Griffin Energy Pty Ltd
Bluewaters Power Station
Phase II
Public Environmental Review

January 2005

Doc No.: BD004-80

Invitation

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. In accordance with Section 38 of the *Environmental Protection Act 1986* a Public Environmental Review (PER) has been prepared which describes the Griffin Energy proposal to bid to sell electricity as an "owner and operator" of a coal fired power station, 4km north east of Collie. The PER is available for a public review period of 8 weeks from 10th January 2005

Comments from the public and government agencies will assist the EPA to prepare an assessment report in which it will make recommendations to the government.

Why Write a Submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless specifically marked confidential, and may be quoted in full or in part in each report.

Why Not Join a Group?

If you prefer not to write your own comments, it may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a Submission

You may agree or disagree with, or comment on, the general issues discussed in the document or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the document:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

Points to Keep in Mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate sections, chapter or recommendation in the document;
- if you discuss sections of the document, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submission is: 7th March 2005

Submissions should be addressed to:
The Chairman
Environmental Protection Authority
9th Floor, Westralia Square
141 St George's Terrace
PERTH WA 6000
Attention: John Güld

More information on how to make a submission can be obtained from the free pamphlet "Environmental Impact Assessment - How to Make a Submission" available from the Library of the Department of Environmental Protection, Tel: (08) 9222 7127 or by calling the project officer John Güld on (08) 9222 7144.

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1 Executive Summary

Griffin Energy Pty Ltd ("Griffin Energy") proposes to construct and operate an additional small base-load power station adjacent to the proposed Bluewaters Power Station at Collie that will efficiently use the significant local coal resource whilst at the same time contribute to a reliable power supply infrastructure for the State. The project, called Bluewaters Power Station Phase II ("Bluewaters II"), will help to ensure the long-term viability of coal mining in Collie, which in turn will support the existing community and infrastructure of the town and surrounding area.

Collie coal is an efficient, available and comparatively inexpensive local source of energy. It contains zero methane and has a low sulphur and ash content. Consequently, coal is a viable and realistic alternative to other sources of energy such as gas, and can be used by base load power stations supplying the State's energy requirements.

The scale and the location of the plant on cleared agricultural land results in a project with minimal environmental impact. Existing air shed emissions are well within accepted Australian and International Standards for air quality, therefore, capacity exists to accept additional emissions without compromising the health of the local Collie community or impacting local environmental values.

Construction and operation of the plant does not require the clearing of any vegetation, disturbance to any ecosystems, threat to any water resources or overloading of any air shed. Ash from the power plant will be returned to the coal mine and mixed with overburden and retained above the water table. Saline water will be disposed of via the existing Collie Power Station ocean outfall, and air emissions will be minimised through the application of best practice emission controls.

The project is a practical and suitable addition to the industrial infrastructure of Collie and the South West region. Griffin Energy sees Bluewaters II as an integral part of the power supply management strategy for the region. The South West Integrated System ("SWIS") is dependent on the reliability of supply, through the 1500 km Dampier to Bunbury Natural Gas Pipeline (DBNGP), which is already at the limit of its capacity. Bluewaters II will spread the risk of power supply interruptions by providing a viable alternative to gas fired power stations. It is only by using alternative fuels, such as coal, that a balanced supply of electricity can be maintained.

In terms of local sustainability, Bluewaters II represents the promise of a revitalized future for Collie. Bluewaters II will be built on cleared land that is currently used for grazing. Bluewaters II will be more efficient than the existing Muja plant, parts of which are planned to be phased out in 2007 subject to the construction and commissioning by that date of new generating capacity to replace it.

The Griffin Group, through Griffin Energy, is actively exploring other opportunities for sustainable energy development. For example, Griffin Energy is a joint venture partner in the Emu Downs wind farm development at Dandaragan.

This document provides the basis of an environmental management programme for Bluewaters II, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed.

