.000000	.021311	2.55
ENE	.003825	.007923	.005191	.000683	.000000	.000000	.000000	.000000	.017623	2.55
E	.003005	.011612	.012432	.005738	.000273	.000000	.000000	.000000	.033060	3.24
ESE	.005464	.011475	.025000	.010656	.000410	.000000	.000000	.000000	.053005	3.50
SE	.003825	.021311	.024180	.003142	.000137	.000000	.000000	.000000	.052596	3.07
SSE	.006148	.029918	.016667	.005464	.001366	.000410	.000000	.000000	.059973	3.00
S	.007787	.022951	.008743	.001503	.001639	.000000	.000000	.000000	.042623	2.62
SSW	.012432	.022678	.011066	.005055	.001503	.000000	.000000	.000000	.052732	2.66
SW	.059153	.035246	.019126	.013661	.002869	.000820	.000000	.000000	.130874	2.38
WSW	.060519	.022678	.022131	.014481	.004918	.001776	.000137	.000000	.126639	2.55
W	.017077	.015710	.016530	.010792	.004781	.000546	.000000	.000000	.065437	3.22
WNW	.007650	.016530	.015164	.008880	.001366	.000000	.000000	.000000	.049590	3.17
NW	.011339	.025546	.013661	.003415	.000683	.000000	.000000	.000000	.054645	2.61
NNW	.016257	.045628	.012842	.002596	.000956	.000273	.000000	.000000	.078552	2.41
N	.014481	.018579	.005191	.000410	.000137	.000000	.000000	.000000	.038798	2.03
CALM									.078552	
TOTAL	.242760	.336612	.229645	.087295	.021175	.003825	.000137	.000000	1.000000	2.53

NUMBERS BELOW BASED ON ALL OBSERVATIONS
NUMBER OF INVALID OBSERVATIONS = 0
NUMBER OF VALID OBSERVATIONS = 7320

APPENDIX 3: STAGE PLANS

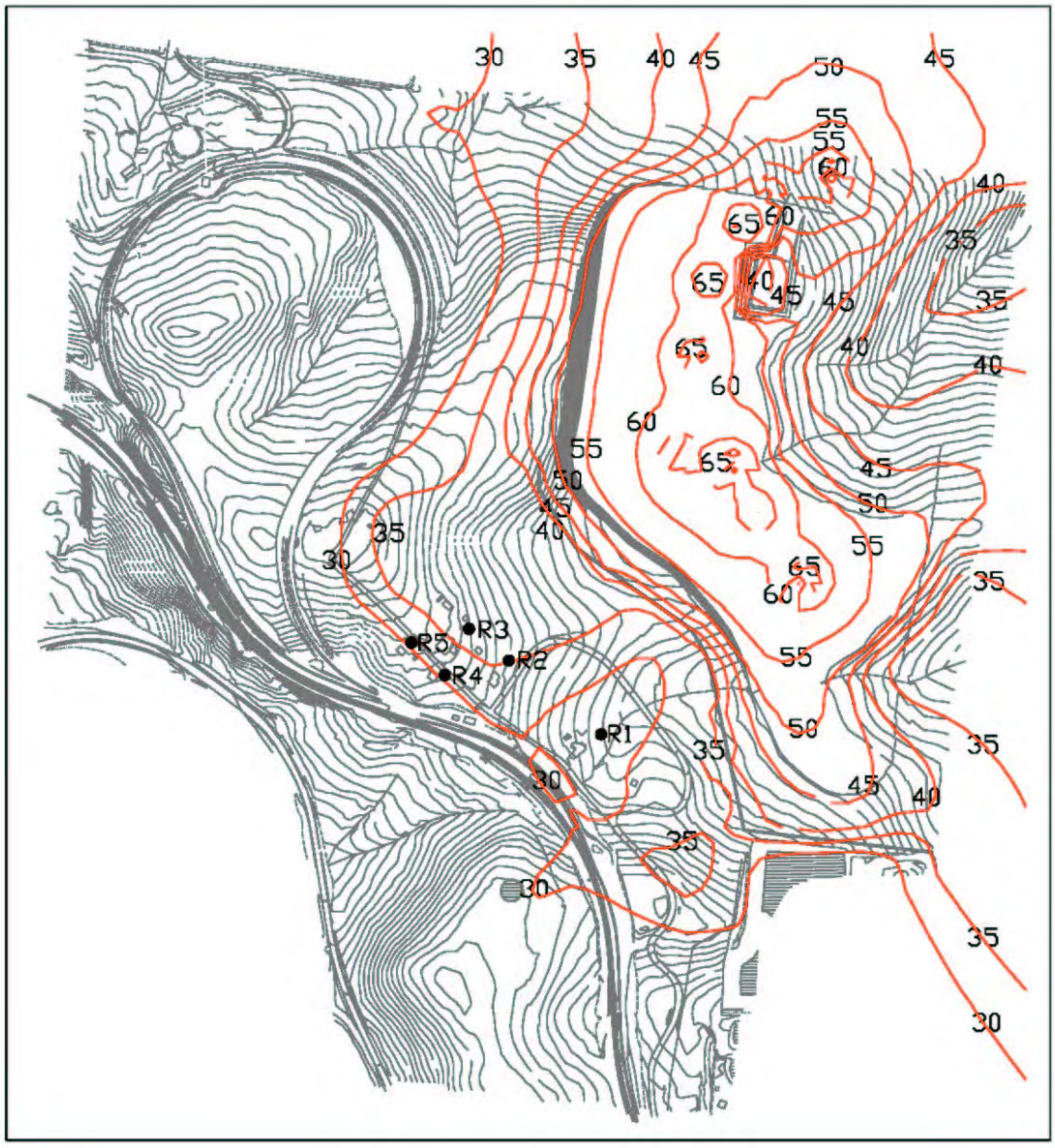
APPENDIX 4: STAGE 1B - NOISE CONTOUR PLOT (CALM)

1 scraper movement/15 min.



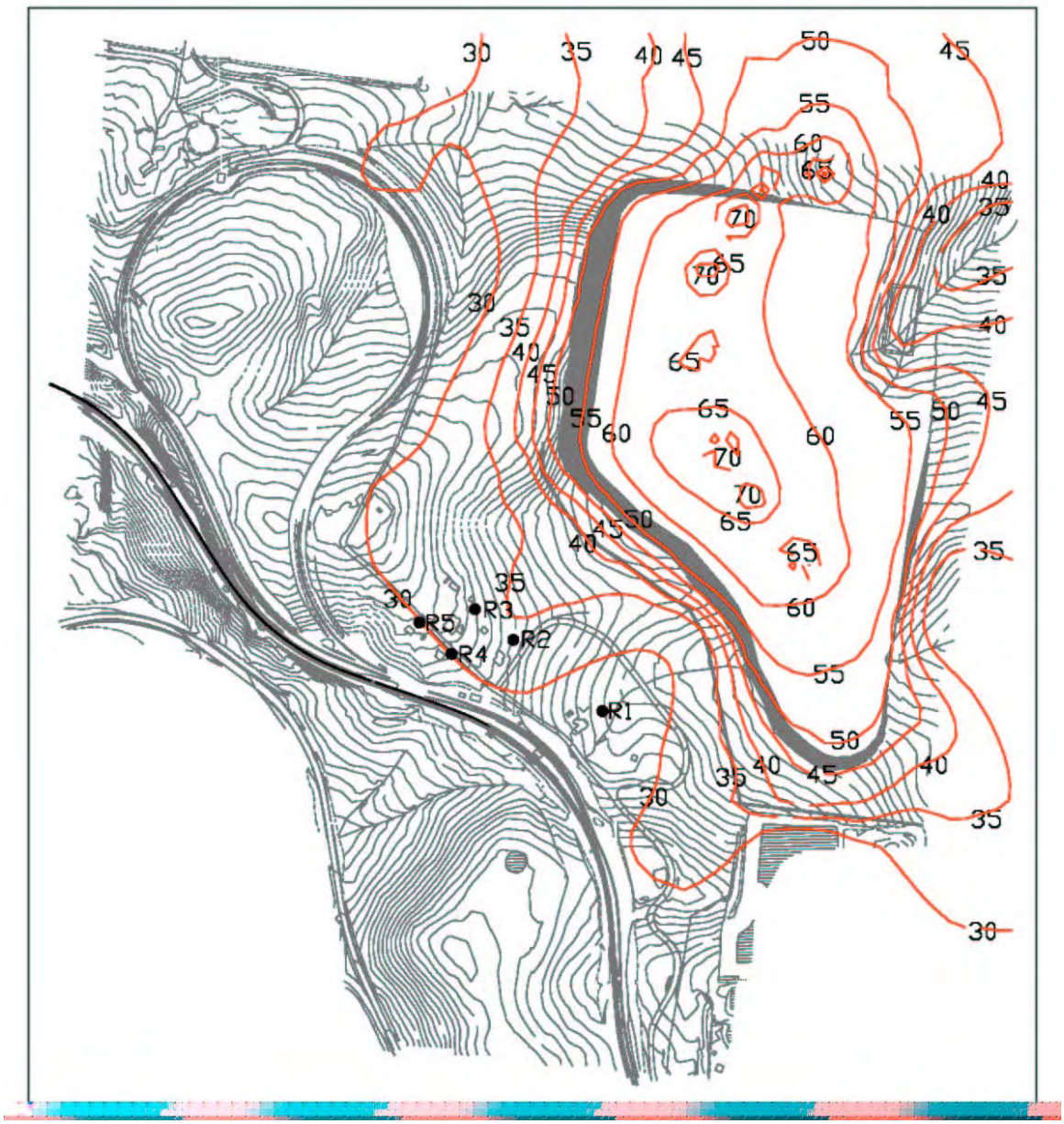
APPENDIX 5: STAGE 2B - NOISE CONTOUR PLOT (CALM)

Surface Miner (Lw103dB(A)) + 2 scrapers/15 min.



APPENDIX 6: STAGE 3B - NOISE CONTOUR PLOT (CALM)

Surface Miner (Lw105dB(A)) + Dozer (Lw100dB(A)) + 3 scrapers/15 min.



APPENDIX 7: BUSH WALKING TRACKS

Sydney Construction Materials



...Building Sydney's Future

File Note

Date: 16th April 2004

Re: Bushwalking tracks in the vicinity of the Newnes Junction development application area

An intensive literature search on popular walking tracks, campsites and picnic areas located on and around the Newnes Plateau, which include the Blue Mountains National Park, the Wollemi National Park, Gardens of Stone National Park and the Newnes State Forest, was carried out.

The main focus for walking activities is well to the north of the Newnes Junction project area and is accessed by the Glow-worm Tunnel Road. The main attractions of the area; Deep Pass, Galah Mountain, Glow Worm Tunnel and Bungleboori Picnic Area, are in a range of 10 to 30kms from the proposed development site.

There are no formed tracks, for bushwalking purposes identified from any of the references in the attached list and no tracks have been identified by National Parks and Wildlife Services Personnel within a 5km radius of the proposed development site. The Dargan's Creek Canyon south of the Bells Line of Road is probably the closest locality used by bushwalkers and canyoners and is located several kilometres south of the project area.

A research programme on the sedimentary history of the Newnes Plateau sandstones carried out jointly by the Company (R. Goldbery) and John Whitehouse from the NSW Department of Mineral Resources has required detailed traversing of the area surrounding the proposed development site at Newnes Junction. During these surveys, no bushwalking tracks have been found on any of the ridges or drainage networks of the area. It is therefore considered extremely unlikely that the area within a 2km radius of the DA proposal will attract any recreational bushwalking activities.

R. Goldbery

(Project Manager)

Newnes Kaolin Pty Ltd, trading as
Sydney Construction Materials

Suite 504, 37 Bligh Street
Sydney NSW 2000

Ph: (02) 9232 8282
Fax: (02) 9232 8275
ABN: 71 065 564 794

REFERENCES

Daly, J & L., 2000, “Take a walk in the Blue Mountains National Park”, Take A Walk Publications, Brisbane, 104p.

Fairly, A, 2001, “Discovering the Blue Mountains on Foot”, Envirobook, Annandale, 80p.

Jamieson R, 2001, “Canyons near Sydney”, Richard Jamieson Publishing, Sydney, 82p.

Land Property Information, NSW, 2002, “Tourist Map of the Wollemi National Park”, Bathurst.

Law, M., 1999, “The Blue Mountains – A guide to selected rock climbs (including Tarari)”, Wild Publications Pty Ltd, 120p.

Meredith, P and Fuchs, P., 2000, “Glove box Guide, The Blue Mountains”, Australian Geographic Pty Ltd, 191p.

National Parks & Wildlife Services, 2001, “Walking Trail Guide, Newnes and the Glow Worm Tunnel”, 19p.

Paton, N, 1987, “Walks in the Blue Mountains National Park”, Kangaroo Press, 144p.

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT C

Flora and Fauna Issues

Gunninah Environmental Consultants

May 2004

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

May 2004

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

May 2004

Project Team:

F Dominic Fanning
Matthew Pauza
Michael Welsh
with the assistance of and input from:

Dr Arthur White of Biosphere Ecological Consultants
HWR Pty Ltd

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

PROPOSED SAND EXTRACTION & KAOLIN MINE
NEWNES JUNCTION

SUPPLEMENTARY SUBMISSION to DIPNR

FLORA & FAUNA ISSUES

May 2004

TABLE of CONTENTS

1	**INTRODUCTION**		**1**
	1.1	The Proposed Activity	1
	1.2	Supplementary Documentation	1
	1.3	Flora & Fauna Issues	2
	1.4	Role of Supplementary Submission on Flora & Fauna	2
2	**FLORA & VEGETATION**		**3**
	2.1	Database	3
	2.2	Flora Species	3
	2.3	Vegetation Communities	4
	2.4	Newnes Plateau Shrub Swamp	5
3	**FAUNA & HABITATS**		**7**
	3.1	Database	7
	3.2	Habitat Features and Resources	7
	3.3	Fauna Assemblage	8
	3.4	Threatened Species	8
4	**SECTION 5A ASSESSMENT of SIGNIFICANCE**		**10**
	4.1	Assessment in EIS	10
	4.2	Supplementary Considerations of s.5A	10
	4.3	Generic Section 5A Assessment of Significance	11
	4.3	Conclusions	12
5	**WORLD HERITAGE AREA ISSUES**		**13**
	5.1	World Heritage Area Listing	13
	5.2	Potential Impact on World Heritage Area Values	13
6	**CONCLUSIONS**		**15**
BIBLIOGRAPHY			**17**

APPENDICES

A Supplementary Vegetation and Flora Survey (HWR 2004)
B Supplementary Survey for the Blue Mountains Water Skink (Biosphere Consultants 2004)
C Combined flora species recorded on the subject site (IEC 2003; P & J Smith 2003; HWR 2004)
D Newnes Plateau Shrub Swamp community (Benson & Keith 1990)
E Fauna surveys undertaken by Gunninah Environmental Consultants
F Combined fauna species list for the subject site (IEC 2003; P & J Smith 2003; HWR 2004)
G Assessments of Significance Pursuant to Section 5A of the EP&A Act

© *Gunninah Environmental Consultants*

H The Greater Blue Mountains Area (GBMA) World Heritage Area

© *Gunninah Environmental Consultants*

PROPOSED SAND EXTRACTION & KAOLIN MINE
NEWNES JUNCTION

SUPPLEMENTARY SUBMISSION to DIPNR

FLORA & FAUNA ISSUES

May 2004

1 INTRODUCTION

1.1 The Proposed Activity

The proposed development involves the extraction of friable sandstone and Kaolin clay using open pit mining methods at a site near Newnes Junction in NSW. The subject site is located to the east of Lithgow, and is adjoined to the south by an existing sand extraction quarry (operated by Rocla) and to the northwest by the existing Clarence Colliery (IEC 2003 - Figure 2.2).

The proposed operation involves the extraction of sandstone material using a dedicated ripping and conveyor system, and transfer to a rail transport system to a processing facility (located elsewhere). Subsequent processing of the raw material will produce kaolin, industrial grade silica sand products and premium quality construction sand. The proposal also involves the implementation of an array of impact amelioration and environmental management measures, designed specifically to protect habitats present on the subject site and downslope or downstream of particular relevance is the presence to the immediate north and east of part of the Blue Mountains National Park (BMNP) and Greater Blue Mountains Area (GBMA) World Heritage Area.

Details of the mining activity (as originally proposed) are provided in the *Environmental Impact Statement* (EIS) which was prepared by International Environmental Consultants Pty Ltd (IEC 2003), and in additional supporting documentation provided by the proponent (Newnes Kaolin Pty Ltd).

1.2 Supplementary Documentation

Subsequent to preparation of the EIS, the *Development Application* and supporting documentation (including the EIS) were placed on public display in 2003. A substantial number of submissions were received in response to the EIS, and the proponents have subsequently been considering a range of measures and options to address many of the issues which have been raised. In addition, supplementary material and information has been collected and collated with respect to a range of matters and issues.

The Department of Infrastructure Planning & Natural Resources (DIPNR) has provided the proponent with the submissions to the EIS, and has requested additional information to assist in the development assessment process. This *Supplementary Submission to DIPNR* ecological presents data derived from supplementary investigations on the site, and additional information regarding flora and fauna.

Specific measures and elements of the project as currently revised and designed, in this regard:

- the implementation of an alternative mining process, involving machinery which rips the sandstone substrate and transfers the material specialised by conveyor for subsequent transport by train and processing;

- an array of measures to be implemented to control noise and dust, and to provide further suppression of these impacts;
- a minor modification to the mine footprint which involves the retention of an area of swampy vegetation in a watercourse in the southeastern part of the site and its protection from mining activities;
- an array of measures associated with stormwater treatment, and the management of water distribution and water quality control, to be implemented as part of the project; and
- other impact amelioration measures associated with the project which have been refined in response to issues raised in the submissions.

These matters are detailed in supplementary documentation provided in this document and by others in response to the proposal and relevant submissions on the applicant. Negotiations and consultation with relevant authorities have also been part of the response to the EIS and submission process.

1.3 Flora & Fauna Issues

A number of the submissions to the EIS raised issues in relation to native biota on the subject site and in the adjoining conservation reserves. Of particular relevance in this regard are issues relating to:

- the adequacy of flora investigations and the description of the natural environment in terms of native flora and vegetation communities, as documented in the EIS;
- the adequacy of fauna surveys undertaken on the subject site and the consideration of native fauna and their habitats, as documented in the EIS, both on the subject site and on adjacent conservation lands;
- the potential for adverse impacts to be imposed upon adjoining habitats for native flora and fauna, particularly the adjoining National Park areas; and
- the potential for adverse impacts to be imposed upon the adjoining Blue Mountains World Heritage Area (as a separate issues from impacts on the natural environment or on the conservation reserves *per se*).

1.4 Role of Supplementary Submission on Flora & Fauna

This *Supplementary Submission* has been prepared to address matters relating to flora and fauna issues raised in the submissions to the original *Development Application* and EIS. The *Report* has incorporated information and data contained in some of those submissions, as well as the information contained in the original EIS documentation and in other published or available material and databases. Specific investigations have also been conducted on the subject site for biota of significance or concern, as raised in several of the submissions.

This *Supplementary Report* provides specific information on and addresses issues which have been raised in relation to:

- flora and vegetation, including the Newnes Plateau Shrub Swamp community and potential threatened flora species;
- flora and fauna habitats, including an array of threatened fauna species and particularly including the Blue Mountains Water Skink;
- the consideration of Section 5A of the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act) as amended by the *NSW Threatened Species Conservation Act 1995* (TSC Act). Whist the original EIS (IEC 2003) contained a Section 5A Assessment in respect of threatened fauna and a separate

assessment in respect of threatened flora, that assessment had utilised the amended Section 5A Assessment which has been passed into legislation but which has not yet been implemented; and

- consideration of the World Heritage Area (WHA) listing of *The Greater Blue Mountains Area* and the potential impacts of the proposed development on the relevant features of that area.

2 FLORA & VEGETATION

2.1 Database

The information on which the consideration and assessment of flora and vegetation on the subject site at Newnes Junction, as contained in this *Report*, was based includes:

- the original investigations of native flora and vegetation conducted for the EIS (IEC 2003). It should be noted that the IEC investigations also included the consideration of information contained in other *Report*s on sites in the immediate vicinity, as well as published scientific papers and other available information;
- data and information contained in submissions on the proposed mining operation and EIS. In particular, the information contained in the submission by P & J Smith has been incorporated into this *Report*, and is regarded as a valuable contribution to the overall information base for the project. Whilst the submission by the NSW National Parks & Wildlife Service (NPWS)[1] does not contain any specific data or records, the matters regarding flora and vegetation contained in that submission have been considered in this *Report*; and
- the supplementary investigations for flora and vegetation undertaken specifically for this *Supplementary Report* on the proposed mining operation at Newnes. The supplementary investigations include a dedicated 3-day flora survey by HWR Pty Ltd (Appendix A) and a 1-day investigation by Dr A White of Biosphere Consultants in mid-March 2004 (Appendix B).

On the basis of the total quantum of investigations for flora and vegetation which have now been undertaken on the subject site at Newnes (IEC 2003; P & J Smith 2003; Biosphere 2004; HWR 2004) and other previous investigations for flora undertaken on other lands in the immediate vicinity (Corkery & Co 1993; IEC 2000), it can be reasonably asserted that a comprehensive and adequate investigation for native flora and vegetation communities has now been achieved.

Data from all of the investigations undertaken on the subject site, as well relevant information from adjoining lands and other studies, has been incorporated into this *Report*. The combined information constitutes the database upon which analysis and assessment of the proposed activity is determined.

2.2 Flora Species

The assemblage of flora species which have been recorded on the subject site at Newnes to date is the culmination of a number of investigations, including those by IEC (2003), P & J Smith (2003), Biosphere (2004) and HWR (2004). In terms of threatened flora species, the results of other investigations undertaken in the immediate vicinity have also been considered (Corkery & Co 1993; IEC 2000).

A total of 171 flora species, including introduced plants and weeds have been recorded on the subject site at Newnes (Appendix C). Whilst the total number of flora species present on the subject site is likely to be greater than that identified to date, the total inventory which has been established is regarded as a reasonable approximation of the full suite of flora species present.

[1] The NPWS has recently been incorporated into the NSW Department of Environment & Conservation (DEC).

It is, nearly always possible to locate additional species on a site as large as that at Newnes by the conduct of further investigations. However, the accumulated information from the investigations conducted to date can reasonably be considered to constitute a comprehensive and adequate database for the site.

The suite of flora species which have been recorded on the site constitutes a sub-sample of that which would occur within the adjoining National Parks and World Heritage Area. The subject site contains only a small sample of the habitats and environments present within that extensive landscape, and the site could therefore support only a sub-set of the species contained within the Blue Mountains National Park or the GBMA World Heritage Area.
It is of particular note that not a single threatened flora species has been recorded by any of the investigators who have conducted surveys on the subject site at Newnes. Whilst it is doubtless possible that individuals or stands of some threatened species could potentially occur on the site, there has to date been no evidence for the presence of any such species.

Eighteen threatened plant species have been listed on the Wallerawang 1:100,000 Map Sheet (HWR 2003 - Appendix A). Of these species:

- four are considered unlikely to occur on the site as the habitat present is only "*marginal*";
- six are also regarded as unlikely to occur because the habitat present is only of "*minimal*" relevance, particularly given the absence of rocky habitats; and
- the remaining eight species were not recorded on the subject site during any investigations conducted to date, despite some "*moderate*" habitat being present.

As indicated above, none of these species had been recorded by any of the researchers who have investigated the subject site at Newnes during any previous studies.

2.3 Vegetation Communities

As indicated in the detailed *Report* by HWR Pty Ltd (2004) and in the submission by P & J Smith (2003), the subject site is predominantly characterised by an open forest/woodland community of Silvertop Ash and Sydney Peppermint. This community is also described as Blue Mountains Sandstone Plateau Forest (BMSPF), and was mapped as that community in the original vegetation mapping provided in the EIS by IEC (2003).

However, there are small patches of other vegetation communities present on the subject site, including:

- a small area of Newnes Plateau forest in the southwestern part of the site (HWR 2004);
- an area of open forest with a higher density of Scribbly Gums (a variant of the BMSPF) in the northern part of the site (HWR 2004);
- some riparian vegetation along the narrow drainage lines which traverse the site. This vegetation type is a variant of the sandstone ridgetop vegetation community, with a component of riparian or moister plant types; and
- small areas of swamp or near-swamp communities within the drainage lines, although these are generally of very restricted distribution. The relatively steep slopes and rapid draining characteristics of the site are not conducive to the establishment of extensive swamp communities. Nevertheless, some small patches of shrub swamp vegetation are present in isolated locations (as discussed in detail below).

Most of the vegetation on the subject site is of an open forest or woodland structure, and may be described as a dry sclerophyll community which is characterised by relatively dry soils, an open to moderate dense shrub layer and a sparse (but locally dense) understorey

layer. This type of vegetation is generally adapted to relatively dry or xeric conditions, such as are typical of the rapidly draining nature of the site and of the soils.

Given those circumstances, vegetation which requires a high soil moisture level is relatively restricted on the subject site (as is typical of much of the sandstone country within the Blue Mountains). Drainage lines on the site are generally narrow and do not support broad areas of soil with a high moisture content. As a consequence, vegetation which requires such circumstances (such as riparian, swamp or wet heath type communities) are only located in restricted portions of the site.

The vegetation mapping by HWR (2004) identifies the presence of riparian or swampy vegetation along two drainage lines which traverse the site. Of these, the northern (central) drainage line is relatively narrow and steep, and supports only very small, isolated and limited areas of swampy or moister riparian vegetation. This community is regarded as a variant of the drier eucalypt forest vegetation on the site. The southern drainage line, conversely, supports a somewhat broader area of moister vegetation, although the abiotic and floristic characteristics of that area do not identify it as a 'swamp' (see Appendix A).

Nevertheless, the vegetation in that portion of the site is considered as having some affinities to the Newnes Plateau Shrub Swamp community, as discussed in detail below. The drainage lines to the east of the subject site do support larger areas of swamp-type vegetation, as a consequence of local topographic features and their general structure.

Development of the mine plan has been cognisant of the critical need to protect habitats downstream of the subject site, particularly areas of riparian or swamp vegetation which may occur along drainage lines within the National Park. The mining operation incorporates a number of measures specifically designed to protect those habitats and resources downstream and downslope of the site, particularly within the GBMA World Heritage Area and in the BMNP.

2.4 Newnes Plateau Shrub Swamp

Amongst the issues raised in the submissions on the *Development Application* and EIS for the proposed mining operation is the possible presence of the Newnes Plateau Shrub Swamp (NPSS) community on the subject land.

This plant community was originally described by Benson & Keith (1990), and is defined as "*Narrow, elongate, shrub-swamps*" which are restricted to the "*eastern half of the Newnes Plateau*" (Appendix D). These swamps "*are formed in characteristic low-slope head water valleys*" where "*sediments are relatively deep … and are periodically water logged*" (Benson & Keith 1990). These elements of the community are significantly in distinguishing NPSS from other moist or riparian habitats in the locality.

The supplementary flora investigations of the subject site have included specific investigation of this plant community and its presence (or otherwise) on the subject site. It had been asserted by P & J Smith (2003) and the NPWS (2003) that this community is or may be present on the site. As a consequence, specific investigations of potential areas for this community were undertaken (Appendices A and B).

Consideration of the characteristics of the NPSS community, and of vegetation on the subject site and the physical features of those portions of the landscape, has resulted in the conclusions that:

- the drainage line which traverses the central part of the subject site, whilst supporting very small and isolated patches of swampy vegetation, does not support the association identified as the NPSS community. This drainage line:
  - is very narrow and relatively steep;
  - does not support areas of long-term moist soil (other than potentially in extremely small areas); and

- does not contain the characteristic floristics of the NPSS community.

This vegetation, therefore, has been designated riparian (swampy) vegetation in the *Report* prepared by HWR (Appendix A); and

- the southernmost drainage line through the subject site supports a small area of relatively moist soil with a sparse tree canopy. This area is characterised as a shrubland dominated by the Tea-tree *Leptospermum trinervum*, and supports a number of the plant species identified in the description of the NPSS community. However, few of the plant species present are indicated as dominant within the NPSS community, and the vegetation present is regarded at best as a marginal example of that community or a variant thereof.

It is to be noted that the NPSS community is not listed as an "*endangered ecological community*" on the TSC Act. This 'community' does not therefore warrant specific or special consideration pursuant to the statutory processes within NSW.

A nomination has been received by the Commonwealth Department of Environment & Heritage (DEH) for the listing of Blue Mountains Swamps as a "*threatened ecological community*" on the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). The NPSS community is part of that complex of swamp communities, but a number of other swamp communities is also part of the nomination, occurring over a much larger area than the NPSS vegetation. The Blue Mountains Swamp communities have not yet been listed on the EPBC Act, and the NPSS community constitutes only one element of that matrix of vegetation types.

As discussed above and in detail in the relevant vegetation *Reports* (Appendices A and B), the subject site supports only one small area of vegetation supporting affinities with (or which could potentially be described as) the NPSS vegetation. That area (in the southeast of the site) has been identified for retention, and the mine plan has been modified to avoid and protect that area of swamp vegetation. Measures of relevance in this regard include:

- retention of the area of swamp vegetation within the southeastern part of the site;
- provision of a 50m buffer to that vegetation;
- the re-routing of natural stormwater runoff from above the mining operation and its discharge into the retained swamp vegetation; and
- a program of monitoring and management of that portion of the site.

3 FAUNA & HABITATS

3.1 Database

The information on which the consideration and assessment of fauna and fauna habitats on the subject site at Newnes contained in this *Report* was based includes:

- the original investigations of native fauna and vegetation conducted for the EIS (IEC 2003). It should be noted that the IEC investigations also included consideration of information contained in other *Report*s on sites in the immediate vicinity, published scientific papers and other available information;
- data and information contained in submissions on the proposed mining operation and EIS. In particular, the information contained in the submission by P & J Smith has been incorporated into this *Report*, and is regarded as a valuable contribution to the overall information base for the project;
- dedicated supplementary fauna surveys undertaken on the subject site over a period of 4 days and 3 nights in March 2004 by Gunninah Environmental Consultants (Appendix E). Surveys were undertaken for the full suite of native fauna species, with particular attention paid to the possible presence of the Blue Mountains Water Skink *Eulamparus leuraenisis* and microchiropteran bats;
- a specific survey was also undertaken by Dr A White of Biosphere Consultants in mid-March 2004 (Appendix B) for the Blue Mountains Water Skink.

The supplementary fauna surveys undertaken by Gunninah (Appendix E) included:

- the deployment of cage traps and Elliott traps for terrestrial and arboreal mammal fauna;
- call playback of a variety of species at several locations across the subject site;
- the deployment of harp traps for microchiropteran bats;
- the use of an Anabat II ultrasonic detector for microchiropteran bats;
- the conduct of spotlighting surveys along existing tracks and trails on the site;
- the conduct of extensive diurnal surveys for native fauna and/or for indirect evidence of their presence across the subject site; and
- inspection and mapping of relevant resources on the subject site (such as hollow-bearing trees).

3.2 Habitat Features and Resources

As discussed in the *Supplementary Fauna Report* for the proposed development at Newnes (Appendix E), the site supports very little by way of rock outcrops or rock shelters, and no caves were recorded. Consequently, species which utilise or depend on this type of resource (*eg* the Broad-headed Snake) are not likely to be present on the site.

The watercourses on the site are generally relatively steep and narrow, and do not hold water for significant periods. The absence of permanent ponds or significant moist areas on the site also limits the potential array of native fauna which could be present. In this regard, areas of swampy vegetation or habitat are extremely limited, and only one area which appears to maintain a generally moist soil condition is present in the southeastern part of the site. Ephemeral ponds or pools of free-standing water, are present at limited locations across the subject site. The marginal nature and extent of moist or swamp habitats present limits the likelihood of the Blue Mountains Swamp Skink being present on the subject site.

The subject site does support an array of hollow-bearing trees, although there are few substantial 'old-growth' trees present. The trees-hollows present on the site (Appendix E) are relatively small or of only moderate size, and would not be of value for species such as

the Glossy Black Cockatoo or the large forest owls. Conversely, these hollows do provide resources and shelter for microchiropteran bats, forest birds (such as parrots and kingfishes) and some arboreal mammals.

3.3 Fauna Assemblage

A total of 98 fauna species have been recorded on the subject site at Newnes Junction (Appendix F) as a consequence of the field investigations conducted to date (IEC 2003; Biosphere 2003, 2004; P & J Smith 2003; Gunninah 2004). Further native fauna species have been recorded on other lands in the immediate vicinity (IEC 2000; Corkery 1993), and a number of additional species would be expected to occur under appropriate climatic or seasonal circumstances.

The total fauna assemblage which could utilise the subject site is doubtless more extensive than that identified to date. A number of species which are present in the adjoining conservation reserves are also likely to utilise the subject site during appropriate seasonal or climatic circumstances.

3.4 Threatened Species

The only threatened fauna species which have been recorded from the subject site at Newnes Junction are two microchiropteran bats (the Common Bent-wing Bat and the Eastern False Pipistrelle). Other threatened species recorded in the immediate vicinity over the course of investigations conducted include the Yellow-bellied Glider and the Koala, which have been recorded on adjacent land but not on the subject site (IEC 2000). It is possible, however, that both of these species do utilise the subject site, at least on occasions.

The Eastern False Pipistrelle (or Eastern False Pipistrelle) generally roosts in tree-hollows in eucalypts, but has also been recorded roosting in caves and buildings (Churchill 1998). This species occurs in southern Queensland, eastern NSW and southern and eastern Victoria, as well as in Tasmania, and is regularly recorded during field investigations.

The subject site provides suitable resources for the Eastern False Pipistrelle, including hollow-bearing trees and a native tree canopy through which to forage. Whilst it is likely that individuals or colonies of the Eastern False Pipistrelle are present on the subject site at Newnes, this species is also likely to be widespread in the extensive conservation reserves in the immediate vicinity, locality and region. The subject site does not support restricted or limited resources for the Eastern False Pipistrelle, and it is not likely that individuals or colonies would be restricted to or dependent on the subject site itself.

Similar considerations apply with respect to the Common Bent-wing Bat. However, this species roosts in caves and man-made structure (including mines and culverts), and there are no suitable roosting habitats for the Common Bent-wing Bat on the subject site at Newnes.

The Common Bent-wing Bat occurs throughout eastern Australia in a band up to several hundred kilometres east of the coast. It is a common species which is regularly (almost invariably) recorded during dedicated microchiropteran bat surveys, and utilises both natural woodland and forest habitats as well as highly modified urban environments. As noted above, the subject site at Newnes does not currently provide roosting resources for the Common Bent-wing Bat, but individuals of this species doubtless utilise the forest canopy for foraging purposes. The subject site, however, constitutes only a minute proportion of suitable habitat for this species in the locality and region.

A dedicated survey was undertaken for the Blue Mountains Water Skink within the moister habitats on the subject site (Biosphere 2004; Appendix B). It is noted by Dr A White of Biosphere Consultants that the subject site does not support habitat of value or suitable moisture regimes for the Blue Mountains Water Skink, but there is potentially suitable habitat in the World Heritage Area downslope (to the east of) the subject site. Given the

circumstances on the site itself, the lack of any records of the Blue Mountains Water Skink is not a surprise. By contrast, Dr A White has recorded the Blue Mountains Water Skink elsewhere on the Newnes Plateau, including in several natural swamps on land nearby and in a tailings dam on the adjacent sand extraction site (A White *pers comm*).

The Yellow-bellied Glider has not been recorded on the subject site, despite the implementation of appropriate survey methods (including spotlighting, call playback and inspection of trees for the characteristic feeding notches of this species). Given the nature of the forest and woodland vegetation on the site, it is not considered particularly likely that Yellow-bellied Gliders would be present. This species tends to use forest communities of a somewhat higher productivity and moisture level than is the case on the subject site at Newnes Junction.

Nevertheless, Yellow-bellied Gliders could potentially utilise the subject site for foraging purposes and could potentially utilise tree-hollows on the site for shelter. It is not likely, however, that the subject site constitutes a significant resource for this species given its nature and condition, and given the lack of evidence for Yellow-bellied Gliders on the subject site. Furthermore, the site constitutes only a minute proportion of the extensive forested habitats in the immediate vicinity and general locality.

Similarly, whilst the Koala has been recorded on adjacent lands, there is no record of this species from the subject site. As is the case with the Yellow-bellied Glider, the forest vegetation present does not provide resources of particular value or significance for the Koala. None of the trees present constitutes a significant or notable foraging resource for the Koala, although the species does utilise a range eucalypts (including the Scribbly Gums) for foraging purposes throughout its distributional range. The subject site generally, however, does not support resources which could be regarded as of significance for the Koala, and the lack of evidence for this species on the subject site is not surprising.

None of the threatened forest owls known to occur in the general locality was recorded on the subject site during any investigations undertaken to date (IEC 2003; P & J Smith 2003; Gunninah 2004). As noted above, the tree-hollows present on the site are generally too small for the large forest owls, and use of the site would consequently be restricted to foraging activities as part of a much larger home range. The forest vegetation on the site does not support a notable or particularly abundant arboreal mammal population, and the subject site cannot be regarded as of significance for any of the threatened forest owl species, even if individuals of such species are present on the site or in the immediate vicinity. However, given the wide-ranging nature of these species and their ability to use various types of forest vegetation, it is considered likely that individuals of those species could utilise the site on occasion.

Several submissions to the EIS suggested the possible use of the site by the Tiger Quoll (Spotted-tailed Quoll). Whilst it is certainly possible that individuals of this species are present on the site, there is no evidence (either direct or indirect) for its presence. Furthermore, the subject site generally provides only limited or marginal resources or habitats for this species, and constitutes only a minute proportion of suitable or potentially suitable habitat and resources in the immediate vicinity and general locality.

Whilst there are a number of other threatened fauna species which could potentially occur on the subject site at Newnes, the site is not regarded as of particular significance or relevance because:

- the site constitutes only a minute fraction of potentially suitable habitat in the vicinity, locality or region. This is particularly so given the extent of conservation reserves in the Sydney Basin Bioregion and the extent of conserved habitats within the GBMA World Heritage Area (exceeding 1 million hectares);
- there are no resources or habitat features of particular significance or value which are restricted to the subject site;
- the proposed development is located at the periphery of extensive conservation areas, and will not therefore intrude into these areas;

- the vegetation and habitats on the site are of limited inherent value for the threatened species which could potentially occur; and
- there is no evidence for other threatened fauna species which would be likely to be threatened or placed at by the proposed operation, or which would be reliant or dependent on the site itself.

Given the considerations above, it is not likely that the subject site constitutes a significant or critical resource for any threatened fauna species. It cannot be regarded as likely that any such threatened biota would be reliant on or dependent on the subject site for their survival in this locality. The proposed development does not therefore constitute a significant adverse impact on or a significant threat to any such biota or their habitats.

4 SECTION 5A ASSESSMENTS of SIGNIFICANCE

4.1 Assessments in EIS

The original EIS prepared by IEC (2003) provided an Assessment of Significance pursuant to Section 5A of the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act). However, as indicated in the submission provided by the NPWS (DEC), the s.5A Assessments which were provided in the EIS were based on the recently gazetted (but not yet implemented) modifications to s.5A of the EP&A Act.

Whilst the amended s.5A Assessment is considered generally to be a more appropriate regime for consideration of the likelihood or otherwise of a "*significant effect*" being imposed upon any "*threatened species, populations or ecological communities, or their habitats*", it is not appropriate at this point to utilise the amended s.5A Assessment. As a consequence, this *Supplementary Submission to DIPNR* provides a s.5A Assessment of Significance for native biota which utilises the original eight factors contained in s.5A of the Act (Appendix G).

4.2 Supplementary Consideration of s.5A

This *Supplementary Submission* provides (in Appendix G) a detailed Assessment of Significance pursuant to s.5A of the EP&A Act in respect of:

- the Koala and Yellow-bellied Glider, which have been recorded on lands nearby but not on the subject site itself. The site does not appear to constitute important or valuable habitat for either of these species;
- the Common Bent-wing Bat and Eastern False Pipistrelle, both which have been recorded on the site;
- other microchiropteran bats known or likely to occur on the site, all of which are highly mobile and wide-ranging. The subject site constitutes only a minute proportion of suitable habitat for these species in the locality and region;
- the large forest owls, no evidence for the presence of which has been recorded on the site. Nevertheless, these wide-ranging and highly mobile species could potentially occur on the site on occasions, as part of their activities over a much greater home range;
- the Blue Mountains Water Skink and Red-crowned Toadlet, although no evidence for either species has been recorded on the site. Nevertheless, there are suitable habitats in the immediate vicinity and these two species have been considered on a precautionary basis;
- the Tiger Quoll, which is known to occur in the general locality but has not been recorded on the subject site. As for most of the other species, the subject site does not constitute a significant area of habitat for the species, particularly in comparison to the vast areas of conservation reserves in the locality and region; and

- threatened plant species which could potentially occur on the subject site, although no specimens of any such species have been recorded. The subject site is not regarded as constituting a significant area of known habitat for any such species, given the extent of conservation reserves in the immediate vicinity, general locality and region.

A generic consideration of the eight factors of s.5A of the EP&A Act is also provided in this *Report* (below) to consider the potential for the proposed mining operation to impose adverse impacts upon any such species or their habitats. That generic analysis does not involve detailed analysis of the specific habitat requirements of other threatened biota which could potentially occur on the site. However, consideration of the project and of the impact amelioration measures proposed for the development, and the nature of those areas to be affected by the development, enables an appropriate consideration of the likelihood or otherwise of "*a significant effect*" being imposed upon any other "*threatened species, populations or ecological communities, or their habitats*".

4.3 Generic Section 5A Assessment of Significance

There are no listed "*endangered ecological communities*" or "*endangered populations*" present on the subject site or in the immediate vicinity. There is therefore no requirement for consideration of s.5A of the EP&A Act in respect of these biota.

There is therefore no requirement for consideration of s.5A of the EP&A Act in respect of these biota.

With respect to other threatened species or their habitats which could occur on the subject site at Newnes, the eight factors of s.5A of the EP&A Act have been considered with respect to the likelihood or otherwise of the proposed mining operation imposing "*a significant effect*":

- it is not considered likely that a "*viable local population*" of any of the additional potential threatened species would be dependent or reliant on the subject site, given the habitats present and their extent in adjoining reserves. Development of the subject site as proposed is not "*likely*" to involve a "*viable local population*" of any threatened species (even if present) being placed "*at risk of extinction*" (Factor a);
- there is no relevant "*endangered population*" listed on the TSC Act as occurring on the subject site or in the vicinity (Factor b);
- the proposed development of the subject site will not involve "*a significant area of known habitat*" (in terms of the "*regional distribution of the habitat*") for any threatened biota being "*modified or removed*", particularly given the vast areas of similar habitats and resources protected in the adjoining and regional conservation reserves (Factor c);
- the subject site is at the periphery of conserved lands and urban development, and does not contribute to "*currently interconnecting or proximate areas of habitat*" for any threatened biota. Consequently, the proposal will not isolate any such areas (Factor d);
- there is no relevant "*critical habitat*" currently declared within NSW (Factor e);
- "*threatened species, populations or ecological communities, or their habitats*" are generally not regarded as "*adequately represented in conservation reserves (or other similar protected areas) in the region*". However, the proposed development of the subject site will not affect the conservation status or the adequacy of conservation of any threatened biota or their habitats (Factor f);
- the TSC Act defines a "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of identified "*key threatening processes*".

The proposed mining operation at Newnes will require the "*clearing of native vegetation*" which has been listed as a "*key threatening process*" on the TSC Act. However, the area of "*native vegetation*" to be removed is minute by comparison with the extent of native vegetation in the vast conservation reserves in the immediate vicinity, locality and region. Given that circumstance, the proposed development is not regarded as contributing in any significant manner to "*key threatening processes*".

Given the considerable extent of conservation reserves and protected habitats in the immediate vicinity, locality and region, and given the lack of specific or restricted resources on the subject site, it is not regarded as likely that the proposed mining operation would "*threaten the survival or evolutionary development of* [any] *species, populations or ecological communities*". On that basis, the proposed development does not constitute a "*threatening process*" as defined in the TSC Act (Factor g);

- none of the additional threatened biota which could theoretically occur on the subject site is "*at the limit of its known distribution*" on the site (Factor h).

Given the above considerations, and other relevant matters (particularly the extent of conservation reserves, the size and location of the site and the regional distribution of potentially relevant species), it cannot be construed as "*likely*" that the proposed mining operation at Newnes, as currently proposed, would impose "*a significant effect on threatened species, populations or ecological communities, or their habitats*".

4.4 Conclusions

The consideration of the relevant factors of s.5A of the EP&A Act with respect to the likelihood or otherwise of "*a significant effect*" being imposed upon any "*threatened species, populations or ecological communities, or their habitats*" is provided above (Chapter 4.3) and in Appendix G to this *Report*. Given the extent of conservation reserves in the immediate vicinity, general locality and region, and the context and circumstances of the proposed development, it is not considered likely that any "*threatened species, populations or ecological communities, or their habitats*" would be subjected to the imposition of "*a significant effect*" as a result of the proposed mining operations at Newnes.

There are no threatened biota which could conceivably be restricted to the subject site, or to habitats thereon. Furthermore, the vegetation types and habitats or resources present on the subject site for the most part are widely distributed and extremely well conserved in the Sydney Basin Bioregion. The small swampy patches on the site are not significant in respect of the distribution and/or conservation of swamp communities within the Blue Mountains. The larger swampy area is, in any case, to be retained and protected.

The subject site does not support any resources or habitat features of restricted distribution or particular conservation significance or value, and the proposed mining operation will implement an array of impact amelioration and environmental management measures to avoid or minimise adverse impacts upon the natural environment.

5 WORLD HERITAGE AREA ISSUES

5.1 World Heritage Area Listing

The Greater Blue Mountains Area (GBMA) World Heritage Area was inscribed in 2000 on the World Heritage list. The GBMA is described as "*an area of breathtaking views, rugged tablelands, sheer cliffs, deep, inaccessible valleys and swamps teeming with life*". The area is described as providing a representation "*of the evolution of Australia's unique eucalypt vegetation and its associated communities, plants and animals*" (Appendix H).

The information available from the Australian Department of Environment & Heritage (DEH) states that the "*Greater Blue Mountains Area consists of 1.03 million hectares of mostly forested landscape on a sandstone plateau 60 to 180 kilometres inland from central Sydney, New South Wales. The property includes vast expanses of wilderness and is equivalent in area to almost one third of Belgium, or twice the size of Brunei*" (Appendix H).

The GBMA was inscribed on the World Heritage list on the basis of two natural criteria (Appendix H):

- natural criterion (ii)

  "*outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals*"; and

- natural criterion (iv)

  "*contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation*".

In addition to being part of the GBMA World Heritage Area, adjoining land to the east of the proposed mine site at Newnes is part of the Blue Mountains National Park (BMNP). The NSW National Parks & Wildlife Service (NPWS)[2], and their submission on the proposed mining operation and the EIS, raised concerns regarding the potential for adverse impacts to be imposed upon the BMNP and the GBMA.

The major concerns of the DEC in relation to the BMNP and GBMA relate to the potential for adverse impacts to be imposed by erosion and sediment discharge from the mine site and by a potential decline in water quality discharged from the site into the conservation reserves. Other matters raised by the DEC include:

- the potential for disturbance arising from noise and dust emanation and vibration during mining operations;
- the visual impacts of the proposal;
- concerns regarding rehabilitation of the mine site;
- impacts on recreational values in the adjoining National Park; and
- the adequacy of the proposed 50m buffer around the mine site.

5.2 Potential Impacts on World Heritage Area Values

The main concern regarding the potential of the proposed mining operation to impose adverse impacts upon the BMNP and GBMA World Heritage Area is the possibility of sediment and erosion discharges into the watercourses of those conservation reserves and the discharge of contaminated stormwater. The concern has been expressed that a deterioration in water quality within the headwaters of the Wollangambe River will occur as a result of the proposed mining operation.

[2] The NPWS has recently been incorporated into the NSW Department of Environment & Conservation (DEC).

The measures which are either inherent in the mining operation itself or which are to be implemented as environmental management and impact amelioration measures for the project are detailed either in the original EIS or in the supplementary documentation which describes the proposed modified mining process.

It is of critical importance in this regard that:

- no processing of material is to occur on the site at Newnes, and there is therefore considerably less opportunity for the contamination of surface waters than is the case on the adjoining extraction site;
- mining will be by way of specialised machinery which rips the rock substratum and transfers the raw material by conveyer for transport by train to an off-site processing plant. Consequently, there will be no generation of significant quantities of sediment or sediment-laden stormwater on the site;
- stormwater generated within the mine site is to be retained, treated and used for on-site dust suppression, irrigation of rehabilitation areas, watering of nursery plants and distribution to the Newnes Junction village; and
- clean surface water from upslope will be directed around the mine footprint and into protected watercourses downstream of the mine.

The measures described above will ensure the protection of habitats and watercourses downstream and downslope of the proposed mining operations, and will provide for the re-use of stormwater (following treatment) generated on the site. This approach has been adopted to minimise or avoid the imposition of adverse impacts on watercourses and habitats downstream of the proposed mine site, particularly within the BMNP and GBMA World Heritage Area.

The original nomination document for the GBMA World Heritage Area considered a number of pressures which may impact on the GBMA, and provides some recommended responses to those pressures. Urban development, water management and coal mining are identified as likely pressures on the GBMA, and specific responses to these pressures have been provided. It is of note that the extraction of sand and kaolin is not identified as a pressure of concern to the GBMA.

Nevertheless, the responses to potential pressures identified in the nomination document for the GBMA have been considered with respect to the sand and kaolin extraction activity proposed at Newnes. In particular, the responses identified for coal mining adjacent to the GBMA have been considered, and these have been adopted for the sand and kaolin activities at Newnes (where appropriate or relevant). In addition, responses identified in the water management and urban development sections of the original nomination document (Chapter 5) have been considered.

In this respect:

- the proposed mining operation has incorporated an array of measures specifically designed to prevent the contamination of stormwater which will be discharges and to control erosion and sediment discharged into the GBMA;
- subsidence is not an issue for the proposed sand and kaolin extraction process because the proposal is an open-cut mine;
- the proposal has been the subject of intensive consideration and assessment pursuant to the *NSW Environmental Planning & Assessment Act* (EP&A Act), and has been supplemented and/or modified in response to comments on the EIS; and
- there is not likely to be any adverse impacts *on "escarpments, cliffs and geological formation such as 'rock pagodas'"* as a result of the sand extraction process, either within the site or in the adjacent GBMA.

Given the considerations detailed within the EIS and the relevant associated and supplementary documentation, the proposed sand mining operation at Newnes is not regarded as likely to impose adverse impacts upon the GBMA World Heritage Area. The proposal involves the use of 'best practice' and innovative mining measures to avoid adverse impacts upon that conservation area, in excess of those originally proposed and beyond those which are implemented on other extraction operations in the immediate vicinity.

6 CONCLUSIONS

This *Supplementary Submission* regarding the potential impacts on native flora and fauna of the mining operations at Newnes Junction has taken into consideration matters and issues raised in a number of submissions to the original EIS. Of particular relevance have been matters identified by the Department of Environment & Conservation (DEC) and by P & J Smith (2003).

Modifications have been made to the proposed mining activity which include:

- the use of an alternative extraction method and specialised mining machinery which reduces significantly the potential for discharge of noise and dust, and which also reduces the potential for erosion and sediment discharge;
- a modification to the mine footprint to retain an area of swampy vegetation in the southeastern part of the site; and
- further refinement of the stormwater treatment measures to be implemented as part of the *Development Application*.

In respect of matters raised by the DEC and by others (including P & J Smith) in response to the original EIS:

- supplementary flora and fauna investigations (as documented in this *Supplementary Submission*) to address the issues and matters raised by the DEC, P & J Smith and others. In this regard, data provided by P & J Smith (2003) have been incorporated into the final documentation contained herein;
- the proposed new mining method will substantially reduce the generation of dust and noise as a consequence of the mining machinery which is to be involved. In addition to a reduction in both noise and dust emissions, there will be a reduction in material available for erosion and/or sediment discharge within the mine area, thereby substantially reducing the potential for adverse impacts on adjoining lands;
- the mine footprint has been adjusted to avoid the swampy vegetation along the watercourse in the southeastern part of the site. Whilst this vegetation does not appear to fully satisfy the criteria which describe the Newnes Plateau Shrub Swamp community, the protection of this small area of vegetation has been incorporated into the project to reduce the overall environmental impact of the activity;
- the 50m buffers to the BMNP and GBMA are regarded as adequate and appropriate given that there will be no discharge of stormwater or of any contaminants from the mine area through these portions of vegetation; and
- the proposed final landform involves extensive areas of rehabilitation and bush regeneration within the excavation area and the provision of a permanent freshwater swamp in the final void to provide water quality treatment and to provide habitat for native biota known to occur in the general area.

Given the modifications to the development design and the additional material provided in this *Supplementary Submission*, it is concluded that:

- the mining operation will not impose an adverse impact upon the Newnes Plateau Shrub Swamp community, given that:

- it is arguable whether that community is present on the site in any case; and
- the only area of vegetation which has affinities with that plant community (in the southeastern part of the site) is to be retained and protected;
- there is no evidence of or suitable habitat for the Blue Mountains Swamp Skink on the subject site, and potential habitat for this species downstream (in the GBMA) is to be protected from mining activities;
- the proposed mining operation would not threaten the survival or evolutionary development of any native biota, including "*threatened species, populations or ecological communities*" given the small area to be affected, the lack of critical or restricted resources and habitats, and the extent of conservation reserves in the immediate vicinity, locality and region;
- there is not likely to be a "*significant effect*" on any "*threatened species, population or ecological community, or its habitat*" pursuant to Section 5A of the *NSW Environmental Planning & Assessment Act 1979* (EP&A Act). There is, therefore, no requirement for the preparation of a *Species Impact Statement* (SIS) for this proposal; and
- specific measures have been incorporated into the proposal to avoid or minimise adverse impacts upon the adjoining Greater Blue Mountains Area (GBMA) World Heritage Area or on the Blue Mountains National Park (BMNP). Furthermore, the subject site constitutes only a very small (minute) disturbance on the periphery of those substantial conservation reserves, and the activity, even on a 'worst case scenario', could potentially adversely affect only a minute proportion of those areas. However, the proposal does not intend to impose adverse impacts upon either the BMNP or the GBMA.

BIBLIOGRAPHY

Barker J and Grigg G. 1977. *A Field Guide to Australian Frogs*. Rigby, Sydney.

Benson DH and Keith DA 1990. The natural vegetation of the Wallerawang 1:100,000 map sheet. *Cunninghamia* 2(2): 305-335.

Bishop A. 1996. *Field Guide to the Orchids of New South Wales and Victoria*. NSW University Press, Kensington.

Briggs JD and Leigh JH. 1996. *Rare or Threatened Australian Plants*. CSIRO, Collingwood.

Christidis L and Boles WE. 1994. *The Taxonomy & Species of Birds of Australia & its Territories*. Royal Australasian Ornithologists Union, Monograph 2, Melbourne.

Churchill S. 1998. *Australian Bats*. New Holland Publishers, Australia

Cogger HG. 2000. *Reptiles & Amphibians of Australia Sixth Edition*. Reed New Holland, Australia.

Corkery & Co. 1993. *Environmental Impact Statement for the Proposed Northern Extension of Underground at Clarence Colliery*. RW Corkery & Co Pty Ltd, Orange.

Cropper SC. 1993. *Management of Endangered Plants*. CSIRO Publishing, Melbourne.

Debus SJS and Rose AB. 1994. The Masked Owl *Tyto novaehollandiae* in New South Wales. *Australian Birds* 28: 40-55.

Debus SJS and Chafer SJ. 1994. The Powerful Owl *Ninox strenua* in New South Wales. *Australian Birds* 28: 21-39.

Duncan A, Baker B and Montgomery N. 1999. *The Action Plan for Australian Bats*. NPWS, Canberra.

Eby P. 1995. *Biology and Management of Pteropus in New South Wales*. NSW National Parks & Wildlife Service, Hurstville.

Ehmann H. 1992. *Encyclopedia of Australian Animals - Reptiles*. Angus & Robertson, Australia.

Ehmann H (*ed*). 1997. *Threatened Frogs of New South Wales: Habitats, Status and Conservation*. Published by Frog and Tadpole Study Group of NSW Inc, Sydney.

Fairley A and Moore P. 1995. *Native Plants of the Sydney District*. Kangaroo Press Pty Ltd, Sydney.

Garnett S. 1992. *Threatened & Extinct Birds of Australia*. Royal Australasian Ornithologists Union & NPWS, Melbourne.

Garnett T and Crowley GM. 2000. *The Action Plan for Australian Birds*. Environment Australia.

Harden GJ (*ed*). 1990. *Flora of New South Wales*. *Volume 1*. New South Wales University Press, Kensington.

Harden GJ (*ed*). 1991. *Flora of New South Wales*. *Volume 2*. New South Wales University Press, Kensington.

Harden GJ (*ed*). 1992. *Flora of New South Wales*. *Volume 3*. New South Wales University Press, Kensington.

Harden GJ (*ed*). 1993. *Flora of New South Wales*. *Volume 4*. New South Wales University Press, Kensington.

Harden GJ and Murray LJ (*eds*). 2000. *Supplement to Flora of New South Wales*. *Volume 1*. University of New South Wales Press, Sydney.

Higgins PJ. 1999. *Handbook of Australian, New Zealand & Antarctic Birds Volume 4*. Oxford University Press, Melbourne.

Higgins PJ and Davies SJJF. 1996. *Handbook of Australian, New Zealand & Antarctic Birds*. *Volume 3*. Oxford University Press, Melbourne.

HWR. 2004. Flora Assessment. Sand Extraction and Kaolin Project. Newnes Junction. HWR Pty Ltd, Orange.

Clarence Colliery Lease Extension. Environmental Impact Statement. International Environmental Consultants, Brighton-Le Sands, Sydney.

IEC 2003. *Environmental Impact Statement. Multi-commodity Sand Extraction and Kaolin Project for Supply of Construction Materials to the Sydney Region from Newnes Plateau.* International Environmental Consultants, Brighton-Le Sands, Sydney.

Leigh J, Boden R and Briggs J. 1984. *Extinct and Endangered Plants of Australia.*

Lindsey RL. 1992. *Encyclopedia of Australian Animals: Birds.* The Australian Museum, Sydney.

MacDonald D. 1984. *The Encyclopedia of Mammals.* George Allen & Unwin, London.

Marchant S and Higgins PJ. 1990. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 1.* Oxford University Press, Melbourne.

Marchant S and Higgins PJ. 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2. Raptors to Lapwings.* Oxford University Press, Melbourne.

Maxwell S, Burbidge AA and Morris K. 1996. *The 1996 Action Plan for Australian Marsupials & Monotremes.* NPWS, Canberra.

NPWS. 2000. *Blue Mountains Water Skink (Eulamprus leuraensis) Draft Recovery Plan.* NSW National Parks & Wildlife Service, Hurstville.

Richards G. 2000. *Proceedings of a Workshop to Assess the Status of the Grey-headed Flying Fox in New South Wales.* Australian Bat Society. Sydney.

Robinson M. 1994. *A Field Guide to Frogs of Australia.* Australian Museum, Sydney.

Simpson K and Day N. 1999. *Field Guide to the Birds of Australia.* Sixth Edition. Penguin Books, Australia.

Strahan R. 1995. *The Mammals of Australia.* Reed Books, Chatswood.

Strahan R (*ed*). 1991. *The Australian Museum Complete Book of Australian Mammals.* Collins Angus & Robertson, Australia.

Tyler MJ. 1997. *The Action Plan for Australian Frogs.* Environment Australia, Canberra.

Tyler MJ (*ed*). 1992. *Encyclopedia of Australian Animals: Frogs.* Australian Museum, Sydney.

White AW. 2002. *Survey for the Giant Burrowing Frog Heleioporous austrailiacus. Newnes Kaolin Site.* Biosphere Ecological Consultants, Sydney.

White AW. 2004. *Survey for Habitat of the Blue Mountains Water Skink Eulamprus leuraensis at Newnes Kaolin Site.* Biosphere Ecological Consultants, Sydney.

York A, Binns D and Shields J. 1991. *Flora and Fauna Assessment in NSW State Forests: Survey Guidelines.* Version 1.1a. Forestry Commission of NSW, Sydney.

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX A

Supplementary Vegetation and Flora Survey (HWR 2004)

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

Flora Assessment
Sand Extraction and Kaolin Project
Newnes Junction

Sydney Construction Materials

Prepared by

Andrew Carty, Geoff Winning & John-Paul King

07 April2004
ver. 1.1

Table of Contents

TABLE OF CONTENTS ..... **I**

1. INTRODUCTION **1**

1.1 SCOPE OF REPORT 1
1.2 PREVIOUS FLORA STUDIES 1
1.3 STUDY AREA 2
1.4 METHODS 2

2. DESCRIPTION OF PROPOSAL AREA **3**

3. FLORA ISSUES **4**

3.1 WHAT DOES "SIGNIFICANT" MEAN? 4
3.2 VEGETATION COMMUNITIES 5
3.3 PLANT SPECIES 8

4. POTENTIAL IMPACTS AND MITIGATION **13**

4.1 THREATENED AND RARE PLANTS 13
4.2 NEWNES PLATEAU SHRUB SWAMP 13
4.3 EDGE EFFECTS 13
4.4 EROSION, SEDIMENTATION & NUTRIENT TRANSPORT 14

5. SECTION 5A ASSESSMENT **15**

5.1 INTERPRETATION OF SECTION 5A OF THE EPA ACT 15
5.2 SECTION 5A ASSESSMENT FOR THE PROPOSAL 18

6. CONCLUSION **19**

7. REFERENCES **20**

APPENDIX 1 ..... **22**

FLORA LIST 22

1. Introduction

1.1 Scope of Report

This report presents an assessment of the potential impacts on flora from the proposed sand and kaolin extraction mine on part of the Newnes Plateau. As well as general flora issues, the report particularly addresses legislative planning requirements relating to flora. This report aims to provide descriptive information about the flora on the site and identify any threatened species, populations or ecological communities legislated under the *Threatened Species Conservation Act 1995* (TSC Act), pursuant to section 5A of the *Environmental Planning & Assessment Act 1979* (EPA Act) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The purpose of this report is to assist the relevant government authority with their determination of the proposal.

1.2 Previous Flora Studies

Previous flora surveys on this particular site include the Environmental Impact Statement (EIS) completed by International Environmental Consultants Pty Ltd (2003) and work completed by P & J Smith Consultants (2003) involved a flora survey of the site. Studies adjacent to the proposal area include EIS's prepared for the Clarence Colliery by Corkery and Co Pty Ltd (1994) and International Environmental Consultants (2000). Regional flora studies include mapping work completed by Benson and Keith (1990), *The natural vegetation of the Wallerawang 1: 100 000 map sheet*, which describes and coarsely maps the different vegetation communities in this area. We have generally utilised such documents in compiling background information for this report.

The key documents presenting the results of flora and fauna surveys are listed in Table 1.1. Collectively, these studies represent a comprehensive description of the flora and fauna of the Newnes Plateau.

Table 1.2. Key previous environmental studies.

Report	*Nature of Report*	*Prepared for*
International Environmental Consultants Pty Ltd (2003)	Environmental Impact Statement (EIS) for proposed sand and kaolin extraction project	Sydney Construction Materials
Corkery and Co Pty Ltd (1993)	EIS for Clarence colliery extension.	Coalex Pty Ltd
Benson and Keith (1990)	Vegetation mapping of Wallerawang 1:100 000 Map Sheet	
Smith and Smith (2003)	Objection to proposed sand and kaolin extraction project	
International Environmental Consultants Pty Ltd (2000)	EIS for Clarence colliery lease extension	Centennial Coal Company Ltd

1.3 Study Area

The proposal area for the mining operation is approximately 25.5 ha in area. The vegetation of the site has been moderately disturbed by vehicles and clearing in the past. The site has an easterly aspect and consists of moderate slopes with wide un-defined drainage lines. Adjacent to the site is the Rocla Quarry to the south, the Clarence Colliery to the north and the small village of Newnes Junction to west along with rail infrastructure. The Blue Mountains World Heritage Area occurs to the east. These surrounding uses in relation to the proposal area are shown in Figure 1.3.

1.4 Methods

The flora of the proposal area was assessed using descriptive methods. This included point surveys of areas along pre-defined transects. Recorded at each point survey was the canopy species present within 10 metres and the understorey species within 5 metres. Point surveys were conducted every 50 metres along each transect. Transects were situated to assess environmental gradients across the drainage lines (north-south) as well as along them (approx. west-east).



NOTES: 1. Base map : M 8931-3-S	HWR Ecological	**Proposal area and surrounding landuse.** Flora Assessment	
4 March 2004		Scale 1 : 7500	**Figure 1.3**

2. Description of Proposal Area

The proposal area comprises three vegetation community types. The vegetation communities recorded on site have affinities to the vegetation communities described and mapped by Benson and Keith, these are in order of abundance; Blue Mountains Sandstone Plateau Forest occurring over the majority of the site, Newnes Plateau Shrub Swamp was found in one area of the southern drainage line and Newnes Plateau Woodland situated in a small area on the west of the proposal area.

A list of plant species recorded within the proposal area is presented in Appendix 1.

3. Flora Issues

3.1 What Does "Significant" Mean?

The term significant is often used to describe species, populations and ecological communities considered to be valuable by someone. However the term is not defined in any legislation and is therefore used variously by different authors. In an attempt to clarify the usage of this term we have provided a brief discussion below of different degrees often applied to this term.

3.1.1 Significance Deriving From Legislation

Species, populations or ecological communities formally listed as threatened under NSW legislation (TSC Act) or Commonwealth legislation (EPBC Act) have significance confirmed by this listing and are referred to as being of state significance or national significance respectively. These listings are subject to a formal review process involving a technical committee and public submissions. Species, populations and ecological communities listed under legislation have express protection and particular consideration under the legislative planning framework.

Threatened species, populations or ecological communities are protected under legislation and therefore the consent authority must take into account the factors listed in section 5A of the EPA Act, often referred to as the 'eight-point test'.

3.1.2 Rare or Threatened Australian Plant List

The Rare or Threatened Australian Plants (ROTAP) list is a formal listing that is subject to a technical review and is published. However, it does not have any legislative backing, and while many ROTAP-listed species are also listed under relevant State or Commonwealth legislation, this is not necessarily the case. The ROTAP list identifies plants that are Presumed Extinct, Endangered, Vulnerable, Rare or Poorly Known at the national level. The ROTAP list categorises plants into the above conservation status categories along with other descriptive categories detailing the specie's distribution, range and reservation.

3.1.3 Informal Significance

Species, populations or ecological communities are often described in published papers or unpublished reports as having "conservation significance", "regional significance" or some other description of significance. These descriptions are the opinions of the author(s) of that paper or report and have generally not been subject to any wider review process. By implications, these informal assignments of significance do not generally carry the same weight as a formal listing, although there weighting often depends on the reputation of the author(s).

3.2 Vegetation Communities

There are three different vegetation communities occurring on site. In order of abundance these are Blue Mountains Sandstone Plateau Forest occurring over the majority of the site, Newnes Plateau Shrub Swamp was found in one area of the southern drainage line and Newnes Plateau Woodland situated in a small area on the west of the proposal area.

3.2.1 Endangered Ecological Communities

None of vegetation communities identified either on the subject site or in its immediate vicinity are presently listed as an Endangered Ecological Community under the TSC Act.

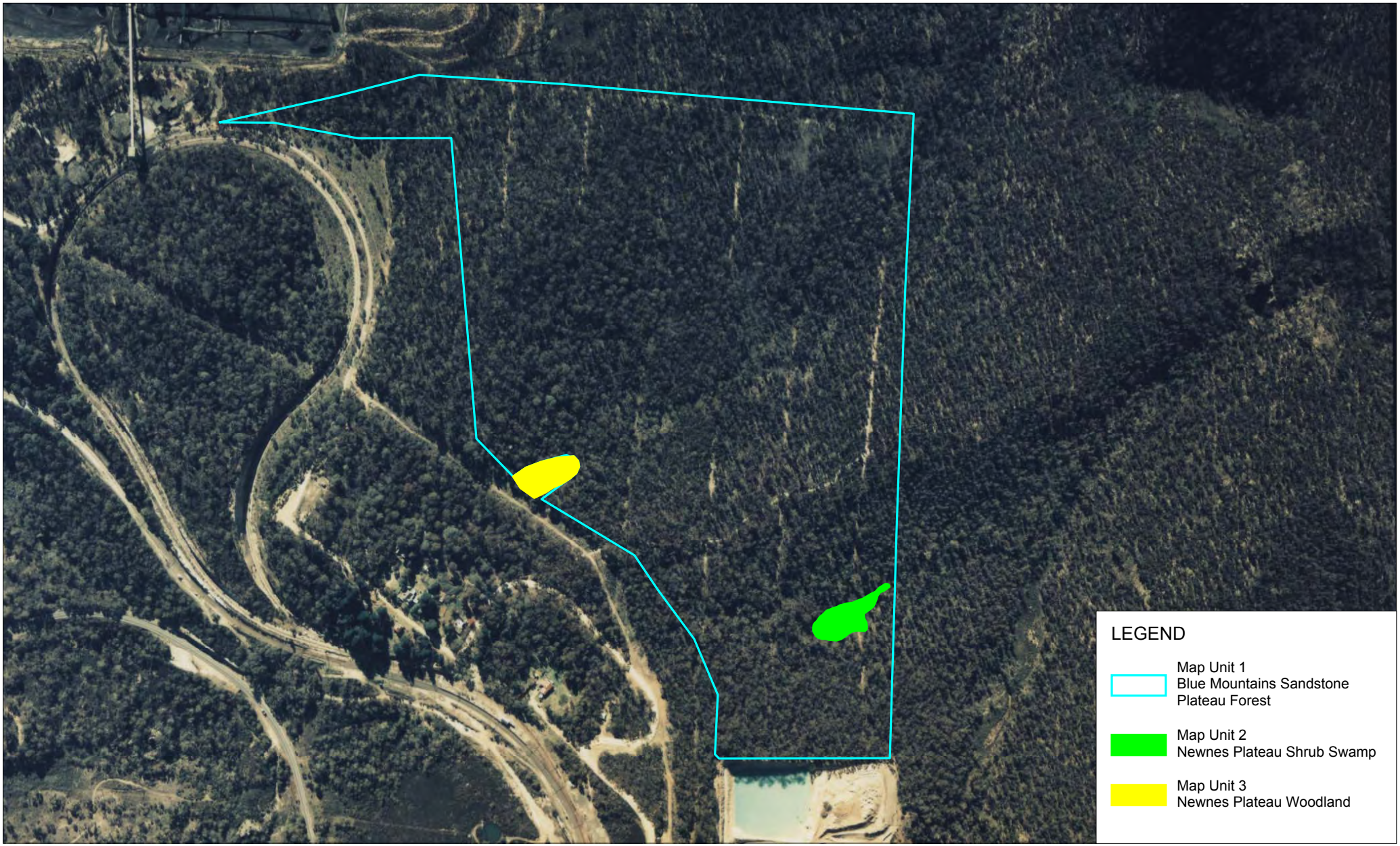
3.2.2 Other "Significant" Ecological Communities

The Newnes Plateau Shrub Swamp is an ecological community that is considered to have high conservation significance and only small patches are protected in conservation reserves (Benson & Keith, 1990). This community is defined as being restricted to the Newnes Plateau where it is apparently naturally rare, only occurring in narrow elongated patches in low-slope headwater valleys (Benson & Keith, 1990).

The Newnes Plateau Shrub Swamp community is not listed as an "Endangered Ecological Community" under the TSC Act, and at the time of this *Report*, had not been nominated for such listing. However, this vegetation community has been nominated as a "Threatened Ecological Community" and is currently under consideration under the EPBC Act (Environment Australia, 2004). Blue Mountains Swamps is the title given under the EPBC Act for an array of swamp communities, encompassing a range of different swamp types in the Blue Mountains area, including the Newnes Plateau Shrub Swamp.

One element of the importance of this ecological community is the threatened flora and fauna species for which it provides habitat, as identified by Benson & Keith (1990) and Smith & Smith (2003). Species listed under the TSC Act and the EPBC Act that have been recorded in the Newnes Plateau Shrub Swamp are *Caladenia tessellata* (an Endangered terrestrial orchid), *Boronia deanei* (a Vulnerable species) and the Endangered Blue Mountains Water Skink (*Eulamprus leuraensis*). The swamp community also provides habitat for a number of plant species of conservation significance (Benson & Keith, 1990; Smith & Smith, 2003), some of which are on the ROTAP list, but none of these species are listed under the TSC Act.

The Newnes Plateau Shrub Swamp community occurs on sandy/loamy soils that are relatively deep, high in organic matter and periodically waterlogged (Benson & Keith, 1990). The structure and floristics of the community varies from an open-scrub to a closed-heath to a sedgeland depending upon abiotic factors such as soil type and hydrology (Benson & Keith 1990). Generally the vegetation consists of low shrubs and sedges with trees usually absent (except for the fringes). Table 3.2 presents a comparison of the species identified by Benson & Keith (1990) as occurring in the Newnes Plateau Shrub Swamp and their presence or absence in the proposal area. Vegetation on the site identified as having affinities to the Newnes Plateau Shrub Swamp is mapped in Figure 3.2.



NOTES: 1. Base map : M 8931	HWR Ecological	**Vegetation communities** Flora Assessment	
17 March 2003		Scale 1 : 6500	**Figure 3.2**

Table 3.2. Plant species identified by Benson & Keith as occurring in the Newnes Plateau Shrub Swamp and their presence or absence in the two patches of moist swamp habitat on the subject site at Newnes.

Benson & Keith- Newnes Plateau Shrub Swamp	Species found in the swamps of the proposal area
Epacris paludosa	No
Epacris microphylla	Yes
Grevillea acanthifolia ssp. acanthifolia	No
Leptospermum grandifolium	Yes
Baeckea linifolia	Yes
Baeckea utilis	No
Boronia deanei	No
Lepyrodia scariosa	Yes
Empodisma minus	Yes
Lepidosperma limicola	Yes
Xyris ustulata	No
Patersonia fragilis	Yes
ALONG WATER CHANNELS	
Gleichenia dicarpa	No
Gymnoschoenus shaerocephalus	No
IN DRIER AREAS	
Hydrocotyle spp.	Yes
Viola hederacea ssp. sieberiana	Yes
Gonocarpus tetragynus	Yes
Xanthosia dissecta	
FRINGES	
Eucalyptus mannifera	Yes
Eucalyptus gregsoniana	Yes
HIGHER CLAY CONTENT	
Leptospermum polygalifolium (L. flavescens)	Yes
Leptospermum myrtifolium	No
Leptospermum continentale	Yes
Leptospermum obovatum	No
Restio australis	Yes
Juncus continuus	Yes
Lomandra longifolia	Yes

The drainage lines running through the Blue Mountains Sandstone Plateau Forest on the subject site contain patches of the species identified by Benson & Keith (1990) as occurring in the Newnes Plateau Shrub Swamp. However, these assemblages of flora species are generally swampy riparian vegetation, and not "diagnostic" for the Newnes Plateau Shrub Swamp community. Further, the

patches on the site are very small and linear with a mix of canopy and understorey species derived from the surrounding Blue Mountains Sandstone Plateau Forest. Most of the vegetation in these locations on site could not be defined as Shrub Swamps due to the lack of characteristic features of a swamp environment, including relatively flat or gently sloping areas that are constantly (or nearly so) moist, (usually) a lack of tree canopy, and a relatively uniform shrub/sedge canopy.

The drainage line in the southern part of the subject site has some affinities to the Newnes Plateau Shrub Swamp described by Benson & Keith (1990), and could be described as a drier version of that community. This analysis is based on the moderate size of the Shrub Swamp in a wide and gently-sloping gully that is relatively moist, with no tree species interspersed throughout and some of the floristics of the Newnes Plateau Shrub Swamp.

The drainage line through the centre of the subject site also has some limited affinities to the Newnes Plateau Shrub Swamp. The areas of swampy vegetation are small and patchy with trees interspersed throughout the patches of shrubland. This area is marginal between Newnes Plateau Shrub Swamp and the more usual drainage line vegetation throughout the subject site. Possible reasons for the difference between this area and the swamp area to the south includes: steeper slopes aiding better drainage allowing for trees to grow in places along the drainage line; the narrow structure of the drainage lines; and the smaller size and linear shape of the patches.

It is significant that both of these swampy areas are lacking species that are characteristic of the Newnes Plateau Shrub Swamp, particularly species identified as being "dominant" in this vegetation community, such as *Grevillia acanthifolia subsp. acanthifolia* and the sedgeland (wetter) species such as *Gymnoschoenus sphaerocephalus* and *Xyris ustulata*. Possible reasons for these species being absent are the abiotic factors including small catchment size (meaning relatively small amounts of water draining into these areas) and moderate slopes (contributing to better drainage).

An area of Newnes Plateau Shrub Swamp mapped by Benson & Keith (1990) to the west of the proposal area was investigated and found to contain the species absent from the subject site. This was much damper and flatter with free flowing water in places where the sedgeland species were found. No free running water was noted in the patches on the subject site, even after significant rain during the site survey. The small size of these swamp communities found in the subject site may also contribute to the lower floristic diversity.

Given the considerations detailed above, it is concluded in this *Report* that:

- the northern (central) drainage line on the subject site does not support vegetation that could reasonably be classified as Newnes Plateau Shrub Swamp; and
- the southern drainage line supports a small area of swamp vegetation that has some affinities with the Newnes Plateau Shrub Swamp community, but lacks many of the significant (or "diagnostic") species. For reasons of caution, this area of vegetation is to be treated as if it is Newnes Plateau Shrub Swamp.

3.3 Plant Species

A number of plant species listed on the TSC Act (1995) and EPBC Act (1999) occur in the local area, these are listed in Table 3.3.1. Other plant species on the ROTAP list occur in the area although are not covered by legislation, these species are listed in Table 3.3.2. These species have been identified as species of particular conservation significance by Benson & Keith (1990) and Smith & Smith (2003).

3.3.1 Threatened Plant Species

Threatened species that are likely to occur in the area were targeted during the survey but no threatened plant species were identified on site. These species are listed in Table 3.3.1 and were identified as occurring in the local area using a search on the NPWS website for threatened species on the Wallerawang 1:100 00 Map Sheet.

Table 3.3.1. Threatened species that occur in the area covered by the Wallerawang 1:100 000 map Sheet.

Species Name	Legal Status		Potential Habitat	Likelihood of being on Site
	TSC Act	EPBC Act		
Acacia bynoeana	E1	V	Dry forest/woodland/heath	Moderate Habitat, meandering searches on slopes and ridges
Prostanthera cryptandroides	V	V	Dry forest, rocky places	Minimal habitat, meandering searches on shallower ridges and slopes
Prostanthera cryptandroides subsp. cryptandroides	V	V	Dry forest, rocky places	Minimal habitat, meandering searches on shallower ridges and slopes
Prostanthera stricta	V	V	Forest on sandy alluvium, near water	Marginal Habitat, meandering searches in creeklines
Apatophyllum constablei	E1	E	Rocky hillsides	Minimal habitat, meandering searches on shallower ridges and slopes
Darwinia peduncularis	V		Dry forest on sandstone	Moderate Habitat, meandering searches on slopes and ridges
Eucalyptus cannonii	V	V	Woodland/shallow soil	Minimal habitat, meandering searches on shallower ridges and slopes
Boronia deanei	V	V	Heath/shrubland on swampy ground	Moderate habitat in creeklines, concentrated searches
Leionema sympetalum	V	V	Rocky outcrops in Dry Forest	Minimal habitat, meandering searches on shallower ridges and slopes
Grevillea evansiana	V	V	Dry forest/woodland sandy soil	Marginal habitat, meandering searches on slopes and ridges

Grevillea obtusiflora subsp. fecunda	E1	E	Open low scrub under dry forest in sandy loam soil	Marginal habitat, meandering searches on slopes and creeklines
Persoonia acerosa	V	V	Dry forest/heath on sandstone	Moderate habitat, meandering searches on slopes and ridges
Persoonia hindii	E1		Dry forest/woodland sandy soil	Moderate habitat, meandering searches on slopes and ridges
Persoonia marginata	V	V	Dry forest on sandstone	Moderate habitat, meandering searches on slopes and ridges
Derwentia blakelyi	V		Dry forest/woodland sandy soil	Moderate habitat, meandering searches on slopes and ridges
Haloragodendron lucasii	E1	E	Dry forest, sheltered slopes, near water	Marginal habitat, meandering searches on slopes and creeklines
Pultenaea glabra	V	V	Dry forest on sandstone	Moderate habitat, meandering searches on slopes and ridges
Pultenaea sp. 'Genowlan Point'	E1		Well drained stony soil near cliffs	Minimal habitat, meandering searches on shallower ridges and slopes

Note: Above species list was obtained using a search on the NPWS website for threatened species on the Wallerawang 1:100 00 Map Sheet.

Species that have a higher likelihood of occurring in the proposal area were searched for more intensively with targeted searches in suitable habitat. These species are detailed below.

Acacia bynoeana

This species is a small shrub to 1m high. It is endemic to central eastern NSW and occurs in an area from the Hunter district on the Central Coast south to Berrima and Mittagong in the Southern Highlands. The total population is estimated to consist of only a few hundred plants (NSW Scientific Committee, 1998). *A. bynoeana* has been recorded within several conservation reserves including the Blue Mountains NP and Agnes Banks NR (NPWS,1999) *A. bynoeana* occurs mainly in heath and dry sclerophyll forest with a typical substrate of sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained (NPWS,1999). The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds (from grading) and in recently burnt open patches (NPWS, 1999). This species is one of the species from Table 3.3.2 to most likely to occur in the proposal area as the vegetation structure and disturbed nature of the site are suitable, but the soil type is possibly a limiting factor. This species was not identified on site after targeted searches.

Darwinia peduncularis

This species occurs as local disjunct populations in coastal New South Wales with a couple of isolated populations in the Blue Mountains. Some populations are within conservation areas including the Wollemi National Park, Blue Mountains National Park and Berowra Valley Regional Park (NPWS, 1999). Darwinia peduncularis is a divaricate shrub that grows in dry sclerophyll forest on sandstone hillsides and ridges. Local populations are small with the total population likely to be less than 2500 or possibly less than 1500 (NPWS, 1999). Populations are vulnerable due to small population sizes and are threatened by altered fire regimes, trail bikes, inappropriate or overused walking trails and weed invasion. This species was not recorded within the proposal area after targeted surveys on slopes and ridges.

Boronia deanei

The Newnes Plateau Shrub Swamp was described by Benson & Keith (1990) and Smith & Smith (2003) as providing habitat for *Boronia deanei*. It was recorded by Corkery & Co Pty Ltd (1993) at Clarence colliery. The species is at its northern limit and has a local disjunct population (Benson & Keith, 1990) and so is vulnerable to stochastic events. This species was not identified in the proposal area.

Persoonia acerosa

This species is an erect to spreading shrub with glabrous to sparsely hairy young branchlets. It occurs in dry open forest, woodland and heath on sandy soils. Its range extends from the central Blue Mountains south to Hill Top and is represented in the Blue Mountains National Park (Weston, 1995). It was not recorded during the survey after targeted searches on slopes and ridges.

Persoonia hindii

This species is restricted to the Newnes Plateau where it occurs in dry sclerophyll forest and woodlands dominated by a variety of Eucalypt species on sandstone soils. It is known from only 9 locations in the Newnes State Forest, with each location occupying only a small area (<1ha) and only 1 to a few individuals occurs at each site (NPWS, 2000). Its small numbers and area of distribution make the species vulnerable to stochastic events. It's threatened by activities associated with forest management, frequent fire and sand mining (NPWS, 2000). This species was not recorded in the proposal area.

Persoonia marginata

This species is a spreading to decumbent shrub with moderately to densely hairy young branchlets. It is restricted to dry sclerophyll forest on sandstone in the Capertee district (Weston, 1995). The species is not known to occur in any conservation reserves. This species was not located in the proposal area after targeted searches.

Derwentia blakelyi

This species is a small glabrous and glaucous shrub or woody herb to 50 cm high. It is restricted to the western Blue Mountains, near Clarence, near Mt Horrible, Nullo Mountain and the Coricudgy Range (NPWS, 2003). It grows in eucalypt forest often in moist areas. The species is currently known from less than 20 locations none of which is in a conservation reserve. Known locations all have small population sizes. Threats to the species include loss of habitat by clearing and an inappropriate fire regime (NPWS, 2003). The risk of local extinction is high because of the small population sizes. This species was not located on the site after targeted searches.

Pultenaea glabra

This species is an erect, glabrous shrub with small scattered populations. It occurs only in the Blue Mountains between Wentworth falls and Katoomba (Fairley & Moore, 1995). Its patchy distribution and relatively low population numbers (Fairley & Moore, 1995) makes it vulnerable to stochastic events. It prefers open forest and scrub on protected slopes. This species was not located on the proposal site after targeted searches.

Caladenia tessellata

The Newnes Plateau Shrub Swamp was identified by Smith and Smith (2003) as providing habitat for *Caladenia tessellata*. It is known from two disjunct populations at Wyong and near Braidwood which could both be considered too far away from Newnes Junction for this threatened species to be relevant to the site (NPWS, 2003). This species was not listed from a search of threatened species of the Wallerawang 1:100 000 Map Sheet on the NPWS website. This species was not recorded in the proposal area.

If any of the above threatened species were previously present on the subject site there are a number of factors that may have contributed to the extinction or decline. These include disturbance events on the site such as past clearing, disturbance from vehicle use along the many tracks dissecting the proposal area and an altered fire regime. If there are any threatened species on site the population size would be relatively low or may only persist in the seed bank.

3.3.2 Other "Significant" Plant Species

There are a number of plant species regarded as having conservation significance that occur on site and are known to occur in the local area. This species have been identified having conservation significance by Benson & Keith (1990) and Smith & Smith (2003). These species are listed in Table 3.3.2. and a further assessment is given for species identified in the proposal area.

Table 3.3.2. Species regarded as having particular conservation significance but not covered by legislation

Species	Significance	ROTAP status	Records on site
Isopogon prostratus	Local disjunct pop./ Nth limit		IEC
Eucalyptus laophila	Local endemic	3RC-t	HWR, S&S
Hakea pachyphylla	Restricted to blue mountains		HWR, S&S
Celmisia longifolia	Local disjunct pop.		No records
Acacia asparagoides	Local endemic	2R	No records

Acacia kybeanensis	Local disjunct pop./ Nth limit		No records
Dillwynia stipulifera	Local disjunct pop./ Nth limit	3RCi	No records
Pultenaea incurvata	Local endemic	2RCt	No records
Eucalyptus gregsoniana	Local disjunct pop.	3RCa	HWR, S&S
Banksia conferta var. penicillata	Local endemic variety	3RC	HWR
Eriostemon obovalis	Local endemic	3RCa	No records

Note: Above species identified as having conservation significance by Benson & Keith and Smith & Smith.

Eucalyptus laophila

This species is a mallee only recently described (Smith & Smith, 2003). It has limited distribution and is a local endemic (Benson and Keith, 1990). It has a scattered distribution throughout the site particularly on the slopes and ridges with shallower soils. These plants should be located on site and incorporated into a seed collection program for rehabilitation projects on and off the proposal area.

Hakea pachyphylla

This species was included in *Hakea propinqua* in the past and has only recently been described as a separate species (Smith & Smith, 2003). It has a scattered distribution throughout the proposal site in most of the habitat types. These plants should be located and mapped on site and incorporated into a seed collection program for rehabilitation projects on and off the proposal area.

Eucalyptus gregsoniana

This species has sporadic and scattered distribution (Eucalink, 2003) making it a significant conservation species. It has a scattered distribution along the swamp edges particularly around the fringes of Swamp 1 (southern end). These plants should be located and mapped on site and incorporated into a seed collection program for rehabilitation projects on and off the proposal area.

Banksia conferta var. penicillata

This species is a local endemic variety of *Banksia conferta var. conferta* which nearest occurrence is located 600km away (Fairley & Moore, 1995). This species was located on the higher ridges and slopes at the north-western end of the proposal area. These plants should be located and mapped on site and incorporated into a seed collection program for rehabilitation projects.

4. Potential Impacts and Mitigation

4.1 Threatened and Rare Plants

The EIS for the project states that approximately 25 ha of vegetation will be cleared for the site. It is recommended to mitigate impacts on biodiversity that a Seed Collection Management Plan be developed for rehabilitation in the proposal area and for other local rehabilitation projects as well as for any landscaping required for the development.

To mitigate the possible loss of threatened plants that may occur on the site (although no records occur) it is recommended that additional concentrated searches be conducted. If any threatened species are found they should be mapped and incorporated into the Seed Collection Management Plan and rehabilitated. At each stage of the six stage development, any located threatened plants should be transplanted and rehabilitated at a suitable site, such as at the Botanic Gardens or a rehabilitation site. Detailed searches should also be conducted for any other species identified as being of regional conservation significance, and locations mapped and incorporated into the Seed Collection Management Plan. The site should be totally rehabilitated at the end of the mining phase with local plant species.

4.2 Newnes Plateau Shrub Swamp

The proposed mining operations will impose impacts on the two patches swampy riparian located on site. Vegetation along the central drainage line cannot be avoided by the mining operations, and will be cleared. However, this vegetation is not considered to constitute Newnes Plateau Shrub Swamp given its size, floristics and vegetation structure.

Conversely, the swampy riparian vegetation in the southeastern part of the subject site has some greater affinities with the Newnes Plateau Shrub Swamp community, and is of a larger size and greater floristic structural relevance. Consequently, even if not satisfying the criteria for the Newnes Plateau Shrub Swamp community, this patch of vegetation is recommended for retention, and is to be provided with a vegetation buffer of 50 metres. The hydrological features supporting this area of vegetation should also be maintained so that the drainage conditions supporting the vegetation are not significantly altered.

Monitoring of the floristics, hydrology and general health of the community should be conducted over the life-phase of the mine to determine the success of this conservation effort.

4.3 Edge Effects

Developments adjoining natural areas have the potential to contribute to a numbers of impacts along the edge of the natural area adjoining the development site. These include altered hydrology, increased nutrients and sediments, soil disturbance and increased light that in turn can aid weed invasion, alter the natural floristics, alter fauna habitat and cause nutrification of wetlands and streams. These impacts are collectively referred to as edge effects and typically result in a

disturbance ecotone between the development and the natural area. The nature of the impacts and the width of the disturbance ecotone are influenced by the type of development, the character of the natural remnant, and management procedures implemented to mitigate the impacts.

It is recommended that a minimum buffer zone of 50 metres be implemented along all boundaries adjacent to the World Heritage Area. To ensure that the buffer zones are effective use of best-practice management of stormwater, control of construction impacts, use of local native plant species in all landscaping, and management of site activities can mitigate this potential problem.

4.4 Erosion, Sedimentation & Nutrient Transport

Removal of vegetation exposes the soils to potential erosion, resulting in siltation in downstream gullies and waterbodies. Sediments often transport nutrients which can result in increased soil nutrient levels in downstream environments, often favouring weed invasion and altering the natural vegetation community. This would be a concern mainly during the construction phase and can be managed using best practice erosion and sedimentation control methods and clearing the minimal amount of vegetation required for each stage of the development.

5. Section 5A Assessment

5.1 Interpretation of Section 5A of the EPA Act

In determining whether there is likely to be a significant effect on threatened species, populations, or ecological communities the consent authority must take into account the factors listed in section 5A of the EPA Act, often referred to as the 'eight-point test'.

While an ecological assessment provides the data, and an interpretation of these data, on which the decision is based, the actual decision as to whether a proposed development will have "a significant effect on threatened species", and therefore whether a species impact statement is required, is a planning decision not a scientific one.

The assessment presented in this report of the potential effects of the proposal is intended as advice to the client and the consent authority on which they can base their decisions. The opinions expressed as to the significance of any predicted effects are our interpretation of the available data.

The following discussion presents a detailed interpretation of the eight factors under s. 5A. The actual assessment of impact of the proposal on each species using these factors is presented in Section 5.2 below.

(a) *in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.*

This is perhaps the most important factor for consideration. It seeks to ensure that local populations of threatened species are retained at a viable level, and that there is sufficient suitable habitat to support such populations. This conservation strategy is strongly supported by biodiversity principles which require conservation of intraspecific diversity as well as conservation of species. This is generally achieved by conserving a species across its whole range.

The phrasing of the factor raises two important questions in relation to each threatened species which is known to occur on a site which is the subject of a development proposal:

(i) What should be considered to be the geographical limit of the "local population"?

The term "local" as a measure of geographical extent is not defined in ecological literature, and could have a different meaning in different contexts, and would probably be interpreted differently by different people. The problem of addressing the term "local population" is probably best approached through a consideration of the meaning of the word "population" rather than "local".

A general definition of "population" would be a group of interbreeding organisms of the same kind, usually species, occupying a particular space. Such a definition was adopted by the TSC

Act, which defined "population" as meaning "a group of organisms, all of the same species, occupying a particular area". Ecologically, this definition is generally modified to mean "a group of organisms of one species occupying a defined area and reproductively isolated to some degree from other similar groups". Based on this definition, the "local population" of a species would comprise the group of interacting individuals of that species that occur in and around the site under study, but which is reproductively separated to some degree from other groups of that species.

Thus a "local population" must exhibit a capacity for ready exchange of genetic material between individuals within the population (i.e. through breeding for animals and pollination for plants), but genetic exchange with individuals outside of the population is substantially limited by a geographical barrier (including anthropogenic barriers). The geographical extent of the local population will often vary for different species, depending on their mobility, in the case of animals, or pollination and/or seed dispersal mechanisms, in the case of plants.

Where detailed data on the true extent of the local population and/or on movement of individuals or genetic material are not available, a precautionary approach is to consider the population present in the study area to be the local population.[1]

For a population to be "viable" it must be capable of maintaining the average number of individuals in the population over the longer term. For smaller populations it is also important that there be a capacity to exchange genetic material with other populations (to prevent inbreeding) through occasional movement of individuals, in the case of animals, or of pollen or seed, in the case of plants. NSW National Parks & Wildlife Service advises a precautionary approach whereby a local population should be considered to be viable unless the contrary can be conclusively demonstrated.[2]

(ii) Given that a development would have an effect on the local population of a species, how do we determine whether this effect would be likely to place the local population at risk of extinction ?

This question relates to the viability of remnant populations. If a development removes or alters a large proportion of the habitat of a species, the population of that species may drop to a level which is not sustainable in the longer term. This is the main question that needs to be addressed in relation to most developments affecting threatened species. It is almost inevitable that development of a site supporting a threatened species would result in the ultimate loss of some individuals of that species. The issue is whether the loss of these individuals would affect the long term viability of the local population of that species, thereby placing it at risk of extinction.

This raises ecological issues such as minimum viable population and minimum area, which have proven difficult to apply in real situations. There are population viability analysis models that

[1] NSW National Parks & Wildlife Service, Threatened Species Management Information Circular No. 2, November 1996.
[2] ibid

can assist in making predictions of the effects of different land management options, although these are often difficult to apply because of the absence of necessary data to calibrate the models for a particular species. While there is clear scope for the application of these models in the near future, at present decisions are generally based on relatively subjective judgements which, in turn, are typically based on the proportion of the known population or habitat to be affected.

We consider this to be the critical factor in the section 5A assessment and, therefore, our assessment of likely effects on each target species focuses on this factor.

(b) *in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.*

This factor applies a similar test as in factor (a) to endangered populations. No endangered populations are to be affected by the proposal.

(c) *in relation to the regional distribution of the habitat of a threatened species, population of ecological community, whether a significant area of known habitat is to be modified or removed.*

This factor takes a broader, regional view, requiring consideration of the regional availability of habitat of the species. The subject site falls within the NSW North Coast region. In relation to threatened species, this factor in effect somewhat duplicates the consideration of the first factor in that any activity which would modify or remove a significant area of regional habitat of a species would also affect the survival of the local population of that species.

(d) *whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.*

Isolation of habitats can lead to a decline in otherwise viable populations of plant and animal species as isolation can prevent exchange of genetic material which could lead to inbreeding. However, geographical isolation is not necessarily always negative. For example, if isolated populations are large enough, genetic drift in such populations can lead to the eventual evolution of new subspecies or species.

Isolation is relative to the species under consideration. For example, highly mobile species such as bats and many bird species can fly over large areas of hostile habitat (e.g. residential development) to reach isolated patches of suitable habitat. Indeed, some of these species would make use of landscape plantings as movement corridors through urban areas. However, strictly terrestrial animals, especially smaller ones such as lizards, can have their movement restricted just by a relatively small distance of hostile habitat. As many plant species rely on animals for transport of propagules (seeds, etc.) geographical isolation which limits fauna movement can also affect the long term viability of plant populations.
The primary considerations are, clearly, the movement capabilities of any threatened species likely to be affected by the development, and the local of the habitat to be affected relative to other habitats.

(e) *whether critical habitat will be affected.*

There is a capacity for critical habitats to be gazetted under the Threatened Species Conservation Act 1995. No such habitats have yet been gazetted.

(f) *whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region.*

In this factor, "conservation reserves (or similar protected areas)" would be most likely intended to refer to land administered by NSW National Parks & Wildlife Service, as this is the only agency which specifically manages its land for conservation purposes. The subject site falls within the NSW Blue Mountains region. The state of our knowledge of the distribution of many threatened species is poor, there are often inadequate references to determine the adequacy of conservation of many species. However, it is probably reasonable to conclude that most threatened species are not adequately reserved.

(g) *whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.*

This factor is somewhat vague in its intention. A "threatening process" is defined in the TSC Act as "a process that threatens, or may have the capability to threaten the survival or evolutionary development of species, populations or ecological communities". The TSC Act also makes provision for the specification of 'key threatening processes' in Schedule 3 of the TSC Act. It is not clear whether the use of the word "recognised" in this factor is intended to refer to specified key threatening processes, or whether it refers to general recognition that a proposed development is of a class which has the capability to threaten the survival of species. The former is generally assumed.

(h) *whether any threatened species, population of ecological community is at the limit of its known distribution.*

Although somewhat debatable, the occurrence of a species at or close to the limit of its known distribution is often considered to confer some conservation significance on that area. This information is readily available in the scientific literature.

5.2 Section 5A Assessment for the Proposal

The development does not require a Section 5A Assessment (Eight Part Test) under the EPA Act due to there being no threatened flora species, populations or ecological communities listed under the TSC Act and/or the EPBC Act located on site the. The threatened species known to occur in the local area have been assessed in Section 3 of this report and mitigation measures for species likely to be in the proposal area are detailed in section 4.

6. Conclusion

The development of the proposed Sand and Kaolin Extraction Project at Newnes Junction is unlikely to have a significant environmental impact due compliance with the following legislated matters;

- no significant effects on threatened species pursuant to Section 5A of the *Environmental Planning & Assessment Act 1979;*
- no endangered, threatened or venerable species, ecological communities or populations listed under the *Threatened Species Conservation Act 1995* or the *Environment Protection & Biodiversity Conservation Act 1999* will be significantly impacted*;*
- no potential effects on matters of Commonwealth significance pursuant to the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* and therefore does not need to be referred to the Environment Minister for consideration.

These conclusions are based on the assumption that the following recommendations would be adopted:

- a Seed Collection Management Plan is developed and additional searches for threatened and regionally significant species is conducted by an experienced botanist with the aim of rehabilitation;
- the swamp towards the south is retained with a 50 metre vegetation buffer zone and the hydrology regime is not significantly altered;
- an absolute minimum buffer zone of 50 metres be implemented along all borders adjoining the Blue Mountains World Heritage Area;
- stormwater from the development site should be managed so there is no increase in volume entering any part of the surrounding bushland;
- best practice erosion and sedimentation control methods should be adopted and enforced during construction;
- the construction site should be managed so there is no accidental incursions into buffer zones and areas not part of the proposal;
- any landscaping to comprise of local native plants from the Newnes Plateau.

(see section 4 for more information concerning reasons for recommendations)

7. References

Benson, D.H. & Keith, D.A. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia 2000) (1990). The natural vegetation of the Wallerawang 1:100 000 map sheet. *Cunninghamia 2(2): 305-335.*

Corkery, R.W. & Co. Pty Ltd. (1993). *Environmental Impact Statement for the Proposed Northern Extension of Underground Coal Mining at Clarence Colliery.* Prepared for Coalex Pty Ltd. R.W. Corkery & Co Pty Ltd, Orange.\

Fairley, A. & Moore, P. (1995). *Native Plants of the Sydney District*. Kangaroo Press Pty Ltd, Sydney.

Harden, G.J (ed.) (2000). *Flora of New South Wales*. Volume 1. Revised Edition. Royal Botanic Gardens/University of NSW Press, Sydney

Harden, G.J (ed.) (2002). *Flora of New South Wales*. Volume 2. Revised Edition. Royal Botanic Gardens/University of NSW Press, Sydney

Harden, G.J (ed.) (1992). *Flora of New South Wales*. Volume 3. Royal Botanic Gardens. Sydney

Harden, G.J (ed.) (1993). *Flora of New South Wales*. Volume 4. Revised Edition. Royal Botanic Gardens. Sydney

International Environmental Consultants Pty Ltd. (2003). *Environmental Impact Statement Multi-commodity Sand Extraction and Kaolin Project for Supply of Construction Materials to the Sydney Region from Newnes Plateau.* Prepared for Sydney Construction Materials. International Environmental Consultants Pty Ltd. Brighton-Le Sands.

NSW National Parks and Wildlife Service (2003). *Caladenia tessellata (a terrestrial orchid) – Endangered Species Listing - NSW Scientific Committee-final determination*. NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service (2000). *Persoonia hindii (a shrub) Endangered Species Listing - NSW Scientific Committee-final determination*. NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service (2003). *Boronia deanei - Vulnerable Species Listing.* NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service (1999). *Threatened Species Information - Acacia bynoeana.* NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service (2003). *Derwentia blakelyi - Vulnerable Species Listing.* NSW National Parks and Wildlife Service

NSW National Parks and Wildlife Service (1999). *Threatened Species Information – Haloragodendron lucasii.* NSW National Parks and Wildlife Service

Websites

Australian Government, Department of the Environment and Heritage. (2004)
Website: http://www.deh.gov.au/biodiversity/threatened/communities/considered/index.html

New South Wales Flora Online, Eucalink (2004)
Website: http://plantnet.rbgsyd.nsw.gov.au/PlantNet/Euc/species.html

Weston, P.H. (1995) New South Wales Flora Online.
Website: http://plantnet.rbgsyd.gov.au/PlantNet/NSWflora/srch.html

Appendix 1

Flora List

DIVISION TRACHEOPHYTA		Vascular Plants
Subdivision Pteridophytina		Seedless Vascular Plants
CLASS LYCOPSIDA		Club Mosses
Order Lycopodiales		Clubmosses
LYCOPODIACEAE	*Lycopodium deuterodensum*	Bushy Clubmoss
CLASS FILICOPSIDA		Ferns
Order Gleicheniales		
GLEICHENIACEAE		
	Gleichenia dicarpa	Pouched Coral-fern
Order Dennstaedtiales		
DENNSTAEDTIACEAE		
	Calochlaena dubia	False Bracken
	Pteridium esculentum	Bracken
LINDSAEACEAE		
	Lindsaea linearis	Screw Fern
Order Blechnales		
BLECHNACEAE		
	Blechnum cartilagineum	Gristle Fern
	Blechnum nudum	Fishbone Water-fern
Subdivision Spermatophytina		Seed Plants
CLASS MAGNOLIOPSIDA		Flowering Plants
SUBCLASS MAGNOLIIDAE		Dicotyledons
Order Laurales		
LAURACEAE		
	Cassytha melantha	Devils Twine
Order Ranunculales		
RANUNCULACEAE		
	Clematis aristata	Toothed Clematis
Order Dilleniales		
DILLENIACEAE		
	Hibbertia obtusifolia s.str.	Blunt-leaf Guinea-flower
Order Rhamnales		
RHAMNACEAE		
	Pomaderris andromedifolia	
Order Euphorbiales		
EUPHORBIACEAE	*Amperea xiphoclada*	Broom Spurge
	Poranthera microphylla	Small Poranthera
Order Violales		
VIOLACEAE		
	Hybanthus monopetalus	Slender Violet-bush
	Viola hederacea	Ivy-leaf Violet
Order Theales		
DROSERACEAE		
	Drosera sphathulata	Common Sundew
Order Casuarinales		
CASUARINACEAE		
	Allocasuarina littoralis	Black She-oak
Order Rosales		
CUNONIACEAE		
	Callicoma serratifolia	Black Wattle
MALACEAE		

	Cotoneaster glaucophyllus	Cotoneaster	i
Order Proteales			
PROTEACEAE			
	Banksia conferta var.penicillata		
	Banksia cunninghamia		
	Banksia marginata	Silver Banksia	
	Banksia oblongifolia	Spoon-leaf Banksia	
	Banksia serrata	Saw Banksia	
	Banksia spinulosa var. spinulosa	Hairpin Banksia	
	Grevillea laurifolia	Laurel Grevillea	
	Hakea laevipes ssp. laevipes		
	Hakea pachyphylla		
	Isopogon anemonifolius	Broad-leaf Drumsticks	
	Lomatia silaifolia	Crinkle Bush	
	Persoonia chamaepitys	Prostrate Geebung	
	Persoonia laurina subsp. *laurina*	Laurel-leaf Geebung	
	Persoonia levis	Broad-leaf Geebung	
	Persoonia myrtilloides	Myrtle Geebung	
	Petrophile pulchella	Conesticks	
	Telopea speciosissima	Waratah	
Order Myrtales			
MYRTACEAE			
	Eucalyptus blaxlandii	Blaxland's Stringybark	
	Eucalyptus laophila		
	Eucalyptus mannifera	Brittle Gum	
	Eucalyptus piperita	Sydney Peppermint	
	Eucalyptus radiata ssp. Radiata	Narrow-leaved Peppermint	
	Eucalyptus sclerophylla	Hard-leaved Scribbly Gum	
	Eucalyptus sieberi	Silvertop Ash	
	Eucalyptus sparsifolia	Narrow-leaved Stringbark	
	Baeckea linifolia	Swamp Baeckea	
	Leptospermum arachnoides	Spider Teatree	
	Leptospermum continentale	Prickly Tea-tree	
	Leptospermum grandifolium	Wooly Tea-tre	
	Leptospermum juniperinum	Prickly Teatree	
	Leptospermum polygalifolium	Yellow Tea-tree	
	Leptospermum sphaerocarpum	Round-fruited Tea-tree	
	Leptospermum trinervium (narrow leaf form)	Flaky-bark Tea-tree	
	Leptospermum trinervium (broad leaf form)	Flaky-bark Tea-tree	
Order Haloragales			
HALORAGACEAE			
	Gonocarpus tetragynus	Poverty Raspwort	
	Gonocarpus teucroides	Raspwort	
Order Rutales			
RUTACEAE			
	Boronia microphylla	Small-leaved Boronia	
Order Fabales			
FABACEAE			
FABOIDEAE			
	Bossiaea heterophylla	Variable Bossiaea	
	Davesia latifolia	Broad-leaf Bitter Pea	
	Daviesia ulicifolia	Gorse Bitter-pea	
	Gompholobium latifolium	Broad-leaf Wedge-pea	
	Hovea ? Heterophylla		
	Mirbelia platyloboides		

	Phyllota squarrosa	Dense Phyllota	
	Pultenaea scabra	Rough Bush-pea	
MIMOSOIDEAE			
	Acacia falcata	Sickle Wattle	
	Acacia implexa	Hickory	
	Acacia longifolia	Sydney Golden Wattle	
	Acacia obtusifolia		
	Acacia terminalis	Sunshine Wattle	
	Acacia ulicifolia	Prickly Moses	
Order Santalales			
SANTALACEAE			
	Choretum pauciflorum	Dwarf Sourbush	
	Leptomeria acida	Native Current	
	Omphacomeria acerba	Leafless Sour Bush	
Order Pittosporales			
PITTOSPORACEAE	*Billardiera scandens*	Apple-berry	
	Rhytidosporum procumbens	Marianthus	
Order Araliales			
ARALIACEAE			
	Polyscias sambucifolia	Elderberry Panax	
APIACEAE			
	Hydrocotyle peduncularis	Hairy Pennywort	
	Platysace lanceolata	Native Parsnip	
	Platysace linearifolia	Narrow-leaf Platysace	
	Xanthosia pilosa	Hairy Xanthosia	
Order Asterales			
ASTERACEAE			
	Arrhenechthites mixta	Purple Fireweed	
	Cassinia aculeata	Dollybush	
	Helichrysum adenophorum var. waddelliae	Waddel Everlasting	
	Helichrysum scorpioides		
	Hypochoeris radicata	Flatweed	i
Order Ericales			
EPACRIDACEAE			
	Brachyloma daphnoides	Daphne Heath	
	Epacris microphylla	Small-leaf Heath	
	Epacris pulchella	Coral Heath	
	Leucopogon lanceolatus	Lance-leaf Beard-heath	
	Monotoca scoparia	Prickly Broom-heath	
Order Goodeniales			
GOODENIACEAE			
	Dampieria stricta	Blue Dampieria	
	Goodenia bellidifolia ssp. Bellidifolia	Daisy-leaved Goodenia	
Order Gentianales			
LOGANIACEAE			
	Mitrasacme polymorpha	Mitre Weed	
RUBIACEAE			
	Galium binifolium	Bedstraws	
	Galium propinquum	Maori Bedstraw	
	Pomax umbellata	Pomax	
SCROPHULARIACEAE			
	Veronica plebeia		
SUBCLASS LILIIDAE		Monocotyledons	
Order Asparagales			
LOMANDRACEAE			

	Lomandra glauca subsp. *glauca*	Glaucous Mat-rush	
	Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	
	Lomandra longifolia subsp. *longifolia*	Spiny Mat-rush	
	Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	
XANTHORRHOEACEAE			
	Xanthorrhoeaea media	Sydney Grass-tree	
	Xanthorrhoea resinosa	Sydney Swamp Grass-tree	
PHORMIACEAE	*Dianella caerulea* var. caerulea	Rough Flax Lily	
	Dianella revoluta	Mauve Flax Lily	
Order Liliales			
IRIDACEAE			i
	Patersonia fragilis	Glabrous Purple-flag	
	Patersonia glabrata	Cauline-leaf Purple-flag	
Order Orchidales			
ORCHIDACEAE			
	Orthoceras strictum	Horned Orchid	
Order Haemodorales			
HAEMODORACEAE	*Haemodorum planifolium*	Bloodroot	
XYRIDACEAE			
	Xyris gracilis subsp. *gracilis*	Slender Yellow-eye	
Order Juncales			
JUNCACEAE			
	Juncus continuus	Sand Rush	
Order Cyperales			
CYPERACEAE			
	Caustis flexuosa	Curved Caustis	
	Gahnia filifolia		
	Gahnia microstachya	Slender Saw-sedge	
	Gahnia sieberiana	Red-fruited Saw-sedge	
	Lepidosperma laterale	Variable Sword-sedge	
	Lepidosperma limicola	Razor Sword-sedge	
	Lepidiosperma tortuosum		
	Schoenus villosus	Hairy Bog-rush	
Order Restionales			
RESTIONACEAE			
	Empodisma minus	Spreading Rope-rush	
	Lepyrodia muellerii		
	Lepyrodia scariosa	Chaffy Scale-rush	
	Restio australis		
Order Poales			
POACEAE			
	Austrostipa pubescens	Tall Spear Grass	
	Austrostipa rudis		
	Dichelachne inaequiglumis		
	Entolasia stricta	Wiry Panic	
	Joycea pallida	Red-anthered Wallaby Grass	
	Microlaena stipoides var. *stipoides*	Weeping Grass	
	Poa labillardieri	Tussock Grass	
	Poa sieberana		

ABBREVIATIONS:
i = introduced (i.e. not indigenous to Australia)
n = native Australian species not considered to be indigenous to the site
c = cultivated (i.e. planted on the site)
t = threatened

spp. = several species of the one genus (sometimes occurring as a hybrid swarm)
sp. = unidentified
species[2]
sp. aff. = unidentified species with characteristics similar to the indicated species or genus[2]
? = unconfirmed species[2]
var. = variety
subsp. = subspecies
cv. = cultivar (i.e. a anthropogenic form of the species)
agg. = an aggregate of several yet to be defined species

NOTES:
1. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons, such as orchids.
2. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.

OCCURRENCE
CODES:
w =

For simplicity, author citations for scientific names are not given, these follow:
Hill & Johnson (1995) for *Corymbia* (Myrtaceae)
Hill (1997) for *Angophora inopina* (Myrtaceae)
Linder & Verboon (1996) and Linder (1997) for *Danthonia* sens. lat. (Poaceae)
Briggs & Johnson (1998) for *Baloskion* and *Sporadanthus* (Restionaceae)
Harden (1990-93) for all other species

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX B

Supplementary Survey for the Blue Mountains Water Skink (Biosphere Consutlants (2004)

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

Survey for Habitat of the Blue Mountains Water Skink *Eulamprus leuraensis* At Newnes Kaolin Site.

Introduction

The Blue Mountains Water Skink *Eulamprus leuraensis* is a poorly known species. The species was described in 1984 based on a few specimens known from the upper Blue Mountains. In the mid-1990's further lizards were found on the Newnes Plateau and since that time there have been more recorded sightings of the lizards on the southern portion of the plateau (White 2002a). In 2003, Blue Mountains Water skinks were found at Clarence (White 2003), less than 2 kilometres from the Newness Kaolin Site. This lizard species is listed under Schedule 1 Part 1 of *the Threatened Species Conservation Act 1995* and is considered to be "endangered".

In March 2004, Biosphere Environmental Consultants Pty Ltd were engaged by Newnes Kaolin Pty Ltd to undertake a habitat assessment for the Blue Mountains Water Skink. In addition, the survey was to also assess the presence of Newnes Plateau Shrub Swamp (Benson and Keith 1990) on the site.

Study Site

The Project Site is approximately 32 Ha and lies immediately north-east of the township of Newnes Junction (Figure 1). The northern boundary of the site is 500 metres long while the eastern boundary is 850 metres long. The site occupies part of the upper western slope of Wollangambe River valley (the river lies just over 1 kilometer to the east). A thin sand layer lies over a heavily decomposing sandstone layer. In a few places the underlying sandstone is visible but there are no escarpment or obvious outcrops on the site.

The site is almost completely wooded. Silver-top Ash *Eucalyptus sieberi* is the dominant tree type present. Ash forest covers over 90% of the site, only the northern portion of the site is dominated by Scribbly Gum *E. rossii*. There is a well-developed shrub layer containing a mixture of species, most notably Waratah, Drumsticks, Geebungs and Wattles. Smaller shrubs contain a high proportion of epacrids.

Two ephemeral watercourses drain the site. The northern water course (Figure 1) has two primary feeder channels that unite on site and flow out through the north-eastern corner of the site. The southern watercourse originates off-site (near Newnes Junction) and passes eastwards towards the Wollangambe River. Both watercourses remain ephemeral until they reach the Wollangambe River. At the time of the survey, neither watercourse was flowing but both contained wet seepage areas; for the northern water course a wet area existed at the 990 m contour while a more diffuse wet soil area existed at the 1020 m contour for the southern watercourse.

The wet area on the northern watercourse consisted of a narrow seepage area (located at 244950; 6293320). The shrub and tree layer give way to Saw Sedges *Ghania radula*, Ferns *Blechnum sp*. , and Black Wattle *Callicoma serratifolium.* Fringing the area is an encircling zone of Parramatta Green Wattle *Acacia parramattensis*. Small pools of water had formed in vehicle tyre ruts across this area. This degree of ground moisture was similar to that observed in 2002 (White 2002b).

The wet area on the southern watercourse consisted of abroad area dominated by the Paperbark Tea-tree *Leptospermum trinervium*. Saw sedges and other sedges such as Scale Sedge *Lepyroidia gracilis* and Cord Rush *Restio complanatus* form the ground cover between the Tea-trees. No pools of water were present in this area but the ground was soft and sodden underfoot in places.

There are no buildings or artificial structures on the site. A well-formed dirt track crosses the site from west to east ("Ridge Track"). The site contains a series of informal tracks running from north to south along the longest axis of the site. These tracks are 100 metres apart and were created for the survey and drilling teams.

Methods

Blue Mountains Water Skink Habitat: The site was traversed on foot on the day of the 17th of March 2004. Habitat for the skink is confined to upland watercourses and particularly hanging swamp where there are open water areas. Areas that were deemed to be Blue Mountains water Skink habitat were identified using the criteria listed in the Blue Mountains Water Skink Recovery Plan (NPWS 2003). Most of the habitat for these animals is confined to Blue Mountains Sedge Swamp or Newnes Plateau Shrub Swamps. Blue Mountains Sedge Swamp does not occur on or near the study site whereas Newnes Plateau Shrub Swamp is known from within the general area.

In general, these habitats consist of dense shrub thickets underlain by sedges. Characteristic plant species include Button Grass *Gymnoschoenus sphaerocephalus*, Narrow-leaved Baeckae *Baeckea linifolia*, Dagger Hakea *Hakea teretifolia*, *Grevillea acanthifolia*, *Tetrarrhena turfosa*, *Xyris ustulate*, *Empodisma minus* and *Lepidosperma limicola* (LeBreton 1996). Lebreton found that Tetrarrhena and Baeckia were strongly correlated with the presence of the skink, as was the presence of permanently wet soil.

Assessment of Newnes Plateau Shrub Swamp: The wet areas associated with the northern and southern watercourse were closely inspected to see if they complied with the definition of this swamp type (Benson and Keith 1990). In brief, these swamps are described as typically, narrow, elongate swamps that lie in the upland valleys on the plateau. The swamps are dominated by shrubs and range from open-scrub to closed heath, with sedges dominating in the wetter areas. There appears to be great floristic variation between swamps; trees are normally absent but they are often fringed by *Eucalyptus mannifera* or *E. gregsoniana*.

The most extensive shrub types are various species of Tea Tree (*Leptospermum sp.*), along with *Baeckae linifolia* and *B. utilis, Grevillea acanthifolia, Epacris paludosa*

and *E. microphylla* and *Boronia deanei*. Very dense vegetation often forms along the permanent water channels, such as Coral fern *Gleichenia dicarpa* and Button Grass. Other plant types are listed in Benson and Howell (1990).

Results

Blue Mountains Water Skink Habitat: Habitat for the Blue Mountains Water Skink is not readily apparent on the study site. The lower section of the Northern watercourse descends into a well marked watercourse that is lined with Coral Fern, Callicoma and Tea Tree and it is only in this area that evident habitat for the skink is present. This area lies immediately east of the study site (Figure 2), inside the World Heritage Area. While it may be possible that the skinks could travel upstream from the habitat area, they are unlikely to proceed far onto the study site as the vegetation changes abruptly at the eastern-most survey track (near the site boundary). The creek-side vegetation quickly gives way to sparse Tea-Tree with Mat Rush (*Lomandra longifolia*) ground cover that would provide little shelter or foraging habitat for these skinks

Newnes Plateau Shrub Swamp: The two "wet" areas on the northern and southern watercourse was surveyed to assess the floristic composition and the structural characteristics of the areas. Both areas contain plants that occur in Newnes Plateau Shrub Swamp but the range of plants seems to be very limited and dominated by only one or two species. The "wet" area on the northern watercourse is very small and contains only three or four of the listed plant species. It is not until the northern watercourses crosses the eastern site boundary that more plant species associated with the Shrub Swamp community begin to appear. The northern zone is so narrow that it is only a few metres wide in places. It does not seem to fit the structural definition of Newnes Plateau Shrub Swamp in that it is not extensive, is not on a low slope and does not have permanent wet areas associated with it and lacks many of the requisite plant species.

The "wet" area on the southern watercourse is larger than that on the northern watercourse and is dominated by Tea Tree, particularly *Leptospermum trinervum*, which is not typically associated with this swamp habitat. *L. grandifolium*, which occurs in Newnes Plateau Shrub Swamp is present here but as a minor species. The southern "wet" area, while wider than the northern watercourse area, is still quite restricted and could not be considered to be extensive. It is also a dry site and there is no open water; the ground is very sandy and there are few damp areas underfoot. The southern "wet" area is floristically closer to Newnes Plateau Shrub Swamp than the northern area, but structurally it is probably not a swamp.

Discussion

Blue Mountains Water Skinks: The study site does not appear to contain habitat for these skinks. The northern watercourse is, however, continuous with habitat that appears to be suitable for them (Figure 2). As the skinks are known to occur in the local area it is prudent to assume that the skinks use the area below the northern watercourse and that all steps should be taken to protect this habitat (in the World Heritage Area). The measures should include the erection of devices (such as silt screens) upstream of the habitat area while still maintaining water flow in the watercourse. The measures employed should retain water quality in the watercourse while not disrupting water flow.

It is also recommended that targeted surveys be carried out for the skinks (in the World Heritage Area), and should the skinks be found, a monitoring program be established to monitor the response of the skinks (and the habitat) to works occurring in the study site.

Newnes Plateau Shrub Swamp: Newnes Plateau Shrub Swamp appears to be absent from the northern watercourse on the study site. It is difficult to know whether the Tea-Tree or "wet" area on the southern watercourse should be considered to be Newnes Plateau Shrub Swamp as it lacks most of the structural components of this ecological community.

References Cited

Benson, D. H., and D.A Keith (1990). The natural vegetation of the Wallerawang 1:100,000 map sheet. Cunninghamia 2(2): 305-335.

LeBreton, M. (1996). Habitat and distribution of the Blue Mountains Water Skink (*Eulamprus leuraensis*). BSc Honours Thesis. University of New South Wales.

NPWS (2001) The recovery plan for the Blue Mountains Water Skink (*Eulamprus leuraensis*). NSW National parks and Wildlife Service, Hurstville.

White, A.W. (2002a). Surveys for the Blue Mountains Water Skink *Eulamprus leuraensis* Newnes State Forest. Prepared for Power Coal Pty Ltd.

White, A.W. (2002b). Surveys for the Giant Burrowing Frog *Heleioporous australiacus*, Newnes Kaolin Site. Prepared for Newnes Kaolin Pty Ltd.

White, A.W. (2003). Assessment of the potential impacts of the expansion of sand quarrying at Kables Sands Pty Ltd, Clarence, on the Blue Mountains Water Skink Skink (*Eulamprus leuraensis*). Prepared for Kables Sands Pty Ltd.

Dr Arthur White

24 March 2004.

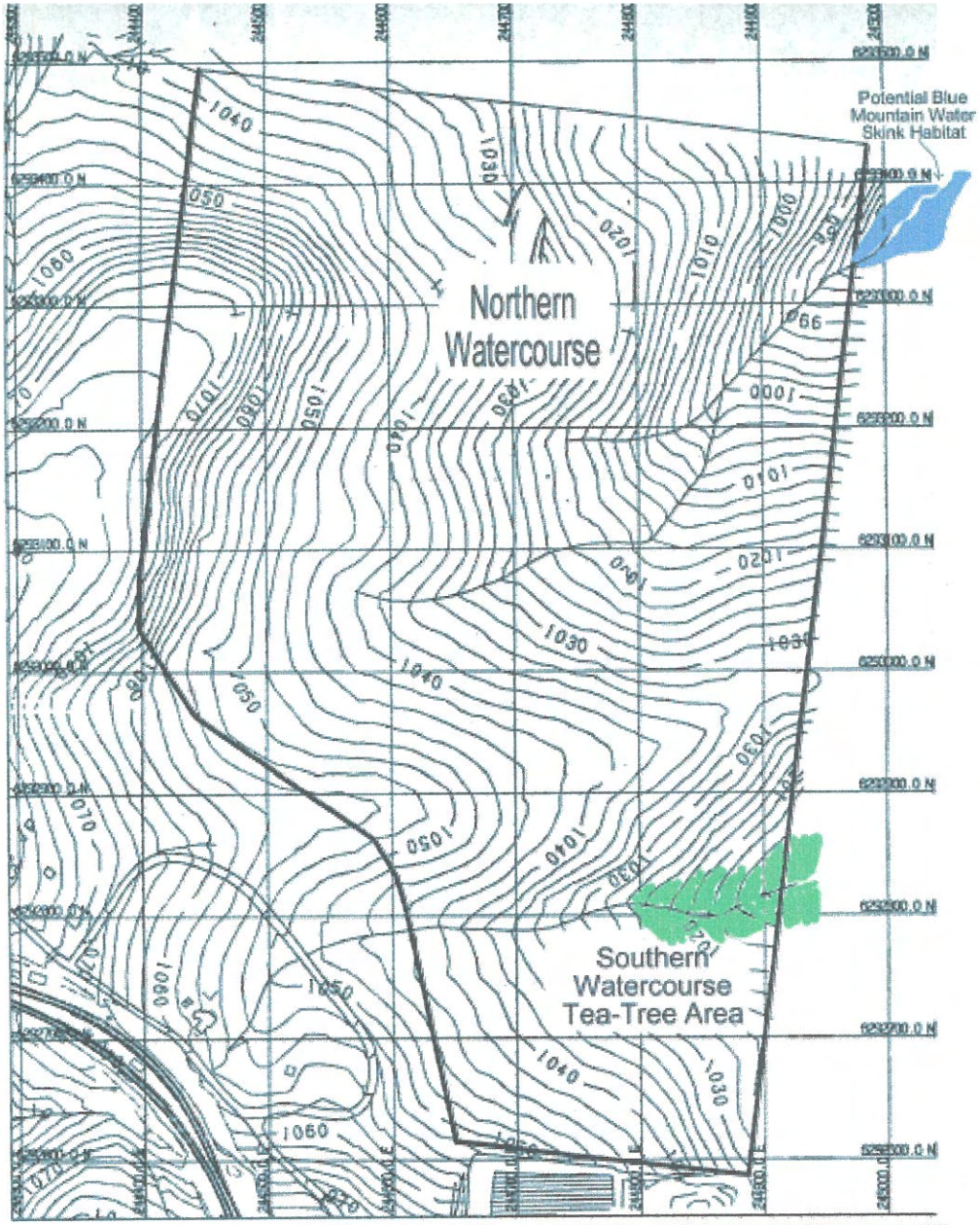


Figure 1

NEWNES KAOLIN SITE

Watercourses and Habitat Areas Scale 1: 4,000

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX C

Combined flora species recorded on the subject site (IEC 2003; P & J Smith 2003; HWR 2004)

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

Key	
A	Current surveys undertaken by HWR (2003)
B	Previous surveys by Smith & Smith (2003) and International Environmental Consultants (EIS) 2003

Family/Class Name	Species Scientific Name	Species Common Name	A	B
Class LYCOPSIDA	**Clubmosses and Quillwarts**			
LYCOPODIACEAE	*Lycopodium deuterodensum*	Bushy Clubmoss	✓	✓
GLEICHENIACEAE	*Gleichenia dicarpa*	Pouched Coral-fern	✓	
DENNSTAEDTIACEAE	*Calochlaena dubia*	False Bracken	✓	
	Pteridium esculentum	Bracken	✓	✓
LINDSAEACEAE	*Lindsaea linearis*	Screw Fern	✓	✓
DICKSONIACEAE	*Calochlaena dubia*			✓
SCHIZAEACEAE	*Schizaea bifida* s. str.	Forked-comb fern		✓
BLECHNACEAE	*Blechnum cartilagineum*	Gristle Fern	✓	✓
	Blechnum nudum	Fishbone Water-fern	✓	✓
Class MAGNOLIDAE	**Flowering Plants**			
LAURACEAE	*Cassytha melantha*	Devils Twine	✓	
RANUNCULACEAE	*Clematis aristata*	Toothed Clematis	✓	
DILLENIACEAE	*Hibbertia cistifolia*			✓
	Hibbertia obtusifolia s.str.	Blunt-leaf Guinea-flower	✓	
RHAMNACEAE	*Pomaderris andromedifolia*		✓	✓
EUPHORBIACEAE	*Amperea xiphoclada*	Broom Spurge	✓	✓
	Poranthera microphylla	Small Poranthera	✓	
TREMANDRACEAE	*Tetratheca rubioides*			✓
VIOLACEAE	*Hybanthus monopetalus*	Slender Violet-bush	✓	✓
	Viola hederacea	Ivy-leaf Violet	✓	✓
DROSERACEAE	*Drosera sphathulata*	Common Sundew	✓	
CASUARINACEAE	*Allocasuarina littoralis*	Black She-oak	✓	
CUNONIACEAE	*Callicoma serratifolia*	Black Wattle	✓	✓
MALACEAE	*Cotoneaster glaucophyllus*	Cotoneaster	✓	
PROTEACEAE	*Banksia conferta* var.*penicillata*		✓	
	Banksia cunninghamia		✓	
	Banksia marginata	Silver Banksia	✓	✓
	Banksia oblongifolia	Spoon-leaf Banksia	✓	✓
	Banksia oblongifolia	Spoon-leaf Banksia	✓	✓
	Banksia serrata	Saw Banksia	✓	✓
	Banksia spinulosa var. *spinulosa*	Hairpin Banksia	✓	✓
	Grevillea laurifolia	Laurel Grevillea	✓	✓
	Hakea laevipes ssp. *laevipes*		✓	✓
	Hakea pachyphylla		✓	✓
	Isopogon anethifolius	Narrow-leaf Drumstick		✓
	Isopogon prostratus	Prostrate Drumstick		✓
	Isopogon anemonifolius	Broad-leaf Drumsticks	✓	✓
	Lomatia silaifolia	Crinkle Bush	✓	✓
	Persoonia chamaepitys	Prostrate Geebung	✓	✓
	Persoonia laurina subsp. *laurina*	Laurel-leaf Geebung	✓	✓
	Persoonia levis	Broad-leaf Geebung	✓	✓
	Persoonia myrtilloides	Myrtle Geebung		✓
	Petrophile canescens			✓
	Petrophile pulchella	Conesticks	✓	✓
	Telopea speciosissima	Waratah	✓	✓

Family/Class Name	Species Scientific Name	Species Common Name	A	B
MYRTACEAE	*Eucalyptus blaxlandii*	Blaxland's Stringybark	✓	✓
	Eucalyptus laophila		✓	✓
	Eucalyptus mannifera	Brittle Gum	✓	✓
	Eucalyptus piperita	Sydney Peppermint	✓	✓
	Eucalyptus radiata ssp. *radiata*	Narrow-leaved Peppermint	✓	✓
	Eucalyptus sclerophylla	Hard-leaved Scribbly Gum	✓	✓
	Eucalyptus sieberi	Silvertop Ash	✓	✓
	Eucalyptus sparsifolia	Narrow-leaved Stringbark	✓	✓
	Baeckea linifolia	Swamp Baeckea	✓	✓
	Leptospemum macrocarpum			✓
	Leptospermum myrtifolium	Swamp Tea-tree		✓
	Leptospermum arachnoides	Spider Teatree	✓	✓
	Leptospermum continentale	Prickly Tea-tree	✓	✓
	Leptospermum grandifolium	Wooly Tea-tre	✓	✓
	Leptospermum juniperinum	Prickly Teatree	✓	✓
	Leptospermum polygalifolium	Yellow Tea-tree	✓	✓
	Leptospermum sphaerocarpum	Round-fruited Tea-tree	✓	✓
	Leptospermum trinervium (narrow leaf form)	Flaky-bark Tea-tree	✓	✓
	Leptospermum trinervium (broad leaf form)	Flaky-bark Tea-tree	✓	✓
HALORAGACEAE	*Gonocarpus tetragynus*	Poverty Raspwort	✓	✓
	Gonocarpus teucroides	Raspwort	✓	✓
RUTACEAE	*Boronia microphylla*	Small-leaved Boronia	✓	✓
FABACEAE	*Bossiaea heterophylla*	Variable Bossiaea	✓	✓
	Davesia latifolia	Broad-leaf Bitter Pea	✓	✓
	Daviesia acicularis			✓
	Daviesia squarrosa			✓
	Daviesia ulicifolia	Gorse Bitter-pea	✓	✓
	Gompholobium latifolium	Broad-leaf Wedge-pea	✓	✓
	Hovea ? Heterophylla		✓	✓
	Mirbelia platyloboides		✓	✓
	Phyllota squarrosa	Dense Phyllota	✓	✓
	Pultenaea scabra	Rough Bush-pea	✓	✓
MIMOSOIDEAE	*Acacia myrtifolia*	Myrtle Wattle		✓
	Acacia falcata	Sickle Wattle	✓	
	Acacia implexa	Hickory	✓	
	Acacia longifolia	Sydney Golden Wattle	✓	✓
	Acacia obtusifolia		✓	✓
	Acacia terminalis	Sunshine Wattle	✓	✓
	Acacia ulicifolia	Prickly Moses	✓	✓
SANTALACEAE	*Choretum pauciflorum*	Dwarf Sourbush	✓	✓
	Leptomeria acida	Native Current	✓	✓
	Omphacomeria acerba	Leafless Sour Bush	✓	✓
PITTOSPORACEAE	*Billardiera scandens*	Apple-berry	✓	✓
	Rhytidosporum procumbens	Marianthus	✓	✓
POLYGALACEAE	*Comesperma ericinum*	Matchheads		✓
	Comesperma volubile	Love Creeper		✓
ARALIACEAE	*Polyscias sambucifolia*	Elderberry Panax	✓	✓
APIACEAE	*Xanthosia stellata*			✓
	Hydrocotyle peduncularis	Hairy Pennywort	✓	✓
	Platysace lanceolata	Native Parsnip	✓	✓
	Platysace linearifolia	Narrow-leaf Platysace	✓	✓
	Xanthosia pilosa	Hairy Xanthosia	✓	
ASTERACEAE	*Arrhenechthites mixta*	Purple Fireweed	✓	✓

Family/Class Name	Species Scientific Name	Species Common Name	A	B
	Cassinia aculeata	Dollybush	✓	✓
	Helichrysum adenophorum var. *waddelliae*	Waddel Everlasting	✓	✓
	Helichrysum Leucopsideum	Satin Everlasting		✓
	Helichrysum rutidolepis	Pale Everlasting		✓
	Helichrysum scorpioides		✓	✓
	Hypochoeris radicata	Flatweed	✓	
CAMPANULACEAE	*Wahlenbergia* sp.			✓
EPACRIDACEAE	*Epacridaceae* sp.			✓
	Brachyloma daphnoides	Daphne Heath	✓	✓
	Epacris microphylla	Small-leaf Heath	✓	✓
	Epacris pulchella	Coral Heath	✓	✓
	Leucopogon lanceolatus	Lance-leaf Beard-heath	✓	✓
	Monotoca scoparia	Prickly Broom-heath	✓	✓
LAMIACEAE	*Prostanthera scutellarioides*	Coast Mint-bush		✓
GOODENIACEAE	*Goodenia dimorpha* var. *dimorpha*			✓
	Dampieria stricta	Blue Dampieria	✓	✓
	Goodenia bellidifolia ssp. *Bellidifolia*	Daisy-leaved Goodenia	✓	✓
LOGANIACEAE	*Mitrasacme polymorpha*	Mitre Weed	✓	✓
RUBIACEAE	*Galium binifolium*	Bedstraws	✓	
	Galium propinquum	Maori Bedstraw	✓	
	Pomax umbellata	Pomax	✓	✓
SCROPHULARIACEAE	*Veronica plebeia*		✓	
Subclass LILIDAE	**Monocotyledons**			
LOMANDRACEAE	*Lomandra cylindrica*	Needle Mat-rush		✓
	Lomandra glauca subsp. *glauca*	Glaucous Mat-rush	✓	
	Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	✓	✓
	Lomandra longifolia subsp. *longifolia*	Spiny Mat-rush	✓	✓
	Lomandra multiflora subsp. *multiflora*	Many-flowered Mat-rush	✓	
XANTHORRHOEACEA*E*	*Xanthorrhoeae resinifera*	Spear Grass-tree		✓
	Xanthorrhoeaea media	Sydney Grass-tree	✓	
	Xanthorrhoea resinosa	Sydney Swamp Grass-tree	✓	✓
PHORMIACEAE	*Dianella caerulea* var. *caerulea*	Rough Flax Lily	✓	✓
	Dianella prunina			✓
	Dianella revoluta	Mauve Flax Lily	✓	✓
IRIDACEAE	*Patersonia sericea*	Silky Purple-flag	✓	✓
	Patersonia fragilis	Glabrous Purple-flag	✓	✓
	Patersonia glabrata	Cauline-leaf Purple-flag	✓	✓
ORCHIDACEAE	*Acianthus* sp.			✓
	Caladenia dimorpha			✓
	Diuris sulphurea	Tiger Orchid		✓
	Genoplesium sp.			✓
	Pterostylis tunstallii			✓
	Pterostylis concinna	Trim Greenhood		✓
	Orthoceras strictum	Horned Orchid	✓	
HAEMODORACEAE	*Haemodorum planifolium*	Bloodroot	✓	✓
	Haemodorum corymbosum	Rush-leaf Bloodroot		✓
XYRIDACEAE	*Xyris gracilis* subsp. *gracilis*	Slender Yellow-eye	✓	✓
JUNCACEAE	*Juncus planifolius*			✓
	Juncus continuus	Sand Rush	✓	✓

Family/Class Name	Species Scientific Name	Species Common Name	A	B
CYPERACEAE	*Caustis flexuosa*	Curved Caustis	✓	✓
	Gahnia filifolia		✓	✓
	Gahnia microstachya	Slender Saw-sedge	✓	✓
	Gahnia sieberiana	Red-fruited Saw-sedge	✓	✓
	Lepidosperma laterale	Variable Sword-sedge	✓	✓
	Lepidosperma limicola	Razor Sword-sedge	✓	✓
	Lepidiosperma tortuosum		✓	✓
	Schoenus brevifolius	Zig-zag Bog-rush		✓
	Schoenus melanostachys	Black Bog-rush		✓
	Schoenus villosus	Hairy Bog-rush	✓	✓
RESTIONACEAE	*Empodisma minus*	Spreading Rope-rush	✓	✓
	Lepyrodia muellerii		✓	
	Lepyrodia scariosa	Chaffy Scale-rush	✓	✓
	Restio australis		✓	✓
POACEAE	*Aristida benethamii* var*. benthamii*			✓
	Aristida personata			✓
	Austrostipa pubescens	Tall Spear Grass	✓	✓
	Austrostipa rudis		✓	✓
	Dichelachne inaequiglumis		✓	✓
	Entolasia stricta	Wiry Panic	✓	✓
	Joycea pallida	Red-anthered Wallaby Grass	✓	✓
	Microlaena stipoides var. stipoides	Weeping Grass	✓	✓
	Poa labillardieri	Tussock Grass	✓	
	Tetrarrhena turfosa		✓	
	Poa sieberana		✓	✓

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX D

Newnes Plateau Shrub Swamp community (Benson & Keith 1990)

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

The natural vegetation of the Wallerawang 1:100 000 map sheet

D.H. Benson and D.A. Keith

Abstract

Benson, D.H. & Keith, D.A. (National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia 2000) 1990. The natural vegetation of the Wallerawang 1:100 000 map sheet. Cunninghamia 2(2): 305–335.* The composition and extent of the present natural vegetation on the Wallerawang 1:100 000 map sheet 8931 (lat. 30°00′– 33°30′S, long. 150°00′–150°30′E) are described and mapped from aerial photography and field traverses. The structure, characteristic species, and associated environmental factors for 18 map units with 29 plant communities are described. These communities include small areas of eucalypt tall open-forest, extensive tracts of open-forest and woodland, and localised patches of sclerophyllous heath and shrub swamp.

The vegetation patterns are influenced by geology (mainly sedimentary and metasedimentary rocks), soil types (mainly low nutrient acid soils) and physiography (dissected sandstone plateaus and deep gorges), as well as modified by elevation (ranging from 400 m to almost 1200 m above sea level) and rainfall (ranging from 620 mm to 1220 mm per annum).

Significant plant communities and 23 rare species are listed. There is a need to conserve representative samples of plant communities on the western side of the map sheet and on the high elevation Newnes Plateau in particular, where proposals for extensive sand extraction threaten important woodlands, heaths and swamps. Particular concentrations of rare species occur on the Newnes Plateau, and in the Capertee Valley near Glen Davis. These areas may represent refugia during periods of climatic change.

Introduction

Massive orange sandstone cliffs, spectacular 'pagoda' country, the dry woodlands of the Wolgan and Capertee valleys, and a history of often isolated and short-lived mining and industrial activity in a harsh natural environment, provide the background to the different plant communities in this map sheet area.

The Wallerawang 1:100 000 Vegetation Map Sheet (based on Wallerawang 1:100 000 Topographic Sheet 8931, Royal Australian Survey Corps) is bounded by latitudes 33°00′–33°30′S, and longitudes 150°00′–150°30′E. It is located in the Central Tablelands botanical subdivision of New South Wales except for part of the north-east corner which is in the Central Coast subdivision. It is about 100 km north-west of Sydney and is due north of the Katoomba sheet (Keith & Benson 1988).

Geology and geomorphology

The Wallerawang map sheet area lies on the western edge of the Sydney Basin.

* Present address: N.S.W. National Parks and Wildlife Service, P.O. Box 1967, Hurstville, Australia 2220.

shrub- or sedge-swamps (map unit 20a). Mottled Gum, *Eucalyptus mannifera* (mostly subsp. *gullickii* though there are intergrades with subsp. *mannifera*) is the most common tree species though *E. radiata* subsp. *radiata*, *E. dives* and *E. dalrympleana* subsp. *dalrympleana* may also be present. *Eucalyptus pauciflora* subsp. *pauciflora* is common on the southern part on the plateau, above about 1170 m altitude.

The understorey is generally open, but with patches of locally denser scrub. The most common shrubs include *Leptospermum flavescens*, *L. myrtifolium*, *L. juniperinum*, *Hakea dactyloides*, *Lomatia silaifolia*, *Phyllota squarrosa* and *Boronia microphylla*. The open ground cover consists of *Helichrysum scorpioides*, *Dianella revoluta*, *Lomandra longifolia*, *Gahnia filifolia* and *Lepyrodia scariosa*.

Map unit 20a – 'Newnes Plateau Shrub-Swamps'

Closed-heath: *Leptospermum grandifolium – Baeckea linifolia – Grevillea acanthifolia*

Sedgeland: *Gymnoschoenus sphaerocephalus – Xyris ustulata*

Narrow, elongate, shrub-swamps are a conspicuous feature of the eastern half of the Newnes Plateau. These swamps are formed in characteristic low-slope headwater valleys, mostly tributaries of Carne Creek where sandy organic sediments are deposited from the surrounding ridges. These sediments are relatively deep, with a high organic matter content and sandy or loamy texture, and are periodically waterlogged. The swamp vegetation is essentially dominated by shrubs and varies in structure from open-scrub to closed-heath, with sedgeland dominated by graminoids in very wet sections. There is a considerable variation in the floristic composition, which is probably related to the soil type and the extent and duration of waterlogging. Soils on the western part of the plateau appear to have more clay than those of the eastern part, which are more sandy, while in each swamp the floristic composition is related to a drainage gradient from occasionally flooded sites to almost permanently running water. Trees are normally absent though there is generally a fringing open-woodland of *Eucalyptus mannifera* subsp. *mannifera* and occasionally the Mallee Snow Gum, *E. gregsoniana*. Dead trees in some swamps appear to indicate fluctuations in drainage conditions.

The most extensive plant community is dominated by shrubs, *Epacris paludosa*, *E. microphylla*, *Grevillea acanthifolia* subsp. *acanthifolia*, *Leptospermum grandifolium* (previously included with *L. lanigerum*), *Baeckea linifolia*, *B. utilis* and *Boronia deanei* with graminoids such as *Restio australis*, *Lepyrodia scariosa*, *Empodisma minus*, *Lepidosperma limicola*, *Xyris ustulata* and *Patersonia fragilis*. Local patterns appear to relate to drainage. Dense vegetation along permanent water channels within the swamp is dominated by *Gleichenia dicarpa* and *Gymnoschoenus sphaerocephalus* (Figure 5). In the drier, more open areas, there is an herbaceous ground cover with *Hydrocotyle* sp., *Viola hederacea* subsp. *sieberiana*, *Gonocarpus tetragynus* and *Xanthosia dissecta*.

In the swamps with a higher clay content, *Leptospermum* species are increasingly important, particularly *Leptospermum flavescens*, *L. myrtifolium*, *L. continentale* J. Thompson, and *L. obovatum*. Ground cover often includes *Restio australis*, *Juncus continuus* and *Lomandra longifolia*.

Periodic fire plays a part in modifying the structure of the shrub-swamp vegetation. After hot burns that kill all above ground vegetation, the sedges and smaller shrubs grow quickly in the increased light, to form a sedgeland, 0.3–0.5 m high. Some of the interesting locally restricted small shrub species such as *Boronia deanei, Dillwynia stipulifera* and *Celmisia* sp. aff. *longifolia* are conspicuous at this stage. The sedgeland is gradually overtopped by the taller growing shrubs, which gradually form a dense canopy about 2–3 m high.

The orientation of these swamps relate to the Deanes Creek Lineament and the Happy Valley Lineament which dominate the hydrology in the central part of the Newnes Plateau (Pecover 1984). The orientation of these swamps (NNE–SSW) contrasts markedly with the deeply incised easterly drainage pattern developed throughout much of the Blue Mountains and Wollemi National Parks and suggests a paleo-drainage pattern on the Newnes Plateau that is considerably older than drainage regimes that have formed many of the deeply incised valleys of the western Blue Mountains. Pecover (1984) suggests that the present land surface of the Newnes Plateau may be at or near the position of a paleo-land surface of Tertiary age or older.

Map unit 20b – 'Coxs River Swamps'

Closed-heath: *Leptospermum obovatum – Leptospermum continentale*

Sedgeland: *Carex* species

Alluvium-filled swamps near Ben Bullen along tributary creeks of the Turon River, and along the upper Coxs River and its tributaries north of Lidsdale are more clayey and perhaps have a higher nutrient status than the Newnes Plateau Shrub Swamps (map unit 20a). In more waterlogged areas there is closed-sedgeland of *Carex gaudichaudiana* and *C. fascicularis*, with herbs including *Viola caleyana, Stellaria angustifolia, Hydrocotyle tripartita, Mitrasacme serpyllifolia, Epilobium billardieranum* subsp. *hygrophyllum, Utricularia dichotoma*, and grasses including *Poa labillardieri* and *Deyeuxia quadriseta*. Sphagnum may be present. In other sites may be closed-heath with *Leptospermum obovatum, L. continentale* and *L. flavescens. Restio australis* and *Baeckea utilis* may be associated with more localized sandy textured soils. Drier areas carry *Poa labillardieri* grassland, occasionally with a light shrub cover of *Leptospermum continentale*. Open-forest of *Eucalyptus viminalis* and *E. dalrympleana* subsp. *dalrympleana* often surrounds these swamps.

Rather similar swamps are found at Hartley Vale and below Nellies Glen on the Katoomba map (Keith & Benson 1988).

Map unit 21c – 'Montane Heath'

Open-heath: *Allocasuarina nana – Banksia ericifolia – Leptospermum attenuatum – Phyllota squarrosa*

Spectacular areas of open-heath are found at high elevations (above 850 m) (Figure 6), mainly on the southern half of the Newnes Plateau, particularly to the north of Lithgow. Heath occupies exposed ridgetops with skeletal sandy soils derived from Narrabeen Group sandstones. Major shrub species are *Allocasuarina nana, Leptospermum attenuatum, L. arachnoides, Isopogon anemonifolius, Banksia ericifolia* var. *ericifolia, Hakea dactyloides*

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX E

Fauna surveys undertaken by Gunninah Environmental Consultants

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

Proposed Sand Extraction and Kaolin Mine
Newnes Junction

Fauna Investigations Report

May 2004

Proposed Sand Extraction and Kaolin Mine
Newnes Junction

Fauna Investigations Report

May 2004

F Dominic Fanning

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

PROPOSED SAND EXTRACTION and KAOLIN MINE

NEWNES JUNCTION

FAUNA INVESTIGATIONS REPORT

May 2004

1 INTRODUCTION

A combined sand and kaolin mining operation is proposed on the Newnes plateau, approximately 7km east of Lithgow and 90km northwest of the CBD of Sydney (see IEC 2003; Figure 2.1). The mining operation is to be undertaken in the immediate vicinity of the township of Newnes Junction, and in close proximity to an existing sand mining operation and the Clarence colliery (see IEC 2003; Figure 2.2).

The proposed mining operation has been the subject of an *Environmental Impact Statement* (EIS), prepared by International Environmental Consultants (IEC 2003). The EIS contained an account of the natural environment of the subject land and surrounding lands, and an assessment of the likely impacts of the mining activity as proposed.

A number of submissions were received in respect of the exhibited EIS and mining application, including a number of specific submissions and comments with respect to the flora and fauna of the subject land and the likely or potential impacts of the proposed development. This *Fauna Investigations Report*:

- provides a response to those submissions;
- co-ordinates and collates existing information regarding native fauna and their habitats on the subject land and in its immediate vicinity; and
- incorporates the findings of supplementary investigations conducted on the subject land.

2 INFORMATION BASE

The data and information upon which this *Report* is based are derived from a number of sources including:

- the investigations conducted for the EIS prepared by International Environmental Consultants (IEC 2003), and other information contained in the EIS;
- data obtained from other investigations in the vicinity, including on the adjoining Rocla sand mining operations (IEC);
- the Wildlife Atlas maintained by the NSW National Parks & Wildlife Service (NPWS)[1];
- data obtained from submissions on the original EIS and mining application, particularly those contained in the submission provided by P & J Smith (2003); and
- supplementary investigations undertaken specifically for this *Report* in response to matters raised in submissions to the original EIS.

[1] The NPWS has recently been incorporated into the NSW Department of Environment & Conservation (DEC).

2.1 Original EIS Investigations

The EIS prepared for the sand and kaolin mining operations at Newnes (IEC 2003) incorporated data derived from:

- previous investigations in the vicinity and general locality;
- a search of the DEC Wildlife Atlas; and
- the results of dedicated field investigations on the subject land for the proposed mining operation.

Fauna investigations were undertaken by IEC on the subject land between the 20th and 24th of March 2000, involving the conduct of dedicated fauna surveys:

- trapping using small and medium Elliott traps and hair tubes;
- spotlighting investigations along tracks and survey lines throughout the site;
- diurnal investigations throughout the subject site; and
- the use of call playback for forest owls, the koala and several gliders.

A supplementary dedicated investigation for threatened amphibian fauna was undertaken, as reported in the EIS (IEC 2003), by Dr Arthur White (Biosphere 2003) with particular emphasis on the Giant Burrowing Frog and Red-crowned Toadlet. Investigations for these species were undertaken in early May 2003, and involved walked surveys of potentially suitable habitat, spotlighting and call playback. Those investigations included opportunistic observations of other native biota, particularly other amphibians and reptiles such as the Blue Mountains Water Skink.

2.2 Other Investigations in the Vicinity

References were also made in the original EIS to other surveys which had been undertaken for native flora and fauna in the immediate vicinity, including on land located to the immediate northwest - the Clarence Colliery site (Corkery & Co 1993; IEC 2000).

2.3 DEC Wildlife Atlas Records

A supplementary inspection of the DEC Wildlife Atlas was undertaken during preparation of this *Report* to complement the information previously obtained from the database.

2.4 Information Obtained from Submissions

Additional information was provided in several of the submissions lodged with the consent authority[2] in respect of the proposed sand and kaolin mine at Newnes. Of particular value in this regard is the submission provided by P & J Smith, a biological consulting firm located in the Blue Mountains.

The submission by P & J Smith (2003) was based on only a relatively short investigation of the subject site, but provides some additional information regarding native fauna (as well as flora) recorded on the site. That information has been incorporated into this *Report*, and supplementary investigations were undertaken specifically with respect to the Blue Mountains Water Skink *Eulamparus leuraensis*, microchiropteran bats and arboreal fauna.

[2] The Consent Authority is the Department of Infrastructure Planning & Natural Resources (DIPNR).

2.5 Supplementary Fauna Investigations

Dedicated fauna surveys were undertaken in early 2004 to provide additional information regarding native biota present on the subject site or which could potentially be present.

Additional fauna surveys were undertaken in March 2004 (by Gunninah Environmental Consultants and by Biosphere Consultants) to supplement the original fauna investigations undertaken for the EIS (IEC 2003; Biosphere 2003).

The supplementary fauna investigations conducted by Gunninah (see Attachment) covered the full spectrum of native fauna with a particular emphasis on potential threatened species including microchiropteran bats, the Blue Mountains Water Skink, forest owls and arboreal mammals, and terrestrial fauna.

A supplementary inspection of the subject site was also undertaken by Biosphere Consultants (Appendix B to the *Supplementary Submission*) on the 17th of March 2004 with particular emphasis on potential habitat for and the possible presence of the Blue Mountains Water Skink. This *Report* provides an assessment of the moist habitats on the site with respect to the Newnes Plateau Shrub Swamp community.

3 RESULTS of the SUPPLEMENTARY INVESTIGATIONS

3.1 Fauna Habitat Features

The drainage lines on the subject site were the focus of investigations particularly for the Blue Mountains Water Skink, but also for threatened amphibians which could occur on the site. As indicated in the *Supplementary Flora Report* prepared by HWR Pty Ltd (Appendix A to the *Supplementary Submission*), small areas of swampy or riparian habitat are located along a drainage line through the centre of the site and a drainage line in the southeastern part of the site. Although these patches of vegetation are small, they were investigated as potential habitat for the Blue Mountains Water Skink, and were also surveyed for other herpetofauna.

Additional mapping of relevant resources for native biota include particularly the identification of areas of the site containing hollow-bearing trees (Figure 1). Trees containing hollows are a significant resource for many native biota, including microchiropteran bats, some birds (such as parrots and kingfishers), forest owls, arboreal mammals and some herpetofauna species.

Hollow-bearing trees are scattered throughout the subject site, as indicated in Figure 1. Given that the majority of the site is forested, that result is not regarded as remarkable notwithstanding previous disturbances and modifications to the vegetation communities present on the land.

It should be noted that most of the tree-hollows present on the site are relatively small, and there are few large hollow-bearing trees. None of the trees present are of sufficient size to form or constitute breeding hollows for the large forest owls (the Powerful Owl, Masked Owl, Sooty Owl and Barking Owl), and these species would only be expected to utilise the site for foraging purposes as part of a much larger home range.

Rock outcrops are of extremely limited distribution on the subject site, and there are no significant cliffs, caves or other similar rocky habitats.

As noted by Biosphere (Appendix B to the *Supplementary Submission*), the subject site does not support significant habitat or resources for the Blue Mountains Water Skink, and the species is not expected to occur on the site.

3.2 Blue Mountains Water Skink

The initial investigations on the subject land (IEC 2003; Biosphere 2003) did not identify habitat of particular suitability or potential value for the Blue Mountains Water Skink. Furthermore, no specimens of this species were recorded during those earlier investigations. The supplementary investigations which have been conducted for this *Report* (including those by Gunninah Environmental Consultants and by Dr Arthur White of Biosphere Consultants) included targeted surveys for the Blue Mountains Water Skink and its habitat on the subject land. Despite the conduct of dedicated surveys for this species, the Blue Mountains Water Skink has not been recorded on the subject site at Newnes.

3.3 Microchiropteran Bats

The supplementary investigations undertaken by Gunninah provide additional data on the microchiropteran bats present on the subject site, including threatened species. The presence of hollow-bearing trees and extensive forested woodland vegetation (both in the subject site and on the extensive adjoining conservation reserves) provide substantial habitat for the threatened microchiropteran bats which either have been recorded on the site or which could be expected to occur. A number of additional species beyond those which have been recorded are likely to occur, although cave-dwelling species would only utilise the site for foraging purposes.

A total of five microchiropteran bats were recorded on the subject site, including two threatened species (the Common Bent-wing Bat and the Eastern False Pipistrelle). The Common Bent-wing Bat utilises caves and similar man-made structures for roosting purposes, and there are no suitable resources in this regard on the subject site. The Eastern False Pipistrelle utilises tree-hollows for roosting, and whilst the subject site supports such resources, these are also characteristic of the extensive conservation reserves in the immediate vicinity and general locality. Similarly, whilst the subject site supports suitable forest habitat for foraging by both species, there are substantial areas of such habitats and resources in the immediate vicinity, general locality and general region.

The subject site is not regarded as of conservation significance for any threatened microchiropteran bat species. There are very extensive similar or identical habitats in the substantial areas of adjoining conservation reserves. The extremely small area of the subject site in relation to the extent of the protected habitats for these species, and the lack of significant or notable resources or features for threatened microchiropteran bats, preclude the site from constituting a significant resource for this group of threatened biota.

Consideration of the likelihood or otherwise of a "*significant effect*" being imposed upon the Common Bent-wing Bat, Eastern False Pipistrelle or other threatened microchiropteran bats has been incorporated into the *Supplementary Submission* for the Newnes project provided by Gunninah Environmental Consultants to DIPNR. The conclusion of those Assessments of Significance pursuant to s.5A of the EP&A Act is that a "*significant effect*" is not "*likely*" to be imposed upon any threatened microchiropteran bats.

3.4 Other threatened Biota

No additional threatened fauna species were recorded from the subject site during the supplementary investigations in early 2004. With respect to threatened fauna, the vegetation and habitat features on the subject site are not regarded as remarkable or of particular significance or value, and it is not considered likely that the subject site constitutes a significant resource for any threatened fauna species.

No evidence of any of the threatened large forest owls (the Powerful Owl, Masked Owl, Barking Owl and Sooty Owl) has been recorded from the site. Whilst individuals of these species could doubtless utilise the site for foraging purposes as part of a much larger home range, the site itself is not regarded as of significance in this regard.

Consideration of the likelihood or otherwise of a "*significant effect*" being imposed upon any threatened fauna species has been considered in the *Supplementary Submission* provided by Gunninah Environmental Consultants to DIPNR with respect to the proposed mining operations at Newnes Junction. Consideration of the eight factors of s.5A of the EP&A Act, and of other relevant matters (including the extent of conservation reserves in the locality and region, the location and size of the subject site, the proposed impact amelioration measures and the distributions of relevant threatened biota) leads to the conclusion that it is not "*likely*" that a "*significant effect*" would be imposed upon any "*threatened species, populations or ecological communities, or their habitats*".

As a consequence, a *Species Impact Statement* (SIS) is not required for the proposed mining operation at Newnes Junction. Furthermore, there is no reasonable justification for refusal of development consent with respect to either s.5A or s.79C of the EP&A Act.

Proposed Sand Extraction and Kaolin Mine
Newnes Junction

Details of Fauna Investigations
March 2004

Supplementary Fauna Survey Methods, Efforts and Results
Gunninah - March 2004

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

FAUNA SURVEY METHODS

A combination of standard survey techniques were employed on the subject land to identify the fauna species present and those that could occur on occasion. The selection of particular survey methods was made with regard to the habitats present on the site, the fauna assemblage expected to occur, previous studies, and threatened species previously recorded in the locality. Field investigations specifically focused on those threatened fauna species that were poorly represented in previous studies on the subject site or which required further assessment.

Fauna surveys were conducted within the subject land in mid-March 2004 (Table 1). Weather conditions were warm to mild, with a slight breeze during the afternoons and evenings. Nights were cold to mild with some background light and industrial noise from the adjacent Clarence Colliery.

Table 1 Summary of fauna survey methods and effort (excluding opportunistic records) applied during field investigations on the subject land at the proposed Newnes Sand and Kaolin Mine.

Survey Method	Total Effort	Date	Target Species
Diurnal bird and herpetofauna census	27 person-hours	15-18 March	birds, reptiles and amphibians
Nocturnal call playback	3 hours	15-18 March	nocturnal avifauna (*eg* owls), arboreal mammals and amphibians (Red-crowned Toadlet and Giant Burrowing Frog)
Ultrasonic call recording	3 hours	15 -18 March	microchiropteran bats
Spotlighting	18 person-hours	15-18 March	nocturnal mammals, amphibians (Red-crowned Toadlet and Giant Burrowing Frog), reptiles and avifauna
Harp trapping	15 trap-nights	15-18 March	microchiropteran bats
Diurnal Blue Mountains Water Skink surveys	8 person-hours	15-18 March	targeted searches for the Blue Mountains Water Skink
Hollow-bearing tree and Scat, Tracks and Traces Surveys	8 person-hours	15-18 March	searches and mapping of hollow-bearing trees and indirect evidence of fauna within the landscape

Fauna surveys included both diurnal and nocturnal investigations. Diurnal fauna surveys consisted of visual and aural censuses of avifauna, herpetofauna and mammalian fauna. Nocturnal fauna surveys included the use of remote ultrasonic bat detectors and call playback, as well as aural and direct visual census using spotlights, and harp-trapping.

Diurnal herpetofauna surveys, including targeted Blue Mountains Water Skink, Giant Burrowing Frog and Red–crowned Toadlet searches, were conducted by direct investigation of potential habitats, and the identification audible calls. Diurnal avifauna and mammalian survey techniques incorporated both traverses and stationary observations along tracks and trails.

Nocturnal spotlight surveys included both visual and aural censuses along tracks and trails, and at regular stationary positions. Nocturnal call playback involved the broadcasting of pre-recorded avifauna and amphibian calls at a number of locations and the identification of response calls. Ultrasonic call detection involved the recording of microchiropteran bat calls using an Anabat II™ recorder, and later identification of individual echolocation calls.

An investigation of trees and tree-hollows for evidence of native fauna (*eg* scratches, sap-feeding notches, nesting material, owl white-wash, dreys, and foraging signs) was undertaken throughout both nocturnal and diurnal survey periods. The approximate locations of hollow-bearing trees have also been documented (Figure 1). General searches for other indirect evidence of fauna activities (such as scats, prints, remains, feathers, bones, fur, nests, burrows and diggings) was undertaken on an opportunistic basis throughout the field investigations on the subject land.

The presence of relevant features or resources (such as hollow-bearing trees, rock outcrops, hollow logs, specific food trees, water features *etc*) which could be of potential significance for native fauna was recorded during the survey. In particular, attention was paid to resources of relevance to threatened fauna known from the locality, including the large forest owls, Blue Mountains Water Skink, Red-crowned Toadlet and microchiropteran bat species.

Records were maintained of all opportunistic observations of fauna species (by direct or indirect evidence) during the investigations on the subject land, and an inventory compiled including all species detected (Appendix B to the *Supplementary Submission*).

Fauna identifications conform largely to nomenclature in Christidis & Boles (1994) and Pizzey & Knight (1997) for avifauna, Cogger (2000) for herpetofauna, Strahan (1995) and Menkhorst & Knight (2001) for most mammals, and Churchill (1998) for microchiropteran bats.

1 Fauna Survey Techniques (excluding trapping)

General fauna survey techniques were conducted across the subject site and involved:

- identification and assessment of the nature and condition of habitats and specific resources and features of relevance for native fauna present;
- dedicated searches for indirect evidence of fauna (*ie* scats, feathers, fur, tracks, dens, nests, scratches, chew marks, owl whitewash *etc*); and
- incidental records of fauna observed on the site and in the vicinity, maintained throughout the survey period.

Specific survey techniques were also employed to enable the detection of the more cryptic and difficult to locate fauna species (*eg* nocturnal fauna) and in particular to target threatened fauna species.

Field surveys for fauna species were conducted from the 15th to the 18th of March 2004 inclusive. Details of specific techniques used, survey locations, survey effort and fauna recorded are provided below, with survey sites indicated on Figure 1.

1.1 Diurnal and Nocturnal Herpetofauna Census

Diurnal and nocturnal herpetofauna searches were conducted in association with avifauna and spotlight surveys at potentially suitable habitat sites, and on an opportunistic basis throughout the survey period (Tables 1 and 2). This involved searches amongst leaf litter and tree debris and under logs and rocks. In addition, targeted surveys for the Blue Mountains Water Skink and Red-crowned Toadlet were conducted in potentially suitable habitats across the subject site.

Table 2 Dedicated diurnal and nocturnal herpetofauna census survey results.

Date	Common Name	Species Name
15th March 2004	Mountain Dragon	*Tympanocryptis diemensis* *Lampropholis guichenoti*
16th March 2004	Copper-tailed Skink Red-throated Skink Eastern Banjo Frog	*Ctenotus taeniolatus* *Pseudemoia playnota* *Limnodynastes dumerilii* *Lampropholis guichenoti* *Lampropholis delicate*
17th March 2004	Copper-tailed Skink Mountain Dragon	*Ctenotus taeniolatus* *Tympanocryptis diemensis* *Lampropholis guichenoti*
18th March 2004	Mountain Dragon Red-throated Skink	*Tympanocryptis diemensis* *Pseudemoia playnota* *Lampropholis guichenoti* *Lampropholis delicata*
TOTAL	**1 amphibian species, 5 reptile species**	

1.2 Call Playback

Nocturnal and diurnal call playback involves the broadcasting of pre-recorded calls to elicit response calls from birds, mammals and amphibians which vocalise for territory proclamation or for social contact. Pre-recorded calls included the Powerful Owl, Barking Owl and Masked Owl. Some arboreal mammals (such as the Yellow-bellied Glider) are known to respond to nocturnal call playback of forest owl species.

The call of each owl species was played for 3 minutes followed by a 5-minute listening period at numerous locations at the subject site (Table 3). Foot-based spotlighting was also conducted in the surrounding area prior to, during and after the nocturnal call playback period.

Table 3 Call playback survey effort and results.

Date	Diurnal/ Nocturnal	Survey Effort (call playback hours)	Target Species	Response
15th March 2004	Nocturnal	0.5	Powerful Owl, Masked Owl, Barking Owl, Yellow-bellied Glider, Sooty Owl, Yellow-bellied Glider	nil
	Nocturnal	0.5	Powerful Owl, Masked Owl, Barking Owl, Sooty Owl	nil
16th March 2004	Nocturnal	0.5	Powerful Owl, Masked Owl, Barking Owl, Yellow-bellied Glider, Sooty Owl	nil
	Nocturnal	0.5	Red-crowned Toadlet, Giant Burrowing Frog	nil
17th March 2004	Nocturnal	0.5	Powerful Owl, Masked Owl, Barking Owl, Sooty Owl, Yellow-bellied Glider	Southern Boobook Owl
	Nocturnal	0.5	Red-crowned Toadlet, Giant Burrowing Frog	Nil
TOTAL		**3.0 hours**	**1 avifauna species**	

1.3 Bat Ultrasonic Call Recording

Microchiropteran bats were surveyed indirectly through the use of an Anabat II Bat Detector, which records their ultrasonic echolocation calls and harp-trapping (see below). This method is useful for the detection of high-flying bat species that are often under-sampled by bat (harp) trapping. Ultrasonic bat calls were recorded using an active trigger on the Anabat system allowing for extended recording. The Anabat systems were placed in a variety of locations before dusk each day and collected later in the night, after the peak activity period (Table 4).

Table 4 Bat ultrasonic call recording survey effort and results.

Date	Survey Effort (recording period)	Location	Triggered/ Traverse	Common Name	Scientific Name
15th March 2004	1 hour of recording	traverse	Triggered	results pending	
16th March 2004	1 hour of recording	traverse	Traverse	results pending	
17th March 2004	1 hour of recording	traverse	Triggered	results pending	
TOTAL	**3 hours**	**X Microchiropteran bat species**			

NB: (C) Confident species identification
(P) Probable species identification
(Po) Possible species identification

1.4 Diurnal Bird Census

Diurnal bird censuses involved dedicated searches across the subject site within a variety of habitat types. These searches were conducted during periods of high bird activity (early morning and late afternoon), as well as opportunistically throughout the survey period, with all species and individuals recorded.

A total of 37 bird species were recorded during the diurnal bird census period on the 15th, 16th, 17th and 18th of March 2004, with additional species recorded by opportunistic means throughout the field investigations. The dedicated diurnal bird census was conducted for a total of 27 person-hours over a 4-day period.

1.5 Spotlighting

Foot-based spotlighting surveys were conducted throughout the study area, to target nocturnal arboreal mammals, owls, amphibians and other nocturnal fauna. Fauna species were detected both visually and aurally (Table 5).

Table 5 Foot-based spotlighting survey effort and results.

Date	Survey Effort (person-hours)	Common Name	Scientific Name
6th August 2002	6	Greater Glider Sugar Glider Common Ringtail Possum	*Petauroides volans* *Petaurus breviceps* *Pseudocheirus perigrinus*
7th August 2002	6	Greater Glider Common Ringtail Possum	*Petauroides volans* *Pseudocheirus perigrinus*
8th August 2002	6	Red-necked Wallaby Greater Glider Tawny Frogmouth	*Macropus rufogriseus* *Petauroides volans* *Podargus strigoides*
TOTAL	**18 person-hours**	**4 mammal species and 1 avian species**	

2 Trapping Survey Techniques

2.1 Bat (Harp) Trapping

The purpose of bat (harp) traps is to capture low-flying species of microchiropteran bats. Traps were placed in perceived "*flyways*" along tracks or creeks or near waterbodies where microchiropteran bat flight paths could be interrupted. Captured bats (Table 6) were identified using external morphology, forearm measurement and body weight (Churchill 1998). Traps were checked each morning with the captured animals released at the point of capture.

Table 6 Bat (harp) trapping survey effort and results**.**

Date	Survey Effort (trap-nights)	Common Name	Scientific Name
15th March 2004	5	Chocolate Wattled Bat Lesser Long-eared Bat Goulds Long-eared Bat Large Forest Bat	*Chalinolobus morio* *Nyctophilus geoffroyi* *Nyctophilus gouldi* *Vespadelus darlingtoni*
16th March 2004	5	Chocolate Wattle Bat Lesser Long-eared Bat Goulds Long-eared Bat Large Forest Bat	*Chalinolobus morio* *Nyctophilus geoffroyi* *Nyctophilus gouldi* *Vespadelus darlingtoni*
17th March 2004	5	Chocolate Wattled Bat Goulds Long-eared Bat Large Forest Bat	*Chalinolobus morio* *Nyctophilus gouldi* *Vespadelus darlingtoni*
Total Survey Effort	**15 trap-nights**	**4 microchiropteran bat species**	

3 Habitat and Tracks, Scats and Traces Searches

3.1 Hollow-bearing Tree Assessment

Hollow–bearing trees provide essential nesting and roosting habitat for a number of species that utilise and are reliant on them. Analysis of the density of such features within the landscape allows a rough assessment of species diversity to be made and enables consideration of the potential for certain species to be present. More specifically, the distribution, density and individual characteristics of hollows provides a means for assessing the potential for particular threatened species (*eg* the large forest owls) to breed within the landscape.

Table 7 Hollow-bearing tree survey results.

Date	Number of hollow-bearing trees	Distribution of hollow-bearing trees	General hollow characteristics	Species predicted to use the resources
16-17th March 2004	approximately 60 -80	confined mostly to the older growth vegetation and the nutrient rich regions of the site on the mid- to lower-slopes and gullies	mostly small (5 to 15cm entrance diameter) with approximately 2-3 larger hollows scattered across the site	small to medium forest and woodland avifauna species, microchiropteran bats and small to medium arboreal mammals. Owls could potentially utilise the few larger hollows on the subject site, although no indirect evidence for such use was obtained.

3.2 Scats, Tracks and Traces Surveys

The survey for scats, tracks and other traces made by various fauna species provides an indirect and non-invasive way to assess the presence or absence of various species within the landscape. Many of the these traces are specific to a particular species (*eg* Glossy Black Cockatoo or Yellow-bellied Glider feeding signs), and permit an assessment the presence and relative abundance of a species within a particular landscape

Table 8 Scat, tracks and traces survey results

Date	Scat, Track or Trace	Species	Location
16th March 2004	regurgitated owl pellet	raptor species, possibly large forest owl	located on the northern boundary between trails 3 and 4

4 Weather Conditions

Weather conditions were recorded on a regular basis throughout the survey period (Table 9).

Table 9 Weather conditions recorded during the field investigations.

Date	Time	Wind	Cloud %	Rain	Night Light	Temperature °C
15th March 2004	Morning Afternoon Evening	n/a n/a 0	n/a n/a 80	n/a n/a 0	- - 2	n/a n/a 10-15
16th March 2004	Morning Afternoon Evening	1 1 1	90 10 80	0 0 0	- - 2	10-15 25-30 10-15
17th March 2004	Morning Afternoon Evening	0 1 1	70 40 100	0 0 0	- - 2	10-15 25-30 10-15
18th March 2004	Morning Afternoon Evening	0 n/a n/a	25 n/a n/a	0 n/a n/a	- n/a n/a	10-15 n/a n/a

Table 10 Standard reporting codes for climatic conditions.

Wind	Rain	Night Light	Temperature
0 = calm	0 = no evidence of rain in the last 24 hours	0 = very dark	Record as a range to the nearest 5 degrees
1 = light, leaves rustle	1 = evidence of rain in the last 24 hours	1 = dark	(*eg* 0-5, 5-10 *etc*)
2 = moderate, moves branches	2 = light rain during survey	2 = moderate detail	
3 = strong, impedes progress	3 = heavy rain during survey	3 = bright	

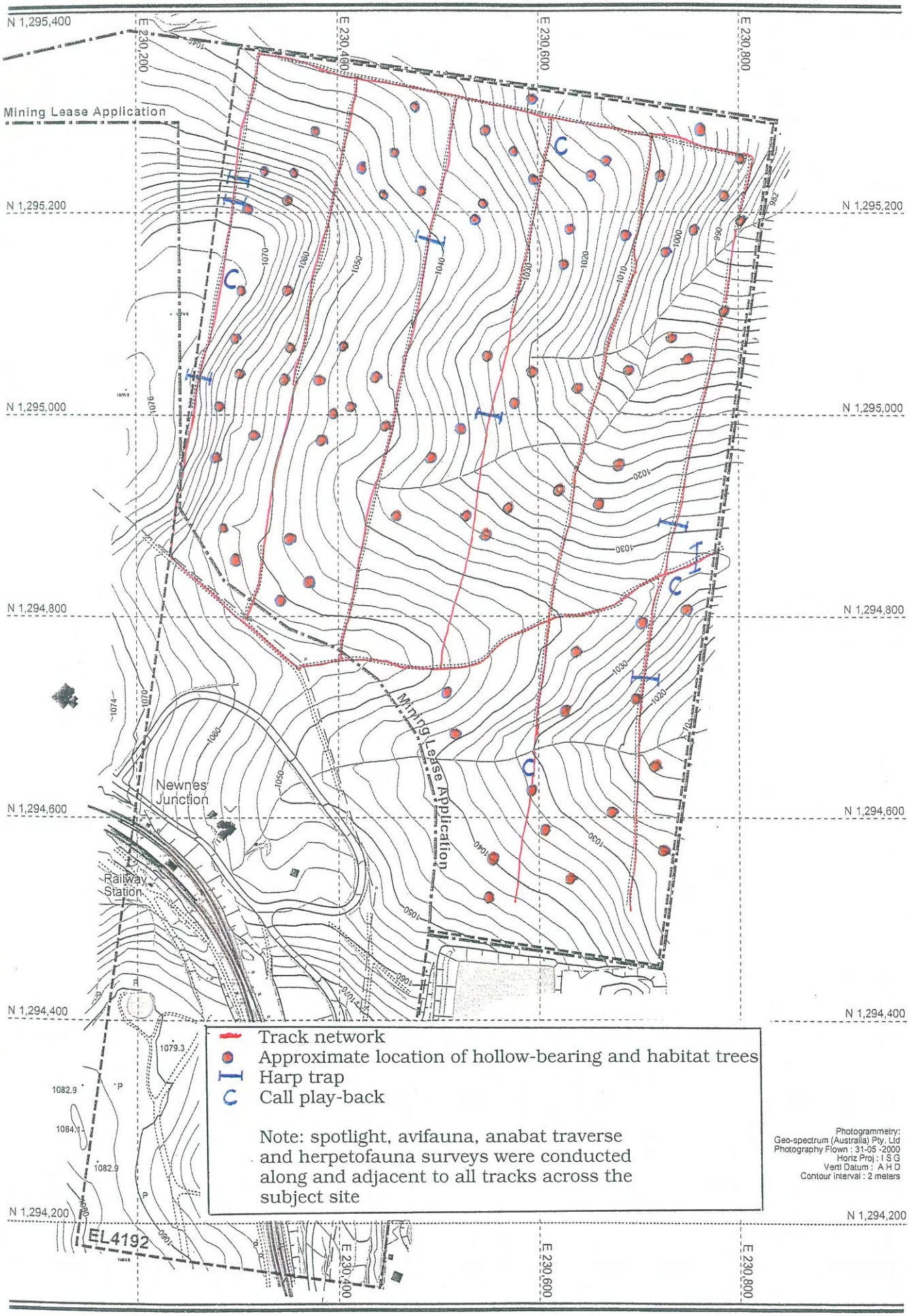


FIGURE 1
Newnes Kaolin Project -Topography

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX F

Combined fauna species list for on the subject site (IEC 2003; P & J Smith 2003; HWR 2004)

APPENDIX F Fauna species recorded on the subject site and in the vicinity.

Key

* Introduced species.

Threatened species as listed in the *NSW Threatened Species Conservation Act 1995*, and the *Environmental Protection and Biodiversity Conservation Act 1999*.

E Endangered
M Migratory Species listed pursuant to the EPBC Act.
V Vulnerable

Survey Key

A Guuninah current survey (2004)
B Smith & Smith (2003) and EIS (IEC 2003)
C Previous surveys in the vicinity (Corkery & Co 1993; IEC 2000)

EPBC Act	TSC Act	COMMON NAME	SCIENTIFIC NAME	A	B	C
		BIRDS				
		Columbidae				
		Common Bronzewing	*Phaps chalcoptera*	✓		
		Crested Pigeon	*Ocyphaps lophotes*	✓		
		Cacatuidae				
		Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	✓	✓	
		Gang-gang Cockatoo	*Callocephalon fimbriatum*	✓	✓	
		Galah	*Cacatua roseicapilla*	✓		
		Sulphur-crested Cockatoo	*Cacatua galerita*	✓		
		Psittacidae				
		Australian King Parrot	*Alisterus scapularis*	✓		✓
		Eastern Rosella	*Platycercus eximius*		✓	✓
		Crimson Rosella	*Platycercus elegans*	✓	✓	
		Aegothelidae				
		Australian Owlet-nightjar	*Aegotheles cristatus*		✓	
		Strigidae				
		Powerful Owl	*Ninox Strenua*			✓
		Southern Boobook	*Ninox novaeseelandiae*	✓		✓
		Podargidae				
		Tawny Frogmouth	*Podargus strigoides*	✓		✓
		Hirundinidae				
		Tree Martin	*Hirundo nigricans*	✓		✓
		Halcyonidae				
		Kookaburra	*Dacelo novaeguineae*	✓	✓	✓
		Sacred Kingfisher	*Halcyon sancta*			✓
		Forest Kingfisher	*Todiramphus macleayii*	✓		
		Megapodiidae				
		Australian Brush-turkey	*Alectura lathami*			✓
		Climacteridae				
		Red-browed Treecreeper	*Climactercis erythrops*		✓	
		White-throated Treecreeper	*Cormobates leucophaeus*	✓	✓	✓
	V	Brown Treecreeper	*Climacteris picumnus*	✓		✓
		Maluridae				
		Superb Fairy-wren	*Malurus cyaneus*	✓		✓
		Variegated Fairy-wren	*Malurus lamberti*	✓	✓	✓
		Pardalotidae				
		Spotted Pardalote	*Pardalotus punctatus*	✓		✓
		White-browed Scrubwren	*Sericornis frontalis*	✓	✓	
		Southern Emu Wren	*Stipiturus malachurus*			✓
		Striated Pardalote	*Pardalotus striatus*			✓
		Weebill	*Smicrornis brevirostris*	✓		

APPENDIX F contd Fauna species recorded on the subject site and in the vicinity.

EPBC Act	TSC Act	COMMON NAME	SCIENTIFIC NAME	A	B	C
		Yellow-rumped Thornbill	*Acanthiza Chrysorrhoa*		✓	✓
		Striated Thornbill	*Acanthiza lineata*	✓	✓	
		Pardalotidae				
		Brown Thornbill	*Acanthiza pusilla*	✓		
		Buff-rumped Thornbill	*Acanthiza reguloides*	✓	✓	
		Meliphagidae				
		Little Wattlebird	*Anthochaera chrysoptera*	✓	✓	✓
		Red Wattlebird	*Anthochaera carunculata*	✓	✓	✓
		Yellow-faced Honeyeater	*Lichenostomus chrysopts*		✓	✓
		New Holland Honeyeater	*Phylidonyris novaehollandiae*	✓	✓	✓
		Brown-headed Honeyeater	*Melithreptus brevirostris*		✓	
		Crested Honeyeater	*Phylidonyris pyrrhoptera*			✓
		White-eared Honeyeater	*Lichenostomus leucotis*	✓	✓	✓
		Niosy Miner	*Manorina melanochephala*		✓	✓
		Bell Miner	*Manorina melanophrys*		✓	
		Eastern Spinebill	*Acanthorhynchus tenuirostris*	✓	✓	✓
		Neosittidae				
		Varied Stittela	*Daphoenositta chrysoptera*	✓	✓	
		Pachycephalidae				
		Grey Shrike-thrush	*Colluricincla harmonica*		✓	
		Petroicidae				
		Scarlet Robin	*Petroica multicolor*	✓		✓
		Eastern Yellow Robin	*Eopsaltria australis*	✓	✓	
		Pomatostomidae				
		White-browed Babbler	*Pomatostomus superciliosus*	✓		
		Cinclosomatidae				
		Eastern Whipbird	*Psophodes olivaceus*	✓		
		Pachycephalidae				
		Golden Whistler	*Pachycephala pectoralis*	✓		✓
		Dicruridae				
		Rufous Fantail	*Rhipidura rufifrons*	✓		
		Satin Flycatcher	*Myiagra cyanoleauca*			✓
		Grey Fantail	*Rhipidura fuliginosa*	✓	✓	✓
		Campephagidae				
		Cicadabird	*Coracina tenuirostris*			✓
		Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	✓		
		Artamidae				
		Australian Magpie	*Gymnorhina tibicen*	✓		✓
		Grey Currawong	*Strepera versicolor*		✓	
		Pied Currawong	*Strepera graculina*	✓	✓	✓
		Corvidae				
		Australian Raven	*Corvus coronoides*	✓	✓	✓
		Corcoracidae				
		White-winged Chough	*Corcorax melanorhamphos*	✓	✓	
		Zosteropidae				
		Silvereye	*Zosterops lateralis*	✓	✓	✓
		MAMMALS				
		Tachyglossidae				
		Short-beaked Echidna	*Tachyglossus aculeatus*	✓		
		Vombatidae				
		Common Wombat	*Vombatus ursinus*	✓	✓	✓
		Petauridae				
		Common Ringtail Possum	*Pseudocheirus peregrinus*	✓	✓	✓
	V	Yellow-bellied Glider	*Petaurus australis*			✓
		Greater Glider	*Petauroides volans*	✓		✓

APPENDIX F contd Fauna species recorded on the subject site and in the vicinity.

EPBC Act	TSC Act	COMMON NAME	SCIENTIFIC NAME	A	B	C
		Phalangeridae				
		Common Brushtail Possum	*Trichosurus vulpecula*	✓		✓
		Macropodidae contd				
		Red-necked Wallaby	*Macropus rufogriseus*	✓		✓
		Swamp Wallaby	*Wallabia bicolor*	✓	✓	✓
		Eastern Grey Kangaroo	*Macropus giganteus*	✓	✓	✓
		Common Wallaroo	*Macropus robustus*			✓
		Dasyuridae				
		Brown Antechinus	*Antechinus stuartii*			✓
		Peramelidae				
		Northern Brown Bandicoot	*Isoodon macrourus*			✓
		Phascolarctidae				
	V	Koala	*Phascolarctos cinereus*			✓
		Muridae				
		New Holland Mouse	*Pseudomys novaehollandiae*			✓
		Bush Rat	*Rattus fuscipes*			✓
		Swamp Rat	*Rattus lutreolus*			✓
		House Mouse*	*Mus musculus*			✓
		Vespertilionidae				
		Gould's Wattled Bat	*Chalinolobus gouldii*			✓
		Chocolate Wattled Bat	*Chalinolobus morio*	✓		
		Lesser Long-eared Bat	*Nyctophilus geoffroyi*	✓		
		Gould's Long-eared Bat	*Nyctophilus gouldi*	✓		
		Little Forest Bat	*Vespadelus Vulturnus*	✓		
		Large Forest Bat	*Vespadelus darlingtonii*	✓		
		Molossidae				
		White-striped Freetail Bat	*Tadarida australis*	✓		✓
		Leporidae				
		Rabbit*	*Oryctolagus cuniculus*	✓		✓
		Canidae				
		Dingo	*Canis familiaris dingo*	✓		✓
		Fox*	*Vulpes vulpes*	✓		✓
		AMPHIBIANS				
		Hylidae				
		Blue Mountains Tree Frog	*Litoria citropa*			✓
		Myobatrachidae				
		Common Eastern Toadlet	*Crinea Signifera*	✓	✓	✓
		Eastern Banjo Frog	*Limnodynastes dumerilii*	✓		
		REPTILES				
		Agamidae				
		Mountain Dragon	*Tympanocryptis diemensis*	✓		✓
		Scincidae				
		Common Bluetongue Lizard	*Tiliqua scincoides*			✓
		Copper-tailed Skink	*Ctenotus taeniolatus*	✓		✓
		-	*Lampropholis delicata*	✓	✓	✓
		-	*Lampropholis guichenoti*	✓		
			Hemiergis decresiensis	✓		
			Acritoscincus duperreyi	✓		
		Red-throated Skink	*Acritoscincus platynotum*	✓		

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX G

Assessments of Significance Pursuant to Section 5A of the EP&A Act

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au

APPENDIX G Assessments of Significance pursuant to Section 5A of the *NSW Environmental Planning & Assessment Act 1979.*

1 INTRODUCTION

1.1 General

The NSW *Threatened Species Conservation Act 1995* (TSC Act) has modified the *Environmental Planning & Assessment Act 1979* (EP&A Act) by including *inter alia* a requirement to determine "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". In this respect, the eight factors of Section 5A (s.5A) of the EP&A Act "*must be taken into account*" by a consent or determining authority when administering sections 78, 79C and 112 of the EP&A Act in the assessment of a *Development Application.*

At the time of preparation of this *Report*, only two threatened species (the Common Bent-wing Bat and Eastern False Pipistrelle) had been recorded from the subject site at Newnes Junction. Two other threatened fauna species (the Koala and the Yellow-bellied Glider) have been recorded from the vicinity and individuals of several other threatened fauna could occur, including several additional threatened microchiropteran bat species. Individuals of some the threatened forest owls known to occur in the Blue Mountains area could also occur on the site.

An Assessment of Significance pursuant to s.5A of the EP&A Act has been prepared for several threatened species which are known to occur or which could potentially utilise the subject site due to the presence of potentially suitable resources. In addition, a s.5A Assessment of Significance has been prepared for the Blue Mountains Water Skink, as this species potentially occurs downslope or downstream. As noted above, only 2 threatened microchiropteran bat species have been recorded on the subject site.

1.2 The Region

In respect of Factor (c) of Section 5A, the TSC Act defines "*region*" as "*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*". The Director-General of the NPWS has given notice that the *Interim Biogeographic Regionalisation of Australia* (IBRA), published by the Australian Nature Conservation Agency (now the Department of the Environment & Heritage), is the appropriate definition of "*region*" for the TSC Act (Government Gazette No 65 - 24 May 1996).

On the basis of the IBRA, the site is located in the Sydney Basin Bioregion, which stretches from Batemans Bay in the south to Port Stephens in the north and west as far as Mudgee. The Sydney Basin Bioregion occupies an area of approximately 40,000km^2, a substantial proportion of which is protected within extensive conservation reserves.

The subject site constitutes only a minute proportion of the bushland vegetation and habitats which are present within the Sydney Basin Bioregion and in the general locality. The Greater Blue Mountains Area (GBMA) World Heritage Area occupies in excess of 1 million hectares (or 10,000km^2), and there are further substantial areas of conserved bushland within the Sydney Basin Bioregion. By contrast, the subject site occupies just 25 hectares (or 0.25km^2).

2 FACTORS for CONSIDERATION

Common Bent-wing Bat	**Vulnerable**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Common Bent-wing Bat roosts in caves and man-made structures, and has a distribution through eastern Australia (within about 300-400km of the coast). This species forages through and above the forest canopy, and is regularly recorded in modified environments, including urban areas. There are no suitable roosting or breeding resources are present on the subject site at Newnes, but the forest canopy provides a suitable foraging environment.

However, the subject site at Newnes constitutes only a minute proportion of the contiguous forest habitats available for foraging by the Common Bent-wing Bat in this general area. The GBMA World Heritage Area includes over 1 million hectares of conserved and protected forest and woodland, and

extensive areas of roosting resources for this species. The subject site by contrast occupies just 25 hectares.

It is not conceivable that a "*viable local population*" of this highly mobile and wide-ranging bat would be reliant on the subject site at Newnes or would be restricted to it.
It is not likely that the "*life cycle*" of the Common Bent-wing Bat would be "*disrupted*" by the proposed development, nor is it likely that a "*viable local population*" of this species would be "*placed at risk of extinction*" as a result of the proposed mining operation at Newnes.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of the Common Bent-wing Bat.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The subject site occupies only a minute proportion of the available habitat for the Common Bent-wing Bat within the region, particularly in respect of the "*regional distribution*", and the considerable protection, of that habitat. As noted above, the subject site occupies just 25ha whilst conserved lands in the region, containing suitable habitat, occupy considerably in excess of one million hectares.

The proposed mining operation at Newnes will not involve "*a significant area of known habitat*" being "*modified or removed*", in respect either of the local or the "*regional distribution of the habitat*" (emphasis added) for the Common Bent-wing Bat.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The Common Bent-wing Bat is a highly mobile and wide-ranging species, capable of travelling over considerable distances in an evening of foraging. Furthermore, this species readily utilises and/or traverses areas of high disturbance.

Substantial areas of potential habitat for this species are present in the extensive conservation reserves in the vicinity. In this regard, the GBMA World Heritage Area occupies an area of bushland in excess of one million hectares, and there are extensive other areas of conserved lands in the region.

The proposed mining operation is located at the edge of the extensive conservation reserves in the locality. The proposal will not result in the isolation of "*currently interconnecting or proximate areas of habitat*" for the Common Bent-wing Bat.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report*, no "*critical habitat*" had been declared by the Director-General of the NPWS for the Common Bent-wing Bat.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

There are insufficient data to determine whether or not the Common Bent-wing Bat is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". Further, despite the vast areas of conservation reserves in the Sydney Basin Bioregion, it can be assumed (on the basis

of pure logic alone) that this species is not "*adequately represented in conservation reserves*". If it was "*adequately represented*" (emphasis added) in such reserves, it presumably would not be "*threatened*".

Regardless of whether the Common Bent-wing Bat is "*adequately represented in conservation reserves in the region*", the proposed mining operation at Newnes will not affect the adequacy of conservation of this species or the extent of habitat protected in conservation reserves.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

The mine proposal at Newnes will require the clearing of an area of "*native vegetation*" as defined in the *Final Determination* for the "*clearing of native vegetation*" (listed as a "*key threatening process*"). However, that removal will not involve the loss of significant areas of potential foraging habitat for the Common Bent-wing Bat from the subject site, and involves no loss of roosting resources.

The substantial extent of adjoining conservation reserves, and the limited resources for the species on the site, preclude the proposed mine at Newnes from constituting an action that could conceivably "*threaten*" the "*survival or evolutionary development*" of the Common Bent-wing Bat.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Common Bent-wing Bat is not "*at the limited of its known distribution*" on the site at Newnes Junction.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with respect to the Common Bent-wing Bat. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the high mobility of the Common Bent-wing Bat and the extent of available (protected) resources in the area, the proposed mining operations at Newnes will not involve the imposition of "*a significant effect*" on this species.

Eastern False Pipistrelle	**Vulnerable**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Eastern False Pipistrelle roosts in tree-hollows, caves and occasionally old buildings (Churchill 1998), and has a distribution through southeastern Australia (within about 300km of the coast). This species forages through and just below the forest canopy, in *"schlerophyll forests from the Great Dividing Range to the coast*" (Churchill 1998).

Whilst the subject site at Newnes provides both foraging and roosting resources for the Eastern False Pipistrelle, constitutes only a minute proportion of the contiguous forest habitats available for this species in this general area. The GBMA World Heritage Area includes over 1 million hectares of

conserved and protected forest and woodland, and extensive areas of roosting resources for this species. The subject site by contrast occupies just 25 hectares.

It is not conceivable that a "*viable local population*" of this highly mobile species would be reliant on the subject site at Newnes or would be restricted to it.

Further, is not likely that the "*life cycle*" of the Eastern False Pipistrelle would be "*disrupted*" by the proposed development, nor is it likely that a "*viable local population*" of this species would be "*placed at risk of extinction*" as a result of the proposed mining operation at Newnes.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of the Eastern False Pipistrelle.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The subject site occupies only a minute proportion of the available habitat for the Eastern False Pipistrelle within the region, particularly in respect of the "*regional distribution*", and the considerable protection, of that habitat. As noted above, the subject site occupies just 25ha whilst conserved lands in the region, containing suitable habitat, occupy considerably in excess of one million hectares.

The proposed mining operation at Newnes will not involve "*a significant area of known habitat*" being "*modified or removed*", in respect either of the local or the "*regional distribution of the habitat*" (emphasis added) for the Eastern False Pipistrelle.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The Eastern False Pipistrelle is a highly mobile and wide-ranging species, capable of travelling over considerable distances (at least 12km - Churchill 1998) in an evening of foraging. Substantial areas of potential habitat for this species are present in the extensive conservation reserves in the vicinity. In this regard, the GBMA World Heritage Area occupies an area of bushland in excess of one million hectares, and there are extensive other areas of conserved lands in the region.

The proposed mining operation is located at the edge of the extensive conservation reserves in the locality. The proposal will not result in the isolation of "*currently interconnecting or proximate areas of habitat*" for the Eastern False Pipistrelle.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report*, no "*critical habitat*" had been declared by the Director-General of the NPWS for the Eastern False Pipistrelle.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

There are insufficient data to determine whether or not the Eastern False Pipistrelle is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". Further, despite the vast areas of conservation reserves in the Sydney Basin Bioregion, it can be assumed (on the basis

of pure logic alone) that this species is not "*adequately represented in conservation reserves*". If it was "*adequately represented*" (emphasis added) in such reserves, it presumably would not be "*threatened*".

Regardless of whether the Eastern False Pipistrelle is "*adequately represented in conservation reserves in the region*", the proposed mining operation at Newnes will not affect the adequacy of conservation of this species or the extent of habitat protected in conservation reserves.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

The mine proposal at Newnes will require the clearing of an area of "*native vegetation*" as defined in the *Final Determination* for the "*clearing of native vegetation*" (listed as a "*key threatening process*"). However, that removal will not involve the loss of significant suitable habitat for the Eastern False Pipistrelle from the subject site, and involves no loss of roosting resources.

The substantial extent of adjoining conservation reserves, and the limited resources for the species on the site, preclude the proposed mine at Newnes from constituting an action that could conceivably "*threaten*" the "*survival or evolutionary development*" of the Eastern False Pipistrelle.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Eastern False Pipistrelle is not "*at the limited of its known distribution*" on the site at Newnes Junction.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with respect to the Eastern False Pipistrelle. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the high mobility of the Eastern False Pipistrelle and the extent of available (protected) resources in the area, the proposed mining operations at Newnes will not involve the imposition of "*a significant effect*" on this species.

Other Microchiropteran Bats

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The other threatened microchiropteran bats which could or may occur on the subject site include a suite of species which utilise tree-hollows for shelter and roosting and other species which predominantly use caves and tunnels. In the case of the latter suite of species, no roosting or breeding resources are present on the subject site at Newnes. For the tree-hollow dependent suite of microchiropteran bats, however, there are suitable roosting resources present.

The subject site at Newnes constitutes only a minute proportion of the contiguous habitats and resources available for microchiropteran bats in this general area. The GBMA World Heritage Area includes over 1 million hectares of conserved and protected forest and woodland, and other suitable resources for microchiropteran bats. The subject site by contrast occupies just 25 hectares.

It is not conceivable that a "*viable local population*" of any microchiropteran bat species would be reliant on the subject site at Newnes or would be restricted to it. As a consequence, it is not possible for any such "*population*", even if present, being "*placed at risk of extinction*" as a result of disturbance to, or the clearing and mining of most of the site.

Further, it is not likely that the "*life cycle*" of any microchiropteran bat species would be "*disrupted*" by the proposed development such as to place a "*viable local population*" of any such species would be "*placed at risk of extinction*".

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

The TSC Act defines an "*endangered population*" as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of any microchiropteran bat species.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The subject site occupies only a minute proportion of the available habitat for these species within the region, particularly in respect of the "*regional distribution*", and the considerable protection, of that habitat. As noted above, the subject site occupies just 25ha whilst conserved lands in the region, containing suitable habitat, occupy considerably in excess of one million hectares.

The proposed mining operation at Newnes will not involve "*a significant area of known habitat*" for any microchiropteran bat species being "*modified or removed*", in respect either of the local or the "*regional distribution of the habitat*" (emphasis added) for these species.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Microchiropteran bats are generally highly mobile and wide-ranging species, capable of travelling over considerable distances in an evening of foraging. Furthermore, many such species utilise and/or traverse areas of high disturbance.

Substantial areas of potential habitat for these species are present in the extensive conservation reserves in the vicinity. In this regard, the GBMA World Heritage Area occupies an area of bushland in excess of one million hectares, and there are extensive other areas of conserved lands in the region.

The proposed mining operation is located at the edge of the extensive conservation reserves in the locality. The proposal will not result in the isolation of "*currently interconnecting or proximate areas of habitat*" for any microchiropteran bat species.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report*, no relevant "*critical habitat*" had been declared by the Director-General of the NPWS for any threatened microchiropteran bats.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

There are insufficient data to determine whether or not any of the threatened microchiropteran bats which do or may occur on the subject site is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". Further, despite the vast areas of conservation reserves in the Sydney Basin Bioregion, it can be assumed (on the basis of pure logic alone) that none of the species

of microchiropteran bats which are listed as "*threatened*" would be "*adequately represented in conservation reserves*". If any such species were "*adequately represented*" (emphasis added) in such reserves, they presumably would not be "*threatened*".

Regardless of whether any microchiropteran bat species, or their habitats, are "*adequately represented in conservation reserves in the region*", the proposed mining operations at Newnes will not affect the adequacy of conservation of these species or the extent of habitat protected in conservation reserves.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

The mine proposal at Newnes does involve the clearing of an area of "*native vegetation*" as defined in the *Final Determination* for the "*clearing of native vegetation*" (listed as a "*key threatening process*"). However, that removal will not involve the loss of significant areas of potential foraging or roosting habitat for any threatened microchiropteran bats from the subject site, and involves no loss of "*known habitat*" for such species.

The substantial extent of adjoining conservation reserves precludes the proposed mine at Newnes from constituting an action that could conceivably "*threaten*" the "*survival or evolutionary development*" of any threatened microchiropteran bats.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

None of the threatened microchiropteran bat species known or likely to occur on the site at Newnes Junction is "*at the limit of its known distribution*".

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with respect to the microchiropteran bat species known to occur in the locality. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the high mobility of these species and the extent of available (protected) resources in the area, the proposed mining operations at Newnes will not involve the imposition of "*a significant effect*" on any threatened microchiropteran bat species.

Yellow-bellied Glider *Petaurus australis*	**Vulnerable**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Yellow-bellied Glider is an arboreal mammal that inhabits the moist and dry sclerophyll forests and woodlands of southeastern Australia (Strahan 1995). This species has been recorded in the vicinity, but not on the subject site at Newnes. No indirect evidence for the Yellow-bellied Glider (*eg* characteristic feed trees or dens) was obtained from the subject site, but individuals could use the site for foraging.

Even if present on the site at Newnes, however, there is no likelihood that a "*viable local population*" of the Yellow-bellied Glider would be "*placed at risk of extinction*" by the proposed mining activity. Given the considerable extent of conservation reserves in the locality and region, and the lack of evidence for use of the site by the Yellow-bellied Glider, is not likely that the "*life cycle*" of the species would be "*disrupted*" by the proposed activity at Newnes to any significant extent, if at all.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of the Yellow-bellied Glider.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The "*regional distribution*" of the Yellow-bellied Glider within the Sydney Basin Bioregion includes a range of locations along the NSW coast, east of the Great Dividing Range (Maxwell *et al* 1996). The subject site represents a sufficient area only for one family group of the Yellow-bellied Glider, if it used by the species at all.

Given the small area of habitat on the subject site and the substantial area of adjoining conservation reserves, the site cannot be construed as constituting "*a significant area of known habitat*" for the Yellow-bellied Glider. The proposal will therefore not involve the modification or removal of "*a significant area of known habitat*" in respect of either the local or "*the regional distribution of the habitat*" (emphasis added) for the Yellow-bellied Glider.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The subject site is located at the periphery of 'potential' habitat for the Yellow-bellied Glider, with very substantial areas of forest located to the north and east. The proposed mine development will not compromise any connectivity of habitat for the Yellow-bellied Glider, and will not isolate any areas of either potential or "*known*" habitat "*from currently interconnecting or proximate areas of habitat*" for this species.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

At the time of this *Report*, no "*critical habitat*" for the Yellow-bellied Glider had been declared by the Director-General of NPWS.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is not considered likely that the Yellow-bellied Glider is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". If it were "*adequately represented*", (emphasis added), it presumably would not be "*threatened*".

Irrespective of the adequacy or otherwise of representation of the Yellow-bellied Glider in conservation or other reserves, the proposed activity will not adversely affect the conservation status of this species or the extent of conservation of its habitat.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Yellow-bellied Glider is not at the "*limit of its known distribution*" on the subject site.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with regard to the Yellow-bellied Glider. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

On the basis of the above considerations, the proposed mine on the subject site at Newnes is not "*likely*" to impose "*a significant effect*" on the Yellow-bellied Glider. A *Species Impact Statement* (SIS) is not required with respect to this species in relation to the proposed development at Newnes.

Red-crowned Toadlet ***Pseudophryne australis***	**Vulnerable**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Red-crowned Toadlet is restricted in its distribution to sandstone landscapes of the Greater Sydney Metropolitan district, between Newcastle in the north, Barren Grounds in the south, and Mount Victoria in the west. This species occupies the small ephemeral watercourses and drainage lines in the upper catchments and along sandstone escarpments and ridgelines, particularly in the "*very small drainage lines called "feeder creeks" which feed runoff water from the ridges to the perennial creeks below or in areas of seepage*" (Ehmann 1997). Red-crowned Toadlets utilise the depressions in these 'feeder creeks', where rock and leaf litter provide moist conditions both for shelter and for breeding. This species does not use permanent ponds for breeding, and "*the water bodies in which the tadpoles develop are only small puddles or depressions where either rock or leaf litter and twig drift hold back the water temporarily*" (Ehmann 1997).

Adult frogs are reported to feed primarily on ants and termites (Wotherspoon 1998), although it is likely that they take other insects and invertebrates as well (Smith & Smith 2000). Tadpoles feed in water on plant material and detritus (Smith & Smith 2000).

The Red-crowned Toadlet has not been recorded on the subject site at Newnes. Whilst there are records of the species in the locality (NPWS Wildlife Atlas), and the Blue Mountains area is a focus for this species, the subject site supports little suitable habitat for this species.

The Red-crowned Toadlet has not been recorded on the subject site at Newnes, and the site provides only limited marginal habitat for this species. Considerable areas of suitable habitat are present in the substantial conservation reserves in the locality and region. It is not "*likely*" that the proposed mining development would cause "*a viable local population*" of the Red-crowned Toadlet "*to be placed at risk of extinction*", even if such a "*population*" is present on the site and on adjoining lands.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no "*endangered population*" of the Red-crowned Toadlet.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Sydney Basin Region contains all of the "*known habitat*" of the Red-crowned Toadlet. As noted above, the Blue Mountains area constitutes a focus for the Red-crowned Toadlet, with substantial numbers of records of the species in this area.

There are vast areas of suitable habitat for the Red-crowned Toadlet in the extensive conservation reserves in the locality and region. The subject site cannot be construed as comprising "*a significant area of known* [or indeed even potential] *habitat*" in respect of "*the regional distribution of the habitat*" (emphasis added) for the Red-crowned Toadlet.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed mining activity on the subject site at Newnes will not isolate any areas of habitat for the Red-crowned Toadlet "*from currently interconnecting or proximate areas of habitat*". The site would be located at the periphery of 'potential' (not "*known*") habitat, and there are vast areas of suitable habitat nearby.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report*, no "*critical habitat*" for the Red-crowned Toadlet had been declared by the Director-General of the NPWS.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

The Red-crowned Toadlet is well represented in conservation reserves within its limited distribution, including Ku-ring-gai Chase, Marramarra, Blue Mountains, Dharug, Wollemi, Sydney Harbour, Lane Cove, Royal and Garigal National Parks, and Barren Grounds Nature Reserve (Ehmann 1997). It has also been recorded in a number of State Forests, Sydney Water catchments and on Council reserves and lands (Ehmann 1997). Furthermore, the subject site is located adjacent to the million hectares plus of the Greater Blue Mountains Area (GBMA) World Heritage Area, which supports extensive suitable habitat for the species.

Consequently, it is considered that the Red-crowned Toadlet is "*adequately represented in conservation reserves (or other similar protected areas) in the region*".

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

Whilst the proposed mine at Newnes will require the "*Clearing of Native Vegetation*" (which is listed as a "*key threatening process*"), only a small area of potential (albeit marginal) habitat for the Red-crowned Toadlet will be affected. The proposed mine at Newnes could not conceivably "*threaten*" the "*survival or evolutionary development*" of the Red-crowned Toadlet, given the substantial areas of suitable habitat in the extensive conservation reserves in the general locality and region which support abundant suitable habitat for this species.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Red-crowned Toadlet is not at "*the limit of its known distribution*" on the subject site at Newnes.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed above with respect to the Red-crowned Toadlet. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the lack of any evidence for the species on the site, the marginal value (at best) of the proposed mine area for the species, and the extent of habitat in the substantial conservation reserves in the locality and region, it is not "*likely*" that the activity could involve the imposition of "*a significant effect*" on the Red-crowned Toadlet.

A *Species Impact Statement* is not required for the proposed development at Newnes with respect to the Red-crowned Toadlet.

Threatened Forest Owls

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The large forest owls occupy extremely large home ranges (up to 1000ha for a single pair), and the subject site could therefore at best constitute only a very small proportion of the home range for a single pair of any of these species. Furthermore, there are considerable areas of suitable habitat for the large forest owls in the extensive conservation reserves in the GBMA World Heritage Area (which exceed 1 million hectares). Consequently, even if the subject site is used by any such species, it could not be regarded as constituting "*a significant area of known habitat*" for any of the large forest owls.

The subject site could not be significant in the survival of even a single pair of any of the large forest owl species. It is not "*likely*" that the proposed development of the subject site would cause "*a viable local population*" (or even individuals) of any of the forest owls "*to be placed at risk of extinction*", or indeed to be adversely affected to any significant extent at all.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*" of the Act.

There is no "*endangered population*" of any of the threatened forest owl species.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Given the substantial area of forest and woodland present in the adjoining conservation reserves (in excess of one million hectares), and the extremely small area of the site compared to the home ranges of the relevant species, the subject site cannot be construed as comprising "*a significant area of known habitat*" in respect of "*the regional distribution of the habitat*" (emphasis added) for any of the forest owl species.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Given the high mobility of these species, and the extent of conservation habitat and resources in the vicinity, the proposed mining activity will not result in any habitat or resources for the large forest owls becoming "*isolated from currently interconnecting or proximate areas of habitat*".