1.1 Sustainability

A definition of sustainability is given in the Sustainability Strategy of Western Australia as:

> *"Sustainability is meeting the needs of current and future generations through the integration of environmental protection, social advancement and economic prosperity."*

This provides for the view that the key to sustainable development lies in the integration of environmental, social and economic development objectives.

Griffin Energy has declared its position on sustainability and maintains the view of a common goal for, and not conflict between, economic development and environmental protection for the present and into the future. To this end Griffin Energy has adopted four Principles of Fairness, which are centred around economic, environmental, social and resources values (Section 5 'Sustainability' on page 41).

When Griffin Energy's sustainability strategy is applied to Western Australia, the South West and the town of Collie, construction of Bluewaters II should produce the following environmental social and economic benefits.

- Environmental values are protected through the appropriate choice of location and technology employed to minimise emissions.
- There is no threat to the community's natural resources capital of clean air, and uncontaminated surface and ground water.
- There is no threat to biodiversity or the State's conservation estate from Bluewaters II.
- The State is provided with a cheaper, reliable, alternative source of electricity as well as a royalty revenue stream.
- The project will help provide a more secure supply of electricity.
- Real competition between fuel suppliers is promoted.
- Enhanced potential to attract industry to the South West.
- Towns and communities of the South West are maintained.
- Existing jobs are retained and more long term positions created thus reducing the drift to the larger population centres.
- A vibrant, healthy population results in better protection of environmental values in the region.
- Community values are upheld through maintenance of community infrastructure such as roads, schools and hospitals.

Costs to the community are small and include:

- Increased emissions of sulphur dioxide, nitrous oxides and other pollutants, but contained within regulated limits.
- Increased greenhouse emissions which will be managed through a Greenhouse Management Program aimed at reducing the impact.
- Potential for a very small increase in community health risk which will be addressed in the environmental management programs for Bluewaters II.

The benefits of Bluewaters II far outweigh the costs, therefore the project meets sustainability criteria as defined in the Western Australia State Sustainability Strategy.

1.2 Background

Griffin Energy is part of The Griffin Group and a sister company of The Griffin Coal Mining Company Pty Limited ("Griffin Coal"). Griffin Energy proposes to construct and operate Bluewaters II adjacent to Bluewaters I at Collie and use infrastructure constructed to service Bluewaters I, thus maximising the use of site, local and regional infrastructure.

If successful in its bid to supply 300-330MW to Western Power Stage 2 Power Procurement Process (PP2), Bluewaters II will supply electricity to the SWIS grid. Electricity will also be placed into the Wholesale Electricity Market upon the reform of the electricity industry in Western Australia.

Griffin Energy, as owner and manager of Bluewaters II, has made the following management commitments in support of the project.

Commitment 1

To prepare and implement an Environmental Management System.

Commitment 2

To prepare and implement a Construction Phase Environmental Management Plan.

Commitment 3

To prepare and implement an Operations Phase Environmental Management Plan.

Commitment 4

To prepare and implement a Greenhouse Management Strategy.

1.3 Environmental Outcomes

Bluewaters II will have a positive impact on the local environment because it will provide part of the capacity required to replace the ageing Muja Power Station units. The technology used in Bluewaters II will result in fewer emissions per Megawatt unit and a consequent lessening of contaminants and wastes to the atmospheric environment.

This impact is due in part to the proposed methods of disposal for fly ash and saline water, which are the major discharges from the station and the technology used to control emissions. The impact of the Bluewaters II is such that the impact per Megawatt unit produced from coal will be reduced through the increased overall efficiency of coal fired generation provided by Bluewaters II.

Overall the project's major issues are greenhouse gas and emissions of sulphur dioxide, nitrous oxide, respirable dust that have potential to increase health risk in the community.

Air emission modelling has clearly demonstrated that there is negligible health risk to the community, whilst greenhouse gas intensity in the electricity grid will be reduced as a consequence of the commissioning of Bluewaters II.

On balance, Bluewaters II will be of significant benefit to the locality of Collie, South West region and the State.

2 Introduction

Griffin Energy proposes to construct and operate a coal fired power station of up to 200 MW capacity, to be known as Bluewaters II, adjacent to the proposed Bluewaters Power Station (Bluewaters I) in the proposed Coolangatta Industrial estate immediately adjacent to The Griffin Coal Mining Company Limited (Griffin Coal) Ewington I mine development, and near to the existing Collie Power Station. Bluewaters II is designed to supplement Bluewaters I and assist in attracting additional new industry to the Collie region and provide electricity for sale through the SWIS.

Griffin Energy believes Bluewaters II will provide for efficient use of the significant local coal resource. Bluewaters II will help to ensure the long-term viability of coal mining in Collie, while maintaining existing community values and infrastructure of the town and surrounding area.

Collie coal is an efficient, available and comparatively inexpensive local resource. It contains zero methane and has a low sulphur and ash content. Consequently, coal is a viable and realistic alternative to other sources of energy such as gas, and can be used by base load power stations supplying the State's energy requirements.

Griffin Energy sees Bluewaters II as an integral part of the power supply management strategy for the region. The SWIS is dependant on the reliability of supply, through the 1500 km Dampier to Bunbury Natural Gas Pipeline ("DBNGP"). Bluewaters II will spread the risk of power supply interruptions by providing a viable alternative to gas fired electricity generation.

The Griffin Group, through Griffin Energy, is actively exploring other opportunities for sustainable energy development, and it is a joint venture partner in the Emu Downs wind farm development at Dandaragan.

Bluewaters II project was referred to the Environmental Protection Authority (EPA) in May 2004. The EPA determined that the project was to be assessed under Part IV of the Environmental Protection Act, 1986. The level of assessment set for the proposal by the EPA was a Public Environmental Review (PER) with an eight week public review period. This document has been prepared in compliance with the Environmental Protection Act, 1986 and in accordance with the EPA guidelines for preparation and submission of a PER (see the EPA website at www.epa.wa.gov.au).

2.1 Purpose and Structure of PER

The proponent is seeking approval to establish a coal fired power station under Section 38 of the Environmental Protection Act, 1986. The proposed power station will have a capacity of 200 MW and be built on a portion of Wellington Location 796 - Shire of Collie immediately adjacent to Bluewaters I enabling maximum utilisation of shared infrastructure and facilities. This area is currently freehold cleared farming land owned by W.R. Carpenter Agriculture Pty Ltd ("WRCA") a member of the Griffin Group of companies.

The objectives of this Public Environmental Review document are to:

- establish the proposal in the context of the local and regional environment;
- satisfactorily describe all parts of the proposal;
- provide the basis of an environmental management programme for Bluewaters II, which shows that the environmental impacts resulting from the proposal, including cumulative impact, will be acceptably managed;
- establish a basis for communicating clearly with the public and government agencies, so that the EPA can obtain an informed public comment to assist in providing advice to government; and

- provide a document that clearly sets out the reasons why the proposal should be judged by the EPA to be environmentally acceptable.

2.2 How to read the PER

Bluewaters II is justified and described in Sections 3 and 4 of the PER. Sustainability issues pertaining to Bluewaters II are addressed in Section 5. Environmental effects are summarised in Section 6. Section 7 details management issues associated with the operation of Bluewaters II. The Stakeholder consultation carried out to date and planned for the future is detailed in Section 8. Management Commitments in support of the project are summarised in Section 9.

Supporting documentation is attached as follows:

- Attachment 1 Flora and Fauna survey and report
- Attachment 2 Health Impact Assessment and Consultation report
- Attachment 3 EPBC determination
- Attachment 4 Air Emissions report from CSIRO
- Attachment 5 Noise Assessment report

2.3 Proponent Information

The proponent for this project is:

Griffin Energy Pty Ltd
15th Floor, 28 The Esplanade
PERTH WA 6000
ACN: 002 015 545

The key contact for this project is:

Mr Wayne Trumble
Executive General Manager Power Generation
Griffin Energy Pty Ltd
15th Floor, 28 The Esplanade
PERTH WA 6000
Phone: (08) 9261 2800
Fax: (08) 9486 7330
Email: wayne.trumble@thegriffingroup.com.au

2.4 Environmental Assessment Process

The environmental impact assessment process is designed to ensure that when significant projects are proposed, built or undergo major modifications, the environment is protected. The impact assessment process is run in parallel with project development so that appropriate protection measures can be incorporated into a project's design.