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report,* no "*critical habitat*" had been declared by the Director-General of the NPWS for any of the large forest owls.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is not likely that any of the large forest owls would be considered "*adequately represented in conservation reserves (or other similar protected areas) in the region*". Conversely, the Sydney Basin Bioregion contains very substantial areas of "*conservation reserves (or other similar protected areas*)", and it is possible that the large forest owls are in fact "*adequately*" conserved in this region.

The proposed mining operation at Newnes will not adversely affect the conservation status of any of the threatened forest owl species or their habitats in the locality or "*region*", because of the extent of resources available in the conservation reserves in the region and the mobility and extent of home ranges of these species.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation. Whilst mining *per se* is not listed as a "*key threatening process*" in Schedule 3 of the TSC Act, the "*clearing of native vegetation*" has been listed as a "*key threatening process*".

The proposed mining operation at Newnes could not conceivably "*threaten*" the "*survival or evolutionary development*" of any of the relevant forest owl species. There are no suitable nesting resources within the mine area, and there are substantial areas of suitable habitat in the general locality and region, protected within the "*vast*" conservation reserves in the Greater Blue Mountains Area.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

No threatened forest owl is at "*the limit of its known distribution*" in the vicinity the subject site at Newnes.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with respect to the threatened forest owls. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the extent of suitable habitat for the forest owls in the vicinity, the small area of habitat (relatively) on the site, the lack of nesting resources and the extent of adjoining conservation reserves, it cannot be considered "*likely*" that the proposed mining activity will involve the imposition of "*a significant effect*" on any threatened forest owl species.

Blue Mountains Water Skink *Eulamprus leuraensis*	**Endangered**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Blue Mountains Water Skink is restricted in its distribution to the swamps and wetlands of the Blue Mountains area, west of Sydney. This species utilises "*an isolated and naturally fragmented habitat of sedge and shrub swamps (Keith & Benson 1988) that have boggy soils and appear to be permanently wet (LeBreton, 1996)*" (NPWS 2000).

The Blue Mountains Water Skink has not been recorded on the subject site at Newnes despite dedicated surveys (Biosphere 2003, 2004; Gunninah 2004). Whilst there is a record of the species in the vicinity (Dr A White *pers comm*), the subject site does not contain suitable habitat for the Blue Mountains Water Skink (Biosphere 2004). There is, however, potential habitat for the species downstream.

The Blue Mountains Water Skink has not been recorded on the subject site at Newnes, and the site does not provide suitable habitat for this species. Significant areas of potentially suitable habitat are present in the vicinity and in the substantial conservation reserves in the locality and region.

Given those circumstances, it is not "*likely*" that the proposed mining operations would cause "*a viable local population*" of the Blue Mountains Water Skink "*to be placed at risk of extinction*".

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in Part 2 of Schedule 1*" of the Act.

There is no "*endangered population*" of the Blue Mountains Water Skink.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Sydney Basin Bioregion contains all of the "*known habitat*" of the Blue Mountains Water Skink.

The subject site does not support suitable habitat for the Blue Mountains Water Skink, and the species has not been recorded on the site (Biosphere 2003, 2004; Gunninah 2004). Consequently, the site cannot be construed as comprising "*a significant area of known habitat*" (emphasis added) for this species. Even were the Blue Mountains Water Skink to occur on the site, the resources present would not constitute a "*significant area of known habitat*" in respect of "*the regional distribution of the habitat*" (emphasis added) for the Blue Mountains Water Skink.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The proposed mining activity on the subject site at Newnes will not isolate any areas of habitat for the Blue Mountains Water Skink "*from currently interconnecting or proximate areas of habitat*". The site would be located at the periphery of 'potential' (not "*known*") habitat, and the final land form may provide supplementary habitat for this species.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report*, no "*critical habitat*" for the Blue Mountains Water Skink had been declared by the Director-General of the NPWS.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

The Blue Mountains Water Skink is not likely to be "*adequately represented in conservation reserves (or other similar protected areas) in the region*". This species has only a limited distribution, with many areas of habitat not located within such reserves.

Conversely, the proposed mining operations at Newnes will not adversely affect the conservation status of the species or the representation of either the species or its habitat in conservation reserves "*in the region*".

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

Whilst the proposed mine will require the "*clearing of native vegetation*" (listed as a "*key threatening process*"), no suitable habitat for the Blue Mountains Water Skink will be affected. Furthermore, potential habitat downstream will be protected by appropriate measures.

Consequently, the proposed mine is not likely to "*threaten*" the "*survival or evolutionary development*" of the Blue Mountains Water Skink. The activity is not therefore a "*threatening process*" as defined in the Act.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Blue Mountains Water Skink is not likely to be at "*the limit of its known distribution*" on the subject site at Newnes, despite the small extent of its distribution.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed above with respect to the Blue Mountains Water Skink. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the lack of any evidence for the species on the site, the lack of suitable habitat on the site, and the extent of potentially suitable habitat in adjoining conservation reserves, it is not "*likely*" that the activity would involve the imposition of "*a significant effect*" on the Blue Mountains Water Skink.

A *Species Impact Statement* is not required for the proposed development at Newnes with respect to the Blue Mountains Water Skink.

Koala *Phascolarctos cinereus*	**Vulnerable Species**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Koala utilises the tree canopy in open forests and woodlands in eastern Australia, and has been recorded in the vicinity, but not on the subject site at Newnes. Additionally, no indirect evidence for the Koala (its characteristic scats) has been obtained from the subject site, although individuals could potentially use the site for foraging.

Even if present on the site at Newnes, however, there is no likelihood that a "*viable local population*" of the Koala would be "*placed at risk of extinction*" by the proposed mining activity. Given the extent of

conservation reserves in the locality and region, and the limited value of the site for the Koala, it is not likely that the "*life cycle*" of this species would be "*disrupted*" by the proposed activity at Newnes to any significant extent, if at all.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of the Koala.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The "*regional distribution*" of the Koala within the Sydney Basin Bioregion includes a number of scattered disjunct coastal sites, and rare inland sites. The subject site represents suitable habitat for only a few individuals of the Koala, if it used by the species at all.

Given the small area of habitat on the subject site and the substantial area of adjoining conservation reserves, the site cannot be construed as constituting "*a significant area of known habitat*" for the Koala. The proposal will therefore not involve the modification or removal of "*a significant area of known habitat*" in respect of either the local or "*the regional distribution of the habitat*" (emphasis added) for the Koala.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The subject site does not constitute an area of "*known habitat*" for the Koala.

The proposed mine development will not compromise any connectivity of habitat for the Koala, and will not isolate any areas of either potential or "*known*" habitat "*from currently interconnecting or proximate areas of habitat*" for this species.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

At the time of this *Report*, no "*critical habitat*" for the Koala had been declared by the Director-General of NPWS.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is not considered likely that the Koala is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". If it were "*adequately represented*" (emphasis added), it presumably would not be "*threatened*".

Irrespective of the adequacy or otherwise of representation of the Koala in conservation or other reserves, the proposed activity will not adversely affect the conservation status of this species or the extent of conservation of its habitat.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

The mine proposal at Newnes does involve the clearing of an area of "*native vegetation*" as defined in the *Final Determination* for the "*clearing of native vegetation*" (listed as a "*key threatening process*"). However, that removal will not involve the loss of habitat for the Koala from the subject site.

The proposed mine operation could not conceivably "*threaten*" the "*survival or evolutionary development*" of the Koala, and is not therefore a "*threatening process*" as defined in the Act.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Koala is not at the "*limit of its known distribution*" on the subject site.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with regard to the Koala. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

On the basis of the above considerations, the proposed mine on the subject site at Newnes is not "*likely*" to impose "*a significant effect*" on the Koala. A *Species Impact Statement* (SIS) is not required with respect to this species in relation to the proposed development at Newnes.

Tiger Quoll *Dasyurus macluatus*	**Vulnerable**

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Tiger Quoll utilises a range of forested environments and habitats, and is typically associated with the denser moist forest environments along watercourses and drainage lines. However, this species is highly adaptable and has also been recorded in small bushland remnants in urban Sydney and on the periphery of urban environment. It is also know to traverse urban areas on occasions.

Even if present on the site at Newnes, there is no likelihood that a "*viable local population*" of the Tiger Quoll would be "*placed at risk of extinction*" by the proposed mining activity. There are considerable conservation reserves in the immediate vicinity, locality and region, containing suitable habitat for this species.

It is not likely that the "*life cycle*" of the Tiger Quoll would be "*disrupted*" by the proposed activity at Newnes to any significant extent, if at all.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*" of the Act.

There is no listed "*endangered population*" of the Tiger Quoll.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The "*regional distribution*" of the Tiger Quoll within the Sydney Basin Bioregion includes essentially all of the forested portions of the Region. The subject site represents only an extremely small area of potential (not "*known*") habitat for the species "*in relation to the regional distribution of the habitat*".

Given the small area of habitat on the subject site and the substantial area of adjoining conservation reserves, the site cannot be construed as constituting "*a significant area of known habitat*" for the Tiger Quoll. The proposal will not involve the modification or removal of "*a significant area of known habitat*" in respect of either the local or "*the regional distribution of the habitat*" (emphasis added) for the Tiger Quoll.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The Tiger Quoll is highly adaptable species which utilises urban as well as forested environments. Given its mobility and adaptability, the proposed mine development will not compromise any connectivity of habitat for the Tiger Quoll, and will not isolate any areas of either potential or "*known*" habitat "*from currently interconnecting or proximate areas of habitat*" for this species.

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under part 3*" of the Act.

At the time of this *Report*, no "*critical habitat*" for the Tiger Quoll had been declared by the Director-General of NPWS.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is not considered likely that the Tiger Quoll is "*adequately represented in conservation reserves (or other similar protected areas) in the region*". If it were "*adequately represented*" (emphasis added), it presumably would not be "*threatened*".

Irrespective of the adequacy or otherwise of representation of the Tiger Quoll in conservation or other reserves, the proposed activity will not adversely affect the conservation status of this species or the extent of conservation of its habitat.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*". Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation.

The mine proposal at Newnes does involve the clearing of an area of "*native vegetation*" as defined in the *Final Determination* for the "*clearing of native vegetation*" (listed as a "*key threatening process*"). However, that removal will not involve the loss of significant areas of potential habitat for the Tiger Quoll.

The substantial extent of adjoining conservation reserves precludes the proposed mine from constituting an action that could conceivably "*threaten*" the "*survival or evolutionary development*" of the Tiger Quoll. The proposed mining operation is not therefore a "*threatening process*" as defined in the Act.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

The Tiger Quoll is not at the "*limit of its known distribution*" on the subject site.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with regard to the Tiger Quoll. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

On the basis of the above considerations, the proposed mine on the subject site at Newnes is not "*likely*" to impose "*a significant effect*" on the Tiger Quoll. A *Species Impact Statement* (SIS) is not required with respect to this species in relation to the proposed development at Newnes.

Threatened Plants

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

A range of threatened plant species have been identified as occurring in the general locality or potentially occurring on the site at Newnes. However, no records of any threatened plant species have been recorded from the site, despite investigations by a number of individual biologists. Nevertheless, a number of threatened plant species are known to occur on the dry sclerophyll ridges of the Blue Mountains, and individuals or small populations of such species could potentially occur on the subject site.

Even if any such individuals or populations were present, however, it is not likely that the site constitutes an isolate or an area of 'critical' habitat for the long-term viability of any such species. It cannot be regarded as likely that any threatened plant species would be restricted to the subject site at Newnes.

The subject site is not likely to be significant for any threatened plant species, given the absence of records for any such species and the lack of restricted or 'critical' habitat or resources. It is not "*likely*" that the proposed development of the subject site would cause "*a viable local population*" of any threatened plant species "*to be placed at risk of extinction*", if any such species is present.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

An "*endangered population*" is defined in the TSC Act as "*a population specified in part 2 of Schedule 1*" of the Act.

There is no relevant listed "*endangered population*" of any plant species.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Given the substantial area of forest and woodland present in the adjoining conservation reserves, and the extremely small area of the site in comparison, the subject site cannot regarded as likely to as comprise "*a significant area of known habitat*" for any threatened plant species. The habitats present are not restricted or of particular significance, and are well represented in the extensive adjoining reserves.

The site cannot be regarded as constituting "*a significant area*" of habitat ("*known*" or potential) for any threatened plant species in respect of "*the regional distribution of the habitat*" (emphasis added) for these species.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Given the extent of conservation of the relevant habitats and resources in the vicinity, locality and region, and the circumstances and context of the site, the proposed mining activity at Newnes will not result in any habitat or resources for threatened plant species becoming "*isolated from currently interconnecting or proximate areas of habitat*".

(e) whether critical habitat will be affected

The TSC Act defines "*critical habitat*" as "*habitat declared to be critical habitat under Part 3*" of the Act.

At the time of preparation of this *Report,* no relevant "*critical habitat*" had been declared by the Director-General of the NPWS for any of the threatened plant species of potential concern.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

It is not likely that any of the threatened plant species would be considered "*adequately represented in conservation reserves (or other similar protected areas) in the region*". Conversely, the Sydney Basin Bioregion contains very substantial areas of "*conservation reserves (or other similar protected areas*)", and it is possible that many of the so-called threatened plant species are in fact "*adequately*" conserved in this region.

The proposed mining operation at Newnes will not adversely affect the conservation status of any of the threatened plant species or their habitats in the locality or "*region*", because of the extent of resources available in the conservation reserves in the region.

(g) whether the development or activity is of a class of development or activity that is recognised as a threatening process

The TSC Act defines "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

Schedule 3 of the TSC Act provides a list of the "*key threatening processes*" which are regarded as of relevance to the Act and its implementation. Whilst mining *per se* is not listed as a "*key threatening process*" in Schedule 3 of the TSC Act, the "*Clearing of Native Vegetation*" has been listed as a "*key threatening process*".

The proposed mining operation at Newnes would not "*threaten*" the "*survival or evolutionary development*" of any of the potentially relevant threatened plant species. There are no habitats or resources of restricted distribution or critical value within the mine area, and there are substantial areas of suitable habitat in the general locality and region, protected within the substantial conservation reserves in the Greater Blue Mountains Area.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution

No threatened plant species is at "*the limit of its known distribution*" in the vicinity the subject site at Newnes.

CONCLUSION

The eight factors which are required to be considered pursuant to s.5A of the EP&A Act in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed in detail above with respect to threatened plant species. Other relevant factors (*eg* the extent of conservation reserves in the immediate vicinity, general locality and region, and the total distribution of the species) have also been taken into the account in considering s.5A of the EP&A Act.

Given the extent of suitable habitat for threatened plants in the vicinity, locality and region, the small area of habitat (relatively) on the site, and the lack of critical resources present, it cannot be considered "*likely*" that the proposed mining activity will involve the imposition of "*a significant effect*" on any threatened plant species.

Proposed Sand Extraction & Kaolin Mine
Newnes Junction

Supplementary Submission to DIPNR

Flora & Fauna Issues

APPENDIX H

The Greater Blue Mountains Area (GBMA) World Heritage Area

Gunninah Environmental Consultants
PO Box 513 Crows Nest NSW 1585
ph: 02 - 9906 5436 fax: 02 - 9906 7770 email: gecon@gunninah.com.au



Skip navigation links

In this theme

- About World Heritage
- Criteria
- Implications of listing
- Laws
- Listing
- Location map

World Heritage Areas

- Australian Fossil Mammal Sites
- Blue Mountains
- Central Eastern Rainforest Reserves
- Fraser Island
- Great Barrier Reef
- Heard and McDonald Islands
- Kakadu
- Lord Howe Island
- Macquarie Island
- Purnululu
- Royal Exhibition and Carlton Gardens
- Shark Bay
- Tasmanian Wilderness
- Uluru-Kata Tjuta
- Wet Tropics
- Willandra

Related themes

- Heritage
- DEH Home

Quick links

The Greater Blue Mountains Area
Inscribed 2000

The Greater Blue Mountains Area was inscribed on the World Heritage List at the 24th Session of the World Heritage Committee, held in Cairns from 27 November to 2 December 2000.

It is an area of breathtaking views, rugged tablelands, sheer cliffs, deep, inaccessible valleys and swamps teeming with life. The unique plants and animals that live in this outstanding natural place relate an extraordinary story of Australia's antiquity, its diversity of life and its superlative beauty. This is the story of the evolution of Australia's unique eucalypt vegetation and its associated communities, plants and animals.

The Greater Blue Mountains Area consists of 1.03 million hectares of mostly forested landscape on a sandstone plateau 60 to 180 kilometres inland from central Sydney, New South Wales. The property includes vast expanses of wilderness and is equivalent in area to almost one third of Belgium, or twice the size of Brunei.

The property, which includes eight protected areas in two blocks separated by a transportation and urban development corridor, is made up of seven outstanding national parks as well as the famous Jenolan Caves Karst Conservation Reserve. These are the Blue Mountains, Wollemi, Yengo, Nattai, Kanangra-Boyd, Gardens of Stone and Thirlmere Lakes National Parks.

The area does not contain mountains in the conventional sense but is described as a deeply incised sandstone plateau rising from less than 100 metres above sea level to 1 300 metres at the highest point. There are basalt outcrops on the higher ridges. This plateau is thought to have enabled the survival of a rich diversity of plant and animal life by providing a refuge from climatic changes during recent geological history. It is particularly noted for its wide and balanced representation of eucalypt habitats from wet and dry sclerophyll, mallee heathlands, as well as localised swamps, wetlands, and grassland. Ninety-one species of eucalypts (thirteen percent of the global total) occur in the Greater Blue Mountains Area. Twelve of these are believed to occur only in the Sydney sandstone region.

The property has been described as a natural laboratory for studying the evolution of the eucalypts. The largest area of high diversity of eucalypts on the continent is located in south-east Australia. The Greater Blue Mountains Area includes much of this eucalypt diversity.

As well as supporting such a significant proportion of the world's eucalypt species, the property provides examples of the range of structural adaptations of the eucalypts to Australian environments.

These vary from tall forests at the margins of rainforest in the deep valleys, through open forests and woodlands, to shrublands of stunted mallees on the exposed tablelands.

In addition to its outstanding eucalypts, the Greater Blue Mountains Area also contains ancient, relict species of global significance. The most famous of these is the recently-discovered Wollemi pine, a "living fossil" dating back to the age of the dinosaurs. Thought to have been extinct for millions of years, the few surviving trees of this ancient species are known only from three small populations located in remote, inaccessible gorges within the nominated property. The Wollemi pine is one of the World's rarest species.

More than 400 different kinds of animals live within the rugged gorges and tablelands of the Greater Blue Mountains Area. These include threatened or rare species of conservation significance, such as the spotted-tailed quoll, the koala, the yellow-bellied glider and the long-nosed potoroo as well as rare reptiles including the green & golden bell frog and the Blue Mountains water skink.

Outstanding Universal Values of the Greater Blue Mountains Area

The Greater Blue Mountains Area was inscribed on the World Heritage List against the natural criteria listed below:

Natural criterion (ii) outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

The combination of fine-scale spatial variation, high environmental complexity and exceptional stability over evolutionary time has allowed some environments and the biota that persist in them to remain largely unchanged over geological time. Even recently, a species of extraordinary global significance, a relict dinosaur of the plant world, the Wollemi pine (Wollemia nobilis) has been discovered in the property.

The steep terrain and sharp environmental gradients have wrought major evolutionary change on some taxa, including the eucalypts, resulting in an exceptional biodiversity within the eucalypt communities that dominate the place. Importantly, the evolutionary processes underpinning this diversity are believed to be ongoing, resulting in an evolutionary 'laboratory' that is exceptional in the World both in its treasures from the past, and its species that are evolving into the future.

Natural criterion (iv) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The Greater Blue Mountains Area affords representation of a major component of global biodiversity not previously represented on the World Heritage List. A substantial proportion of Australia's biodiversity associated with the range of ecosystems that dominate large parts of the continent and lie between rainforest and arid ecosystems occur within the Greater Blue Mountains Area.

The Greater Blue Mountains Area represents the highest biodiversity in

temperate forest environments with integrity, in Australia and globally, both within and across taxonomic levels. The property includes almost ten percent of the Australian vascular plant flora and is outstanding on a global scale for its biodiversity. Australia, with approximately ten percent of the global total of known vascular plants is a major centre of biodiversity. The Greater Blue Mountains Area also contains a significant number of rare and threatened species, many endemic to the area.

Download information and map of Greater Blue Mountains Area

This information is available as PDF files. You will need Adobe Acrobat Reader installed on your computer to view this file.

- Greater Blue Mountains Area World Heritage Nomination (gbm-nomination.pdf - 5610 KB)
- Supporting Documentation (gbm-supplementary.doc - 675 KB)
- Map of the Greater Blue Mountains Area (gbm-map.pdf - 630 KB)

If you are unable to access this material, please contact the Department of the Environment and Heritage to organise a suitable alternative format.

Further information

World Heritage Values for the Greater Blue Mountains Area

New South Wales National Parks and Wildlife Service:
http://www.npws.nsw.gov.au

Jenolan Caves Reserve Trust:
http://www.jenolancaves.org.au

World Heritage Committee Blue Mountains information (scroll down to 'Australia' and 'Greater Blue Mountains Area')
http://www.unesco.org/whc/nwhc/pages/doc/mainf3.htm

World Heritage Monitoring Centre Blue Mountains natural site data sheet:
http://www.wcmc.org.uk:80/protected_areas/data/wh/blue_mountain.html

The Colong Foundation for Wilderness:
http://www.colongwilderness.org.au

Last updated: Thursday, 07-Oct-2004 16:42:37 EST

Department of the Environment and Heritage
GPO Box 787 Canberra ACT 2601 Australia
Telephone: +61 (0)2 6274 1111

© Commonwealth of Australia 2005

The Greater Blue Mountains Area World Heritage Values

The Greater Blue Mountains Area was inscribed on the World Heritage List in 2000. The World Heritage criteria against which The Greater Blue Mountains Area was listed remain the formal criteria for this property. These criteria have been included in the Values Table below. The World Heritage criteria are periodically revised and the criteria against which the property was listed in 2000 may not necessarily be identical with future criteria.

Examples of the World Heritage values for which The Greater Blue Mountains Area was listed are included in the Values Table for each criterion. These examples are illustrative of the World Heritage values of the property, and they do not necessarily constitute a comprehensive list of these values. Other sources including the nomination document and references listed below the Values Table are available and could be consulted for a more detailed understanding of The Greater Blue Mountains Area.

Values Table

Natural criteria against which The Greater Blue Mountains Area was inscribed on the World Heritage List in 2000	**Examples of World Heritage values of The Greater Blue Mountains Area for which the property was inscribed on the World Heritage List in 2000**
Criterion (ii) outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.	The Greater Blue Mountains Area provides outstanding examples representing on-going ecological and biological processes significant in the evolution of Australia's highly diverse ecosystems and communities of plants and animals, particularly eucalypt-dominated ecosystems. The World Heritage values include: • primitive species with Gondwanan affinities that are of outstanding significance in terms of the evolution of plant life, including the Wollemi Pine (Wollemia nobilis) and the primitive gymnosperm Microstrobus fitzgeraldii; • a centre of diversification of the eucalypts which provides an outstanding record of the products of evolutionary processes associated with the global climatic changes of the late Tertiary and the Quaternary; • the highly unusual juxtaposition of diverse scleromorphic species with Gondwanan taxa; • an exceptional representation of the major eucalypt groups and aspects of their evolution and radiation, including species in the following groups: - genera: Eucalyptus (including Corymbia) and Angophora; - subgenera: Eucalyptus, Corymbia and Symphyomyrtus; • examples of species divergence occurring in a relatively small

	area, including: - differentiation of eucalypt taxa in isolation in response to persistent habitat islands (e.g. those associated with sandstone plateaux isolated by deep valleys) - mutually exclusive distributions of taxa in the series Strictae (the mallee ashes) and Haemostomae (the scribbly ashes) resulting from long-term isolation of breeding populations (allopatric speciation); • eucalypt taxa demonstrating very high levels of hybridisation; • representative examples of dynamic processes in eucalypt-dominated ecosystems, including the full range of interactions between eucalypts, understorey, environment and fire, extending from forests with rainforest boundaries to mallee communities with heath boundaries, demonstrating the exceptional ecological amplitude of the eucalypts.
Criterion (iv) contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.	The Greater Blue Mountains Area includes significant habitats for in situ conservation of biological diversity, including the eucalypts and eucalypt-dominated communities, taxa with Gondwanan affinities, and taxa of conservation significance. The World Heritage values include: • outstanding levels of plant diversity expressed at different taxonomic levels (152 families, 484 genera, ca 1500 species) and for all three measures of species diversity (local species richness or "alpha" diversity, species turnover across environmental gradients or "beta" diversity, and regional species richness or "gamma" diversity); • plant taxa with very high levels of species diversity, including the families - Fabaceae (149 species), Myrtaceae (150 species), Orchideae (77 species), Poaceae (57 species), Asteraceae (69 species), Proteaceae (77 species), Cyperaceae (43 species), and the genera - Eucalyptus (91 species), Acacia (64 species); · exceptional diversity of habitats that contribute to the property being one of the three most diverse areas on earth for scleromorphic species and the only one of these areas that is dominated by trees and without a Mediterranean climate, including plateau tops, ridges, exposed rocks, cliffs, rocky slopes and sheltered gorges and valleys; • exceptional diversity of habitats providing outstanding representation of the Australian fauna within a single place, including 400 vertebrate taxa - 52 native mammals, 265 birds or 33% of the Australian total, 63 reptiles, more than 30 frogs, and examples of species of global significance such as the platypus (Ornithorhynchus anatinus) and the echidna (Tachyglossus aculeatus aculeatus), and invertebrate taxa - butterflies (120 species) and moths (estimated 4000 species); • very high diversity of scleromorphic taxa represented within 20 plant families including Myrtaceae, Proteaceae, Epacridaceae, Fabaceae (Faboideae and Mimosoideae), Dilleniaceae, Rutaceae, and Euphorbiaceae (Tribe Stenolobeae); • ancient, relict species with Gondwanan affinities that have survived past changes of climate within refugia, for example in recessed canyons and perpetually moist areas, including: - the Wollemi Pine (Wollemia nobilis); and - the primitive gymnosperm Microstrobus fitzgeraldii;

- other primitive species with Gondwanan affinities, including:
  - Lomatia, Dracophyllum, and Podocarpus;
  - taxa in the family Lauraceae;
  - Atkinsonia, the most primitive extant root parasitic genus; and
  - taxa in the family Winteraceae, such as Tasmannia.
- taxa contributing to an exceptional diversity of eucalypts and eucalypt-dominated ecosystems, including:
  - 2 eucalypt genera (Eucalyptus including Corymbia, Angophora);
  - 3 eucalypt subgeneric groups (Eucalyptus, Corymbia, Symphyomyrtus);
  - 91 eucalypt species (13% of the global total); and
  - highly diverse understoreys of flora and fauna species;
- structural forms contributing to an exceptional diversity of eucalypts and eucalypt-dominated ecosystems, including:
  - tall open forest (towering, single-stemmed trees);
  - open forest;
  - woodland;
  - low open woodland; and
  - mallee shrubland (small, multi-stemmed shrubs);
- more than 70 plant communities, including 56 open forest and woodland communities contributing to an exceptional diversity of eucalypt-dominated ecosystems associated with:
  - wet environments (including the margins of rainforests);
  - dry environments (rapidly-draining, drought-prone sandstone plateaux);
  - low-nutrient environments (including sandstone-derived substrates);
  - fire-prone environments (including the sandstone plateaux); and
  - fertile environments (remnants of formerly widespread Tertiary basalts).
- high levels of diversity of invertebrate fauna, including Lepidoptera (4000 moth species, 120 butterfly species), and cave invertebrates (67 taxa recorded at Jenolan Caves);
- plant taxa of conservation significance and their habitats, including:
  - endemic species (114 plant species);
  - relict species;
  - species with a restricted range; and
  - rare or threatened species (127 species).
- animal taxa of conservation significance and their habitats, including:
  - endemic species;
  - relict species;
  - species with a restricted range; and
  - rare or threatened species (40 vertebrate taxa - including 12 mammal species and 15 bird species - and 12 invertebrate taxa).

Further information

Description of the Greater Blue Mountains Area

Greater Blue Mountains World Heritage Nomination

The following documents may be available in the Department of the Environment and Heritage

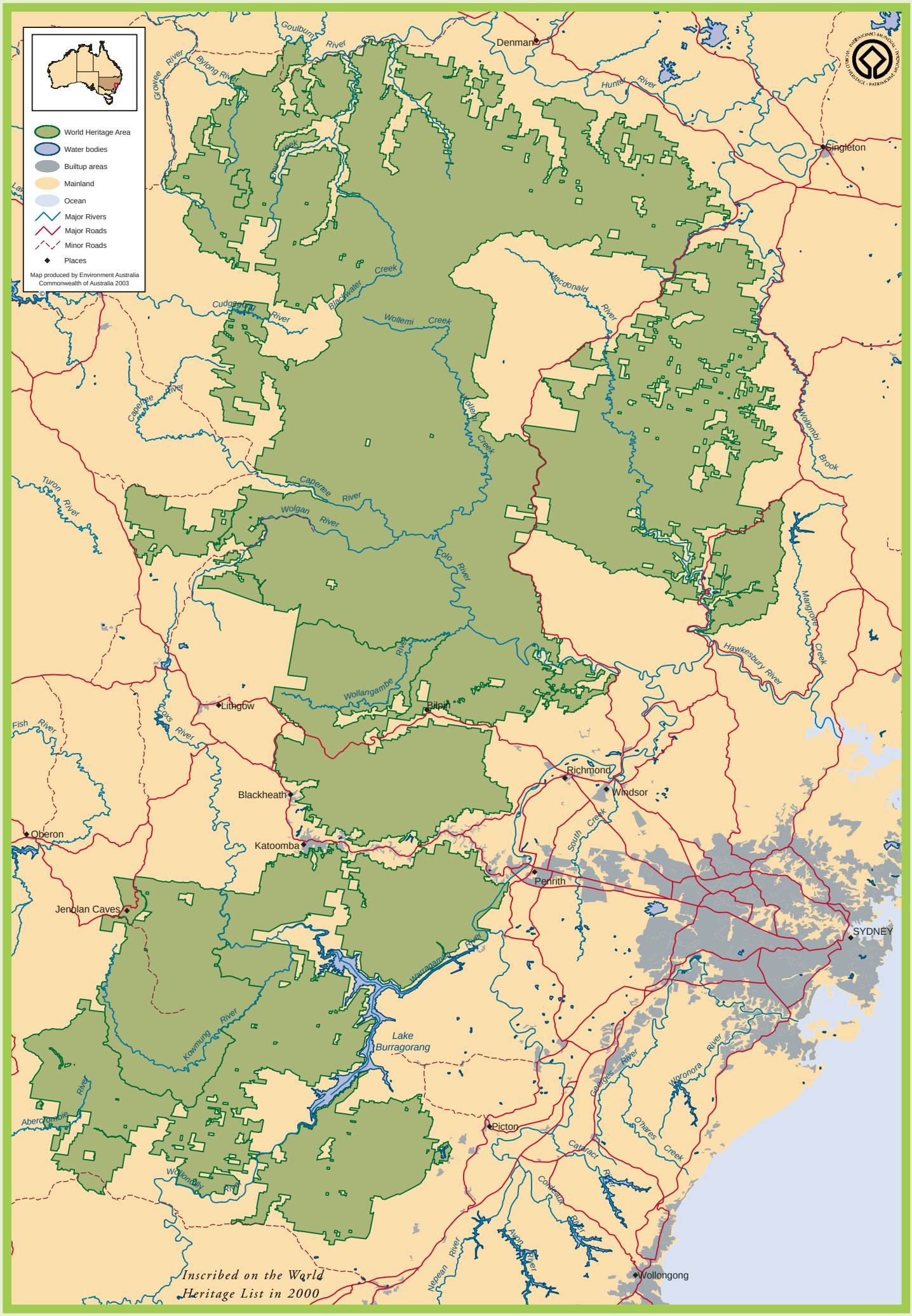
library:

- *Nomination of The Greater Blue Mountains Area for inscription on the World Heritage List by the Government of Australia.* Prepared by the New South Wales National Parks and Wildlife Service in association with Environment Australia, 1998
- *The Greater Blue Mountains Area World Heritage Nomination*, Supplementary Documentation. Provided by Australia in support of the nomination, January 2000.
- *New Information provided by Australia Regarding the Nomination of The Greater Blue Mountains Area for Inscription on the World Heritage List*, September 2000.

Last updated: Sunday, 20-Jun-2004 05:39:32 EST

Department of the Environment and Heritage
GPO Box 787 Canberra ACT 2601 Australia
Telephone: +61 (0)2 6274 1111

© Commonwealth of Australia 2005



The Greater Blue Mountains Area

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT D

Surface Water Management Plan

Hughes Trueman

May 2004

SYDNEY CONSTRUCTION MATERIALS

SURFACE WATER MANAGEMENT PLAN

NEWNES JUNCTION SAND & KAOLIN EXTRACTION PROJECT

HUGHES TRUEMAN

MAY 2004

JOB NO. 04S112

PREPARED BY:	QA CHECK:	COORDINATED:	STATUS:	DATE:
S PERRENS	A TOURLE	S PERRENS	Final	26 May 2004

This copyright is included for the protection of this document

COPYRIGHT

© Hughes Trueman Pty Ltd

All intellectual property and copyright reserved.

Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the Copyright Act, 1968, no part of this report may be reproduced, transmitted, stored in a retrieval system or adapted in any form or by any means (electronic, mechanical, photocopying, recording or otherwise) without written permission. Enquiries should be addressed to Hughes Trueman Pty Ltd.

TABLE OF CONTENTS

PAGE NO

1.0 INTRODUCTION 1
2.0 REVISED EXTRACTION PLAN 2
3.0 WATER MANAGEMENT SYSTEM – OPERATIONAL PHASE 3
3.1 OVERVIEW OF WATER MANAGEMENT SYSTEM 3
3.2 DESIGN OF THE MAIN RETENTION POND 7
3.3 DESIGN OF THE LOWER RETENTION POND 8
3.4 WATER TREATMENT PLANT 9
3.5 WATER BALANCE ANALYSIS 9
3.6 WATER REUSE OPTIONS 17
3.7 CLEAN WATER DIVERSION CHANNELS 17
3.8 MAINTENANCE AREA 18
3.9 SOIL STOCKPILES 18
4.0 WATER MANAGEMENT SYSTEM – REHABILITATION PHASE 19
4.1 OVERVIEW 19
4.2 PROPOSED WETLAND 19
5.0 CONCLUSIONS 22
6.0 REFERENCES 23

LIST OF FIGURES

Figure 1 Final Pit Development and Infrastructure Layout
Figure 2 Site Preparation
Figure 3 End of Stage 1 of Extraction
Figure 4 End of Stage 2 of Extraction
Figure 5 End of Stage 3 of Extraction
Figure 6 End of Stage 4 of Extraction
Figure 7 Timing of Extraction Stages
Figure 8 Final Rehabilitation
Figure 9 Final Rehabilitation 3D Perspective
Figure 10 Surface Miner
Figure 11 Pond Water Level Variation over 30 Years – Site Preparation Conditions
Figure 12 Pond Water Level Variation over 30 Years – Stage 1 Conditions
Figure 13 Pond Water Level Variation over 30 Years – Stage 2 Conditions
Figure 14 Pond Water Level Variation over 30 Years – Stage 3 Conditions
Figure 15 Pond Water Level Variation over 30 Years – Stage 4 Conditions
Figure 16 Gooches Crater
Figure 17 Water Level Variation over 30 Years – Wetland after Rehabilitation

1.0 INTRODUCTION

In the light of comments received on the original EIS and the preparation of a revised quarry plan, Hughes Trueman was commissioned by Sydney Construction Materials to review and update the water management plan covering the operational and rehabilitation phases of the project, and final landform.

The revised quarry plan allows the extraction to take place in a manner that permits drainage to be directed into the pit throughout the extraction and rehabilitation processes, and a free draining site to be created once rehabilitation is complete. This arrangement will allow the site to store sufficient water to meet all on-site water needs throughout the life of the project, primarily for dust suppression and watering of newly established rehabilitation plantings. The proposed system will also be capable of retaining all runoff from storms in excess of the 100 year average recurrence interval (ARI), 72 hour storm. There will be no uncontrolled discharge from the site during operational and rehabilitation phases of the project. Any discharge will only be by means of controlled flow from the water treatment plant.

This report describes the features of the surface water management system and presents the results of detailed water balance analysis using the long term rainfall records from Lithgow. The analysis demonstrates the ability of the system to provide a reliable water supply for on-site purposes while ensuring that no uncontrolled stormwater discharge occurs from the site.

2.0 REVISED EXTRACTION PLAN

The original extraction plan as shown in the EIS has been revised to accommodate the use of a surface miner as the primary extraction unit and scrapers to deliver the material to the stockpiling area rather than dozers, front end loaders and trucks. The revised method allows the noise criteria to be met at all stages of mining. As the excavation expands, final slope batters and berms are formed and progressively rehabilitated in the same way as previously proposed. Figures 1 to 10 (located at the end of this chapter) have been prepared by MineConsult and set out the staging of extraction and the associated facilities. Further details of the staging plan as it relates to water management are provided in Chapter 3 below.

The sequence of the benches remains largely unchanged; however the starting point will be to the west and moving progressively to the east and south while the size of each bench is larger given that it will be worked at the same level throughout. A key feature of the new extraction method is the ability to slope the floor of the pit very accurately which will facilitate in pit drainage. The extraction process will create a graded surface that slopes at approximately 1% in a westerly direction towards the back of the pit throughout the project except for the final phase of Stage 4 when the slope will be reversed in preparation for the final landform. The extraction method also allows for windrowed material to remain in pit where required in order to contain runoff as well as reduce runoff velocity.

3.0 WATER MANAGEMENT SYSTEM – OPERATIONAL PHASE

The main consequence of the new extraction method will be to increase the exposed area more rapidly than set out in the EIS. However the lack of benches within the working pit will significantly enhance the ease of construction of in-pit storage and the control runoff within the pit. The original design allowed for a series of water retention pits to be constructed on the western end of each working bench. Water from these pits then flowed into the main retention ponds on the northern end of the pit adjacent to the treatment plant. Originally it was proposed that these retention ponds, with a combined capacity of 57 ML, would overflow back into the pit in the event of a storm greater than the design storm occurred.

Under the revised extraction plan, a single main retention pond will be located on the northern end of the pit. This retention pond will serve as:

- the main collection point for stormwater runoff;
- the storage for supply of water for dust suppression and watering for vegetation establishment;
- the primary settlement pond for water that will be pumped to the water treatment plant for treatment to a standard suitable for use by the village and plant nursery or discharge into the natural creek system.

The new extraction method creates a series of windrows of excavated material as the surface miner passes over the pit floor. These windrows are then collected by a scraper which delivers the material to the stockpiling area. This process essentially creates a series of absorption banks within the pit which will reduce runoff velocity in times of rainfall. The windrows are created along the contour (essentially north to south) and therefore against the natural flow of water (east to west). The windrows will serve several purposes including:

- Act as “contour banks” that will reduce the length of uninterrupted slope and hence reduce the erosion capacity of overland flow. This will reduce the erosion potential within the working area and reduce the overall solids loading entering the retention pond;
- Pond water behind the bank and allow settling of the coarser sand fraction.

3.1 OVERVIEW OF WATER MANAGEMENT SYSTEM

The key philosophy underlying the design and operation of the water management system is that there will be no uncontrolled discharge of water from the site. The only water discharged into the northern creek that drains into the World Heritage Area will be treated in a water treatment plant and discharged at a controlled rate.

Although most of the features of the site water management system remain the same as those set out in the EIS, for the sake of clarity the sections below summarise the features of the system and their

functioning at various stages in the extraction process. Further details of the design and operation of individual facilities are set out in subsequent sections of this report.

3.1.1 SITE PREPARATION STAGE

The site preparation stage of the project (shown on Figure 2) will involve the establishment of the site infrastructure including the following water management facilities:

- Construction of a small in-pit retention pond to collect runoff from the working surface for transfer by pumping to the main retention pond located outside the pit.
- Construction of a main retention pond (32 ML) in a location and with sufficient capacity to subsequently serve Stage 1 of the extraction process.
- Construction of a lower retention pond (10 ML) located so as to collect runoff from the haul road and maintenance facility.
- Construction of a clean water diversion channel located on the ridge above the high wall. This diversion channel will convey clean runoff from the hillside above the pit into the creek channel located towards the southern end of the final pit extent (shown as a dotted line on Figure 2).
- Construction of a water treatment plant capable of treating 1 ML/day to a suitable standard for discharge to the World Heritage Area and for use in the village of Newness Junction and the plant nursery.
- Construction of a pipeline from the treatment plant to a storage tank located on the hilltop to the west of the pit. This tank will act as a reservoir for water supply to the village and the plant nursery.
- Construction of a collection drain approximately along the 1032 m contour as shown on Figure 2 to divert runoff from the hill side into the main retention pond for provision of water for dust suppression during the early stages of quarry development.

The water management facilities will be operated in the following manner:

- Runoff collected in the small in-pit retention pond will be pumped to the main retention pond for storage and settlement of coarse sediments. The exception to this would be in the event of an extreme rainfall event when the main retention pond was nearly full. Under these circumstances, water would be allowed to temporarily pond within the working area (which will slope down from east to west at about 1% providing about 4 ML of in-pit storage at this stage). Under no circumstances would sediment laden water from the working area be transferred to the main retention pond so as to cause an overflow of untreated water from the main retention pond.
- Water in the main retention pond will be retained and pumped as required to the lower retention pond and used for dust suppression purposes or treated for use by the village or plant nursery, or discharged into the northern creek that drains to the World Heritage Area. If water level in the main retention pond rises above the design storage zone level (see Section 3.2 for

further details), water will be pumped for treatment and discharge in order to return the water level to the design storage level as soon as practicable.

- Runoff from the area of the haul road and conveyor will be collected in the lower retention pond and given first priority for use for dust suppression or treatment and re-use or discharge to the creek flowing into the World Heritage Area, according to the requirements at the time.

3.1.2 STAGE 1

Stage 1 will involve the downward excavation of the working area as product is extracted and the consequent expansion of the excavation area from an area of about 1.6 ha at the end of the Site Preparation stage to about 10 ha at the end of Stage 1 as shown in Figure 3. During this stage, the water management system will remain essentially the same as for the Site Preparation stage. The main differences will be:

- As a result of the expanded area combined with the slope downward from east to west at about 1%, the available storage capacity within the excavation pit to retain runoff from extreme storms will increase to approximately 50 ML.
- The main retention pond will be retained at a total capacity of 32 ML.
- The lower retention pond will be retained at a total capacity of 10 ML.

Water will continue to be drawn from the lower retention pond for dust suppression and treatment as described for the Site Preparation stage. Similarly, water will be transferred from the in-pit retention pond to the main retention pond except when there is a risk of overflow from the main retention pond. When water level rises above the design storage zone level in the main retention pond (see Section 3.2 for definition of zones within the retention pond) , water will be pumped for treatment and discharge to restore the water level to the designated storage level as soon as practical after a storm.

3.1.3 STAGE 2

The configuration of the site and the water management facilities at the end of Stage 2 are shown on Figure 4. At the completion of Stage 2, the working area will have expanded to about 18 ha. This stage will involve the following alterations to the water management facilities:

- Construction of a new main retention pond (45 ML capacity) in the north western corner of the excavation.
- Extension of the clean water diversion channel around the southern end of the pit and then linking back to the southern creek that drains to the World Heritage Area.

The enlargement of the excavation area will provide in-pit water storage capacity of approximately 220 ML in addition to the volume stored in the main retention pond.

The main retention pond will continue to be operated in a manner that seeks to restore the water level to the design storage level as soon as practicable after a storm

3.1.4 STAGE 3

The main change to occur between the end of Stage 2 and the end of Stage 3 will be a further lowering of the working area and a corresponding increase in the excavation area to about 20.4 ha as shown on Figure 5. The water management facilities will remain the same as for Stage 2. The total available water storage within the pit above the level of the main retention pond will be about 350 ML.

3.1.5 STAGE 4

During Stage 4 the extent of the pit will only increase slightly (by about 0.5 ha), as shown on Figure 6. The main changes will be the lowering of the base of the pit and the gradual reworking of the slope of the floor so that, by the end of Stage 4, the pit will slope towards the north eastern corner in preparation for final rehabilitation and the provision of a free draining outlet from the site after rehabilitation is complete. In order to preserve sufficient in-pit water storage capacity to retain all runoff from exceptionally heavy storms, a minimum low wall height of 2 m will be retained on the eastern side of the pit. This will provide a minimum of 120 ML of in-pit storage above the level of the main retention pond.

The main changes in the water management system during Stage 4 will be:

- The pre-existing low level retention pond on the eastern side of the pit will be enlarged to provide sufficient capacity (22.5 ML) to meet the water supply requirements.
- For this final stage of operations only, and in order to minimise any backfilling required of the retention pond prior to rehabilitation of the site, no separate provision will be made for a sediment settlement zone within the retention pond. Any water in excess of the water storage requirements will be allowed to pond in the pit. While this may cause some interruption to mining operations, it will only affect a small proportion the pit in the lowest part. The ability of the treatment plant to treat and discharge 1 ML/day will allow normal operations to be restored rapidly.
- Drainage from the stockpiling conveyor and maintenance facilities will continue to be directed into the enlarged retention pond.
- As the surface level is gradually altered to slope towards the east, the former main retention pond will be subsumed as the extraction of material occurs from the area surrounding the retention pond.
- All water for dust suppression and treatment will be sourced from the remaining retention pond.

3.2 DESIGN OF THE MAIN RETENTION POND

As noted above, the main retention pond will serve as a storage reservoir for on-site water needs and as a primary settlement pond for water that will subsequently be treated prior to discharge from the site, or reuse by the village or plant nursery. Any runoff in excess of that retained within the retention pond will be temporarily stored within the extraction area, but will be prevented from draining off-site by the storage capacity available as a result of grading of the extraction surface.

For design purposes, four different water and sediment storage zones have been designated. In sequence, starting from the bottom of the retention pond, these are:

- **Sediment storage zone** which has been designed using the design criteria set out in Chapter 6 and Appendix A of the latest edition of *"Managing Urban Stormwater: Soils and Construction"* (Landcom, 2004). The required settlement storage capacity, allowing for retention of all sediment over the life of the retention pond will increase in proportion to the disturbed area with a requirement of 2.5 ML (2,500 m^3) at the end of Stage 4 of extraction.
- **Water storage zone** which has been designed to provide sufficient capacity to provide for the on-site water needs. The required volume has been established using a long term water balance analysis (see Section 3.5). The required storage volume at the end of Stage 4 of extraction is 18 ML.
- **Sediment settlement zone** which has been designed on the basis of settlement basins for Type F or Type D soils as set out in *"Managing Urban Stormwater: Soils and Construction"* (Landcom, 2004). The adopted design criteria for this component of the retention pond are the most conservative listed, namely:
  - 20 day 95th percentile rainfall 135 mm
  - Volumetric runoff coefficient 0.8

  The design capacity of the sediment settlement zone for the end of Stage 3 is 22 ML.
- **Surcharge zone** which will accommodate all excess runoff from the site in the event of extreme rainfall events such as the 100 year ARI 72 hour storm (307 mm). This runoff will be temporarily stored within the pit above the level of the top of the retention pond. The adequacy of the pit to accommodate the excess runoff is demonstrated by the water balance analysis set out in Section 3.5.

The capacity of the main retention pond will increase progressively as extraction progresses, as shown in Table 1.

Table 1: Main Retention pond Capacity for Various Stages of Extraction

	Stage				
	Preparation	1	2	3	4
Disturbed Area (ha)	1.6	10.0	18.0	20.4	20.9
Sediment storage zone (ML)	0.5	2.5	2.5	2.5	2.5
Water storage zone (ML)	13.0	16.0	17.5	18.0	18.0
Sediment settlement zone (ML)	1.7	10.8	19.5	22.0	2
Required pond capacity (ML)	20.2	31.3	40.0	42.5	20.5
Proposed pond capacity (ML)	32	32	45	45	22.5

Table 2 compares the available surcharge water storage capacity within the pit with the volume of runoff that would occur from a 100 year ARI 72 hour design storm. The surcharge storage capacity within the pit arises because of the proposed 1% downward slope from east to west which forms a wedge shaped storage area with the lowest sections of the pit along the western high wall. As the base of the pit is lowered and width of the pit enlarges, so the width and depth of water that can be stored below the level of the eastern edge of the pit increases. Table 2 shows that, even if the main retention pond was full at the commencement of a 100 year ARI 72 hour design storm, there would be ample excess water storage capacity within the pit. In practice (see water balance analysis in Section 3.5), the average water level in the retention pond will be close to the level corresponding to the water storage zone. Therefore, the volume of the sediment settling zone can also be expected to be available for the retention of runoff from a major storm event.

Table 2: Comparison Between In-pit Storage Volume and 100 year ARI 72 Hour Design Storm Volume

	Stage			
	1	2	3	4
100 year ARI runoff volume (ML)	25	45	50	52
Surcharge zone capacity (ML)	50	220	350	70

3.3 DESIGN OF THE LOWER RETENTION POND

The lower retention pond will act as the capture point for runoff from the area immediately north of the pit. This area contains the haul road leading to the main office and stockpile area, the stockpiling conveyor, the maintenance area and topsoil stockpiles. The total area draining to the lower retention pond is about 3.5 ha. The lower retention pond will also act as a balancing storage for water transferred from the main retention pond.

Water retained in the lower retention pond will be given priority for providing:

- water for dust suppression,
- water for vegetation establishment,

- water for treatment and discharge off-site or transfer to the storage tank for use in the village or by the plant nursery.

The capacity of the lower retention pond will be 10 ML comprising:

- 7.2 ML temporary holding capacity to accommodate runoff from the contributing catchment resulting from a 100 year ARI, 72 hour storm (307 mm of rainfall);
- 2 ML balancing storage for water transferred from the main retention pond. This is equivalent to two day's pumping to the treatment plant;
- 0.8 ML allowance for sediment accumulation.

Because the lower retention pond will act as the primary distribution point for serving various water needs, the water level will be maintained at a low level in order to maintain the design "air space" for runoff capture. Even in the event of a 100 year ARI storm, it would only require 7 days operation of the treatment plant to restore the design "air space".

3.4 WATER TREATMENT PLANT

As stated in the EIS, the slowest settling, most mobile particles in the runoff from the extraction area will be those that consist of the finest kaolin clays, and therefore the most valuable material on site. The treatment plant designed by Worley International Pty Limited will be capable of extracting this fine component. In order to achieve maximum efficiency from the treatment plant, settlement of the coarser fraction will primarily occur within the main retention pond.

We were advised that the plant proposed could meet the required discharge standard of 15 mg/L of suspended solids. Testing of the groundwater contained in the EIS showed that the other water quality parameters would be acceptable so long as the water was not allowed to pond for too long. Evaporation would concentrate naturally occurring minerals and salts within the water and would then need to be diluted with fresh rainwater prior to disposal.

The treatment plant will only be operated periodically. This will occur immediately after stormwater runoff fills the main retention pond above the storage zone level. Because the treatment will only occur in response to runoff, there will be minimal loss by evaporation leading to concentration of minerals and salts in water that is subsequently discharged.

3.5 WATER BALANCE ANALYSIS

In order to verify the performance of the proposed water management system, a daily water balance model has been developed specifically for this site. The model accounts for all the important water related processes occurring on the site including:

- Runoff from the disturbed area that contributes water to the retention pond,
- Rainfall onto, and evaporation from, the water surface in the retention pond,

- Extraction of water for dust suppression purposes,
- Pumping water for treatment and discharge once the water level in the retention pond was above the designated storage zone.

In the model, extraction of water for dust suppression was assessed on the basis of climatic conditions. Dust suppression watering was assumed to occur on all days except when cumulative rainfall exceeded evaporation. Using this method, the assessed annual volume of water required for dust suppression at the end of Stage 4 is 18.5 ML/year, which is slightly more that the average of 50,000 L/day (18 ML/year) documented in the EIS.

Pumped water for treatment and discharge was assumed to occur whenever the water level in the retention pond was above the designated storage zone. Treatment was assumed to occur at a rate of 1 ML/day.

3.5.1 CLIMATIC DATA

The following climatic data was obtained from the Bureau of Meteorology for use in the water balance analysis:

- **Rainfall**
  Lithgow (63224) — 1/4/1889 – 18/5/2005 (1/1/1940 – 31/5/1965) missing (88 years complete)
- **Pan Evaporation**
  Bathurst Agricultural Research Station (63005) — 1/1/1973 – 31/12/2003 (31 years)

Table 3 below summarises the monthly rainfall and evaporation data for the area. It can be seen that average rainfall is fairly uniformly distributed throughout the year, while evaporation, as expected, shows a distinct summer dominance.

Table 3: Monthly and Annual Rainfall and Evaporation

Month	Rainfall (mm)				Evap
	Average	Percentile			Average
		10%	50%	90%	(mm)
1	92.9	25.4	79.8	176.4	181
2	84.3	12.1	65.6	175.3	133
3	85.1	22.1	68.8	155.8	124
4	63.9	11.6	50.6	128.7	86
5	65.1	18.1	46.8	131.2	60
6	67.4	17.5	53.3	145.4	51
7	67.9	15.0	51.3	140.3	56
8	62.9	15.9	46.6	116.5	77
9	59.4	20.4	53.5	104.7	99
10	67.2	19.5	58.9	133.6	137
11	69.6	18.0	65.4	139.2	154
12	75.6	18.6	65.2	143.6	178
Year	859	623	860	1,087	1,336

For water balance modelling purposes, the 30 year period 1973 to 2002 was adopted because both rainfall and evaporation records were available for the whole period. In order to verify the fact that this period is representative of the longer term records a number of checks were carried out on the annual total rainfall as well as rainfall sequences from 1 day to 60 days duration. Tables 4 and 5 summarise the statistics for these two periods. For comparative purposes Table 5 also includes the 50 and 100 year ARI rainfall estimates for Newnes Junction derived from the rainfall intensity:duration data contained in Volume 2 of *"Australian Rainfall & Runoff"* (1987).

Table 4: Highest Rainfall Years in the Lithgow Record

Year	Rainfall (mm)
1990	1363.1
1978	1345.0
1973	1296.5
1893	1266.0
1934	1229.9

Table 4 shows that three of the top five rainfall years at Lithgow are included in the period 1973 -2002 which has been adopted for water balance analysis.

Table 5: Maximum Cumulative Rainfall (mm) over Consecutive Days

Days of	Historic Record		Australian Rainfall & Runoff	
Rainfall	1889-2004	1973-2002	50 year ARI	100 year ARI
1	179	179	195	214
2	268	268	252	273
3	310	310	279	307
4	332	332		
5	338	338		
10	342	342		
15	359	359		
20	360	360		
30	385	385		
45	465	461		
60	595	488		

The data in Table 5 shows two noteworthy features:

- The rainfall during the period 1973 – 2002 contains the highest periods of rainfall for durations up to 30 days that occurred in the whole historic record. In other words, the period 1973 – 2003 contains rainfall data that is representative of the wettest periods that have been recorded at Lithgow.
- For a three day rainfall event, the 1973 – 2004 historic record contains a sequence of wet days that are slightly above the three day 100 year ARI rainfall derived from "*Australian Rainfall and Runoff*". It follows that if the water management system can handle the runoff from the 1973 – 2002 historic rainfall sequence it could also cope with the 100 year ARI three day rainfall.

3.5.2 STORMWATER RUNOFF

For runoff estimation purposes, a rainfall:runoff model developed by the CRC for Catchment Hydrology (Mudgway et al, 1997) has been adopted for this site. The advantage of this model is that it specifically accounts for variation in the impervious fraction of the catchment. The model results mimic the real world and exhibit a variation in the volumetric runoff coefficient depending on the daily rainfall, a small proportion of rainfall is converted into runoff in a low rainfall day and a high proportion on a very wet day. For modelling purposes, it has been assumed that the disturbed area catchment draining to the retention pond will act as though it was 90% impervious. With this degree of imperviousness, the model predicts a volumetric runoff coefficient of 0.85 for a rainfall of 100 mm/day. This is higher than the value of 0.80 adopted for determination of sediment zone capacity and indicates that the adopted model can be expected to generate large volumes of runoff from heavy storms that would test the ability of the water management system to store runoff without uncontrolled discharge.

3.5.3 GROUNDWATER SEEPAGE

In line with the findings of the groundwater study (Kalf & Associates 2003), the long term groundwater seepage into the pit has been taken to be 0.2 ML/day, of which it has been assumed that half would evaporate from the face of the high wall. For water balance modelling purposes, it has also been assumed that the seepage rate is approximately proportional to the area of the exposed high wall (as shown on Figures 3 – 6). Two scenarios for groundwater contribution have been assessed:

- Groundwater seepage is ignored (ie the most critical conditions for running short of water for dust suppression and vegetation establishment purposes).
- Groundwater seepage is included in the analysis (ie the most critical conditions where water levels in the retention ponds and pit are likely to be highest).

3.5.4 WATER BALANCE ANALYSIS

The water balance model has been run for the site preparation stage and all four stages of the extraction process, in order to assess the ability of the water management system to:

- Retain all runoff within the site and only allow discharge by means of pumped water for treatment;
- Provide a high degree of reliability for supply of water for dust suppression and vegetation establishment purposes.

For each stage of the project the catchment area included in the model includes the working extraction pit area, the high wall, the soil stockpile areas to the west of the pit and the haul road and conveyor area. A summary of the main statistics for each Stage of extraction is provided in Table 6 for situations in which groundwater seepage flow is ignored. Figures 11 – 15 are graphs of the water level variation in the retention pond and pit that would occur over a 30 year climate sequence (assuming that there was no change in the site layout in the meantime) and assuming that groundwater made a contribution to the total water supply from the extraction pit. As noted above, the scenarios shown in Figures 11 – 15 represent those conditions in which water levels in the retention ponds and pit are likely to be greatest.

Table 6: Summary of Performance of the Water Management System

Stage >	Prep	1	2	3	4
Catchment area (ha)	16.5	17.0	24.5	26.9	27.2
Effective percentage impervious	50%	90%	90%	90%	90%
Pan factor	0.85	0.85	0.85	0.85	0.85
Dust suppression area	1.5	3.0	3.0	3.0	3.0
Discharge treatment rate (ML/day)	1	1	1	1	1
Minimum storage for treatment to occur	12.6	16.8	17.5	18.0	18.0
Width of pit storage area (m)	50	150	280	350	350
Length of pit storage area (m)	300	400	400	400	600
Average runoff (ML/year)	38.8	61.0	87.9	96.5	97.4
Total pond volume (ML)	42	42	50	50	22.5
Water Consumed for Dust Suppression (ML/year)	9.3	18.6	18.5	18.5	18.5
Days per year watering for dust suppression occurs	124	124	125	125	125
Water treated for discharge (ML/year)	20.2	33.1	58.1	66.7	68.7
Days per year water treated for discharge	20.2	33.1	58.1	66.7	68.7
Maximum storage in record (ML)	44.4	52.8	76.6	85.8	87.5
Maximum storage area (ha)	1.45	3.08	4.69	5.42	8.90
Maximum water depth above pond (m)	0.48	0.77	1.17	1.35	1.48
Maximum days water level above pond level	5	14	29	37	74
Minimum storage in record (ML)	0	0	0	0	0.8
Average days empty per year	2.1	1.6	0.8	0.4	0.0

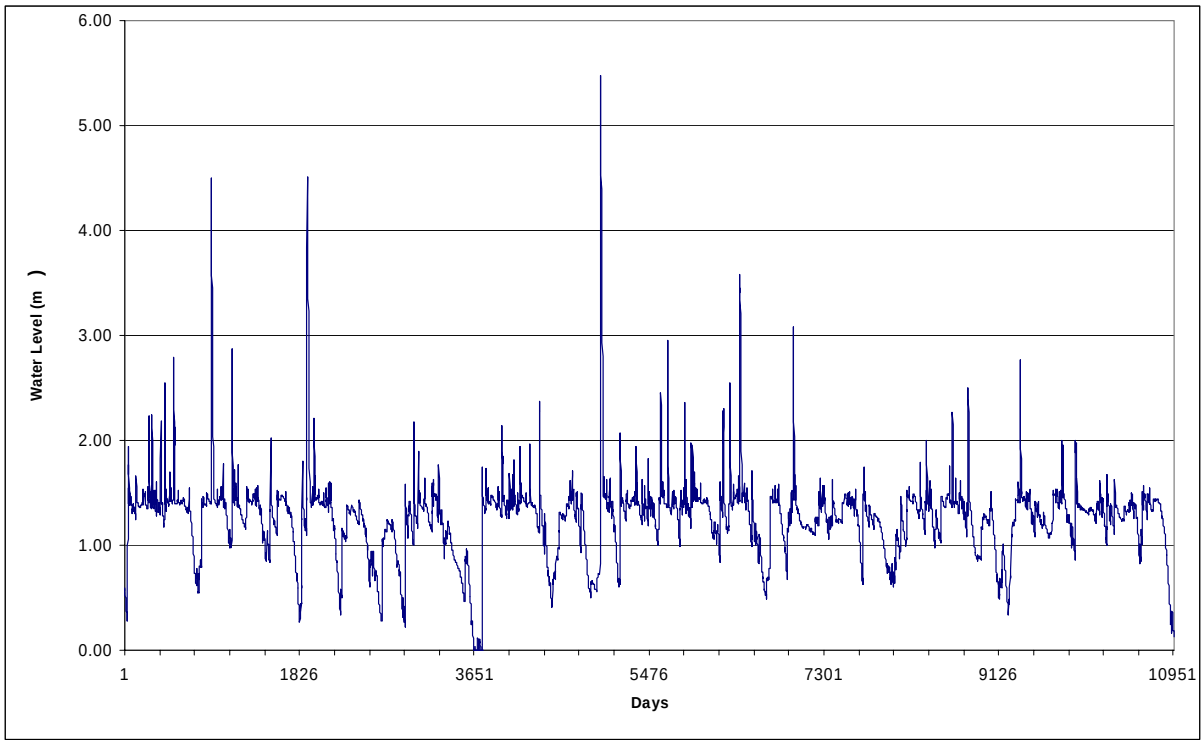


Figure 11
Pond Water Level Variation over 30 Years – Site Preparation Conditions

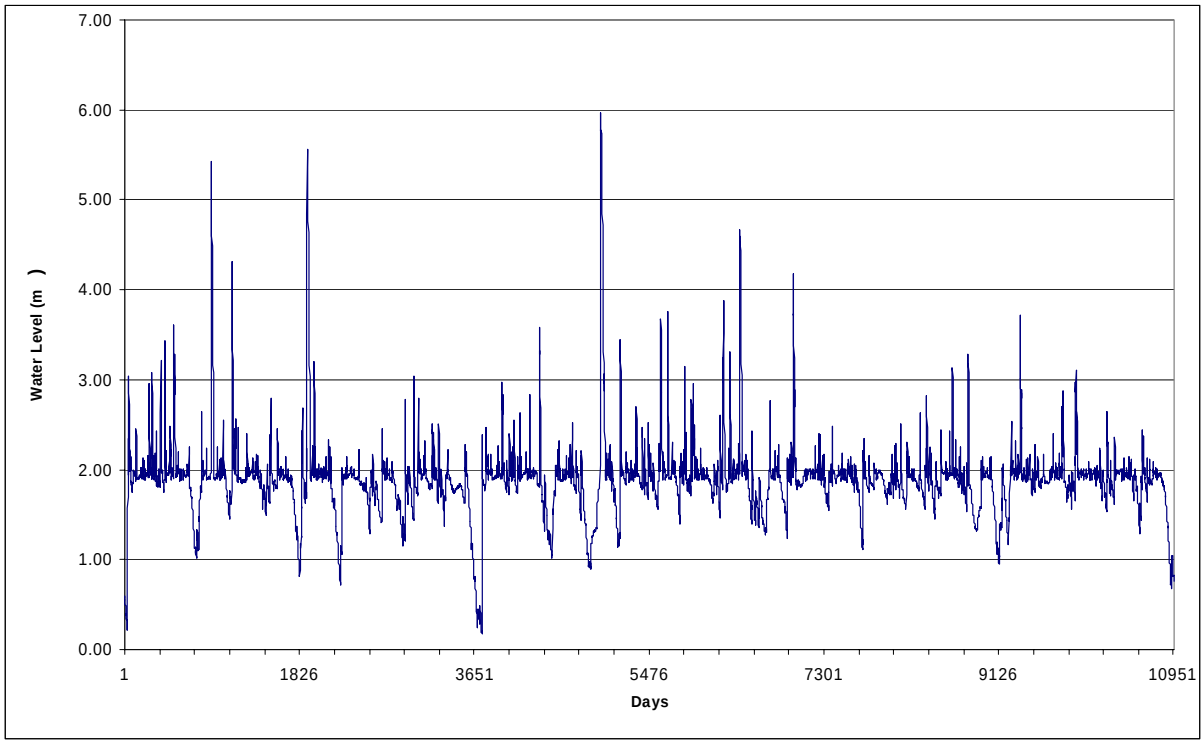


Figure 12
Pond Water Level Variation over 30 Years – Stage 1 Conditions

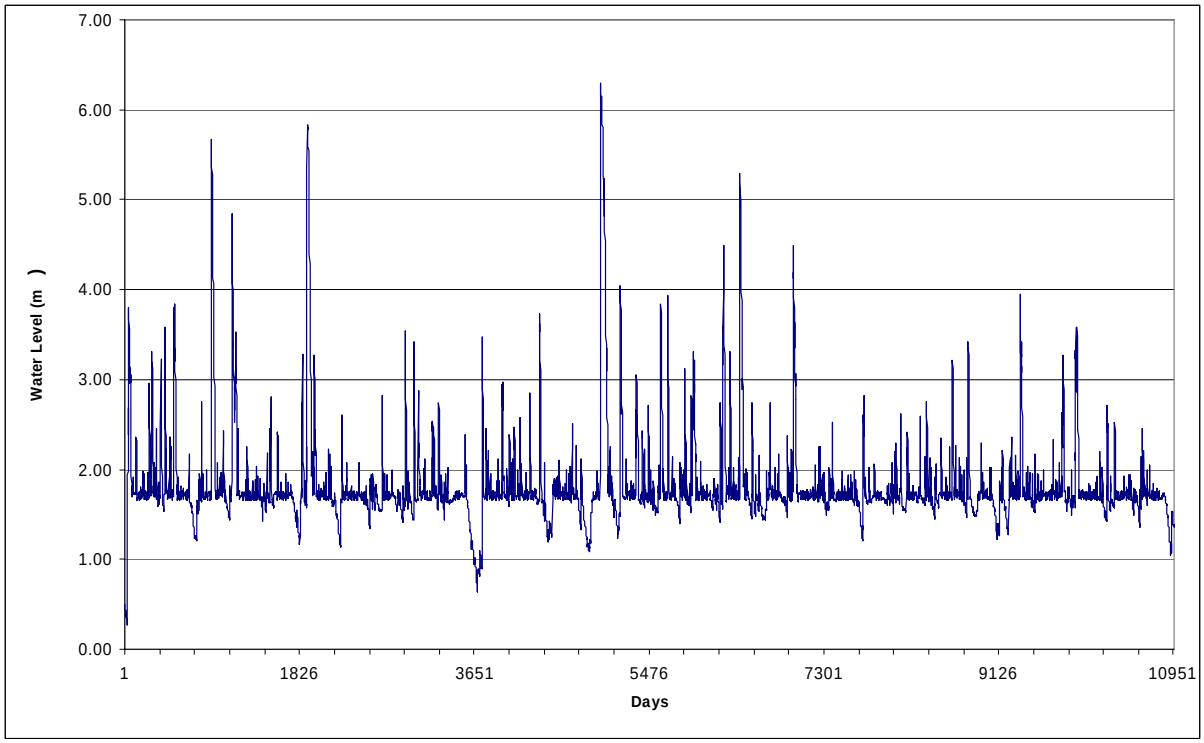


Figure 13
Pond Water Level Variation over 30 Years – Stage 2 Conditions

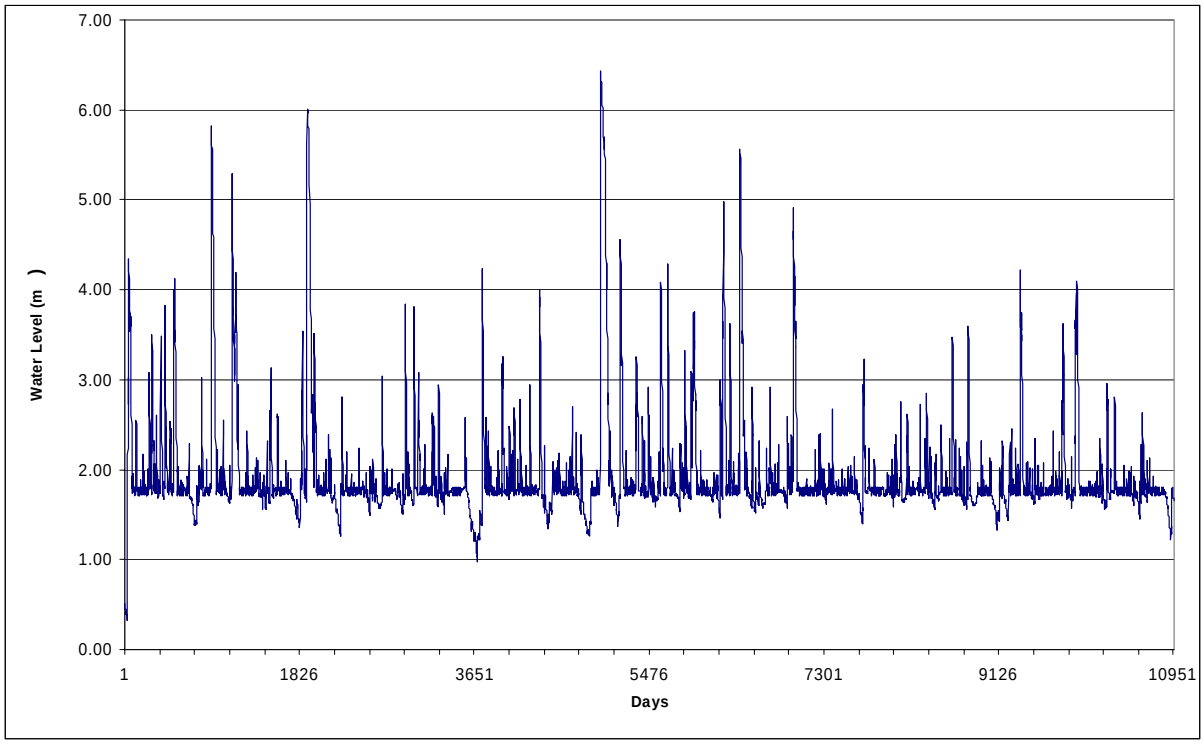


Figure 14
Pond Water Level Variation over 30 Years – Stage 3 Conditions

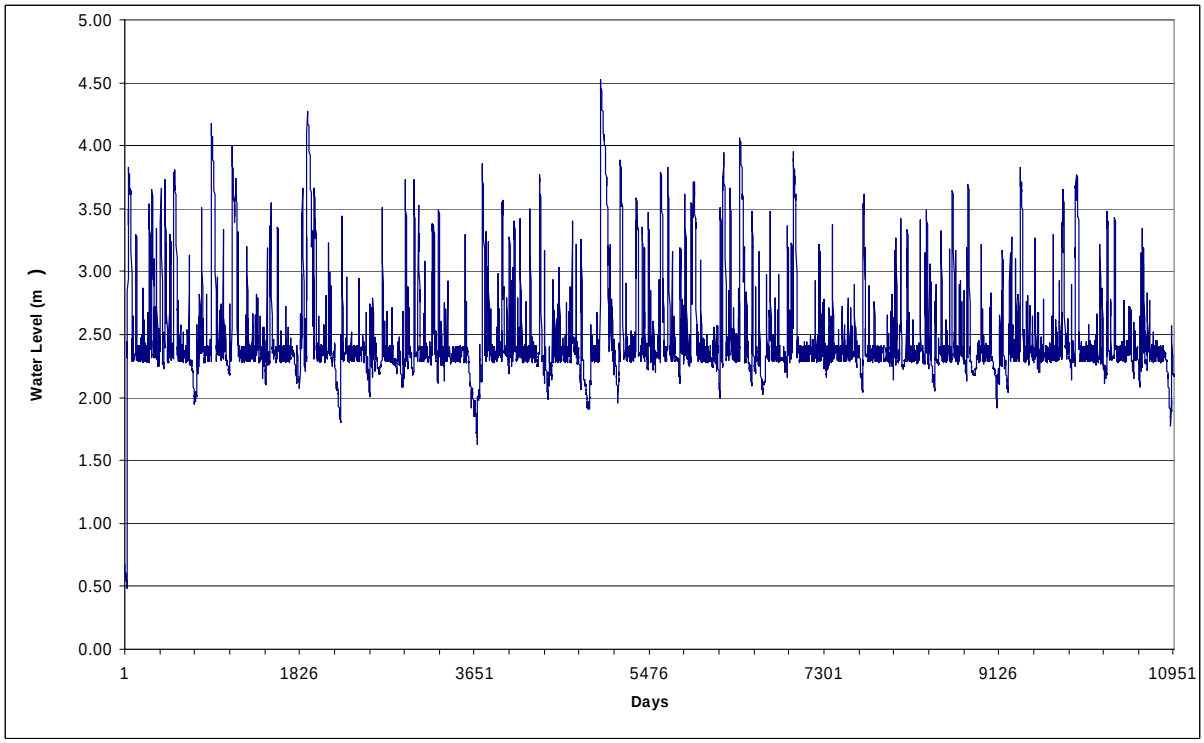


Figure 15
Pond Water Level Variation over 30 Years – Stage 4 Conditions

The summary statistics in Table 6 and Figures 11 – 15 show the following key aspects of the expected performance of the water management system:

- During all stages, the total storage capacity of the site will be in excess of the 1 in 100 year, 72 hour storm event. Even during Stage 4, when there is the largest contributing catchment and only a relatively small retention pond (in preparation for rehabilitation), the maximum depth of ponded water above the edge of the retention pond would be about 1.5 m, corresponding to a maximum volume of excess stored water of about 65 ML. This volume compares to the total volume of the pit below the eastern lip of about 120 ML at this Stage of the project. There would therefore be a large factor of safety against any uncontrolled discharge draining into the adjoining World Heritage Area. During Stages 2 and 3 the available in-pit storage (220 ML and 350 ML respectively) is about 10 times the maximum required storage outside the retention pond (27 ML and 36 ML respectively).
- If a rainfall sequence occurred that led to storage of about 65 ML above the level of the retention pond during Stage 4, it would only take eight weeks of operation of the treatment plant to remove all water from the section of the working area that had been inundated (about 9 ha). For Stages 2 and 3 the maximum require time would be four to five weeks.
- For all Stages the water management system has sufficient capacity to provide the estimated water required for dust suppression and vegetation establishment.

3.6 WATER REUSE OPTIONS

After removal of solids, the expected water quality would be suitable for discharge offsite. Due to the nature of the sandstone resource and lack of mineralisation, groundwater inflows are generally potable and are in fact used for domestic drinking water and commercial bottled water operations. This fact allows for greater reuse options should the site not be allowed to discharge. Options available include supplying an on site nursery which will be developed in conjunction with Lithgow Nurseries and developing a water supply system for Newnes Junction.

Although other reuse options may be developed, the water pollution control system as provided in the EIS and further clarified in this report, should not preclude discharge offsite if the necessary water quality criteria are met.

3.7 CLEAN WATER DIVERSION CHANNELS

Two sections of clean water diversion channel will be developed as permanent features of the landscape which will continue to function after extraction has been completed. The first section will be constructed during site preparation (see Figure 2). It will run in a southerly direction approximately parallel to the western edge of the pit, and discharge into the southern creek that discharges from the

extraction pit area. This channel will intercept clean runoff from a catchment area of about 8 ha located to the west of the pit.

As a result of the proposal to avoid a small swampy area within the southern drainage line, a second diversion channel will be constructed as part of the Stage 2 works (see Figure 4) to redirect clean water runoff from the catchment area from above the pit. This diversion channel, which has a total catchment area of about 16 ha, will commence at about the same location as the first channel joins the southern creek and convey water around the southern end of the pit.

Both channels will be designed to convey the 100 year ARI peak flow for the catchment concerned (approximately 4 m^3/s and 6.5 m^3/s respectively). The routes of both channels will require excavation in rock and in some places the channel will need to be cut 2-3 m deep in order to achieve a satisfactory grade. In other locations, the channels are required to convey water down grades in excess of 10%. In these locations it is likely that constructed drop structures will be required to control velocity and prevent scour of the friable sandstone.

3.8 MAINTENANCE AREA

A small maintenance area will be established near the eastern end of the conveyor. This area will include a workshop for maintenance of machinery and re-fuelling facilities. All maintenance work will be conducted within the workshop. The fuel storage area will be appropriately bunded in accordance with DEC requirements for spill containment. The hardstand area outside the workshop and adjacent to the refuelling facility will be sealed and graded so as to drain all runoff to a oil trap before discharging into the drainage system connected to the lower retention pond.

3.9 SOIL STOCKPILES

A number of soil stockpiles will be established around the western and northern edges of the pit. As described in the EIS these stockpiles will be protected with sediment fencing and planted with a cover crop to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct runoff into the pit.

4.0 WATER MANAGEMENT SYSTEM – REHABILITATION PHASE

4.1 OVERVIEW

At the completion of operations, the extraction pit will have a floor level grading from RL 989.5 m AHD on the eastern side adjacent to the retention pond to 993 m AHD on the western side. The final major operational activity will be to excavate sufficient extra material to refill the remaining retention pond (located on the eastern side of the pit) to a level consistent with the surrounding excavated area. A small retention pond (about 20 m^3) will be retained to provide an extraction point for water to be pumped to the treatment plant.

During the initial phase of rehabilitation the water management system will continue to operate in a similar manner to the final operational phase with off site discharge only occurring by means of water discharged from the treatment plant. The treatment plant will be operated so as to retain a wetland swamp area with water up to a maximum of 0.5 m deep in the centre of the remnant depression.

Once vegetation establishment has reached a stage where there is judged to be minimal erosion (approximately 5 years), the site will be reconfigured to permit free drainage of water from the site once the wetland/swamp is filled to a depth of 0.5 m. A channel will be excavated through the rock at an elevation of 990 m AHD (0.5 m above the base of the wetland swamp) to allow free drainage from the pit into the existing northern creek that drains into the World Heritage Area.

4.2 PROPOSED WETLAND

As noted above, the wetland would be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit. The area surrounding the location of the final retention pond will be graded at flatter grades (typically 0.5%) than used elsewhere in the pit (1.0%) in order to create a free form shallow depression with a total area of about 4 ha. It is anticipated that sedges and other wetland plants endemic to the area will colonise this wetland area to form a swamp ecosystem analogous to that in Gooches Crater (see Figure 16).

Once a channel has been excavated to allow overflow from the wetland to discharge off-site, the wetland will be dependant on water supply from the contributing catchment of about 24 ha. The water balance model developed for the operational phases of the project (see Section 3.5) has been modified to account for the expected runoff characteristics of the rehabilitated catchment and used to assess the wetting and drying behaviour of the wetland as a result of surface runoff (Figure 17). (Note that in practice, it is anticipated that some groundwater seepage will assist in maintaining water within the wetland for longer than shown by the analysis).

The main aspects of the water balance analysis are summarised in Table 7.



Figure 16
Gooches Crater

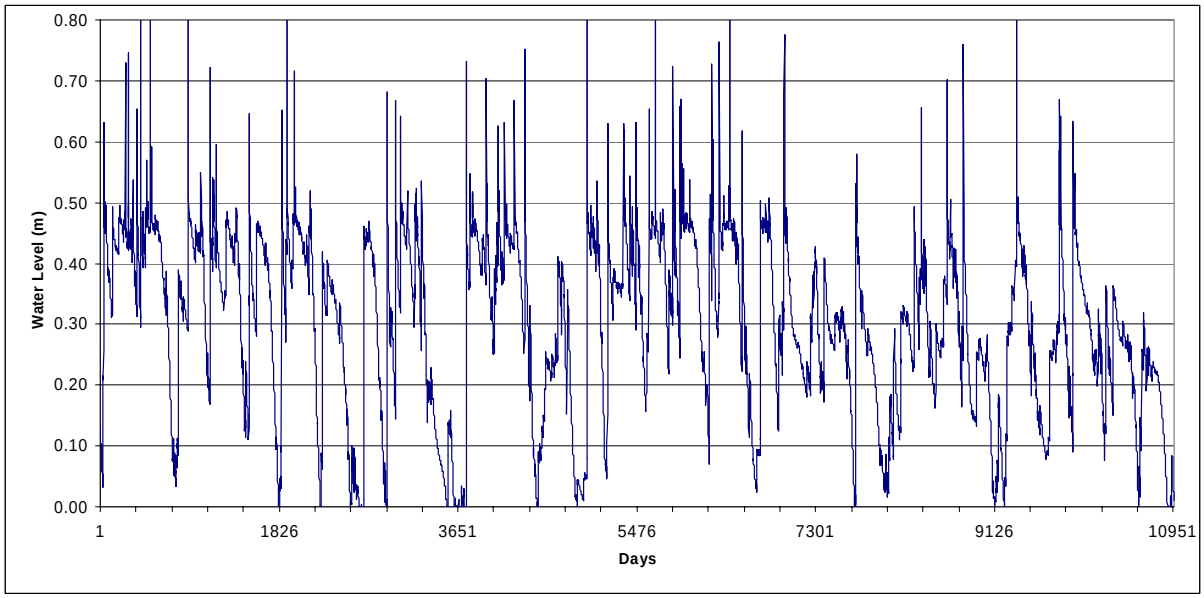


Figure 17
Water Level Variation over 30 Years – Wetland after Rehabilitation

Table 7: Hydrologic Behaviour of the Wetland System

Catchment area (ha)	24
Effective percentage impervious	20%
Pan factor	0.85
Overflow level above lip of main pond	0.5
Total storage at overflow (ML)	7.40
Average Runoff (ML)	34.1
Average overflow (ML/year)	16.7
Days per year overflow occurs	8
Maximum storage in record (ML)	7.4
Maximum storage area (ha)	5.14
Minimum storage in record (ML)	0.0
Average days empty per year	6

The data in Table 7 and Figure 17 shows that the water level in the wetland system would vary significantly, but that the wetland would dry out relatively infrequently. On occasions when the wetland did dry out it would only remain dry for a relatively short period of time.

5.0 CONCLUSIONS

The analysis presented in this report demonstrates that, during the operational stages, the proposed water management system is capable of:

- Ensuring that no uncontrolled runoff can leave the site even in the event of a 100 year ARI three day storm.
- Treating and discharging excess water collected on site.
- Providing an adequate supply of water for dust suppression and other purposes.

As part of the final rehabilitation a wetland swamp area will be created in the north –eastern corner of the site. During the rehabilitation stage of the project, the water treatment plant will be retained and operate in the same manner as during the operational phase. Following successful establishment of vegetation and consequent reduction in sediment loads in runoff, the treatment plant will be decommissioned. At the same time the site will be converted to be free draining by the construction of a small channel to allow overflow from the wetland to drain into the northern creek.

6.0 REFERENCES

Mudgway, L B, Duncan, H P, McMahon, T A, Chiew F H S, (1997), *"Best Practice Environmental Guidelines for Urban Stormwater"*, CRC for Catchment Hydrology, Report 97/7.

Institution of Engineers Australia, (1998), *"Australian Rainfall and Runoff, A Guide to Flood Estimation"*, Volumes I and II.

Kalf & Associates, (2002), *"Hydrogeological Assessment of Proposed Newnes Junction Kaolin Pit"*.

Landcom, (2004), *"Managing Urban Stormwater; Soils and Construction"* Volume 1, (4th Edition).

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT E

Archaeological Assessment Supplement

Mills Archaeological and Heritage Services

August 2003

D O C U M E N T E

Mills Archaeological and Heritage Services Pty Ltd.
60 Watkin Street
Newtown 2042
Ph: (02) 95171413
Fax: (02) 95179860
Email: robynnemills@ozemail.com.au
****

Response to NPWS comments on the Archaeological assessment of the Kaolin Project, Newnes – Lithgow.

Two experienced archaeologists and an experienced field officer from the Bathurst LALC conducted the survey of the Kaolin Mine. It is the professional opinion of the consultants and the LALC representative, that there are no "*heritage values*" located "*on the development area"*. This assessment is based on the survey of 38 ha of the Kaolin development area of which, taking an average 30% visibility across the site into account, an estimated 30.8% or 11.6 ha were effectively surveyed. As stated, visibility across the survey area averaged 30% and photographs 3 and 4 presented in the report show this to be the case.

The predictive model used for this survey was developed and tested at the adjacent Clarence Mine Lease Area where Mills and Kelton surveyed a 2,600 hectare area and identified:

- 4 open camp sites
- 2 shelters with artefacts
- 3 PADs,
- re-identified the location of NPWS Site #45-2-0186 (shelter with art)
- 4 areas of archaeological sensitivity
- the creation of two exclusion zones was recommended.

These results verify the site distribution potential identified in the predictive model.

The fact that no sites or PADs were identified by the consultants and the LALC representative within the Kaolin development area was not the result of either the limited nature of the survey or the absence of ground visibility, but rather the result of the absence of potential archaeologically sensitive landform units within the survey area.

- 87% of the survey area was steep hillslope where the possibility of large camp sites being present is extremely low
- The hillcrest area which constituted 5.3% of the surveyed area had been heavily impacted by the Clarence coal stockpile but was subject to a 100% on foot assessment.
- There are no permanent creeklines, springs or swamps within the Kaolin boundaries.
- There were no depositional landforms present within the Kaolin boundaries and negligible topsoil resources indicating a very low potential for subsurface artefacts.

Therefore the likelihood of large sites being present in the development area is extremely low.

Predictive modelling is not an exact science however, the model developed and tested by Mills and Kelton over a 2,638 ha area of the Clarence and Kaolin development areas shows unequivocally that Aboriginal activities were focused on sandstone outcrops and outliers, hanging swamps, springs, permanent streams and to a lesser degree ridgeline and crests where limited evidence for use of the area for transport routes was identified.

None of these highly sensitive landform units are present in the Kaolin area.

Because of factors such as visibility on the day and/or the extent of the survey, one can never say definitively that there is no potential for sites to be present in a particular survey area. Indeed one could say that any reasonably intact area in the State of NSW has a potential for archaeological material to be present. However the real test is to identify locations in which sites of potentially high scientific and or cultural significance are present.

Surveys over 2,638ha in the Clarence Mine and Kaolin Sands Quarry areas by Mills and Kelton have identified with a high degree of certainty, areas of potentially high archaeological significance and have recommended that these areas be included in an exclusion zone. These areas, which lie outside the Kaolin project area have been included in subsidence protection zones within the Clarence Colliery mine plan.

It is the opinion of the consultants and the LALC representative that *"Preliminary observations"* at the Kaolin Mine do not need to be substantiated by sub-surface testing as no areas where sub-surface testing was appropriate or justified were identified.

Cultural Assessment

Prior to this survey extensive consultation was undertaken with the following Aboriginal groups to determine those groups who had an interest and cultural affiliation with the survey area.

- State LALC (General inquiries)
- Deerubbin LALC (Kevin Kavanagh)
- Gandangara LALC (Lenny Malone)
- Bathurst LALC (Warwick Peckham)

Details of this consultation are set out in section 2 of the report.
As a result of this consultation it was determined by the Aboriginal communities that the group, which should investigate the area was Bathurst LALC.

Bathurst LALC concludes that no sites or areas of potential archaeological deposit (PADs) are present within the Kaolin Survey area.

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT F

Conservation, Restoration, and Enhancement Project

Sydney Construction Materials

November 2004

Newnes Plateau Conservation, Restoration, and Enhancement Project



A component of the Sydney Construction Materials Newnes Junction Sand and Kaolin Extraction Proposal

Developed under the NSW Government Green Offsets Policy process

November 2004

Executive Summary

Sydney Construction Materials is seeking approval for the development of a construction sand, specialty sand, and Kaolin extraction operation at Newnes Junction, near Lithgow.

Consistent with emerging NSW environmental offsets policy, Sydney Construction Materials has prepared a report entitled "Newnes Junction Conservation, Restoration, and Enhancement Project" to provide the basis for ensuring that the net environmental result of the development is positive.

The project involves the adoption of nine offset objectives, designed with the NSW Government's developing offsets policy in mind. This will provide a framework for the execution of the projects described in this paper, and will enable relevant government authorities to gauge the success of this strategy. Sydney Construction Materials intends to work with these government authorities to ensure the final result of this operation is a net gain for the community and the environment.

Sydney Construction Materials intends to mitigate the impact of the Newnes Junction development through the provision of both on-site and off-site offsets. On-site offsets include innovative rehabilitation and final landform design techniques that will be employed to create an area that is aesthetically appealing and consistent with the surrounding landscape. Indeed, the final landform design is based on the nearby Gooches Crater, a picture of which is shown on the front cover of this paper. Off-site, three separate offset projects will be undertaken:

1. The first project involves the rehabilitation of a nearby area of Newnes Plateau Shrub Swamp, an important plant community in the region, and a potential habitat for endangered fauna species.
2. The second project involves the rehabilitation and on-going management of a scenic and historically significant area of vacant Crown land – the Dargan's Creek Reserve.

   (The final objective of projects 1 and 2 is to have them classified as Reserve Crown lands to ensure their long-term management and protection.)
3. The third project involves the establishment of a native plant nursery to provide plant stock for the extractive operation's rehabilitation, and to supply the local community with a variety of native flora.

Sydney Construction Materials will provide upfront funding for these offsets, and will continue to fund them for the duration of the development. It is proposed that the Hawkesbury-Nepean Catchment Management Authority (HNCMA) become the Scheme Manager, holding and disbursing the funds, and using its standard project reporting process to report to the Company, DIPNR, NSW EPA, and other relevant stakeholders.

The implementation of this strategy will provide a benchmark for environmentally friendly extractive operations that are capable of delivering significant environmental, economic, and social gains to the wider community.

Table of Contents

1. Introduction 1
1.1 Project background 1
1.2 Acknowledgements 2

2. Current green offset regulatory environment 3
2.1 Government policy development 3
2.2 Green offsets for sustainable development: concept paper 4
2.3 Offsets, salinity and native vegetation: discussion paper 4

3. Objectives 7

4. The offsets 8
4.1 Introduction 8
4.2 Funds 8
4.3 Scheme manager 8
4.4 On-site offsets 8
4.5 Off-site offsets 18
4.6 Future rehabilitation prospects 26

5. Fulfilment of objectives 27
5.1 Objective 1 27
5.2 Objective 2 27
5.3 Objective 3 27
5.4 Objective 4 35
5.5 Objective 5 35
5.6 Objective 6 36
5.7 Objective 7 36
5.8 Objective 8 36
5.9 Objective 9 36

6. Conclusion 38

1. Introduction

1.1 Project background

Sydney Construction Materials is currently in the process of gaining approval for the development of a multi-commodity friable sandstone resource on the Newnes Plateau, approximately 10km East of Lithgow. The project is unique in many ways and it differs to other conventional quarries/mines in that:

- it will utilise innovative, state-of-the-art surface mining technology;
- there will be no on-site processing – all resource will be processed off-site in the Sydney Metropolitan region;
- all resource will be transported off-site by rail – there will be no off-site truck transport of any resource;
- all components of the resource will be utilised – there will be no waste products;
- the project will employ progressive rehabilitation using terraced landscaping with native species throughout the life of the development.;
- the mine plan has been designed such that all water on the site will drain towards the mine. There will be no uncontrolled discharges of water from the site – all water to be released (max. 1ML/day) be controlled, and will first be treated to ANZECC Code standards; and
- there will be no EPA Industrial Noise Policy exceedances for the life of the project.

This proposal will assist in the provision of sand and other construction materials for Sydney's construction industry, eventually supplying over 1 million tonnes per annum (tpa) to feed the city's 7 million tpa appetite. Construction sand will comprise the bulk of the products from the site at approximately 82.5% of the resource by weight. This will be used for the production of ready mixed concrete, fibre cement, and other pre-made concrete products. Miscellaneous sand markets, including asphalt manufacture, general building and plumbing applications, landscaping applications, and bagged 'hardware' sands, will also be supplied by this development.

The proposal will also supply specialty sands including silica flour, fine silica flour, glass sand (flint and amber grade), and filter and drainage sand, as well as a range of high quality recreational and landscaping sands. This group of products accounts for just under 9.1% of the Newnes Junction resource by weight.

By far the most valuable component of the resource, however, is the kaolin, although only comprising 8.5% of the resource by weight. Products using Kaolin include bricks, pavers, ceramics, refractories, pozzolans (concrete strength enhancer), and high-value calcined kaolin, used for paper coating, paper fillers, paint and plastics fillers, and adhesive fillers.

The specialty sands and kaolin products are currently imported from other States, and, for some products, from overseas. The establishment of this development, therefore, would result in the creation of significant import replacements. Every part of the friable sandstone resource will be utilised – there will be no waste products whatsoever.

The Newnes Junction project will necessitate the progressive clearing of approximately 25ha of sparsely populated regrowth situated on Crown Land. Although there are no rare or threatened species on the project site (see Gunninah Environmental Consultants Flora and Fauna survey), and the mine site will be rehabilitated, Sydney Construction Materials, in conjunction with the Lithgow Landcare department, intends to offset the loss of this habitat through the establishment of environmental restoration projects. The establishment of these

projects will aim to satisfy the objects of the developing NSW Government policy for significant developments – minimal, or zero, net environmental impact.

1.2 Acknowledgements

In developing this Conservation, Restoration, and Enhancement Project, Sydney Construction Materials has made use of the discussion and concept papers produced by the NSW EPA and DIPNR (discussed in section 2 below).

Further, the offset strategy and objectives developed by Umwelt (Australia) Pty Ltd for the Hunter Valley Coal Corporation (HVCC) Mt Owen Operations Environmental Impact Statement, 2003, were used as a basis for this proposal. Particular note is made of the letter in Appendix A of the above EIS from NPWS and DIPNR to Umwelt concerning the Offset Objectives and Assessment Criteria of the HVCC Biodiversity Offset Strategy. This feedback has also been incorporated into the development of Sydney Construction Materials' Newnes Plateau Conservation, Restoration, and Enhancement Project (the Strategy).

The green offset projects described below have been developed in conjunction with the Lithgow office of the Department of Infrastructure, Planning, and Natural Resources (DIPNR) and the Lithgow Landcare office. Matt Grey, Eric Mahony, and Trish Kidd were of particular assistance in the development of this strategy.

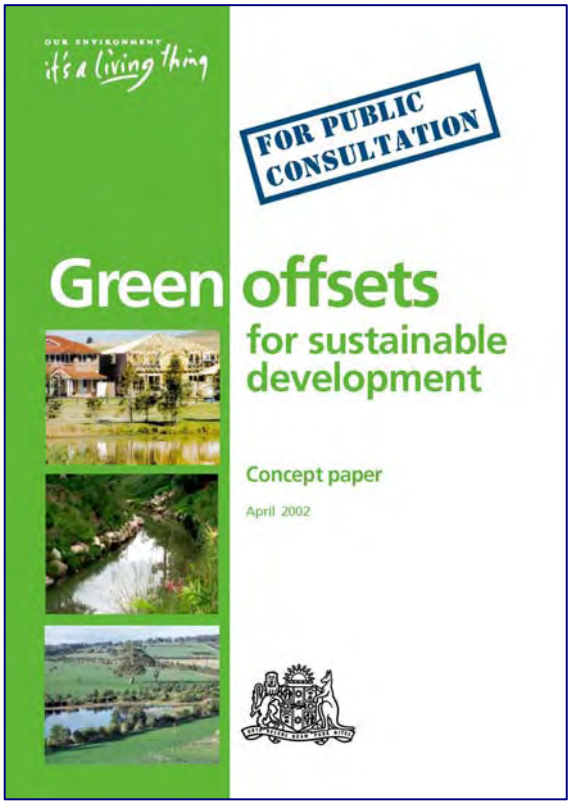
2. Current green offset regulatory environment

Current government policy has been considered in the development of the green offset projects proposed in this strategy, which are discussed in detail in Section 3 below. This section summarises the current state of green offset policy.

2.1 Government policy development

The NSW government is in the process of developing a framework for green offsets and in particular, a "native vegetation offset" policy, which will set out:

- cases where offsets may be used,
- whether offset requirements should be set on a case-by-case basis or through ratios common across a region or state,
- how to balance the social, economic and environmental impacts of developments where land clearing is involved,
- practical and robust measurement and prediction methods to assess the current condition of native vegetation to be cleared and the benefits of offset actions; and
- mechanisms to ensure the ongoing management of offset sites over the long term.



Papers relating to green offsets released by the NSW Government include the following:

- *Green Offsets for Sustainable Development: Concept Paper*, NSW Environment Protection Authority (EPA), April 2002, and
- *Offsets, Salinity and Native Vegetation: Discussion Paper*, Department of Land and Water Conservation (DLWC, now DIPNR), July 2001.

An overview of these papers is provided below.

It should be noted that at present, there is no "overarching offsetting policy endorsed by the NSW Government."[1] Further, while the Concept Paper and Discussion Paper (outlined below) "have provided a useful introduction to the issues associated with offsetting, [they] do not represent an endorsed Government position."[1] Sydney Construction Materials recognises, therefore, that green offsets policy is currently still in development, that it will continue to develop throughout the course of this project's development, and that it will most likely be subject to change as more information becomes available. Sydney Construction Materials is committed to ensuring that the environmental integrity of the Newnes Plateau area is maintained well into the future, and will work with relevant government agencies to safeguard the ecological properties of the region.

[1] Quoted from NPWS/DIPNR letter to Umwelt, September 2003.

2.2 Green offsets for sustainable development: concept paper

This paper outlines the principles underlying green offsets. A green offset is defined by the EPA (2002) as an action taken outside a development site (but near to it) that reduces pollution or environmental impacts. Green offset schemes ensure that there is a net environmental improvement as a result of development.

2.2.1 Principles of green offset schemes

The principles of green offset schemes include the following:

- environmental impacts must be avoided first by using all cost-effective prevention and mitigation measures. Offsets are then only used to address remaining environmental impacts;
- all standard regulatory requirements must be met;
- offsets must never reward ongoing poor environmental performance;
- offsets will complement other government programs; and
- offsets must result in a net environmental improvement.

Offsets must be:

- enduring – they must offset the impact for the period that the impact occurs;
- quantifiable – the impacts and benefits must be readily identifiable;
- targeted – offset the impacts on a "like for like" or better basis;
- located appropriately – offset the impact in the same area;
- supplementary – beyond the existing requirements and not already being funded under another scheme;
- enforceable – through development consent conditions, licence conditions, covenants or contract.

All offsets will be based on open and accountable administration, with safeguards, such as advisory panels to oversee offset schemes. Each scheme will be required to produce a public annual report.

The paper also explores the establishment of combined offset funds administered by a scheme manager and overseen by an advisory panel, whereby financial contributions are pooled to allow for larger offset works programs.

2.3 Offsets, salinity and native vegetation: discussion paper

DIPNR proposes the following principles for a native vegetation offset policy.

1. It should be consistent with relevant government policies;
2. It should provide a net gain that improves the condition of the environment, that is:
    a. based on "like for like" or better;
        - involving a similar vegetation type or one with higher environmental value;
        - vegetation to be ranked based on values most relevant to the region.
    b. clearly defined, measurable units to assess the environmental value of native vegetation and offset sites;
    c. effective for the period that the clearing has an impact; and

d. based on the best available science.

3. It should not lead to permanent environmental costs, due to the delay before offset actions yield environmental benefits. Offsets should only be applied where:

   a. the values lost can be replaced at least as rapidly as they are lost;

   b. where the loss of values causes no permanent harm; or

   c. where clearing is postponed until the offset is fully functional.

   Where time lags are relatively short and the risk is manageable, it may be possible to compensate for time lag by increasing the number of offset credits required e.g. larger offset.

4. It should only proceed when the offset site is making acceptable progress towards the predicted ecological state, and management arrangements are legally secure.

   a. This does not mean the offset must be fully mature,

   b. Achievement of specified standard before clearing proceeds, or

   c. It may be acceptable to see that certain actions towards implementing the offset have been taken e.g. fences, stock excluded, trees planted.

An offset policy would be based on a system of credits and debits with possible options for calculating these being the use of regional offset ratios, on a case-by-case basis using a set formula, or monetary contributions to a pool of funds. Environmental variables are identified and measured (such as habitat structural diversity, presences of weeds, topographic complexity and species richness). When determining the required offsets, the following should be considered:


Offsets, Salinity and Native Vegetation

Discussion Paper

CONTENTS Page

Executive Summary	2
1. Introduction	4
2. Policy background	5
3. Proposed principles for an offset policy	7
4. Calculating credits and debits	12
5. Developing an offset agreement	14
6. An offset policy – costs, advantages and obstacles	15
7. Offsets and potential market mechanisms	18
8. Extending offsets to other forms of development	21
9. Next steps	22
Appendix 1	23
Appendix 2	25
Appendix 3	27
DLWC Contacts	28

- the area of clearing;
- the negative impact of the clearing, expressed as a set of environmental values lost;
- the area of the offset action;
- the positive impact of the offset action;
- risk of the offset failing;
- the net gain required for environmental improvement; and
- the adjustment (where applicable) for time lag.

Potential offset actions include:

- revegetation of previously cleared area;
- regeneration;
- restoration – quality and extent of native vegetation improved through combination of regeneration and revegetation; and
- enhancement – quality of an area improved through management actions.

Offset actions should only be used where there are good prospects that it will lead to improvement in environmental values.

Given the lack of research and data in this area, an adaptive and precautionary approach is needed until knowledge improves and as such:

- clearing can not be justified if the impact of the clearing or the benefit of the offset cannot be estimated adequately;
- ongoing monitoring is required to assess effectiveness of offsets; and
- offset requirements must be reviewed as knowledge improves.

2.3.1 Developing an offset agreement

DIPNR considers that the five steps in implementing an offset agreement are as follows:

1. determine if clearing with offset is permitted – permissibility may be documented in regional vegetation management plan or catchment management plan;
2. determine baseline conditions – of land to be cleared and offsets, so that offset debits and credits can be calculated;
3. develop proposed offset arrangement;
4. confirm offset arrangement – with relevant stakeholders;
5. monitor compliance – management plan.

3. Objectives

Given the status of current government policy regarding green offsets, the currently available literature on green offsets was considered in the development of objectives and assessment criteria for the Strategy. Table 1 below outlines the specific objectives to be addressed by the Strategy.[2]

Sydney Construction Materials has reviewed the objectives, and has amended them to address the particular circumstances of the Newnes Junction proposal. Upon granting of Development Approval, Sydney Construction Materials will progress the details for each of the projects (discussed in Section 4.5 below), and prepare criteria for assessing their success.

No.	Objective
1.	Environmental impacts are avoided using all cost effective measures available with offsets used only to address remaining impacts
2.	Regulatory requirements met, and offsets consistent with government policy
3.	Net environmental improvement, i.e. "like for like" or better, in terms of: • Quantity: area of community / habitat to be retained, revegetated, rehabilitated. • Quality: species diversity; vegetation density; age / maturity; vegetation health; level of disturbance from weeds and presence/abundance of feral animals; specific habitat details for each key species. • Physical, biological and chemical constraints: erosion; soils; surface and groundwater; topography.
4.	No permanent environmental costs due to time lag in establishing offset
5.	Offset to last for the term of the impact
6.	Impacts and benefits are readily identifiable and quantifiable
7.	Offsets are located appropriately – offsets the impact in the same area
8.	Offset areas are supplementary beyond existing requirements i.e. must be in addition to existing offset areas
9.	Minimise risk and threats: • enforceable and legally secure • threats from future development and land use conflicts • adequate resources for management and monitoring, including best practice, adaptive management, open and accountable administration such as advisory panel and public annual report

Table 1: Green offset strategy objectives and criteria

[2] Adapted from Umwelt (Australia) Pty Ltd in the Hunter Valley Coal Corporation Mt Owen Operations Environmental Impact Statement, 2003.

4. The offsets

4.1 Introduction

Sydney Construction Materials is committed to the improvement and protection of the environment at the proposed development site and on degraded lands near the site. This is demonstrated by the inclusion of a progressive rehabilitation program (with the use of terraced landscaping techniques), in conjunction with this Strategy, which are designed to rehabilitate degraded sites on and near the proposed development.

The Projects outlined here form the structure of a program of investment in environmental projects and related activities, which, it is anticipated, will become part of the conditions of consent for the development. A well planned and managed green offsets strategy will provide a model for future developments in this sector of the Hawkesbury Nepean Catchment and elsewhere.

Three specific projects have been identified that will, over the life of the development, enable the rehabilitation and maintenance of significant areas of public lands with similar, or "like" characteristics to the land affected by the mine. All projects are to be implemented within the Wollangambe River, Lett River, and Farmer's Creek Catchments. The projects are outlined below. These projects will, in effect, mitigate, or offset the disturbance created by the proposed Newnes Junction development. In addition to these specific projects, Sydney Construction Materials will continue to identify additional areas near the proposed development site that are suitable for rehabilitation.

4.2 Funds

Sydney Construction Materials will make a substantial up-front contribution to establish required infrastructure, materials, and initial project management, and will continue to fund the scheme for the life of the mine. It is estimated that an up-front amount of $50,000.00 will allow the projects to be adequately resourced from the beginning of the development. Following this, an amount of approximately $30,000.00 per annum will allow for on-going project management, implementation, and maintenance (the equivalent of a part-time care-taker). More detailed costing of the projects, along with more detailed management plans, will be developed upon approval of the development.

4.3 Scheme manager

It is proposed that the Hawkesbury-Nepean Catchment Management Authority (HNCMA) become the Scheme Manager, holding and disbursing funds provided by Sydney Construction Materials, and using its standard project reporting process to report to the Company, DIPNR, NSW EPA, and other stakeholders.

4.4 On-site offsets

4.4.1 Progressive rehabilitation

Sydney Construction Materials will utilise an innovative site rehabilitation technique, not used anywhere else on the Newnes Plateau – progressive rehabilitation through terraced landscaping. As the surface miner progresses through the resource, 2-metre-wide benches will be left at every 3 metres of depth to provide a horizontal platform on which native flora species will be planted. Irrigation will be provided from mine seepage water. Figure 1 below shows an overview sketch of the rehabilitated site, identifying the terraced landscaping that will be utilised on the walls of the development, and indicating the area of free-draining wetland that will be created at the bottom of the site at the end of the development's life.

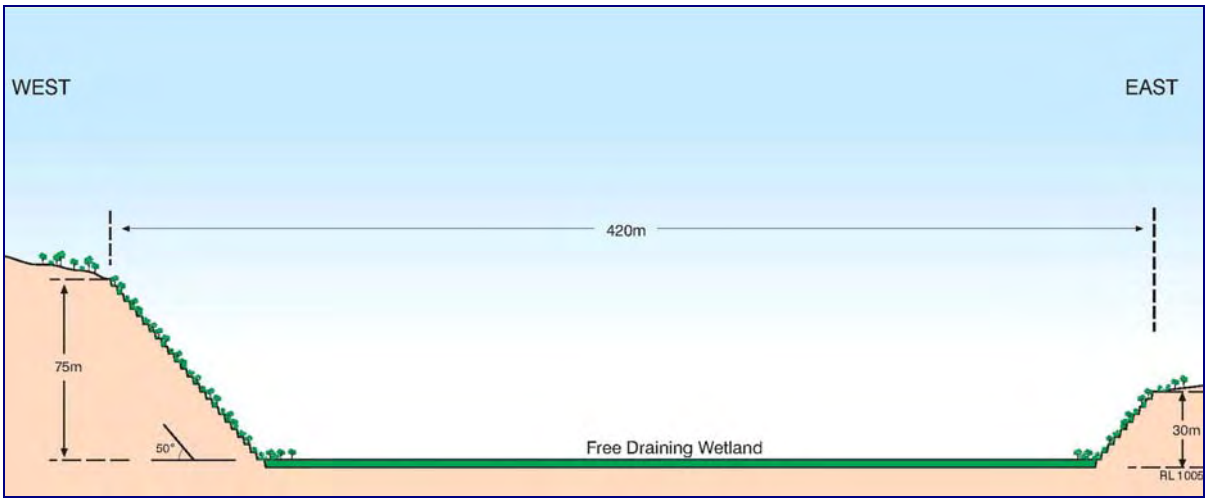


Figure 1: Conceptual design for progressive rehabilitation – overview.

Figure 2 below shows a detailed cross-section of the intended terraced landscaping, indicating batter angles, bench widths, and bench heights.

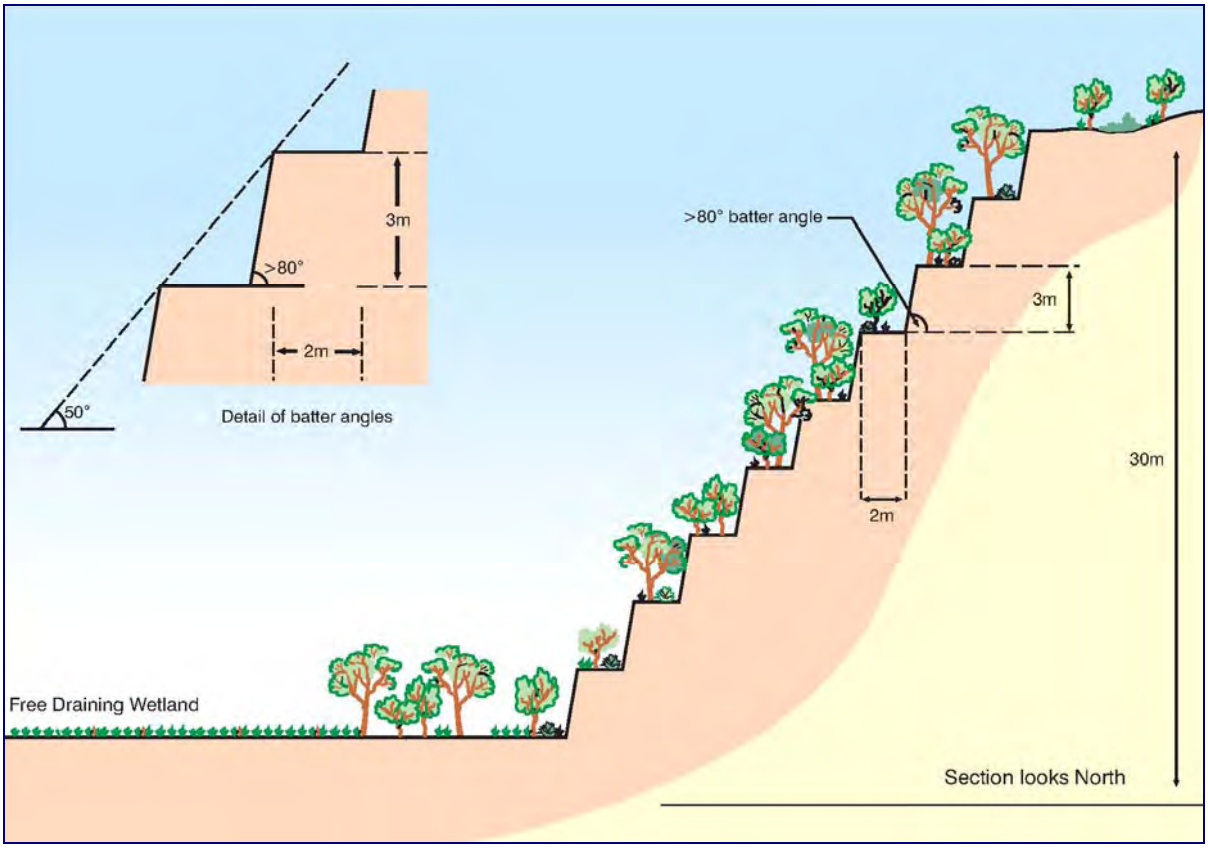


Figure 2: Conceptual design for progressive rehabilitation – detailed cross-section.

Figure 3 and Figure 4 below show how successful this rehabilitation technique has been in the past at other locations. It shows a quarry extracting friable sandstone that is similar to what the Newnes Junction site will look like during the course of mining. This picture is from a Pioneer quarry project on the Somersby Plateau. The top row of vegetation is about 3 years old and the bottom row about 6 months old.



Figure 3: Progressive rehabilitation – top bench: 3 yrs old, bottom bench: 6 mon. old.



Figure 4: Native tree & shrub seeding on sand quarry benches (2 yrs old).

Figure 5 to Figure 8 below show what the visual impact of the development will be at the conclusion of operations on the site.

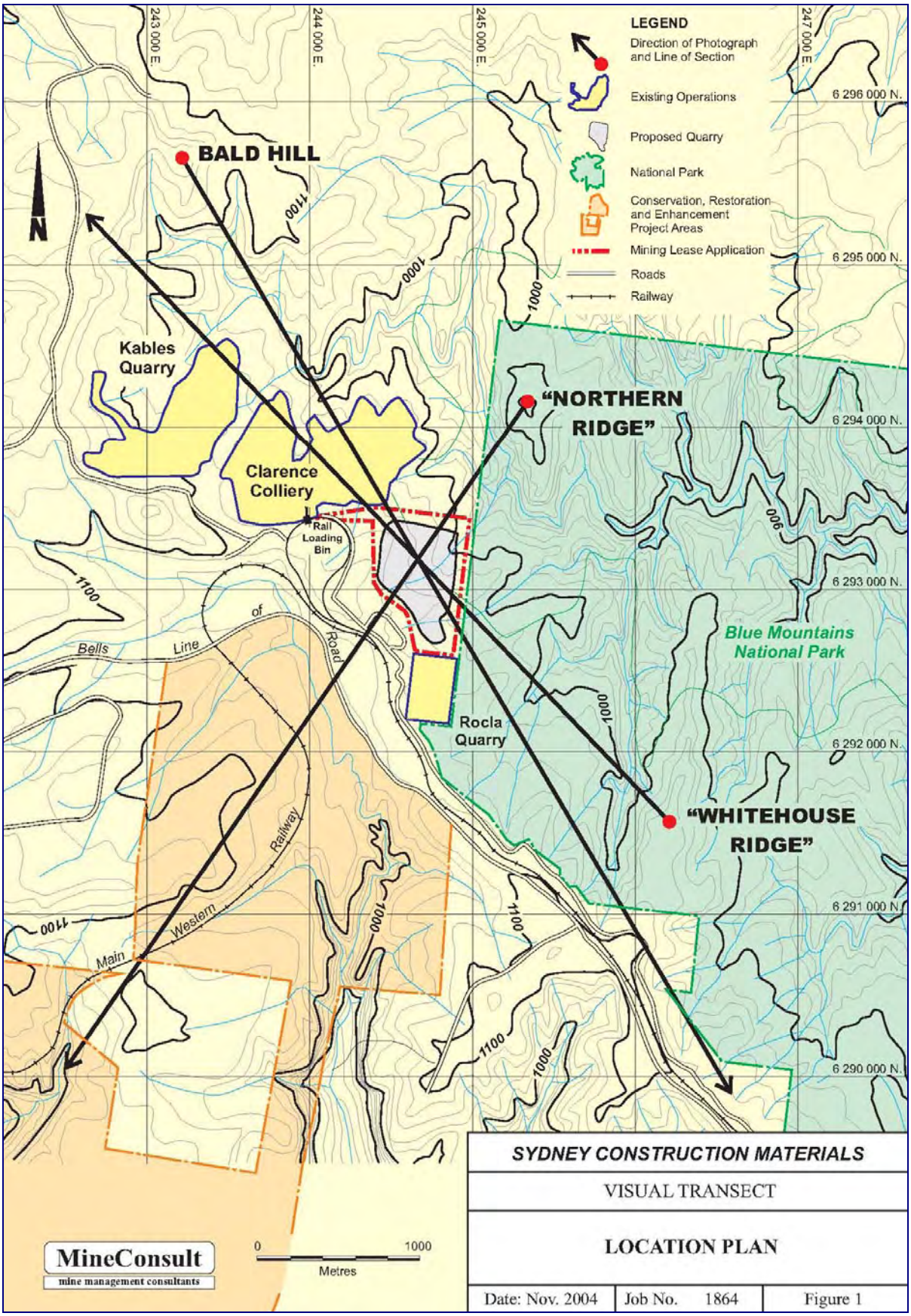


Figure 5: Location map showing location of proposed Sand & Kaolin operation, other existing operations, Blue Mountains National Park, approximate area of Conservation, Restoration, and Enhancement projects, and Visual Transect Lines.

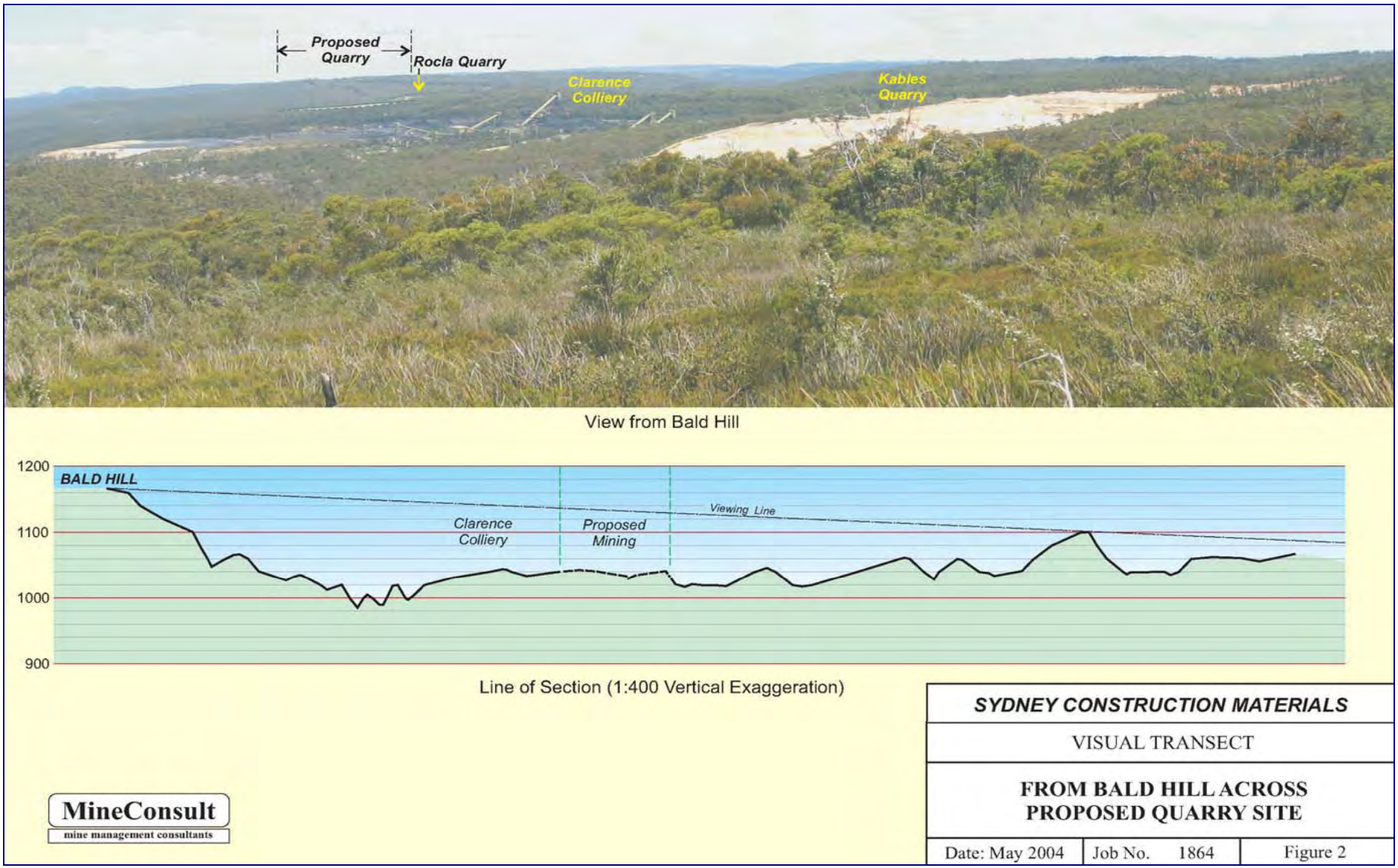


Figure 6: Visual transect from Bald Hill south-east across proposed development.

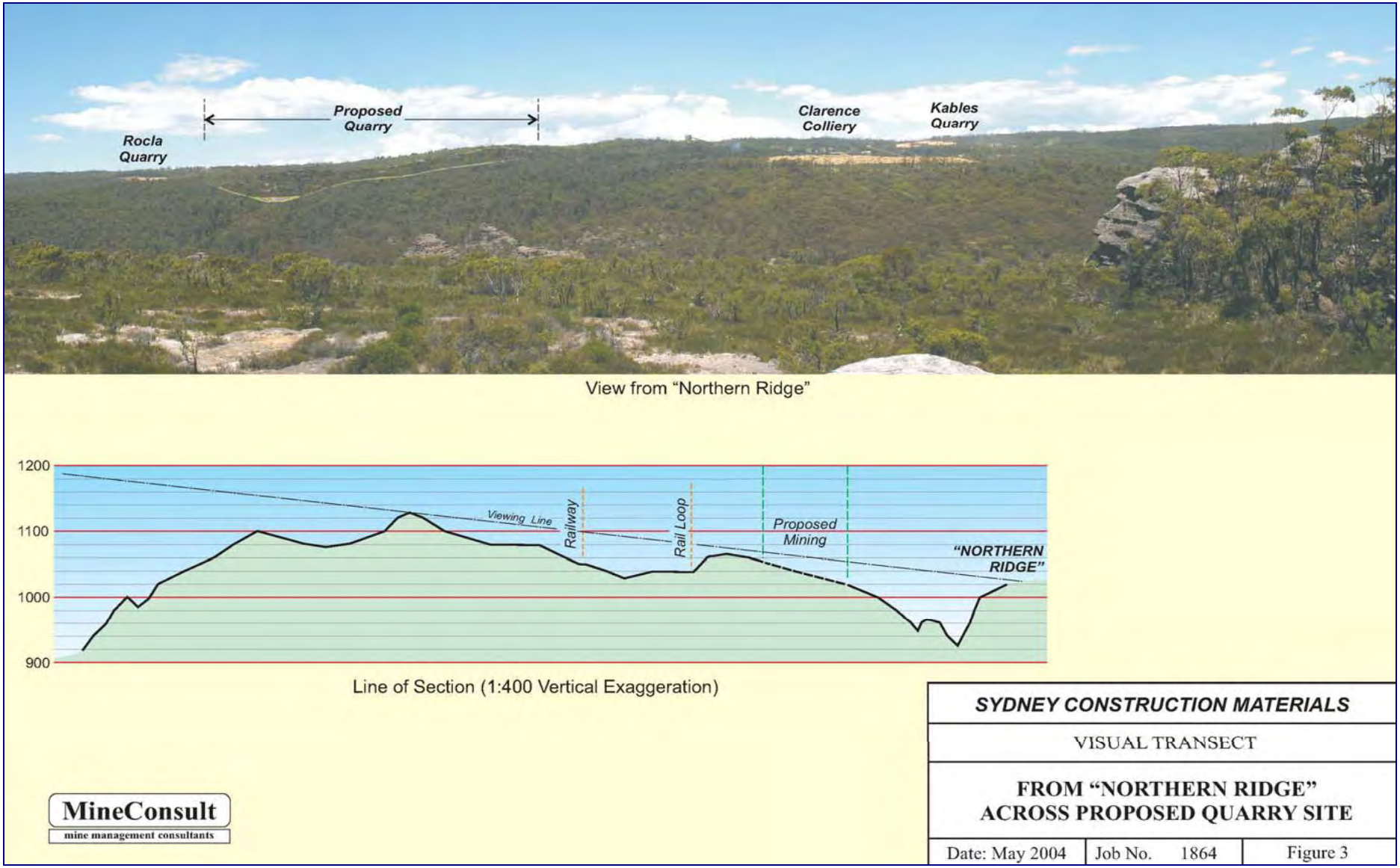


Figure 7: Visual transect from "Northern Ridge" south-west across proposed development.

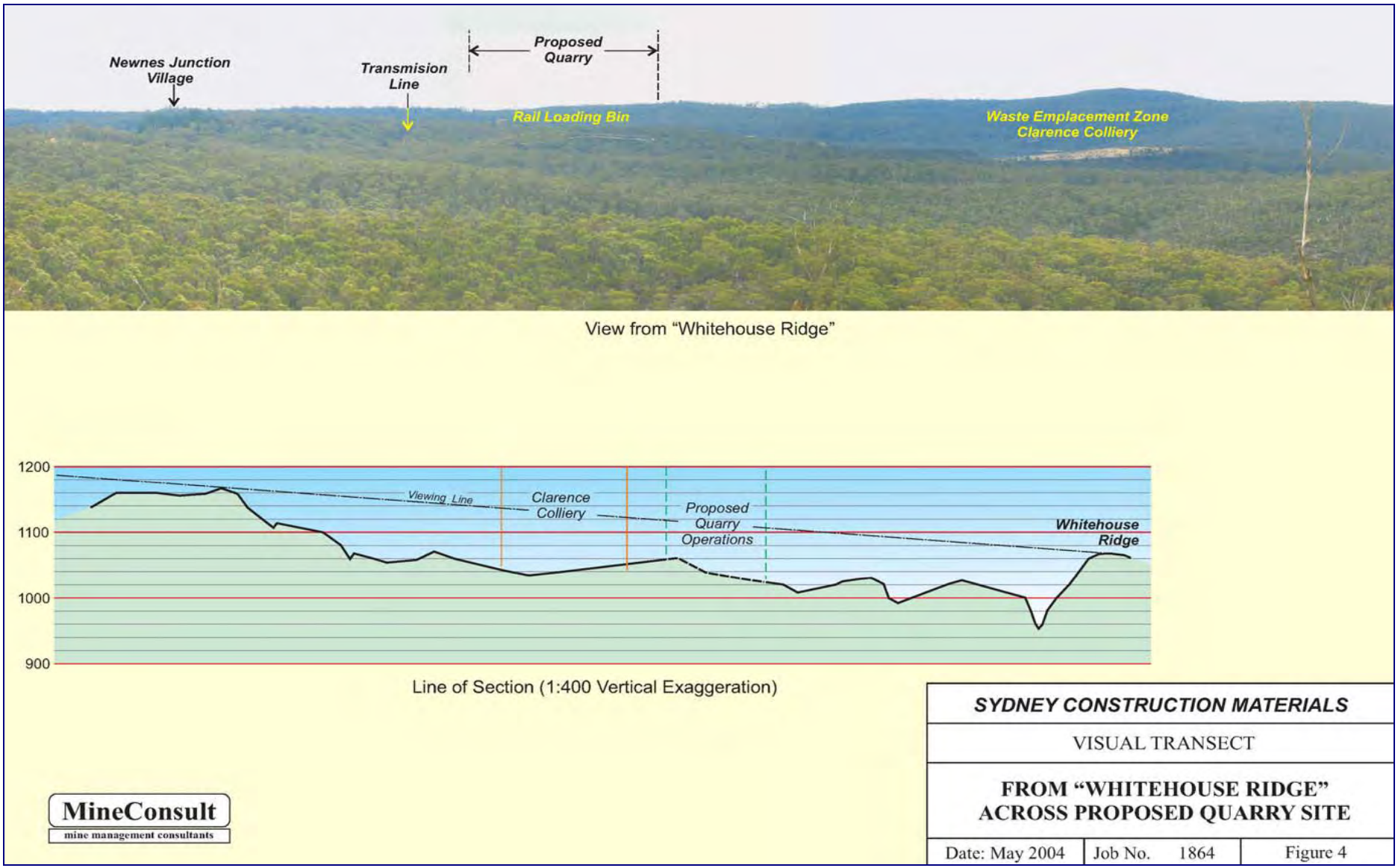


Figure 8: Visual transect from "Whitehouse Ridge" north-west across proposed development.

The reasons for engaging in progressive rehabilitation include:

- to mitigate the visual impact of the mine throughout its life by providing a vegetated wall at all times,
- to reduce the rehabilitation task that would otherwise result at the end of the development's life,
- to allow for enhanced integration into the surrounding vegetation, and
- to minimise erosion and ensure landscape stability.

As is quite clear from the figures above, the progressive terraced landscaping of the walls will ensure that there will be minimal visual impact throughout the life of the development.

Sydney Construction Materials recognises that as site rehabilitation will be a necessary condition of development consent, the terraced landscaping cannot be included as a form of green offset. Nevertheless, its inclusion in this report is tendered as evidence of Sydney Construction Materials' commitment to environmentally sustainable extractive operations.

4.4.2 Diversion of southern drainage

At the beginning of Stage 2, the proposed development will affect the upper reaches of the drainage line that runs across the southern end of the site. This drainage feeds eventually into the Wollongambe River. Sydney Construction Materials is committed to safeguarding the high quality of water that flows into this important river, and has amended the mine plan to ensure that there are no uncontrolled discharges into this drainage. It is proposed that prior to Stage 2 commencement, the flow of water into this drainage be diverted around the southern end of the mine and back into the drainage, ensuring continuity of supply.

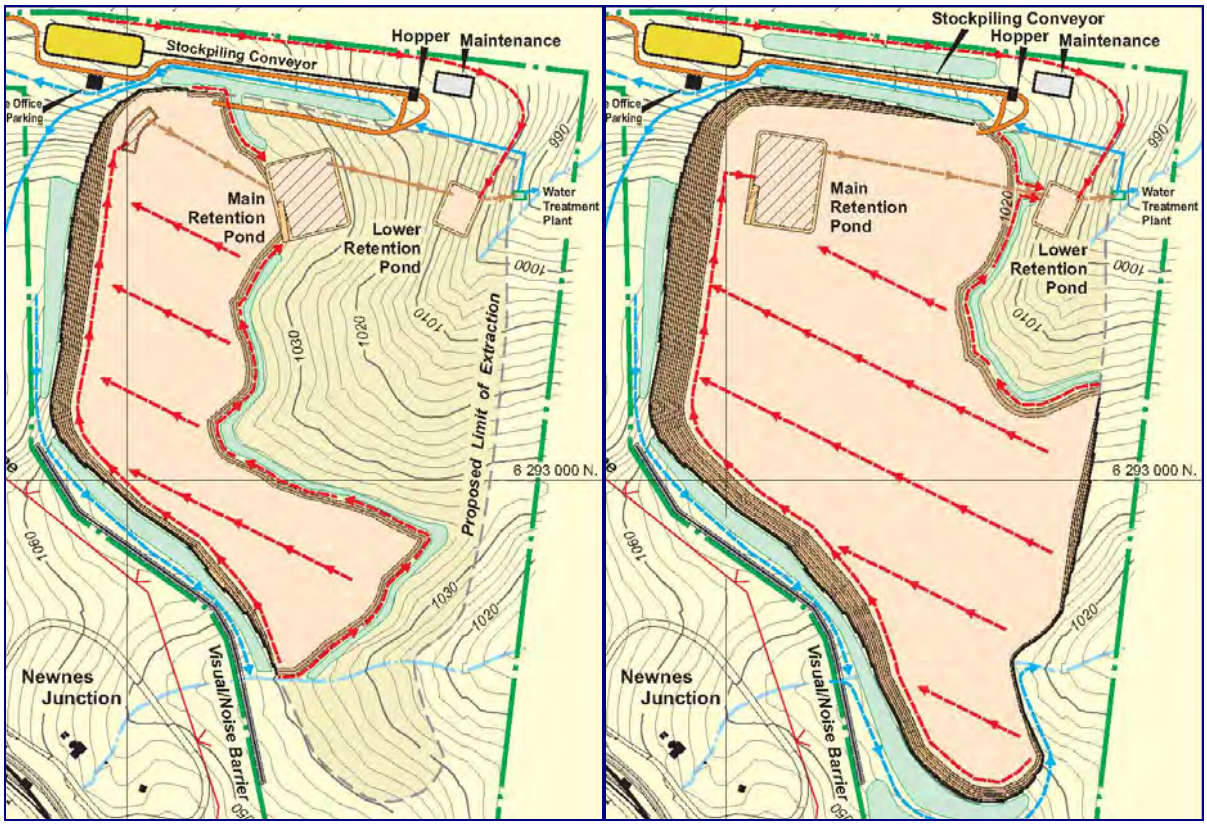


Figure 9: In the left-hand picture, the southern drainage can be seen at the bottom of the picture, cutting across the site from east to west (end of Stage 1 – year 5). In the right-hand picture (end of Stage 2 – year 10), the new course of the southern drainage can be seen diverted around the southern end of the site and back into its original course.

Any surface water outside the area of the development draining towards the western edge will also be directed around the southern end and into this southern drainage. This drainage also contains plant species that show some affinity for the Newnes Plateau Shrub Swamp. Although not true NPSS (it does not contain some of the required dominant species, excluding its classification under this nomenclature), Sydney Construction Materials nevertheless believes that it is an important environment. The measures taken, as described above, will ensure the safety and integrity of this area.

Further details on water management, and in particular the diversion of the southern drainage, can be found in the Surface Water Management Plan (Perrens report) and the Soil and Water Management Plan (GSS Environmental report).

4.4.3 Final landform

The area currently supports open eucalyptus woodland forest. The broad rehabilitation objective for the post-quarrying landform is to establish a similar land use. The topography of the final landform will consist of a large number of small, stepped sandstone benches formed in an amphitheatre configuration, each with a revegetated bench. The amphitheatre void will be some 450m wide and 400m long at its western edge, and 650m long at its eastern edge. Until such time as extraction has ceased, rehabilitation will occur around the edges of the pit only, and will not involve the pit floor. Once operations have been completed, all buildings and infrastructure will be removed from the pit. These areas will be reshaped and ripped where necessary for topsoiling and revegetation. It is proposed that the haul road will remain for use in the ongoing management of the site rehabilitation and for fire fighting purposes. The pit floor will be vegetated with appropriate native species to create a stable, free-draining wetland.

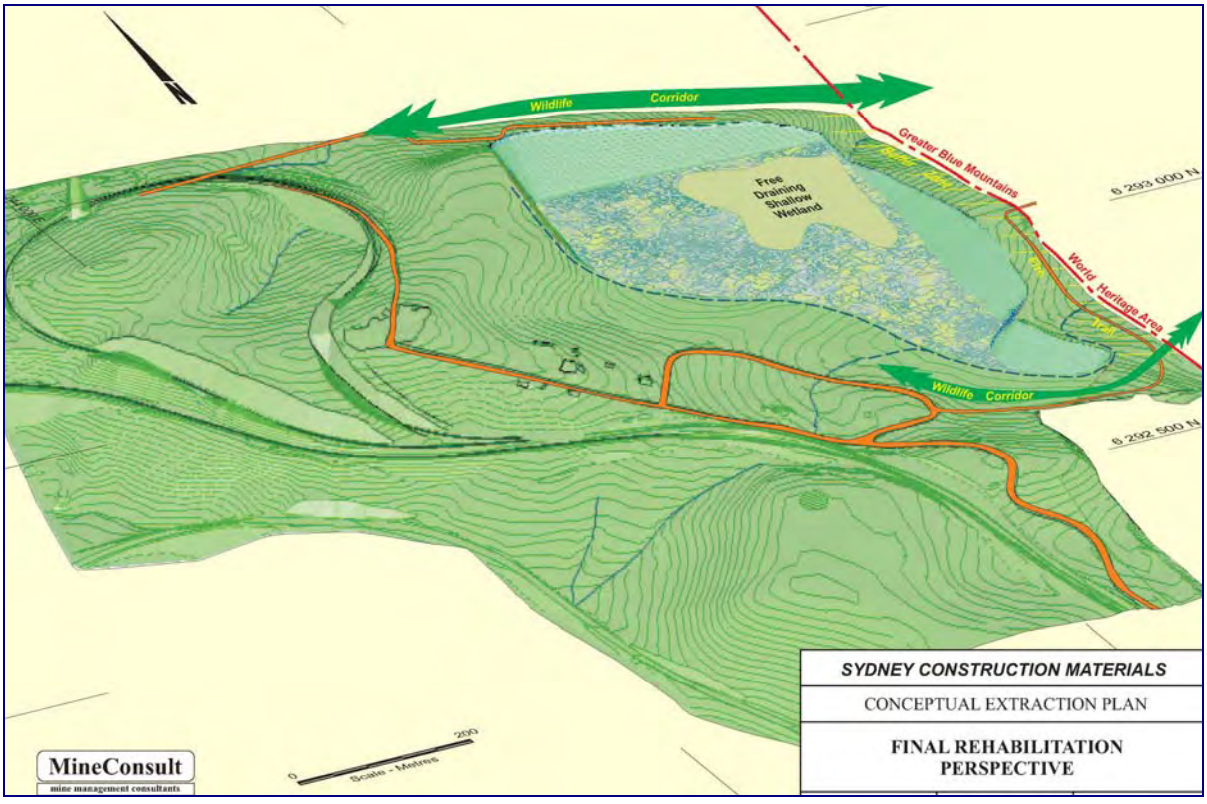


Figure 10: 3D perspective of final rehabilitation layout.

The concept for a functioning wetland in the final void is illustrated in Figure 10 above and Figure 11 below. The wetland will be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit. It is anticipated

that sedges and other wetland plants endemic to the area will colonise this wetland area to form a swamp ecosystem analogous to that in Gooches Crater shown in Figure 12 below.

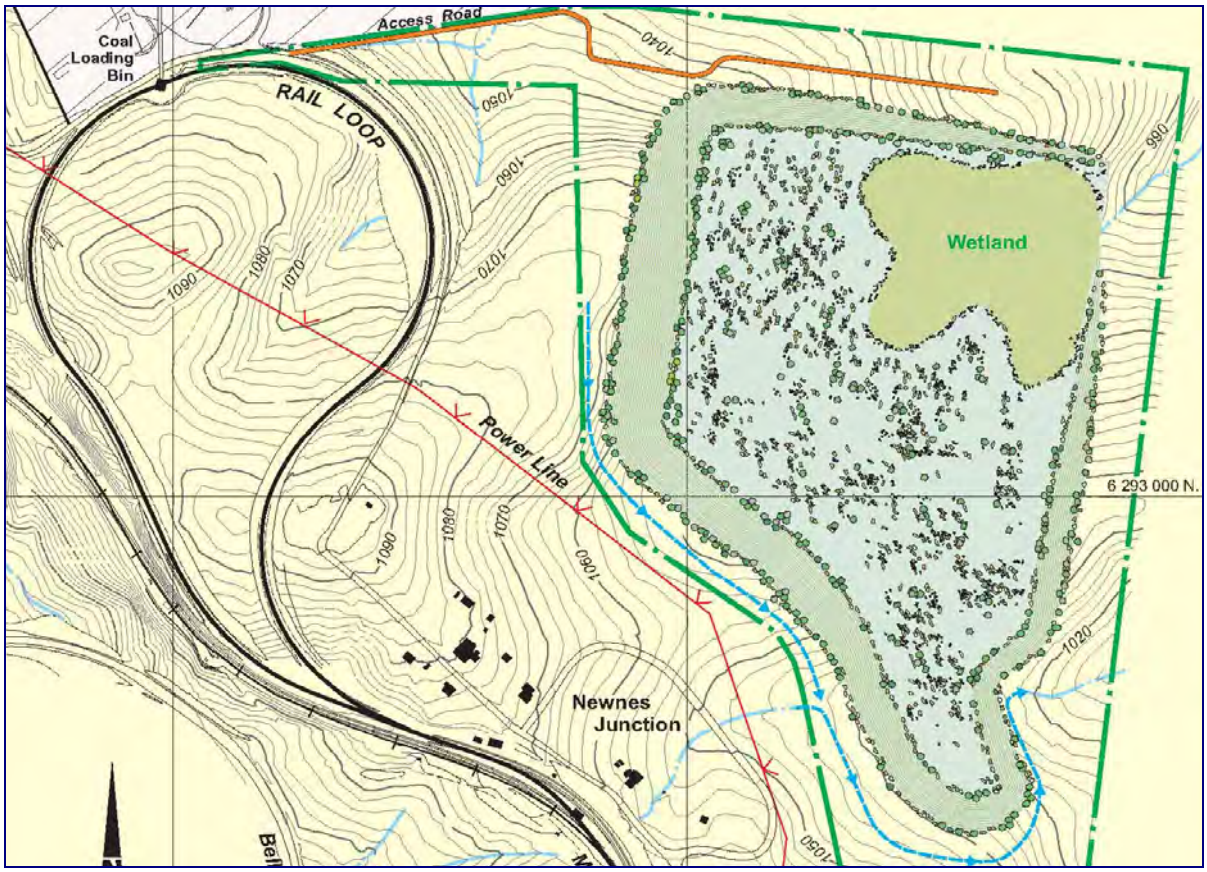


Figure 11: Plan view of final rehabilitation layout.



Figure 12: The final rehabilitation layout is modelled on nearby Gooches Crater.

Further details of the final landform can be found in section 6.2 in the document "Soil and Water Management Plan" prepared by GSS Environmental.

4.5 Off-site offsets

Sydney Construction Materials, in conjunction with the Lithgow office of the Department of Infrastructure, Planning and Natural Resources (DIPNR), and the Lithgow Oberon Landcare Co-ordinator, have developed the following green offset projects. These projects will be conducted in consultation with relevant local government authorities, and other local environmental groups. These projects have been designed to reflect the intent of the NSW government green offsets policy process, based on the concept and discussion papers discussed in Section 2 above, and with reference to the Hunter Valley Coal Corporation Mt Owen Operations EIS.

4.5.1 Project 1 – Newnes Plateau Shrub Swamp rehabilitation

Site Name:	Newnes Shrub Swamp – Vacant Crown Land, Newnes Plateau
Site Location:	The Newnes Plateau Shrub Swamp (NPSS) site is located on the western edge of the road to the Newnes Glow Worm Tunnel, approximately 6 km north of Lithgow township. It is approximately 5ha in area.
Site Description:	This site on Crown land consists of a unique ecological community, known as a Newnes Plateau Shrub Swamp (as described by Keith and Benson 1990). It is dominated by Tea Trees (*Leptospermum juniperinum* and *Leptospermum lanigerum*), Button Grass (*Gymnoschoenus sphaerocephalus*), Razor Sedge (*Lepidosperma limicola*), *Xyris ustulata* and *Baeckea linifolia*. There are two broad types of these swamp communities – Sedge Swamp and Shrub Swamp, both sharing very similar geology and roles in local hydrology. They are separated by the make up of their vegetative components. This vegetation type has formed as a result of local geology, which is part of the Banks Wall Sandstone, and the associated hydrology, which results from the sandstone being inter-bedded with narrow layers of claystone, or tightly cemented sandstone that are impervious to groundwater. The groundwater seeps out over the broad sandstone layer above the impervious layer, which results in the site having a constant supply of water. Organic matter accumulates throughout these swamps in a partly decomposed state as peat. This peat has the capacity to absorb water. The resulting retention of groundwater and surface water is then gradually released into adjoining streams. As a result these streams will continue to run for months after rainfall. The site provides the potential to be habitat for the Blue Mountains Swamp Skink (*Eulamprus leuraensis),* currently listed on the *Threatened Species Conservation Act (TSC) 1995*. To date, five locations on the Newnes Plateau have had recordings of the Blue Mountains Swamp Skink. Plant species that are recognised as threatened and which occur in the habitat of the Blue Mountains Swamp Skink include the vulnerable species *Pultenaea glabra.* Regionally significant plant species include *Xyris ustulata* (endemic from Mt Coricudgy to the Budawangs), *Almalaea incurvata* (endemic to Central Tablelands), and *Grevillea acanthifolia* subsp. *acanthifolia* (endemic to Central Tablelands over 450 m) (NPWS Atlas of NSW Wildlife). The diversity of vegetation contained within the swamp community and

adjoining Eucalypt woodlands has the potential to provide habitat for both common and vulnerable wildlife.

Apart from the Blue Mountains Swamp Skink, other threatened fauna species occurring in the same habitat include the endangered Giant Dragonfly (*Petalura gigantea*) and vulnerable Giant Burrowing Frog (*Heleioporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*). The swamps also provide habitat for three regionally significant fauna species, the Southern Emu-wren (*Stipiturus malachurus*), Lewin's Rail (Dryolimnas pectoralis) and Buff-banded Rail (*Gallirallus philippensis*) (Washington 1999).

Impacts on Site: This Shrub Swamp community is presently being impacted by Radiata Pine (*Pinus radiata*) wildings, which are spreading into the site from nearby pine forests. These pines have the potential to substantially modify this ecosystem and in turn lead to the displacement of significant local flora and fauna.

Proposed Works: The proposed works would see treatments of these pines through stem injection and cut and paint techniques in order to ensure there is minimal damage to the Shrub Swamp community.

The potential for complete restoration of this site is very high. The works proposed would also see an area of high conservation value within the catchment being targeted.

Once restoration of this area has reached an adequate level, the Company will investigate the feasibility of this land reverting back to Crown land reserve status, or being rezoned under the Lithgow LEP for environmental protection.

4.5.2 Project 2 – Crown land rehabilitation near Clarence

Site Name:	Dargan's Creek Crown Lands
Site Location:	The site is located on the southern side of the Bells Line of Road at Clarence approximately 10-15km east of the Lithgow township – see Figure 13 below. Specifically, the lots are 266, 239, 234, 250, 251, 82, 248, 235, 246, 244, 261 and adjoining unnumbered crown parcels. The site is located at the most north-eastern extremity of the Cox's River Catchment.
Site Description:	The subject site is approximately 864 hectares. It comprises numerous parcels of crown land, which were reserved for public recreation until May 12th 2000. In the Government Gazette of that date, the Reservation status was revoked, with the land becoming vacant crown land, and as such has not been actively managed since that time. The land slopes significantly towards the Hartley Valley to the south, from the plateau edge at approximately 1100m down to 800m in the valley. Dargan's Creek is one of three main headwaters that drain south into the Hartley Valley into the Lett River. This in turn has an eventual confluence with the Cox's River approximately 20km downstream. Site characteristics are similar to those at the proposed Mine site. The site flora consists of numerous plant communities ranging from Eucalypt based Woodlands / Open Forest, through to Montane Heathlands and Sedge Swamps. The diversity of vegetation types and their distribution has resulted directly from the varied make up of the local geology, which is part of the Triassic Banks Wall Sandstone, and its associated hydrology.

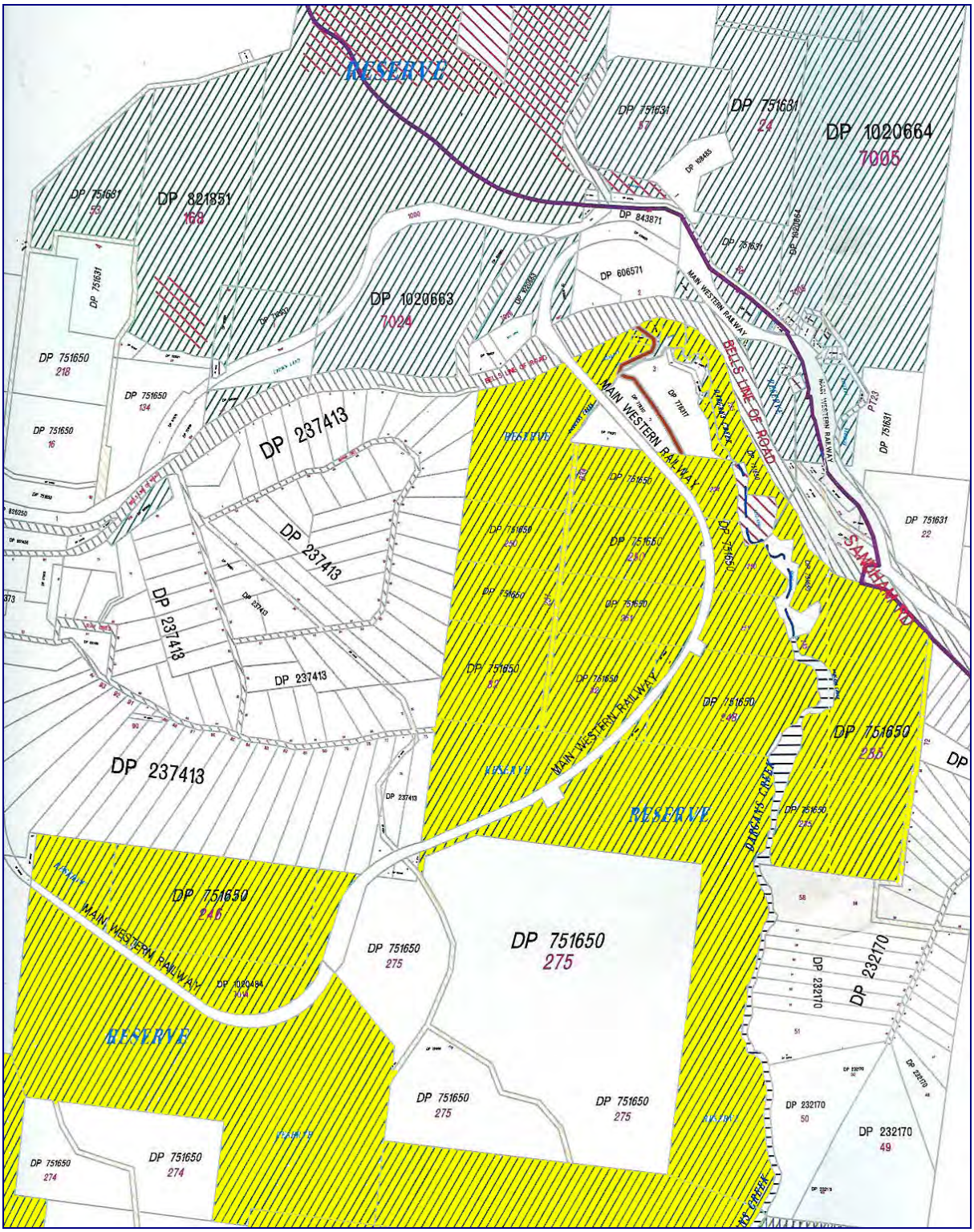


Figure 13: Yellow area denotes location of Green Offset project #2

Benson & Keith (1990) mapped native plant communities of the Dargan Creek area for the Wallerawang 1:100,000 map sheet. They recognise the following plant communities occurring in or close to the Dargan Creek area:

9j "Montane Gully Forest"

Open-forest: *Eucalyptus fastigata*, *E. cypellocarpa*, and *E. dalrympleana*

10f "Newnes Plateau Woodland"

Woodland: *Eucalyptus seeberi*, *E. oreads*, and *E. dives*

21c "Montane Heath"

Open-heath: *Allocasuarina nana*, *Banksia ericifolia*, *Leptomspermum attenuatum*, and *Phyllota squarrosa*

20a "Newnes Plateau Shrub Swamp"

Closed Heath: *Leptospermum grandifolium*, *Baeckia linifolia*, and *Grevillea acanthifolia*

Sedgeland: *Gymnoschoenus sphaerocephalus*, and *Xyris ustulata*

21d "Pagoda Rock Complex"

Open-heath: *Allocasuarina nana*, *Leptomspermum arachnoides*, and *Lepidosperma viscidum*

Open-Scrub: *Eucalyptus laophila*

Woodland: *E. piperita*, and *E. rossii*

The site, as with that described above in Project 1, has the potential to be habitat for the Blue Mountains Swamp Skink (*Eulamprus leuraensis*). Plant species that are recognised as threatened and occur in this type of habitat include the vulnerable species *Pultenaea glabra*, currently listed as Vulnerable on the *TSC Act 1995*.

Regionally significant plant species include *Xyris ustulata* (endemic from Mt Coricudgy to Budawangs), *Almalaea incurvata* (endemic to Central Tablelands), and *Grevillea acanthifolia* subsp. *acanthifolia* (endemic to Central Tablelands over 450 m) (NPWS Atlas of NSW Wildlife). Further, the site contains other significant plant species such as Snow Daisy (*Celmisia longifolia*), Oak–leaved Daisy (*Olearia quercifolia*), *Acacia meiantha*, *Dillwynia stipulifera*, and *Eriostemon obovalis*.

All plant taxa that are scheduled under the *Threatened Species Conservation Act 1995* and have recorded sightings (NPWS Atlas 2004) from within or adjacent to the study area are listed in Table 2 below. According to Briggs and Leigh (1988), the area accounts for a number of species that are listed as having particular conservation significance. (ROTAP). It is highly likely that additional and comprehensive ground-truthing of the reserve would reveal additional locations of species of significance, of both flora and fauna.

Genus	Species	Location	TSC Act 1995	ROTAP coding 1988	EPBC Act 1999
Acacia	*bynoeana*	Occurs on the north side of the highway east of the headwaters of Dargan Creek	E1	3VC	V
Boronia	*deanei*	Occurs in the Dargan swamp creek swamps as well as adjacent Newnes State Forest	V	3VCa	V
Derwentia	*blakelyi*	Occurs at the base of the hill bordering Dargan's creek swamp to the north. Its distribution is extremely limited and its conservation status in National Parks has not been adequately established.	V		
Persoonia	*acerosa*	Locally endemic from Valley Heights to Clarence occurs on the north side of the highway to the west of the headwaters of Dargan's Creek.	E1	2VC	V
Acacia	*meiantha*	Is known to grow beside Chifley road near the Clarence railway underpass. The species has not been found anywhere else and thus has an extremely limited range. Grows in dry sclerophyll forest or woodland, in sandy to clayey soil; in Mullions Ra. and at Clarence; rare.		2RCi	
Almalaea	*incurvata*	A small moist area swamp shrub endemic to the Blue Mountains with a disjunct population occurring in the Newnes area.		2RCt	
Celmisia	*longifolia*	Snow Daisy Recorded growing at Newnes plateau. Grows typically at elevations of more than 900-m alt., usually in bogs or seepages, wet soil and swamps; chiefly from Newnes area to Kosciusko N.P.			
Dillwynia	*stipulifera*	Is a rare swamp-dwelling shrub that occurs at the headwater of Dargan's creek. It is known only from here and the Lithgow Water Supply catchment locally (to the northwest) and in the Budawang Ranges.		3RCa	
Eriostemon	*obovalis*	Local endemic of the northwestern Blue Mountains plateau occurring in the Dargan creek gorge along cliff lines		3RCa	
Eucalyptus	*gregsoniana (pauciflora nana)*	Wolgan Snow Gum A mallee that is represented in parts of Clarence and Newnes plateau and recorded growing at the Colliery site. Sporadic and scattered, in mallee heath on sandy soils of limited drainage in elevated areas; from Newnes Plateau to Wadbilliga.		3RCa	
Isopogon	*prostratus*	Is recorded as a disjunct local population at its northern limit on Newnes Plateau. Mostly in heath and dry sclerophyll forest, often in exposed situations; on the tablelands from Newnes Plateau south to the Tuross R. and on the coast from Eden to Nadgee, rare.			
Olearia	*quercifolia*	Oak–leaved Daisy. Restricted to the upper Blue Mountains and considered to be "at risk". It occurs only between Wentworth Falls and Clarence. Grows in swampy or moist terrain and has been recorded growing close by to the Clarence colliery site		3RC-	

Table 2: Rare or threatened plant species on or near the green offset site.

Impacts on Site:

Two dams were constructed in the early 20th century in the upper section of Dargan's Creek as a water supply for steam trains. Recreation is a major land use in the area and includes swimming at Dargan Creek dams, rock climbing and camping. The area has always been a popular swimming hole in summer for locals, and was once a well-kept secret, ensuring that overuse, rubbish, traffic, and pedestrian and vehicular encounters were not an issue.

The site is being and for some time has been impacted primarily by fragmentation from vehicle tracks, which in some locations is leading to substantial erosion problems.

Swamps are particularly sensitive to impacts created by weeds, vehicles, and access tracks. Roads, which cut across and interrupt areas of subsurface water flow, may lead to drying of swamps if residual water flow is insufficient to sustain the swamp. Tracks can alter the hydrology by redirecting water away from dependent downstream vegetation and fauna species, allowing normally moist areas to dry out. Likewise, rerouted waters can have deleterious impacts on adjacent vegetation communities.

Reduced infiltration may lead to lowering of the water table and drying of swamps. Clearing of areas adjacent to or above swamps may result in water being channelled into creeks rather than infiltrating the soil and recharging the groundwater feeding the swamps. Channelling also results in higher velocity discharge, which may cause erosion.

Vehicular access is contributing to the compaction of soft swamp soils, and effectively dividing vegetation communities on the site. Where boggy patches occur, excavations have been undertaken to empty puddles and drain still standing pools of water, thus channelling water away from its natural course and distribution through vegetation.



Figure 14: Heavily eroded, overused vehicle tracks. The boggy area has occurred where a makeshift track has crossed a swamp's natural path.



Figure 15: Another example of heavily eroded, overused vehicle tracks.

The site is increasingly being used throughout the year, particularly in the warmer months for swimming, picnicking, and camping. Abseiling and adventure companies and schools have also been known to take groups into the area on a regular basis. Trail bike riding and four wheel driving activities are becoming more commonplace.

State Rail has attempted to restrict access with the erection of initially one gate approximately 20m into the area adjacent to the railway line. Repeated vandalism of the gate to gain access, and the establishment of semi-permanent occupation of the site by State Rail staff undertaking railway upgrading, has led to the installation of a series of cyclone gates erected at intervals along the railway line. Access is required by State Rail Authority and Transgrid in order to access powerlines that transverse the site on adjacent lands north of the dams.

Ranges of plant communities are being impacted by Radiata Pine (Pinus radiata) wildings, which are spreading into the site from nearby pine forests. These pines have the potential to substantially modify the various ecosystems and in turn lead to the displacement of significant local flora and fauna. There are also minor infestations of Blackberry, Scotch Broom and Gorse.



Figure 16: *Pinus radiata* wildings such as this one are common.

Proposed Works:

The proposed works would see treatment of pines through stem injection and cut and paint techniques to ensure there is minimal damage to the other plant communities. Other weed species will be identified and a weed management plan drawn up and implemented.

In order to resolve the problem of duplicated, heavily eroded access tracks, those required for future access to the land need to be identified in consultation with State Rail, Emergency services, Transgrid and Lithgow City Council. It is proposed that identification and rationalisation of tracks directly necessary for access, maintenance of power lines, firefighting purposes, and railway maintenance be conducted. All duplicated or unnecessary tracks will be machine-ripped and brush-matted to stabilise and revegetate them. The proposed works would see these duplicated tracks reduced to walking track scale where vehicle access was no longer necessary.

The site is also subject to rubbish dumping and these works would also reduce access to these sorts of activities through fencing and public

education. Further, through this Project, the rubbish dumped will be removed and properly discarded.

Once restoration of this area has reached an adequate level, the Company will investigate the feasibility of this land reverting back to Crown land reserve status, or being rezoned under the Lithgow LEP for environmental protection. All of the preceding proposed works would be carried out for the preparation and execution of a Plan of Management for the site that would be required were it to be reclassified as Reserved Crown Land.

4.5.3 Project 3 – Newnes Junction community nursery

Site Name:	**Newnes Plateau Community Nursery**
Site Location:	On or immediately adjacent to mining lease at Newnes Plateau.
Project Description:	Discussions with Newnes Junction local residents have established a desire to establish and operate a small community nursery in Newnes Junction. Sydney Construction Materials plans to establish such a nursery, and to model it on the Lithgow and District Native Plant Community Nursery in Coalbrook Street, Lithgow. The nursery will be staffed by the local community of Newnes Junction with supervision and resources provided by Lithgow and District Community Nursery, funded by this strategy. As well as providing a local source of native flora for Newnes Junction, Bell, and Clarence residents, the nursery will also be used to provide the seed stock and native plants necessary for the rehabilitation of the mine walls as part of the site's progressive rehabilitation, and any flora required for the rehabilitation projects described above.
Proposed Works:	The proposed works would involve those activities necessary for the establishment of a native plant nursery. These include site establishment, and construction and maintenance of nursery facilities, such as: • Polyhouse & Shadehouse • Watering system • Seedbank • Seed storage facilities • Propagation facilities

4.6 Future rehabilitation prospects

Sydney Construction Materials is committed to promoting the maintenance of environmental integrity on the Newnes Plateau. Progressive rehabilitation through terraced landscaping on the site, the restoration and rehabilitation of surrounding ecologically sensitive areas, and the establishment of a native plant nursery are integral to the Company's vision for the region. These initiatives demonstrate Sydney Construction Materials' desire to see the utilisation of a valuable resource conducted in an environmentally sound manner.

The list of projects described above is by no means exhaustive. Sydney Construction Materials is aware of other sites on or near the plateau potentially suitable for restoration. Further, Sydney Construction Materials recognises the record of previous nearby mine and quarry operators, and is open to the possibility of undertaking or supporting additional restoration projects in the surrounding area, including restoration of commercially forested areas, and quarries and mines no longer in operation.

5. Fulfilment of objectives

The following section details the means by which each of the Objectives detailed in Section 3 above are fulfilled by the design of the mine and the proposed green offset projects.

5.1 Objective 1

Objective 1 (see Section 3 above) outlines the need to ensure that *environmental impacts are avoided using all cost effective measures available with offsets used only to address remaining impacts*.

Chapter 4 of the EIS details the project justification and alternatives.

In determining the design of this development, the Company has engaged in significant investigation to ensure that all cost-effective measures of reducing or eliminating environmental impacts were explored. For example:

- Sydney Construction Materials will utilise state-of-the-art surface mining technology, eliminating potential exceedances of the NSWEPA Industrial Noise Policy, and minimising dust generation,
- all processing will occur off-site, eliminating the need for on-site settling ponds and eliminating the potential for spillage,
- mining will occur in a staged manner, with progressive rehabilitation, lessening the total area disturbed at any one time (see Section 5.3.1 below), which, combined with the point above, mitigates the proposal's visual impact,
- any water to be discharged will first be treated, eliminating any downstream water quality impacts.

The remaining impact is that related to the necessary clearing of the land. As the resource to be mined is approximately one metre at most below surface level, it is not possible to remove it without clearing the vegetation above. Therefore, Sydney Construction Materials has proposed the offset programs described in Section 4.5 above.

5.2 Objective 2

Objective 2 (see Section 3 above) outlines the need for *regulatory requirements to be met, and offsets to be consistent with government policy*. As discussed in Section 2.1, the NSW Government is currently in the process of developing a framework for green offsets, however, there is currently no overarching offset policy.

Nevertheless, the existing discussion and concept papers available, as outlined in Section 2.1 to 2.3, have been reviewed and, in combination with existing industry practice, have provided a benchmark upon which the Strategy objectives have been developed.

5.3 Objective 3

Objective 3 (see Section 3 above) outlines the need for green offsets to provide *net environmental improvement, i.e. "like for like" or better, in terms of quantity, quality and other factors*.

5.3.1 Quantity

The Sydney Construction Materials Newnes Junction project will require the clearing of land for the extraction of friable sandstone. Although the total area of land cleared at the end of the development will be approximately 25ha, clearing will take place in a staged manner.

Figure 17 below displays in graphical form the proportion of the site to be cleared at various stages of the development. Table 3 below outlines this numerically.

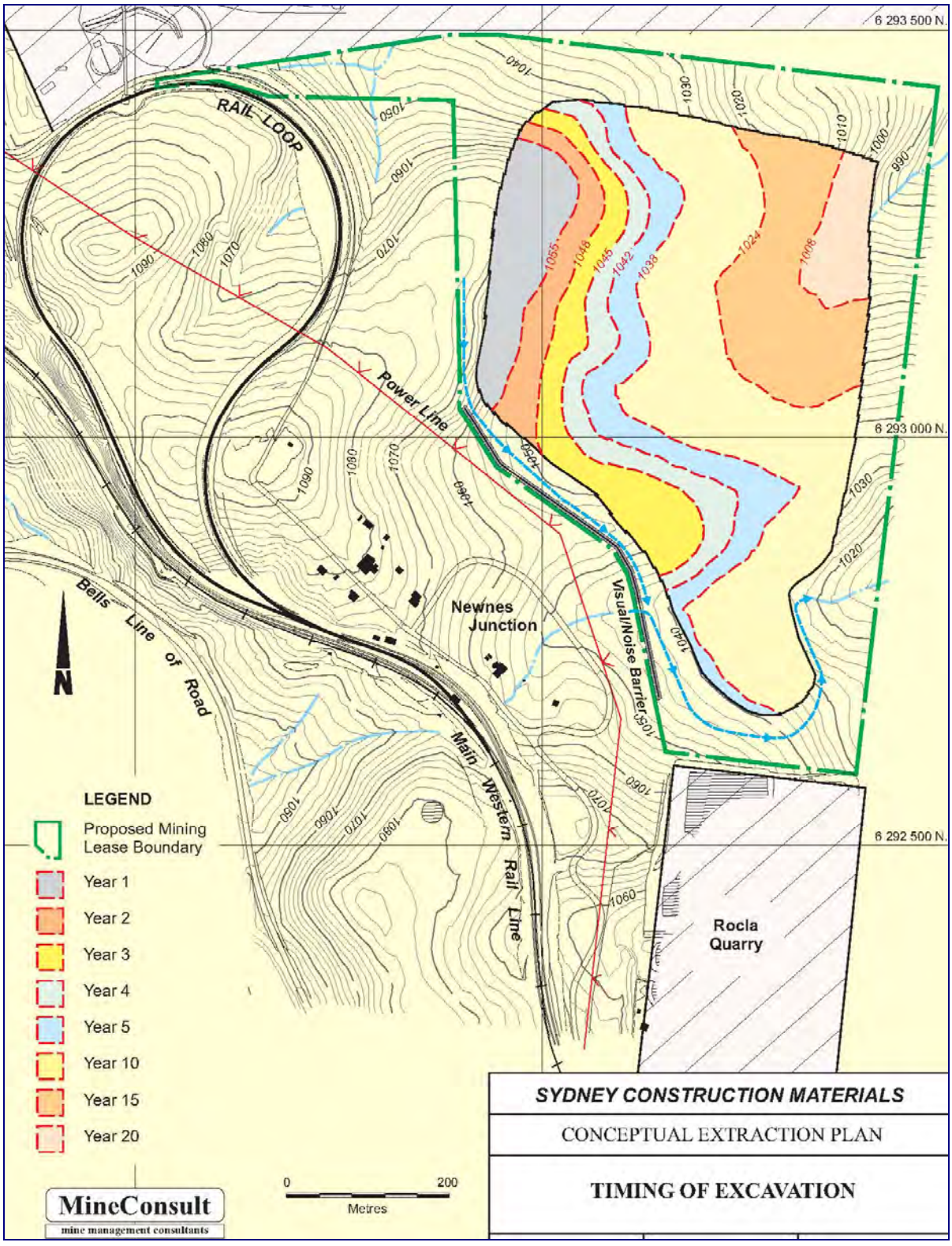


Figure 17: Staged timing of excavation

End of Year	Incremental Area Cleared	Total Area Cleared
1	2.04ha	2.04ha
2	1.48ha	3.52ha
3	2.64ha	6.16ha
4	2.07ha	8.23ha
5	2.90ha	11.13ha
10	8.87ha	20.00ha
15	3.85ha	23.85ha
20	1.16ha	25.01ha

Table 3: Area of site affected in staged development

Clearance	Area
Total Area	25ha
Offsets	
Project 1	5ha
Project 2	864ha
Project 3	n/a
Total	**869ha**

Table 4: Comparison of area affected vs. proposed offsets

The intention of Objective 3 is to ensure that any green offsets provide similar, or "like for like" environmental replacements for any development impacts, resulting in net environmental improvement. As Table 4 above shows, the total area of land identified for restoration under Projects 1 and 2 totals 869ha. The total area of land to be cleared totals 25ha. The types of proposed works do not require large lead times, and will demonstrate positive results in a very short period of time. In the medium to long term, therefore, the ratio of green offsets to cleared area is in excess of 30:1.

5.3.2 Quality

The following section, which details the quality of vegetation on the proposal site, is drawn from the Gunninah Environmental Consultants Supplementary Submission to DIPNR on Flora and Fauna Issues for the Sydney Construction Materials Newnes Junction development.

5.3.2.1 Development site characteristics

5.3.2.1.1 Database

The information on which the consideration and assessment of flora and vegetation on the subject site at Newnes Junction was based includes:

- the original investigations of native flora and vegetation conducted for the EIS (International Environmental Consultants (IEC), 2003). It should be noted that the IEC investigations also included the consideration of information contained in other

reports on sites in the immediate vicinity, as well as published scientific papers and other available information;

- data and information contained in submissions on the proposed mining operation and EIS. In particular, the information contained in the submission by P & J Smith[3] has been incorporated, and is regarded as a valuable contribution to the overall information base for the project. Whilst the submission by the NSW National Parks & Wildlife Service (NPWS)[4] does not contain any specific data or records, the matters regarding flora and vegetation contained in that submission have also been considered; and
- other supplementary investigations for flora and vegetation were undertaken specifically for the proposed development at Newnes. These supplementary investigations included a dedicated 3-day flora survey by HWR Pty Ltd and a 1-day investigation by Dr A White of Biosphere Consultants in mid-March 2004[5].

On the basis of the total quantum of investigations for flora and vegetation which have now been undertaken on the subject site at Newnes[6] and other previous investigations for flora undertaken on other lands in the immediate vicinity[7], it can be reasonably asserted that a comprehensive and adequate investigation for native flora and vegetation communities has now been achieved.

Data from all of the investigations undertaken on the subject site, as well relevant information from adjoining lands and other studies, has been incorporated. The combined information constitutes the database upon which analysis and assessment of the proposed activity is determined.

5.3.2.1.2 Flora species

A total of 171 flora species, including introduced plants and weeds have been recorded on the subject site at Newnes (see Appendix C in the GEC "Flora & Fauna Issues" report provided as supplementary information to DIPNR on the EIS). While the total number of flora species present on the subject site is likely to be greater than that identified to date, the total inventory that has been established is regarded as a reasonable approximation of the full suite of flora species present.

It is nearly always possible to locate additional species on a site as large as that at Newnes by the conduct of further investigations. However, the accumulated information from the investigations conducted to date can reasonably be considered to constitute a comprehensive and adequate database for the site.

The suite of flora species that have been recorded on the site constitutes a sub-sample of that which would occur within the adjoining National Parks and World Heritage Area. The subject site contains only a small sample of the habitats and environments present within that extensive landscape, and the site could therefore support only a sub-set of the species contained within the Blue Mountains National Park or the Greater Blue Mountains World Heritage Area.

It is of particular note that not a single threatened flora species has been recorded by any of the investigators who have conducted surveys on the subject site at Newnes. Whilst it is

[3] See public submissions to the Sydney Construction Materials EIS.
[4] The NPWS has recently been incorporated into the NSW Department of Environment & Conservation (DEC).
[5] See GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues"
[6] IEC, 2003; P & J Smith, 2003; Biosphere, 2004; HWR, 2004
[7] Corkery & Co, 1993; IEC, 2000

doubtless possible that individuals or stands of some threatened species could potentially occur on the site, there has to date been no evidence for the presence of any such species.

Eighteen threatened plant species have been listed on the Wallerawang 1:100,000 Map Sheet (HWR 2003 – Appendix A). Of these species:

- four are considered unlikely to occur on the site as the habitat present is only "*marginal*";
- six are also regarded as unlikely to occur because the habitat present is only of "*minimal*" relevance, particularly given the absence of rocky habitats; and
- the remaining eight species were not recorded on the subject site during any investigations conducted to date, despite some "*moderate*" habitat being present.

As indicated above, none of these species had been recorded by any of the researchers who have investigated the subject site at Newnes during any previous studies.

5.3.2.1.3 Vegetation communities

As indicated in the detailed report by HWR Pty Ltd (2004)[8] and in the submission by P & J Smith (2003)[9], the subject site is predominantly characterised by an open forest/woodland community of Silvertop Ash and Sydney Peppermint. This community is also described as Blue Mountains Sandstone Plateau Forest (BMSPF), and was mapped as that community in the original vegetation mapping provided in the EIS by IEC (2003).

However, there are small patches of other vegetation communities present on the subject site, including:

- a small area of Newnes Plateau forest in the south-western part of the site (HWR 2004);
- an area of open forest with a higher density of Scribbly Gums (a variant of the BMSPF) in the northern part of the site (HWR 2004);
- some riparian vegetation along the narrow drainage lines which traverse the site. This vegetation type is a variant of the sandstone ridge top vegetation community, with a component of riparian or moister plant types; and
- small areas of swamp or near-swamp communities within the drainage lines, although these are generally of very restricted distribution. The relatively steep slopes and rapid draining characteristics of the site are not conducive to the establishment of extensive swamp communities. Nevertheless, some small patches of shrub swamp vegetation are present in isolated locations (as discussed in detail in section 5.3.2.1.4 below).

Most of the vegetation on the subject site is of an open forest or woodland structure, and may be described as a dry sclerophyll community, which is characterised by relatively dry soils, an open to moderate dense shrub layer, and a sparse (but locally dense) understorey layer. This type of vegetation is generally adapted to relatively dry or xeric conditions, such as are typical of the rapidly draining nature of the site and of the soils.

Given those circumstances, vegetation which requires a high soil moisture level is relatively restricted on the subject site (as is typical of much of the sandstone country within the Blue Mountains). Drainage lines on the site are generally narrow and do not support broad areas of soil with high moisture content. As a consequence, vegetation that requires such

[8] See GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues", 2004.
[9] See public submissions to the Sydney Construction Materials EIS.

circumstances (such as riparian, swamp or wet heath type communities) are only located in restricted portions of the site.

The vegetation mapping by HWR (2004) identifies the presence of riparian or swampy vegetation along two drainage lines, which traverse the site. Of these, the northern (central) drainage line is relatively narrow and steep, and supports only very small, isolated, and limited areas of swampy or moister riparian vegetation. This community is regarded as a variant of the drier eucalypt forest vegetation on the site. The southern drainage line, conversely, supports a somewhat broader area of moister vegetation, although the abiotic and floristic characteristics of that area do not identify it as a swamp[10].

Nevertheless, the vegetation in that portion of the site is considered as having some affinities to the Newnes Plateau Shrub Swamp community. The drainage lines to the east of the subject site do support larger areas of swamp-type vegetation, as a consequence of local topographic features and their general structure.

Development of the mine plan has been cognisant of the critical need to protect habitats downstream of the subject site, particularly areas of riparian or swamp vegetation that may occur along drainage lines within the National Park. The mining operation incorporates a number of measures specifically designed to protect those habitats and resources down-stream and down-slope of the site, particularly within the GBMWHA and in the BMNP.

5.3.2.1.4 Newnes Plateau Shrub Swamp

Amongst the issues raised in the submissions on the development application and EIS for the proposed development is that related to the possible presence of the Newnes Plateau Shrub Swamp (NPSS) community on the subject land.

This plant community was originally described by Benson & Keith (1990), and is defined as "*Narrow*, *elongate, shrub-swamps*" which are restricted to the "*eastern half of the Newnes Plateau*"[11]. These swamps "*are formed in characteristic low-slope head water valleys*" where "*sediments are relatively deep ... and are periodically water logged*" (Benson & Keith 1990). These elements of the community are significant in distinguishing NPSS from other moist or riparian habitats in the locality.

The supplementary flora investigations of the subject site have included specific investigation of this plant community and its presence (or otherwise) on the subject site. It had been asserted by P & J Smith (2003) and the NPWS (2003) that this community is or may be present on the site. As a consequence, specific investigations of potential areas for this community were undertaken[12].

Consideration of the characteristics of the NPSS community, and of vegetation on the subject site and the physical features of those portions of the landscape, has resulted in the conclusions that:

- the drainage line which traverses the central part of the subject site, whilst supporting very small and isolated patches of swampy vegetation, does not support the association identified as the NPSS community. This drainage line:
    - is very narrow and relatively steep;

[10] See Appendix A in GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues" report, 2004
[11] See Appendix D in GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues" report, 2004
[12] See Appendicesx A and B in GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues" report, 2004

- does not support areas of long-term moist soil (other than potentially in extremely small areas);
- does not contain the characteristic floristics of the NPSS community; and
- contains scattered medium to large eucalyptus trees.

This vegetation, therefore, has been designated riparian (swampy) vegetation in the report prepared by HWR[13]; and

- the southernmost drainage line through the subject site supports a small area of relatively moist soil with a sparse tree canopy. This area is characterised as a shrubland dominated by the Tea-tree (*Leptospermum trinervum*), and supports a number of the plant species identified in the description of the NPSS community. However, few of the plant species present are indicated as dominant within the NPSS community, and the vegetation present is regarded at best as a marginal example of that community or a variant thereof.

It is to be noted that the NPSS community is not listed as an "*endangered ecological community*" on the *TSC Act 1995*. This community does not therefore warrant specific or special consideration pursuant to the statutory processes within NSW.

A nomination has been received by the Commonwealth Department of Environment & Heritage (DEH) for the listing of Blue Mountains Swamps as a "*threatened ecological community*" on the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act). The NPSS community is part of that complex of swamp communities, but a number of other swamp communities are also part of the nomination, occurring over a much larger area than the NPSS vegetation. The Blue Mountains Swamp communities have not yet been listed on the *EPBC Act*, and the NPSS community constitutes only one element of that matrix of vegetation types.

As discussed above and in detail in the relevant vegetation reports[14], the subject site supports only one small area of vegetation supporting affinities with (or which could potentially be described as) the NPSS vegetation. That area (in the southeast of the site) has been identified for retention, and the mine plan has been modified to avoid and protect that area of swamp vegetation, although the effect of this measure is to reduce the available resource. Measures of relevance in this regard include:

- retention of the area of swamp vegetation within the south-eastern part of the site;
- provision of a buffer around that vegetation;
- the re-routing of natural stormwater runoff from above the mining operation and its discharge into the retained swamp vegetation (see Section 4.4.2 above); and
- a program of monitoring and management of that portion of the site.

5.3.2.2 Green offset site characteristics

Characteristics of the proposed Green Offsets sites are described in section 4.5 above.

5.3.2.2.1 Downstream conservation values

A number of public reserves are present within the catchment downstream of the Dargan Creek crown lands (Project 2). Many of the remediation and restoration works undertaken in the reserve are likely to have beneficial outcomes on these downstream environments.

[13] See Appendix A in GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues" report, 2004
[14] See Appendicesx A and B in GEC's "Supplementary Submission to DIPNR: Flora & Fauna Issues" report, 2004

One such reserve is on the Lett River, locally known as "Hyde Park", in which a population of *Asterolasia buxifolia*[15] has recently been re-discovered for the first time since it was initially described by Allan Cunningham in the 1830s and 40s. It had previously been presumed extinct in the wild. The species occurs in the riparian zone, mostly within 20m of the Lett River. The population size is estimated to be in the order of 50-100 plants.

The native vegetation of the Cox's River riparian zone has been very heavily compromised, and for the most part destroyed. The combination of tenure and terrain at Hyde Park has preserved an area of species-rich and mostly very healthy native shrubby riparian vegetation, to a degree that is now very uncommon both on the Lett River and on the main course of the Cox's River, into which the Lett River flows (about 5km downstream).

The "Hyde Park" riparian zone on both banks of the Lett River, probably represent the best substantial linear area of this vegetation type left at valley-floor altitude on the middle part of the Cox's River system.

Possible threats to *Asterolasia buxifolia* include weeds and alterations to water flow regimes. The species is also threatened due to a small population size and possible stochastic events.

An additional species of note is *Grevillea rosmarinifolia* subspecies *rosmarinifolia* (Type form). This form of the species was thought for many years to be extinct in the wild until recently. The site and the surrounds (both banks of the Lett River and for some distance up- and down-stream) contain a population in excess of 450 plants of the Type form, initially recorded in late 1999.

On this site *G. rosmarinifolia* occupies ground on the riverbanks and those parts of the lower slopes within or adjacent to the flood zone at least over 1.5 km both up and down stream. It does not occur more than about 25-30 m from the river.

Subspecies *rosmarinifolia* as a whole is widespread from the Hartley/Hampton area, south along the Great Divide into eastern and central Victoria. Partly because of the unresolved taxonomy, and the considerable overall range of the species, neither the subspecies nor its Type Form have ever been listed or nominated for listing under NSW legislation.

The Type Form of *Grevillea rosmarinifolia* subsp. *rosmarinifolia* should be awarded some conservation significance, even pending full taxonomic resolution of the populations currently regarded as within the species, and even without a formal listing under the *TSC Act 1995*. A description of the subspecies, and notes on some of the forms, are given in Makinson, Flora of Australia vol. 17a: 300-1 (2000).

Genus	Species	Location	TSC Act 1995	ROTAP coding 1988	EPBC Act 1999
Asterolasia	*buxifolia*	Lett River riparian zone, northern bank only	E1		
Grevillea	*rosemarinifolia*	Both banks of the Lett river. species sufficiently sporadic in occurrence to be considered naturally rare			

Table 5: Rare or threatened plant species recorded in Hyde Park on the Lett River, downstream of the Dargan's Creek site

[15] *Asterolasia buxifolia* is described in the revised edition of Harden, G.J. (2002) *Flora of NSW Volume 2* pp 312 –313. University of NSW Press, Kensington

5.3.2.3 Summary

As discussed in section 5.3.2.1 above, no flora or fauna of conservation significance were detected on the proposed development site. The flora alone on the proposed offset sites contain over 10 species that are listed as Rare, Vulnerable or Endangered under the *TSC Act*, the *EPBC Act*, and the ROTAP listing. Moreover, as discussed in section 5.3.2.2.1 above, there exist plant communities of significant conservation values that will benefit from rehabilitation works carried out under this strategy.

Both projects sites 1 and 2 contain areas of Newnes Plateau Shrub Swamp. These areas also have the potential to be habitat for the Blue Mountains Swamp Skink, a species listed under the *Threatened Species Conservation Act*. The proposed development site has one small area, which, although not true NPSS, does share some affinity with it. Nevertheless, it has been excluded from the mine footprint.

Sydney Construction Materials considers the investigations into the quality of these sites to have identified areas with environmental values of much higher conservation significance than those of the proposed development site.

5.4 Objective 4

Objective 4 (see Section 3 above) outlines the need for green offsets to ensure that there are *no permanent environmental costs due to time lag in establishing the offsets*.

As it is proposed to provide "like for like" habitat in terms of area (quantity) and quality immediately, there will be no time lag in the establishment of the offset. The restoration of the degraded land described in Sections 4.5-4.5.3 above will provide immediate offsets for the area affected by the development. The revegetation and natural regeneration of the offset areas, made possible by the eradication of weeds and illegal tracks, will provide further habitat in the medium to long term.

Further, given that there will be progressive clearing associated with the project throughout the duration of the development, the offsets will actually secure habitat well in excess of that being cleared throughout the mine life.

5.5 Objective 5

Objective 5 (see Section 3 above) outlines the need for green offsets *to last for the term of the impact*.

Sydney Construction Materials' Newnes Plateau Conservation, Restoration, and Enhancement Project proposes to provide offset areas in perpetuity. That is, irrespective of the term of the impact, the offsets will adequately provide compensation for the impact.

The area described in Project 2 is currently vacant Crown land. Once restoration of this area has reached an adequate level, the Company will investigate the feasibility of this land reverting back to Crown land reserve status. As described above, Sydney Construction Materials will continue to fund the restoration of this project throughout the life of the development.

The local nursery to be established under Project 3 will provide the plant stock required for the progressive rehabilitation of the development site. To do so, it will be necessary for this nursery to operate at least until the end of operations. This nursery could also provide plant stock for the rehabilitation of other degraded sites in the area. It is anticipated that over the life of the development, this nursery will grow to become a significant supplier of native flora to the region, enabling it to remain in operation well after the cessation of mining activities.

5.6 Objective 6

Objective 6 (see Section 3 above) outlines the need for *impacts and benefits to be readily identifiable and quantifiable*.

The EIS, and supplementary information supplied to DIPNR, provides further information regarding the impacts potentially generated by this development, and the measures taken to lessen or eliminate them.

The key impact addressed by this Green Offsets Strategy is the loss of approximately 25ha of vegetation. This loss has been quantified in terms of the area to be cleared and the quality in terms of vegetation types to be cleared, in Section 5.3 above.

Sections 4.5 above outline the benefits to be generated by each of the proposed offset projects.

5.7 Objective 7

Objective 7 (see Section 3 above) outlines the need for *offsets to be located appropriately, offsetting the impact in the same area*.

This objective refers to the appropriate location of offsets in terms of the offsets providing net environmental improvement in the same local region as the impacts. As all three projects occur within a few kilometres of the proposed development site, as described in Section 4.5 above the proposed offsets satisfy this objective.

Given that Objective 3 of the Strategy includes provision of "like for like" in terms of quantity and quality, it is considered that an appropriate offset is one that includes similar vegetation communities, species, habitat value, and similar physiological characteristic such as topography and soil type. One of the more significant vegetation communities on the Newnes Plateau is the Newnes Plateau Shrub Swamp (NPSS). Although no true NPSS exists on the development site, there is one community (on the southern drainage) that shows some affinity with NPSS. Because of the similarity of this drainage to NPSS, Sydney Construction Materials amended the mine plan to exclude this section of land, with consequent loss of resource. The sites on which it is proposed that Projects 1 and 2 be located were chosen precisely for the NPSS located therein, thus also satisfying Objective 7. Further detail is given in Section 5.3 above.

5.8 Objective 8

Objective 8 (see Section 3 above) outlines the need for *offset areas to be supplementary beyond existing requirements i.e. they must be in addition to existing offset areas*.

As the proposed development is new, i.e. not an application for an extension, there are currently no related offsets in the region. Consequently, any offsets established as part of this development will be new, designed solely for the purpose of satisfying this development's requirements.

As discussed in Section 4.4 above, Sydney Construction Materials will employ progressive rehabilitation throughout the life of the development. Sydney Construction Materials recognises that site rehabilitation is required by the *Mining Act 1992*, and therefore cannot be considered a green offset. Nevertheless, attention is drawn to this feature of the proposal as the nature and extent of the rehabilitation confirms Sydney Construction Materials' commitment to the promotion of environmental integrity in the Newnes Junction area.

5.9 Objective 9

Objective 9 (see Section 3 above) outlines the need for the *minimisation of risks and threats:*

- *enforceable and legally secure,*
- *threats from future development and land use conflicts,*
- *adequate resources for management and monitoring, including best practice, adaptive management, open and accountable administration such as advisory panel and public annual report.*

As discussed in Sections 4.5.1, 4.5.2, and 5.5 above**|**5.5 above**}**, it is proposed to provide protection for each offset area through reclassification as Crown land reserve.

Threats from future development and land use have been considered in the selection of offset areas. An assessment of the likelihood of sand resources being located beneath potential offset areas has been undertaken. Although the land on which Project 2 is proposed has a Section 119 direction applying to it, it is understood that the resource in this region is high in iron content. This, coupled with the absence of rail infrastructure providing access to this area, indicates that any future project over this area will be economically unfeasible. Based on current knowledge there are no economical sand resources located beneath any of the proposed land restoration areas.

The enhancement of habitat within the offset areas is consistent with surrounding land uses, being primarily coal mining, sand quarrying, residential (Clarence Village, Bell, Newnes Junction), forestry, and environmental conservation.

Sydney Construction Materials will invest up front establishment funds as well as on-going management funds to ensure adequate resources for management and monitoring do exist. It is anticipated that the Hawkesbury-Nepean Catchment Management Authority (HNCMA) will be the Scheme Manager, holding and disbursing these funds, and using its standard project reporting process to report to the Company, DIPNR, NSW EPA, and other stakeholders in a public, annual report. This will also ensure that the administration of the scheme remains open and accountable.

Sydney Construction Materials recognises that as this area of policy is still under development, it will be ready to adapt to new developments in the field of green offsets.

6. Conclusion

Sydney Construction Materials has designed the Newnes Junction Sand & Kaolin development to eliminate or mitigate, to the greatest extent feasible, any impact on the surrounding environment. The project will, however, result in the staged clearance of 25ha of regrowth forest on vacant Crown land. An assessment has been undertaken in order to identify appropriate offsets to compensate for this clearance. As well as employing progressive rehabilitation to minimise the overall impact of the development, diversion of an affected drainage, and a regionally-compatible final landform, the Strategy provides for the protection of over 869ha of vacant crown land of similar quality to 25ha to be progressively cleared. Furthermore, the establishment of a local native flora nursery will facilitate the responsible rehabilitation of the site, and will continue to serve as a regional source of native plants well after project completion. The detailed assessment of the proposed clearance area and proposed offsets, as contained in the Strategy, demonstrates that these on- and off-site offsets will provide "like for like" both immediately and a net improvement in the medium to long term. All offsets are to be located on Crown land. At the completion of restoration, it is proposed that the offset areas be submitted for reclassification as Crown land reserves.

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT G

Supplementary Visual Impacts Assessment

Sydney Construction Materials
December 2004

Sydney Construction Materials

Newnes Junction Sand and Kaolin Extraction Proposal

Supplementary Visual Impacts Assessment

December 2004

Executive Summary

Sydney Construction Materials is seeking approval for the development of a construction sand, specialty sand, and kaolin extraction operation at Newnes Junction, near Lithgow.

Section 5.5 of the Sydney Construction Materials EIS (2004) dealt with the visual implications of the proposed development. This paper is a supplement to that section of the EIS, following a review of the government agency and public submissions to the EIS.

Measures taken to mitigate the potential visual impact in relation to this development include:

- the use of environmentally consistent colour schemes for all visible infrastructure (site office, water treatment facility, conveyor, and train loading system),
- the use of progressive clearing, minimising the total area of land cleared at any given time,
- the use of progressive rehabilitation, further minimising the total area of land cleared ant any given time,
- the use of terraced landscaping, which will ensure that there will be no more than 3 vertical metres of exposed rock wall at any given time, and
- a final landform design inspired by a nearby natural feature, known as "Gooches Crater".

These design features will allow the development to be rapidly integrated into the surrounding landscape both during and after operations.

Sydney Construction Materials engaged MineConsult to prepare visual transects of the proposed development from the areas identified in Section 5.5 of the EIS (see Appendix 1 and Figure 5 below). These transects provide an understanding of how the development will look at the end of operations from nearby selected vantage points. They demonstrate that the visual impact from those locations will be minimal.

A review of formed bushwalking tracks in the area was also conducted. It revealed that there are no formed bushwalking tracks with a clear view of the development within 5km, indicating that the chance of a recreational bushwalker being visually impacted by the development is minimal.

Due to the mining and rehabilitation methods proposed to be employed by Sydney Construction Materials, the visual impact from the Newnes Junction development will be minimal at all times.

Table of Contents

1 Introduction....1
2 Purpose....2
3 Visibility of the proposed development....3
4 Viewing points....6
4.1 Previous study – Sydney Construction Materials EIS....6
4.2 New study – MineConsult visual transects....6
4.3 Methodology....8
4.4 Viewing locations....8
5 Mitigating measures....15
5.1 Progressive clearing....15
5.2 Terraced landscaping....16
5.3 Bushwalker access in the area....19
6 Conclusion....20

1 Introduction

Sydney Construction Materials is currently seeking approval for the development of a multi-commodity friable sandstone resource on the Newnes Plateau, approximately 10km East of Lithgow.

The proposal will assist in the provision of sand and other construction materials for Sydney's construction industry, eventually supplying over 1 million tonnes per annum (tpa) to feed the city's 7 million tpa appetite. The proposal will also supply specialty sands including silica flour, fine silica flour, glass sand (flint and amber grade), and filter and drainage sand, as well as a range of high quality recreational and landscaping sands. The most valuable component of the resource, however, is kaolin, although only comprising 8.5% of the resource by weight. Products using kaolin include bricks, pavers, ceramics, refractories, pozzolans (concrete strength enhancer), and high-value calcined kaolin, used for paper coating, paper fillers, paint and plastics fillers, and adhesive fillers.

The Newnes Junction project will necessitate the progressive clearing of approximately 25ha of sparsely populated regrowth situated on Crown Land. Sydney Construction Materials will utilise innovative progressive rehabilitation techniques throughout the life of the development that will mitigate the visual impact that may otherwise arise from such a project.

This paper provides information in addition to that in the EIS (2004) regarding the nature and degree of visual impact in relation to this development.

2 Purpose

Government agency and public submissions were tendered during the display period of the DA/EIS process for the Sydney Construction Materials Newnes Junction Sand and Kaolin Extraction Proposal. Some of these submissions raised concern that the development would result in significant visual impacts to users of the National Park and other surrounding areas. This report is tendered as a response to those submissions, and is provided as a supplement to the Visual Implications Section (section 5.5) of the EIS (Sydney Construction Materials, 2004). It discusses the areas of visual impact identified in the EIS, provides views and visual transects from locations surrounding the proposed development, and outlines the mitigating measures, progressive clearing and progressive rehabilitation with terraced landscaping, which will minimise any visual impact relating to this development. A brief review of established bushwalking tracks is also provided so as to give an understanding of potential visitor activity in the area.

3 Visibility of the proposed development

During operations at the development site, infrastructure associated with the development will be visible. This includes the site access road, site office, water treatment plant, and the conveyor and train loading facility. All of these will be designed to have minimal visual impact, and will be coloured an environmental green, to lessen their visibility.

Other operations in the area, when extracting sand, quarry through the resource, leaving bare rock walls, often with little or no attempt to ameliorate the visual impact that results. The Sydney Construction Materials development differs significantly to existing sand extraction operations in that it will employ the innovative technique of progressive rehabilitation using terraced landscaping (discussed in section 5.2 below). The result of this technique is that no more than 3 vertical metres of rock wall will be visible at any stage of the extraction process, as can be seen in Figure 1 below. This minimises visual impact during operations, both near to and at a distance from the site. Further, it allows for a more rapid integration of the site into the surrounding landscape at the conclusion of operations.



Figure 1: Terraced landscaping on the Somersby Plateau (Mark Burns, Global Soil Systems)

The proposed final landform is a free-draining wetland. The initial design was for a water body to occupy the site once operations had concluded, but following consultation with local environmental groups, and public feedback on the EIS, the decision was made to modify the final landform to result in a feature more consistent with the surrounding landscape. Figure 2 below shows a 3D perspective of the intended final landform.

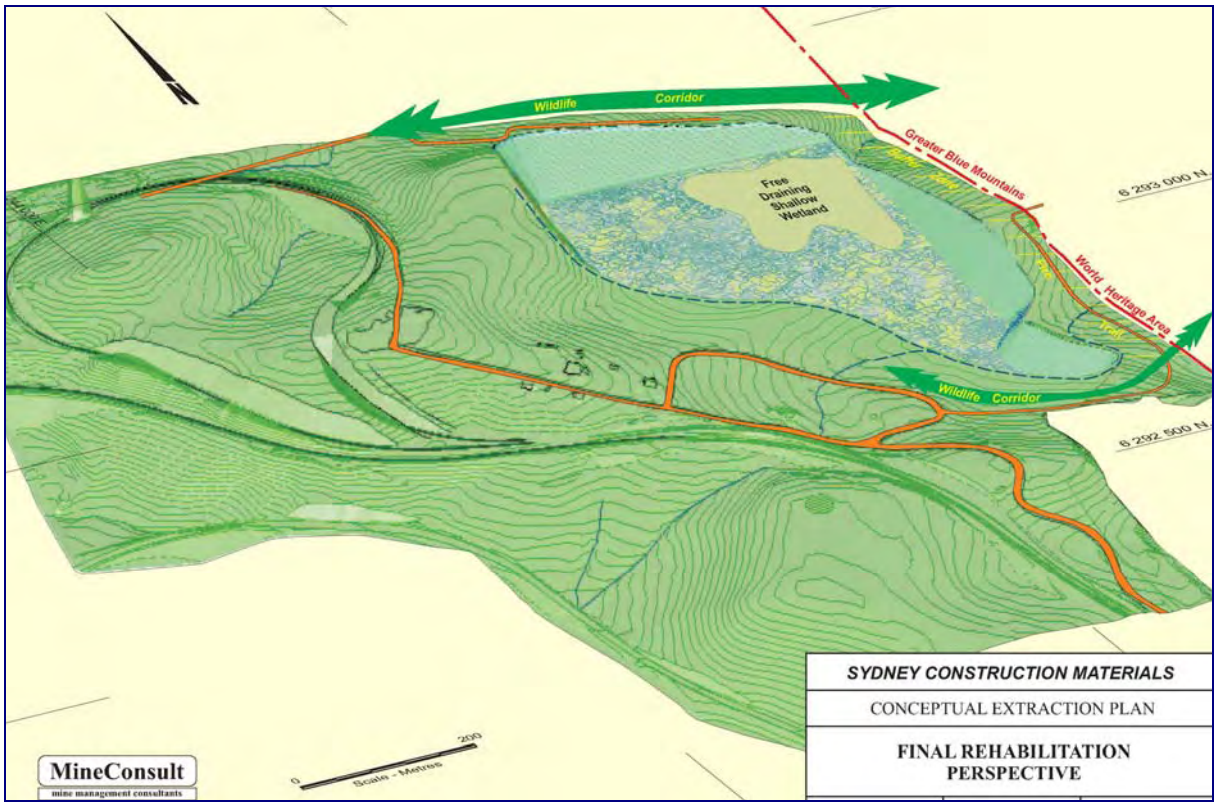


Figure 2: 3D perspective of final rehabilitated landform

Figure 3 below shows a plan view of the intended final landform.

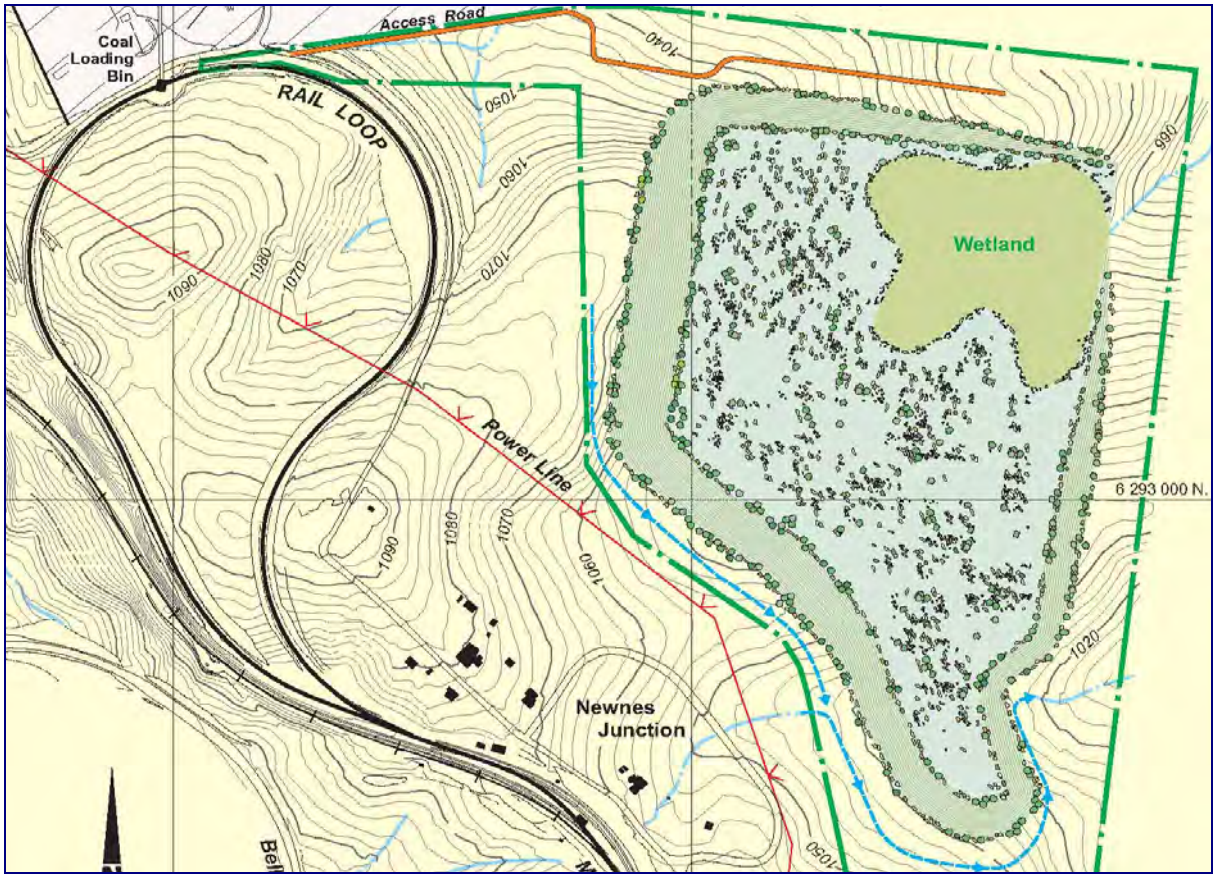


Figure 3: Plan view of final rehabilitated landform

Figure 4 below shows the nearby natural landform known as Gooches Crater. This nearby natural feature provided inspiration for the intended final landform shown in Figure 2 and Figure 3 above. It shows a free-draining wetland area located just outside of the Blue Mountains National Park, a few kilometres north-east of the proposed development site.



Figure 4: The final rehabilitated landform is inspired by nearby Gooches Crater

4 Viewing points

4.1 Previous study – Sydney Construction Materials EIS

Section 5.5 of the Sydney Construction Materials EIS (2004) dealt with the visual implications of the proposed Newnes Junction Sand & Kaolin Extraction development. Figure 5.2 in the EIS was used to display those surrounding areas that belong to high, medium, or low visual catchments. A modified version of Figure 5.2 has been reproduced in Figure 5 below, showing the areas identified in the EIS.

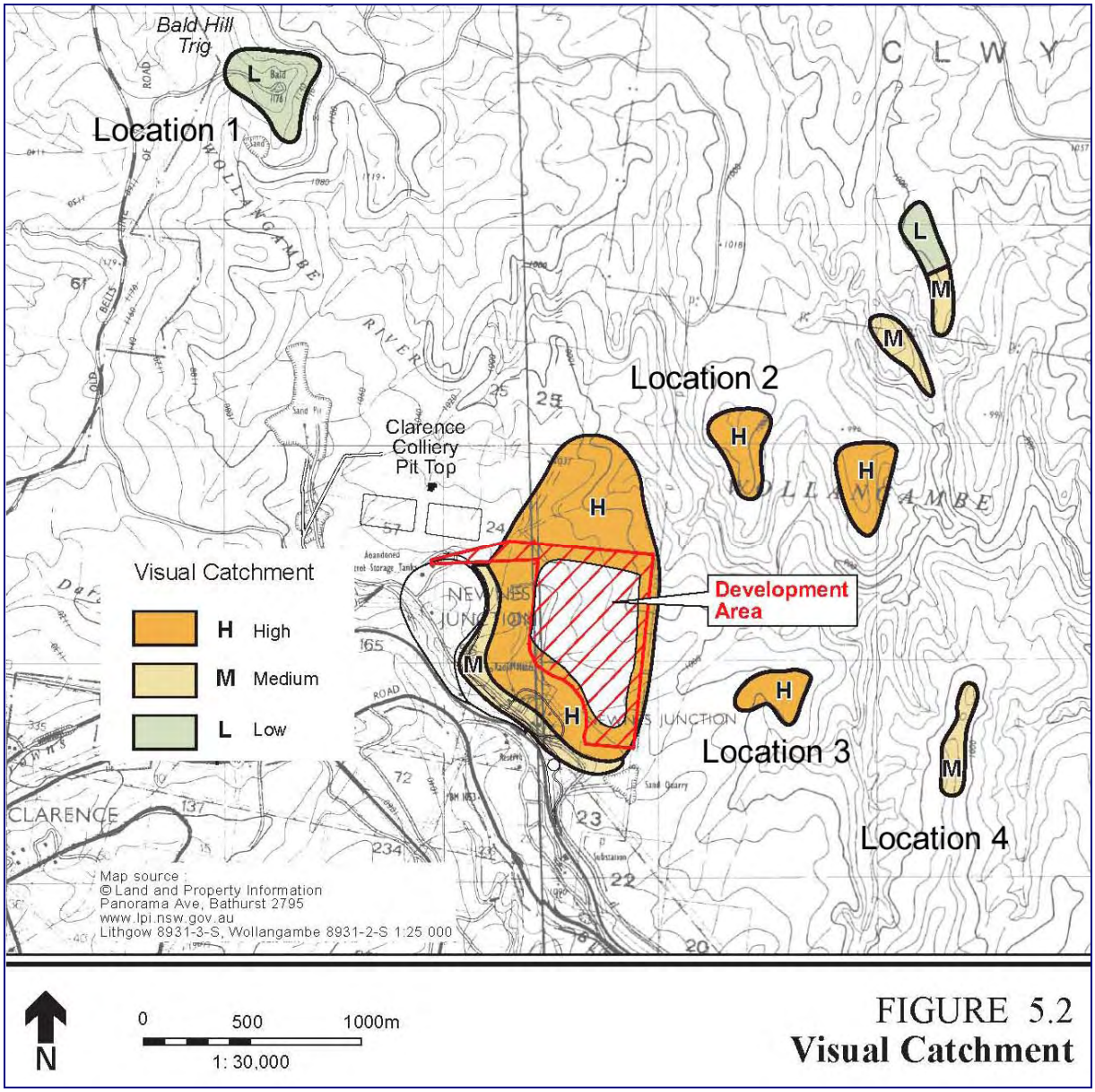


Figure 5: Modified Figure 5.2 (Visual Catchment) from the Sydney Construction Materials EIS (2004), referencing Locations 1-4 (discussed below)

4.2 New study – MineConsult visual transects

Following public feedback on the EIS, Sydney Construction Materials commissioned MineConsult to produce images depicting the visual impact of the development from the locations identified in the EIS. Figure 6 below identifies the locations of and directions from which the views in sections 4.4.1 to 4.4.4 were obtained.

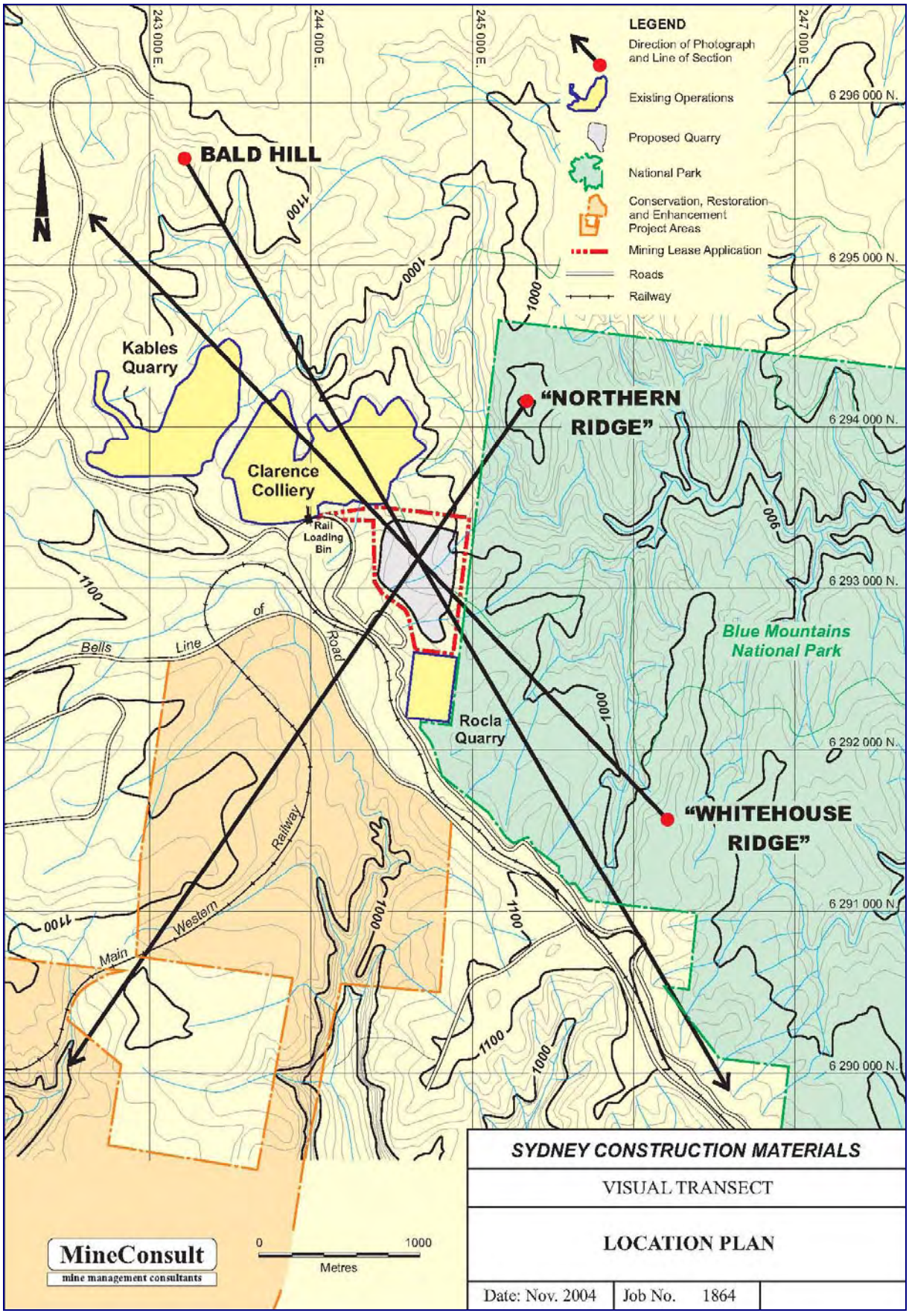


Figure 6: Location map showing location of proposed Sand & Kaolin operation, other existing operations, Blue Mountains National Park, and Visual Transect Lines.

4.3 Methodology

This Visual Impacts Supplement was undertaken from four locations with potential views of the proposed development. Selection of these viewing points was based on an assessment of the topography in proximity to the proposed development. The areas chosen as viewing points (as shown in Figure 5 above) are:

1. Location 1 – Bald Hill Trig Station
2. Location 2 – "Northern Ridge"
3. Location 3 – "Eastern Ridge"
4. Location 4 – "Whitehouse Ridge"

Photographs were taken from each viewing point in the direction of the project in order to understand the visual quality of the area. The locations from which these photographs were taken were recorded using the Global Positioning Satellite (GPS) system. A 3-dimensional model of the development, which incorporates a digital representation of the surrounding topography, was then manipulated to produce a view of the development from each photograph location. This was then super-imposed over photographs from Locations 1, 2, and 4 (Location 3 is discussed in section 4.4.3 below), and finally overlaid with vegetation to represent the results of the terraced landscaping.

The construction of visual transects using topographic maps overlain with the conceptual plans for the proposed development was also completed for Locations 1,2, and 4.

The following sections describe the views of the project at the conclusion of operations.

4.4 Viewing locations

4.4.1 Location 1 – Bald Hill Trig Station

As discussed in section 5.5 of the Sydney Construction Materials EIS (2004) (see Appendix 1), the Bald Hill Trig Station north-west of the proposed development provides the best view of the site due to its proximity to the development, height, and well-maintained access road (which provides ready access to the trig station). The visual impact from this area was described as "Low" in the EIS.

Figure 7 below shows the view from Bald Hill Trig Station. In the foreground, the Kables Quarry and Clarence Colliery can be clearly seen. To the left of the colliery in the background, the outline of the proposed Sydney Construction Materials development is visible. The lack of any established vegetation higher than grasses means there would be no amelioration of the development from this location

Taken in isolation from existing neighbouring extractive and transport activities and without progressive rehabilitation, the Sydney Construction Materials proposal would have resulted in some small visual impact from the Bald Hill Trig Station. This is consistent with the findings of the Visual Impacts assessment in the EIS.

When viewed in the context of existing neighbouring developments, however, with the progressive rehabilitation that will be employed at the site during operations, the visual impact of the development from the Bald Hill Trig Station will be insignificant.

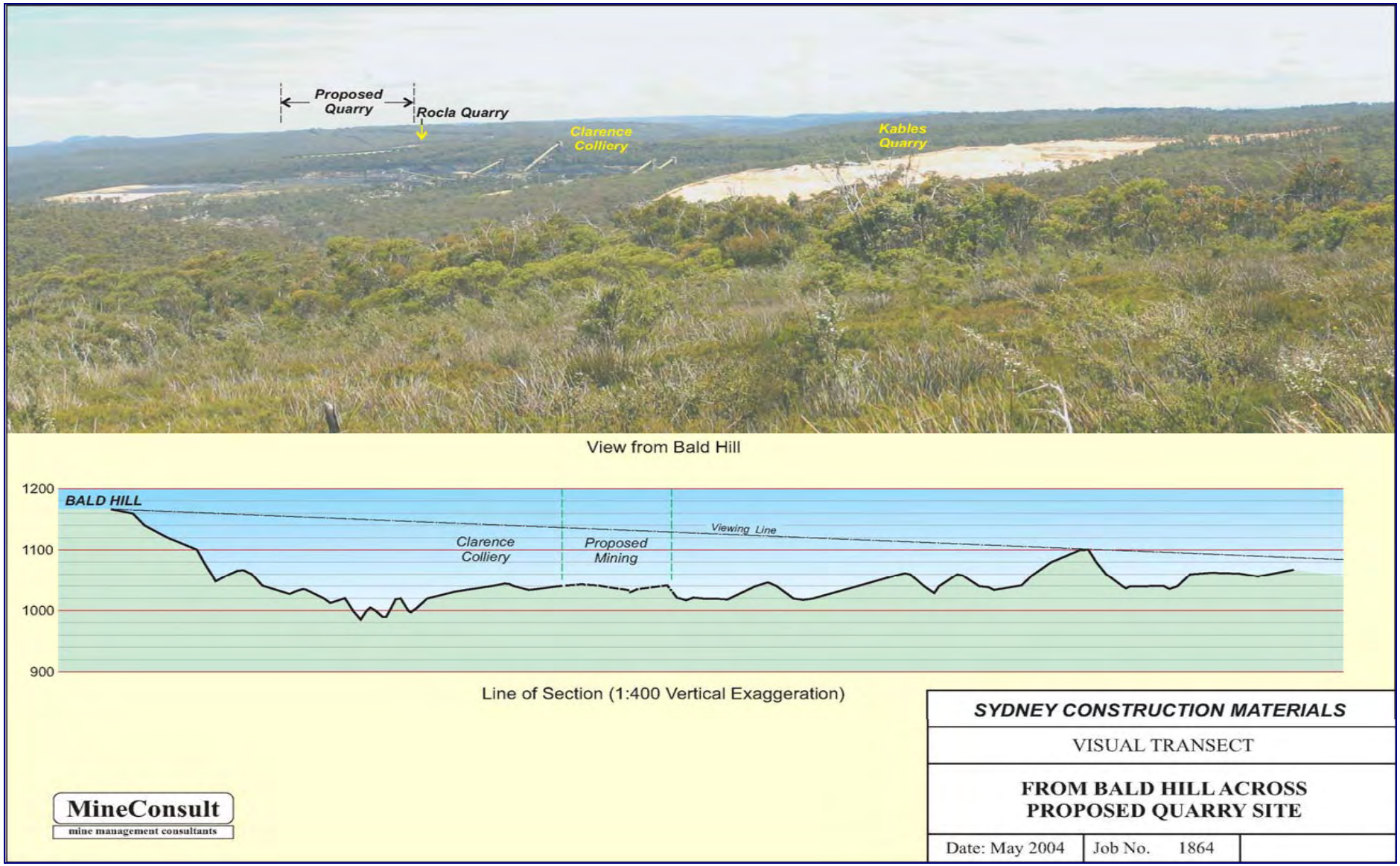


Figure 7: Visual transect from the Bald Hill Trig Station towards the proposed development

4.4.2 Location 2 – "Northern Ridge"

In the Sydney Construction Materials EIS (2004) (Appendix 1), the area now designated as the "Northern Ridge" was classified as belonging to a "High" visual catchment, given it's proximity to the proposed development, and its height. The sparse, shrub vegetation at the site is like to provide no visual screening of the development, as shown in Figure 8 below. In Figure 8, the Clarence Colliery and Kables Quarry can be seen to the right of the picture, as can the pagoda formations, from which unobscured views of the development site would also be possible. On the left hand or southern side of Figure 8, the Rocla quarry is visible. Directly adjacent to it is the proposed development site.

The aspect from the "Northern Ridge" will also include some minimal views of the floor of the development. At the conclusion of operations, the floor will be rehabilitated to resemble Gooches Crater, seen in Figure 4 above.

If the proposed development were observed in isolation to the other extractive operations, and without progressive rehabilitation, the visual impact from the "Northern Ridge" would be high, an assessment that would accord with the original EIS position.

However, as is the case with the view from Figure 7 above, the Sydney Construction Materials development cannot be seen in isolation from existing development on the Newnes Plateau, nor should it be viewed without the progressive clearing and progressive rehabilitation. As seen in Figure 1 above, the terraced landscaping technique will mean that only 3 vertical metres of rock wall, at most, will be visible at any stage during development. Because of the mitigative actions to be taken during operations, and adopted following submissions on the EIS, the visual impact from the "Northern Ridge" will be significantly ameliorated.

Figure 5 above from the EIS also showed 3 other areas belonging to "High", "Medium", and "Low" visual catchments. The area directly to the east of the "Northern Ridge" is slightly lower than and reasonably close to the "Northern Ridge". As such, the visual impact from this location would be virtually identical to, if not less than, that of the "Northern Ridge".

The "Medium" and "Medium/Low" areas to the north-east of Location 2 are further away than, and lower than, the "Northern Ridge", and so the visual impact from these sites would be lower still than that at the "Northern Ridge".

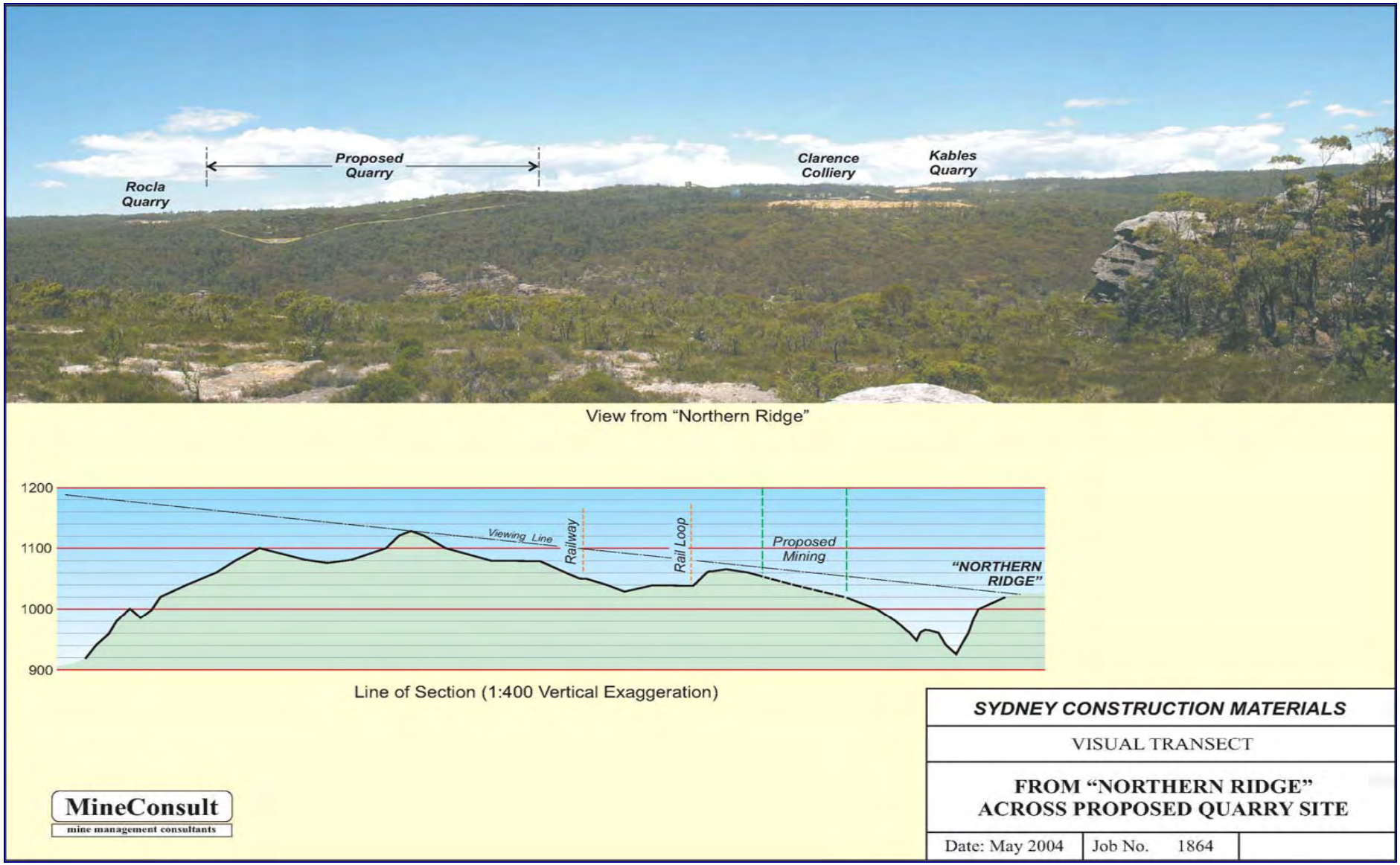


Figure 8: Visual transect from "Northern Ridge" towards the proposed development

4.4.3 Location 3 – "Eastern Ridge"

The view from the "Eastern Ridge" towards the development is significantly restricted due to the relatively flat local topography and the presence of established vegetation, as shown in Figure 9 below. Detailed ground searches may reveal a spot near this location that will allow glimpses of the development, but as the development site will be progressively rehabilitated, the visual impact from any such location will be negligible. Further, as access to this location is difficult due to its distance from roads and bushwalking tracks (see section 5.3 below), the likelihood of recreational bushwalkers seeing the development from the "Eastern Ridge" is very low.



Figure 9: View looking west towards proposed development site from "Eastern Ridge"

4.4.4 Location 4 – "Whitehouse Ridge"

Section 5.5 of the EIS (2004) described the "Whitehouse Ridge" (so named after the owner of the land through which access is obtained) as belonging to a "Medium" visual catchment. Figure 10 below shows that from this location, the waste emplacement zone of the Clarence Colliery is clearly visible. The Clarence rail loading bin, adjacent to which the Sydney Construction Materials rail loading bin will be located, is also visible.

If the proposed development were observed in isolation to the other extractive operations, and without progressive rehabilitation, the visual impact from the "Whitehouse Ridge" would be "Medium" to "Low", an assessment that would accord with the original EIS position.

However, its distance from the proposed development (over 1km), viewing angle, and the on-site progressive rehabilitation mean that there will be very little visual impact from this location. This is evidenced by the view in Figure 10 below.

Further, as access to this location is restricted due to the need to cross private property (freehold land), the possibility of recreational bushwalkers traversing this ridge, and seeing the development is negligible.

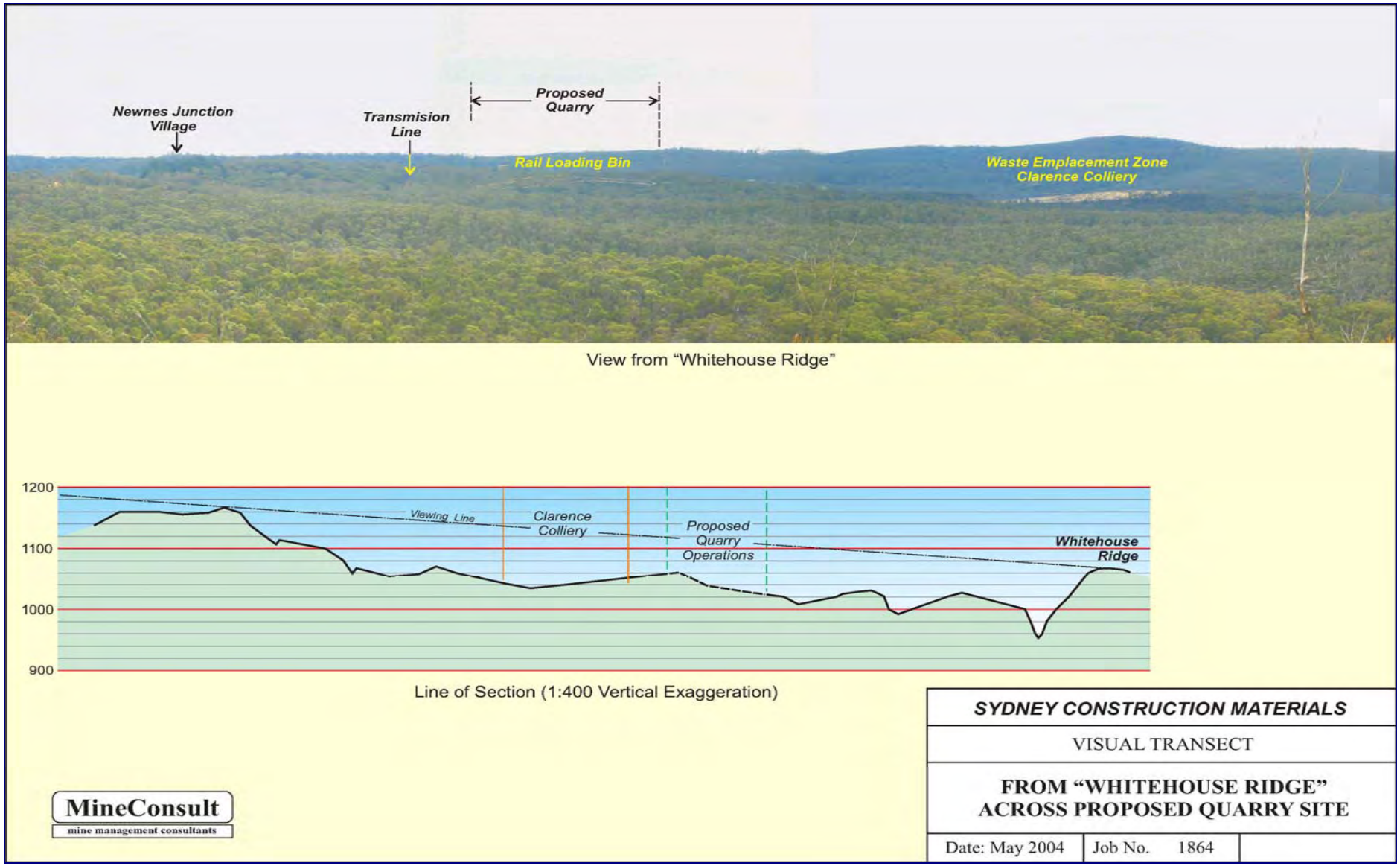


Figure 10: Visual transect from "Whitehouse Ridge" towards the proposed development

5 Mitigating measures

The descriptions of the above viewing locations all refer to the mitigating measures that will be employed onsite during operation of the proposed development. This section addresses the key activities – progressive clearing, and progressive rehabilitation – in further detail. The lack of formal bushwalker access to the area is also discussed below.

5.1 Progressive clearing

The Sydney Construction Materials Newnes Junction Project will require the clearing of land for the extraction of friable sandstone. Although the total area of land cleared at the end of the development will be approximately 25ha, clearing will take place in a staged manner in order to minimise the visual impact of the development throughout its life. Figure 11 below displays in graphical form the proportion of the site to be cleared at various stages of the development. Table 1 below outlines this numerically.

End of Year	Incremental Area Cleared	Total Area Cleared
1	2.04ha	2.04ha
2	1.48ha	3.52ha
3	2.64ha	6.16ha
4	2.07ha	8.23ha
5	2.90ha	11.13ha
10	8.87ha	20.00ha
15	3.85ha	23.85ha
20	1.16ha	25.01ha

Table 1: Area of site affected in staged development

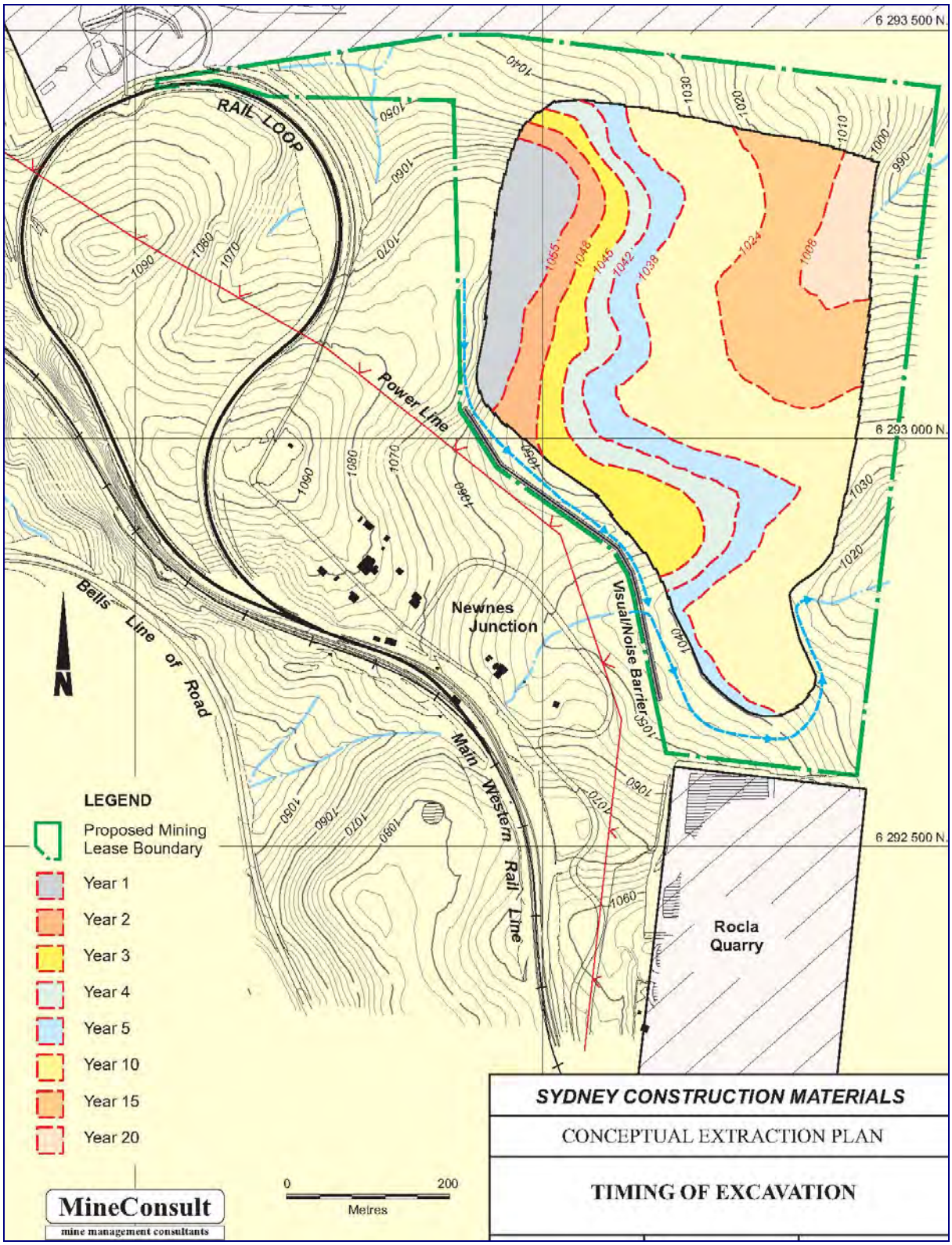


Figure 11: Staged timing of excavation

5.2 Terraced landscaping

The principal difference between the Sydney Construction Materials proposal and other existing operations in the surrounding area is that in conjunction with progressive clearing, this project will incorporate progressive rehabilitation using terraced landscaping. Following is a description of how this technique works.

As the surface miner progresses through the resource, 2-metre-wide benches will be formed at every 3 metres of depth to provide a platform on which native flora species will be planted. Irrigation for the benches will be provided from mine seepage water and any accumulated rainfall runoff. Figure 12 below shows an overview cross-section sketch of how the rehabilitated site will look at the end of the development's life. It identifies the terraced landscaping that will be utilised on the walls of the development, and indicates the area of free-draining wetland that will be created at the bottom of the site at the end of the development's life.

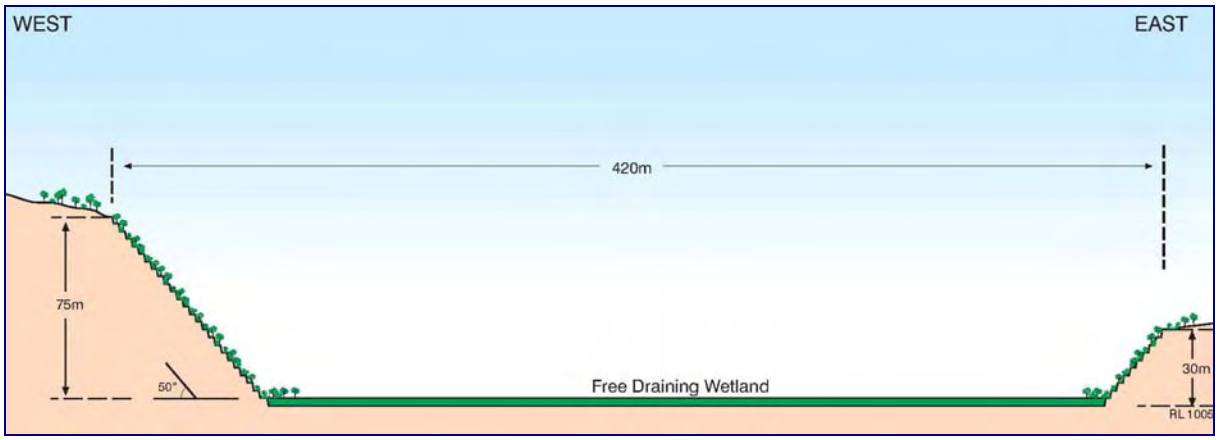


Figure 12: Conceptual design for progressive rehabilitation – overview.

Figure 13 below shows a detailed cross-section of the intended terraced landscaping, indicating batter angles, bench widths, and bench heights.

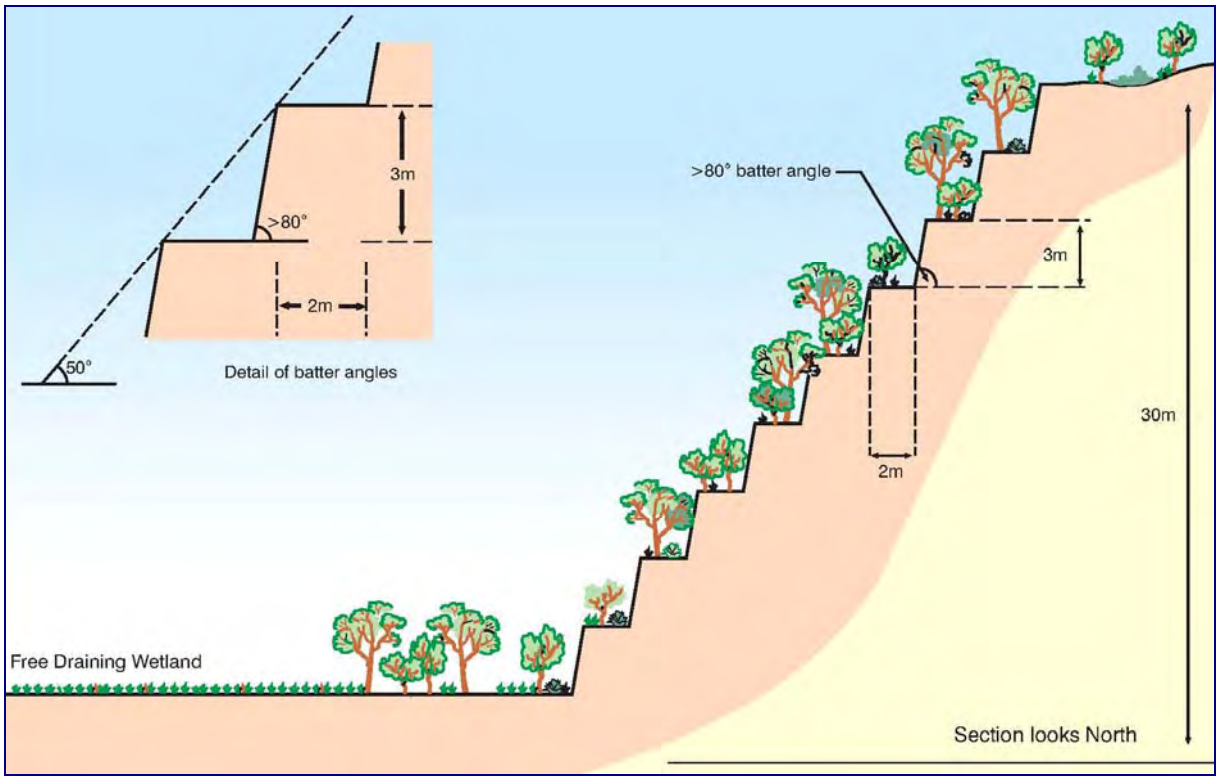


Figure 13: Conceptual design for progressive rehabilitation – detailed cross-section.

Figure 14 and Figure 15 below show how successful this rehabilitation technique has been in the past at other locations. It shows a quarry extracting friable sandstone at Somersby on the NSW Central Coast that is very similar to the Banks Wall

Sandstone at Newnes Junction. The photos show what the proposed quarry walls at Newnes Junction will look like after the program of progressive rehabilitation. The top row of vegetation is about 3 years old and the bottom row about 6 months old.



Figure 14: Progressive rehabilitation – top bench: 3 yrs old, bottom bench: 6 months old (Mark Burns, Global Soil Systems)



Figure 15: Native tree & shrub seeding on sand quarry benches (2 yrs old) (Mark Burns, Global Soil Systems)

These figures provide evidence of the fact that terraced landscaping is a tried and proven method of land rehabilitation. They demonstrate that significant levels of visual mitigation can be obtained very quickly with a high degree of success. Moreover, Figure 15 above demonstrates that significant levels of visual mitigation can be obtained at close proximity to the development, and within a short timeframe after mining at a given location has occurred. It is quite clear that once a bench has been formed, rehabilitation can commence immediately, resulting in a very short period of time that any one section of wall will be exposed. As the clearing of land will also occur in a staged manner (see section 3 above), the overall impact at any given time during and following operations will be minimal.

5.3 Bushwalker access in the area

Attached at Appendix 2 is a Sydney Construction Materials file note regarding investigations into bushwalker access to the area surrounding the proposed development.

The investigations involved on-site, and an intensive literature, search on walking tracks, campsites and picnic areas located on and around the Newnes Plateau. It found that the main focus for walking activities is well to the north of the Newnes Junction project area and is accessed by the Glow-worm Tunnel Road. The main attractions of the area – Deep Pass, Galah Mountain, Glow Worm Tunnel, and Bungleboori Picnic Area – are 10-30kms from the proposed development site.

There are no formed tracks within a 5km radius of the proposed development site. The Dargan's Creek Canyon south of the Bells Line of Road is probably the closest locality used by bushwalkers and canyoners and is located several kilometres south of the project area.

The file note concludes that it is unlikely that the area within a 2km radius of the proposed development will attract any recreational bushwalking activities. Consequently, the number of people on a recreational bushwalk in the area that might see any of the visually-mitigated development is very low.

6 Conclusion

The proposed Sydney Construction Materials development at Newnes Junction will result in the progressive clearing of approximately 25ha of vacant Crown Land. The progressive rehabilitation techniques to be employed will mitigate any visual impacts, through the provision of a well vegetated quarry wall throughout the life of the development. Conventional quarrying methods would result in an un-rehabilitated rock wall, clearly visible from the surrounding area – the Sydney Construction Materials proposal is clearly very different.

Visual transects from neighbouring vantage points, some as close as a few hundred metres to the development, indicate that due to the geographical location and rehabilitation techniques to be employed, the visual impact of this development will be very low. Moreover, the visual transects clearly demonstrate that there will be minimal addition to the cumulative impact of the industrial activity on the Newnes Plateau by the Sydney Construction Materials development.

Furthermore, the investigation carried out into the presence of formed bushwalking tracks in the area did not identify any within 5km of the proposed development. The likelihood of any bushwalkers being visually impacted by the development is, therefore, negligible, even without regard to the visual impact mitigation measures to be implemented.

Appendix 1

Section 5.5 from Sydney Construction Materials EIS, 2004 – "Visual Implications"

5.5 Visual Implications

The visual assessment was carried out on the basis of fieldwork and the study of the stereoscopic aerial photographs. Recommended amelioration treatments have been proposed to minimise the visual impacts associated with the works.

5.5.1 Visual Catchment

The visual catchment of the proposed mine site extends around the site to varying distances as shown on **Figure 5.2**. The best views of the site that are readily accessed are available from Bald Trig, located in the Newnes State Forest, some 2 km to the north-west of the site. This site is the highest point in the area and has views of the National Park, Clarence Colliery, Kables Sands and the Rocla Quarry.

Views from the east are limited, since the area is covered by National Park with few permanent, formed tracks that would allow public access to gain views of the site. The site can be viewed from short sections of the unformed track leading to Gooches Crater, a feature known to bushwalkers, but cannot be seen from the feature itself. Views of Clarence Colliery pit top, the two existing quarries, access roads and railway infrastructure are also visible from this location.

Clear views of the kaolin mine would be available from rock pagodas located immediately opposite the site and on the edge of the National Park. Access to the top of these pagodas is extremely difficult and requires rock-climbing equipment. From this site, clear views of other industrial and residential activities on the western side of the National Park are available.

The site will be visible from residents at Newnes Junction, particularly on the northern side of the road. Although the quarry benches will not be visible in the early stages of the development, the removal of trees will be noticeable and may also open up views to Clarence Colliery.

5.5.2 Existing Landscape Elements

In general terms, the visual catchments in the study area contain a number of major landscape elements, including:

- slopes vegetated with native species of trees and shrubs including the site itself and the adjacent Blue Mountains National Park to the east;
- exposed high points and slopes from which the site may be readily seen (if the topography permits);
- industrial elements including coal mining infrastructure and reject emplacement to the north of the site and sand quarries to the south and north east of the site;
- dirt access roads to industrial sites and the Newnes Junction township;
- small village residences within the township of Newnes Junction; and
- transportation elements including road and rail infrastructure.

Each of the units found within the study landscape is briefly described to provide an indication of the existing landscape characteristics of the proposed kaolin mine.

Vegetated Slopes – many of the slopes within the area are vegetated with native species including much of the adjacent National park. The slopes have a low visual diversity due to the consistency of form and colour.

Exposed high points and slopes – exposed high points and slopes, including cliffs, pagodas, slot canyons and smaller escarpments characteristic of the sandstone landscape of the Newnes Plateau occur adjacent to the Wollangambe River to the east of the site. These sites occur at high elevations within the landscape or in areas where vegetation is low or non existent. No such sites occur within the proposed mining lease.

Industrial elements – within the existing landscape a number of industrial developments occur, and visual elements associated with these developments include coal reject emplacement areas at Clarence Colliery, coal handling infrastructure and stockpiles, rail loading bin, conveyors and buildings, and sand quarries associated with Kables and Rocla.

Dirt roads – dirt roads providing access to the various industrial operations in the area (Kable Sands, Clarence Colliery and Rocla Quarry) and the Newnes Junction township are located to the west of the site.

Village residences – there are half a dozen dwellings in the village of Newnes Junction that are stand alone houses constructed primarily of wood and/or brick. Some of these dwellings are currently being renovated and there is the potential for other blocks to have dwellings constructed on them in the future. There is a buffer of some 200 m from the residences to the proposed mine site and until recently this entire area was vegetated with open woodland eucalyptus species. Recently some of this area has been cleared and a large dirt road has been constructed, providing access for public vehicles to the east. A minimum of 100 m of vegetation will remain between the residences and the ultimate pit limits.

Transportation elements – within the landscape, major roads and railways occur, creating linear visual elements within the landscape consisting of ribbons of clearing the transportation routes within them. The highway surface is asphalt and generally consists of 2 lanes. There are no views of the proposed mine site from the Bells Line of Road.

5.5.3 Assessment Criteria

In assessing the visual impacts of the proposed line, the visual catchment around the corridor was mapped according to the visual sensitivity of the areas within the catchment (refer **Figure 5.2**). The visual effect of the proposed mine site is the result of a complex combination of factors including:

- the existing visual environment;
- progressive and final visual characteristics of the proposed mine;

- distance;
- topography;
- vegetation cover;
- visual contrast generated;
- number of viewers;
- duration of view;
- angle of view; and
- visual sensitivity.

Existing visual elements - the nature of existing visual characteristics of the landscape is an important element in considering the impacts of the proposed mine.

Given the existing industrial elements within the landscape, including the sand quarries, which contrast with the dark green vegetation of the State Forests and National Park, the proposed mine will not introduce a new visual element into the landscape. The impacts of the proposed development are therefore related to increasing an existing visual element within the landscape.

Visually, the most significant impacts occur at sites closest to the proposed mine and from vantage points which directly overlook the site.

Where the site is not visible from surrounding areas there will be no visual impact. Where the mine is visible from elevated vantage points with uninterrupted views, the impacts will be greater, particularly, if these vantage points are frequented by residents or visitors to the area or users of the National Park.

Where areas of timber interrupt a view of the site, visual impacts will be less than if the screening effects of the timber were not present and such visual impacts diminish quickly with distance. Since clearing of the native vegetation will be required, the visual impacts become higher since the visual contrasts generated as a result are generally stark and highly noticeable over longer distances.

Other issues include the characteristics of backdrop surrounding the mine, and the degree to which the operation can be blended into the landscape. The prominence of the mine within the landscape also plays a role with the site being more visible from ridges located in the adjacent National Park than from sites closer to the mine.

Visual characteristics of the proposed mine - The characteristics of the physical components of the proposed kaolin mine, when compared with the existing landscape elements, contribute to the visual impact of the development.

The visual characteristics of the proposed mine will primarily consist of areas cleared of native vegetation with infrastructure and roads or mine benches located in them. The cleared areas will be light in colour, consisting of fresh sandstone which is white, yellow and light brown. In the early stages of the mine, cleared areas will be limited to the area of the access road and infrastructure and the initial mine stage. As the mine develops further, it will include larger cleared areas and rehabilitating vegetation at the edge of existing benches.

Distance - In terms of the visual impact, areas closest to a mine are generally subject to the highest degree of visual impact, where the mine is clearly visible from such areas.

In general terms, the further the mine is located from a point, the lower the visual impact will be. Within the visual catchment view lengths have been divided into foreground (0-0.5 km), within which the mine site would form a prominent feature in the landscape, middleground (0.5-2 km), within which the mine site can be readily seen but would not be as highly prominent, and background (2-5 km), within which the mine site can be readily detected within the landscape but is not visually dominant.

Topography - The topography of the viewer will have a significant effect on the visual impact of the proposed mine activities.

High elevations and cleared outcrops - Where the mine is viewed from areas of high elevation or cleared outcrops, it can be silhouetted against the darker surrounding vegetation and will consequently have a high visual impact.

Mid-slopes - when the mine site is viewed from mid-slope areas, the visual impacts are generally lower, due to the view of the site being partially screened by intervening vegetation, making it more difficult to see.

Valley floors – where the site of the viewer is within a gully, it is unlikely that the mine site will be visible since it will be screened from view by the surrounding valley sides and ridges.

Vegetation cover - the amount and nature of existing vegetation in the intervening landscape is very important when determining the visual impact of a mine site. If the landscape between the mine and the viewer is cleared, the mine can be visible for considerable distances. The visual impacts will be highest close to the mine but will still lessen with distance.

Where scattered vegetation occurs, the impacts are generally lower, since scattered vegetation can screen the high contrast areas within the mine site.

Since clearing is required for the mine site in an area of existing vegetation, the visual impacts in terms of vegetative cover will be higher, as a result of the enlargement of a highly contrasting element (ie. cleared areas of exposed sandstone) into the landscape.

Number of viewers affected - when determining the visual impacts of a mine site the number of viewers is taken into consideration. Visual impacts are regarded as higher when a greater number of people are affected by the mine.

Duration of view - the duration of viewing also contributes to the visual impacts of a mine site. Static views (i.e. from residences, recreational areas and tourist lookouts) are regarded as more important than transitory views (i.e. from roads).

Angle of view - Visual impacts also depend on the locations and angles from which the mine is viewed. The greater proportion of given vista the mine site occupies the

greater the impact. This is determined by the angle of view and the distance of the mine from the viewer.

Visual Sensitivity - visual sensitivity is a measure of the perceived visual impacts on the visual environment, or the ability of an area to absorb the visual impacts of a development.

5.5.4 Visual Assessment

The following categories of visual impact were established for the visual assessment, based on the assessment criteria outlined above.

- ❒ high visual impact;
- ❒ moderate visual impact;
- ❒ low visual impact; and
- ❒ negligible visual impact.

The categories above have been used in **Table 5.1** to determine the general visual impacts of the proposed mine site on the environment. The existing nature of the environment (including the topography and the presence of otherwise similar industrial elements within the landscape), the distance from which the mine is viewed and the vegetation cover of the area are clearly shown in the table. Other criteria considered for the assessment include the duration and angle of view (road views will be intermittent and of short duration), visual sensitivity and the number of viewers. While these criteria are not all shown in the tables, they were taken into consideration when determining the mapping of the visual impacts.

Table 5.1 - Visual Impacts of Proposed Mine Site

Landscape Element	Distance								
	Foreground Views 0-500 m			Mid ground Views 500-2000 m			Background Views 2000-5000 m		
From which mine will be Viewed	Intervening Vegetation			Intervening Vegetation			Intervening Vegetation		
	None	Scatt-ered	Dense	None	Scatt-ered	Dense	None	Scatt-ered	Dense
Exposed sites	H	M	n/a	H	M	n/a	L	L	n/a
Vegetated slopes	H	M	N	M	L	N	n/a	N	N
Industrial areas	M	L	N	L	L	N	N	N	N
Dirt Roads	H	M	L	M	L	N	L	L	N
Village residences	n/a	M	L	n/a	n/a	n/a	n/a	n/a	n/a
Main Transport elements	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

H - High visual impact
M - Moderate visual impact
L - Low visual impact
N - negligible visual impact
n/a – mine site not visible from such an area

5.5.5 Visual Impacts

The fact that the existing landscape is dominated by industrial elements to both the north and south of the site has been a major consideration in this visual assessment. Given the existing impacts of industrial developments in the landscape, the visual impacts of the proposed mine have been assessed on the basis of incremental impacts in areas from which existing developments are visible.

The impacts will include visual changes in the landscape associated with clearing of vegetation on site, exposure of the underlying sandstone material and construction of infrastructure required in the mining operations.

Specific visual impacts occurring in relation to the proposed mine are discussed below.

Newnes Junction Residences

In the early stages of mining, the operation will not be visible from any residential dwelling. However, in later stages of mining the reduced intervening timber will be noticed and in final stages of mining it may be possible for residences to view sections of the quarry faces. These views will be mitigated with additional tree planting within the buffer between the quarry and the residences as well as early rehabilitation of completed quarry faces, which will assist in screening the quarry faces.

Blue Mountains National Park

The mine will be located adjacent to the Blue Mountains National Park, with the topography sloping down from the mine site to the park boundary. A minimum 50 m buffer will be left on NKPL land. Only the operating pit will be fenced. An area will be dedicated for walking access from Newnes Junction to the National Park.

The area is currently vegetated with eucalypt woodland, and will therefore offer a substantial vegetation buffer. There are no permanent formed roads in the adjacent portion of the National Park, and public access to any areas within the park from which the mine may be viewed would be restricted to hikers.

The site can be viewed from the unformed track leading to Gooches Crater, a feature known to bushwalkers, but cannot be seen from the feature itself. Views of Clarence Colliery pit top, the two existing quarries, access roads and railway infrastructure are also visible from this location.

Clear views of the kaolin mine would be available from rock pagodas located immediately opposite the site and on the edge of the National Park. Access to the top of these pagodas is extremely difficult and requires rock-climbing equipment. From this site, clear views of other industrial and residential development on the western side of the National Park are available.

Adjacent Industrial Sites

The kaolin mine cannot be viewed easily from any existing industrial sites since each has a small but effective vegetative buffer. The mine could be partially viewed from the Clarence Colliery Coal Preparation Plant and Rail Loading Bin as well as elevated sites within the coal reject emplacement.

Key Transportation Routes

The mine cannot be viewed from Bells Line of Road or Main Western Railway line but could be viewed from the Clarence Rail Loop. The mine will not be visible from the proposed extension to the Zig Zag Railway which will link to Newnes Junction Station, nor from the station itself.

Dirt Roads

The mine will be visible from a section of the access road leading around the Clarence Rail Loop. Residents of Newnes Junction use this road that also passes the Clarence Colliery Pit Top, overlooks the coal stockpiling area and passes beneath the conveyor leading to the main rail-loading bin.

Vegetated Slopes

The proposed buffer between the mine and the National Park is considered sufficient to screen views from lower vantage points heading towards the site. Even at the boundary of the National Park looking west towards the mine, no views will be available due to the dense intervening vegetation.

5.5.6 Mitigation Measures

To reduce the visual impacts of the proposed mine site on the landscape, a number of techniques will be employed. These will include the following:

- maintaining a minimum 50 m vegetated buffer between the site and the adjacent National Park to minimise visual impacts of the mine site on the park areas immediately bordering the lease boundary;

- maintaining the remaining vegetation occurring between the residences in Newnes Junction and the proposed mine limits to screen the effects of the mine as much as possible;

- designing the mine with shallow benches some 3 m high and rehabilitating these benches with native vegetation as soon as practicable to screen the high wall with vegetation. Rehabilitating the edges of the shallow benches will improve views directly into the mine site from the National Park where the mine is visually prominent in the landscape;

- colouring the stockpile enclosure environmental green, to make it blend into the existing landscape as much as possible;

- colouring conveyor covers and other constructions on site environmental green where this is practical so that these elements blend into the existing landscape;

- minimising vegetation removal during construction and mine operation. This will ensure that visual impacts associated with the development are minimised; and

- infill vegetation planting to further screen the site from local residents if required.

5.5.7 Conclusion

The main visual impacts will occur from elevated vantage points surrounding the mine. This is the case for all industrial activities in the region, which can be invariably seen from higher, or overlooking vantage points. In this case however, views of the site can, with some difficulty, be seen from elevated points within the National Park. These locations are not easily accessible and when located, other industrial sites are equally visible. This is also true along other sections of the park boundary, which abut residential areas, agricultural land, industrial activities and major public infrastructure.

Views of the quarry from residential receptors in Newnes Junction will be mitigated by intervening vegetation that will be maintained during the quarry, and augmented as necessary. Although the project will result in some visual impacts, the net effects are considered acceptable.

Appendix 2

Sydney Construction Materials file note – "Bushwalking tracks in the vicinity of the Newnes Junction development application area"

Sydney Construction Materials



...Building Sydney's Future

File Note

To: Atkins Acoustics
ATTN: Carl Fokkema

Date: 16th April 2004

Re: Bushwalking tracks in the vicinity of the Newnes Junction development application area

An intensive literature search on popular walking tracks, campsites and picnic areas located on and around the Newnes Plateau, which include the Blue Mountains National Park, the Wollemi National Park, Gardens of Stone National Park and the Newnes State Forest, was carried out.

The main focus for walking activities is well to the north of the Newnes Junction project area and is accessed by the Glow-worm Tunnel Road. The main attractions of the area; Deep Pass, Galah Mountain, Glow Worm Tunnel and Bungleboori Picnic Area, are in a range of 10 to 30kms from the proposed development site.

There are no formed tracks, for bushwalking purposes identified from any of the references in the attached list and no tracks have been identified by National Parks and Wildlife Services Personnel within a 5km radius of the proposed development site. The Dargan's Creek Canyon south of the Bells Line of Road is probably the closest locality used by bushwalkers and canyoners and is located several kilometres south of the project area.

A research programme on the sedimentary history of the Newnes Plateau sandstones carried out jointly by the Company (R. Goldbery) and John Whitehouse from the NSW Department of Mineral Resources has required detailed traversing of the area surrounding the proposed development site at Newnes Junction. During these surveys, no bushwalking tracks have been found on any of the ridges or drainage networks of the area. It is therefore considered extremely unlikely that the area within a 2km radius of the DA proposal will attract any recreational bushwalking activities.

R. Goldbery

(Project Manager)

Newnes Kaolin Pty Ltd, trading as
Sydney Construction Materials

Suite 504, 37 Bligh Street
Sydney NSW 2000

Ph: (02) 9232 8282
Fax: (02) 9232 8275
ABN: 71 065 564 794

REFERENCES

Daly, J & L., 2000, Take a walk in the Blue Mountains National Park, Take A Walk Publications, Brisbane, 104p.

Fairly, A, 2001, discovering the Blue Mountains on Foot, Envirobook, Annandale, 80p.

Jamieson R, 2001, Canyons near Sydney, Richard Jamieson Publishing, Sydney, 82p.

Land Property Information, NSW, 2002, Tourist Map of the Wollemi National Park, Bathurst.

Law, M., 1999, The Blue Mountains – A guide to selected rock climbs (including Tarari). Wild Publications Pty Ltd, 120p.

Meredith, P and Fuchs, P., 2000, Glove box Guide, The Blue Mountains, Australian Geographic Pty Ltd, 191p.

National Parks & Wildlife Services, 2001, Walking Trail Guide, Newnes and the Glow Worm Tunnel, 19p.

Paton, N, 1987, Walks in the Blue Mountains National Park, Kangaroo Press, 144p.

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT H

Hydrogeological Impact report

Kalf and Associates

December 2004

NEWNES KAOLIN PTY LTD
(Trading as Sydney Construction Materials)

HYDROGEOLOGICAL IMPACT
NEWNES KAOLIN PROPOSED OPEN-CUT

Dr Frans Kalf
Kalf and Associates Pty Ltd and
Water Research Laboratory UNSW
14 December 2004

Contents

1.0 INTRODUCTION 3
1.1 Background 3
1.2 Objectives 3
1.3 Rainfall 3
1.4 Topography and Drainage 4
1.5 Geology 5
1.6 Groundwater Occurrence 5

2.0 FIELD INVESTIGATIONS 6
2.1 Overview 6
2.2 Drilling Investigation 6
2.4 Water Quality 8

3.0 HYDROGEOLOGICAL INTERPRETATION 8
3.1 Head elevations and gradient 8
3.2 Groundwater Quality 9

4.0 MINING IMPACT ON GROUNDWATER SYSTEM 9
4.1 Numerical Model Simulation 9
4.2 Mining Simulation 11
4.3 Effects of Rocla Quarry 12

5.0 FINAL VOID GROUNDWATER CONDITIONS 13
5.1 Groundwater flow system before mining 13
5.2 Groundwater flow system at the end of mining 14
5.3 Groundwater flow system after mining 14

6.0 CONCLUSIONS AND CONSIDERATIONS 15

REPORT LIMITATIONS 17

FIGURES

APPENDIX

DRILLING, HYDRAULIC TESTING AND INSTALLATION OF OBSERVATION BORES (PIEZOMETERS)

1.0 INTRODUCTION

1.1 Background

Newnes Kaolin Pty Ltd is proposing to mine both sand and kaolin from a proposed pit at Newnes Junction, east of Lithgow (Figure 1.1-1). The proposed pit will be excavated over a 20-year period to a reduced level (RL) of 993m. The kaolin material will be separated out from the crushed sandstone strata.

The proposed pit site area lies within hilly topography just north of the existing Rocla Quarry, which has been mining similar material since the late 70's.

This report outlines the hydrogeology of the site and makes an assessment of the potential hydraulic and water quality impacts of the proposed pit during and after mining on the surrounding groundwater system.

1.2 Objectives

The specific objectives of this report are to:

1 Interpret the regional hydrogeology of the site based on the outcome of the drilling investigation
2 Determine the potential hydraulic impacts using a numerical modelling method.
3 Indicate possible mining groundwater impacts in the short and longer-term.

1.3 Rainfall

Daily rainfall analysis from Lithgow records since 1890 to 2000 indicates an average annual rainfall of 816mm. The mean rainfall from the

Newnes Forest Centre is 1072mm, no doubt higher due to orographic effects.

At Lithgow average monthly rainfall is highest during the months June to August inclusive and lowest during February. Average monthly rainfall for the two stations is given in Table 1.3-1 and 1.3-2 below.

Table 1.3-1

Average Monthly Rainfall - Lithgow

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
58.7	40.4	59.5	60.3	72.3	84.7	85.9	85.7	73.2	79.3	60.0	55.9

Table 1.3-2

Average Monthly Rainfall – Lithgow (Newnes Forest Centre)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
121.	114.	103.	79.	80.7	83.0	68.3	83.5	67.9	91.5	89.0	90.9

1.4 Topography and Drainage

The proposed kaolin mine is located on the south-western edge of the Newnes Plateau along the western boundary of the Wollangambe River catchment. Within the proposed mining area the drainage is predominately towards the north-east. To the south-west, beyond the Old Bells Line road that lies on the surface water divide, the drainage direction is to the south within the Dargans Creek catchment. The drainage divide has elevations up to about 1090 m RL that fall away rapidly to less than 1000 m RL along Dargans Creek.

The drainage gullies across the site are largely ephemeral with some seepage evident at lower elevations along the eastern boundary after wet periods.

The proposed site area has a elevation of more than RL 1050m along the western boundary falling away to less than RL 1000m at the north-east corner of the site area.

1.5 Geology

The mining area lies within the Triassic Narrabeen Group sandstone and shale, which in turn is underlain by the Permian Illawarra Coal Measures, comprised of coal, sandstone, shale and tuff. The upper part of the Triassic sequence at the proposed mining site (based on exposures in the adjacent Rocla quarry and drilling described herein) comprises largely a medium to coarse grained solid sandstone with some ironstone bands. The matrix of the sandstone consists mainly of kaolin and it is this material that will be separated into product as part of the mining process.

1.6 Groundwater Occurrence

Groundwater occurs in both primary (limited) and secondary structures in the Triassic sandstone and is supplied entirely by infiltration and recharge. Permeability of the sandstone overall has been found to be low.

At Clarence Village some kilometres to the south-west (Figure 1.1-1) from the proposed pit, standing water levels in shallow aquifer system are in the range 12 m to 64 m from ground surface. Topographic surface elevations in this area are in the range 1080 m to 1140 m RL. A number of bores here obtain supplies of several litres per second.

2.0 Field Investigations

2.1 Overview

A field investigation and drilling program was initiated and completed at the site during November 2004 (see the Appendix). The drilling program at three sites around the periphery of the proposed Newnes open-cut pit, included the construction of two holes at each site, one shallow and one deep (Figure 2.1-1). The sites have been designated as the North-West (NW), North-East (NE) and Southern (S) bore (piezometer) sites. The deep bores at each site were drilled to 60 m at the NE and NW sites and 54 m at the southern site S whilst the shallow holes at each site were about 18 m in depth. Airlift, packer and recovery tests were conducted and water samples collected from the deep boreholes. Full details of the field work is given in the Appendix which is an independent report prepared by the Water Research Laboratory UNSW who supervised the drilling programme.

2.2 Drilling Investigation

Drilling was completed to a maximum depth of 60 m and encountered solid sandstone at all three sites. Between the southern (S) site at an elevation of about RL 1059m and the north-eastern (NE) site at RL 995m, a sequence 124m in thickness comprised entirely of bedded sandstone was penetrated.

All holes provided very little groundwater “make” during the drilling operations. Borehole NW yielded the maximum bore inflow rate of 6 litres per minute (i.e. ~0.1 L/sec) after completion. At the NE site final airlifting gave a yield of up to 5 litres per minute whilst at the south(S) bore no constant airlift yield was achievable during drilling operations.

Although packer testing was carried out the tests are considered to be unreliable because of packer leakage and therefore the permeability

derived from these tests overestimate the true values by a substantial amount.

The recovery tests subsequently conducted on these bores are considered to be the more accurate and yielded the following permeability values shown in Table 2.2-1. The values vary depending on screened interval adopted (see Appendix).

Table 2.2-1

Recovery Test Permeability

Bore	*Permeability (m/d)*
NW	0.046 (36m interval)-0.084 (18 m interval)
NE	0.11 (5m interval) – 0.073 (8.6 m interval)
S	0.03 (12m interval) – 0.019 (30 m interval)

Water levels recorded in the shallow bores about a week or more after completion, taken prior to water quality sampling of the deep bores are shown in Table 2.2-2. The reduced levels are at this stage approximate and rounded to the nearest metre based on topographic contour interpolation.

Table 2.2-2

Bore Water Levels

Bore	*Water Level (shallow piezometer) m RL*
NW	1028
NE	982
S	1043

2.4 Water Quality

Water quality analysis of samples taken from the three deep bores indicate groundwater of low salinity with electrical conductivity at holes NW, NE and S measured to be respectively 31, 40.5 and 150 micro-Siemens per centimetre with corresponding pH values of 4.1, 4.4 and 6.2.

3.0 Hydrogeological Interpretation

3.1 Head elevations and gradient

Figures 3.1-1, 3.1-2 show the contoured potentiometric surface based on the measured water levels in the deep and shallow bores respectively. Figure 3.1-3 shows the difference in head between these two contoured potentiometric surfaces.

The shallow bore water levels indicate a difference in head of about 61m between the S and NE bore locations. The calculated gradient is therefore 0.084 which is considerable although not unexpected because of the relatively steep topographic gradient in the same general direction.

Based on a bulk permeability of 0.02 m/day and porosity of 5% the flow velocity is calculated to be 0.034 m/day whilst a permeability of 0.05 m/day yields a velocity of about 0.1m/day. For a 50 m metre saturated thickness of sandstone the natural groundwater flow per unit width of sandstone would be about 0.1m^3/day and 0.25 m^3/day for these permeability values.

3.2 Groundwater Quality

The drilling results indicate the presence of water bearing zones at various depth intervals of very good quality. The good quality groundwater indicates significant groundwater circulation and recharge in the area.

4.0 Mining Impact on Groundwater System

4.1 Numerical Model Simulation

A numerical model was set up to determine the hydraulic impact of mining on the groundwater system.

Standing water levels in shallow bores NW, NE and S measured on 24 November 2004 plus the known general topography of the region were used as the basis for simulated initial pre-mining head conditions in the model.

The model was set up using an internationally recognized groundwater modelling computer code MODFLOW-SURFACT (MS) with a single layer comprising 100 x 100 of 50 m square cells.

To simulate the relatively steep hydraulic gradient to the north-east across the site, boundary line conditions were used in the model. These comprised a constant head boundary line and a flux boundary line to simulate approximately the valley drainage system and groundwater ridge respectively lying to the south-west and a line of constant heads on the north-eastern side of the model representing the drainage system along the Wollangambe River.

The shallow bore water levels were then calibrated using trial and error methods under steady state modelling conditions. Two calibrations were setup using uniform permeability values of 0.05m/day and then 0.02 m/day for the model layer. Both simulations used a recharge rate of 8% of the annual rainfall. Each of these separate simulations is discussed below.

Case 1: Permeability 0.05m/day

Figure 4.1-1 presents the steady–state calibrated head contours and flow vectors. The flow vectors show the flow direction and relative magnitude by their length. Also shown in this diagram is the outline of the proposed mine site. The model heads are related to the true heads using an offset of 795 m and are given by the relation:

True head RL (m) = Model head (m) + 795 m

Thus a model head of 248 m (at the model bore S for example) is equivalent to a field water level of 248 + 795 = 1043 m (i.e. measured at bore S on 24 November 2004).

A plot comparing the measured and computed heads at the shallow piezometers at the NW, NE and the S locations is shown in Figure 4.1-2. The overall fit between measured and computed heads is quite good with a root-mean-square (RMS) error of 1.2 m.

Case 2: Permeability 0.02 m/day

Figure 4.1-3 presents the steady–state calibrated head contours and flow vectors for this case together with the outline of the proposed mine site. The model heads are related to the true heads using an offset of 751.26 m given by the relation:

True head RL (m) = Model head (m) + 751.26 m

Thus a model head of 291.74m is equivalent to a field water level (at the S bore) of 291.74 + 751.26 = 1043 m.

A plot comparing the measured and computed heads at the shallow piezometers at the NW, NE and the S locations is shown in Figure 4.1-4. The overall fit between measured and computed heads is quite good with a root-mean-square (RMS) error of 1.5 m.

4.2 Mining Simulation

Case 1: Permeability K= 0.05 m/day

A 20 year transient simulation of progressive mining at the site was conducted using the previous Case 1 steady state heads as a starting head condition. For this simulation a specific yield of 1% was used. Mining was assumed to occur uniformly over the site for this period to a maximum mining depth of RL 993 m.

The mining was simulated using a modified drain function in the MS code that progressively lowered the mining head down to RL 993m over 20 years. This function also allows for the formation of a seepage face in the pit high walls.

The results of the simulation are given in Figures 4.2-1 and 4.2-2 which show the heads after 10 and 22 years (two years after mining ceases) respectively. Also shown in these figures are the groundwater flow vectors. The 22 year simulation was found to be equivalent to a steady state condition in which inflow from the system was balanced by outflow.

The results overall show that the influence of the open cut mine is created locally around the mine. Also whilst there is inflow into the mine void over time, there would be continued flow beneath the site towards the Wollangambe drainage valley.

Maximum inflow to the open-cut for this case is unlikely to exceed 1.2 ML/day and during mining would be much less than this rate.

Case 2: Permeability K= 0.02 m/day

For this case a steady-state simulation was used to determine the final equilibrium heads surrounding the mine. Mining was assumed to occur uniformly over the site to a maximum mining depth of RL 993 m.

The results of the simulation are shown in Figures 4.2-3. They show that the influence of the open cut mine is created locally around the mine but is less extensive than the case for the higher permeability value. Again whilst there is inflow into the mine void over time, there is continued flow beneath the site towards the Wollangambe drainage valley in the long-term.

Maximum inflow to the open-cut for this case is unlikely to exceed 0.8 ML/day and during mining would be much less than this rate.

This is currently considered to be the most likely case scenario.

4.3 Effects of Rocla Quarry

It was not possible to include the Rocla quarry in the calibration since there are no monitored water levels in the vicinity of this site area. However a measure of the effect of the quarry in addition to the proposed Newnes open-cut is shown for Cases 1 and 2 in Figures 4.3-1 and 4.3-2 respectively.

Inflows to each of these cases show that for Case 1 (K=0.05 m/d) the inflow to the Rocla quarry is about 10 L/sec which is known to be too high based on estimates of inflow (less than 5 L/sec). For Case 2 the inflow is about 5 L/sec which is a better match with the actual inflow magnitude experienced at this site.

This comparison suggests that the Case 2 permeability is likely to be a closer representation of the bulk permeability of the proposed site than the value adopted for Case 1 (K= 0.05 m/day).

The Rocla quarry which was established in the 70's indicates that watertable drawdown around the pit has not influenced vegetation species surrounding the pit as these plants rely mainly on soil moisture conditions for survival. The same conditions would apply to the proposed pit and therefore no influence on vegetation surrounding the pit would be expected.

5.0 Final Void Groundwater Conditions

Figures 5.1-1, 2 and 3 show diagrammatically a transect extending from a south-west to north-east direction across the north-east corner of the proposed pit and shows the groundwater flow system during various stages of mining including:

- Groundwater flow system before mining
- Groundwater flow system at the end of mining
- Groundwater and surface flow system after mining

5.1 Groundwater flow system before mining

Figure 5.1-1 shows the groundwater system prior to mining. Rainfall locally recharges the sandstone rock formation with the bulk of this

rainfall running off and some of the infiltrated moisture removed by evaporation by vegetation (evapotranspiration). Rainfall reaching the watertable flows in a down gradient direction to the south-west on the south-western side of the topographic ridge and to the north-east on the other side of the ridge toward the river. All groundwater flow is directed downward and is responsible for the difference in water levels observed in the three sets of observation piezometers completed at the site. That is, the water level in the shallow bores is higher than the average level in the deep bores indicating downward flow. All groundwater flow is also down gradient finally joining the Wollangambe River drainage system to the north-east.

5.2 Groundwater flow system at the end of mining

Figure 5.2-1 shows the groundwater system immediately after the end of mining. The flow system stays fundamentally the same except at relatively shallow depth in the vicinity of the mine where flow is directed into the void. There would also be some fall in the water table immediately up and down gradient of the void although the overall deeper groundwater flow would not be affected and would continue to flow towards the river as it did prior to mining.

5.3 Groundwater flow system after mining

Figure 5.3-1 shows the system some years after mining ceases with essentially the same flow system as given in Figure 5.1-2. However, from this time onwards the void would become an elevated wetland area with shallow ponding of groundwater inflow, direct rainfall and runoff. This collected water will flow out as surface water over the pit edge towards the river. Both groundwater and surface water will remain of very good quality in this wetland area because of the rate of inflow and

continual flushing action. Much of the groundwater intercepted will be returned to the Wollangambe drainage system

6.0 Conclusions and Considerations

1) The drilling and testing of three sets of observation bore piezometers around the periphery of the proposed mine pit has indicated low permeability sandstone validating a previous assessment. Bulk permeability is likely to be in the range 0.02 to 0.05 m/day with the value 0.02 m/day being the most likely.

2) Numerical model simulation of the proposed mining over a 20 year period indicate that two years or so after mining stops the groundwater system would reach equilibrium. The open-cut pit at that time will only influence the water table locally but will still allow the majority of deeper groundwater flow to reach the river drainage system.

3) Mining at the site will have no influence on the groundwater system at the Clarence village as this groundwater is well beyond the drawdown influence of the proposed open-cut.

4) Inflow to the pit is unlikely to exceed 0.8 ML/day with much less inflow likely during the mining operation.

5) Some years after mining ceases the pit will behave as a flow-through system and become an elevated wetland zone of good quality water.

6) The Rocla quarry which was established in the 70's indicates that watertable drawdown around the pit has not influenced vegetation species surrounding the pit as these plants rely mainly on soil moisture conditions

for survival. The same conditions would apply to the proposed pit and therefore no influence on vegetation surrounding the pit would be expected.

7) The pit construction will not measurably influence surface runoff and baseflow in the Wollangambe River system because of the relatively small area of the total catchment affected. Seepage and surface flow from the area will in time be re-established to the catchment.

8) Once the mining is commenced water level measurements should be conducted initially on a monthly basis in each hole over time to establish seasonal trends and then measured approximately every 3 months. This consideration is suggested to allow the drawdown estimates provided in this report to be verified.

Report Limitations

Kalf and Associates Pty Ltd has prepared this report for the use of Newnes Kaolin Pty Ltd, trading as Sydney Construction Materials (the client), in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose as discussed with the client and outlined in this report and does not include any geotechnical issues regarding the constructed pit, or pit closure. Such advice should be sought from a qualified geotechnical consultant.

The methodology adopted and sources of information used by Kalf and Associates (KA) are outlined in this report. KA has made no independent verification of this information beyond the agreed scope of works and KA assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to KA was false.

The report was prepared during November-December 2004 and is based on the conditions encountered and the information available at the time of preparation. KA disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Qualified legal practitioners can only give legal advice.

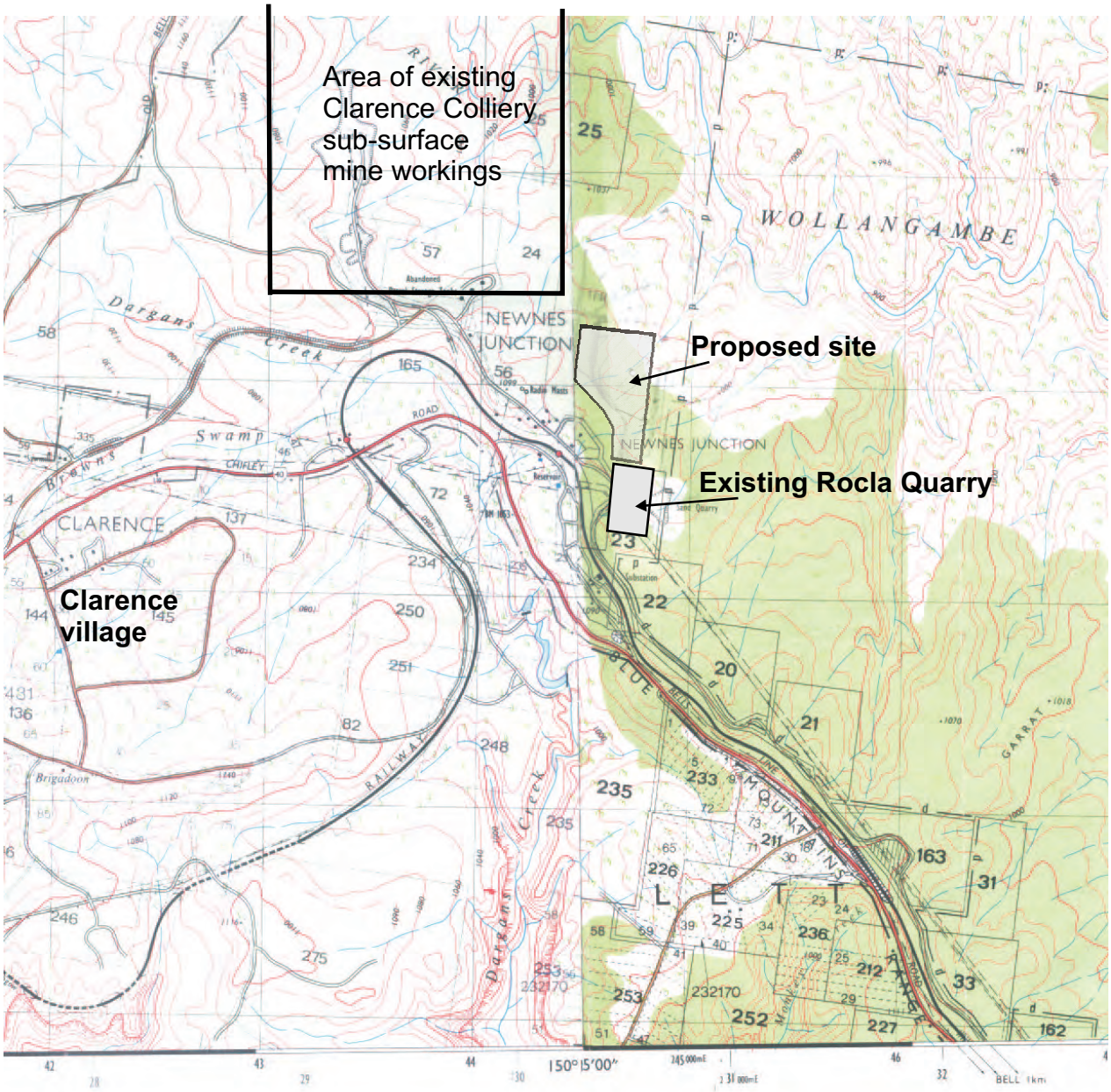
This report relies on information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of conditions as constrained by the scope of work. The behaviour of groundwater is complex and may vary over short distances. Our conclusions are based upon the analytical and field data provided by the Water Research Laboratory UNSW (WRL) and models developed on this information. Future advances in regard to the understanding of the ground and groundwater conditions could impact on our conclusions and recommendations regarding this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, KA must be notified of any such findings and be provided with an opportunity to review the findings and recommendations of this report.

Groundwater models and modeling are as accurate as the data will allow and should be regarded as tools to be updated as additional data becomes available. The findings in this report based on various computer model scenarios do not necessarily imply a recommendation or recommendations that a specific course or courses of action should be taken. They are meant to indicate possible or probable outcomes that the client should consider before a particular course or courses of action is/are decided upon based on all considerations relevant to the operation and closure of mining.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

FIGURES



Scale: 1 km Grid

1:25000 Base Maps:
LITHGOW 8931-III-S
WOLLANGAMBE 8931-II-S

FIGURE 1.1-1
Proposed Quarry Site

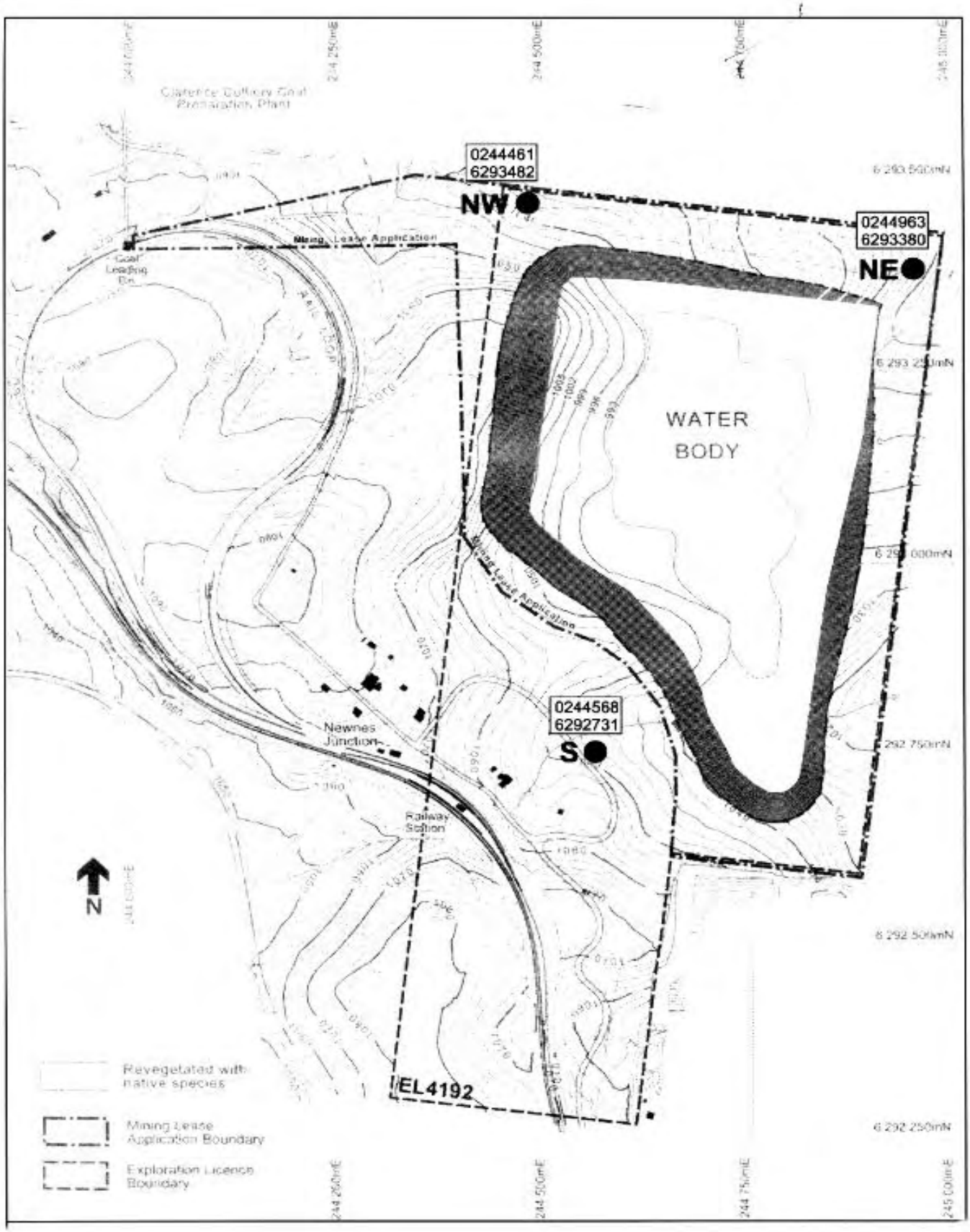


Figure 2.1-1

Shallow and deep bore locations

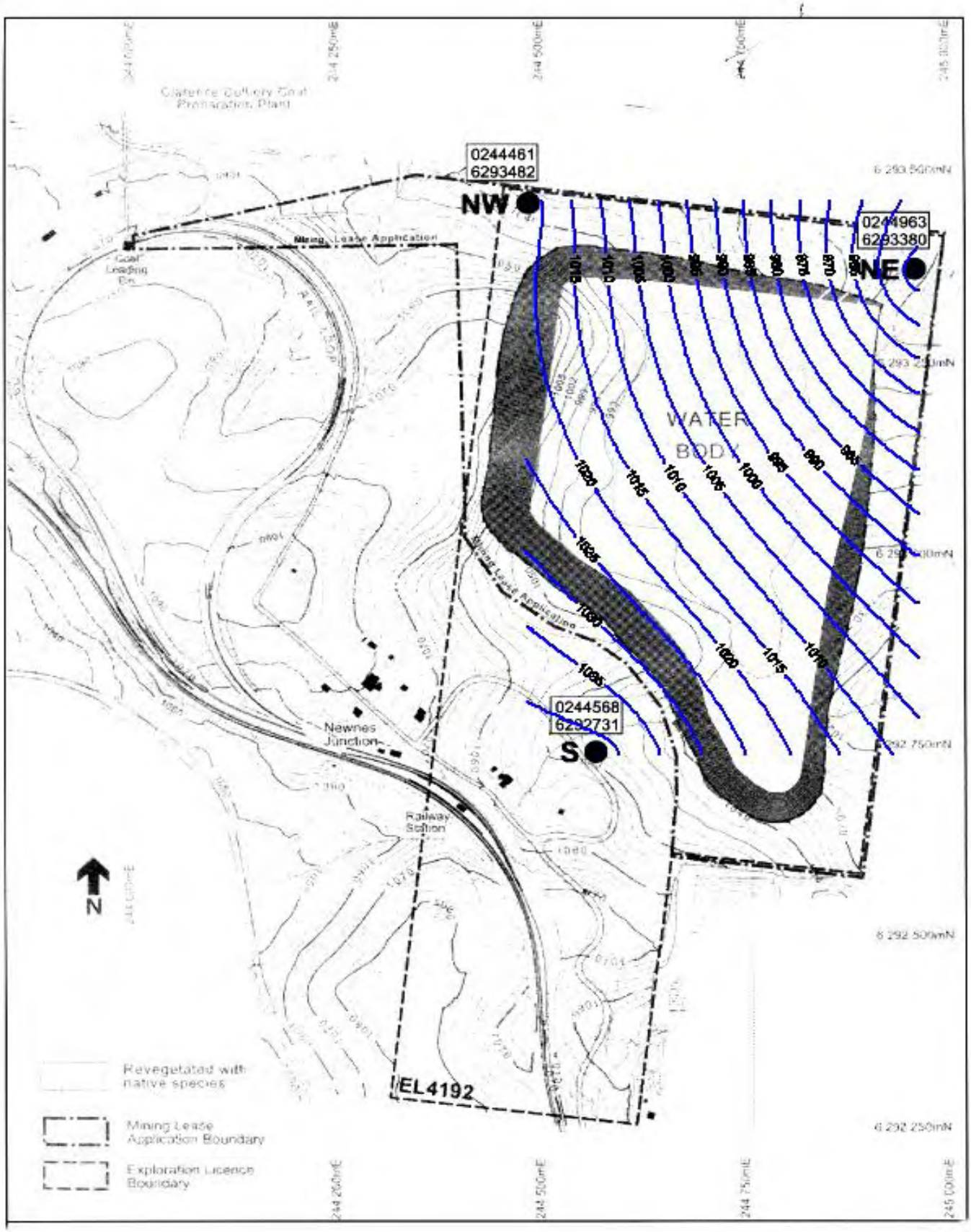


Figure 3.1-1

Deep bore average potentiometric surface (m RL)

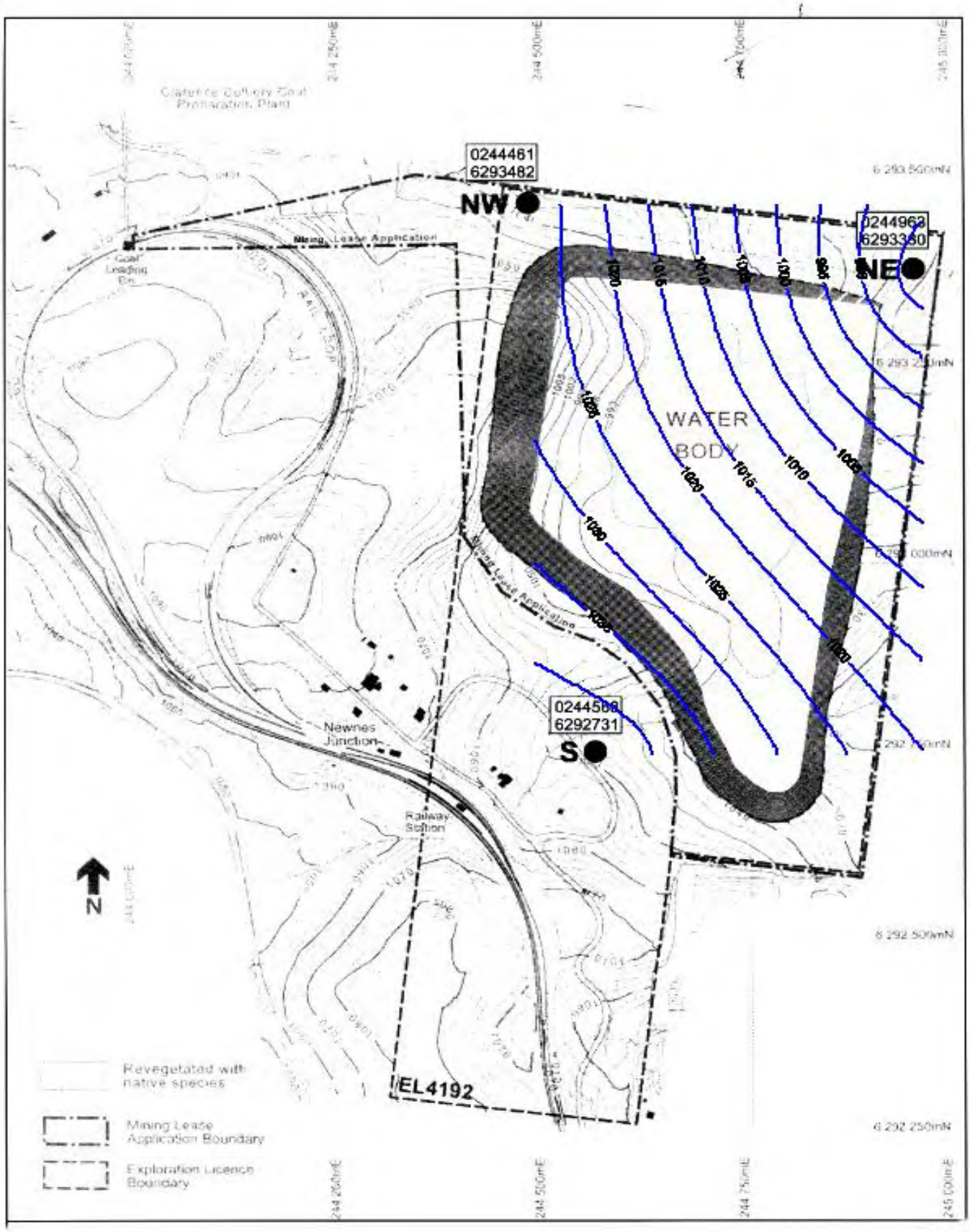


Figure 3.1-2

Shallow bore average potentiometric surface (m RL)

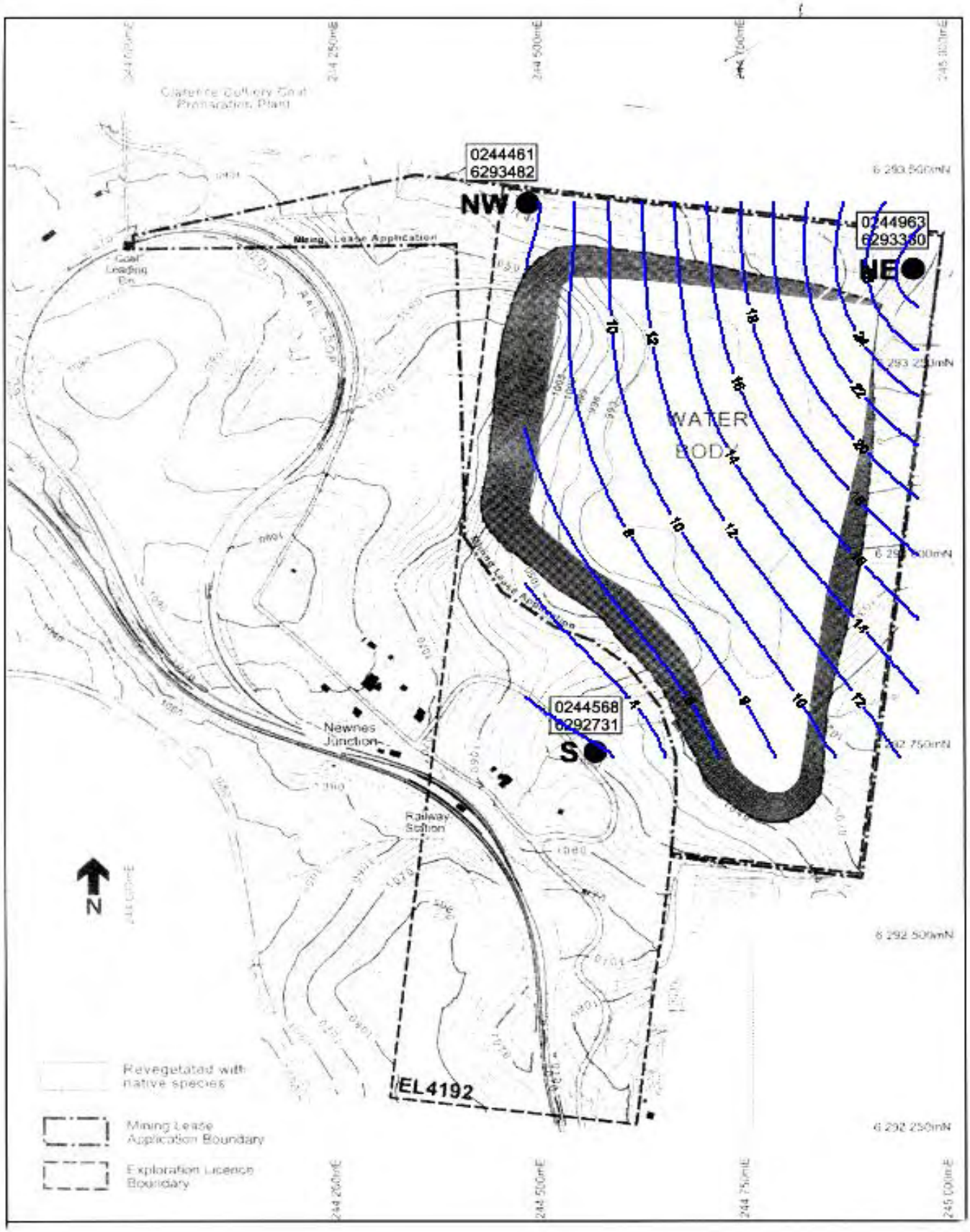


Figure 3.1-3

Difference in potentiometric surface deep and shallow bores (m)

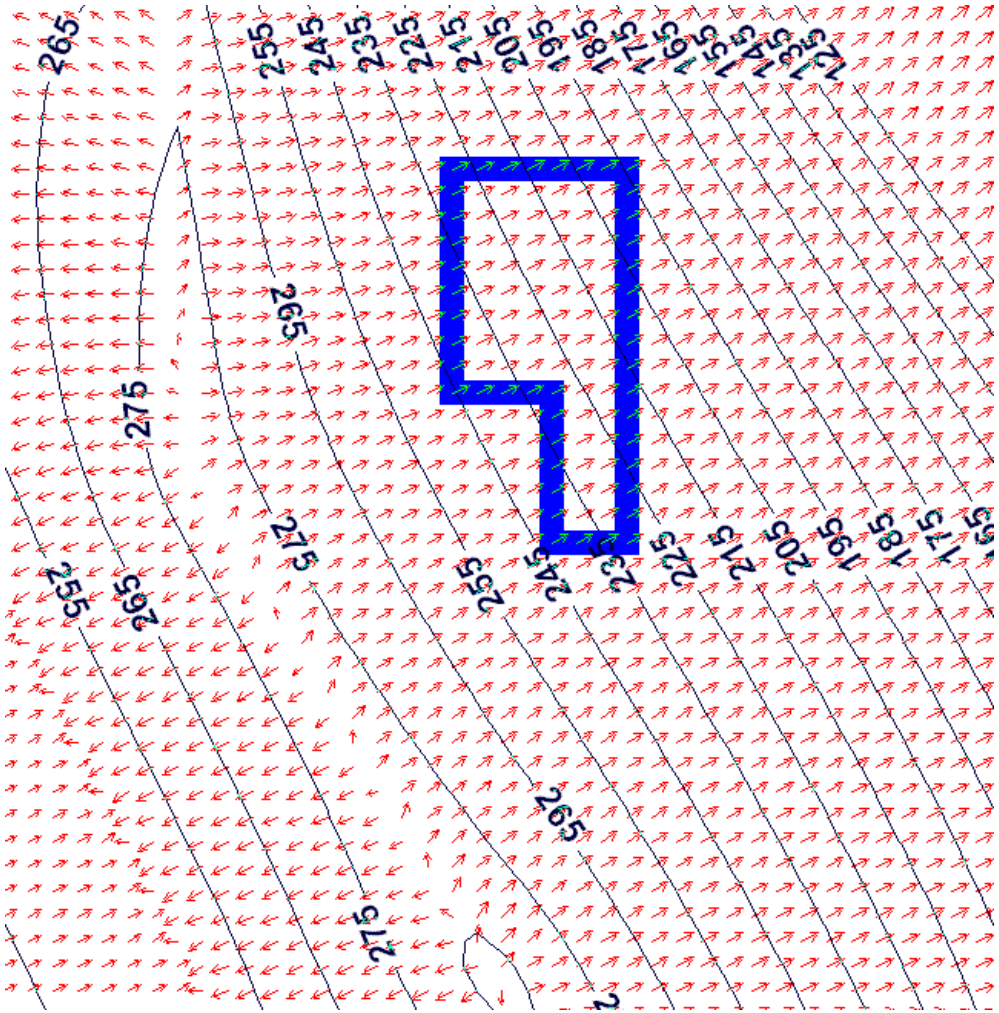
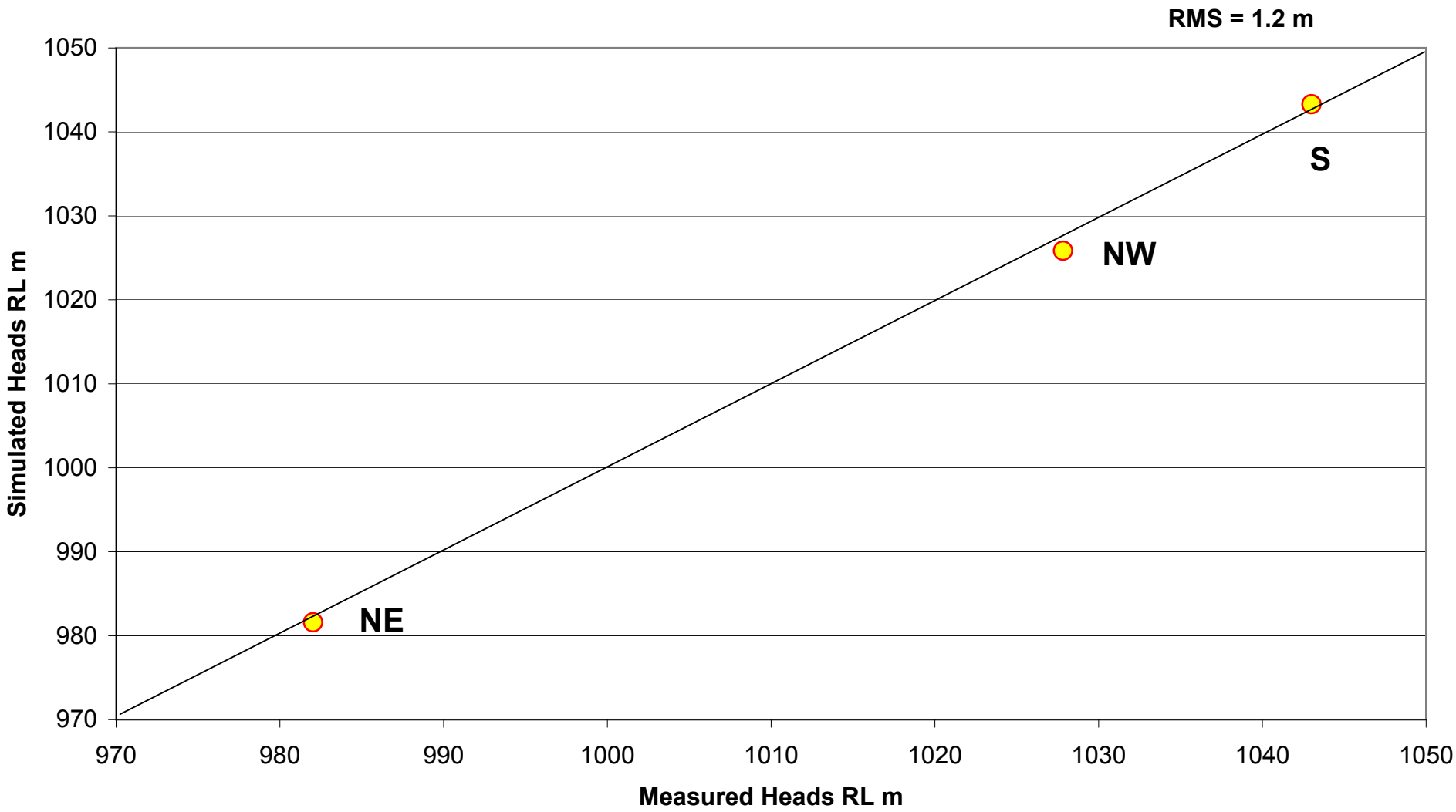


Figure 4.1-1 Simulated steady state hydraulic heads and flow vectors before mining: K = 0.05 m/day

Figure 4.1-2 Measured and Computed Heads at Observation bores



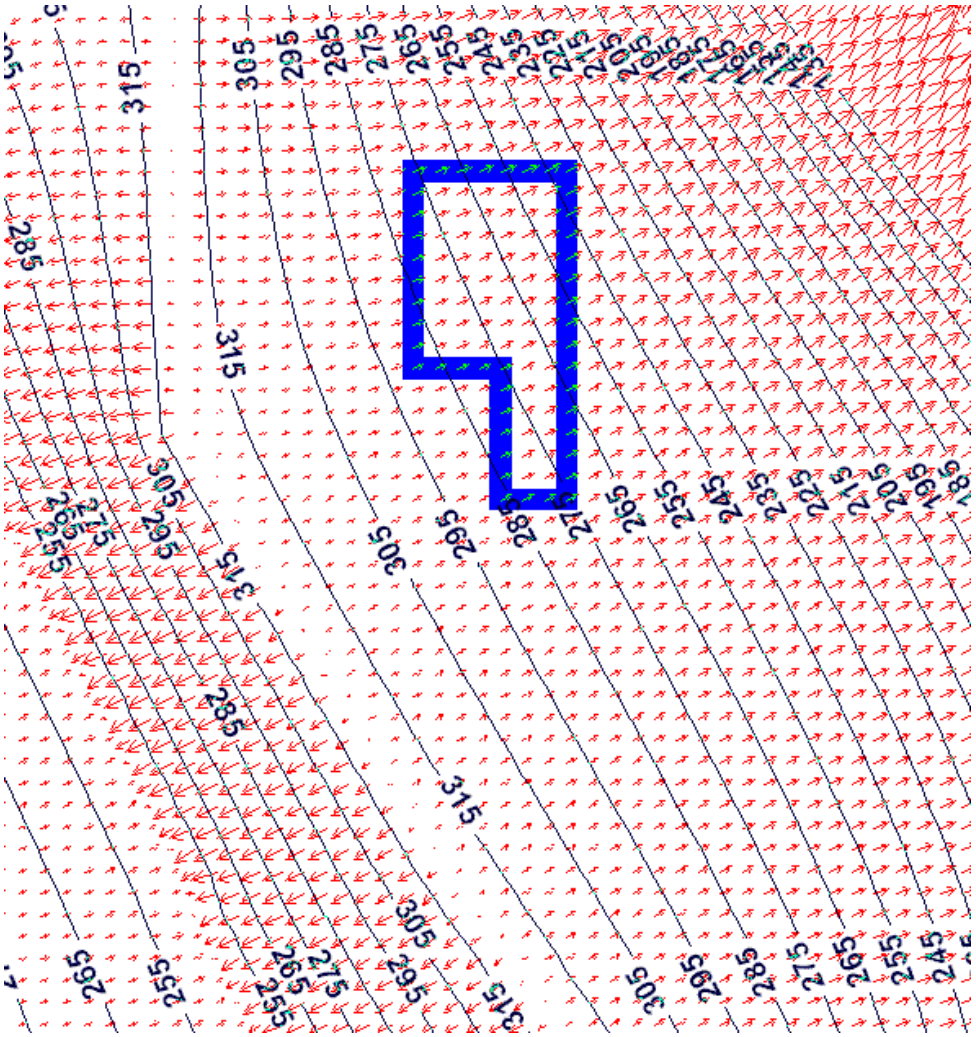
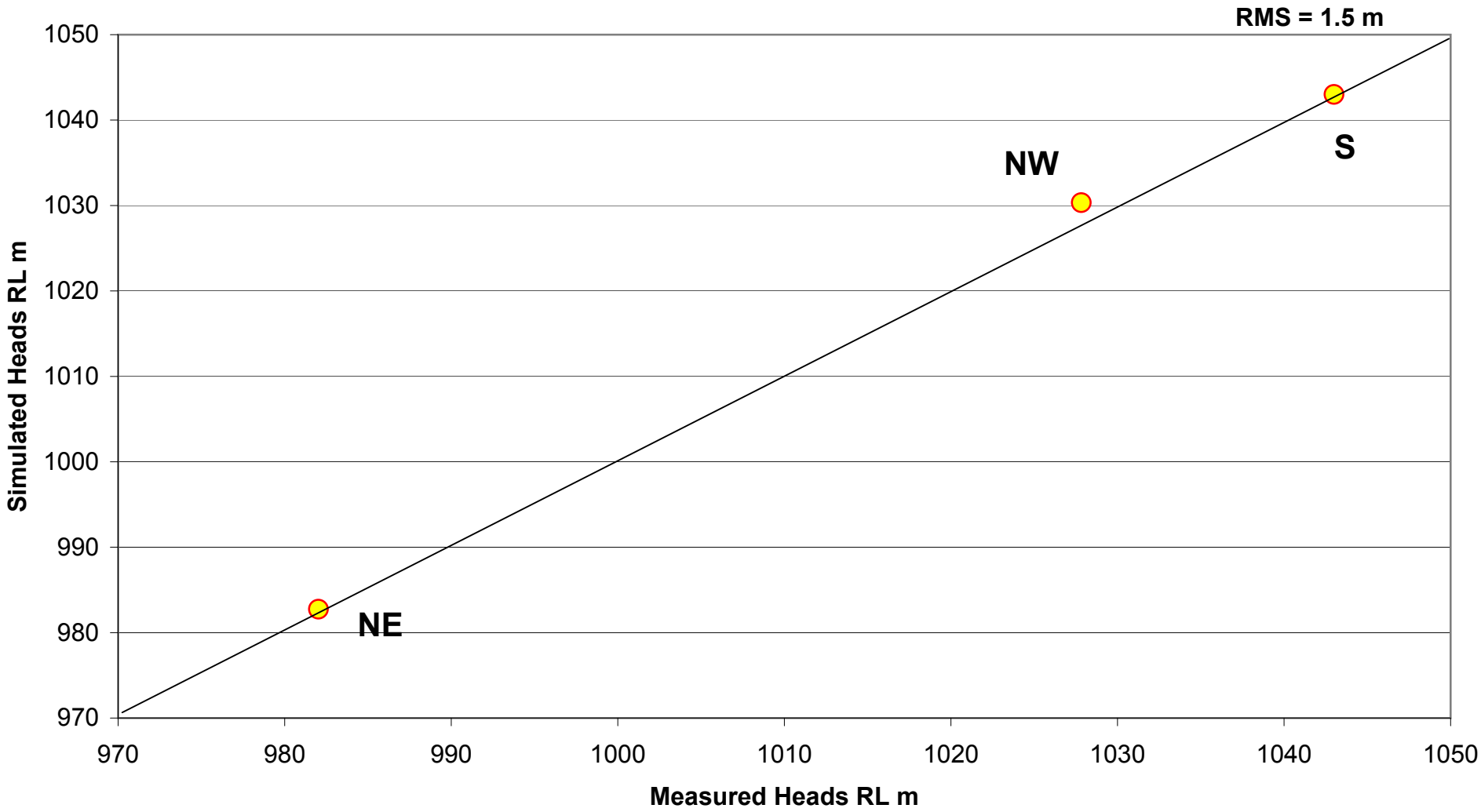


Figure 4.1-3 Simulated steady state hydraulic heads and flow vectors before mining: K = 0.02 m/d case

Figure 4.1-4 Measured and Computed Heads at Observation bores



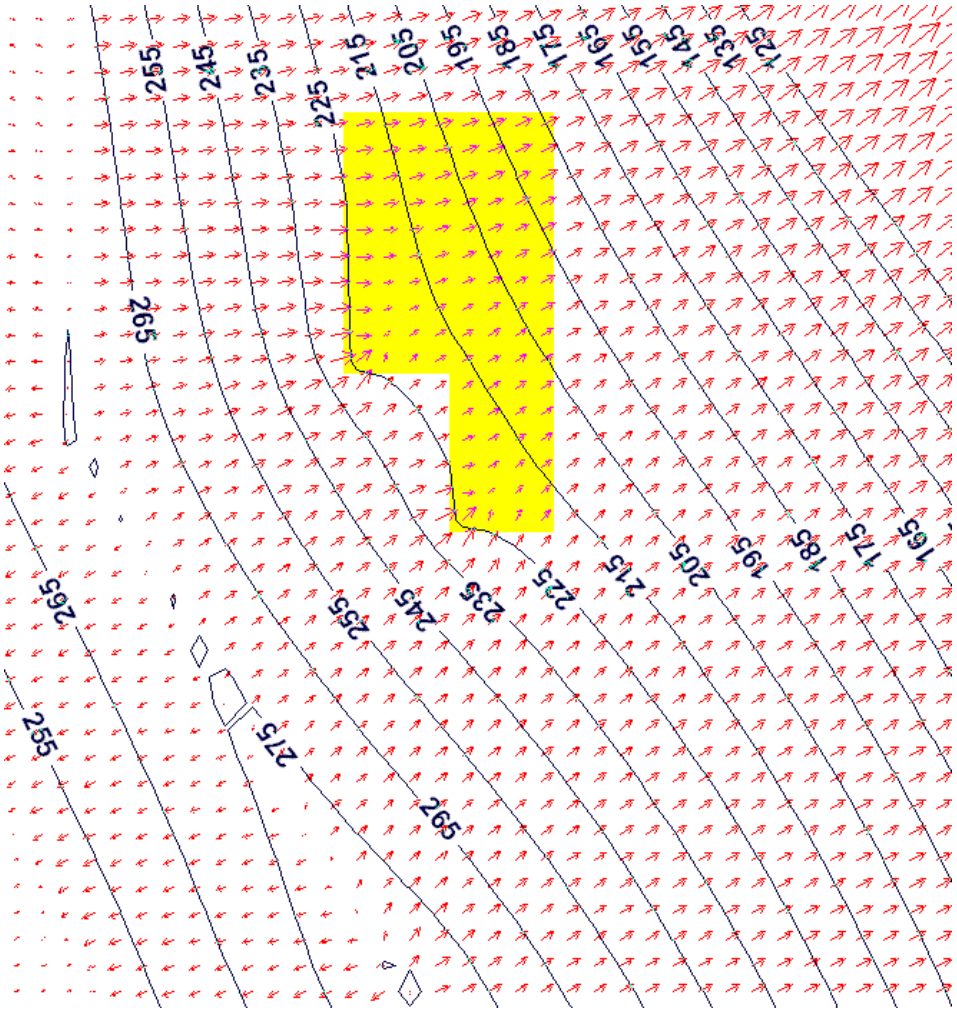


Figure 4.2-1 Simulated transient hydraulic heads and flow vectors after 10 years of mining

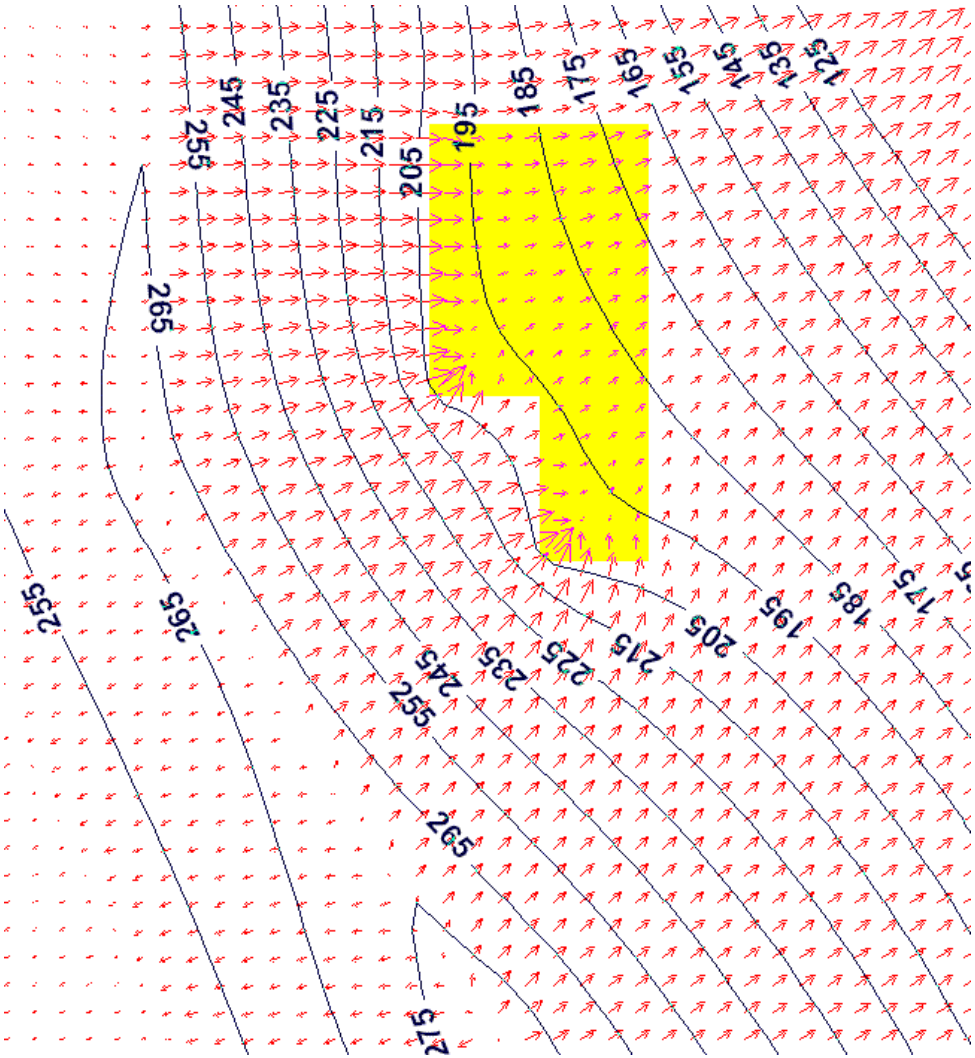


Figure 4.2-2 Simulated steady state hydraulic heads and flow vectors after mining: K = 0.05 m/d case

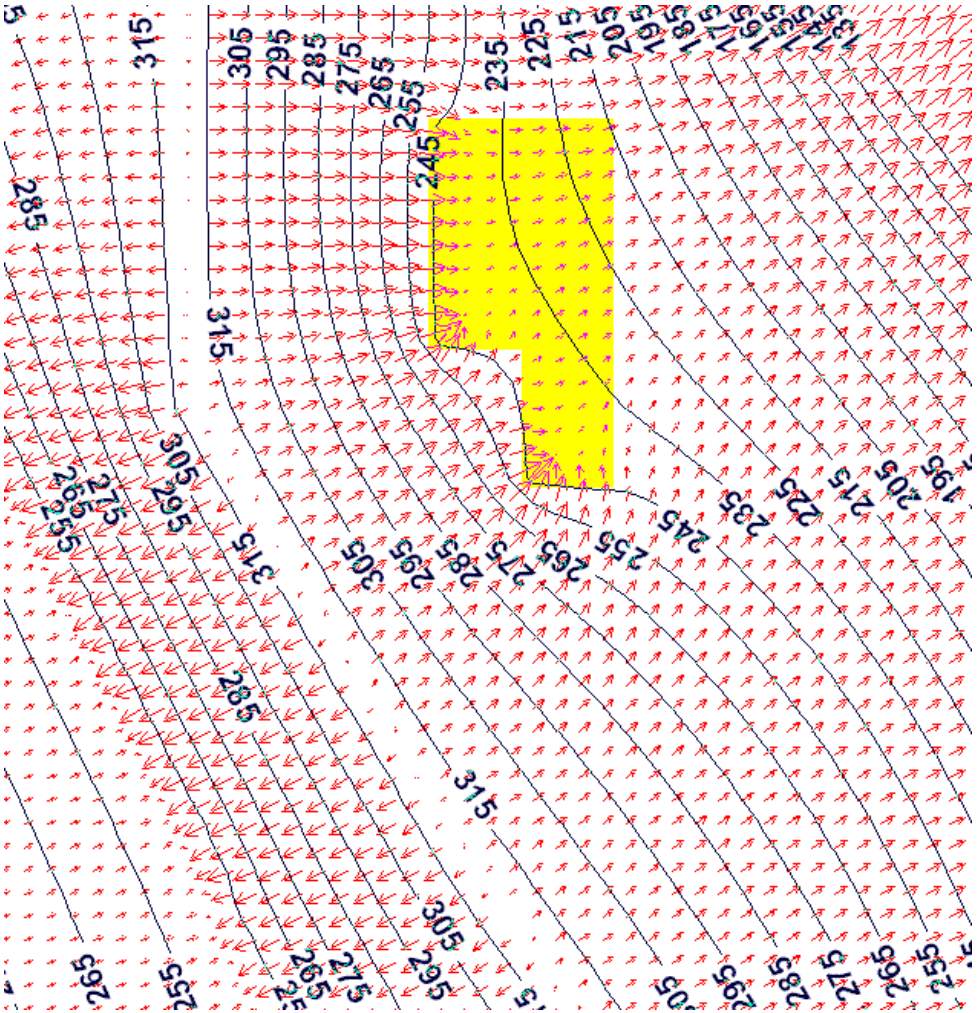


Figure 4.2-3 Simulated steady state hydraulic heads and flow vectors after mining: K = 0.02 m/d case

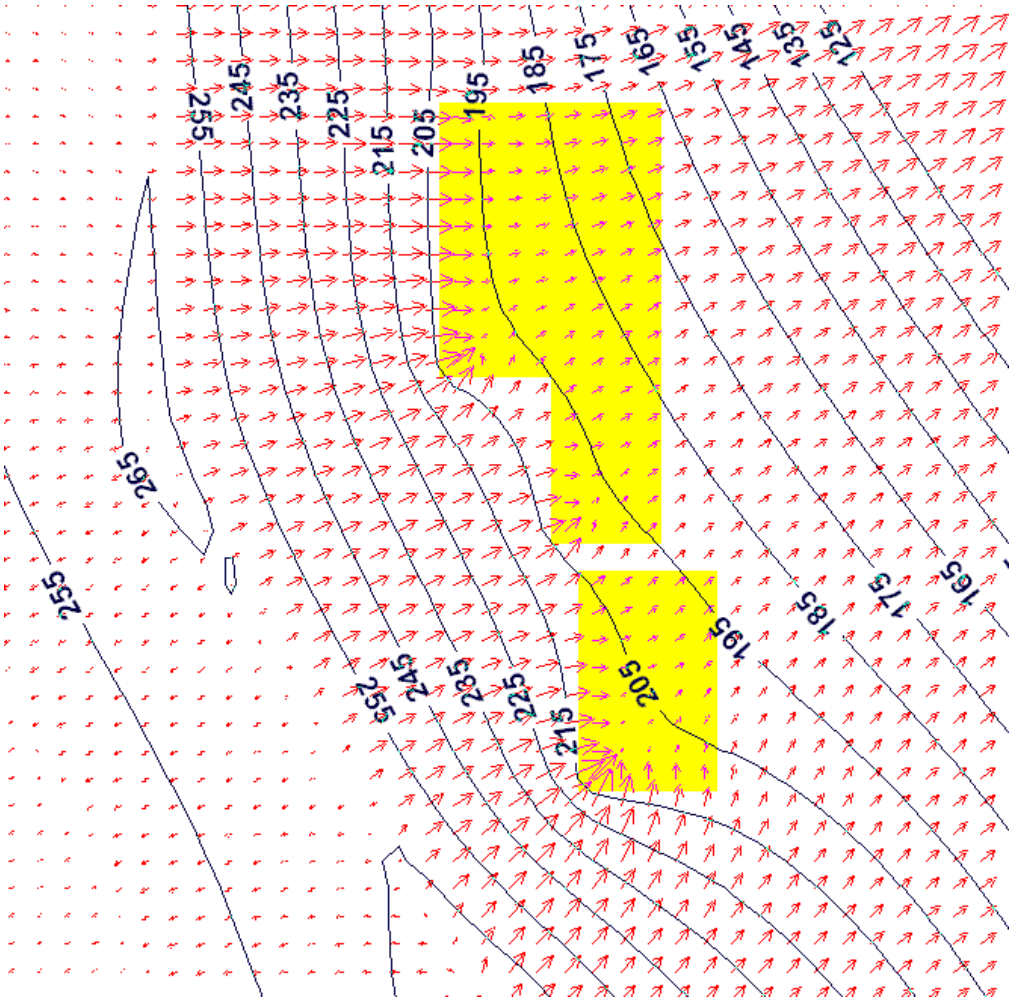


Figure 4.3-1 Simulated steady state hydraulic heads and flow vectors after mining plus Rocla quarry : K = 0.05 m/d case

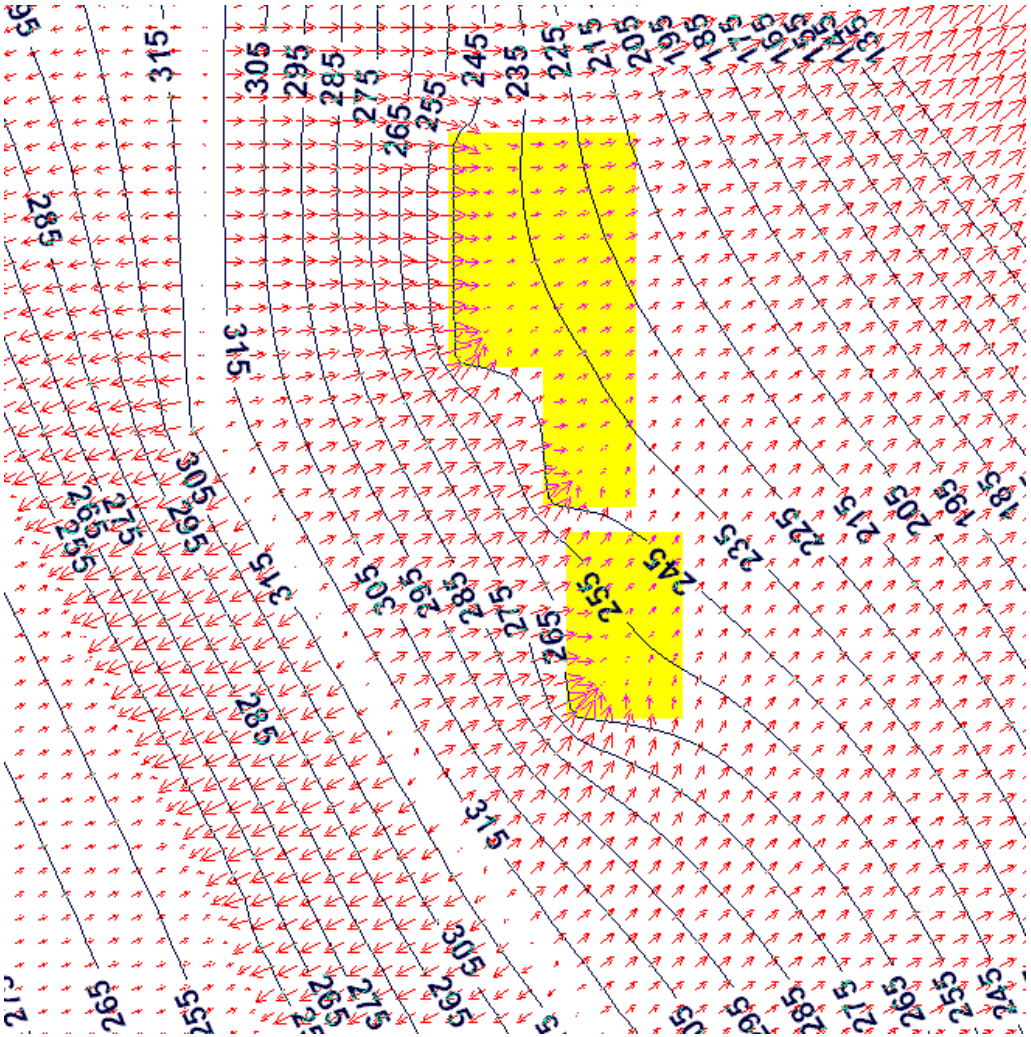


Figure 4.3-2 Simulated steady state hydraulic heads and flow vectors after mining plus Rocla quarry : K = 0.02 m/d case

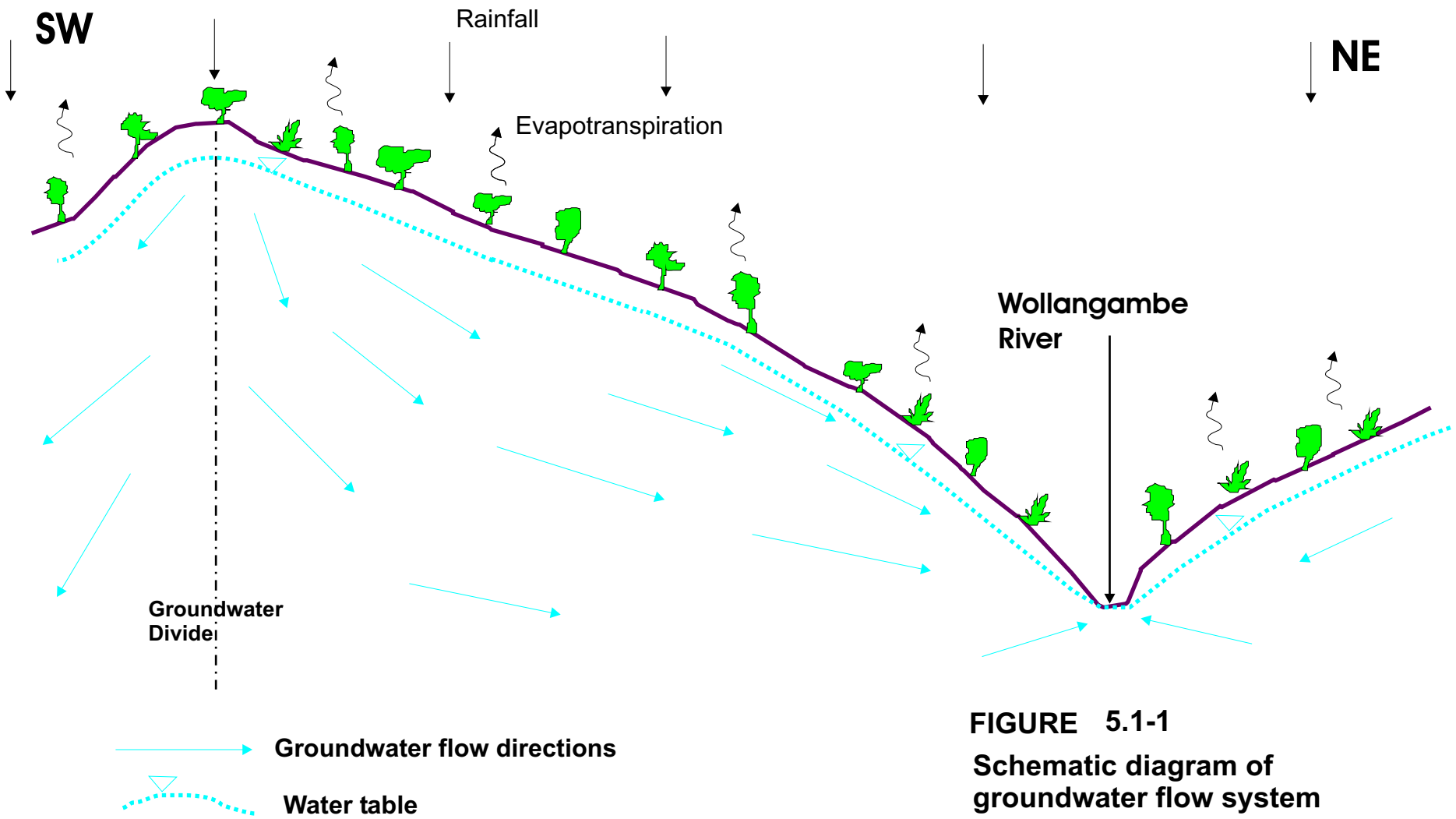


FIGURE 5.1-1

Schematic diagram of groundwater flow system before mining

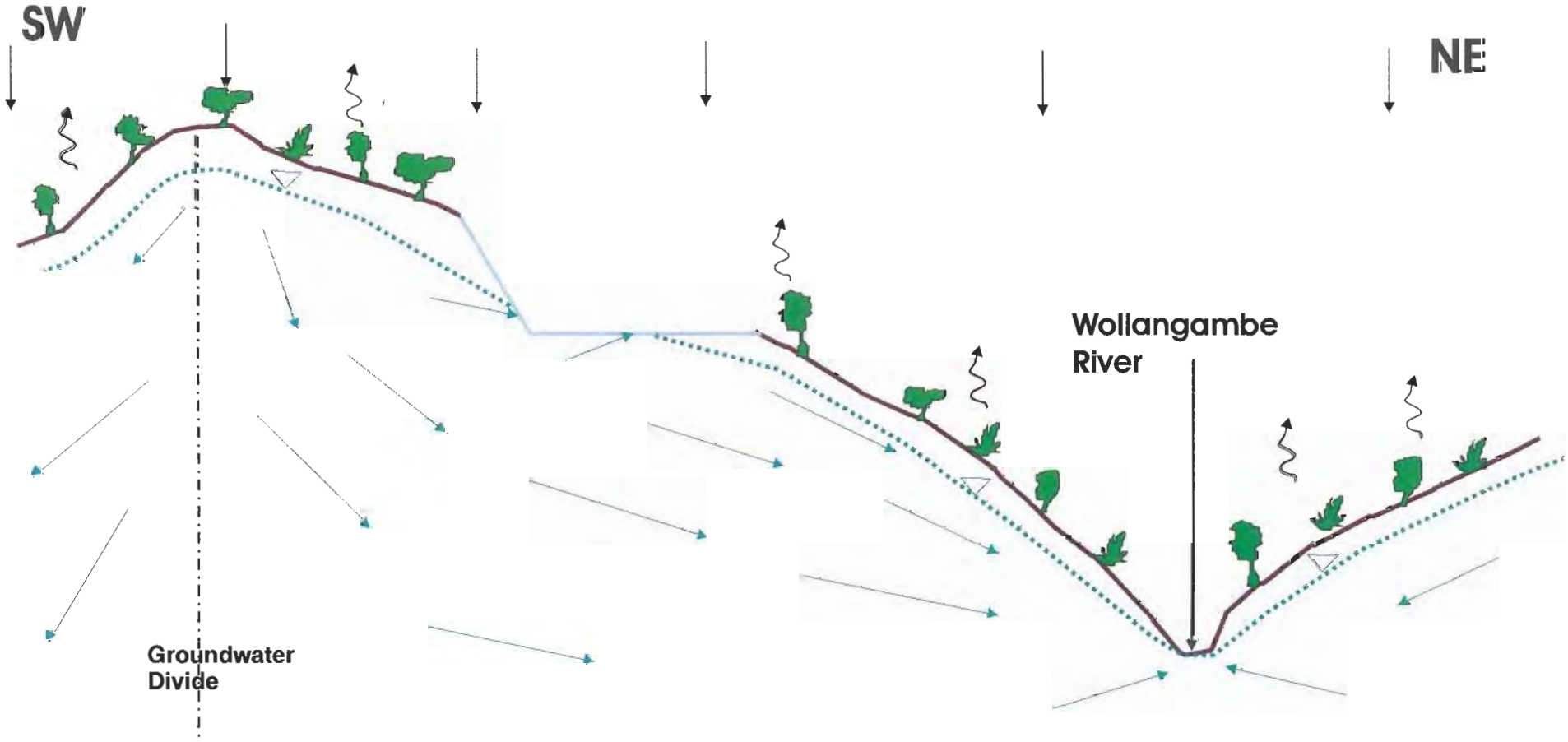


FIGURE 5.2-1

Schematic diagram of Groundwater flow system at the end of mining

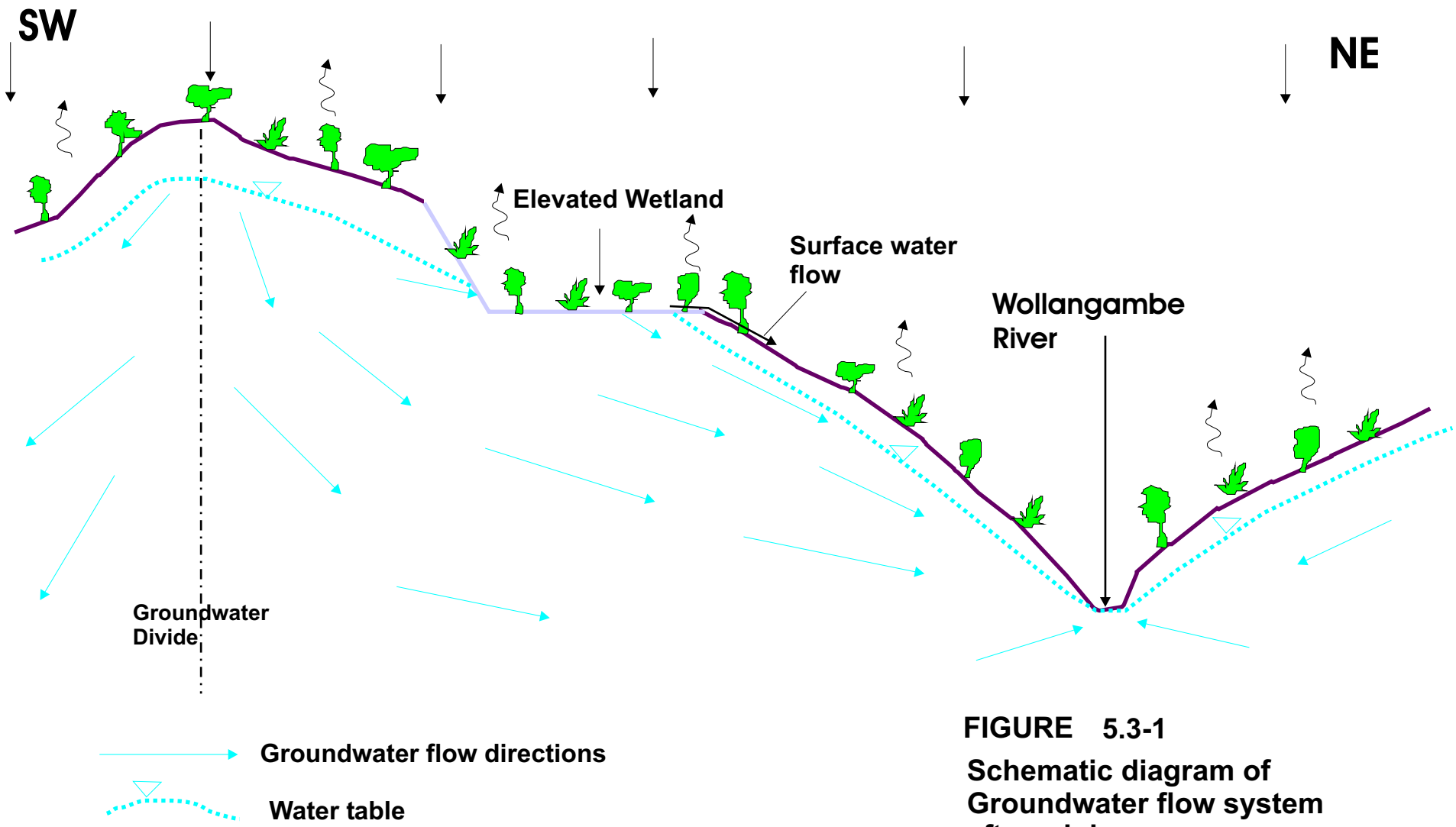
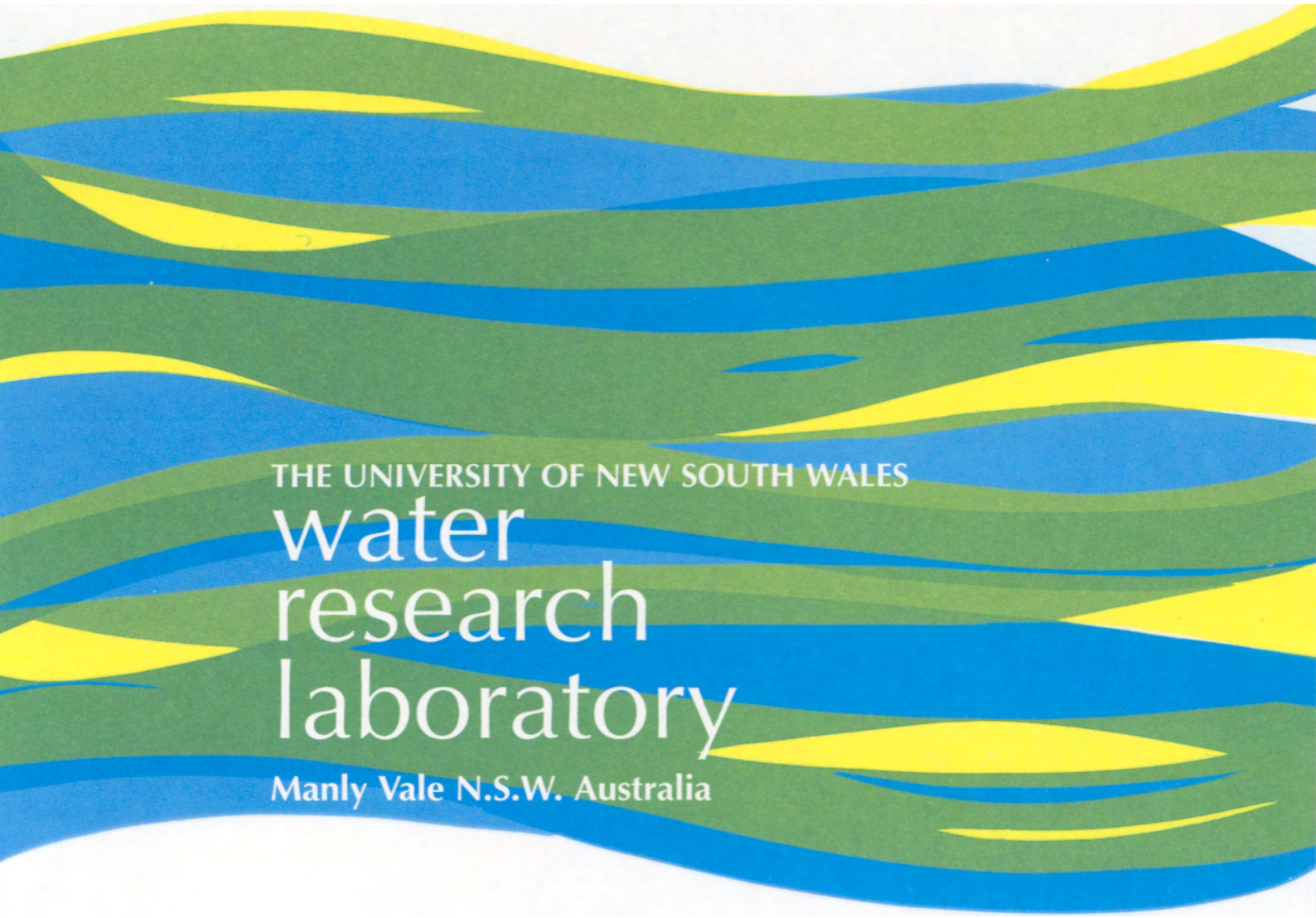


FIGURE 5.3-1

Schematic diagram of Groundwater flow system after mining

APPENDIX

Drilling, Hydraulic Testing and Installation of Observation bores (piezometers)



MULTI-PIEZOMETER INSTALLATIONS AT NEWNES JUNCTION

by

W A Timms, S E Pells and M Groskops

Technical Report 2004/40
December 2004

THE UNIVERSITY OF NEW SOUTH WALES
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING
WATER RESEARCH LABORATORY

MULTI-PIEZOMETER INSTALLATION AT NEWNES JUNCTION

WRL Technical Report 2004/40 December 2004

by

W Timms, S E Pells and M Groskops

Water Research Laboratory
School of Civil and Environmental Engineering
University of New South Wales ABN 57 195 873 179
King Street
Manly Vale NSW 2093 Australia

Telephone: +61 (2) 9949 4488
Facsimile: +61 (2) 9949 4188

Technical Report No 2004/40
Report Status Final
Date of Issue December 2004

WRL Project No. 04039
Project Manager Wendy Timms

Title	Multi-Piezometer Installations at Newnes Junction
Author(s)	W A Timms, S E Pells and M Groskops

Client Name	Frans Kalf and Associates
Client Address	52 York Terrace Bilgola NSW 2107
Client Contact	Frans Kalf
Client Reference	

The work reported herein was carried out at the Water Research Laboratory, School of Civil and Environmental Engineering, University of New South Wales, acting on behalf of the client.

Information published in this report is available for general release only with permission of the Director, Water Research Laboratory, and the client.

CONTENTS

1. INTRODUCTION 2

2. OVERVIEW 3

3. DRILLING 4
   3.1 Method summary 4
   3.2 North West Site 4
      3.2.1 Lithology 4
      3.2.2 Water Inflow 5
   3.3 North East Site 5
      3.3.1 Lithology 5
      3.3.2 Water Inflow 5
   3.4 Southern Site 6
      3.4.1 Lithology 6
      3.4.2 Water Inflow 6

4. PIEZOMETER INSTALLATIONS AND GROUNDWATER LEVELS 7

5. PERMEABILITY TESTING 9
   5.1 Packer Tests - Methodology and Interpretation 9
   5.2 Water Level Recovery Tests – Methodology and Interpretation 10
   5.3 North West Site 11
   5.4 North East Site 13
   5.5 Southern Site 14
   5.6 Summary and Comparison 15

6. WATER QUALITY SAMPLING 16

7. REFERENCES 17

APPENDIX A – Borehole Logs
APPENDIX B – Hydraulic Conductivity Analyses

LIST OF TABLES

1. Piezometer Completion Details
2. Measured Groundwater Levels
3. Hydraulic Conductivity Measurements

LIST OF FIGURES

1. Locality Map
2. Piezometer Locations

1. INTRODUCTION

The Water Research Laboratory, University of New South Wales (WRL) was commissioned to supervise drilling, permeability testing, installation of piezometer standpipes and water quality testing at a proposed mine site in Newnes Junction, NSW.

A summary of procedures and results from the drilling and testing are presented in this report. Detailed interpretation is to be undertaken by Kalf and Associates.

2. OVERVIEW

The location of the proposed mine site is near Newnes Junction in the Blue Mountains region, west of Sydney, NSW (Figure 1). The extent of the proposed mine lease is shown in Figure 2. Three locations were chosen for drilling investigations at the North West, North East and Southern extremities of the mine lease (Figure 2).

At each of the three drilling locations, a deep (60 m) and shallow (17.5 m) borehole was drilled using rotary air hammer techniques. This drilling technique was chosen as it does not require the use of drilling fluids, which would obscure examination of any aquifers that may be penetrated. Air lifting of the boreholes at various stages during drilling allowed estimations of yields to be made, and provided information on the location and extent of any aquifers or saturated fractured zones. Lithological logging was also performed. Results from drilling at each of these sites are discussed in detail in Section 3 and borehole logs are provided in the Appendix.

Packer testing was performed on the 60 m bores to give an estimate of the hydraulic conductivity of the rock mass at various depths in the borehole. At some locations, brief water level recovery tests were also performed to give a supplementary estimation of hydraulic conductivity. Details of these permeability tests are given in Section 4.

3. DRILLING

3.1 Method summary

Airlifting associated with the rotary air hammer drilling method brings drilling spoil and any available water to the surface. Logging of bores was performed by examining the spoil being airlifted from the drill face. It is possible to get the colour and composition of the material but due to the grinding action of the rotary hammer drill method it is not possible to discern the structure, strength and grain size / clay content of the sandstone material.

The flow rate of water that was brought to the surface by airlifting was assessed volumetrically and by use of a v-notch weir. The volumetric method involves recording the time taken to fill a container of known volume. The v-notch weir method involves measuring the depth of flow over a v-shaped weir and applying a known head-discharge relationship.

Assessment of water yields by airlifting was done as drilling progressed. Additionally, drilling was paused for approximately 10 minutes at various stages (at the change of drill rods (every 6 m) or if a fractured zone was struck) and airlifting, whilst stationary, was performed to assess the yields at progressive depths. With the exception of the last 5 m of the north-eastern 60 m bore, water was not added during drilling so that the nature of existing water zones could be examined.

Borehole logs for each of the three sites are presented in the Appendix. Included on the logs are details of air lifting tests performed during drilling. Each site is discussed in more detail below.

3.2 North West Site

3.2.1 Lithology

Massive sandstone beds extended from 100 mm below ground to the full depth at 60 m. The upper 7 to 8 m was characterised by an orange to deep orange colour. Below 8 m, sandstone was a cream to off white colour, with occasional bands of light orange and very occasional thin beds of ironstone. Small pieces of quartz (1-2mm) could be found within the cream coloured sandy / dusty spoil. Below the watertable, spoil became slurry-like and difficult to log accurately. Drilling was significantly slower at depths greater than 20 m.

3.2.2 Water Inflow

Slight moisture was observed in the spoil in the upper 6 m, but appeared to become drier with depth up to approximately 24 m. From 24 m to 30 m, small amounts of water inflow was noted (less than 1 L/minute). Below 30 m and to the end of the bore at 60 m, a consistent inflow of approximately 5 to 6 L/minute was recorded as drilling progressed.

A very small amount of water (< 1 L) was recovered after pausing at 12 m depth. At 18 m , no water was recovered, although drilling was only paused for only 2 minutes. After a 14 minute pause at 24 m, airlifting brought up approximately 30 to 40 L of water, but this quickly dried up and drilling spoils remained dry until 30 m. At 30 m depth, a volume of 50 to 60 L was recovered and a flow rate of less than 6 L/minute was sustained. At 60 m depth airlifting was continued for 15 minutes during which time a flow of approximately 5 L per minute was recorded using the v-notch weir. Airlifting of the bore from 60 m depth also allowed flushing of fines from the borehole in preparation for subsequent packer testing.

3.3 North East Site

3.3.1 Lithology

Sandstone beds extended from 400 mm below ground to the base of the 60 m bore. Two regions of soft material – assessed to be clay infilling layers, where struck at the end of the hole (58.0 to 58.8 m and 59.8 to 59.9 m). These layers were identifiable as the drill rods progressed very rapidly and a small amount of grey high plasticity clay was brought to the surface.

Throughout the bore, sandstone was mostly a grey / cream colour with regions of orange and occasional purple / ochre as shown on the bore log. In some regions of the cream colour material, quartz particles up to 2 mm diameter were recovered.

3.3.2 Water Inflow

No water was recovered during drilling or during stationary airlifting tests down to 54 m depth. However, collaring of drill rods that was occurring from 36 m was attributed to presence of some moisture. To counteract collaring, water was added during drilling of the last 6 m.

Drilling on the 5th November left the bore at 54 m depth. Upon resuming on 6th November, approximately 20 to 30 L of water was recovered immediately and then no further water was produced.

At 60 m, airlifting was performed to remove drilling water used from 54 m and examine yields. Drilling water appeared to be removed very quickly, after which flows reduced markedly and stabilised at approximately 4 to 5 L/minute. This suggested that the soft regions struck from 58 m could be water bearing zones. However, it is possible that clay regions could be slowly releasing drilling water after being pressurised during drilling.

3.4 Southern Site

3.4.1 Lithology

Depth to sandstone was approximately 1 m. Orange and yellow coloured layers extended to 13 m depth. Thereafter, sandstone was a cream / off white colour with some quartz.

3.4.2 Water Inflow

Some moisture was noted in the spoil from 1 to 7 m, but appeared to become drier with depth until 41 m. A moist band was noted between 22 and 24 m, but no water was recovered.

Drilling on 8th November left the bore at 41 m depth. On 9th November, drilling rods were raised and then lowered slowly with the air on. Water was lifted from 31 m to 41 m but no constant flow was developed.

No further water was recovered during drilling to the final depth of 54 m.

4. PIEZOMETER INSTALLATIONS AND GROUNDWATER LEVELS

Standpipe piezometers were installed in each borehole after completion of drilling and packer testing using Class 18 50 mm PVC casing, screened at 3 m or 6 m intervals. These details are shown on the bore logs in the Appendix.

A summary of the piezometer completion details is given in Table 1.

Table 1
Piezometer Completion Details

Borehole ID	GPS coordinates[#]	Depth (m BG)	Elevation (±1 mAHD)	Screen Intervals (m BG)	Other Details
NW60	0244461 6293482	60	1037	15-18, 21-24, 27-30, 33-36, 39-42, 45-48, 51-54, 57-60.	Gravel Pack to 3m above top screen
NW17.5		17.5		14.5 – 17.5	Gravel Pack to 3m above top screen
NE60	0244963 6293380	60	995	15-18, 21-24, 27-30, 33-36, 39-42, 45-48, 51-54, 57-60.	Gravel Pack to 3m above top screen *
NE17.5		17.5		14.5 – 17.5	Gravel Pack to 3m above top screen
S54	0244568 6292731	54	1059	24-30, 36-42, 48-54	Gravel Pack to 3m above top screen
S17.5		17.5		14.5 – 17.5	Gravel Pack to 3m above top screen

* ~3m of casing broken off and lying in base of NE60.

Handheld GARMIN GPS

** Estimated elevation from contour map of site

Groundwater levels were measured by electronic dip meter on several occasions (Table 2). Groundwater levels were measured relative to ground level until 9/11/04 when steel monuments were installed. After 9/11/04, groundwater levels were measured relative to the top of the 50 mm PVC casing within the steel monument (approximately 0.5 m above ground).

On the 24/11/04, automated loggers and a pressure transducer were temporarily installed in NW60 and S54 to monitor groundwater level recovery after sampling. This data is presented in Sections 5.3 and 5.5.

Table 2
Measured groundwater levels

Borehole	Date	Time	SWL (m BPVC)	SWL (m BGL)	SWL (mAHD)**	Comment
NW60	3/11/04	06:35 am	-	14.52		Dip prior to starting work - 12 hours recovery since previous day.
	6/11/04	8:50 am	-	14.3		Dip 2 days after completion. Rainfall event the previous day.
	24/11/04	8:40 am	14.88	14.38*	1022.6	Prior to sampling.
NW17.5	6/11/04	8:50 am	-	9.49		Dip 2 days after completion. Rainfall event the previous day.
	24/11/04	8:40 am	9.67	9.17*		Prior to sampling
NE60	6/11/04	4:00 pm	-	30		Static level dipped during packer testing
NE60	7/11/04	6:45 am	-	43		Dip prior to starting work - 12 hours recovery since previous day. Flow of water in bore audible but level static.
	24/11/04	11:15 am	42.9	42.4*	952.6	Prior to sampling
NE17.5	24/11/04	11:15 am	13.47	12.97*		Prior to sampling
S54	9/11/04	6:30 am	-	15		Airlifting before resuming drilling from 42 m. 12 hours recovery since previous day.
	24/11/04	12:50 am	18.1	17.6*	1041.4	Prior to sampling
S17.5	24/11/04	12:50 am	16.5	16.0*		Prior to sampling

* Assuming 0.5 m stickup of PVC inside steel monument

** Surface mAHD estimated from contour map of site

5. PERMEABILITY TESTING

5.1 Packer Tests - Methodology and Interpretation

Packer tests involve sealing off a section of the bore using inflatable rubber seals ('packers') and injecting water into the sealed section at various pressures. Water injected into the sealed region will flow into the rock units enclosed by the packers at a rate proportional to the water pressure applied. By recording flow rate at various water pressures, estimates of rock mass hydraulic conductivity can be made.

Results are normally expressed in Lugeon units, defined as flow rate of one litre per minute per meter length of test section under a water pressure of 1000 kPa. This is approximately equivalent to mass hydraulic conductivity of 1×10^{-7} m/ second, or 8.64×10^{-3} m/day.

In practice, pressures of 1000 kPa are rarely used during testing and so the value of flow at 1000 kPa is extrapolated from the results from tests performed at lower pressures. A common hurdle to performing packer tests is in establishing a tight water seal between the packers and the borehole walls. It is noted that if water was leaking past the packer *at a constant rate*, the result of the test would not be affected as it is not the total flow that determines the interpretation of the packer test but rather the gradient in flow rate between various pressures. However, in practice the rate of water loss through a leak will increase with increasing pressure, and hence the results of such a packer test will show a higher gradient of flow versus pressure, and thus the Lugeon value will be overestimated. In short, leaking packer tests will give an overestimate of hydraulic conductivity.

The procedure for packer tests was as follows:

1. The borehole was washed out by airlifting for 10 minutes at the completion of drilling.
2. Drilling logs were examined to decide on an appropriate location for the packer test.
3. Packer equipment was assembled and packers and water line was lowered into the hole to the target depth.
4. Packers were inflated using compressed air and checked for air leaks. Packers were adjusted / repaired as required until pressure was maintained.
5. The water supply pump was turned on and valves were adjusted to deliver the first test pressure.
6. If there were any indications packers were not sealing, packers would be deflated and relocated and steps 4 to 5 repeated until a seal was achieved.

7. Once flow rates had stabilised, time and water meter readings were made repeatedly until a consistent flow rate was recorded.
8. Valves were adjusted to deliver the second (higher) test pressure and step 6 was repeated.
9. Step 7 was repeated for subsequent increasing test pressures up to the highest test pressure.
10. Step 7 was then repeated in decreasing order of pressures from the highest test pressure.
11. Packers were deflated and repositioned for the next test.

In some tests, a good seal between the packer and the bore could not be found despite repeated attempts. In these cases, the packer tests were performed in the knowledge that the result would give an overestimate due to leaking. In some of these cases, an attempt was made to quantify the rate of leakage and hence give a better indication of hydraulic conductivity. Full details are given for each site in Sections 4.3 to 4.5 below.

5.2 Water Level Recovery Tests – Methodology and Interpretation

Estimations of hydraulic conductivity can be made by monitoring the rate of recovery of water levels within a bore to static conditions. For falling head data, a Hvorslev (1951) method was used which relies of determining a 'basic time lag' (T_o), taken as the time for the water level to recover to 63% from the initial drawdown. The formula chosen was for the case of a well point in an infinite, homogeneous and isotropic aquifer:

$$K = \frac{r^2 \ln\left(\frac{L}{R}\right)}{2LT_0} \qquad (1)$$

where: K is permeability (m/s)
r is radius of standpipe (m)
R is radius of screen, including any gravel pack (m)
L is length of screen (m)
T_o is the basic time lag (seconds)

A second interpretation method by Hvorslev (1951), was used to calculate hydraulic conductivity from recovery data based on constant drawdown and pump rate. This method was based on the following two formulae:

$$K = \frac{q}{h.f} \tag{2}$$

$$f = \frac{2\pi L}{\ln(L/D + \sqrt{1+(L/D)^2}} \tag{3}$$

where: K is permeability (m/s)
h is driving head (m)
q is steady state pump rate (m^3/s)
f is shape factor
D is effective diameter (m)
L is length of screen (m)

This method assumed a constant pump rate and a constant drawdown and relied on dip measurements prior to pumping and at a constant pump rate (to calculate the driving head). An estimate of effective screen length was used to calculate a shape factor (Equation 3) for input to Equation 2. A hydraulic conductivity was calculated for each of two effective screen lengths – open screen only (shorter interval) and open screen plus blank casing between each screen (longer interval).

5.3 North West Site

Packer testing at the north west site was performed on the 3rd and 4th November 2004. Results from packer tests are shown in Appendix B and a summary of results is shown in Table 3.

For the first test, a single packer was used to isolate the bottom 12.3 m of the borehole. A single packer test is preferable where possible as it reduced the number of locations from which leakage could occur. From this test, a lugeon value of 6.4 was estimated, giving an hydraulic conductivity estimate of approximately 0.06 m/day.

For the second test, two packers were used in a ‘straddle’ configuration to isolate a section of bore from 39.7 to 48.65 m depth (8.95 m section of borehole). This test was performed successfully without any observed leakage, and a value of 7.2 lugeons (~ 0.06 m/day) was estimated.

Table 3
Summary of Hydraulic Conductivity Measurements

Location	**Test Type**	**Interval** (m depth)	**Hydraulic Conductivity** (m/day)	**Comment**
NW 60	Single Packer	47.7 to 60	0.056	No leakage observed
	Double "Straddle" Packer	39.7 to 48.65	0.063	No leakage observed
	Double "Straddle" Packer	21.7 to 30.65	< 0.141 (< 0.09 including estimation of leakage rates)	Rate of flow leakage past upper packer assessed visually.
	Double "Straddle" Packer	15.7 to 24.6	< 0.48 (< 0.24 including estimation of leakage rates)	Rate of flow leakage past upper packer measured using v-notch weir.
	Falling Head	12 to 60	0.001	Recovery from 11.95 to 14.3 m BGL after installation of standpipe
	Recovery	24 to 60	0.046 (L=36 m) 0.084 (L=18 m)	Recovery after pumping @ 10.4 L/s for sampling 24/11/04.
NE 60	Falling Head	30 to 60	0.75	A crude estimate based on recovery to 'quasi' static level after pumping in water
	Rising Head	30 to 60	0.04	Recovery to 'quasi' static level airlifting
	Double "Straddle" Packer	42.2 to 47.95	0.75	No leakage observed, leakage past bottom packer possible
	Double "Straddle" Packer	36.2 to 41.95	0.9 to 1.2	No leakage observed, leakage past bottom packer possible
	Recovery	51.4 to 60	0.11 (L=5 m) 0.073 (L=8.6 m)	Recovery after pumping @ 4.5 L/s for sampling 24/11/04.
S 54	Recovery	36 to 54	0.03 (L=12 m) 0.02 (L=21 m)	Recovery after pumping @ 6.3 L/s for sampling 24/11/04.

Repeated attempts to seat the packers between 30.7 and 39.6 m were unsuccessful as leaking was observed. The packer was moved up for further tests from 21.7 to 30.65 m, where leaking was again observed, despite repeated attempts. It was decided to persevere with these tests and try to quantify the rate of leakage for each pressure using a v-notch weir placed adjacent to the headworks where the leaking flows exited the top of the bore. A value of 16.3 lugeons (~ 0.14 m/day) was recorded for the leaking test. When the leaking rate removed from the packer flow rate, a best estimate value of 10.9 lugeons (~ 0.1 m/day) was made.

Leaking was also recorded for a packer test from 15.7 to 24.6 m depth. A value of 56 lugeons (~ 0.5 m/day) was recorded for the leaking test. When the estimated leakage rate was taken into account, a best estimate value of 27 lugeons (~ 0.24 m/day) was made.

After packer testing equipment was removed and the standpipe piezometers were installed (approximately 50 minutes after completion of packer testing) it was noted that water levels in the standpipe were receding (ie. falling from elevated levels due to packer testing and displacement of water from the piezometer installation). Repeated dip measurements were performed over a period of two hours to monitor this recovery (from 11.95 m BGL) and hence provide an estimate of hydraulic conductivity. Dip readings were taken again two days later to get a value of static water level (taken as 14.3 m BGL). From the data, it was seen that 63% of the recovery (ie. water level at 13.4 m BGL) occurred at 2 hours from the start of monitoring, giving a time lag of 7200 seconds, or 0.08 days. Using Equation 1 with a standpipe radius of 0.025 m, a borehole radius of 0.098 m and a screen length of 8×3 m lengths, an hydraulic conductivity of 0.001 m per day was estimated. This estimate is based on inflows over the full depth of the saturated region from approximately 12 meters to 60 meters.

Recovery of water levels after sampling (24/11/04) were used to derive hydraulic conductivity over the entire piezometer screen. Hydraulic conductivity of 0.046 and 0.084 m/day was calculated for effective screen lengths of 36 and 18 m respectively (Table 3). These values are similar to those provided by packer tests at deeper test intervals, but much higher than for falling head hydraulic conductivity.

5.4 North East Site

A single-packer test from 47.7 m and a double-packer test from 47.7 to 53.45 m were both unsuccessful due to excessive leakage past the packer. During these tests, flow rates of up to 2 L/second were directed into the borehole, but insufficient pressure was maintained. It is noteworthy that 700 to 900 L of water was added at rates between 1.6 and 2 L/second during each of these tests (at approximately 70 kPa gauge pressure), but this failed to cause the borehole to overflow. The assessed dry volume (above the water table ~ 35 m BGL) of the borehole during this testing is approximately 230 L. Therefore, a volume of between 500 to 600 L of water must have flowed into the aquifer over a period of 6 to 8 minutes.

After attempting the above tests, packers were deflated and repeated dip measurements and tests involving changing the water level confirmed that the water level in the bore would

quickly recover to approximately 30 m BGL where it would stabilise. A volume of 240 L was added to the hole over a period of 2 minutes after which water levels raised to over 25 m BGL. Dip readings showed that the water level recovered from 25 m BGL back to 30 m BGL within two minutes. This suggested a time lag in the order of 30 seconds for the open borehole. This would indicate an hydraulic conductivity in the order of 0.7 m/day (assuming an effective length of open borehole of 30 m).

Airlifting was then performed from 47 m, but a constant water yield was not developed. After airlifting, dips were performed to monitor the rate of recovery to 30 m BGL, from which a time lag of 0.0068 days was calculated. This gives an estimate of hydraulic conductivity of 0.04 m/day (see Appendix B). These estimations should be considered as rough indications only as the static water level was observed to be at 43 m BGL the following day.

Two successful packer tests were then performed for the intervals 42.2 to 47.95 and 36.2 to 41.95 m BGL. The results from these packer tests are shown in Table 1 and in Appendix B.

Recovery of water levels after sampling (24/11/04) were used to derive hydraulic conductivity over the entire piezometer screen. Hydraulic conductivity values of 0.11 and 0.073 m/day were calculated for effective screen lengths of 5 and 8.6 m respectively (Table 3). These values are less than those provided by packer tests, but much higher than for falling head hydraulic conductivity.

5.5 Southern Site

Several attempts at obtaining a good packer seal in the southern bore were unsuccessful so no packer testing was possible. It was thought that a worn drill bit was causing irregularities in the hole which prevented packer seals, so a second hole was attempted with a new drill bit. This second hole was over-sized for effective packer operation.

Recovery of water levels after sampling (24/11/04) were used to derive hydraulic conductivity over the entire piezometer screen. Hydraulic conductivity of 0.03 and

0.019 m/day was calculated for effective screen lengths of 12 and 30.9 m respectively (Table 3).

5.6 Summary and Comparison

In summary, a range of methods including packer testing and falling/rising groundwater levels have been used to calculate hydraulic conductivity at discrete depth intervals, and over the entire length of the piezometer.

The highest hydraulic conductivity was observed at the NE 60 site on the edge of the valley, and relatively low hydraulic conductivity at the S 54 site. Measured hydraulic conductivity at the three piezometer sites was in the range of 0.03 – 1.2 m/day (3.5×10^{-7} to 1.4×10^{-5} m/s), with the exception of one anomalous falling head value of 0.001 m/day at NW 60. This range of hydraulic conductivity over 1.5 orders of magnitude is typical of such sandstone environments, and is similar to hydraulic conductivity of 10^{-7} to 10^{-5} m/s measured by packer testing in the Katoomba area (Brown, 2003).

6. WATER QUALITY SAMPLING

Water samples (n = 3 plus method blank) were obtained from three deep piezometers on the 24th November. A GRUNDFOS MP1 submersible electric pump was used to obtain samples. All piezometers were pumped for at least half-an-hour prior to sampling to remove ~3 bore volumes of water and/or stable pH and electrical conductivity (EC) were observed.

Analysis of field parameters (temperature, pH, and EC) was completed on-site with calibrated water quality meters and sondes. Samples for analysis were collected in laboratory supplied bottles and submitted to Australian Laboratory Services (ALS) which is NATA certified for the analyses undertaken. Samples for cation analysis were filtered on-site with a 0.45 μm filter, and acidified.

Table 4 presents water quality results. Groundwater at this site was generally of very low salinity and was acidic. Groundwater chemistry was similar for NW60 and NE60 piezometers (NaCl type), but S54 groundwater was dominated by high alkalinity and consequently, higher electrical conductivity and pH. A maximum iron concentration of 1.1 mg/L observed in NE60 may be attributed to drill casing lost down the hole, since iron concentrations <0.02 mg/L were observed at the other piezometers. Manganese concentrations were <0.05 mg/L.

Table 4
Water quality results, sampled 24/11/04.

Parameter	Units	NW60	NE60	S60	Method Blank
Temperature	°C	15.3	17.1	16.5	-
pH		4.1	4.4	6.2	-
EC @ 25°C	μS/cm	30.6	40.5	150	-
Ca	mg/L	<1	<1	25	<1
Mg	mg/L	<1	<1	<1	<1
Na	mg/L	9	10	11	<1
K	mg/L	<1	<1	9	<1
Alk as $CaCO_3$	mg/L	<1	<1	64	<1
SO4	mg/L	<1	<1	8	<1
Cl	mg/L	11	12	15	<1
Fe	mg/L	<0.01	1.09	0.02	<0.01
Mn	mg/L	0.02	0.08	0.05	<0.01
Total cations		0.47	0.54	2.03	-
Toal anions		0.32	0.34	1.86	-
Anion/Cation difference		0.15	0.2	0.17	-

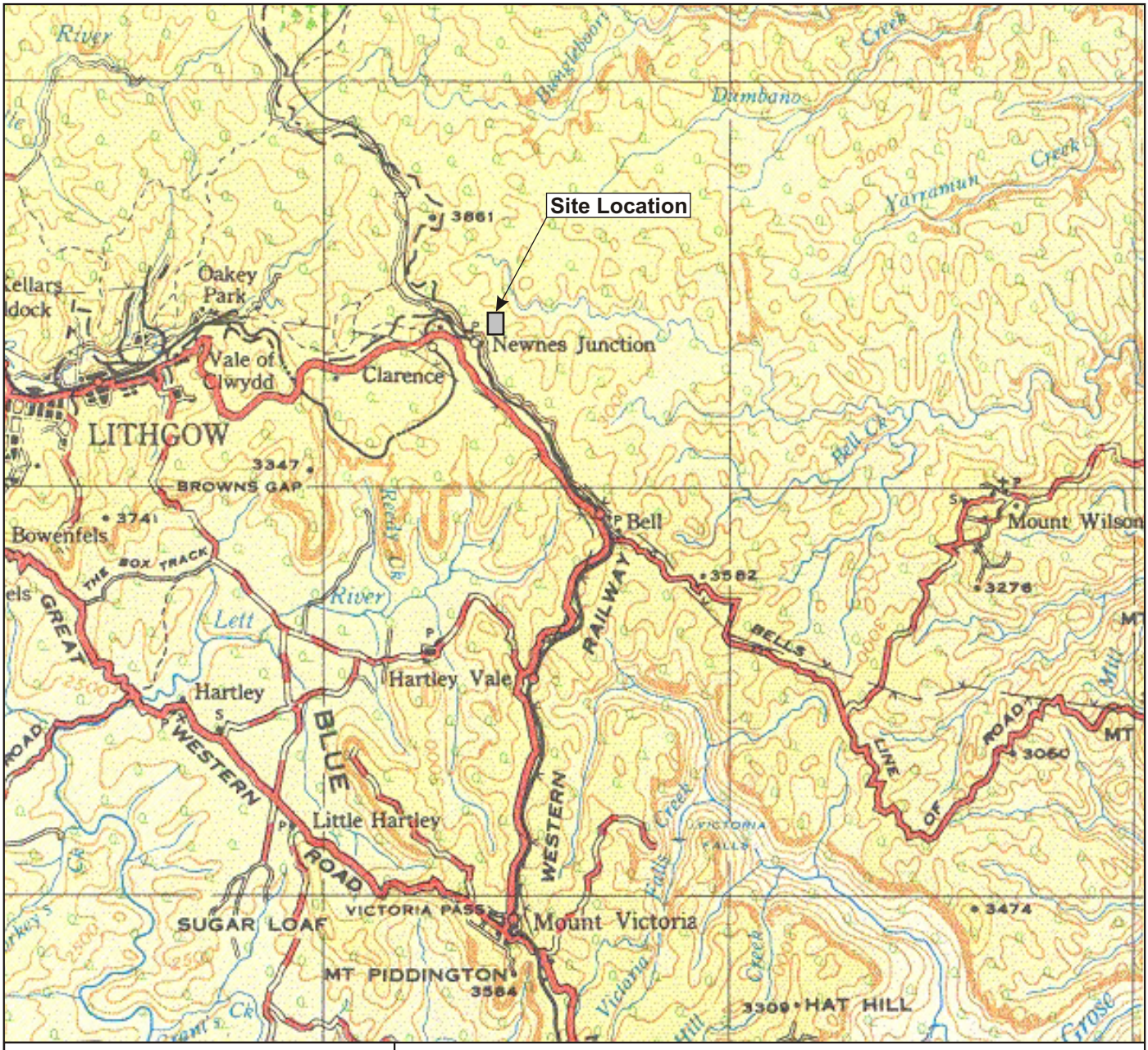
* anions were filtered except Cl, alkalinity

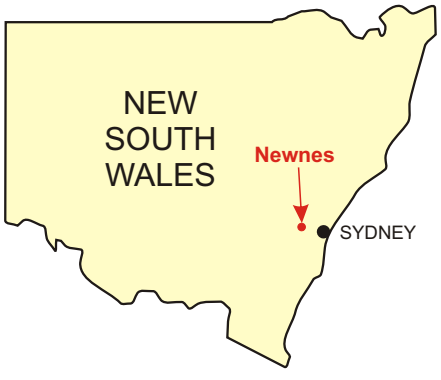
7. REFERENCES

Brown, S.J.A., 2003. Hydrogeology of the Blue Mountains – Simulating the impacts of water inflows into tunnel excavations using MODFLOW. Masters thesis, University of Technology, Sydney.

Hvorslev, 1951. Time lag and soil permeability in ground-water observations. US Army Core of Engineers, Bulletin No. 36.

Kruseman, G.P. and de Ridder, N.A., 1990. Analysis and evaluation of pumping test data. ILRI Publication 47, Netherlands.





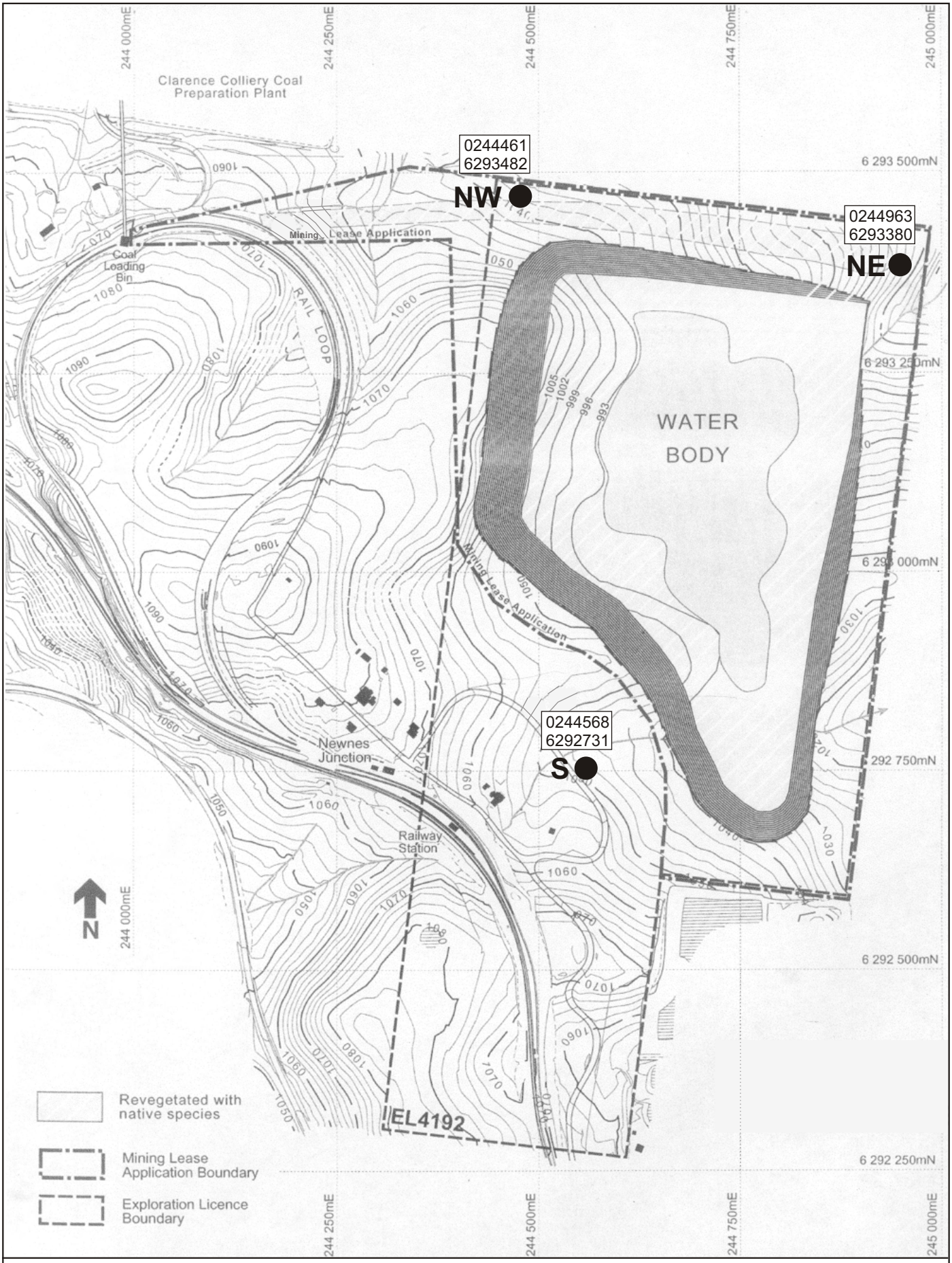
Map source: Royal Australian Survey Corps (series R502, SI 56-5)

N

0 5km

Scale

WRL Report No. 2004/40	LOCALITY MAP	Figure 1 04039-01.cdr



Map source: Kalf and Associates Pty Ltd

WRL Report No. 2004/40	PIEZOMETER LOCATIONS	Figure 2 04039-02.cdr

Appendix A

Borehole Logs

University of New South Wales
School of Civil & Environmental Engineering
Water Research Laboratory

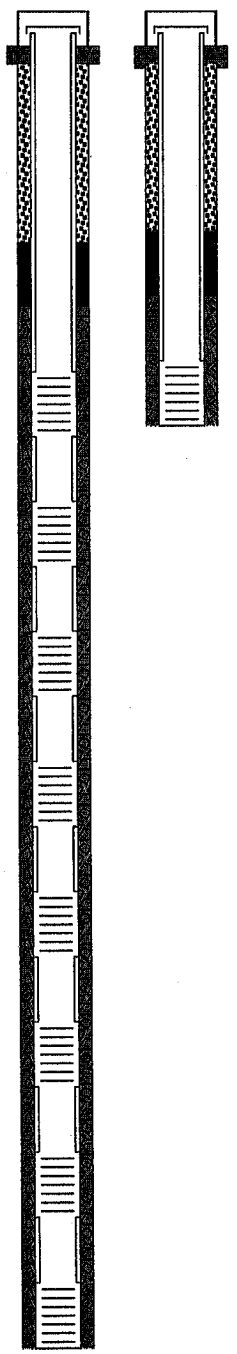
Project: 04039 Newnes Junction
Date: 2nd to 4th November 2004
Hole No. NW
Logged By: S.Pells
Driller: McDermott
Drill Hole Diameter: 98mm
Method of Drilling: Rotary Air Hammer

Depth Below Ground (m)	Lithology	Graphic Log	Water Development	Piezometer 60m	Piezometer 17.5m	Well construction comments
0	Top soil					lockable steel monument
	Orange, sandy		Very slight moisture			Sand Backfill Using Drill Cuttings
	Cream, very fine sand					
6	orange to deep orange		Becoming drier with depth			
	cream / off white		Becoming dry			Bentonite Plug
			Some moisture			
12			Becoming dry			2 to 5 mm Graded Washed Quartz Gravel Pack
			10 minute pause. ~ 1 litre recovered.			
	cream / off white, occasional brown/orange		Very slight moisture			
18			2 minute pause. No water recoverd.			
	cream / off white powder with quartz < 2mm pieces. Hard.		Dry and dusty.			
24	layer of ironstone ~ 50 to 100 mm. Very hard.		Dry			
	cream, loose or fractured layer.		Slight moisture			
	cream / off white powder with quartz < 2mm pieces. Hard.		14 minute pause. ~ 30 to 40 L immediately recovered. Very slight flow stabilising at approximately 0.2 L/min.			
30			Quickly becoming dry.			
			13 minute pause. ~ 50 to 60 L immediately recovered. Stabilising at < 1 L / min			
36			Wet			Class 18 50 mm ID 64 mm OD uPVC Casing & Machine Slotted Screen. No Geotextile Sock Used
			Volumetric test measured < 6 L / min of slurry (spoil included)			
42			Flow rate ~ 1 L / min over v-notch weir. Volumetric testing measures 5-6 L/min of slurry.			
	cream / brown slurry. Hard.					
48			Flow rate increasing slightly.			
			End drilling 2nd Nov 5:40 pm			
54			Resume drilling 3rd Nov 6:40 am ~ 100 L immediately recovered. Flow easing.			
			Flow rate over v-notch weir increasing with depth from 2 L / min to to ~ 6-7 L / min .			
60			15 minutes airlifting. ~ 5 L/min over v-notch weir.			

University of New South Wales
School of Civil & Environmental Engineering
Water Research Laboratory

Project: 04039 Newnes Junction
Date: 5th to 7th November 2004
Hole No. NE
Logged By: S.Pells
Driller: McDermott
Drill Hole Diameter: 98mm
Method of Drilling: Rotary Air Hammer

Depth Below Ground (m)	Lithology	Water Development
0	Top soil.	
	Orange.	Very slight moisture
6		
	Cream / grey.	
	Orange.	
12	Cream / grey. Some fine quartz pieces.	Dry
18	Cream / grey. Medium to soft.	10 minute pause. No water recovered.
	Cream / grey.	Dry
	Orange. Soft.	Dry and dusty.
	Cream / grey. Some brief orange zones.	10 minute pause. No water recovered.
24	Orange / yellow. Hard thin ironstone layer.	
	Orange. Medium to soft.	Dry and dusty.
	White / grey powder.	10 minute pause. No water recovered.
	Bright orange / ochre with brief white layer. Soft.	
30	White / grey powder with alternate orange layers	Dry and dusty.
	Ironstone layer. Pieces up to 8 mm. Hard.	10 minute pause. No water recovered.
36	White / grey.	Dry and dusty.
		Tendency to collaring of drill rods attributed to slight moisture.
42		10 minute pause. No water recovered.
	White / grey with quartz pieces. Occasional ironstone and ochre layers.	Dry and dusty.
48		2 minute pause. No water recoverd.
		Tendency to collaring of drill rods attributed to slight moisture.
54	grey / brown slurry.	End drilling 5th Nov 5:00 pm Resume drilling 6th Nov 7:00 am. Airlifted 20 to 30 L water, then dried up.
	Very Soft. Some grey high plasticity clay.	Drilling water used from 54 m to counteract collaring.
60	grey / brown slurry. Very Soft. Some grey high plasticity clay.	Drilling water used. At 60 m airlifted for 10 minutes to remove all drilling water. Flow appeared to stabilise at 4-5 L/ min.

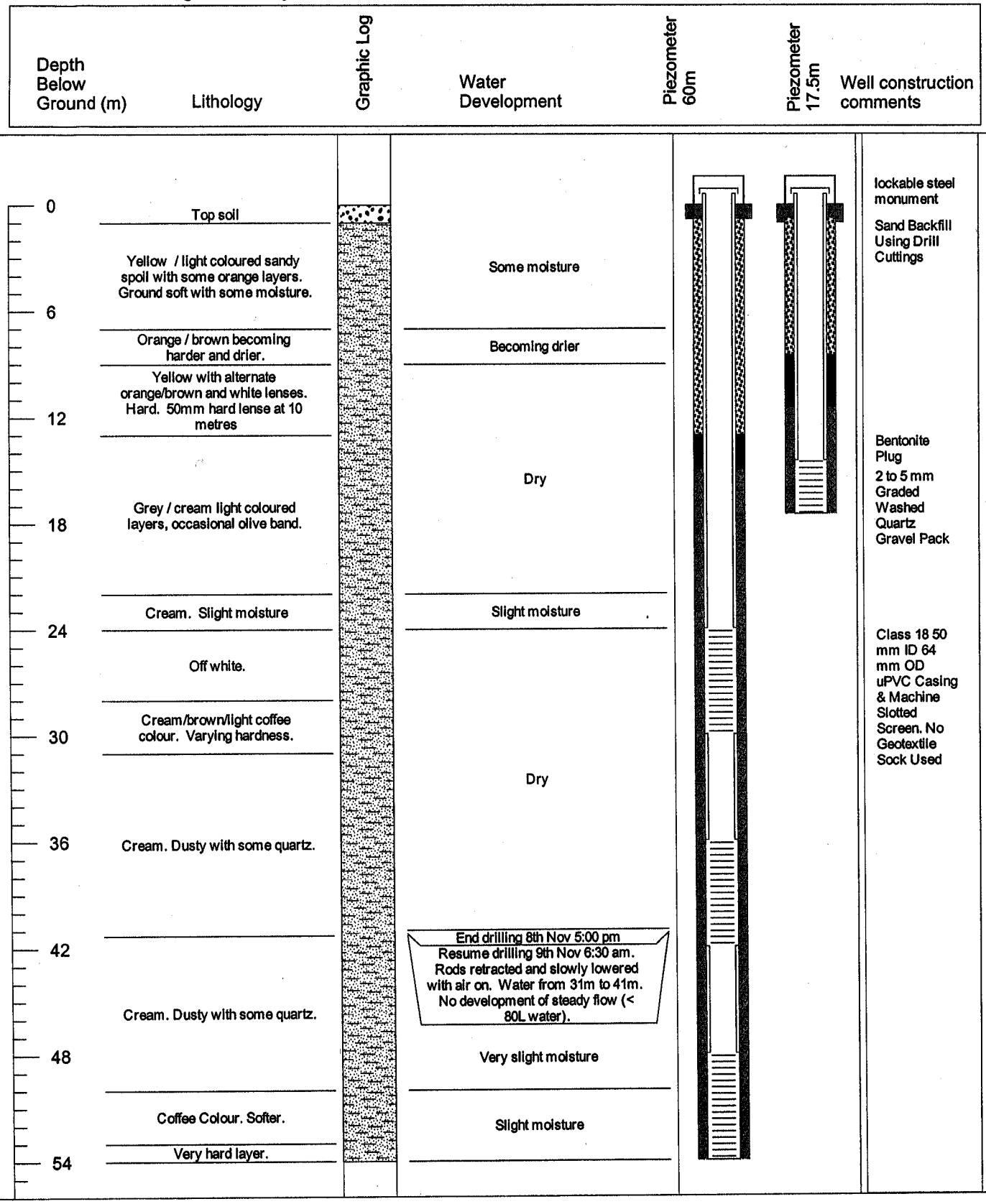


Lockable steel monument
Sand Backfill Using Drill Cuttings
Bentonite Plug
2 to 5 mm Graded Washed Quartz Gravel Pack
Class 18 50 mm ID 64 mm OD uPVC Casing & Machine Slotted Screen. No Geotextile Sock Used

University of New South Wales
School of Civil & Environmental Engineering
Water Research Laboratory

Project: 04039 Newnes Junction
Hole No. S
Driller: McDermott
Method of Drilling: Rotary Air Hammer

Date: 8th to 10th November 2004
Logged By: M. Groskops
Drill Hole Diameter: 98mm



Appendix B

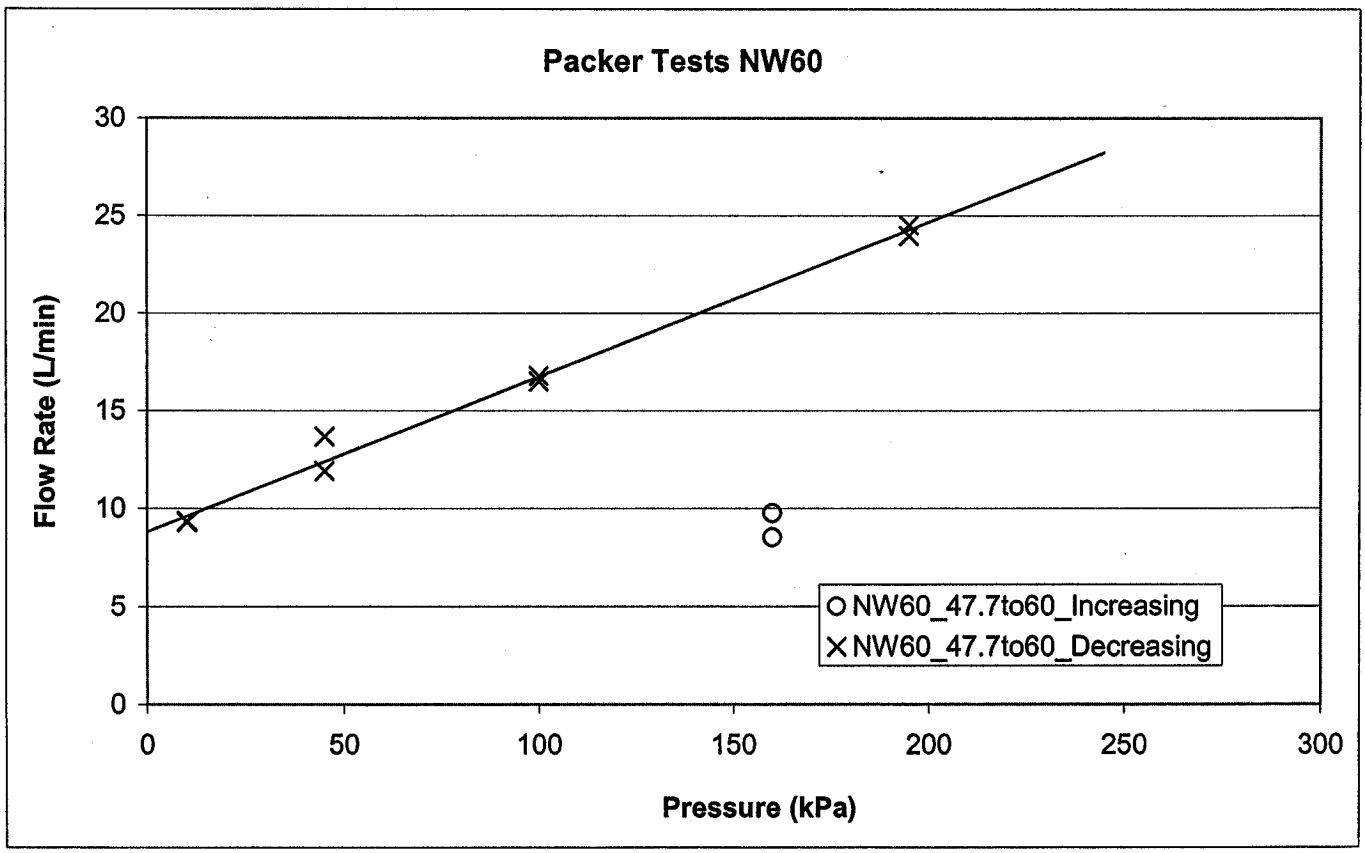
Hydraulic Conductivity Analyses

Permeability Testing NW60

Bore	NW60		
Packer Configuration	single		
Depth Interval	47.7	60	metres
Distance Gauge Above Ground	1.5		metres
Length of Packer	12.3		metres

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
160	643	95.195	95.234	39	240	9.75	0	9.75
160	643	95.234	95.2681	34.1	240	8.53	0	8.53
195	678	95.508	95.5815	73.5	180	24.50	0	24.50
195	678	95.5815	95.6534	71.9	180	23.97	0	23.97
100	583	95.678	95.7283	50.3	180	16.77	0	16.77
100	583	95.7283	95.7778	49.5	180	16.50	0	16.50
45	528	95.793	95.834	41	180	13.67	0	13.67
45	528	95.834	95.8697	35.7	180	11.90	0	11.90
10	493	95.883	95.9016	18.6	120	9.30	0	9.30
10	493	95.904	95.916	12	77	9.35	0	9.35

	Total Flow	Effective Flow	
Gradient	0.0792	0.0792	L/min/kPa
Flow per metre at 1000 kPa	6.4	6.4	L/Min/metre @1000kPa (Lugeons)
	6.44E-05	6.44E-05	cm/sec
Permeability	0.056	0.056	m/day

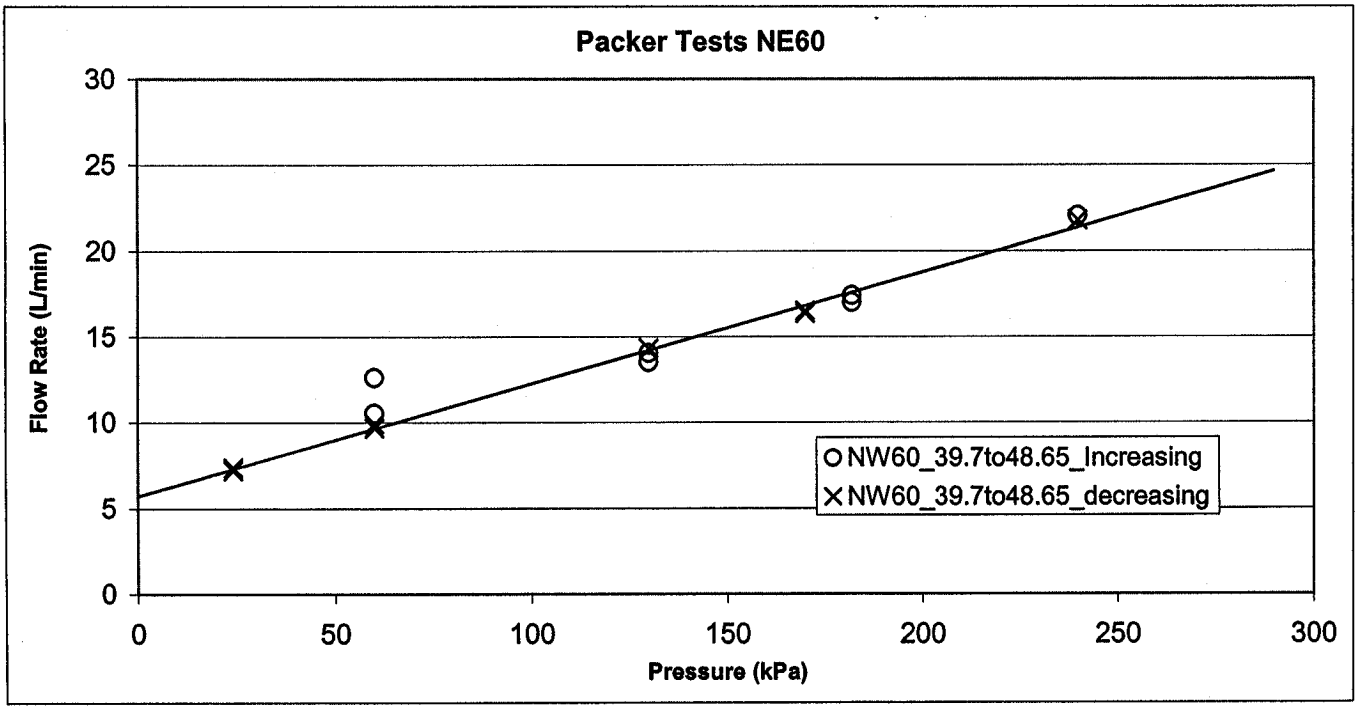


Permeability Testing NW60

Bore	NW60		
Packer Configuration	double		
Depth Interval	39.7	48.65	metres
Distance Gauge Above Ground	1.5		metres
Length of Packer	8.95		metres

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
60	464	96.29	96.3152	25.2	120	12.60	0	12.60
60	464	96.3152	96.3257	10.5	60	10.50	0	10.50
130	534	96.34	96.3821	42.1	180	14.03	0	14.03
130	534	96.3821	96.3956	13.5	60	13.50	0	13.50
182	586	96.415	96.4498	34.8	120	17.40	0	17.40
182	586	96.4498	96.5008	51	180	17.00	0	17.00
240	644	96.53495	96.557	22.05	60	22.05	0	22.05
240	644	96.557	96.5897	32.7	90	21.80	0	21.80
170	574	96.604	96.6205	16.5	60	16.50	0	16.50
170	574	96.6205	96.63685	16.35	60	16.35	0	16.35
130	534	96.651	96.6653	14.3	60	14.30	0	14.30
60	464	96.675	96.6943	19.3	120	9.65	0	9.65
60	464	96.6943	96.7042	9.9	60	9.90	0	9.90
24	428	96.711	96.7182	7.2	60	7.20	0	7.20
24	428	96.7182	96.72555	7.35	60	7.35	0	7.35

	Total Flow	Effective Flow	
Gradient	0.064818112	0.064818112	L/min/kPa
Flow per metre at 1000 kPa	7.2	7.2	L/Min/metre @1000kPa (Lugeons)
	7.24225E-05	7.24225E-05	cm/sec
Permeability	0.063	0.063	m/day



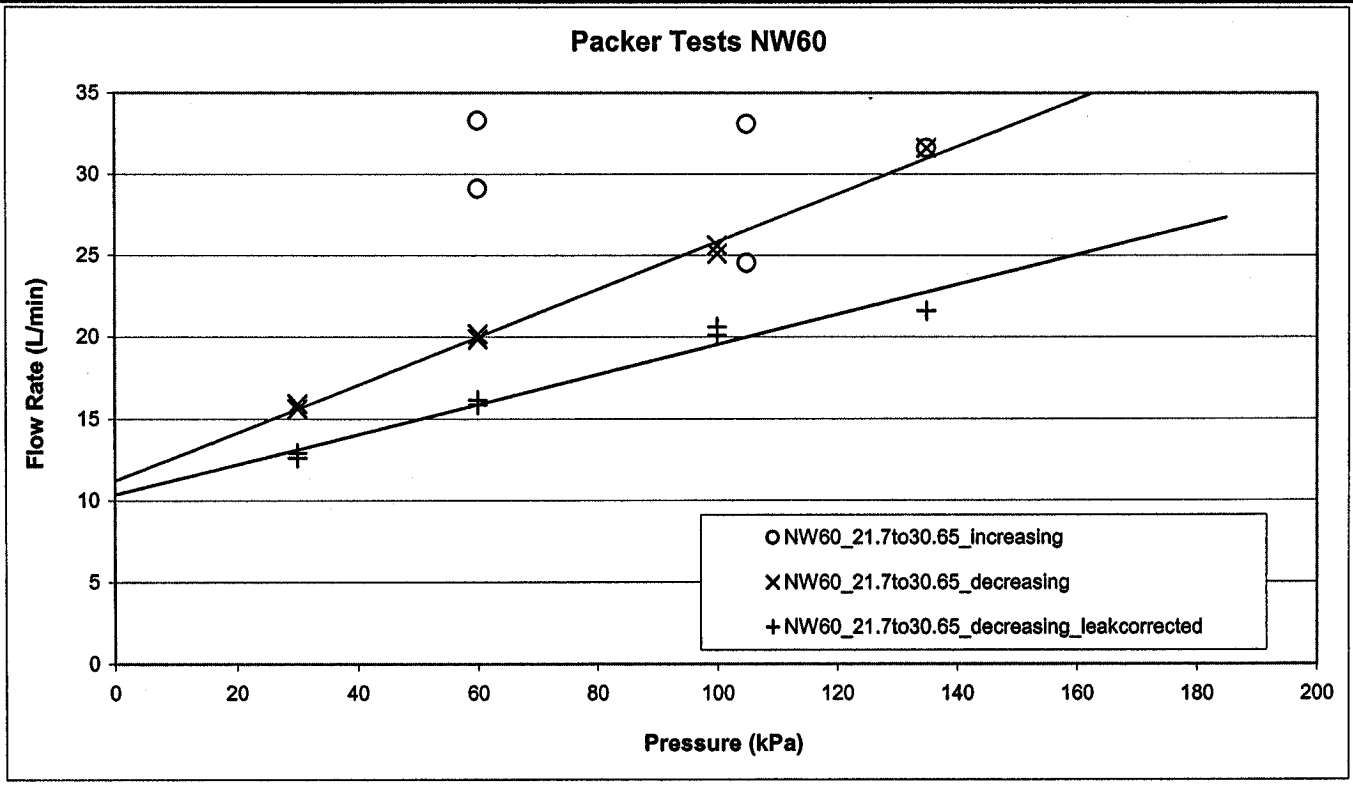
Permeability Testing NW60

Bore	NW60		
Packer Configuration	double		
Depth Interval	21.7	30.65	metres
Distance Gauge Above Ground	1.5		metres
Length of Packer	8.95		metres

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
60	288	97.79	97.8233	33.3	60	33.300	4.0	29.300
60	288	97.8233	97.8524	29.1	60	29.100	4.0	25.100
105	333	97.873	97.9061	33.1	60	33.100	5.0	28.100
105	333	97.9061	97.947	40.9	100	24.540	5.0	19.540
135	363	98.03	98.0616	31.6	60	31.600	10.0	21.600
100	328	98.074	98.0996	25.6	60	25.600	5.0	20.600
100	328	98.109	98.1341	25.1	60	25.100	5.0	20.100
60	288	98.144	98.16385	19.85	60	19.850	4.0	15.850
60	288	98.16385	98.184	20.15	60	20.150	4.0	16.150
30	258	98.197	98.2126	15.6	60	15.600	3.0	12.600
30	258	98.2126	98.2285	15.9	60	15.900	3.0	12.900

Leak approximately 5 to 10 L/min when gauge pressure at 135 kPa (total pressure equals 363 kPa).
Leak flow no longer overfilled bore for lesser pressures, therefore >5L/min leak difference b/w 100 and 135 kPa
Assume values based on this observation

	Total Flow	Effective Flow	
Gradient	0.146289212	0.091813313	L/min/kPa
Flow per metre at 1000 kPa	16.3	10.3	L/Min/metre @1000kPa (Lugeons)
	0.000163452	0.000102585	cm/sec
Permeability	0.141	0.089	m/day



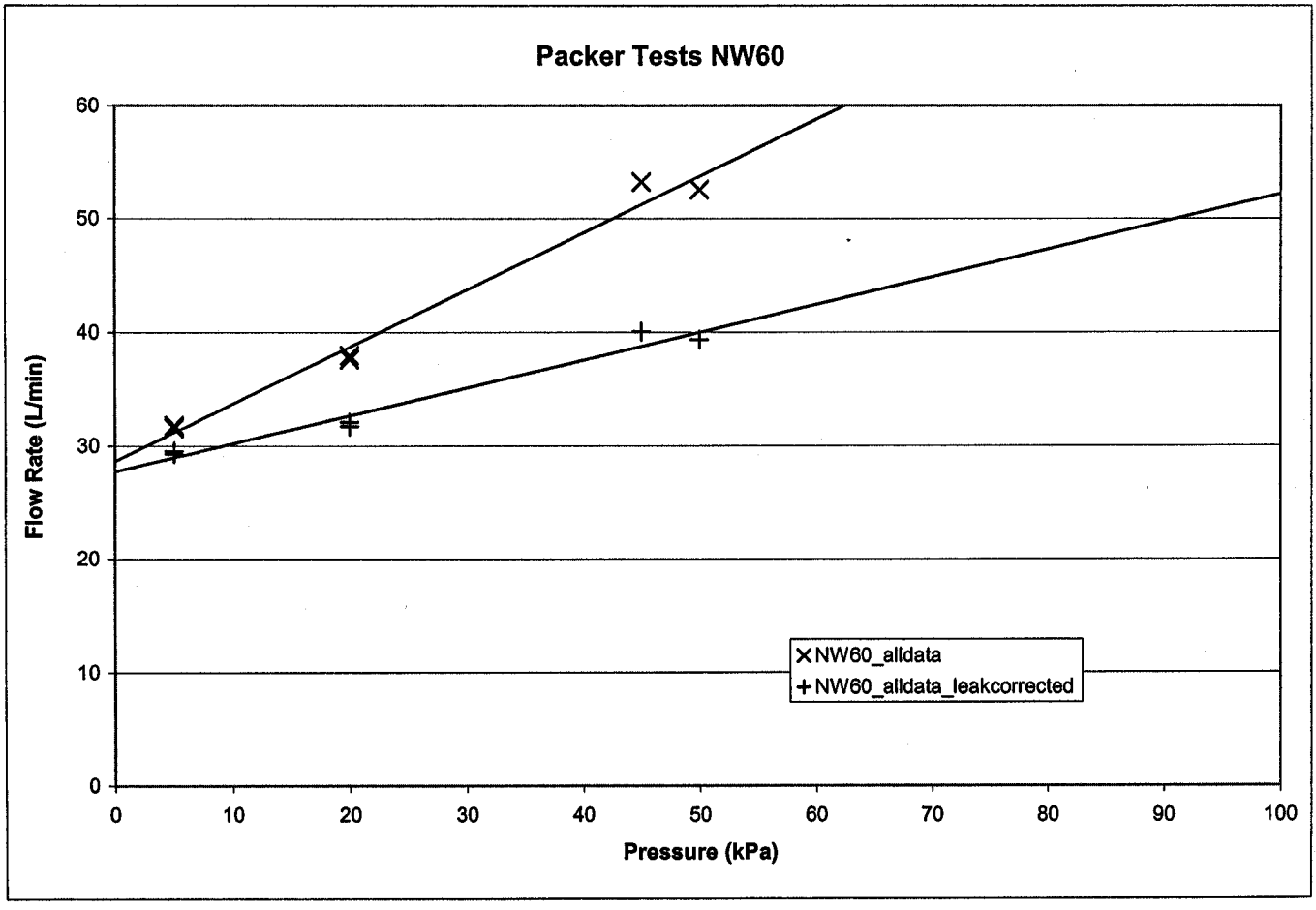
Permeability Testing NW60

Bore	NW60			
Packer Configuration	double			
Depth Interval	15.7	24.65	metres	
Distance Gauge Above Ground	1.5		metres	
Length of Packer	8.95		metres	

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
45	214	98.582	98.7417	159.7	180	53.233	13.2	40.033
50	219	98.7417	98.8468	105.1	120	52.550	13.2	39.350
20	189	98.882	98.9579	75.9	120	37.950	5.9	32.070
20	189	98.971	99.0462	75.2	120	37.600	5.9	31.720
5	174	99.064	99.1166	52.6	100	31.560	2.3	29.295
5	174	99.13	99.1618	31.8	60	31.800	2.3	29.535

Leak flow rates measured with v-notch weir

	Total Flow	Effective Flow	
Gradient	0.501048255	0.244394393	L/min/kPa
Flow per metre at 1000 kPa	56.0	27.3	L/Min/metre @1000kPa (Lugeons)
	0.00055983	0.000273066	cm/sec
Permeability	0.484	0.236	m/day



Permeability Testing NW60

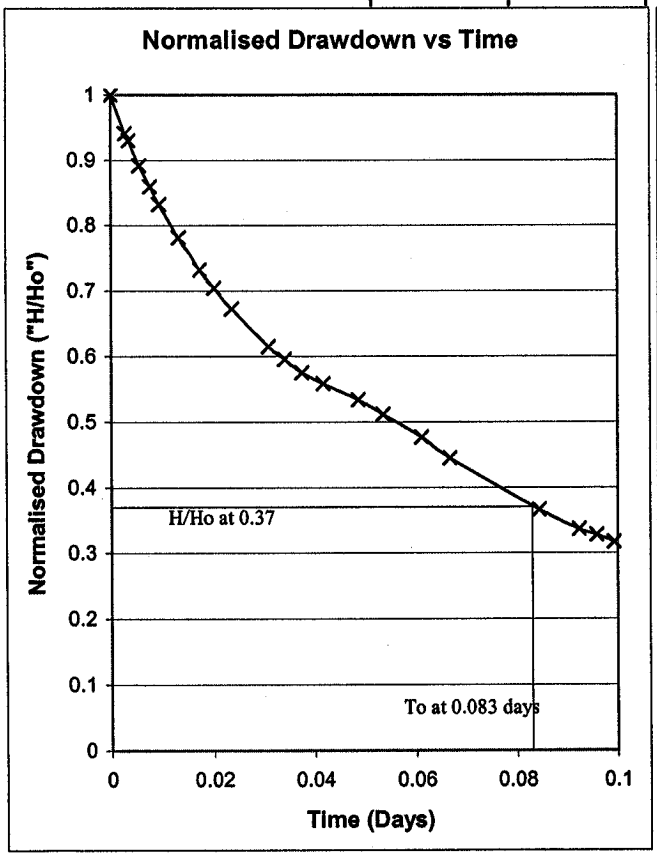
Falling Head Test - NW60

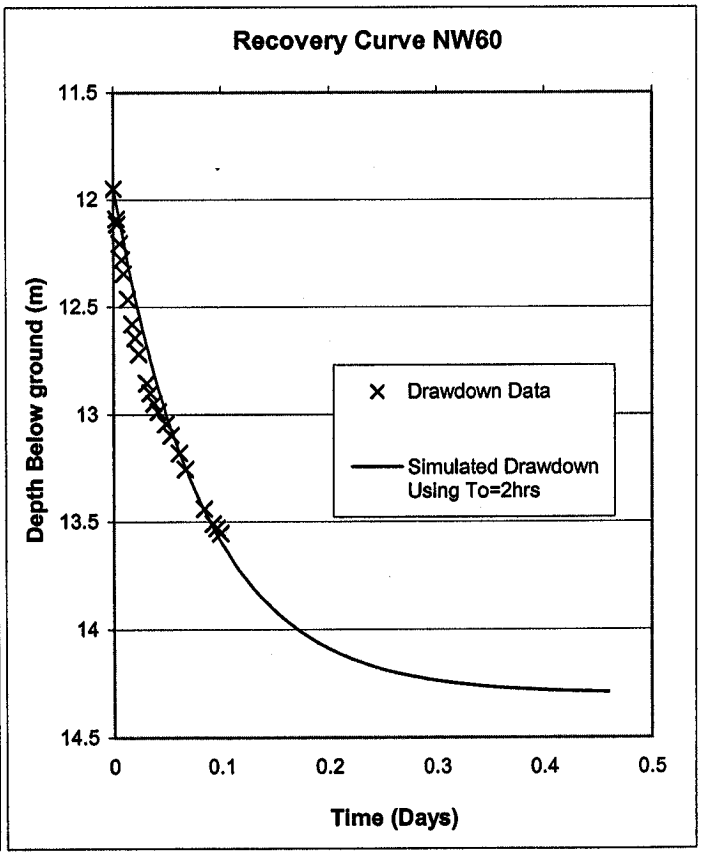
Date and Time	Elapsed Time (Days)	Dip Reading (m BGL)	Normalised Drawdown ("H/Ho")
4/11/2004 15:17:00	0	11.95	1
4/11/2004 15:21:00	0.0027778	12.09	0.94042553
4/11/2004 15:22:00	0.0034722	12.115	0.92978723
4/11/2004 15:25:00	0.0055556	12.205	0.89148936
4/11/2004 15:28:00	0.0076389	12.28	0.85957447
4/11/2004 15:30:30	0.009375	12.345	0.83191489
4/11/2004 15:36:00	0.0131944	12.465	0.78085106
4/11/2004 15:42:00	0.0173611	12.58	0.73191489
4/11/2004 15:46:00	0.0201389	12.645	0.70425532
4/11/2004 15:51:00	0.0236111	12.72	0.67234043
4/11/2004 16:01:30	0.0309028	12.855	0.61489362
4/11/2004 16:06:00	0.0340278	12.9	0.59574468
4/11/2004 16:11:00	0.0375	12.948	0.57531915
4/11/2004 16:17:00	0.0416667	12.988	0.55829787
4/11/2004 16:27:00	0.0486111	13.045	0.53404255
4/11/2004 16:34:00	0.0534722	13.098	0.51148936
4/11/2004 16:45:00	0.0611111	13.18	0.47659574
4/11/2004 16:53:00	0.0666667	13.255	0.44468085
4/11/2004 17:18:30	0.084375	13.44	0.36595745
4/11/2004 17:30:00	0.0923611	13.51	0.33617021
4/11/2004 17:35:00	0.0958333	13.53	0.32765957
4/11/2004 17:40:00	0.0993056	13.555	0.31702128
6/11/2004 8:20	1.7104167	14.3	0

radius	0.025 m
Bore R	0.049 m
Screen	24 m
Time Lag	0.0833 days

$$K = \frac{r^2 \ln\left(\frac{L}{R}\right)}{2LT_0}$$

K 0.00097 m/day





Permeability Testing NE60

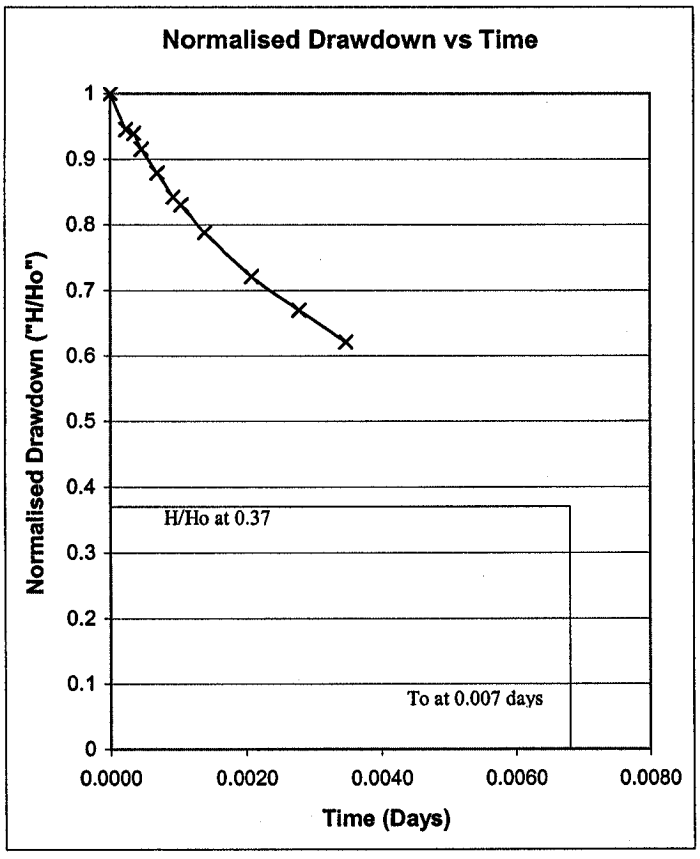
Rising Head Test - NE60

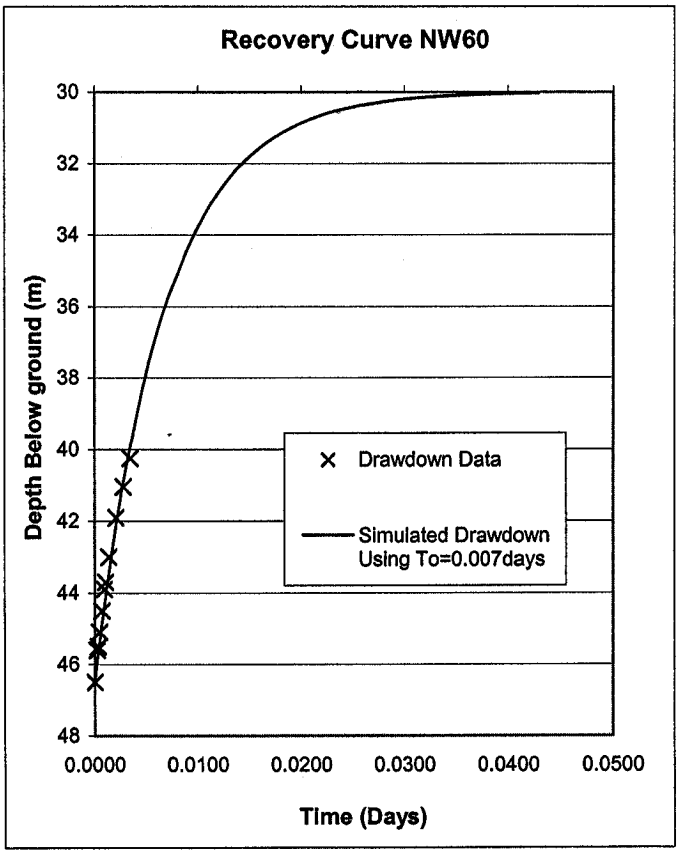
Date and Time	Elapsed Time (Days)	Dip Reading (m BGL)	Normalised Drawdown
6/11/2004 16:30:00	0.0000	46.5	1
6/11/2004 16:30:20	0.0002	45.6	0.94545455
6/11/2004 16:30:30	0.0003	45.5	0.93939394
6/11/2004 16:30:40	0.0005	45.1	0.91515152
6/11/2004 16:31:00	0.0007	44.5	0.87878788
6/11/2004 16:31:20	0.0009	43.9	0.84242424
6/11/2004 16:31:30	0.0010	43.7	0.83030303
6/11/2004 16:32:00	0.0014	43	0.78787879
6/11/2004 16:33:00	0.0021	41.9	0.72121212
6/11/2004 16:34:00	0.0028	41.05	0.66969697
6/11/2004 16:35:00	0.0035	40.25	0.62121212

total drawdown	16.5
radius	0.049 m
Bore R	0.049 m
Screen	30 m
Time Lag	0.006 days

$$K = \frac{r^2 \ln\left(\frac{L}{R}\right)}{2LT_0}$$

K 0.04280 m/day



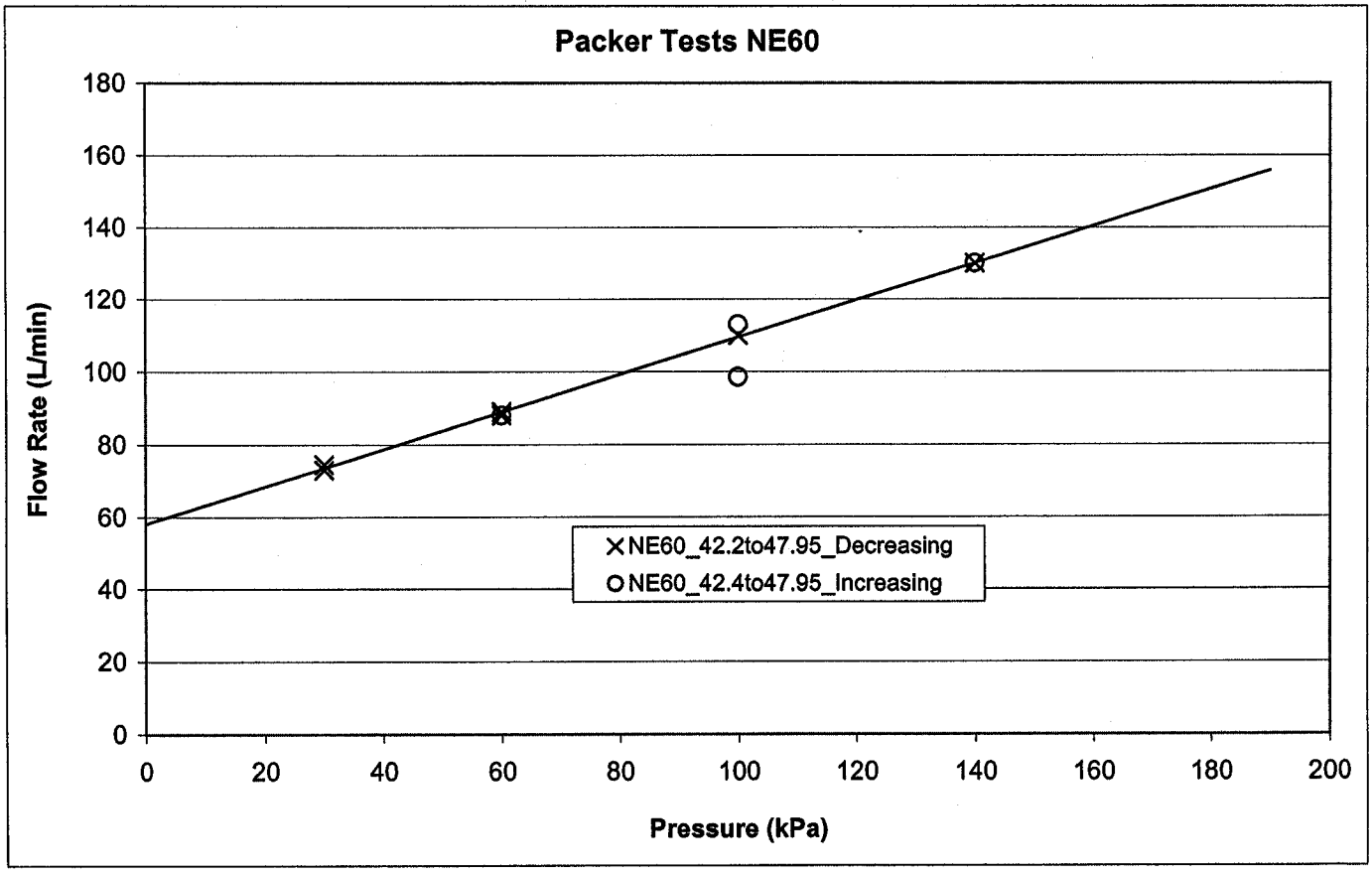


Permeability Testing NE60

Bore	NE60			
Packer Configuration	double			
Depth Interval	42.2	47.95	metres	
Distance Gauge Above Grou	1.5		metres	
Length of Packer	5.75		metres	

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
60	489	102.39	102.566	176	120	88.000	0	88.000
100	529	102.64	102.753	113	60	113.000	0	113.000
100	529	102.753	102.8515	98.5	60	98.500	0	98.500
140	569	102.95	103.08	130	60	130.000	0	130.000
100	529	103.14	103.25	110	60	110.000	0	110.000
60	489	103.29	103.379	89	60	89.000	0	89.000
60	489	103.379	103.467	88	60	88.000	0	88.000
30	459	103.5	103.5745	74.5	60	74.500	0	74.500
30	459	103.6	103.673	73	60	73.000	0	73.000

	Total Flow	Effective Flow	
Gradient	0.498511294	0.498511294	L/min/kPa
Flow per metre at 1000 kPa	86.7	86.7	L/Min/metre @1000kPa (Lugeons)
	0.000866976	0.000866976	cm/sec
Permeability	0.749	0.749	m/day

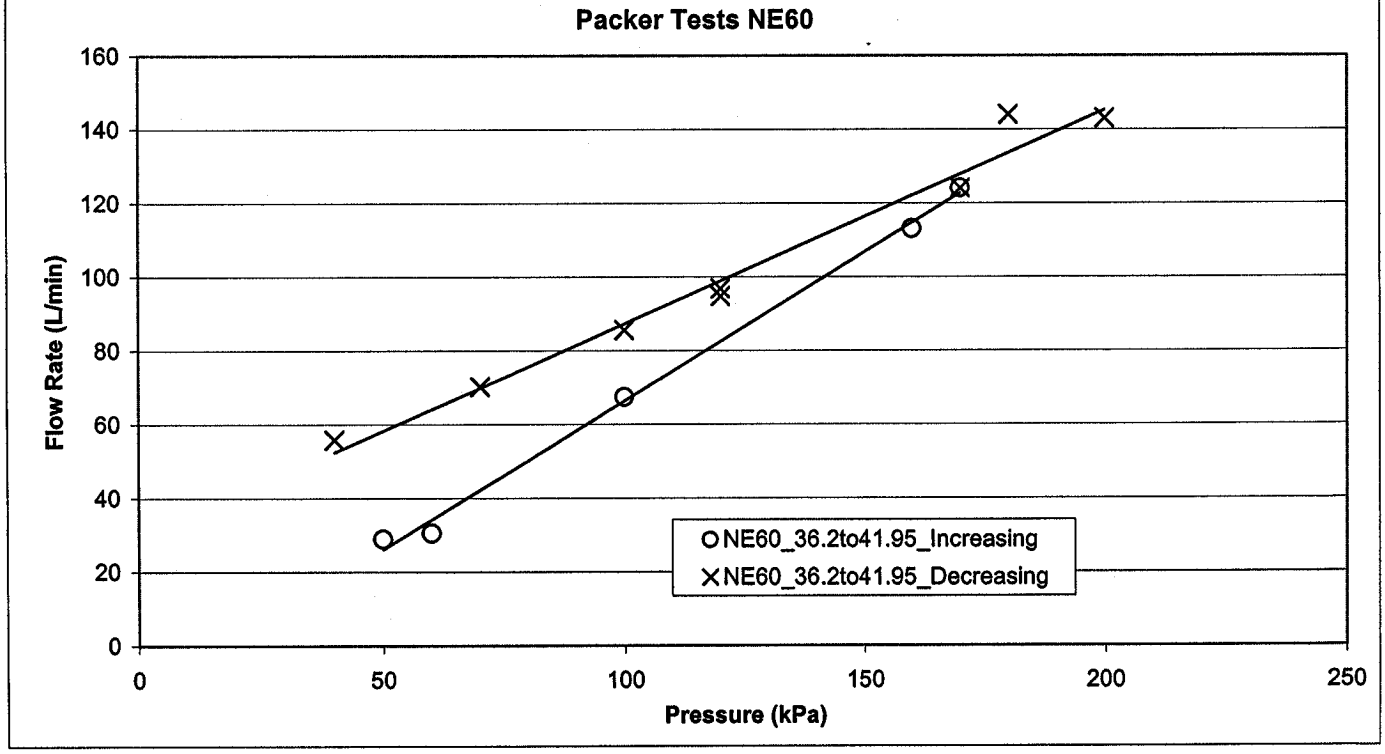


Permeability Testing NE60

Bore	NE60		
Packer Configuration	double		
Depth Interval	36.2	41.95	metres
Distance Gauge Above Grou	1.5		metres
Length of Packer	5.75		metres

Gauge Pressure (kPa)	Total Pressure at Upper Packer (kPa)	Meter In (m3)	Meter Out (m3)	Volume into Bore (L)	Elaspsed Time (secs)	Flow Into Bore (L/min)	Leak Flow (L/min)	Effective Flow (L/min)
50	479	103.9172	103.949	31.8	66	28.909	0	28.909
60	489	103.96	103.9905	30.5	60	30.500	0	30.500
100	529	104.035	104.136	101	90	67.333	0	67.333
160	589	104.205	104.318	113	60	113.000	0	113.000
170	599	104.435	104.497	62	30	124.000	0	124.000
120	549	104.55	104.6468	96.8	60	96.800	0	96.800
120	549	104.6468	104.7415	94.7	60	94.700	0	94.700
100	529	104.7845	104.87	85.5	60	85.500	0	85.500
70	499	104.9078	104.978	70.2	60	70.200	0	70.200
40	469	105.009	105.0648	55.8	60	55.800	0	55.800
200	629	105.11	105.1815	71.5	30	143.000	0	143.000
180	609	105.1815	105.2535	72	30	144.000	0	144.000

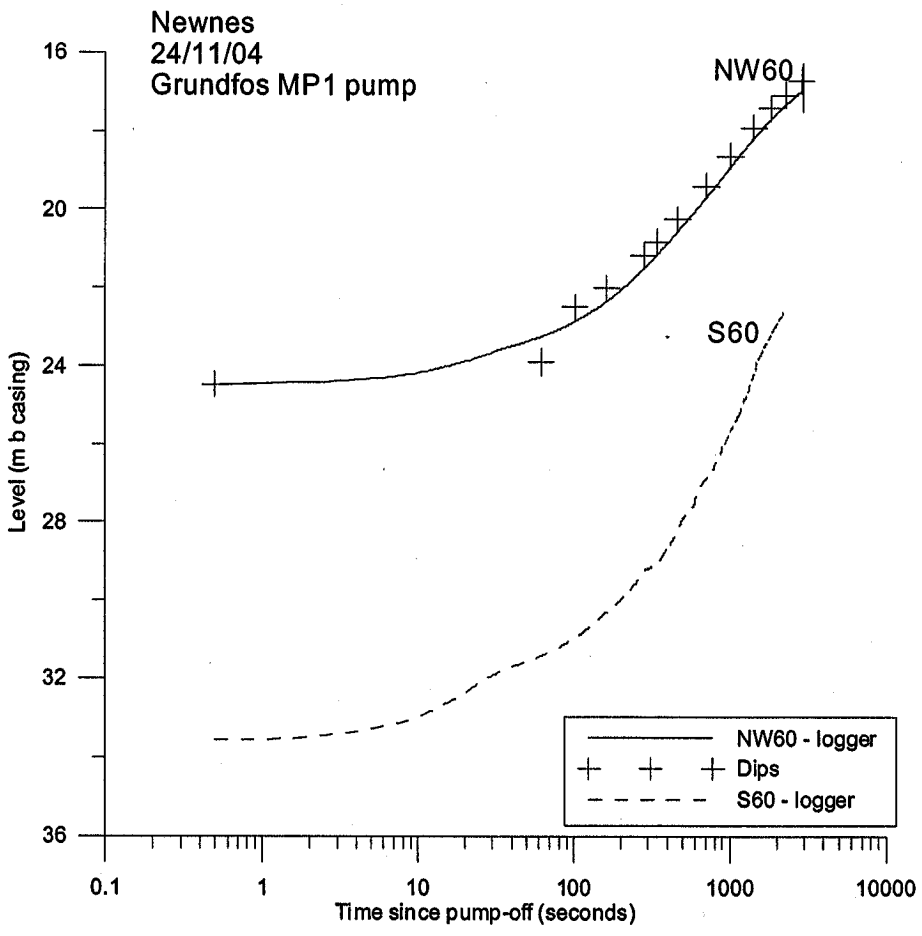
	Total Flow - Increasing	Total Flow - Decreasing	
Gradient	0.804935347	0.579907407	L/min/kPa
Flow per metre at 1000 kPa	139.988756	100.9	L/Min/metre @1000kPa (Lugeons)
Permeability	0.001399888	0.001008535	cm/sec
	1.210	0.871	m/day



RECOVERY DATA ANALYSIS

After sampling on 24/11/04
Pumped with Grundfos MP1
Hydraulic conductivity calculated with equations 2 & 3
D = 0.098 m

Location	Interval (m depth)	Pump rate (L/min)	SWL (m BG)	SWL pump (m BG)	Screen length L (m)	K (m/day)
NW 60	24 to 60	10.4	14.4	24	36	0.046
					18	0.084
NE 60	51.4 to 60	4.5	42.4	51.4	5	0.11
					8.6	0.073
S 54	36 to 54	6.3	17.6	33.1	12	0.03
					21	0.02



SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT I

Soil and Water Management Plan

GSS Environmental

October 2004

F I N A L R E P O R T

Soil and Water Management Plan (SWMP)

Newnes Junction Sand & Kaolin Extraction Project

Newnes Junction, NSW.



Prepared for

Sydney Construction Materials Pty Ltd

Dr Ron Goldbery
Director
Suite 504, Level 5
37 Bligh St.,
SYDNEY, NSW, 2000

30 October 2004.

Project Ref: SCM 1-1

DOCUMENT CONTROL SHEET

***Project No.*:** SCM 1-1

***Title*:** **Soil & Water Management Plan –**
Newnes Junction Sand & Kaolin Extraction Project

***Project Manager*:** Rod Masters

***Author*:** GSS Environmental

***Client*:** Sydney Construction Materials

***Client Contact*:** Dr Ron Golbery

ISSUE AND AMENDMENT CONTROL HISTORY

Issue	Date	Description	By	Checked
# 1 (Draft)	27/08/04	Issued for comment	Rod Masters	Craig Bagnall
# 2 (Draft)	23/09/04	Issued for comment	Rod Masters	Craig Bagnall
# 3 (Final)	30/10/04	Final	Rod Masters	Craig Bagnall

Distribution:

Master: GSS Environmental
Copies 1 to 6: Dr Ron Goldbery

SOIL & WATER MANAGEMENT PLAN

Sydney Construction Materials

Newnes Junction Sand & Kaolin Extraction Project, Newnes Junction, NSW.

Exploration Licence 4192 (EL4192)

Prepared by:

GSS Environmental
PO Box 3214,
WAMBERAL, NSW 2260.

CONTENTS

I) PURPOSE OF THE REPORT 6

II) ACKNOWLEDGEMENTS 6

1. INTRODUCTION 7

1.1 Project Overview and Location 7
1.2 Objectives 8

2.0 NATURE OF THE DEVELOPMENT 8

3.0 EXISTING SITE CONDITIONS 9

3.1 Geology 9
3.2 Soils 9
3.3 Vegetation 10
3.4 Site Topography and Surface Hydrology 11
3.5 Land Capability 12
3.6 Existing, Neighbouring and Future Land Use 12
3.7 Receiving Waters & Surface Water Quality 13
3.8 Groundwater 14
3.9 Climate 15

4.0 PROPOSED DEVELOPMENT 17

4.1 Site Preparation Stage 17
4.2 Stage One 18
4.3 Stage Two 19
4.4 Stage Three 19
4.5 Stage Four 20
4.6 Surface Water Flow Changes 20
4.7 Water Demand and Water Balance 20

5.0 EROSION AND SEDIMENT CONTROL 21

5.1 Minimal Disturbance 22
5.2 Management of Soil Stockpiles 23
5.3 Clean Water Diversion Works 24
5.4 In-Pit Water Management 24
5.5 Quarry Haul Roads 25
5.6 Sediment Control 26
5.6.1 Design of the Main Retention Pond 26
5.6.2 Design of the Lower Retention Pond 28
5.6.3 Water Treatment Plant 28
5.6.4 Additional Erosion & Sediment Controls 29
5.7 Maintenance Area 30

6.0 REVEGETATION 30

6.1 Roads and Infrastructure Areas 31
6.1.1 Conservation and Re-spreading of Topsoil 31
6.1.2 Scarification 32
6.1.3 Hydromulching 32
6.2 Active Quarry Disturbance Areas 33
6.2.1 Progressive Rehabilitation Strategy and Objectives 33
6.2.2 Surface Preparation 36
6.2.3 Direct Seeding 36
6.2.4 Scheduling of Works 37
6.2.5 Final Land Use 37
6.2.6 Fencing and Weed Control 39
6.2.7 Maintenance 39

7.0 OPERATION AND MONITORING 40

7.1 Maintenance of Surface Water Controls 40
7.2 Surface Water Monitoring 40
7.3 Rehabilitation Monitoring 40
7.4 Reporting & Review 40

8.0 WORKFORCE TRAINING & AWARENESS 41

9.0 REFERENCES 41

i) PURPOSE OF THE REPORT

GSS Environmental (GSSE) has been engaged by Sydney Construction Materials (SCM) to develop a comprehensive *Soil & Water Management Plan* (SWMP) for the Newnes Junction Sand & Kaolin Extraction Project. This plan addresses in detail all aspects of soil disturbance, erosion prevention, soil storage and movement, retention of any mobilised sediments and soil-related aspects of water management on and off the site. The plan is intrinsically related to the *Surface Water Management Plan* for the development prepared by Hughes Trueman Pty Ltd.

In addition, the report sets out to address the specific requirements identified by the various government agencies and as outlined in the Director General's Requirements provided by the Department of Infrastructure, Planning and Natural Resources (DIPNR), including specific requirements by (the former) National Parks & Wildlife Service, now part of Department of Environment & Conservation (DEC).

The following *SWMP* has been formulated by GSSE in accordance with the NSW Department of Housing's "*Managing Urban Stormwater: Soils and Construction Manual*" (2004) or the "Blue Book" as it is known in government circles.

ii) ACKNOWLEDGEMENTS

GSSE wishes to acknowledge the following significant references specifically prepared for this development:

- *Surface Water Management Plan* (Hughes Trueman Pty Ltd, May 2004); and
- The *Environmental Impact Statement (EIS)* for the development (International Environmental Consultants Pty Ltd, April 2003).

Information and designs developed within these documents have been integrated into this SWMP.

1. INTRODUCTION

The following section of the report provides a general project overview, including the location of the site and the scale of the proposed development.

1.1 Project Overview and Location

Newnes Kaolin Pty Ltd, (trading as Sydney Construction Materials) has proposed to develop an open pit quarry operation on Exploration Lease EL4192 to extract and primary crush high quality friable sandstone at Newnes Junction, some 10km east of Lithgow NSW. A location plan is provided in this SWMP as **Figure 1**. The proposed development is located adjacent to three existing extractive industries, being the Clarence Colliery and Pioneer sand quarry to the north and northwest respectively, and the Rocla sand quarry to the south, as shown on **Figure 1**. With total estimated reserves of over 20Mt, the pit life is expected to exceed 21 years. Approximately 1.1Mt per annum will be extracted on average, with a maximum expected of 1.4Mt p.a. Areas adjacent the quarry have been extensively quarried/mined for construction sands and coal. The major components of the proposed development proposal are described further in **Section 4** below.

An Environmental Impact Statement (EIS) for the development was prepared by International Environmental Consultants Pty Ltd (IEC) and lodged with DIPNR in May 2003. In response to comments by various regulatory authorities requesting further information to address certain issues for the EIS, a SWMP has since been developed by Hughes Trueman Pty Ltd (May, 2004). A significant component of the water management system is the control of sediment within the quarry area. The issues of erosion / sediment control and rehabilitation of the site, contained in the Surface Water Management Plan have been extended by GSSE to form the SWMP. The principle underlying design criteria heavily influencing both of these plans**,** as set by the proponents, is that **there will be no uncontrolled discharge of water from the site whatsoever.** A revised extraction program and significant water management modifications (including two retention ponds and a water treatment plant) for the development to achieve this objective were subsequently described in detail in the Hughes Trueman document. This SWMP incorporates these robust modifications.

The quarry operation will be located on the ridgeline between the Rocla Quarry (adjacent to the south) and the Clarence Colliery pit top (adjacent to the northwest). The proposed disturbance area is approximately twenty five (25) hectares. Bordering the east of the site is the Blue Mountains National Park (BMNP), which is part of the Greater Blue Mountains World Heritage Area, containing the headwaters of the Wollangambe and Coli Rivers wilderness areas. The proximity to, and importance of, the BMNP has been a driver for conservative and sustainable water and soil management for the development. Indeed, this resulted in the principle underlying design criteria set by the proponents that, to protect potential receiving waters, there will be no uncontrolled discharge of water from the site whatsoever.

An aerial photograph showing the location of the quarry in a regional context is included in this SWMP as **Plate 1**.

On 19 August 2004, Rod Masters from GSS Environmental conducted an inspection of the site in order to prepare this SWMP.

1.2 Objectives

This SWMP proposes erosion and sediment control measures and revegetation protocols designed to:

- Minimise erosion processes;
- Minimise sediment-laden ("dirty water") runoff into retention ponds that may require subsequent treatment by a water treatment plant prior to off-site release;
- Minimise maintenance costs for sustainable operation and closure of the quarry;
- Progressively revegetate and rehabilitate the active working quarry area to blend with the local environment.

2.0 NATURE OF THE DEVELOPMENT

The development as described in the EIS (IEC, 2003), and revisions/additions described in the Surface Water Management Plan (Hughes Trueman, 2004), result in a staged development of the quarry as described in detail in **Section 4** of this plan. In summary, the proposed development will essentially consist of the following elements:

- An open cut pit development, using accurate surface mining technology to achieve a 1% pit floor crossfall drainage (infall) to retain all dirty water onsite for treatment and prevent any uncontrolled drainage offsite;
- Water quality controls - major dirty water retention (expanding in proportion with staged extraction and exposed surface of the quarry) and a water treatment plant for capture of any residual solids;
- A small primary crushing operation;
- Conveyors;
- Stockpiles;
- A train-loading facility; and
- Site office and amenities for approximately 10 staff.

The revised quarry plan utilizes a surface miner as the primary extraction unit and scrapers to deliver the material to the stockpiling area. A key feature of this method is the ability to slope the pit floor very accurately which will facilitate *in-pit drainage*, creating a graded surface that slopes at approximately 1% in a westerly direction towards the back of the pit throughout the extraction and rehabilitation processes, except for the final phase of Stage 4 when the slope will be reversed in preparation for the final landform. As the excavation expands, final slope batters and berms are formed and *progressively rehabilitated*. The extraction method also allows for windrowed material to remain in pit, where required, in order to contain runoff as well as reduce runoff velocity.

The proposed surface water management works will also be capable of retaining all runoff from storms in excess of the 100year average recurrence interval (ARI), 72 hour duration storm. As such, there will be no uncontrolled discharge from the site during operational and rehabilitation phases of the project. Any discharge will only be by means of controlled flow from the water treatment plant. Further details on the staging of the quarry's development are contained in **Section 4** of this plan.

3.0 EXISTING SITE CONDITIONS

The following section of the report outlines the existing conditions of the proposed site. It includes reference to geology, soils, vegetation, topography, drainage, receiving surface waters and groundwater. It also includes some detail on climate, with particular reference to rainfall and the impacts that this has on the management of water across the site.

3.1 Geology

In regional geology terms, the material sequence being quarried belongs to the Triassic Narrabeen Group that overlies the Permian Illawarra Coal Measures of the Sydney Basin. The site forms part of the *Banks Wall Sandstone* in what are known generally as the Newnes Plateau Sandstones. The rock types consist of non-marine fluviatile sediments (sandstones) with some claystones and shales.

3.2 Soils

The soils of the proposed site comprise, in the main, of a very shallow (<0.30m) cover of poor quality, sandy loam over most of the proposed kaolin mining area. The soils of EL4192 are generally very sandy, shallow and well drained, supporting open woodland vegetation. The sub-strata across the site is predominately weathered, medium-grained, cream to white sandstone. The sandstones at Newnes are soft and break readily with relatively little energy to disaggregate into kaolin, silica sand and fine silica. The *Banks Wall Sandstone* sequence is comprised of around 50-80% quartz and 5-30% clay, with a small percentage of lithic fragments. It typically contains approximately 20% of clay and silt sized (75µm) material which is comprised primarily of kaolinitic clays and a small proportion of fine silica, mica, and iron oxide. The 'kaolin fraction' includes very fine silica minerals sized at <10µm.

A characteristic of the sandstone within the project area is that it forms a thin hardened crust, but rarely exceeding a few mm, and mantles friable, crumbly sandstone with a clay matrix of kaolin and an overall absence of ironstone crusts. Soils derived from the friable sandstone are low fertility sandy soils with a moderate to extreme erosion hazard. They consist of sandy yellow loams with a brown to yellow sub soil, with no distinct differentiation between topsoil and underlying weathered sandstone.

Within the proposed mining lease area, two soil landscapes occur; the Medlow Bath and Wollangambe Soil Landscapes. The Medlow Bath soils are found across the majority of the site on the higher and flatter slopes, while the Wollangambe soils occur on the steeper slopes toward the eastern edge of the site.

- The Medlow Bath soils occur on narrow crests and moderately inclined sideslopes (typically 10-20%), and are characterised by localised rock outcrops supporting partially cleared open forest and open woodland. The soils on crests are generally shallow (<0.40m) organic rich sands overlying either bedrock or well-drained earthy sands (<0.8m deep). On the side slopes there tends to be modereately deep (<1.0m) yellow earths and earth sands. Associated with the rock outcrops are shallow (<0.06m) Lithosols/Siliceous sands.

- The Wollangambe soils landscapes consist of rounded convex crests and moderately to steeply inclined side slopes (typically <35%) on Narrabeen Group sandstones. Localised rock outcrops are common, including broken scarps, small rock ledges and cliffs. On the crests soils are shallow (<0.3m) siliceous sands/lithosols, earthy sands, yellow earths and red earths. Shallow siliceous sands / lithosols occur on rock ledges and low broken scarps.

3.3 Vegetation

The vegetation communities at the site can be generally described as open eucalypt woodland. Only one flora community was identified within the study area by investigations for the EIS (IEC, 2003). This was the *Silvertop Ash – Sydney Peppermint Forest*. The vegetation is dominated by the Sydney Peppermint (*Eucalyptus piperita*), with Silvertop Ash (*Eucalyptus sieberi*) being less abundant on the site. In the northwest corner of the site the dominant Sydney Peppermint is replaced by the dominating Scribbly Gum (*Eucalyptus sclerophylla*).

Understory species do not show a corresponding change with the above change in the dominating canopy species, a pattern that is observed within the Silvertop Ash - Sydney Peppermint Forest, and is therefore not considered as a separate vegetation unit.

The site shows evidence of severe impact by the 1997 wildfire (bushfire) that swept across the Newnes Plateau. The degree of disturbance and resulting re-emergence and regeneration of the canopy varies across the site, although there is abundant seedling development of the upper canopy species.

The lower strata flora (shrub and ground layer understorey plants) is fairly low in diversity, being dominated by a few species, which may be due to the fire. Weed species are not common. As described by the EIS (IEC, 2003), flora species found at the site in both the understorey layers and the upper canopy are described in **Table 1** below.

No *threatened* flora, as defined under both the NSW *Threatened Species Act* (1995) and the Federal *Environment Protection and Biodiversity Conservation Act* (1999), were identified on the site by the EIS investigations (IEC, 2003). However, the EIS compiled a list of Flora Species of Conservation Significance that can found in the surrounding region, as shown in **Table 2** below. Further details on the character and known distribution for each species listed in Table 2 can be found in section 5.6.4 of the EIS (IEC, 2003). Subsequent work carried out by Gunninah Environmental Consultants (2004) in the period following the submission of the EIS conferred the findings of the EIS that there are no threatened or endangered species on the proposed quarry site. Furthermore, it was established that riparian environments containing small patches of swampy vegetation do not have the characteristic features of Newnes Plateau Swamp (HWR, 2004) (White, 2004).

Appropriate species from both of these two lists in **Tables 1** and **2** respectively have been considered for quarry revegetation as described in **Section 6**. of this plan. Species proposed for use in the revegetation program are also marked with an asterisk (*) in **Tables 1** and **2** below.

TABLE 1: **Dominant Flora at the Site** (IEC, 2003)

Flora Strata	Genus/Species	Common Name
Upper Canopy	*Eucalyptus piperita**	Sydney Peppermint
	*Eucalyptus sieberi**	Silvertop Ash
	*Eucalyptus sclerophylla**	Scribbly Gum
Shrub Layer	*Lomatia silaofolia**	Crinkle Bush
	*Daviesia latifolia**	Broad-leaf Bitter-pea
	Platysace minearifolia	Narrow-leaf Bitter-pea
	*Banksia spinulosa**	Hairpin Banksia
	Boronia microphylla	Small-leaved Boronia
	*Acacia terminalis**	
	*Epacris pulchella**	
	*Telopea spesiosissima**	Waratah
Ground Layer	*Mirbelia platylobioides*	
	Phyllota squarrosa	
	*Dampiera stricta**	Blue Dampiera
	Goodenia dimorpha var. dimorpha	
	Grevillea laurifolia	
	Patersonia glabrata	Leafy Purple-flag

* = proposed for potential use in revegetation at the site as described later in this plan.

TABLE 2: **Species of Conservation Significance in the Surrounding Region** (IEC, 2003)

Genus/Species	Potential Habitat	Conservation Status
*Acacia byoeana**	Heath / Woodland	V
*Acacia flocktoniae**	Forest	N(v)
Almaleea incurvata	Swamp	E
Apatophyllum constablei	Forest	E
Boronia deanei	Swamp	V
Caladenia tessellata	Widespread	N(v)
Derwentia blakelyi	Forest	V
Diuris aequalis	Forest	N(v)
*Eucalyptus pulverulenta**	Rocky Outcrops	N(v)
Haloragodendron lucasii	Forest / Woodland	E
Persoonia acerosa	Forest	V
Persoonia marginata	Forest	V
*Prostanthera cryptandroides**	Forest	V
*Pultenaea glabra**	Forest/Shrub	N(v)
Thesium australe	Widespread	N(v)

V = *Vulnerable* under NSW legislation
E = *Endangered* under NSW legislation
N = Listed as Endangered (e) or Vulnerable (v) under Federal legislation
* = proposed for potential use in revegetation at the site as described later in this plan.

3.4 Site Topography and Surface Hydrology

The proposed site is located in relatively steep topography and elevation of the site ranges from 1090m in the western area of the site to 1010m AHD toward the east. The hill and ridge system that contains the site forms part of a catchment which generally drains eastward across the site toward the Wollangambe River located in the Blue Mountains National Park, and whilst there are no major watercourse through the site there are minor ephemeral creek drainage lines to the northeast and southeast of the site which are shown in **Figure 1**. The catchment areas of these two ephemeral creeklines are about 30 hectares (northern drainage line) and 16 hectares (southern drainage line). The northern drainage line flows into the

Wollangambe River approximately 400m from the site tributary, and the southern drainage line flows into another tributary of the Wollangambe River before joining the river about 1.5km from the site. As such, potential impact to the river is more sensitive via the northern drainage line due to its closer proximity. This drainage line will have the water treatment plant for the development dedicated to it.

The area supports relatively open woodland, with increased tree densities in the gullies. The two small ridges that cross the site are orientated southwest to northeast, rising to the southwest.

3.5 Land Capability

DIPNR (formerly DLWC) has classified the land in the area according to its capability for agricultural use. The classification depends on a number of factors including slope and soil fertility and results in eight (8) capability classes. Class VI comprises the least productive grazing land. In accordance with the DIPNR (formerly DLWC) classifications for land use capabilities, the EIS states that the area affected by the development falls within classification Class VI. This land is unsuitable for cultivation and has limited grazing capacity.

Following closure and rehabilitation, the land capability of the area will not alter from its current land capability. The land is currently not suited to grazing or agriculture and is best vegetated.

3.6 Existing, Neighbouring and Future Land Use

The proposed development site is situated on vacant Crown Land, vegetated with eucalyptus woodland and used primarily by local residents to access the adjacent Blue Mountains National Park. The shallow and infertile sandy soils of the site reflect very little agricultural potential.

Neighbouring land uses, identified in the EIS (2003), include:

- *Coal Mining* – industrial use of land north and northeast for the Clarence Colliery by Centennial Coal Co. for coal mining reject emplacement areas, pit top facilities and rail loading loop;
- *Sand Quarrying* – Rocla sand quarry is immediately to the south. Kable Sands is some 2km to the northwest of the Clarence Colliery, Boral formerly operated a sand quarry on the plateau nearby;
- *Recreational and Environmental Protection* – adjacent Blue Mountains National Park listed as part of the Greater Blue Mountains World Heritage Area based on eucalypt biodiversity, wilderness and cultural values;
- *Residential* – Newnes Junction village located immediately southwest of the site, consisting of six (6) dwellings;
- *Transportation Routes* – Main western railway line and the Bell Line of Road both to the south; and
- *Forestry Activities* – State Forests own extensive areas of land to the north and west of the site.

The EIS for the development proposes that the future land use of the site after closure and rehabilitation will be similar to that of the current site, but with substantially different

topography. The final land use is to be determined in consultation with relevant community and government authority bodies closer to mine closure in over twenty years. The progressive rehabilitation of the site with native vegetation will result in a final landform consisting of a terraced (benched) vegetated basin with a free draining wetland located in the base of the basin providing a habitat and conservation area.

3.7 Receiving Waters & Surface Water Quality

The hill and ridge system that contains the site forms part of a catchment that generally drains eastward into the Blue Mountains NP and the headwaters of the Wollangambe River (feeding into the Colo River and Hawkesbury system). The Wollangambe and Colo Rivers have both been recognised as 'wild and scenic' rivers under section 61 of the National Parks & Wildlife Act, 1974. These rivers are important in that they are of significant conservation value, and are popular recreation areas.

Water quality within the upper reaches of the Wollangambe River catchment (into which site waters flow) is primarily controlled by runoff from:

- Vacant Crown Land;
- Industrial areas within the catchment, including the Clarence Colliery and the Rocla sand quarry. These sites have controlled discharges into the Wollongambe system and water management systems in place to minimize their impact;
- The main western railway at the top of the ridge;
- The township of Newnes Junction, including dirt roads, septic systems and cleared areas.

The waters into which the proposed site discharges are classified as *Class P Protected Waters*. The water quality of controlled discharge would need to meet a suspended solids standard of 15mg/L i.e. sensitive water standards according to current ANZECC guidelines. There would also need to be a dilution factor of 19:1 such that discharge cannot raise background suspended solids levels by more than 15mg/L.

Water quality in the Wollangambe River is generally good, being naturally low in pH (4.5-5.5), iron, manganese and suspended solids. A summary of background water quality parameters upstream and downstream of the site are detailed below in **Table 3** provided by the EIS (IEC, 2003).

TABLE 3: **Background Surface Water Quality** (IEC, 2003)

Parameter/Analyte	Units	Upstream	Downstream
Acidity			
To pH 3.7 (as $CaCO_3$)	mg/L	<1	<
To pH 8.3 (as $CaCO_3$)	mg/L	4	4
Alkalinity			
CO_3 (as $CaCO_3$)	mg/L	<1	<1
HCO_3 (as $CaCO_3$)	mg/L	2	2
OH (as $CaCO_3$)	mg/L	<1	<1
Calcium	mg/L	1.3	0.8
Chloride	mg/L	9.0	6.0
Specific Conductance	µS/cm	31	27
Iron (total)	mg/L	0.06	0.39
Iron (filterable)	mg/L	<0.05	<0.05
Potassium	mg/L	0.9	1.4
Langelier Saturation	-	-6.7	-6.9
Magnesium	mg/L	0.7	0.4
Manganese (total)	mg/L	<0.05	<0.05
Manganese (filterable)	mg/L	<0.05	<0.05
Sodium	mg/L	4.8	2.9
pH	-	4.5	4.5
Total Sulphur (as SO_4)	mg/L	3.7	2.3
Total Dissolved Solids (TDS)	mg/L	20	15
Total Hardness (as $CaCO_3$)	mg/L	6.1	3.6
Total Suspended Soilds (TSS)	mg/L	<1	3

3.8 Groundwater

An assessment of hydrogeology for the site was undertaken as part of the EIS process (refer section 6.4.8 of the EIS (IEC, 2003) for details), which considered both hydraulic and water quality issues and potential impacts.

Groundwater onsite occurs in both primary and secondary structures in the Triassic sandstone geology and is supplied entirely by infiltration and recharge to a shallow groundwater system in the upper sandstone. This aquifer is distinct from additional and much deeper aquifer zones beyond 100-200m and more within the underlying Permian coal measure strata. Varying depths to ground water can be expected across the site ranging from 2m to 25m below ground surface (bgs). These depths are consistent with seepages in the lower lying gullies that cross the western boundary of the site. In summary, the predominant groundwater flow occurs in an easterly to norh-easterly direction with some groundwater being re-directed towards the Rocla sand quarry to the south. Beyond the main western railway line groundwater flow would be generally in a south-westerly direction toward Dargans Creek.

Existing groundwater quality from the shallow aquifer system in the area is variable, but generally very good with low to moderate salinity, low dissolved solids, generally low metals (with the exception of slightly elevated managanese which will require removal to meet discharge criteria), and variable pH typical of 'soft' water. The material to be quarried at the site is well above the aquifer used for domestic water supply to Clarence Village as well as a commercial bottled drinking water company. Expected groundwater quality is shown in **Table 4** below.

TABLE 4: **Expected Groundwater Quality** (IEC, 2003)

Parameter/Analyte	Units	Ponded Groundwater Sample 1	Ponded Groundwater Sample 2	Fresh Groundwater
Acidity				
To pH 3.7 (as $CaCO_3$)	mg/L	<1	<1	<1
To pH 8.3 (as $CaCO_3$)	mg/L	<1	4	20
Alkalinity				
CO_3 (as $CaCO_3$)	mg/L	4	<1	<1
HCO_3 (as $CaCO_3$)	mg/L	17	6	6
OH (as $CaCO_3$)	mg/L	<1	<1	<1
Calcium	mg/L	5.0	1.9	1.9
Chloride	mg/L	11.0	11.0	10.0
Specific Conductance	µS/cm	60	30	35
Iron (filterable)	mg/L	<0.05	<0.05	<0.05
Potassium	mg/L	1.5	1.4	0.9
Langelier Saturation	-	-0.4	-5.3	-0.6
Magnesium	mg/L	0.7	0.4	1.1
Manganese	mg/L	0.11	0.09	0.06
Sodium	mg/L	9.0	3.7	5.4
pH	-	9.2	5.3	4.6
Total Sulphur (as SO_4)	mg/L	3.6	1.8	8.7
Total Dissolved Solids (TDS)	mg/L	40	20	20
Total Hardness (as $CaCO_3$)	mg/L	15.5	6.6	9.2
Total Suspended Soilds (TSS)	mg/L	10	27	1350

During excavation of the pit, the shallow aquifer and local water table will be intersected, and as quarrying progresses water make will flow into pit voids. Whilst water table levels will ultimately stabilise by reaching an equilibrium when quarrying depth stabilizes at the end of quarrying, the creation of a drawdown zone during quarrying will cause groundwater flow directions to be directed toward the pit. Outside of this zone of influence groundwater flow directions will remain unaffected. It is not expected that the development will have any hydraulic effect on the Clarence Village system. Any significant drawdown influence will be restricted to within approximately 500m or so of the pit under maximum development. Final pit inflow is expected to be approximately 0.2ML/day, with a major proportion of that lost to evaporation from the high walls.

At least three groundwater monitoring sites are proposed in a westerly direction at increasing distances from the western boundary of the proposed pit, and will be established prior to development to establish background levels. A 6 week baseline monitoring period commenced in October 2004 at 3 sites within the corners of the Mining Lease Application area. Each monitoring site will consist of a shallow and deep test borehole. The aim of the initial monitoring will be to obtain accurate parameters for inclusion in the groundwater model. Samples will be analysed for major ionic constituents and water levels on a monthly basis (initially) to establish seasonal trends. Quarterly monitoring will eventuate after sufficient data are acquired and trends established.

3.9 Climate

The climate of the Newnes Plateau region is typically cool and temperate, characterised by mild summers and cold winters. It is influenced predominantly by the local topography, altitude, aspect and exposure. The rainfall is generally seasonally distributed with higher falls

occurring during the summer months, however temperature ranges, frosts, fog and snow incidence increase with increasing altitude. Frosts and snow occur from April to November.

With respect to site soil and water management issues, climatic rainfall and evaporation characteristics are described both in the EIS (IEC, 2003) and the *Surface Water Management Plan* (Hughes Trueman, 2004).

Total mean annual rainfall for Lithgow is 1070.6mm, with maximum falls during January, February and December. The months with the lowest rainfall are July and September. There is a marked seasonality in rainfall with higher rainfall in the summer months and drier conditions from April to September. Based on Australian Rainfall & Runoff (1987) data, the rainfall for the 100year ARI, 72hour duration storm event (as used for current surface water management for the development) is 4.27mm/hr. **Table 5** from the *Surface Water Management Plan* below shows the monthly rainfall (mm), including percentile distribution of the rainfall for each month.

Table 5: Monthly and Annual Rainfall and Evaporation Percentiles

Month	Rainfall (mm)				Evap
	Average	Percentile			Average
		10%	50%	90%	(mm)
1	92.9	25.4	79.8	176.4	181
2	84.3	12.1	65.6	175.3	133
3	85.1	22.1	68.8	155.8	124
4	63.9	11.6	50.6	128.7	86
5	65.1	18.1	46.8	131.2	60
6	67.4	17.5	53.3	145.4	51
7	67.9	15.0	51.3	140.3	56
8	62.9	15.9	46.6	116.5	77
9	59.4	20.4	53.5	104.7	99
10	67.2	19.5	58.9	133.6	137
11	69.6	18.0	65.4	139.2	154
12	75.6	18.6	65.2	143.6	178
Year	859	623	860	1,087	1,336

The *Surface Water Management Plan* adopted the 30 year period 1973 to 2002 for water balance modeling and surface water control (eg ponds) design purposes because both rainfall and evaporation records were available for the whole period. In order to verify that this period is representative of the longer term records a number of checks were carried out on the annual total rainfall as well as rainfall sequences from 1 day to 60 days duration. **Tables 6** and **7** summarise the statistics for these two periods. For comparative purposes Table 7 also includes the 50 and 100 year ARI rainfall estimates for Newnes Junction derived from the rainfall intensity : frequency : duration data contained in Volume 2 of "Australian Rainfall & Runoff" (1987).

Table 6: Highest Rainfall Years in the Lithgow Record

Year	Rainfall (mm)
1990	1363.1
1978	1345.0
1973	1296.5

1893	1266.0
1934	1229.9

Table 6 shows that three of the top five rainfall years at Lithgow are included in the period 1973 -2002 which has been adopted for water balance analysis.

Table 7: Maximum Cumulative Rainfall (mm) over Consecutive Days

Days of	Historic Record		Australian Rainfall & Runoff	
Rainfall	1889-2004	1973-2002	50 year ARI	100 year ARI
1	179	179	195	214
2	268	268	252	273
3	310	310	279	307
4	332	332		
5	338	338		
10	342	342		
15	359	359		
20	360	360		
30	385	385		
45	465	461		
60	595	488		

The data in **Table 7** shows two noteworthy features:

- The rainfall during the period 1973 – 2002 contains the highest periods of rainfall for durations up to 30 days that occurred in the whole historic record. In other words, the period 1973 – 2003 contains rainfall data that is representative of the wettest periods that have been recorded at Lithgow.

- For a three day rainfall event, the 1973 – 2004 historic record contains a sequence of wet days that are slightly above the three day 100 year ARI rainfall derived from "*Australian Rainfall and Runoff*". It follows that if the water management system can handle the runoff from the 1973 – 2002 historic rainfall sequence it could also cope with the 100 year ARI three day rainfall.

4.0 Proposed Development

A summary overview of the project and a list of the key aspects of the nature of development are contained in **Sections 1** and **2** of this plan, respectively. Detailed descriptions of the development proposal are contained in the EIS (IEC, 2003).

A detailed description of the revised staged extraction plan for the quarry development is described in the *Surface Water Management Plan* (Hughes Trueman, 2004), as detailed below.

4.1 Site Preparation Stage

The site preparation stage of the project is shown in **Figure 2**. This stage will involve the establishment of the site infrastructure including the following water management facilities:

- Construction of a small in-pit retention pond to collect runoff from the working surface for transfer by pumping to the main retention pond located outside the pit.
- Construction of a main retention pond (32 ML) in a location and with sufficient capacity to subsequently serve Stage 1 of the extraction process.
- Construction of a lower retention pond (10 ML) located so as to collect runoff from the haul road and maintenance facility.
- Construction of a clean water diversion channel located on the ridge above the high wall. This diversion channel will convey clean runoff from the hillside above the pit into the creek channel located towards the southern end of the final pit extremity.
- Construction of a water treatment plant capable of treating 1 ML/day to a suitable standard for discharge to the Blue Mountains National Park and for use in the village of Newnes Junction.
- Construction of a pipeline from the treatment plant to a storage tank located on the hilltop to the west of the pit. This tank will act as a reservoir for water supply to the village.
- Construction of a collection drain approximately along the 1032 m contour as shown on **Figure 2** to divert runoff from the hillside into the main retention pond for provision of water for dust suppression during the early stages of quarry development.

The water management facilities will be operated in the following manner:

- Runoff collected in the small in-pit retention pond will be pumped to the main retention pond for storage and settlement of coarse sediments. The exception to this would be in the event of an extreme rainfall event when the main retention pond was approaching full capacity. Under these circumstances, water would be allowed to temporarily pond within the working area (which will slope down from east to west at about 1% providing about 4 ML of in-pit storage at this stage). Under no circumstances would sediment laden water from the working area be transferred to the main retention pond so as to cause an overflow of untreated water from the main retention pond.
- Water in the main retention pond will be retained and pumped as required to the lower retention pond and used for dust suppression purposes or treated for use by the village, or discharged into the northern creek that drains to the Blue Mountains National Park. If the water level in the main retention pond rises above the design storage zone level (see **Section 5.6** for further details), water will be pumped for treatment and released in order to return the water level to the design storage level as soon as practicable.
- Runoff from the area of the haul road and conveyor will be collected in the lower retention pond and given first priority for use for dust suppression or treatment and re-use or discharge to the creek flowing into the World Heritage Area, according to the requirements at the time.

4.2 Stage One

Stage 1 will involve the downward excavation of the working area as product is extracted and the consequent expansion of the excavation area from an area of about 1.6 ha at the end of the Site Preparation Stage to about 10 ha at the end of Stage 1 as shown in **Figure 3**. During this stage, the water management system will remain essentially the same as for the Site Preparation Stage. The main difference will be an increase in the available storage capacity within the excavation pit to retain runoff from extreme storms to approximately 50 ML.

The proposed extraction method creates a series of windrows of excavated material as the surface miner passes over the pit floor. These windrows are then collected by a scraper which delivers the material to the stockpiling area. This process essentially creates a series of absorption banks on the leading edge of the pit. The banks will reduce runoff velocity during rainfall. They will be constructed along the contour (essentially north to south) and therefore perpendicular to the natural flow of water (east to west). The windrows will act as "contour banks" that will reduce slope lengths of uninterrupted slope and hence reduce the erosion capacity of overland flow. This will reduce the erosion potential within the working area and reduce the overall solids loading entering the retention ponds. Additional erosion and sediment controls are outlined in **Section 5.6.4** of this SWMP.

The main retention pond will be retained at a total capacity of 32 ML and the lower retention pond will be retained at a total capacity of 10 ML.

Water will continue to be drawn from the lower retention pond for dust suppression and treatment as described for the Site Preparation Stage. Similarly, water will be transferred from the in-pit retention pond to the main retention pond except when there is a risk of overflow from the main retention pond. When water level rises above the design storage zone level in the main retention pond (see **Section 5.6** for definition of zones within the retention pond) , water will be pumped for treatment and discharge to restore the water level to the designated storage level as soon as practical after a storm.

4.3 Stage Two

The configuration of the site and the water management facilities at the end of Stage 2 are shown on **Figure 4**. At the completion of Stage 2, the working area will have expanded to about 18 ha. This stage will involve the following alterations to the water management facilities:

- Construction of a new main retention pond (45 ML capacity) in the north western corner of the excavation.
- Extension of the clean water diversion channel around the southern end of the pit and then linking back to the southern creek that drains to the Blue Mountains National Park.

The enlargement of the excavation area will provide in-pit water storage capacity of approximately 220 ML in addition to the 55ML of storage capacity in the retention ponds.

The main retention pond will continue to be operated in a manner that seeks to restore the water level to the design storage level as soon as practicable after a storm.

The leading edge windrowed topsoil system will continue throughout this stage to prevent sediment leaving the site.

4.4 Stage Three

The main change to occur between the end of Stage 2 and the end of Stage 3 will be a further lowering of the working area and a corresponding increase in the excavation area to about

20.4 ha as shown on **Figure 5**. The water management facilities will remain the same as for Stage 2. The total available water storage within the pit will be about 350 ML.

4.5 Stage Four

During Stage 4 the extent of the pit will only increase slightly (by about 0.5 ha), as shown in **Figure 6**. The main changes will be the lowering of the base of the pit and the gradual reworking of the slope of the floor so that, by the end of Stage 4, the pit will slope towards the north eastern corner in preparation for final rehabilitation and the provision of a free draining outlet from the site after rehabilitation is complete. In order to preserve sufficient in-pit water storage capacity to retain all runoff from exceptionally heavy storms, a minimum low wall height of 2 m will be retained on the eastern side of the pit. This will provide a minimum of 120 ML of in-pit storage above the level of the main retention pond.

The main changes in the water management system during Stage 4 will be:

- The pre-existing low level retention pond on the eastern side of the pit will be enlarged to provide sufficient capacity (22.5 ML) to meet the water supply requirements.
- For this final stage of operations only, and in order to minimise any backfilling required of the retention pond prior to rehabilitation of the site, no separate provision will be made for a sediment settlement zone within the retention pond. Any water in excess of the water storage requirements will be allowed to pond in the pit. While this may cause some interruption to mining operations, it will only affect a small proportion the pit in the lowest portion. The ability of the treatment plant to treat and discharge 1 ML/day will allow normal operations to be restored rapidly.
- Drainage from the stockpiling conveyor and maintenance facilities will continue to be directed into the enlarged retention pond.
- As the surface level is gradually altered to slope towards the east, the former main retention pond will be subsumed as the extraction of material occurs from the area surrounding the retention pond.
- All water for dust suppression and treatment will be sourced from the remaining retention pond.

4.6 Surface Water Flow Changes

There are ephemeral drainage lines within the proposed site. The *Rivers and Foreshore Act (1948)* contains approval requirements for some developments on protected lands as defined in the Act. Although there are works proposed on protected lands (eg drainage lines), an approval is not required as the works will be within a Mining Lease Area and covered by a mining approval in accordance with Section 22H of the Act.

4.7 Water Demand and Water Balance

A significant and detailed analysis of the demand for water for all identified uses on site, and a detailed water balance analysis using hydrological modeling for the development and revised quarry extraction plan, was undertaken by Hughes Trueman Pty Ltd as part of the *Surface Water Management Plan (May 2004)*. The assessment included stormwater runoff in the 100 year ARI, 72hour (3 day) storm event, and groundwater seepage assessments. The results predicted varying water levels in water control structures onsite over a 30 (thirty) year

climate sequence. The statistics of the assessments showed the following key aspects of the expected performance of the water management system:

- During all stages, the total storage capacity of the site will be in excess of the 1 in 100 year, 72 hour duration storm event. Even during Stage 4, when there is the largest contributing catchment and only a relatively small retention pond (in preparation for rehabilitation), the maximum depth of ponded water above the edge of the retention pond would be about 1.5 m, corresponding to a maximum volume of excess stored water of about 65 ML. This volume compares to the total volume of the pit below the eastern lip of about 120 ML at this Stage of the project. There would therefore be a large factor of safety against any uncontrolled discharge draining into the adjoining Blue Mountains National Park. During Stages 2 and 3 the available in-pit storage (220 ML and 350 ML respectively) is about 10 times the maximum required storage outside the retention pond (27 ML and 36 ML respectively).

- If a rainfall sequence occurred that led to storage of about 65 ML above the level of the retention pond during Stage 4, it would only take nine weeks of operation (pumping at a rate of 1 ML/day) of the treatment plant to remove all water from the section of the working area that had been inundated (about 9 ha). For Stages 2 and 3 the maximum require time would be four to five weeks.

- For all Stages the water management system has sufficient capacity to provide the estimated water required for dust suppression and vegetation establishment.

The *Surface Water Management Plan* should be referenced for further detailed information if required.

5.0 Erosion and Sediment Control

All proposed erosion and sediment control measures have been formulated by GSSE in accordance with the NSW Department of Housing's (Landcom) *Managing Urban Stormwater: Soils and Construction Volume 1* (4th Edition, 2004) manual or the "Blue Book" as it is known in government circles.

Given the significant sensitivity of the site's soils to erosion processes and the sensitivity of the potential receiving waters of the National Park, the principal objective of surface water management for the project is to ensure that there is no uncontrolled discharge of water from the site whatsoever, and that the controlled water quality leaving the site meets the appropriate quality standards. This objective is intrinsic to erosion and sedimentation designs and controls for the project.

The principle design aspect of the development to achieve this goal is the use of accurate surface miner machinery to create *infall* benches to drain all dirty water into the pit only and eliminate out-of-pit runoff. Dirty water is then processed through primary and secondary retention ponds for settling of coarse sediments prior to a tertiary water treatment plant that will remove fine suspensions of sediment to a quality suitable for controlled release into the creeks leaving the site into the Blue Mountains National Park. The design of the retention system and the onsite pit-storage capacity has been designed to more than withstand the rainfall of the 100 year ARI, 72 hour duration (3 day) storm event and ensure no uncontrolled offsite discharge in such an event. Exposed slopes are not planned

between the quarry pit and the National Park to further reduce potential for runoff and erosion issues.

This extensive level of sediment treatment and control is complimented by a number of minor erosion and sediment controls and management processes to minimise the amount of sediment entering the dirty water system and hence requiring treatment. This will be achieved by implementing the following controls:

- Conducting best practice land clearing procedures for all proposed disturbance areas;
- Separating *undisturbed* runoff from *disturbed* runoff where possible to minimise and isolate the amount of disturbed or "dirty water" runoff;
- Directing sediment-laden runoff into designated sediment control retention ponds and the water treatment plant;
- Diverting "clean water" runoff unaffected by the operations upstream into natural depressions;
- Constructing the haul road and working pit face with effective surface drainage;
- Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments; and
- Implementing an effective revegetation and maintenance program for the site.
- Maintaining the proposed 50m buffer between the quarry pit and the National Park boundary.

5.1 Minimal Disturbance

Land disturbance will be minimised by clearing the smallest practical area of land for the shortest possible times. This will be achieved by:

- limiting the cleared width to that required to accommodate excavation within the quarry area and haul road corridor; and
- programming the works so that only the areas which are actively being excavated are cleared, therefore limiting the time the areas are exposed and limiting the potential for erosion and sedimentation.

Figure 7 shows the timing of excavation and development of the quarry pit over time. Clearing will coincide with this quarrying sequence.

Prior to the commencement of clearing, an internal site clearance permit will be issued by the Quarry Manager. General clearing and grubbing will not be undertaken until earthwork operations are ready to commence. All proposed erosion and sediment control measures will

be implemented in advance of, or in conjunction with, clearing and grubbing operations. Prior to clearing commencing, the limits of clearing shall be marked by pegs placed at intervals on each side of the disturbed area. All operations will be planned to ensure that there is no damage to any trees outside the limits to be cleared.

5.2 Management of Soil Stockpiles

A number of soil stockpiles will be established around the western and northern edges of the pit. Both open and covered stockpiles will be utilized where relevant to operations. Due to material characteristics, handling requirements require the main resource stockpile (of around total 12, 000t split into two areas of premium and standard grade product) located to the north of the site near the loader to be fully covered by a protective roof over the entire stockpile area.

Stockpiles will be protected with sediment fencing and planted with a sterile cover crop (annual species) to ensure stabilisation. Surface drainage in the vicinity of the stockpiles will be configured so as to direct any runoff into the pit. As previously outlined, the surface of the pit is designed to control all runoff as infall to the dirty water management system (ponds and treatment plant), with no uncontrolled discharge from the pit.

Topsoil stripping within the disturbed area will be undertaken when the soil is in a slightly moist condition thus reducing damage to soil structure. The soil materials will not be stripped in either a dry or wet condition. Stripped material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit.

If longer term stockpiling (ie greater than 6 months) is required, a maximum stockpile depth of two (2) metres will be maintained to preserve viability and reduce soil deterioration. Soil stockpiles will be sown with the sterile cover crop (annual species).

Where the stockpile is not wholly contained within the "closed loop" water management system, temporary sediment control measures such as sand bags and silt fences will be used to prevent sediment from leaving the area. Stockpiles will be placed in areas so as to avoid impediment of natural localized drainage lines and minimise the likelihood of water ponding against the stockpile.

Topsoil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 50 mm on 3:1 or steeper slopes and to a minimum depth of 100 mm on flatter slopes. Re-spreading on the contour will aid runoff control and increases moisture retention for subsequent plant growth.

Re-spread topsoil will be leveled to achieve an even surface, avoiding a compacted or an over-smooth finish.

5.3 Clean Water Diversion Works

Two sections of clean water diversion banks will be utilised as permanent mitigation controls on the site to minimise erosion and divert run-on water around the disturbed areas and re-direct contaminated runoff into the existing internal drainage system that will ultimately report to the main sediment retention dam as shown **Figures 2** to **6**. A typical cross section for the proposed clean water diversion banks is illustrated in **Figure 8**.

The first section of diversion channel will be constructed during the initial stage of site preparation. It will run in a southerly direction approximately parallel to the western edge of the pit, and discharge into the southern creek that discharges from the extraction pit area. This channel will intercept clean runoff from a catchment area of approximately eight (8) hectares located to the west of the pit.

To avoid a small swampy area within the southern drainage line, a second diversion channel will be constructed as part of the Stage 2 works to redirect clean water runoff from the catchment area from above the pit. This diversion channel, which has a total catchment area of about sixteen (16) hectares, will commence at about the same location as the first channel joins the southern creek to convey water around the southern end of the pit.

Both channels will be designed to convey the 100 year ARI, 72 hour duration peak flow for the catchment concerned (approximately 4 m^3/s and 6.5 m^3/s, respectively). The routes of both channels will require excavation in rock and in some places the channel will need to be cut 2-3 m deep in order to achieve a satisfactory grade. In other locations, the channels are required to convey water down grades in excess of 10%. In these locations, the diversion bank channels will be reinforced with durable, competent rip rap to prevent soil erosion and prevent scour of the friable sandstone, as described in **Section 5.4** below. All completed banks will be topsoiled and sown with sterile cover crops.

5.4 In-Pit Water Management

Through the use of accurate surface mining machinery, infall drainage of the pit floor and quarry benches will be constructed to contain runoff to the internal dirty water control system throughout all stages of active quarrying. The only exception will be the final phase of Stage 4 when the site is prepared for the final landform wetland design requiring outfall drainage with runoff reporting to a designed wetland. A schematic representation of the proposed bench drainage system is provided in **Figure 9**.

The benched terraces will be developed to discharge water in a controlled fashion to the next bench using stabilised drop-down structures. Drop-down structures will be constructed between each of the benches to provide controlled drainage of water down slope toward the pit floor and into the dirty water management system. The drop structures will be stabilised using concrete slurry ("shotcrete") to prevent erosion of the terraces. Once shotcreted, the drop structure areas will become far more competent and remain stable in the long term. **Plate 2** shows the benching system in the adjoining Rocla quarry.

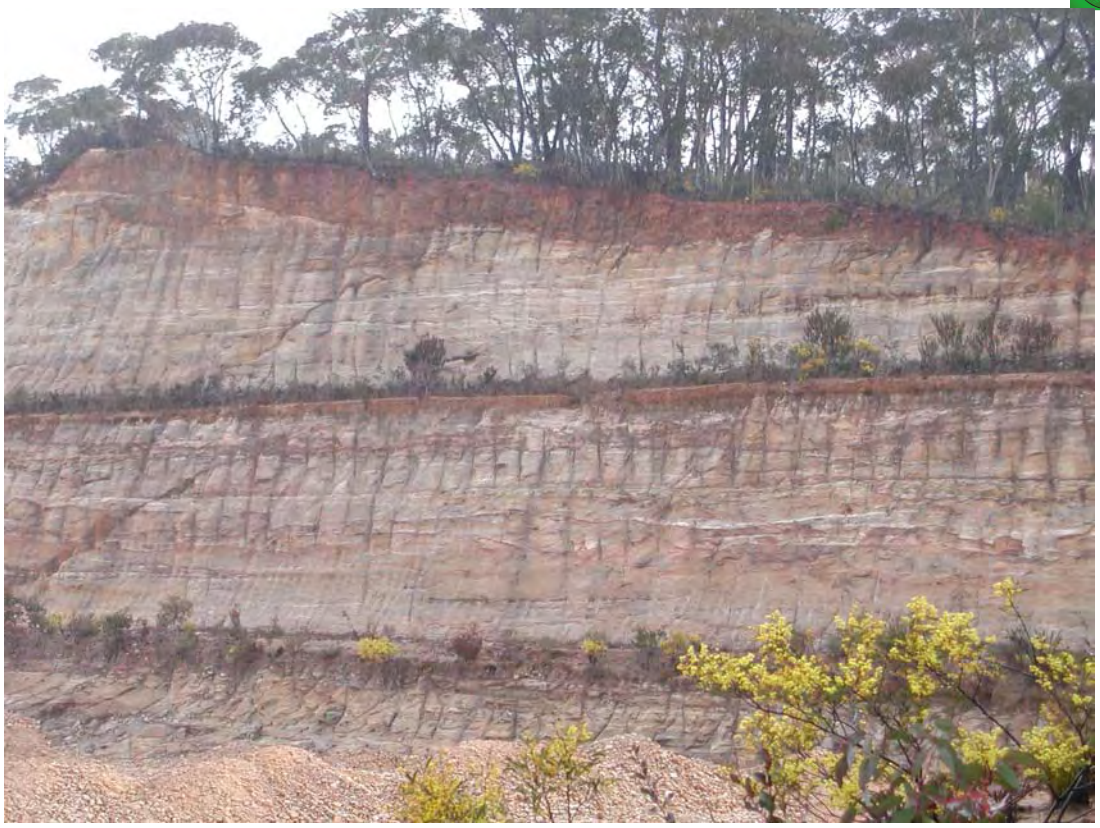


Plate 2: Adjoining Rocla sand quarry bench system.

The wall height between the benches will be far shorter for the proposed SCM quarry. The terraced walls will have slopes equal to or greater than eighty (80) degrees to minimise the amount of rainfall on them and the erosion risk over the long term. Each bench will be progressively rehabilitated to reduce erosion and improve aesthetics by proving visual screening of the quarry walls as discussed in **Section 6** of this plan. A typical cross-section of the proposed quarry benching system is shown in **Figure 10**.

All water collecting inside the pit area during the initial stages of quarrying will report to a minor in-pit retention pond (de-watering pond) located in the northwest corner of the pit. Dirty water will be pumped to the Main Retention Pond, as shown in **Figures 2** and **3.**

During Stages 2 to 4, all pit water will report directly to the Main Retention Pond which is located in-pit during those stages, as shown in **Figures 4, 5** and **6**.

5.5 Quarry Haul Roads

The quarry haul road will be constructed to ensure surface drainage is optimised and stabilised thereby reducing roadside erosion and sedimentation. Cross-fall drainage structures and mitre drainage will be implemented for the entire length of the haul road. Ramp gradients will be no greater than 10% to allow use in wet weather. Crowning will generally be implemented on any steeper sections of the haul road. Outfall drainage will be constructed where the road traverses

small fill batter areas and in-fall drainage will occur where the road traverses larger fill batter areas.

Mitre drains will be constructed to take water from the shoulders or table drains of the haul road to the Main Retention Pond or Lower Retention Pond where relevant.

Road runoff will be intercepted at regular intervals to reduce runoff velocity in each mitre drain. Drain spacing will not exceed fifty (50) metres. Drain outlets will be ponded using silt fencing and sand bags to ensure effective sediment control at the periphery of the small haul road.

5.6 Sediment Control

Runoff from the quarry area will report to the dirty water management system consisting of retention ponds and treatment plant. The maximum contributing dirty water catchment to the Main Retention Pond will be 20.9 hectares during Stage 4 of quarry development, progressively increasing from 1.6 hectares during site preparation stage and 10.0 hectares during Stage 1 of the quarry. The Main Retention Pond and Lower Retention Pond will be responsible for optimising the retention of sediment carried in stormwater runoff prior to final removal of unsettleable sediment (eg colloidal) suspensions by the Water Treatment Plant before water is released into the natural drainage system.

The Main Retention Pond will serve as:

- the main collection point for stormwater runoff;
- the storage for supply of water for dust suppression requirements;
- the primary settlement pond for water that will be pumped to the Lower Retention Pond and then to the Water Treatment Plant for treatment to a standard suitable for use by the village or release into the natural creek system.

Both rentention ponds have been designed in accordance with the "Blue Book" for the most conservative scenario using Type F and Type D soils (where finer suspensions of solids have the most stringent requirements for settling) for the 100 year ARI, 72 hour storm event. The capacity of the ponds increases in each stage of quarry development in response to increased disturbed catchment area and water treatment requirements, and is described in significant detail in the *Surface Water Management Plan* (Hughes Trueman, 2004). Extracts of designs from that plan are contained in the following sections.

5.6.1 Design of the Main Retention Pond

The main retention pond will serve as a storage reservoir for on-site water needs and as a primary settlement pond for water that will subsequently be treated prior to discharge from the site, or reuse by the village. Excess runoff from that retained within the retention pond will be temporarily stored within the extraction area Accumulated pit water will be prevented from draining off-site due to the large storage capacity.

Four different water and sediment storage zones have been designed. In sequence, starting from the bottom of the retention pond, these are:

- Sediment storage zone that has been designed in accordance with the "Blue Book". The required settlement storage capacity, allowing for retention of all sediment over the life of the retention pond, will increase in proportion to the disturbed area with a requirement of 2.5 ML (2,500 m3) at the end of Stage 4 of extraction.
- Water storage zone which has been designed to provide sufficient capacity to provide for the on-site water needs. The required volume has been established using a long term water balance analysis (see **Section 4.7**). The required storage volume at the end of Stage 4 of extraction is 18 ML.
- Sediment settlement zone which has been designed on the basis of settlement basins for Type F or Type D soils as set out in the "Blue Book". The adopted design criteria for this component of the retention pond are the most conservative listed, namely:
    - 20 day 95th percentile rainfall 135 mm
    - Volumetric runoff coefficient 0.8

  The design capacity of the sediment settlement zone for the end of Stage 3 is 22 ML.
- Surcharge zone which will accommodate all excess runoff from the site in the event of extreme rainfall events such as the 100 year ARI 72 hour storm (307 mm). Runoff will be temporarily stored within the pit above the level of the top of the retention pond. The adequacy of the pit to accommodate the excess runoff is demonstrated by the water balance analysis set out in **Section 4.7.**

The capacity of the main retention pond will increase progressively as extraction progresses, as shown in **Table 8**.

Table 8: Main Retention pond Capacity for Various Stages of Extraction

	Quarry Development Stage				
	Preparation	1	2	3	4
Disturbed Area (ha)	1.6	10.0	18.0	20.4	20.9
Sediment storage zone (ML)	0.5	2.5	2.5	2.5	2.5
Water storage zone (ML)	13.0	16.0	17.5	18.0	18.0
Sediment settlement zone (ML)	1.7	10.8	19.5	22.0	2
Required pond capacity (ML)	20.2	31.3	40.0	42.5	20.5
Proposed pond capacity (ML)	32	32	45	45	22.5

Table 9 below compares the available surcharge water storage capacity within the pit with the volume of runoff that would occur from a 100 year ARI 72 hour duration design storm. The surcharge storage capacity within the pit arises because of the proposed 1% downward slope from east to west that forms a wedge shaped storage area with the lowest sections of the pit along the western high wall. As the base of the pit is lowered and width of the pit enlarges, so the width and depth of water that can be stored below the level of the eastern edge of the pit increases. **Table 9** shows that, even if the main retention pond was full at the commencement of a 100 year ARI 72 hour design storm, there would be ample excess water storage capacity within the

pit. In practice (see water balance analysis in **Section 4.7**), the average water level in the retention pond will be close to the level corresponding to the water storage zone. Therefore, the volume of the sediment settling zone can also be expected to be available for the retention of runoff from a major storm event.

Table 9: Comparison Between In-pit Storage Volume and 100 year ARI 72 Hour Design Storm Volume

	Quarry Development Stage			
	1	2	3	4
100 year ARI runoff volume (ML)	25	45	50	52
Surcharge zone capacity (ML)	50	220	350	70

5.6.2 Design of the Lower Retention Pond

The lower retention pond will act as the capture point for runoff from the area immediately north of the pit. This area contains the haul road leading to the main office and stockpile area, the stockpiling conveyor, the maintenance area and topsoil stockpiles. The total area draining to the lower retention pond is approximately 3.5 ha. The lower retention pond will also act as a balancing storage for water transferred from the Main Retention Pond.

Water retained in the lower retention pond will be given priority for providing:

- water for dust suppression,
- water for treatment and release off-site or transferred to the storage tank for use in the village.

The capacity of the lower retention pond will be 10 ML comprising:

- 7.2 ML temporary holding capacity to accommodate runoff from the contributing catchment resulting from a 100 year ARI, 72 hour storm (307 mm of rainfall);
- 2 ML balancing storage for water transferred from the main retention pond. This is equivalent to two days' pumping to the treatment plant;
- 0.8 ML allowance for sediment accumulation.

As the lower retention pond will act as the primary distribution point for serving various water needs, the water level will be maintained at a low level in order to maintain the design capacity for runoff capture. In the event of a 100 year ARI storm, it would only require 7 days operation of the treatment plant to restore the design capacity to the pond.

5.6.3 Water Treatment Plant

As stated in the EIS (IEC, 2003), the slowest settling, most mobile particles in the runoff from the extraction area will be those that consist of the finest kaolin clays. The treatment plant designed by Worley International Pty Limited will be capable of extracting this fine component at a capacity of around 1ML/day. In order to achieve maximum efficiency from the treatment plant, settlement of the coarser fraction will

primarily occur within the Main Retention Pond. The fully automated chemical treatment plant will involve several processes, including coagulation and flocculation to remove finer clays and colloidal suspensions, and additional treatment to remove the more elevated manganese levels naturally occurring in sediments.

The proposed plant proposed will meet the required discharge standard of 15 mg/L of suspended solids. The treatment plant will only be operated periodically. This will occur immediately after stormwater runoff fills the Main Retention Pond above the storage zone level.

Water released from the treatment plant will flow to the Wollangambe River via a rip rap lined channel and drop structure.

5.6.4 Additional Erosion & Sediment Controls

The current proposed extraction method creates a series of windrows of excavated material as the surface miner passes over the pit floor. These windrows are then collected by a scraper which delivers the material to the stockpiling area. This process essentially creates a series of absorption banks within the pit, which will reduce runoff velocity during rainfall. The windrows will be constructed along the contour (essentially north to south) and therefore perpendicular to the natural flow of water (east to west). The windrows will serve several purposes including:

- Act as "contour banks" that will reduce slope lengths of uninterrupted slope and hence reduce the erosion capacity of overland flow. This will reduce the erosion potential within the working area and reduce the overall solids loading entering the retention ponds;
- Pond water behind the bank and allow settling of the coarser sand fraction.

Silt fencing will be installed downslope of the entire length of the windrowed material. Prior to any construction work onsite (including clearing of vegetation, soil stripping or access road construction), temporary erosion and sedimentation control structures will be put in place. Additional control works including, but not limited to, sediment filter fencing, sand bag sediment filters and revegetation will be employed. These will be particularly used during construction of drainage line crossings or other activities near depressions. Silt traps will be constructed downstream of each crossing and remain in place (and be regularly inspected for functionality) for the life of the quarry.

Sediment filter fencing and sandbag weirs will be installed in the longitudinal drainage adjoining the roads / disturbed areas and will be in advance of, and in conjunction with, earthworks to prevent contaminated water leaving the site. The weirs will be installed at fifty (50) metre intervals.

The filter fabric used in the silt fences will have a permeability coefficient of about 0.02m/s to allow sufficient flow during minor storms without water buildup, and have a retention efficiency of at least 75%. Having two fences in parallel will increase the overall retention efficiency.

Sand bag sediment filters will be used "as required" during the construction of drainage and road works, however the use of sand bags will be limited to situations only where erosion and sediment control is required for a short period (i.e. maximum of three (3) months).

Any batters will be constructed to minimise exposed areas and minimise potential surface for erosion. Batters that may require treatment include those on access roads and other construction areas, and as these areas may be steep and erodable, stabilization, revegetation and rehabilitation works will be undertaken quickly to minimise erosion. Hydromulching will be used to immediately protect underlying fill material from wind and water erosion. Hydromulching applications will typically consist of sterile annual grasses (to eliminate weed issues for the nearby National Park), bitumen or polymer binder, seed and fertiliser. Materials used in hydromulching are biodegradeable and decompose to form a beneficial organic humus.

5.7 Maintenance Area

A small maintenance area will be established near the eastern end of the conveyor. This area will include a workshop for maintenance of machinery and re-fuelling facilities. All maintenance work will be conducted within the workshop. The fuel storage area will be appropriately bunded in accordance with DEC and Australian Standard (AS1940) requirements for spill containment.

The hardstand area outside the workshop and adjacent to the refueling facility will be sealed and graded so as to drain all runoff to an oil and grease trap before discharging into the drainage system connected to the lower retention pond.

6.0 Revegetation

Revegetation of disturbed areas is an integral component of the site SWMP and as such will be undertaken as soon as possible after disturbance occurs. The benefits of progressive, active revegetation of disturbed areas include reduced erosion, improved water quality, increased fauna habitat, improved aesthetics and visual screening.

The proposed techniques for vegetative stabilisation of the site include, but are not limited to, the following:

1. Conservation and re-spreading of topsoil;
2. Scarification of the topsoiled areas;
3. Broadcasting endemic native tree and shrub species , and
4. Hydromulching using sterile annual cover crop species and native ground covers.

6.1 Roads and Infrastructure Areas

This section relates specifically to the rehabilitation associated with infrastructure areas that are established outside the active quarry area.

In accordance with undertakings in the EIS (IEC, 2003), rehabilitation works will be conducted on all exposed batters associated with access roads, stockpile areas and water management structures. These works will be progressively implemented as soon as practicable after construction to stabilize surfaces, prevent erosion and protect water quality in those areas.

Revegetation of all minor cut and fill batters within the haul road corridor will be undertaken for effective embankment stabilisation. A vegetative surface cover will inhibit erosion of the batter surfaces and will reduce sedimentation in table drains.

6.1.1 Conservation and Re-spreading of Topsoil

As the quarry proceeds, topsoil will be stripped and stockpiled from successive areas and stored prior to use in progressive, active rehabilitation activities. In accordance with the EIS (IEC, 2003), only topsoil that has been derived from the site area will be used in the rehabilitation programme to ensure exotic weed species are not brought onsite and protect potential release to the adjacent National Park. Some 38,000m^3 of topsoil will be produced, and a shortfall of material is not expected due to much of the surface area of the final landform comprising wetland that will not require extensive topsoil for revegetation.

The biologically useful component of available topsoil ranges from the top 10cm or more within or near drainage lines to less than 5cm over the remaining area. As such, the available useful topsoil is a highly valuable resource, containing weed-free soil and seeds of species naturally found onsite, in addition to nutrients and organic matter that will assist in the revegetation of the area.

Topsoil will be stripped and placed in *controlled* topsoil stockpiles (in accordance with controls listed **Section 5.4** of this plan) in areas adjacent to the initial quarrying areas. These areas will have silt fencing controls constructed downslope to contain sediment movement downslope. A small dozer will be used for stripping and/or placement of topsoils to avoid excessive compaction and subsequent loss of important soil structure. Topsoil stripping within the disturbed area will be undertaken when the soil is in a slightly moist condition thus reducing damage to soil structure, achieving a higher standard of revegetation and reducing maintenance requirements. The soil materials will not be stripped in either a dry or wet condition. Stripped material will be placed directly onto the disturbed areas and spread immediately if excavation sequences, equipment scheduling and weather conditions permit. This will be used for the initial landscaping works to be carried out on the pit benches.

If longer term stockpiling (ie greater than 6 months) is required, a maximum stockpile depth of two (2) metres will be utilised. Stockpile side slopes of 3H:1V and of variable length will be maintained to preserve viability and reduce soil deterioration that can occur from anaerobic conditions in larger stockpiles. Longer term soil stockpiles will be sown with sterile cover crops as soon as possible after stockpiling to

stabilise the surface and maintain biological activity in the soil. Stockpiles will be placed in areas so as to avoid impediment of natural localised drainage lines and minimise the likelihood of water ponding against the stockpile.

When the outer edge of a bench is ready for rehabilitation, topsoil will be recovered from the stockpiles and placed on the strip that has been prepared for revegetation.

Topsoil will be re-spread in the reverse sequence to its removal, so that the organic layer, containing any seed or vegetation, is returned to the surface. Topsoil will be spread to a minimum depth of 50 mm on 3:1 or steeper slopes and to a minimum depth of 100 mm on flatter slopes. Re-spreading on the contour will aid runoff control and increases moisture retention for subsequent plant growth.

Re-spread topsoil will be leveled to achieve an even surface, avoiding a compacted or over-smooth finish.

6.1.2 Scarification

In order to optimise seedbed condition, scarification will be conducted when the soil is moist to produce a loose and friable seed bed which is essential for good vegetation establishment from seed.

Cultivating on the contour will be conducted to assist in delaying runoff, increasing infiltration and controlling erosion of the seed bed until an effective vegetative cover is established. As a minimum treatment, steep batters (>2:1) will be scarified using a tined bucket on an excavator to achieve surface roughness prior to sowing.

6.1.3 Hydromulching

Hydro mulching will be undertaken to provide cover for the soil to improve vegetative growth and modify the soil surface to control erosion. Securely pressed against the surface of the soil, the wood fibre mulch will provide a high degree of erosion control and improve moisture availability to establishing cover crops and ground covers. The mulch will also have the effect of protecting the soil surface against raindrop impact, improving the micro-environment for seed germination and establishment by reducing evaporation losses and assisting in the control of surface erosion caused by raindrop impact and overland water flow.

Hydromulching will be used to immediately protect underlying fill material in steep areas such as batters (eg access road, construction areas) from wind and water erosion. Hydromulching applications will typically consist of sterile annual grasses (to eliminate weed issues for the nearby National Park), polymer binder, seed and fertiliser. Materials used in hydromulching are biodegradeable and decompose to form a beneficial organic humus.

Hydromulching will ideally be undertaken during the period October to March. The extent of soil moisture will not be a determinant for initiating the operation. The wood fibre mulch will afford sufficient seed protection and moisture conservation to optimise the level of germination success if the pre-existing soil moisture levels are low.

6.2 Active Quarry Disturbance Areas

6.2.1 Progressive Rehabilitation Strategy and Objectives

The objectives of the proposed rehabilitation strategy are to:

- Minimise the environmental impact of the expanding operation during development and operational phases, ensuring that protection of water quality and erosion control works are key priorities, and that progressive rehabilitation is completed as soon as possible;
- Ensure that site drainage and sedimentation structures remain stable and functional under extreme rainfall events;
- Ensure that vegetative matter and topsoil is made available for the site rehabilitation as required;
- Guarantee that the resource is extracted and the site rehabilitated in a manner that will ensure the quality of surface runoff and groundwater infiltration at all times; and
- Produce a final "walk away" landform that is geotechnically stable and blends aesthetically into the surrounding landforms, yet as far as possible does not limit possible future land uses.

Native open woodland vegetation cover currently occurs over most of the proposed quarry site. It is proposed to re-establish a similar cover to the majority of the post-quarrying landform. Native vegetation will largely be established using directly applied seed and from the seed store within re-spread topsoil. Supplementary native pasture and/or tubestock seeding will be undertaken where specific species combinations are required. A plant nursery will be established at the site to propagate all tubestock to be used during the rehabilitation process.

The revegetation program ("terrace landscaping") will progressively re-establish native tree / shrub / ground cover and will stabilise reshaped and benched areas. Benches will be deep ripped to actively promote infiltration of water which will enhance soil moisture requirements for direct tree seeding and minimise surface runoff to underlying benches and the pit floor dirty water control system. Surface preparation is further described in **Section 6.2.2** below. Revegetation will also visually screen disturbed areas and will re-establish habitat for native fauna. A successful example of progressive revegetation of benching in an active friable sandstone quarry on the Somersby Plateau, NSW is illustrated in **Plates 3** to **6**.



Plate 3: Revegetated sand quarry benches.



Plate 4: Native tree & shrub seeding on sand quarry benches (6 months old).



Plate 5: Native tree & shrub seeding on sand quarry benches (2 years old).



Plate 6: Established native trees & shrubs on sand quarry benches (2 years old).

6.2.2 Surface Preparation

The decompaction of soil is important in assisting rapid tree growth through deep root growth and enhanced soil water infiltration. Ripping depth must be sufficient to penetrate any near-surface rock or clay. Inadequate site preparation and weed control are often the two biggest single factors responsible for tree revegetation failure. Thorough site preparation will be undertaken to ensure rapid establishment and growth of seedlings. All proposed seeding areas will be deep ripped to an indicative depth of 400 – 500 mm.

6.2.3 Direct Seeding

Direct seeding (via broadcasting) is preferred over tube stock planting as it enables a far greater success rate, limits the need for ongoing maintenance (e.g watering) and is the most effective method in achieving a successful rehabilitation outcome.

Proposed species for revegetation have been selected from selected from local native species identified in **Tables 1** and **2** in this plan. Not all native trees and shrubs are suited to direct seeding due to their innate germination requirements. In cases, it may be required to supplement with some tubestock to increase biodiversity. A mixture of native trees and shrubs will be sown onto the majority of the reshaped and benched pit areas following topdressing and site preparation. Tree and shrub seeding using endemic species will complement natural regeneration from seed contained within the soil seed bank. The mix used for revegetation of the disturbed quarry area will include many of the major tree and shrub species shown in **Table 10** below.

TABLE 10: PROPOSED SPECIES MIX FOR QUARRY DIRECT SEEDING

RECOMMENDED SPECIES MIX
Eucalyptus piperita
Eucalyptus sieberi
Eucalyptus sclerophylla
Lomatia silaofolia
Daviesia latifolia
Banksia spinulosa
Acacia terminalis
Epacris pulchella
Telopea spesiosissima
Acacia byoeana*
Acacia flocktoniae*
Eucalyptus pulverulenta*
Prostanthera cryptandroides*
Pultenaea glabra*

* = denotes flora of conservation significance from surrounding region

Seed will be sourced from local NPWS licenced seed collectors. Some native species have difficult dormancy mechanisms that need to be broken before germination can

occur. Native seed for revegetation of the quarry will be appropriately pre-treated in order to break dormancy restrictions. Subject to sufficient follow up rain, high initial tree densities can be expected. These high densities will quickly help stabilise and screen the site and will result in healthy mature tree stands over time. It is intended to create, over time, a mosaic of variable native species and plant densities representative of that currently occurring in the area. Growth rates of between 1 and 2 metres per year can be initially expected for many of the more dominant trees and shrubs.

Correct treatment and application of seed in the appropriate ratios is important in controlling emerging weeds and in allowing the tree stand to develop in a positive direction. The native tree and shrub seed mix will be sown at a total combined rate of approximately 7 kg/ha. Seed will be broadcast evenly onto topdressed areas. It will not be buried. Seeding will be conducted in late spring, summer and early autumn giving superior results due to higher ground temperatures.

6.2.4 Scheduling of Works

Some twenty five (25) hectares of native woodland vegetation will be disturbed by quarrying over the duration of the project. Rehabilitation work will be undertaken *progressively* as soon as reshaped, benched and topsoiled areas become available. **Figure 7** illustrates the timing and sequencing of active quarrying for the revised staged extraction plan and therefore provides an indication of revegetation scheduling given that seeding will be undertaken immediately after extraction areas are exhausted.

6.2.5 Final Land Use

The area currently supports open eucalyptus woodland forest. The broad rehabilitation objective for the post-quarrying landform is to establish a similar land use. The topography of the final landform will consist of a large number of small, stepped sandstone benches formed in an amphitheatre configuration , each with a revegetated berm. The amphitheatre void will be some 450m wide and 400m long at its western edge, and 650m long at its eastern edge. Until such time as extraction has ceased, rehabilitation will occur around the edges of the pit only, and will not involve the pit floor. Once operations have been completed, all buildings and infrastructure will be removed from the pit. These areas will be reshaped and ripped where necessary for topsoiling and revegetation. It is proposed that the haul road will remain for use in the ongoing management of the site rehabilitation and for fire fighting purposes. The pit floor will be vegetated with appropriate native species to create a stable, free-draining wetland.

A final Closure Plan (including a detailed wetland design) will be developed prior to the commencement of Stage 4 of the quarry. The plan will reflect current understanding, best management practice, and design criteria requirements at the time, to refine design issues of the concept envisaged prior to the quarry development to establish a stable and sustainable wetland. Whilst it us understood that standards are likely to change within the active mine period, it is anticipated that the wetland will be designed in accordance with the equivalent of the Constructed Wetlands Manual 1998 (DIPNR, formerly DLWC). This will involve input from, and

consultation with, government regulatory agencies including DEC (comprising the former NPWS and EPA), Dept of Mineral Resources, and DIPNR.

The concept for a functioning wetland in the final void is illustrated in **Figures 11** and **12**. At the completion of operations, the extraction pit will have an expected floor level grading from RL 989.5 m AHD on the eastern side adjacent to the retention pond to 993 m AHD on the western side. The final operational activity will be to excavate sufficient extra material to fill the remaining retention pond (located on the eastern side of the pit) to a level consistent with the surrounding excavated area. A small retention pond (about 20 m^3) will be retained to provide an extraction point for water to be pumped to the treatment plant.

During the initial phase of rehabilitation the water management system will continue to operate in a similar manner to the final operational phase with off site discharge only occurring by means of water released from the treatment plant. The treatment plant will be operated so as to retain a wetland swamp area with a maximum depth of 0.5 m in the centre of the remnant depression.

The wetland will be formed as a shallow depression with the low point in the location of the final retention pond in the north east corner of the pit. The area surrounding the location of the final retention pond will be graded at flatter slopes (typically 0.5%) than used elsewhere in the pit (1.0%) in order to create a free form shallow depression with a total area of about 4 ha. It is anticipated that sedges and other wetland plants endemic to the area will colonise this wetland area to form a swamp ecosystem analogous to that in Gooches Crater, a natural crater feature located approximately 2 km north west of the project area, as shown in **Plate 7** below.



Plate 7: Gooches Crater *(courtesy Hughes Trueman, 2004).*

Once vegetation has fully established (approximately 5 years), the site will be reconfigured to permit free drainage of water from the site once the wetland/swamp is filled to a depth of 0.5 m. A channel will be excavated through the rock at an elevation of 990 m AHD (0.5 m above the base of the wetland swamp) to allow free drainage from the pit into the existing northern creek that drains into the Blue Mountains National Park.

Once a channel has been excavated to allow overflow from the wetland to discharge off-site, the wetland will be dependant on water supply from the contributing catchment of about 24 ha. The water balance model developed for the operational phases of the project has been modified to account for the expected runoff characteristics of the rehabilitated catchment and used to assess the wetting and drying behaviour of the wetland as a result of surface runoff.

6.2.6 Fencing and Weed Control

Fencing will be erected and maintained to exclude and prohibit the movement of persons and vehicles into areas that have been rehabilitated. The fencing will be routinely checked and repaired where necessary.

Weeds present one of the most significant problems to the creation of forest ecosystems. The minimisation of grass and weed competition over the first six (6) to twelve (12) months after seeding is critical to successful tree establishment. Weed control will be undertaken on an "as required" basis should cyclical weed invasion events. As trees establish and mature they will compete and eventually eliminate most weeds and grass underneath. For this reason, dense direct seeding (as opposed to planting) is an effective long-term weed control mechanism that reduces maintenance significantly, particularly ongoing weed control. Weeds in most tree-seeded stands typically disappear after 18 months to two years.

6.2.7 Maintenance

Due to the hardiness of young direct tree seedlings (compared to planted tubestock), sown trees require minimal maintenance. Direct seeded seedlings require no watering while planted seedlings (tubestock) may require extensive watering if conditions remain dry. No maintenance fertiliser will be required for tree areas. Effective control of weed species within rehabilitated areas will be a critical and essential component of the proposed revegetation plan. Weed and noxious animal control will be undertaken on all rehabilitation areas according to relevant state and local government legislation and policy.

All erosion and sediment control measures will be maintained in a functioning condition until individual areas have been deemed "successfully" rehabilitated. Structural soil conservation works will be inspected after high intensity rainfall so that de-silting and prompt repairs and/or replacement of damaged works can be initiated as required.

7.0 Operation and Monitoring

The following section describes the operation and monitoring program for soil and water management at the proposed development. The Quarry Manager (or their nominated representative) is responsible for the Environmental Monitoring program at the site.

7.1 Maintenance of Surface Water Controls

Site drainage and sediment control structures will be inspected regularly after runoff events (>20mm of rain) to check for scouring of diversion drains and accumulation of materials in sediment traps (e.g. silt fences & sand bags) and settling dams. Sediment control structures will be de-silted when the design capacity of the structure has been reduced by 30% (or as necessary). All scouring of drains will be stabilised as soon as possible.

7.2 Surface Water Monitoring

All water quality monitoring will be undertaken in accordance with the water sampling and analysis Guidelines as prescribed by DEC and the relevant Australian Standards.

Water samples will be taken in accordance with Development Consent requirements and the EPL licence issued for the site by the DEC. It is envisaged that this will include analysis for selected, relevant key parameters from the background surface water quality testing program. The analysis will be undertaken by a NATA (or equivalent) laboratory.

7.3 Rehabilitation Monitoring

Revegetation works will be monitored in order to assess success, effectiveness of techniques, and fine tune rehabilitation methodologies to ensure that a suitable vegetation community is established in the open pit area. A number of aspects of the rehabilitation program will be required to be monitored and inspected to help ensure a successful result. Both quantitative (eg stem density measurements) and qualitative (eg photographic records and inspections) monitoring and assessment will be undertaken.

It is noted that some mortality is expected for a proportion of tree and shrub revegetation seedlings, providing benefits of nutrient and organic decomposition to the soil. Changes in stand composition will occur as direct-seeded stands are initially very dense, with numbers declining rapidly over the first five years as quick-growing and short-lived species (such as Acacias) die out and as more dominant canopy species emerge. As tree seeded stands mature the ratio of different species changes. The initial fast-growing understorey species provide useful functions in stabilising soils, shading out weeds and assisting in nitrogen and organic buildup in soils to encourage long-living canopy species to emerge.

Eventually the stand will thin even further as individual eucalypt species dominate over others. Stem densities will show decline quickly during this process. In the first five years stem densities may decline from around 20,000 to 5,000 stems per hectare.

7.4 Reporting & Review

All water quality monitoring data will be recorded and the original laboratory report maintained on site. Details of all monitoring required by Development Consent or DEC (formerly EPA) Licence will be reported in the *Annual Environmental Management Report (AEMR)*.

Details of all monitoring required under an Environmental Protection Licence (EPL) issued in accordance with the *Protection of the Environment Operations Act (1997)* will be reported in the Annual Return. This Management Plan will be reviewed in accordance with the requirements of Development Consent or at a minimum of every three (3) years.

8.0 Workforce Training & Awareness

Sydney Construction Materials will develop and maintain a training and awareness program that will provide the workforce (including sub-contractors) with the knowledge and skills necessary to meet the objectives of this SWMP.

It will include, but not be limited to, the following key principles:

- Ensuring that prior to the commencement of site works all erosion and sediment control requirements have been installed;
- Ensuring that erosion and sediment control works are regular maintained and are operational; and
- Familiarisation with Environmental Incident Reporting requirements and the Emergency Response Procedures relevant to the site.

9.0 References

1. International Environmental Consultants Pty Ltd (May, 2003), "*Environmental Impact Statement: Multi-Commodity Sand Extraction and Kaolin Project for Supply of Construction Materials to the Sydney Region From Newnes Plateau*";
2. Hughes Trueman Pty Ltd (May, 2003), "*Surface Water Management Plan: Newnes Junction Sand & Kaolin Extraction Project*";
3. NSW Department of Housing (Landcom) (4th Edition, 2004), "*Managing Urban Stormwater: Soils and Construction Volume 1*", known as the "Blue Book".
4. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) October 2000, ***Water Quality Guidelines***, Paper No. 4 - Volume 1 (Chapters 1-7);
5. HWR (2004), "*Flora Assessment. Sand Extraction and Kaolin Project, Newnes Junction*".
6. White, A.W. (2004), "*Survey for Habitat of the Blue Mountains Water Skink (Eulamprus leuranensis) at Newnes Kaolin Site*". Biosphere Ecological Consultants, Sydney.
7. Gunninah Environmental Consultants (2004), "*Proposed Sand Extraction and Kaolin Mine, Newnes Junction. Supplementary submission to DIPNR; Flora & Fauna Issues*".

SYDNEY CONSTRUCTION MATERIALS

SUPPLEMENTARY INFORMATION

DOCUMENT J

Additional Supplementary Information

Sydney Construction Materials

March 2004

Sydney Construction Materials

Newnes Junction Sand and Kaolin Extraction Proposal

Additional information as requested during meeting with DIPNR, 23rd February, 2005

March 2005

Introduction

This paper presents all additional information as requested by DIPNR, DEC, and DPI, and as summarised during a meeting with DIPNR on 23rd February, 2005.

Table of Contents

1. Noise Impact Assessment – EPA, 22nd August 2003 2
2. Visual Impact of Acoustic Barrier – DIPNR, 23rd February 2005 6
3. Flora and Fauna Assessment – DIPNR, 18th September 2003 10
4. Impacts of Vegetation Clearing – DIPNR, 18th September 2003 11
5. Surface Water Impacts – DIPNR, 18th September 2003 12
6. Final Void – DIPNR, 18th September 2003 13
7. Groundwater Assessment – DIPNR, 18th September 2003 18
8. Iron Factor – DIPNR, 18th September 2003 19
9. Justification of Kaolin Extraction – DIPNR, 23rd February 2005 28
10. Interactions with Zig-Zag Railway – DIPNR, 18th September 2003 38
11. Flora and Fauna Assessment – NPWS, 22nd September 2003 39
12. Aboriginal Heritage Assessment – NPWS, 22nd September 2003 40
13. Potential Air Quality Impacts – DEC, 10th October 2003 41
14. Potential Noise Impacts – DEC, 10th October 2003 45
15. Groundwater Assessment – DIPNR, 5th November 2003 48

List of Appendices 49

1. Noise Impact Assessment – EPA, 22nd August 2003

1.1 Issues Raised

Following are the issues raised by the EPA in their letter to DIPNR of 19th August 2003, as forwarded to SCM by DIPNR on 22nd August 2003.

a) *The noise emissions need to be evaluated to clearly state the level of noise predicted at affected residents.*

   The Environment Impact Statement (EIS) focuses on two residents, the most affected, but other potentially adversely residents should be specified especially where predictions exceed the Project specific noise as derived by the Environment Protection Authority's (EPA) Industrial Noise Policy (INP).

b) *The EIS partitions the noise sources impacting on residents and fails to clearly show the cumulative impacts and a worst-case scenario. For example the cumulative impacts of mining, rail loading and stage preparation should be evaluated.*

c) *Additionally the EPA's INP requires that annoyance factors be taken into account. The EIS does not appear to include annoyances in its predictions. Given the types of operations being carried out on site there could be up to 10 dB that would need to be added to the predicted noise emission.*

d) *In relation to construction noise, a major error has been made. The EIS claims background noise level (BG) + 10 dB allowance far construction not exceeding 26 weeks and a BG + 20 for each of 6 stage preparations and noise bund constructions.*

   The EPA's Environmental Noise Control Manual (ENCM) at Chapter 171 states "This may not applicable to long term constructions such as coal mines which may take several years."

   Consequently and in conformity with past approaches in the mining industry, any noise emissions after the commencement of mining operations will be considered as the noise emitted from the premises and come within the INP. The +10 dB and +20 dB allowances will not apply after mining commences.

e) *The above issues will have a significant effect on the project ability to meet acceptable noise levels and may require a re-design of operations.*

   The EPA requires that impact of noise be re-assessed in terms of the above and in (accordance with the relevant protocols so that it can be re-evaluated.

1.2 Responses

This section details SCM's responses to the issues listed above. It should be noted that these responses are directly from the Noise Impact Assessment – this section simply clarifies the details of that study.

1.2.1 a) Noise levels at affected residents

With regards to a), DIPNR and DEC are referred to the revised "Noise Impact Assessment" (RNIA) by Atkins Acoustics and Associates (May 2004), submitted to DIPNR on 26th May, 2004.

1.2.2 b) Cumulative noise

For the purposes of determining the cumulative noise impact of train loading and extraction, Atkins Acoustics[1] determined the impacts generated by loading alone and by extraction alone. An analysis of the two together was then conducted. This paper explains the results, and provides an operating regime under which no noise exceedances will be generated.

1.2.2.1 Train Loading

The activities considered for the noise assessment of train loading operations are discussed in section 5.3 of the RNIA. Table 10 in that report lists the components as:

- Surge Bin
- Class 81 Locomotive (at Notch 3 power setting)
- Conveyor Drive – 200 kW
- Conveyor Belt – 400m
- FEL (Volvo L150C)

The second paragraph in section 6.3 (Train Loading Operations) states, "The results of the noise predictions for train loading activities show that the recommended project specific noise levels can be achieved at all reference residential locations." This indicates that, for train loading alone, there will be no noise exceedances.

1.2.2.2 Extraction Operations

The activities considered for the noise assessment of extraction operations are discussed in section 5.2 of the RNIA. Table 9 in that report lists the components as:

- Dozer (CAT D6)
- Surface Miner (Wirtgen 2200M)
- 35-50t Scraper (CAT 651)

The first paragraph on page 32 (section 6.2 – Mine operations) states, "The noise predictions… show extraction activities during both calm and west wind meteorological conditions satisfy the recommended project specific noise goals at all reference residential receiver locations under the operating scenarios referenced." This indicates that, for extraction operations alone, there will be no noise exceedances.

[1] Refer to the revised Noise Impact Assessment by Atkins Acoustics and Associates (May 2004), submitted to DIPNR on 26th May, 2004.

1.2.2.3 Cumulative noise

Paragraph 3 in section 6.3 (Train Loading Operations), the Noise Impact Assessment predicts that during periods when extraction operations and train loading operations are occurring simultaneously, “exceedances (1-3dB(A)) of the project goal (37-38 dB(A)) may occur at some reference receiver locations located at the western end of Newnes [Junction] village (Reference Locations R2-R5).”

Extensive research has been conducted into minimising the noise impacts of the project to the greatest extent possible, including:

- Adoption of alternative mining method
- Muffling of all site machinery through application of noise reduction technology by Metford Laboratories
- Installation of acoustic bund and barrier

Given that these activities result in the potential for some noise exceedances, Sydney Construction Materials will make a commitment, to be detailed in the project Development Consent Conditions, to cease extraction operations for the period during in which noise exceedances would be generated if conducted simultaneously with train loading operations.

Train loading operations at maximum production will occur nine (9) times per week. Each operation will take between 45-60 min. However, due to the configuration of the rail loop, which passes through a large cutting thereby shielding it from the Newnes Junction village, the period during which cumulative noise exceedances would be likely to occur would be somewhat less than 60 min. As such, SCM undertakes to perform noise monitoring throughout train loading operations to determine the period during which cumulative noise impacts would exceed the project noise goal. Extractive operations would be temporary halted during such times to ensure compliance with project noise goals.

1.2.2.4 Locomotive noise

The fourth paragraph in section 6.3 (Train Loading Operations) of the Noise Impact Assessment indicates that the bulk of the noise from train loading activities is associated with the locomotive. Given this, and given that the locomotive will be located outside the mine lease area at all times, Atkins Acoustics recommends that it not be considered for cumulative noise impact assessments. This is a recommendation only, and does not indicate that the locomotive was excluded from the cumulative noise impact assessment (see section 5.3 of the Noise Impact Assessment, pp23-24).

Given that DIPNR disagrees with this recommendation, and given that cumulative noise exceedances can be readily eliminated through manipulation of extraction operation schedules, Sydney Construction Materials does not intend to challenge the validity of including locomotive noise in the determination of projected cumulative noise impacts.

1.2.3 c) Annoyance Factors

The EPA requested that the Noise Assessment consider annoyance characteristics in accordance with the guidelines and procedures presented in the Environmental Protection Authority, Industrial Noise Policy (EPA, INP). The modifying factors outlined in Section 4 of the EPA, INP that could be considered include: tonality, impulsiveness and low frequency content.

Measured 1/3 octave noise levels of the main plant and equipment (dozer, FEL, truck and generator) have been reviewed in accordance with the EPA, INP Section 4 and do not exhibit tonal characteristics.

A review of similar operations (Rocla, Newnes Junction) has confirmed that noise sources are not impulsive therefore corrections for impulsive characteristics are not relevant.

In terms of dominant low frequency content, a review of measurement results of the main plant and equipment (dozer, FEL, truck and generator) has found that the measured A-weighted and C-weighted noise levels from these plant vary do not vary by more than 15dB(A) in accordance with the EPA, INP Section 4. Hence low frequency adjustments are not relevant.

1.2.4 d) Construction Noises

The EPA has confirmed that the use of construction noise goals will not be accepted for staged development of the site. Accordingly, a ‘construction phase’ of less than 26 weeks (background L_{A90} +10dB(A)) will occur, and will include site establishment, erection of infrastructure and development of an acoustic barrier for the purpose of noise control. Details of the acoustic barrier can be found in the RNIA. The RNIA was conducted with the RNIA in place, with results indicating that there will be no noise exceedances throughout the project life.

1.2.5 e) Re-design of Operations and Re-assessment of Noise Impacts

As detailed in the RNIA, the development was altered to include the erection of an acoustic barrier. Reassessment of the development with the barrier in place is also detailed in the RNIA.

2. Visual Impact of Acoustic Barrier – DIPNR, 23rd February 2005

2.1 Issue Raised

During discussions held with DIPNR (David Kitto and Phil Jones) on 23rd February 2005, it was brought to the attention of the Company that it would be necessary to provide an assessment of the visual impact of the proposed visual/acoustic barrier (the "Barrier") included in the revised quarry design to mitigate visual and acoustic impacts from the proposal.

2.2 Response

This section discusses the visual aspect of the Barrier to be installed as part of the mitigative measures for the SCM Newnes Junction project from the local residences. It provides a visual transect from the Newnes Junction residence closest to the Barrier, and discusses the measures required to eliminate any visual impact relating to the Barrier.

2.2.1 Overview of impact of proposed visual/acoustic barrier

Figure 1 below provides a plan view of the proposed Project area, including the location and orientation of the Barrier. Figure 2 below provides a detailed plan view of the relationship between the Barrier and the nearest residence, including the location of the cross section A-A. The cross section A-A is depicted in Figure 3, Figure 4 and Figure 5 below.

Figure 3 below shows an aerial view of the Project area. It shows the approximate location of the Barrier, and gives an indication of the extent of vegetation already existing between the nearest residence and the Barrier.

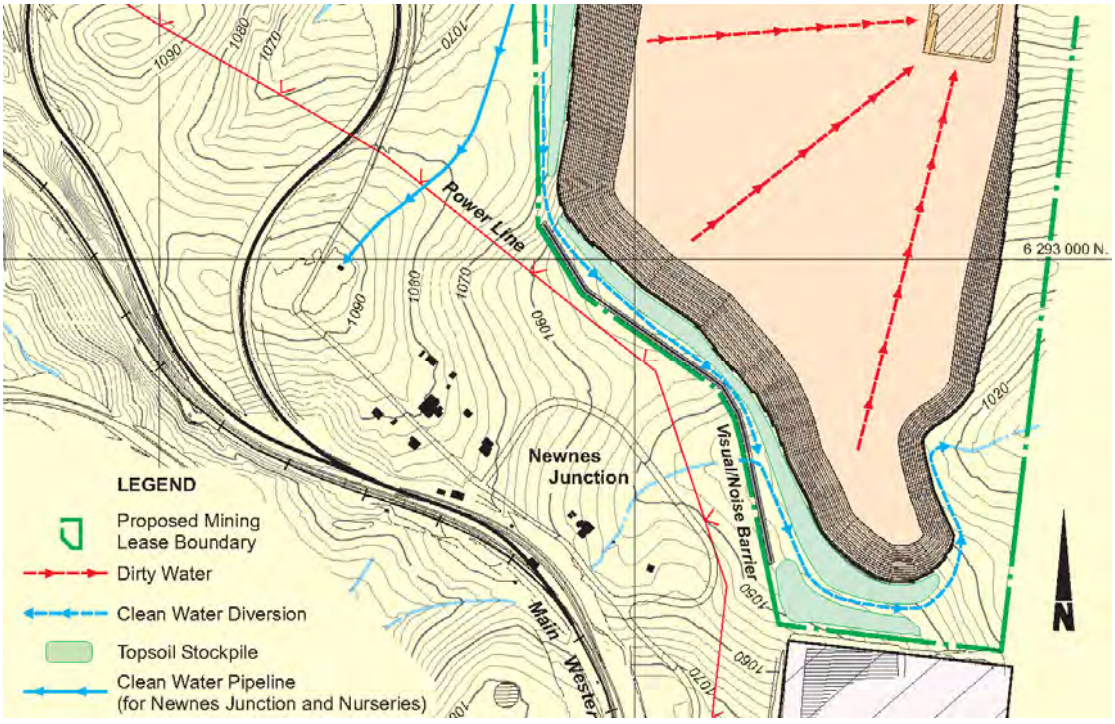


Figure 1 - Plan view of Project area

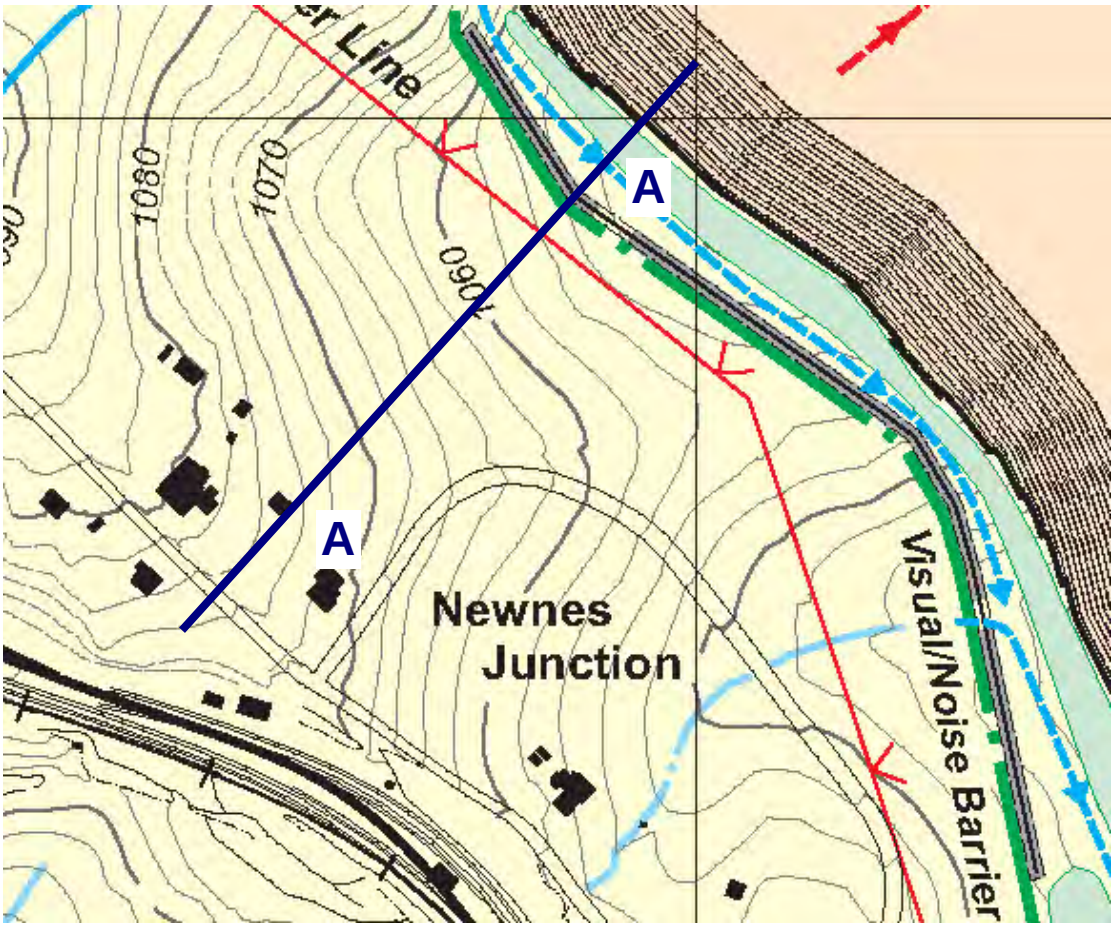


Figure 2 - Detail of visual/acoustic barrier including cross-section A-A for visual transect

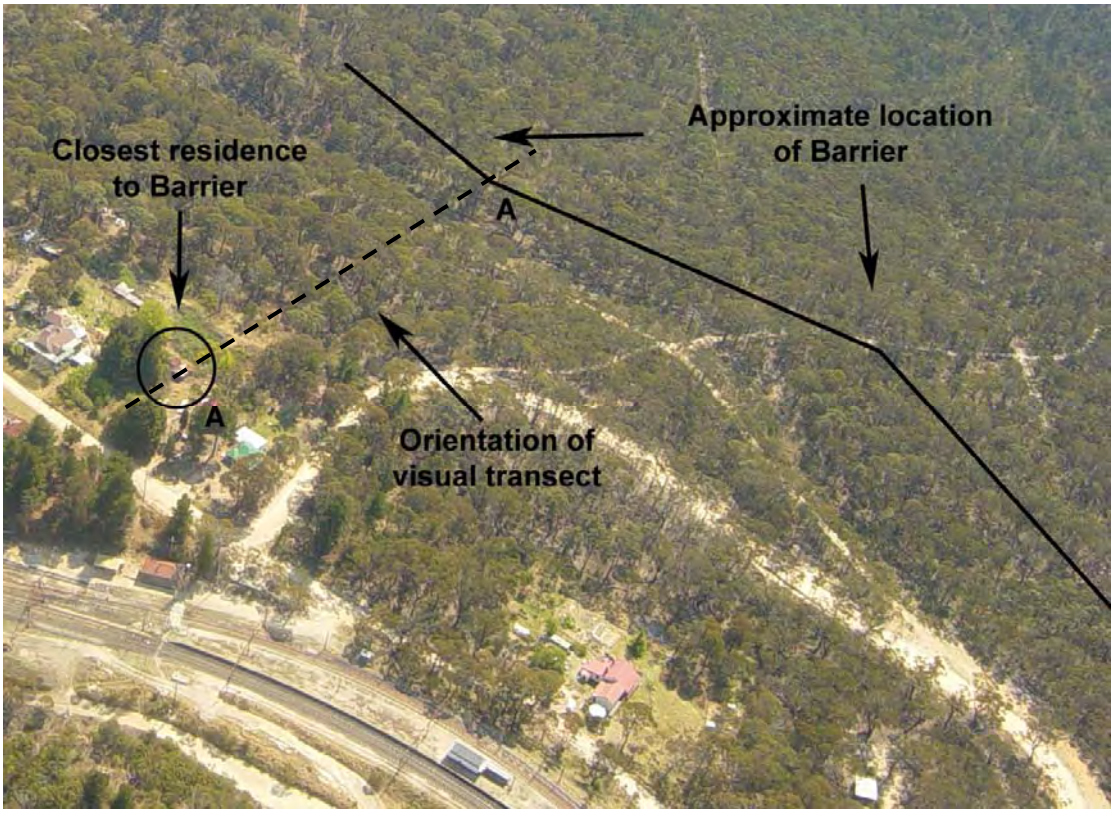


Figure 3 - Aerial view of Barrier locality

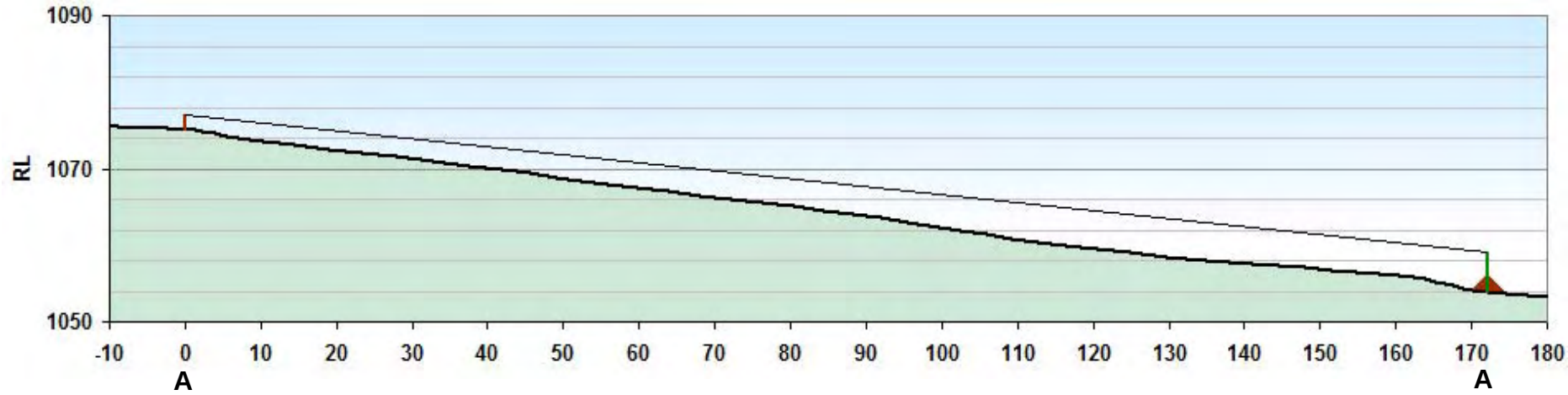


Figure 4 - Visual transect of Barrier from nearest residence, unvegetated

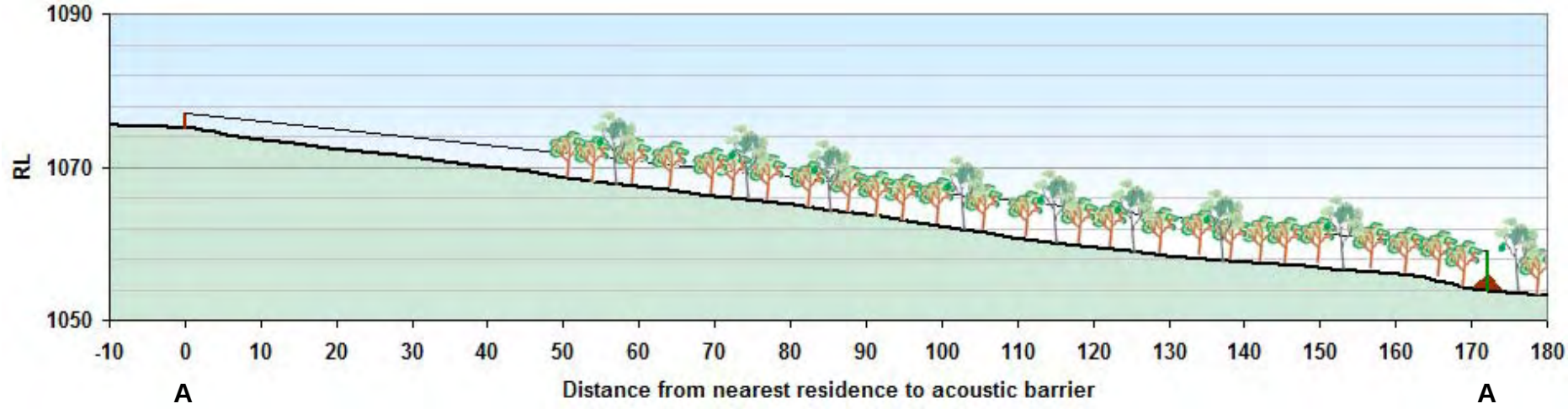


Figure 5 - Visual transect of Barrier from nearest residence, vegetated

2.2.2 Findings

Investigations by the Company indicate that there will be minimal visual impact as a result of the installation of the Barrier. Examination of Figure 4 reveals that it is quite clear that at 50 metres from the nearest residence, a tree 3 or more metres tall will completely obscure the Barrier for a 2 metre tall person standing at the nearest residence. From Figure 3, it is quite clear that although there is an area of cleared land between the nearest house and the Barrier, there is nevertheless more than 100 metres of established vegetation that will provide adequate visual mitigation. Figure 3 also reveals that the amount of vegetation between the other residences and the Barrier is greater than that between the nearest residence and the Barrier, which means the visual impact from those residences will be equally non-evident.

2.2.3 Conclusion

It is the Company's conclusion that although a 5 metre high visual/acoustic barrier might be expected to have a visual impact on the residents of Newnes Junction, the fact that there will remain over 100 metres of existing vegetation ranging in height to well over 3 metres indicates that there will be minimal, if any, visual impact created by the Barrier at the residences.

3. Flora and Fauna Assessment – DIPNR, 18th September 2003

3.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

1. ***Flora and Fauna Assessment.*** *The Department requires an adequate assessment of the existing flora and fauna of the site in order to assess the impacts of the proposal. The flora and fauna assessment has failed to identify areas of Newnes Plateau shrub/heath swamp that exist on the site which are potential habitat for the Blue Mountains Water Skink. The Department is yet to receive comment from the National Parks and Wildlife Service on the flora and fauna assessment. This will be forwarded when it is received. The Department has received a submission by P & J Smith Ecological Consultants which identifies deficiencies with the flora and fauna component of the EIS. A copy of the submission is enclosed. Please provide the additional information required to remedy the deficiencies identified by P & J Smith.*

3.2 Response

DIPNR is referred to the report entitled, "Flora and Fauna Issues" by Gunninah Environmental Consultants (May 2004), submitted to DIPNR on 26th May, 2004. The report includes a revised Section 5A Assessments of Significance, information additional to that in the EIS, and includes:

- a Supplementary Vegetation and Flora Survey (HWR Pty Ltd – Andrew Carty, Geoff Winning, and John-Paul King), and
- a Supplementary Survey for the Blue Mountains Water Skink (Biosphere Environmental Consultants Pty Ltd – Dr Arthur White).

4. Impacts of Vegetation Clearing – DIPNR, 18th September 2003

4.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

2. ***Impacts of Vegetation Clearing.*** *The EIS identifies that over 25 hectares of native vegetation will be cleared by the proposal. Please provide information of the measures to be undertaken by the applicant to mitigate or offset this impact. The Department believes there should be a net environmental improvement in the area, in the medium to long term.*

4.2 Response

DIPNR is referred to the report entitled, "Conservation, Restoration and Enhancement Project" by Sydney Construction Materials (November 2004), submitted to DIPNR on 11th January, 2005.

5. Surface Water Impacts – DIPNR, 18th September 2003

5.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

3. ***Surface Water Impacts.*** *Please provide an assessment of the proposal configured so that the final land form is free draining. Also provide an assessment of the impacts on the upper reaches of the Wollangambe River in terms of flow regime water quality and aquatic habitat.*

5.2 Response

DIPNR is referred to the reports entitled, "Surface Water Management Plan" by Hughes Trueman (May 2004), submitted to DIPNR on 26th May, 2004, and "Soil and Water Management Plan" by GSS Environmental (October 2004), submitted to DIPNR on 11th January, 2005.

6. Final Void – DIPNR, 18th September 2003

6.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

4. ***Final Void.*** *Please demonstrate the final void is safe in the long term for people and animals. Also assess the impacts of the proposed water impoundment on the ecology of the local area.*

6.2 Response

This section details Sydney Construction Materials' response to the above issue. It discusses the elimination of over flow, wall breach, and drowning risks and the elimination of erosion, site collapse, and fall risks in the Project area.

6.2.1 Elimination of over flow, wall breach, and drowning risk

In an attempt to create a visually appealing feature with the final landform of the Newnes Junction project, SCM proposed a shallow lake at the bottom of the development at the conclusion of operations. It was considered that this option would constitute a far more suitable rehabilitation than is currently performed in the extractive industry.

Following discussions with local environmental groups, and taking submissions to the EIS into consideration, SCM altered the final design concept to provide a free-draining wetland at the conclusion of operations rather than a shallow lake (see Figure 6 below). Details of the altered quarry plan and final rehabilitation landform can be found in the "Quarry Plan" by MineConsult Pty Ltd (May 2004). This design, inspired by the nearby Gooches Crater (Figure 7), is in keeping with the surrounding landscape, and will result in a far safer, much more stable environment than the original shallow lake concept.

As water will not pool in the final landform, as it will be free-draining, there will be no risk of over flow or wall collapse during storm events. The quarry wall at the north-eastern corner of the development will be excavated at the end of operations, allowing the to-be-created wetland to drain into the existing drainage. This wetland will act as a natural filter, supplying clean rainwater to the Wollangambe River. Moreover, as water will not be able to pool, there will be no possibility for humans or animals to drown, further increasing the safety of the development's final landform.

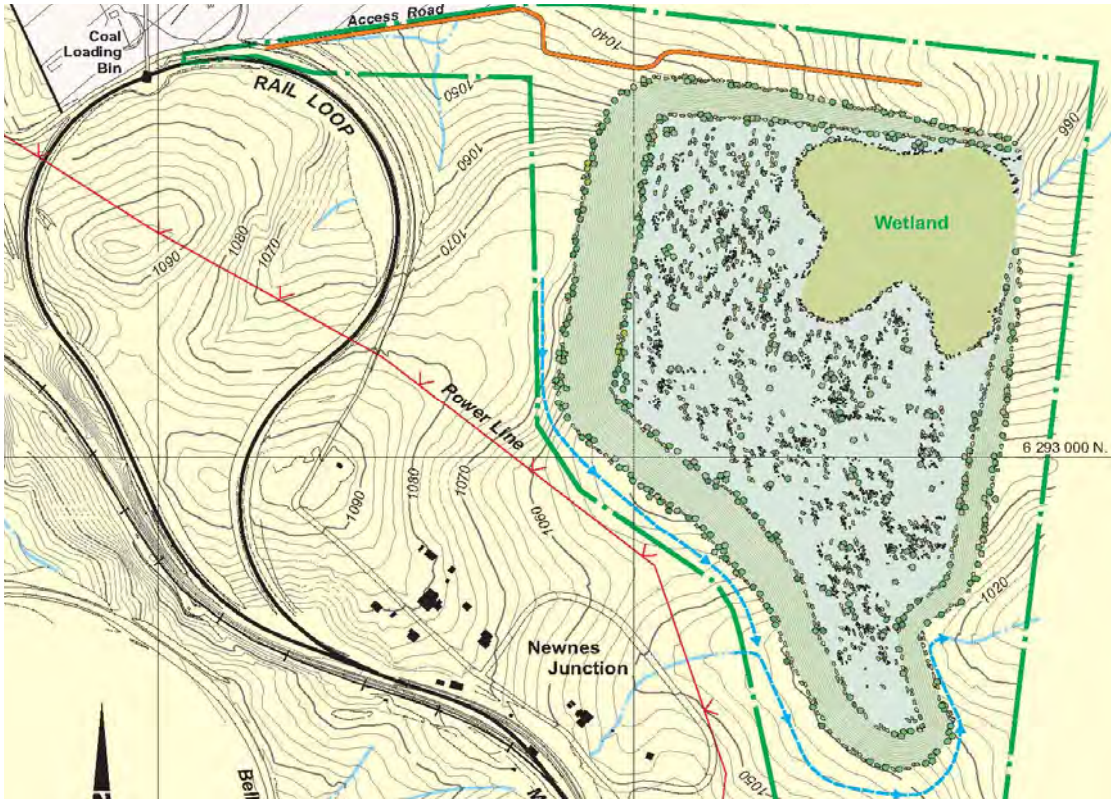


Figure 6 - Conceptual design of final landform, including free-draining wetland



Figure 7 - Gooches Crater, the inspiration for the development's final landform

6.2.2 Elimination of erosion, site collapse, and fall risk

The progressive rehabilitation to be employed throughout operations at the Sydney Construction Materials development will create a series of steps or terraces down the wall of the development. This is done specifically so as to provide benches on which native vegetation will be planted to enable the site's rehabilitation and visual integration, but also provides a significant safety feature for the development (see Figure 9 below).

As can be seen in Figure 8 below, these benches will be left every 3 vertical metres down the development wall. By growing native vegetation on these benches, the walls of the development will be stabilised, preventing erosion or collapses. In addition, the visual impact potentially created by such a development can be effectively eliminated, by providing a green, vegetated wall. The slight gradient of the benches towards the wall (see Figure 10 below) will provide further safety and landform security by promoting the motion of loose objects towards the wall. By slowing the flow of water over the edge, this feature will also contribute to the slowing of potential erosion. Moreover, by placing a 2 metre wide bench every 3 vertical metres, the distance a person could potentially fall is significantly reduced to just 3 metres. Other quarries in the area, and indeed other natural landforms, do not provide similar such levels of safety, with some permitting potential falls in excess of 20 metres. Further details on the design of the terraced landscaping can be found in section 6.2 of the Soil and Water Management Plan prepared by GSS Environmental (October 2004).

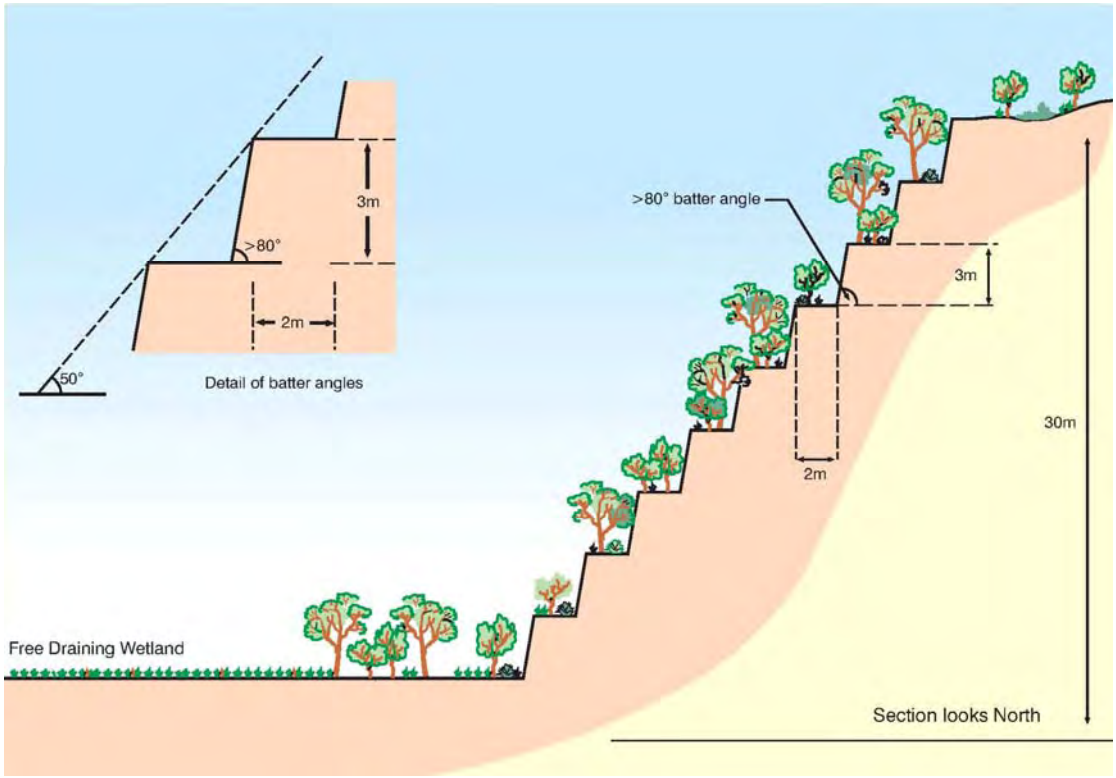


Figure 8 - Cross-sectional detail of progressive rehabilitation



Figure 9 - Actual terraced landscaping in progress

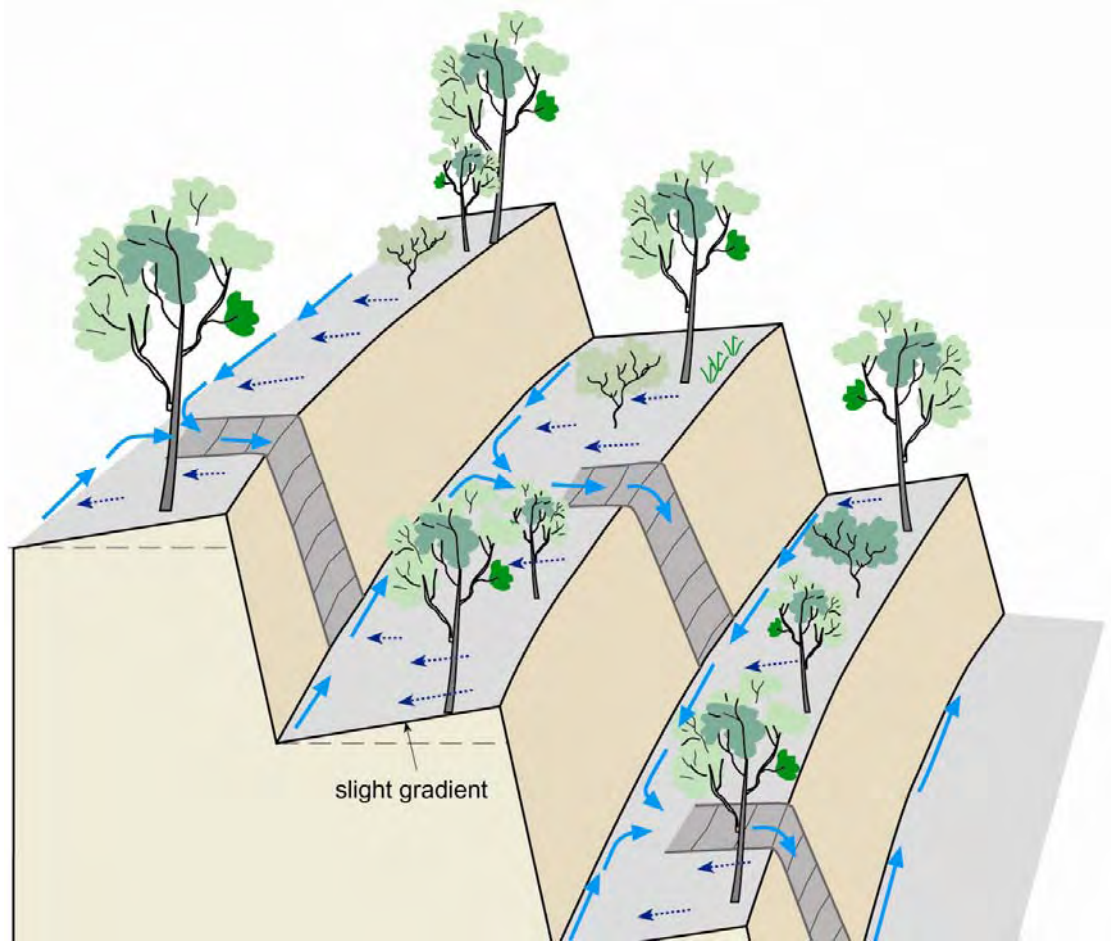


Figure 10 – Close-up detail of terraced landscaping benches

6.2.3 Conclusion

Sydney Construction Materials believes that the work done to ensure the safety of surrounding bushland and to provide a development with minimal visual impact has resulted in a development far superior to and far safer than any current extractive operations. The removal of the shallow lake from the final landform, eliminating over flow, wall breach, and drowning risks, and the provision of terraced landscaping, eliminating erosion, collapse, and fall risks, will ensure the safety of the development site after the conclusion of operations in perpetuity.

7. Groundwater Assessment – DIPNR, 18th September 2003

7.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

5. ***Groundwater.*** *You are required to provide a groundwater assessment that utilises sufficient baseline data to thoroughly evaluate the likely drawdown impacts.*

7.2 Response

DIPNR is referred to the report entitled, "Hydrogeological Impact: Newnes Kaolin Proposed Open-Cut" by Kalf and Associates and the Water Research Laboratory UNSW (December 2004), submitted to DIPNR on 11th January, 2005.

8. Iron Factor – DIPNR, 18th September 2003

8.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

6. ***Iron Factor.*** *Please provide an explanation of the derivation and use of the "iron actor" referenced in section 4.1. Please address the issues raised by the DMR in their submission of 5 September 2003.*

Following is a summary of the issues raised by the DPI (formerly the DMR) in their submission of 5 September 2003.

Issue #	Issue Summary
1	Geology and resource reporting not well documented in EIS.
2	No map showing drill-hole locations.
3	No details provided of the distribution of the pale (low iron) and darker (high iron) coloured sandstones within the site (include cross-sections to illustrate this).
4	Resources not reported in a format consistent with JORC code.
5	No details of the basis on which resource estimates have been determined, nor reference to reports in which it was calculated.
6	No explanation of "iron factor" or how it was determined.
7	No qualification for reliability of quoted "iron factor" values.
8	Agreement/consent required from holders of conflicting titles (CCL 705: Coalex P/L, Clarence Coal Investments P/L & Authorisation 307: Hartley Valley Coal Company P/L).
9	Follow-up whether Mining Lease should be extended over areas of conflict in point 8 above. This may result in a part cancellation of affected coal titles.
10	Information in EIS relating to soil stripping, water management, fauna and flora management, rehabilitation/revegetation and final closure land use is only conceptual. Details will be required under the Mining, Rehabilitation and Environmental Management Process (MREMP), including the development of a satisfactory Mining Operation Plan (MOP).
11	Further information and clarification on specific rehabilitation objectives is required prior to commencement of operations.
12	Attention should be drawn to design of overburden emplacement stockpiles, means of retaining safe and adequate access to rehabilitation benches, and location of topsoil stockpiles (so as to ensure they're not adversely affected by mine operations and do not impede progressive rehabilitation).
13	Further detail on ongoing maintenance and upgrading of reclaim tunnel (transport route between mine site and rail loop) required.

14	Evidence of any necessary licences and approvals for the use of ground water from the sump must be presented in the MOP. Details of the type of work and the nature of the infrastructure as well as environmental management procedures should also be included.
15	Groundwater hydrology investigations are inadequate. Baseline data presented is insufficient for thorough evaluation of drawdown impacts.
16	Onsite water management should be designed for 1/50 year 1 hour rain event in parallel with design rainfall isopleths from the BOM.
17	Concern relating to the proposed width of the rehabilitated slope benches. The conceptual width does not allow mobile plant to access and egress safely and for fall protection of machinery and people. Design for construction and maintenance of benches must be supported by adequate risk assessment of potential hazards.

8.2 Responses

The submission by the Department of Primary Industries (DPI), Mineral Resources, (Ref L03/0455) on the Sydney Construction Materials (SCM) EIS lodged on May 2003 highlighted the importance of the proposed development site with its large resources of friable sandstone to be utilised for a range of construction and industrial uses. It is noted in the submission that this deposit has the potential to be an important source of construction sand for the Sydney Region, particularly when the Penrith Lakes Scheme and Kurnell cease production in the near future. In addition, it is acknowledged that the substantial resources of kaolin within the matrix of the sandstones have potential for use in a range of applications.

The DPI supports the Newnes Junction Sand and Kaolin Project as an appropriate and effective development of a valuable resource and the ultimate benefit of the local region and the State.

This section details SCM's response of the issues raised in the DMR submission.

8.2.1 Issue # 1 – Geology and Resource Reporting

Exploration geology over the tenement area (Exploration Licence 4192) has been carried out under the requirements of the Department of Mineral Resources (DMR) since 1992 resulting in a substantial database of geological information. Although they are in the possession of the DMR (now DPI), they are classified confidential and therefore not available for public scrutiny.

MineConsult was commissioned in 1999 to prepare a conceptual quarry design and to prepare a resource statement based on available drilling data (MineConsult, 1999, Report 1438). The friable sandstone has been subdivided into two grades based on iron content. Premium grade comprises white, off white and pale yellow sandstone, whilst standard grade comprises variegated sandstones. At this current stage of mine planning and resource assessment, reporting under the Joint Ore Reserves Committee (JORC) code has been initiated but not yet finalised.

Drill hole data (based on 11, 9 inch auger drill holes) was used to create a geological model using Gemcom computer software. Grades of premium and standard ores were determined from the drill logs and computer modelling in a pit shell design of 10 metre horizontal slices (MineConsult 1999). Average grade of kaolin (7.6%) was determined from laboratory separation from bulk drill hole samples (Goldbery 1997).

Since 1999, the pit design has undergone certain changes to accommodate environmental concerns raised during the submission process. Final resource assessment is presented in MineConsult (2004).

In summary, the geological characteristics of the friable sandstone of the Banks Wall Sandstone, within the proposed quarry area are best summed up in the following table:

Premium Grade – 74%	Pea Gravel[2] > 2mm	=	2.26%
Standard Grade – 26%	Sand[2] (+ 75μm)	=	77.40%
Kaolin Grade – 7.6% (-10μm)	Kaolin[2] (-20μm)	=	7.60%
Shales/Claystones – Absent	Silt[2] (-75 to +20μm)	=	12.44%
Ironstone – Traces (thin bands only)		=	100.00%
Aquifers – Absent (Kalf & Assoc., 2004)			

Table 1: Main Characteristics of Friable Sandstone Ore

8.2.2 Issue # 2 – Drill Hole Locations

Several generations of drilling programmes have been carried out on EL4192 since 1992. The following table provides a summary of the data:

Drilling Method	No. of Holes	Year	Report (Location Map)
Reverse Circulation	9	1992	Brink & Co. (1992)
Reverse Circulation	57	1994	Goldbery (1995)
Auger 4inch & 9inch	15	1996	Goldbery (1997)

Table 2: Summary of Drilling Programmes

Each of the reports referred to in Table 2 above, contain a drill-hole location map.

8.2.3 Issue # 3 – Distribution of Premium and Standard Grade Sandstones

Although the RC programme of 1994 (see section 8.2.2 above) produced samples contaminated with silica flour and was hence unsuitable for kaolin grade determination, the colour variation were a reliable guide to the sub-surface distribution of Premium and Standard grades of friable sandstone. Detailed cross sections appear in Goldbery (1996). Cross sections of the auger-drilling programme of 1996, appear in Goldbery (1998).

[2] Based on sieve analysis, various reports. Brink and Co (1992), Goldbery (2002)

8.2.4 Issue # 4 – JORC Code Format

The classification and calculation of the reserves of the two classes of friable sandstone (Premium and Standard) have been based on auger drill hole data from the western portion of the tenement (EL4192) i.e. drill lines 1-3 (Figure 11 below) (MineConsult, 1999 – Appendix A).

The resource over this area is classed as estimated reserves, whilst the resource over the eastern area is classed as probable reserves. It is however acknowledged that until finalisation of the JORC code analysis, these reserve classifications remain tentative even though there are no changes anticipated in the outcome. JORC code analysis, however, is not required for the Development Application process.

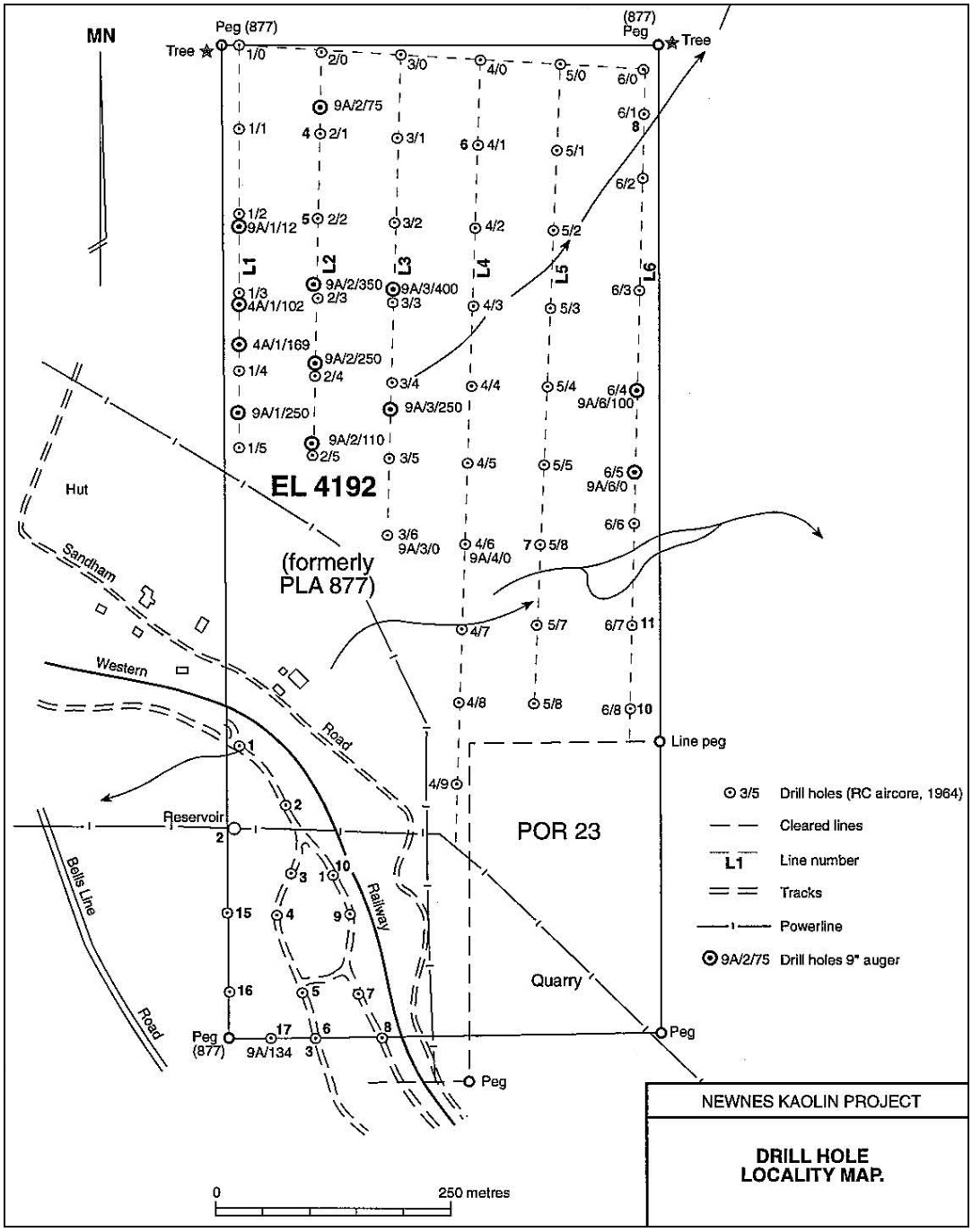


Figure 11 - Map of drill hole locations

8.2.5 Issue # 5 – Resource Estimates

Initial modelling and resource estimates have been discussed in section 8.2.1 above. Revised resource estimates have been prepared in accordance with changes in the conceptual mine plan, in response to environmental issues raised during the display period of the EIS. The final estimates have been presented in MineConsult (2004).

8.2.6 Issue # 6 – Explanation of "Iron Factor"

Quantification of ironstone (ferricrete) occurrences within regional drill holes over the Newnes Plateau (Pecover 1986) has been achieved by assigning a conversion factor for each of the drill log terminologies of Pecover (1986). The values assigned are subjective, however when applied to each of the eleven drill holes and measured sections it provides us with the relative means of comparison of ironstone values over the Newnes Plateau – see Figure 12below. Figure 12 contains graphical logs from drill holes and measured sections at various locations on the Newnes Plateau (Pecover, 1986) showing the distribution of ferricrete densities and the calculated iron factors. The conversion table used follows below:

Pecover (1986) Drill Log Terminology for Ferricrete Concentration	**Factor for Conversion to Ironstone Thickness**	**Probable Factor Based on Field Exposures**
Ferricrete (F)	1m = 1m (100%)	100%
Thin closely spaced bands of Ferricrete (Cl)	1m = 0.75m (75%)	30%
Numerous bands of Ferricrete (N)	1m = 0.5m (50%)	20%
Minor thin bands of Ferricrete (M)	1m = 0.25m (25%)	10%

Table 3 – "Iron factor" conversion table

Following site visits to exposures of friable sandstone containing ferricrete bands, in particular the Clarence Sand and Gravel Quarry (Boral Pit) on the southern side of the Main Glow Worm Tunnel Road (Boral), more accurate "ground truthed" conversion factors, scaled down to less than half the original estimates, have been included in the table.

When calculating the iron factor in a particular drill hole, the thickness of ironstone (ferricrete) in each of the logged intervals is calculated back as an adjusted thickness. For example, for a 6m interval logged as friable sandstone with numerous bands of ferricrete, the calculated thickness of ferricrete is 50% x 6m = 3m. The final iron factor is the percentage of total ferricrete thickness over the entire drilled section.

Measured section NPS1 of Pecover (1986) (4^{th} sample, Figure 12 below) yielded an iron factor of 38.5. When recalculated with probable values (see previous table), the iron factor is 18. As all iron factor values are calculated on the same scale the results are relative and there is no difference to the final interpretations.

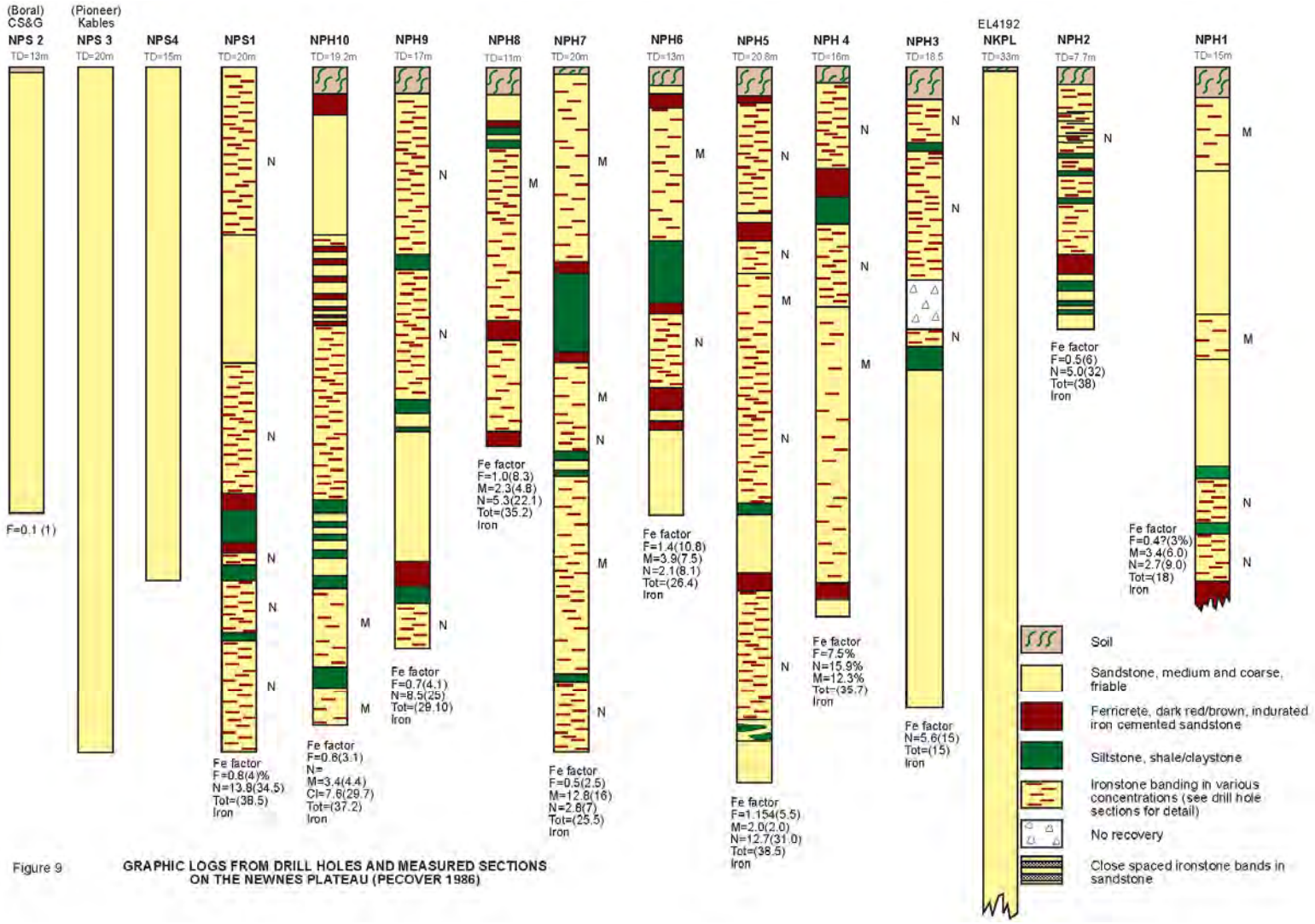


Figure 12 - Graphic Logs from Drill Holes and Measured sections on the Newnes Plateau (Pecover 1986)

8.2.7 Issue # 7 – Reliability of quoted "iron factor"

Iron factors based on a subjective interpretation of the drill cuttings by the geologist carrying out the drill logging can never produce precise quantitative results. Only diamond drill core can achieve this. However, the terminology employed to qualify a measure of concentration of ironstone banding can be readily sorted into a sequence from most abundant to least abundant, and then converted to a quantitative value.

On the assumption that the drill logger is consistent with the application of his descriptive terminology, a direct comparison can be made between drill holes and the percentage of ironstone in each of the drill holes.

8.2.8 Issues # 8 & 9 – Agreement to use portion of existing Coal Title

The portions of the existing Coal Titles will be leased from titleholders to access land for conveyance of friable sandstone to the Rail Loop.

Agreements have been reached through a Heads of Agreement with Centennial Coal Company over the use of a portion of CCL705 for rail access.

8.2.9 Issues # 10, 11 & 12 – Rehabilitation; stockpile designs (MOP)

The GSS Environmental (2004) report provides details of the distribution of soil stockpiles along the pit margins; their management, design of clean water diversion works; in pit water management; quarry haul road design and management and sediment control plans. Hughes Trueman (2004) deals with detailed Surface Water Management plans.

The Mining Operation Plan (MOP), a requirement of the Mining, Rehabilitation and Environmental Management Process (MREMP) is a prerequisite for the commencement of mining and not a requirement of the EIS. The proponent is aware of these obligations. Details of rehabilitation and revegetation processes consistent with the surrounding undisturbed areas have been presented in the GSS Environmental (2004) report.

The final landform constitutes a wetland design, designed in accordance with the equivalent of the Constructed Wetlands Manual (1998) (DIPNR, formerly DLWC) and will involve input from and consultation with, government regulatory agencies including DEC (comprising the former NPWS and EPA).

It is anticipated that sedges and other wetland plants endemic to the area will colonise this wetland area to form a swamp ecosystem analogous to that in Gooches Crater, a natural crater feature located approximately 2km north east of the project area.

8.2.10 Issues # 13 & 14 – Maintenance of reclaim tunnel, ground water licences

These issues will be dealt with in the MOP, presented for approval prior to commencement of mining.

8.2.11 Issue # 15 – Groundwater Hydrogeology

The hydrogeological impact of the proposed development at Newnes Junction has been assessed in accordance with the guidelines requested by Dan McKibbin, Senior Natural Officer (Ground Water Management, Sydney South

Coast Region, DIPNR). Drilling was completed to a maximum depth of 60m at three sites within the proposed development area. Packer testing and recovery tests were carried out for permeability and ground water modelling using these results followed. Kalf and Associates Pty Ltd (2004) have prepared a detailed report, concluding that the sandstones have low permeability and thorough modelling has shown that there will be minimal disturbance of the groundwater as a result of mining.

8.2.12 Issue # 16 – 1/50Year Rain Event

Onsite water management has now been designed to cater for a 1/100 year ARI 72 hour storm event. DIPNR is referred to the "Surface Water Management Plan" by Hughes Trueman (May 2004).

8.2.13 Issue # 17 – Stockpile/overburden design; rehab benches

Rehabilitation benches do not need to be accessed after ripping and direct seeding. The method of vegetating terraced landscaping structures has been successfully applied to a quarried friable sandstone sequence in the Somersby region. Six months produced a significant growth of native trees and shrubs (GSS Environmental, 2004).

The terrace design (see figure 3.14, Sydney Construction Materials, EIS, May 2003, reproduced in Figure 10 above) illustrates the slight gradient of each terrace directed back to the pit wall. This provides both for optimum water retention on the ripped surface of the bench and also is a safety factor, which inhibits loose material falling down the terraces into the active pit during mining operation.

8.2.14 References

Brink and Co. Pty Ltd, 1992, Report on Resource Evaluation (Clay, Sand, Sandstone) at Newnes Crossing, Blue Mountains.

GSS Environmental, 2004, Soil and Water Management Plan (SWMP) Newnes Junction Sand and Kaolin Extraction Project, Newnes Junction, NSW, SCM 1-1

Goldbery, R, 1995, Third Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit (confidential)

Goldbery, R, 1996, Fourth Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit (confidential)

Goldbery, R, 1997, Fifth Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit (confidential)

Goldbery, R, 1998, Sixth Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit (confidential)

Goldbery, R, 2002, Tenth Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit (confidential)

Hughes Trueman, 2004, Surface Water Management Plan, Newnes Junction Sand and Kaolin Extraction Project, 045112

Kalf and Associates Pty Ltd, 2004, Hydrogeological Impact, Newnes Kaolin Proposed Open-Cut

MineConsult, 1999, Newnes Kaolin quarry conceptual mine design, report No. 1438 (unpublished)

MineConsult, 2004, Newnes Junction Sand and Kaolin Extraction Project Quarry Plan, report no. 1864 (unpublished)

Pecover, S.R., 1986, Construction and industrial sand resources of the Newnes Plateau Geological Survey of New South Wales, Report GS 1986/214 (unpublished)

9. Justification of Kaolin Extraction – DIPNR, 23rd February 2005

9.1 Issue Raised

During discussions held with DIPNR (David Kitto and Phil Jones) on 23rd February 2005, it was brought to the attention of the Company that it would be necessary to provide a justification of the Company's claims regarding the feasibility of extracting, processing and marketing Kaolin from the Project area.

9.2 Response

Some submissions on the Sydney Construction Materials EIS brought into question the economic feasibility of extracting and marketing kaolin from the Newnes Junction deposit. This section provides justification of SCM's plans to extract friable sandstone, process off-site, and market the kaolin component of the NJ resource.

9.2.1 Kaolin Investigations Prior to the Granting of Exploration Licence 4192 (EL4192)

Considerable interest for commercial development of the kaolin resource within the friable sandstones at Newnes Junction dates back to 27 September, 1988 with an application lodged for a Prospecting Licence 887 (PLA 887) for Group 5 (Clays) with the NSW Department of Mineral Resources (DMR) by Australian Aggregates Pty Ltd.

The "kaolin" tenement predates by almost four years an application lodged by the same party on 23 January 1992 for a sand extraction licence over the same area at Newnes Junction. The application was refused on 9th September 1996 – on the basis that "if it could be proven that damage to the environmental and nature conservation values of the locality could be minimised, mining may become a viable land use for this area if the decision was made for economic benefit to outweigh the loss of natural resource". Newnes-Kaolin Pty Ltd applied for a new application for a licence to extract sand on 10 October 2000.

PLA 887 was converted to Exploration Licence 4192 by the DMR on 7 February 1992 and title was transferred to the Newnes Kaolin Pty Ltd partnership during 1994. The stimulus for kaolin exploration at Newnes Junction was no doubt initiated by an investigation carried out by the DMR in June 1984 (Kmetoni, 1984).

The investigation was undertaken to evaluate the industrial mineral potential of sand washing tailings from the current Rocla Pit (formerly Australian Aggregates Pty Ltd) as a raw material resource for the production of beneficiated kaolin. The beneficiated clay produced through hydrocyclone classification was proven to be high quality china clay suitable for use in whiteware ceramics. It should be pointed out that samples for analyses for the DMR investigation were taken directly from the tailings dam adjacent to EL4192, and as such, provide an excellent representative sample of the kaolin from the proposed extraction site.

Magnetic filtration for further beneficiation of the kaolin carried out by the Aquafine Corporation in USA (Kmetoni, 1985) showed the technical feasibility of producing beneficiated kaolin, with a significantly lower iron content, from the Rocla tailings dam with the following proportions:

Fe_2O_3	As low as	0.34%
TiO_2	As low as	0.26%
Kaolinite (dickite)	As high as	83%
Al_2O_3	As high as	35.1%
Brightness	(unfired)	77%
Brightness	Calcined briquettes	93%

Table 4: Some Technical Specifications of Newnes Junction Kaolin

According to the Department of Mineral Resources (Kmetoni 1985), the beneficiated kaolin is therefore suitable for high-grade china clay in whiteware ceramics, refractories and also as mineral fillers.

9.2.2 Kaolin Investigation Following Granting of EL4192

Sydney Construction Materials (SCM) has carried out an extensive evaluation of the kaolin resource within the tenement area since the granting of EL4192 in 1992. X-ray diffraction analyses of kaolin obtained from drill hole and outcrop samples were carried out by the CSIRO Division of Exploration and Mining (Goldbery, 1995).

Kaolinite occurs together with Dickite (a polymorph) in well crystalline form very similar in characteristics to well crystalline kaolin from Georgia in the USA. The results clearly demonstrate the homogeneity and high-grade characteristics of the kaolin.

Quantitative analyses to determine the <10μm kaolin content of bulk samples of friable sandstone from 9 inch auger drill holes on the tenement (Goldbery, 1997) were carried out at Macquarie University on a purpose built, bulk sample separation plant. The results gave an overall grade of 7.6% kaolin for the friable sandstone deposit (Goldbery, 1997). The actual grade of kaolin is anticipated to be higher, based on analyses of kaolin content vs. depth (from drillhole samples), which show an increase of kaolin to a maximum of over 15% at 20m and therefore a more realistic figure for overall grade is closer to 10%, a figure which coincides with the kaolin grade determined by Kmetoni (1984) from the Rocla tailings dam.

9.2.3 Newnes Plateau Geological Characteristics

Geological modelling, based on available data on the Newnes Plateau, has shown that the project site is unique. The quality of the kaolin, as determined by percentage of iron oxide and brightness, increases across the plateau in a south-east direction towards the Project area. Beneficiation studies carried out by the DMR (Kmetoni 1984 a,b,c) determined the iron content (Fe_2O_3) and brightness on a suite of raw untreated kaolin samples and beneficiated (magnetic filtration and calcination to 1200°C) kaolin samples from each of the three sand extraction pits on the Newnes Plateau. These include the pits

operated by the former Clarence Sand and Gravel Pty Ltd (now Boral), Kables (now Pioneer) and Australian Aggregates Pty Ltd (now Rocla) (Figure 13). [3]

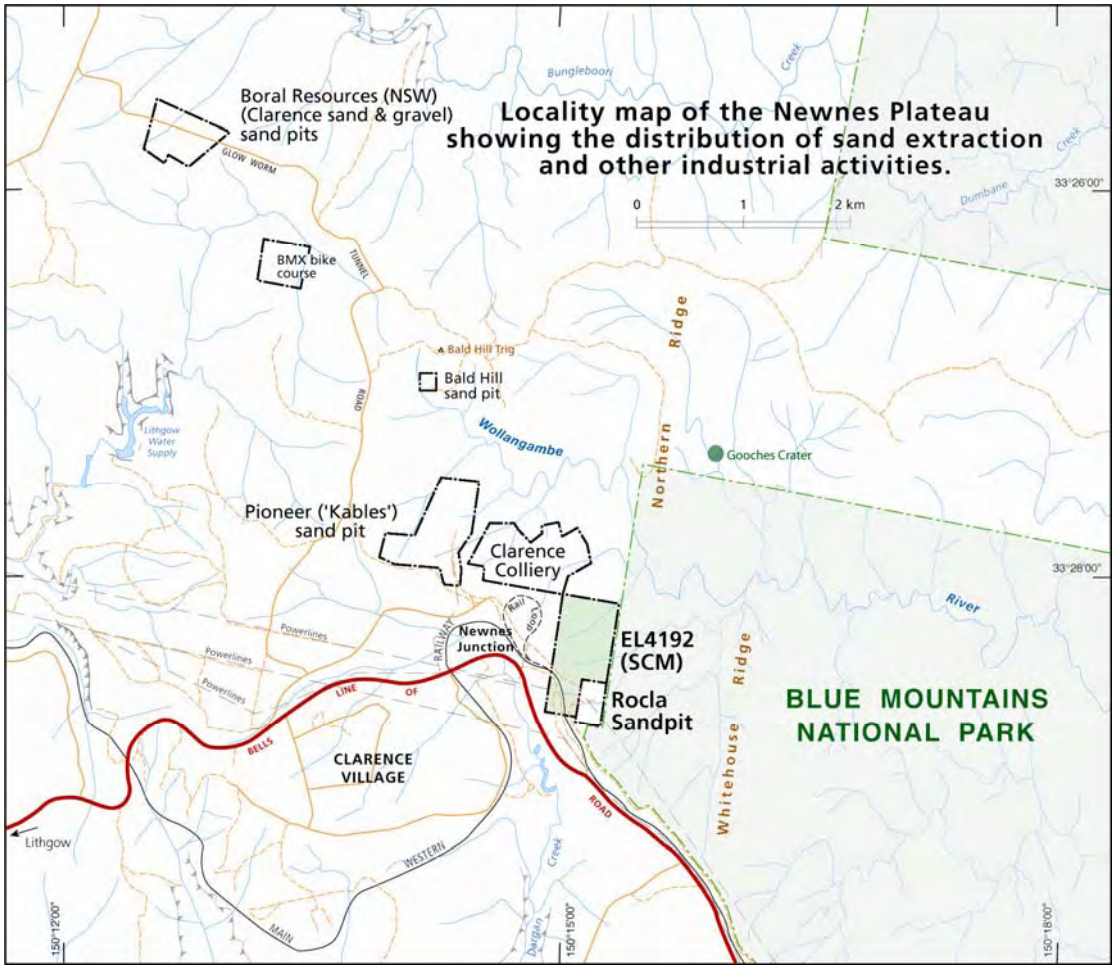


Figure 13: Locality map of the Newnes Plateau showing the distribution of sand extraction and other industrial activities

The results have been plotted in Figure 14, and show a definite improvement in kaolin quality moving from the Boral pit in the north to the Rocla pit in the south. Anecdotal evidence gives 4% (pers. comm. Keith Muir & Kables mine manager, from unpublished CSIRO report, quoted in "The Environment Groups'" submission to the SCM EIS) for the percentage of kaolin in the friable sandstone from the Kables (Pioneer) pit to the north. The nearly double kaolin content at the Newnes Junction site further reinforces the theory regarding the general direction of enrichment of the kaolin resource already reflected by a progressive lowering of iron content and consequent increase in brightness of the kaolin from north-west to south-east.

[3] The determination of the kaolin content from drill hole samples taken from the Project area were carried out by Mr Keith Maxwell from the Macquarie University School of Earth Sciences. Mr Maxwell does not and has never held any commercial interest in this Project. Testing of the kaolin fraction within the tailings dams at the Rocla site, carried out by Kmetoni (1989), indicated an average of 10% kaolin.

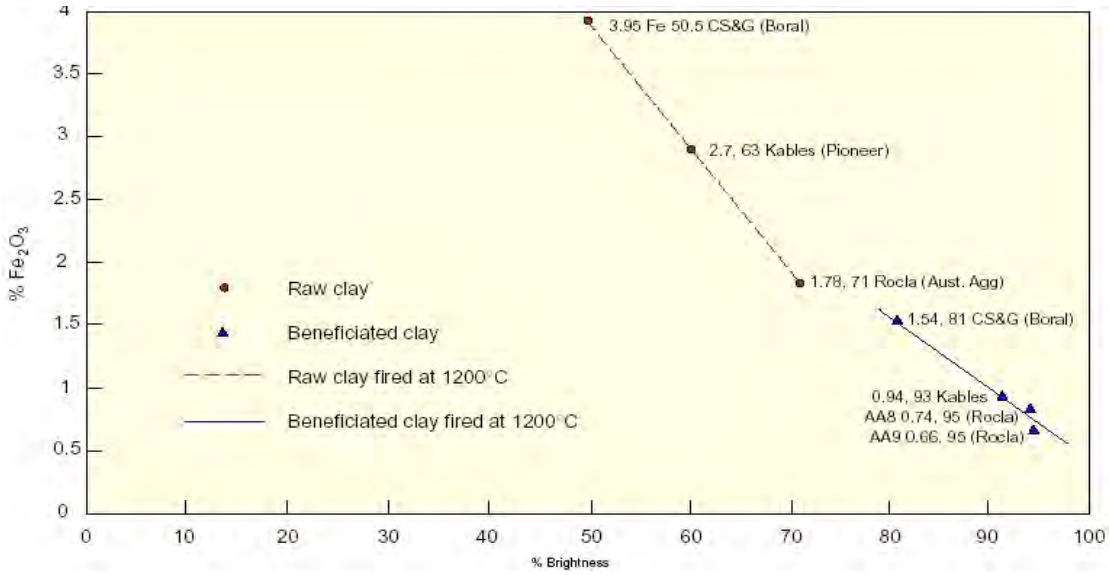


Figure 14: Plot of average % Fe_2O_3 against average % Brightness for Three Newnes Plateau Pits, Raw and Beneficiated, Calcined at 1200°C

As EL4192 is adjacent to the Rocla Pit, it clearly demonstrates that it has the capability of yielding the highest quality of kaolin of all the existing sand operations on the Newnes Plateau.

9.2.4 Newnes Junction Kaolin Properties

As discussed above and below, significant market research has gone into determining the economic feasibility of extracting, processing, and marketing the Newnes Junction kaolin. Attached at Appendix 1 is an outline of the material properties of the Newnes Junction kaolin resource and a comparison with other currently available kaolins.

9.2.5 Kaolin Processing Plant

Sydney Construction Materials has held commercial discussions with landholders of three sites within the Great Sydney area for locating a sand washing and kaolin processing facility. These discussions, however, are the subject of commercial confidentiality, and as such, cannot be made public at this stage.

A conceptual flow-chart describing the process for production of the various kaolin products is shown in Figure 15 below. The friable sandstone will be washed in attrition cells to remove the kaolin and silt matrix (particle size <75 µm) from the loosely bound quartz sand and gravel fraction, and then passed through screens to remove pea gravel (particle size >2mm). The next process involves a series of hydro-cyclone sizers in which sand (particle size >75µm), kaolin (particle size <20 µm), and remaining quartz silt (particle size 75 µm-20 µm) are separated.

The kaolin component is passed to a thickening tank where it settles to produce a slurry of 20% solids. Investigations are underway to determine the feasibility of bacterial beneficiation to further reduce the already very low iron content. If this process is to be implemented, it would occur at this stage. If bacterial beneficiation is not implemented, the kaolin will pass through magnetic separators to remove any particles coated with a film of iron oxides,

before being passed through a filter press to significantly lower the moisture content. Although low in iron content, this component is not white enough for the higher-end products, and so would be sold for low value building products (light coloured bricks, tiles, and pavers).

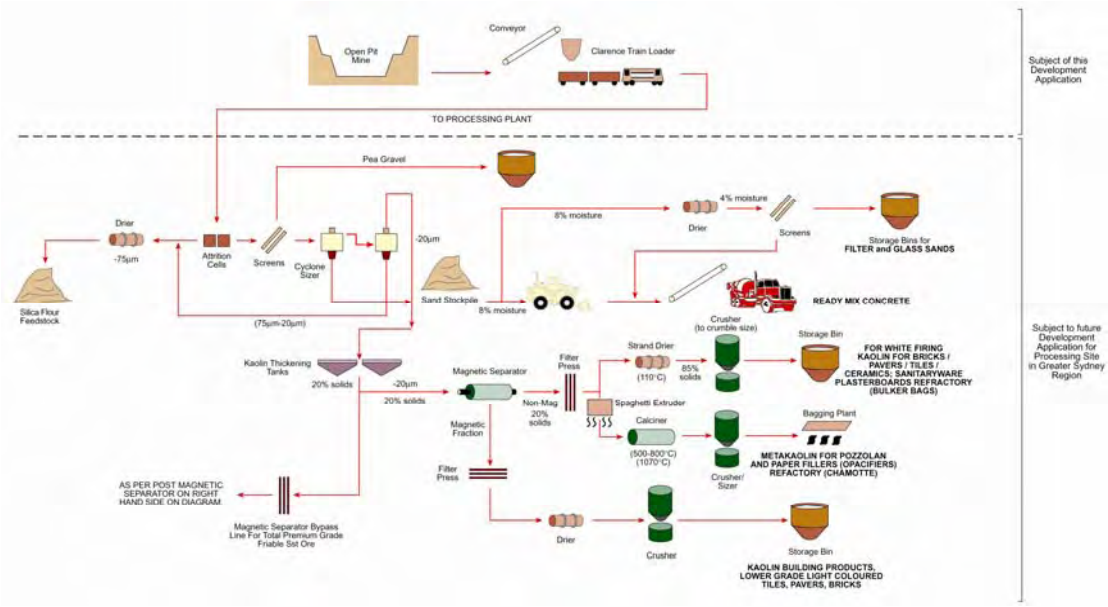


Figure 15: Conceptual SCM kaolin processing flow chart

The non-magnetic kaolin component will be further processed, first by being passed through a filter press, before proceeding into one of two processes. The first involves drying and crushing to produce white firing kaolin for bricks, pavers, tiles, ceramics, sanitaryware, plasterboards, and refractory clays. The second involves calcining (heating to between 500°C and 1200°C depending on final application) and crushing to produce metakaolin for pozzolans (cement additive) or paper and paint fillers (opacifiers & functional fillers).

These processes have been designed in conjunction with Stratum Resources (experts in modern processing plant technology) and Roger Smith & Associates (Mineral Processing Engineers), following significant processing and product investigations. The market research underpinning the production of the various kaolin products is discussed below.

9.2.6 Market Research

9.2.6.1 Resource characteristics

Kaolin is the most valuable component of the Newnes Junction deposit. Kaolin is a near-white clay, predominantly composed of the mineral kaolinite, the chemical composition of which is $Al_2Si_2O_5(OH)_4$ (hydrous kaolinite). For many modern industrial applications, kaolin must be extensively refined and processed (mainly water-washing, delaminating and calcining) from its original state to obtain important, required commercial characteristics. After beneficiation, kaolin ranks as one of the most valuable of the industrial clays.

The Newnes Junction kaolin occurs as a matrix within quartzose sandstone, and averages 7.6% by volume with individual zones exceeding 15% concentrations. The kaolin has been formed on site by ground water alteration of detrital feldspar and other clay minerals, such as illite, and as a result, has

recrystallised into a homogeneous, well-ordered, crystalline platy kaolinite, exhibiting superb industrial properties.

There are other deposits of kaolinite sand/sandstone deposits elsewhere in the world (e.g. Europe), where, like the SCML resource, the host sand is a valuable co-product.

9.2.6.2 Industrial properties

In comparison to other clay minerals, the kaolin from the Newnes Junction deposit has a range of unique optical, physical, and a compositional properties that makes it ideally suited for a broad selection of industrial uses. These properties (from Kmentoni 1986 report) are summarised below.

- High brightness (reflectivity): 77/100 GE (raw); > 93/100 GE calcined
- Particle size: 50% finer than 2 microns
- Low alkalis: K_2O ~0.72%; Na_2O ~0.10%
- Low iron content (after magnetic separation): ~0.34%
- Low titanium: ~0.26%
- High alumina: ~35.1%
- High Pyrometric Cone Equivalent (PCE): 32
- Well ordered, crystalline structure; hexagonal plates (mixture of kaolinite and dickite), close resemblance to world's best kaolins, i.e. Georgia USA, Cornwall UK

9.2.6.3 Industrial uses

The main industrial uses of kaolin include:

- Partially-calcined (750-800^{o} C kaolin with its high brightness is used as a paper filler and coater (in the form of Metakaolin) and replaces expensive TiO_2 as an opacifier.
- Uniform particle size and homogeneity is necessary for optimum use in plastics, paint, and rubber as functional fillers, improving the tensile strength, electrical properties, and dimensional stability of finished products.

The above uses of kaolin account for approximately 60% of worldwide kaolin consumption (2002), and require a high-quality product. The remainder is used in the following applications:

- Excellent additive in mix for bricks, tiles, and pavers to produce a range of pastel coloured products. The kaolin additive, known as "white-firing clay", is currently in short supply in Sydney.
- Low alkalis and low iron are necessary chemical properties for the production of Metakaolin, a cement pozzolan.
- High PCE, combined with suitable chemistry, i.e. low alkalis and low iron, are necessary ingredients for the production of refractory kaolin.

- Main whiteware ceramic markets include sanitaryware and glazes, utilising the higher grades of kaolin.
- Unrefined kaolin is used in traditional ceramics such as floor and wall tiles.

9.2.6.4 Sources of kaolin

World production of kaolin in 2002 was an estimated 24.6 Mt with an annual growth rate of around 1.75%. Overall demand for kaolin is forecast to grow at a rate of approximately 2% pa to attain some 27.7 Mt in 2010. Kaolin is produced in over 60 countries, and in most cases output is relatively small. Processed production only exceeds 1 Mtpa in the USA, UK, Brazil, and probably China.

The majority of kaolin is consumed close to where it is produced, but there is a substantial amount shipped over large distances. Apart from supply and demand, the main factor affecting the price of kaolin is the cost of processing.

9.2.6.5 Australian production

There are six main kaolin producers in Australia, mainly supplying the local market. A period of consolidation of ownership has led to Unimin (part of Sibelco, Belgium) emerging as a major domestic producer. Australia currently produces close to 155,000 tpa. Kaolin occurs in all states of Australia with major deposits in WA, NSW, Qld, and Vic. There are very large resources of kaolin in WA and SA but the lack of water of suitable quality for processing has been a consistent impediment to the development of these deposits (mainly high salt levels). Several of the deposits are in remote locations resulting in prohibitively high costs of transportation (e.g. Broome, Skardon River).

Victoria has a significant 200,000 t kaolin resource at Axedale, with an open cut mine producing 50,000 tpa of ball clay, suitable only for the ceramic white ware industry. At the Lal Lal and Pittong deposits near Ballarat, Imerys Minerals Australia (formerly English China Clays) produces around 60,000 tpa of kaolin used mainly for paper coating.

Cape York Peninsula has been the focus of active mining development of kaolin deposits since the late 1990s. The Weipa operation by Comalco ceased production in 1996, exploration is ongoing by Cape York Kaolin south of Weipa, and Minerals Corporation, the owner of Skardon River Kaolin, operating in the same region has experienced technical problems with processing and are still attempting to commercialise this operation. It plans to export calcined kaolin to Europe and Asia. Unimin Australia is the largest producer of kaolin in Queensland from its recently acquired Kingaroy deposit, where it processes crude kaolin, dried pelletised, and bagged for general use, and produces a delaminated kaolin for paper coating.

South Australia is a small producer of kaolin mainly used in cement manufacture and industrial fillers. At Williamstown, a mixed sillimanite-kaolinite product (Kaosil) is used for the manufacture of refractories and insulators (< 3,000 tpa).

Kaolin in NSW is currently sourced from Gulgong, mainly ceramic and filler grade products. Altogether, the Gulgong plants have a combined production capacity of 40,000 tpa. It is apparent that current production is becoming sub-economic because of excessive overburden thickness, with kaolin restricted to deep pockets only.

Additional sources of kaolin are in the Southern Highlands area around Marulan and Windellama, where individual small pockets of kaolin are mined for the bricks, tiles, and pavers industry to produce light coloured products.

The huge advantage of the SCML kaolin resource is its outstanding technical properties, which make it suitable for a wide range of industrial applications. Its source will be in the Western Sydney area as a co-product of washed friable sandstone. Processing facilities will be located within industrialised Western Sydney on a rail facility for export and interstate distribution and adjacent to a source of non-saline water for processing.

The Newnes Junction kaolin resource fits the motto for a successful industrial mineral project “BIG, WHITE, AND CLOSE TO MARKET”. The deposit has a resource of approximately 2 Mt, a beneficiated brightness of ~93/100, and will be located virtually in industrial Western Sydney.

9.2.6.6 End uses

Markets into which SCM intends to sell the Newnes Junction Kaolin include:

Metakaolin – pozzolans	High Reactivity Metakaolin is a semi-calcined kaolin, used to significantly enhance the performance characteristics of cement-based mortars, concretes, and related products. It contributes to increased strength, reduced permeability, greater durability, efflorescent control, and control degradation caused by Alkali Silica Reaction (“ASR”).
Metakaolin – opacifier	Metakaolin plays an important role in paper manufacture as a paper coating, used to reduce strikethrough (the ability to see printing on the reverse side) in thin paper, thus allowing the use of thinner paper. Also used as an opacifier in paint to achieve the same effect.
Plastic filler	Used in the production of polyvinyl chloride, polypropylene, polyethylene, and unsaturated polyesters. Minerals are added to polymers as low cost extenders and/or reinforcement materials.
Rubber filler	Kaolin is a major non-black filler material used in rubber, accounting for a portion of all the non-black filler used. It is used in shoe heals and soles, floor tiles and mats, conveyor belts, bicycle tyres, household products, toys, rubber, and clothing.
Refractory clays and Chamotte	SCML kaolin has excellent refractory properties, i.e. high Pyrometric Cone Equivalent (PCE), low alkalis, and high purity, allowing it to serve as a suitable raw material for refractory kaolin production.

Glass fibre reinforcement	Used as a reinforcer in the production of glass-fibre products (e.g. printed circuitboards).
Ceramics	Kaolin is a prime ingredient in a wide range of traditional products, such as floor and wall tiles, tableware, sanitaryware, and electrical porcelain.
Plasterboard filler	Used as a filler in the manufacture of various types of white plasterboard.
Brick and tile additive	Structural clay products include common and facing bricks, clay pipefittings, roofing tiles, outdoor pavers, and other fired clay products used as basic components in the building and construction industries. In order to achieve the currently fashionable pastel shades of bricks, tiles, and pavers, it is necessary to use a blend of a number of different raw materials.

9.2.7 Failure of Other Operators to Market Kaolin

Sydney Construction Materials cannot comment on the specific reasons for the failure of other operators on the Newnes Plateau (Rocla, in particular) to market the kaolin in their developments. As discussed above, independent testing of the kaolin fraction in the Rocla tailings dam indicates that it represents 10% of the resource, so the argument that it is too low a proportion of the deposit is not valid. Indeed, since Rocla have already gone to the effort of extracting the kaolin from the ground, and the market research discussed above indicates that there is clearly a market for the resource, the decision to bury this valuable co-product in tailings dams is difficult to understand.

Sydney Construction Materials suggests that one reason for Rocla's failure to market this valuable resource is that it is a construction sand business, not an industrial minerals business. The two industries are currently quite separate, and historically have maintained independence. However, given that SCM is not privy to internal Rocla discussions, this suggestion should be considered speculation only.

The situation in the Kables Sands quarry to the north west is different. Sampling has shown that the kaolin content averages only about 4% in the Kables quarry, making it less feasible to extract, beneficiate and market than at the proposed SCM and Rocla developments.

9.2.8 Conclusion

This is the only location on the Newnes Plateau adjacent to a rail loop, allowing the extracted product to be economically transported entirely by rail. The combination of the high-grade industrial characteristics of the kaolin in the Project area, the high market demand for Kaolin products, together with its proximity to the rail loop, make this a unique resource on the Newnes Plateau.

9.2.9 References

Goldbery, R, 1995, Third Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit, 22p, 3 appendices (confidential)

Goldbery, R, 1997, Fifth Annual Report to the New South Wales Department of Mineral Resources on Exploration Licence 4192, Newnes Plateau Clay Deposit, 33p (confidential)

Kmetoni, J.R.S, 1984 a, Beneficiation of Sand Washing Tailings from Australian Aggregates Pty Ltd, Clarence, New South Wales. Department of Mineral Resources NSW, Chemical Laboratory Branch, unpublished report 84/23, 29p, 6 appendices.

Kmetoni, 1984 b, Beneficiation of Sand Washing Tailings from Kables Pty Ltd, Clarence, NSW. Department of Mineral Resources NSW, Chemical Laboratory Branch, unpublished report, 84/35

Kmetoni, 1984 c, Beneficiation of Sand Washing Tailings from Clarence Sand and Gravel Pty Ltd, Clarence, NSW. Department of Mineral Resources, NSW, Chemical Laboratory Branch, unpublished report, 84/29

Kmetoni, J.R.S., 1985, Effect of Magnetic Filtration on Classified Clay from Sand Washing Tailings, Australian Aggregates Pty Ltd, Clarence, NSW, unpublished report, 8p

Minerals Corporation Ltd, 2001, Prospectus for the issue of Proposed ASX listed Converting Notes

Sydney Construction Materials, 2003, Environmental Impact Statement for Multi-Commodity Sand Extraction and Kaolin Project for Supply of Construction Materials to the Sydney Region from Newnes Plateau (unpublished)

Stratum Resources, 2001, Background and Sales Opportunities for Newnes Kaolin Pty Ltd (NKPL) Focusing on Kaolin and Silica Co-Products from the Proposed Project, 70p, 1 appendix (confidential unpublished report)

10. Interactions with Zig-Zag Railway – DIPNR, 18th September 2003

10.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 18th September 2003:

7. ***Interactions with the Zig Zag Railway.*** *The Zig Zag Railway has development consent to extend its railway line to the village of Newnes Junction. Please assess the potential impacts of the proposed mine on the operation of the railway and vice versa.*

10.2 Response

Sydney Construction Materials has met with representatives of the Zig Zag Railway and has discussed its potential interaction with the Newnes Junction Sand and Kaolin Extraction Proposal. Zig Zag Railway did not raise any objections. A letter from SCM to ZZR confirming these discussions is attached at Appendix 2.

11. Flora and Fauna Assessment – NPWS, 22nd September 2003

11.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 22nd September 2003 summarising NPWS's requests for further information:

> *The applicant is required to provide the following:*
>
> - *Provision of a thorough and comprehensive evaluation of the habitat of the site,*
> - *Provision of 8-part tests for species potentially affected.*

11.2 Response

NPWS is referred to the report entitled, "Flora and Fauna Issues" by Gunninah Environmental Consultants (May 2004), submitted to DIPNR on 26th May, 2004. The report includes a revised Section 5A Assessments of Significance, information additional to that in the EIS, and includes:

- a Supplementary Vegetation and Flora Survey (HWR Pty Ltd – Andrew Carty, Geoff Winning, and John-Paul King), and
- a Supplementary Survey for the Blue Mountains Water Skink (Biosphere Environmental Consultants Pty Ltd – Dr Arthur White).

12. Aboriginal Heritage Assessment – NPWS, 22nd September 2003

12.1 Issue Raised

The following issue was raised in DIPNR's letter to SCM on 22nd September 2003 summarising NPWS's requests for further information:

> *The applicant is required to provide the following:*
>
> - *Provision of a revised assessment of Aboriginal Heritage values to address issues as identified by the National Parks and Wildlife Service in its earlier submission (dated 13 August 2003)*.

12.2 Response

NPWS is referred to the document entitled, "Response to NPWS Comments on the Archaeological Assessment" by Mills Archaeological and Heritage Services (August 2003), submitted to DIPNR on 26th May, 2004.

13. Potential Air Quality Impacts – DEC, 10th October 2003

13.1 Issue Raised

The following issues were raised in DEC's letter to SCM on 10th October 2003:

1. *Provide predictions of the maximum dust concentrations and deposition levels at the boundary of the proposal and the Greater Blue Mountains World Heritage Area (Blue Mountains National Park), and Wollemi Wilderness Area, for;*

   - *Predicted maximum 24-hour average PM10 concentration at ground level as µg/m3*
   - *Predicted annual average PM10 concentration at ground level as µg/m3,*
   - *Predicted annual average TSP concentration at ground level as µg/m3,*
   - *Predicted annual average dust deposition at ground level as g/m2/month.*

   The predictions should be provided for Stage 2 (indicative of conditions early in the operation of the quarry), and for Stage 5 when the proposed quarry would be operating at maximum production and with the greatest area of disturbed area (when the potential Impact on the World Heritage Area is expected).

   The proponent needs to clarify the difference, if any, between the modified buffer and the buffer which may be implemented for the proposed quarry. There needs to be greater focus and discussion on the Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area.

2. *Provide a map showing the predicted extent and concentrations of dust deposition over the Greater Blue Mountains World Heritage Area (Blue Mountains National Park), and Wollemi Wilderness Area ie what area will be affected and in what concentrations. A preliminary map is provided for the proponent's benefit.*

3. *Provide details of walking tracks, if any, in Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area in the vicinity of the interface between these areas and the proposed quarry, and assess the likely impacts of predicted air pollution levels (dust, TSP, PM10) on persons using those tracks.*

4. *Provide details on the potential impacts of predicted air pollution levels (TSP, dust) on flora and fauna in the adjacent Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area. The sensitivity of individual plant species to dust, and the sensitivity of the botanical community (in that part of the World Heritage Area and Wilderness Area closest to the proposed quarry) as an ecological entity, should be assessed. Any potential impacts on fauna in these areas should also be addressed.*

5. *Provide details of design, orientation, plant arrangement and operation, etc. that would reduce the dust, TSP, PM10 emissions in the Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area.*

13.2 Response

This section clarifies the Company's findings on the Air Quality Impact Assessment (AQIA) (Holmes Air Sciences, 2003) of the proposed Newnes Junction Sand and Kaolin Extraction development. It should be noted that the issues raised in the DEC's submission were covered in the Air Quality Impact Assessment in SCM's EIS (Holmes Air Sciences, 2003, included in SCM EIS, Appendix F).

Nevertheless, following are responses to DEC's requests regaring the Air Quality Impact Assessment.

13.2.1 Issue #1 – Air Quality Impacts at Boundary of GBMWHA and Wollemi Wilderness Area

Table 5 below details the criteria for which results were requested by DEC, the Project goals for those criteria, and the modelled results at stages 2 and 5 of the project. These figures are inferred from Figures 7-14 in the Air Quality Impact Assessment by Holmes Air Sciences (2003), included in the SCML EIS.

Criteria	**Target[4]**	**Stage 2[5]**	**Stage 5[5]**
Predicted maximum 24-hour average PM_{10} concentration at ground level as µg/m^3		~10	~20
Predicted annual average PM_{10} concentration at ground level as µg/m^3	12	~1	~5
Predicted annual average TSP concentration at ground level as µg/m^3	45	~2	~7
Predicted annual average dust deposition at ground level as g/m^2/month	2	~0.2	~1

Table 5 - Air quality impact results (Holmes Air Sciences, Figures 7-14)

It is clear from these results that the air quality impact from the SCM proposal will not exceed the air quality goals determined in the Air Quality Impact Assessment.

The nearest part of the Wollemi Wilderness Area to the Project area is over 10km distant. Given that it is unlikely that there would be any exceedances outside the Project area as a result of this development, there is therefore very little likelihood of there being any adverse air quality impacts on the Wollemi Wilderness Area.

[4] These figures are from section 5 in the Air Quality Impact Assessment (Holmes Air Sciences, 2003) included at Appendix F of the SCML EIS.
[5] These figures are estimates, based on Figures 7 – 14, Air Quality Impact Assessment (Holmes Air Sciences, 2003) at Appendix F of the SCML EIS. The point at which readings were taken is the north-eastern corner of the Lease area.

13.2.2 Issue #2 – Maps of Air Quality Impacts

Figures 7-14 in the AQIA contain maps showing the extent of air quality impacts from the proposed development on the GBMWHA.

13.2.3 Issue #3 – Impacts on Users of Nearby Walking Tracks

Attached at Appendix 3 is an SCM File Note on investigations into the presence of established bushwalking tracks in the vicinity of the proposed development. The conclusions of SCM's investigations are:

- The main focus for walking activities is well to the north of the Newnes Junction project area and is accessed by the Glow-worm Tunnel Road. The main attractions of the area – Deep Pass, Galah Mountain, Glow Worm Tunnel and Bungleboori Picnic Area – are in a range of 10 to 30kms from the proposed development site.
- There are no formed tracks for bushwalking purposes identified from any of the references in the attached list[6] and no tracks have been identified by National Parks and Wildlife Services Personnel within a 5km radius of the proposed development site. The Dargan's Creek Canyon south of the Bells Line of Road is probably the closest locality used by bushwalkers and canyoners, but is located several kilometres south of the project area, and is in the opposite direction of the prevailing winds.

13.2.4 Issue #4 – Air Quality Impacts on Flora and Fauna

Sydney Construction Materials is not aware of any specific criteria against which the impact of TSP and dust on flora and fauna in the GBMWHA are to be measured.

In Australia there is limited research into the impact of dust on the flora and fauna. An examination of the literature indicates that the overall level of knowledge and science of dust pathway impacts is at an early stage; however, most attention is directed to examining any changes in the floristic or fauna composition of the receiving area. Also, studies undertaken in Europe and the United States indicate discernible impacts from dust generation are more related to levels of metals contained in the dust, for example, mercury or copper, and the sensitivity of the receiving environment.

The material to be extracted from the Newnes Junction proposal is essentially inert and contains only small amounts of iron. Literature indicates that iron deposition may be an aid to growth in certain environments. This also applies to other mineral nutrients contained within the dust mix.

An examination of the vegetation immediately adjacent to existing extraction operations at Newnes Junction (Rocla and Kables) indicates no change in the floristic composition as a result of dust deposition or any other impact. This is consistent with the findings of other assessments such as those conducted at Maroota.

In assessing the impact of dust, it is important to take account of the receiving environment's resilience. It is recognised that much of the Australian landscape is susceptible to natural dust generation through drying phases and

[6] See Appendix 3

is accentuated by agricultural practices. The Newnes Plateau is characterised by dry forest on poor quality soils and is prone to dust generation, particularly during droughts.

It is a matter of scientific record that much of the vegetation in Australia developed in parallel with the drying of the continent and the existence of dust storms and high ambient dust levels. Whether the flora and fauna developed as a result of the existence of higher ambient dust levels is a matter for conjecture.

There is no evidence that the existing extraction and mining operations or the addition of a new development will result in measurable impacts on flora and fauna. It would be trite to say that any deposition of dust on leaves is removed by rain but sometimes the obvious is not so obvious.

Any assessment of cumulative impact needs to take into account the likely cessation of extraction at the Rocla operation prior to or shortly after commencement of the SCM proposal due to lack of reserves.

13.2.5 Issue #5 – Dust Reduction Measures

Based in part on feedback to the EIS, and in part on the emergence of more efficient mining technology, SCM has adopted surface mining technology for the extraction of ore from the Project area. Furthermore, the Mining Plant to be employed will provide continuous dust suppression by means of an onboard water tank specifically designed for such a task. These measures will eliminate some of the potential dust emission sources discussed in the Air Quality Impact Assessment, further reducing the already minimal air quality impacts of this development.

13.2.6 Conclusion

Based on an analysis of the findings in the Air Quality Impact Assessment prepared by Holmes Air Sciences (2003) for the Sydney Construction Materials EIS (2003), the air quality impact on the adjoining Greater Blue Mountains World Heritage Area will be well below project air quality goals.

Further, given that the Wollemi Wilderness Area, a part of the GBMWHA, is over 10km distant at its nearest approach to the Project area, it is predicted from the results of the Air Quality Impact Assessment that the air quality impacts there will be negligible.

Finally, with the adoption of surface mining technology, the potential dust emission sources of this development will be lower than those resulting from other conventional quarrying operations.

14. Potential Noise Impacts – DEC, 10th October 2003

14.1 Issue Raised

The following issues were raised in DEC's letter to SCM on 10th October 2003:

1. *Provide predictions of the maximum noise levels (L_{Aeq}) at the boundary of the proposed quarry and the Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area, and evaluate them in terms of the DEC's Industrial Noise Policy.*
2. *Provide a map showing the above predicted extent and levels of noise impact over the Greater Blue Mountains World Heritage Area (Blue Mountains National Park), and Wollemi Wilderness Area. A preliminary map is provided for the proponent's benefit.*
3. *Provide details as to the impacts of predicted noise levels on fauna in the adjacent Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area.*
4. *Provide details of design, orientation, plant arrangement and operation, etc. that would reduce noise emissions in the Greater Blue Mountains World Heritage Area and Wollemi Wilderness Area.*

14.2 Response

It should be noted that the majority of issues raised in the DEC's submission were covered in the revised Noise Impact Assessment conducted by Atkins Acoustics (May 2004), which was submitted to DIPNR on 26th May, 2004.

Following are DEC's requests and SMC's responses based on the revised Noise Impact Assessment.

14.2.1 Issue #1 – Noise levels at Boundary of GBMWHA and Wollemi Wilderness Area

The DEC is referred to the revised "Noise Impact Assessment" (RNIA) by Atkins Acoustics and Associates (May 2004), submitted to DIPNR on 26th May 2004. In particular, DEC is referred to section 7.0 Findings and Recommendations. The third paragraph down indicates that the recommended noise goal of 50dB(A) can be satisfied within 150m of the park boundary.

14.2.2 Issue #2 – Maps of Noise Impacts

The DEC is referred to the revised "Noise Impact Assessment" (RNIA) by Atkins Acoustics and Associates (May 2004), submitted to DIPNR on 26th May 2004. In particular, DEC is referred to Appendices 4, 5 and 6, which include noise contour plots at various stages of development.

14.2.3 Issue #3 – Noise Impacts on Fauna

Sydney Construction Materials (SCM) is not aware of any specific criteria against which the impact of predicted noise levels on fauna in the Greater Blue Mountains World Heritage Area (GBMWHA) are to be measured. Nor is

SCM aware of any evidence for the imposition of significant impacts on native fauna by similar activities elsewhere.

Personal observations and investigations undertaken during other projects (*e.g.* the Lake Cowal gold mine project and a proposed helicopter landing pad in northern Sydney) by F Dominic Fanning of Gunninah Environmental Consultants indicate that the impacts on wildlife of low-level, continuous or gradual noise are extremely limited. Even precipitous noise (*e.g.* blasting in quarries) has been documented as having little effect on wildlife such as nesting falcons (see below).

In a paper entitled "*Effects of Military Noise on Wildlife: a Literature Review*" by Ronald P Larkin (Centre for Wildlife Ecology, Illinois Natural History Survey), results indicate that…

> *"Risk of hearing damage in wildlife is probably greater from exposure to nearby blast noise from bombs and large weapons than from long-lasting exposure to continuous noise or from muzzle blast of small arms fire ... Military blast noise from bombs and large weapons poses greater risk, if any, of hearing damage in wildlife than does continuous noise or small arms fire.".*

The literature regarding the issues of noise and its impacts on native fauna within Australia is relatively sparse, but a substantial body of information is available from overseas, particularly from the United States of America. Investigations there have been related principally to the impacts of aircraft overflights on fauna (especially birds), and to the use of sound to discourage birds from using facilities (‘hazing’).

In general terms, the impacts of helicopter and aircraft overflights appear to be of little concern to native wildlife. Hockin *et al* (1992) report that Red-tailed Hawks in Britain readily habituated to helicopter overflights, and that…

> *“least terns were found to nest on take-off pads of Harrier jets despite their frequent use (Altmann and Gano, 1984). It is also relevant to note that in the United Kingdom many of the Sites of Special Scientific Interest controlled by the Ministry of Defence are used as training areas and artillery ranges support diverse breeding bird populations (Fuller, 1982).”*

Ellis et al (1991) reported that the responses of birds to *“real and simulated mid- to high-altitude sonic booms were often minimal and never appeared productivity limiting”*, and Andersen et al (1989) concluded, *“aircraft overflights are often initially startling, but animals generally adapt to them very well under most circumstances”*.

The use of noise to discourage birds from using certain facilities or sites appears to has generally been unsuccessful. Jeffress (1990) reviewed the use “*hazing*” techniques as an avian deterrent on cyanide ponds at gold mines in the USA, and concluded that “*sound devices have a very limited overall effectiveness as deterrents to waterfowl*”. The use of radio-controlled boats and planes, pyrotechnics, cannons, rock music, avian distress and predator calls, sirens, whistler bombs, and a range of other devices have failed to have other then a short-term effect on waterfowl (Allen 1990; Jeffress 1990). In one instance, the use of 10 automatic acetylene-based bird scarers along an

airport runway "*proved effective for 1 week, after which birds even started perching on them*" (Hockin *et al* 1992).

Similar observations pertain to species such as the Grey-headed Flying Fox and other frugivorous bats in eastern Australia. The use of noise has been spectacularly unsuccessful in deterring such species from raiding fruit orchards or from roosting in certain trees or at certain locations.

At the Temora Gold Mine (Gidginbung NSW), a pair of Peregrine Falcons were reported nesting in the open pit (C Doon *pers comm*). This pair apparently bred successfully and the nest site was subsequently destroyed by a "*pit pushback*" which had been delayed until the young Peregrine Falcons had fledged. This pair of Falcons subsequently built a new nest elsewhere in the open pit, and there were three nesting pairs of Peregrine Falcons within the active Temora Gold Mine pit in 1995.

Whilst the Newnes Junction proposal obviously does not involve military activities, the findings from the above research would reasonably apply to this Project. In particular, the quasi-continuous, low-level ('white') noise from the Project area is not likely to disrupt or otherwise adversely affect wildlife in the adjacent Greater Blue Mountains World Heritage Area.

The Newnes Junction Project complies with the recommended noise guidelines and goals, and the noise emissions from the site will be significantly lower than from a military installation. Furthermore, given that for much of the Project life operations will be located in a pit, shielded from the GBMWHA, the potential for adverse impacts on wildlife will be extremely limited.

14.2.4 Issue #4 – Noise Reduction Measures

The DEC is referred to the revised "Noise Impact Assessment" (RNIA) by Atkins Acoustics and Associates (May 2004), submitted to DIPNR on 26th May 2004. In particular, DEC is referred to section 7.1 Noise Control Recommendations, pages 37-38.

15. Groundwater Assessment – DIPNR, 5th November 2003

15.1 Issue Raised

The following request was raised in DIPNR's fax to SCM on 5th November 2003:

> *Dan McKibben has provided comment on the Groundwater Assessment and the need for the applicant to undertake site-specific groundwater investigations.*

15.2 Response

DIPNR is referred to the report entitled, "Hydrogeological Impact: Newnes Kaolin Proposed Open-Cut" by Kalf and Associates and the Water Research Laboratory UNSW (December 2004), submitted to DIPNR on 11th January, 2005.

List of Appendices

Appendix 1 – Newnes Junction Kaolin Specification Sheet
Appendix 2 – Letter from Sydney Construction Materials to Zig Zag Railway
Appendix 3 – Sydney Construction Materials File Note on Bushwalking Tracks

Appendix 1 – Newnes Junction Kaolin Specification Sheet

Sydney Construction Materials

CLAY NKPL GP1

Description: A dry milled kaolin, (china clay) of good white colour. Typically used for the manufacture of whiteware ceramics, manufacture of paints, or as a filler where a white colour is required.

Specifications

Typical Chemical and Physical Properties

			Commercial Kaolin Currently Marketed in NSW		
		NKPL-GP1 %	**HR1/F %**	**Q38 %**	**Q145 %**
Silica	SiO_2	50.7	48.4	50.3	49.3
Alumina	Al_2O_3	35.1	33.4	34.3	33.8
Magnesia	MgO	0.15	0.2	0.3	0.4
Potash	K_2O	0.72	0.2	1.1	2.4
Soda	Na_2O	0.10	0.2	0.2	0.1
Lime	CaO	0.04	0.1	0.1	0.1
Ferric Oxide	Fe_2O_3	0.34	1.3	0.9	0.8
Titania	TiO_2	0.26	2.5	1.5	1.5
Loss of Ignition	(1000°C)	12.49	12.8	12.0	10.9

Mineralogy (NKPL – GP1)

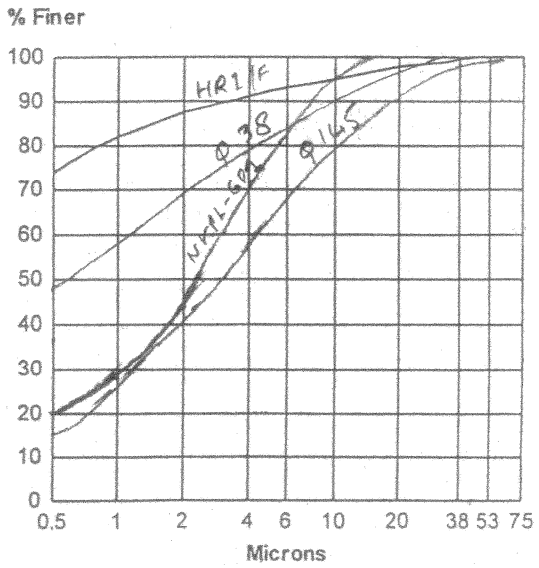
Quartz	-	9.4%
Kaolinite	-	83.0%
Mica	-	6.1%

Brightness – R457nm

NKPL-GP1	-	77
HR1/F	-	71
Q38	-	72
Q145	-	72

Calcined Brightness (NKPL GP1)

1000°C	-	76
1100°C	-	85
1200°C	-	93



Typical Particle Size Distribution

PCE (Pyrometric Cone Equivalent) – 31.5 to 32

Notes:

1. NKPL GP1 sample from Rocla tailings dam; -20μm, non-magnetic, split after separation (Kmetoni, 1985)
2. HR1 – Home Rule 1 (Gulgong)
3. Q38, Q145 – Gulgong
4. Particle size for NKPL-GP1 determined by Kmetoni (1985)

Appendix 2 – Letter from Sydney Construction Materials to Zig Zag Railway

Sydney Construction Materials



...Building Sydney's Future

12th April 2004

Mr Michael Forbes OAM FCIT
General Manager
Zig Zag Railway Co-Operative Limited
PO Box 187
Clarence, NSW 2790

Dear Michael,

RE: Proposed and Sand Extraction and Kaolin Mining Operation – Newnes Junction

During the course of the last year we have been in the process of refining our development proposal for and sand extraction and kaolin mining development at Newnes Junction.

Some time has elapsed since we had the opportunity to meet with you on two occasions to discuss the plans for the extension of the Zig Zag railway to the old Newnes rail station.

Sydney Construction Materials (SCM) is in the final stages of supplying to the NSW Government additional information on the operation of the proposed development. In this light we are conscious of our discussions and we wish to confirm our verbal commitments.

Firstly, when the mining/extraction project is approved and operational, we wish to affirm our commitment to assist in the extension of the Zig Zag Railway through the provision of in-kind services such as earthmoving equipment and other assistance on terms to be further discussed once your plans are finalised and our approvals have been granted.

Secondly, we re-confirm our offer to work with the Zig Zag Co-Operative to identify opportunities to utilise existing houses at Newnes Junction that may be acquired by SCM for the benefit of the society and the preservation of railway heritage. As you are aware SCM has made offers to local residents to acquire their properties in the event the project is approved and they wish to re-locate.

SCM is also cognisant of the issues raised in your letter to the Department of Infrastructure Planning and Natural Resources dated 4 August 2003.

Newnes Kaolin Pty Ltd, trading as
Sydney Construction Materials

Suite 504, 37 Bligh Street
Sydney NSW 2000

Ph: (02) 9232 8282
Fax: (02) 9232 8275
ABN: 71 065 564 794

In that letter you highlighted two matters. In summary, you identified part of the access road and rail loop currently serving the Clarence Colliery and Kable Sands is on land owned by the Zig Zag Co-operative. These issues are not in dispute by Sydney Construction Materials.

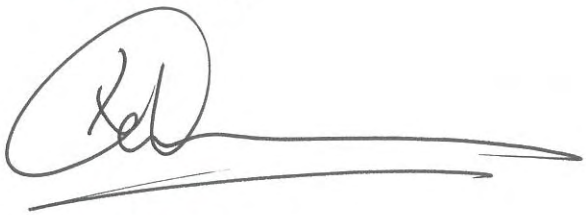
In the first instance, our requirement for the access road is limited to daily transport of employees entering the site of the mining operation. As all product will be shipped by rail, no ore trucks will use the access road. Secondly, the rail loop, which is now owned by Clarence Colliery, would be utilised by trains transporting raw sand and kaolin to the Sydney region. The addition of nine trains per week on the rail loop is within the historical usage and design parameters of the existing rail loop.

During our discussions, your willingness to accommodate the proposed operation in so far as it would not impact on the plans for the extension of the railway was appreciated. As the re-establishment of the Old Newnes railway station is some distance from the existing Newnes Junction station and the proposed mining lease, it will not be impacted by SCM activities.

We look forward to pursuing with you plans to boost what is one of this nation's great railway heritage and tourism ventures.

Should you have any further queries please contact me on 02-92328282 or 0418-221956.

Kind regards,



Ian Wisken
Project Adviser

Appendix 3 – Sydney Construction Materials File Note on Bushwalking Tracks

Sydney Construction Materials



...Building Sydney's Future

File Note

Date: 16th April 2004

Re: Bushwalking tracks in the vicinity of the Newnes Junction development application area

An intensive literature search on popular walking tracks, campsites and picnic areas located on and around the Newnes Plateau, which include the Blue Mountains National Park, the Wollemi National Park, Gardens of Stone National Park and the Newnes State Forest, was carried out.

The main focus for walking activities is well to the north of the Newnes Junction project area and is accessed by the Glow-worm Tunnel Road. The main attractions of the area; Deep Pass, Galah Mountain, Glow Worm Tunnel and Bungleboori Picnic Area, are in a range of 10 to 30kms from the proposed development site.

There are no formed tracks, for bushwalking purposes identified from any of the references in the attached list and no tracks have been identified by National Parks and Wildlife Services Personnel within a 5km radius of the proposed development site. The Dargan's Creek Canyon south of the Bells Line of Road is probably the closest locality used by bushwalkers and canyoners and is located several kilometres south of the project area.

A research programme on the sedimentary history of the Newnes Plateau sandstones carried out jointly by the Company (R. Goldbery) and John Whitehouse from the NSW Department of Mineral Resources has required detailed traversing of the area surrounding the proposed development site at Newnes Junction. During these surveys, no bushwalking tracks have been found on any of the ridges or drainage networks of the area. It is therefore considered extremely unlikely that the area within a 2km radius of the DA proposal will attract any recreational bushwalking activities.

R. Goldbery

(Project Manager)

Newnes Kaolin Pty Ltd, trading as
Sydney Construction Materials

Suite 504, 37 Bligh Street
Sydney NSW 2000

Ph: (02) 9232 8282
Fax: (02) 9232 8275
ABN: 71 065 564 794

REFERENCES

Daly, J & L., 2000, “Take a walk in the Blue Mountains National Park”, Take A Walk Publications, Brisbane, 104p.

Fairly, A, 2001, “Discovering the Blue Mountains on Foot”, Envirobook, Annandale, 80p.

Jamieson R, 2001, “Canyons near Sydney”, Richard Jamieson Publishing, Sydney, 82p.

Land Property Information, NSW, 2002, “Tourist Map of the Wollemi National Park”, Bathurst.

Law, M., 1999, “The Blue Mountains – A guide to selected rock climbs (including Tarari)”, Wild Publications Pty Ltd, 120p.

Meredith, P and Fuchs, P., 2000, “Glove box Guide, The Blue Mountains”, Australian Geographic Pty Ltd, 191p.

National Parks & Wildlife Services, 2001, “Walking Trail Guide, Newnes and the Glow Worm Tunnel”, 19p.

Paton, N, 1987, “Walks in the Blue Mountains National Park”, Kangaroo Press, 144p.