The environmental impact assessment process is designed to:

- ensure that government receives timely and competent advice prior to decision making;
- encourage and provide opportunity for public engagement in the assessment process;
- ensure that project proponents take primary responsibility for protecting the environment affected by their proposals;
- encourage the development of environmentally sound proposals which will minimize environmental impacts and maximize environmental benefits;
- provide for ongoing environmental management; and

- promote environmental awareness and education.

Bluewaters II will be assessed under the Western Australian Environmental Protection Act, 1986.

Following referral of Bluewaters II to the EPA in May 2004, the EPA advised Griffin Energy that a Public Environmental Review (PER) was required and that the PER would be subject to eight weeks of public review.

The full EPA process for a PER can be found at the EPA website at www.epa.wa.gov.au.

Bluewaters II was referred to the Commonwealth Department of Environment and Heritage under the Environment Protection and Biodiversity Act. The determination under this process was that the project was not a controlled action and thus not required to be assessed under this Commonwealth Act. The determination is included as Attachment 3.

2.5 Key Issues Arising from the Proposal

Bluewaters II is located immediately adjacent to the Bluewaters I Power Station on cleared agricultural land and will make maximum use of existing infrastructure. It is also located in an area that is currently a traditional centre for coal and electricity generation.

Of the major outputs from Bluewaters II, ash and saline water will be managed adequately through appropriate techniques. Ash will be returned to the mine void and saline water will be disposed of via the existing and proven, Collie Power Station ocean discharge line for saline water.

Atmospheric emissions have been modelled by the CSIRO using their TAPM emission model. Sulphur dioxide (SO_2), nitrous oxides (NO_x), carbon monoxide (CO), mercury (Hg), fluorides, respirable dust (PM_{10}), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAH) and ozone (O3) were modelled using TAPM. The modelling clearly demonstrated that the levels of these emissions were well within accepted Australian and International Standards including Australian National Environment Protection Measures (NEPM) Standards.

Greenhouse gas emissions will amount to approximately 1,300,000 tonnes per annum (at full load).

Greenhouse gas will be managed and minimised through the application of the best available technology appropriate to the size and operating capacity of Bluewaters II. Griffin Energy will also be signing on to the Australian Greenhouse Office Greenhouse Challenge and will be an active participant in that program. Bluewaters II will be designed in line with the Australian Greenhouse Office Generator Efficiency Guidelines. Griffin Energy has proposed to undertake a number of initiatives to manage greenhouse emissions.

2.6 Applicable Legislation

In addition to the requirement that the project gain the approval of the Minister for Environment and Heritage, other legislative requirements must be met before Bluewaters II can commence operation. The following table lists some of the key legislation that may apply to Bluewaters II. Also detailed in the table are responsible authorities and key agencies.

Table 1 - Applicable Legislation.

Applicable Legislation - State
Department of Indigenous Affairs • *Aboriginal Heritage Act, 1972 - 1980* Scope: Protects aboriginal sites **Department of Agriculture** • *Agriculture and Related Resources Protection Act, 1976* Scope: Management of pests and weeds **Local Government Authority** • *Bush Fires Act, 1974* Scope: Fire safety **Department of Conservation and Land Management** • *Conservation and Land Management Act, 1984* Scope: Protection and management of national, marine, conservation and regional parks, State forests, and timber, nature, and marine nature reserves. • *Wildlife Conservation Act, 1950* Scope: Protection of rare and endangered flora and fauna. **Environmental Protection Authority - Department of Environment** • *Environmental Protection Act, 1986* Scope: The EPA was established as in independent authority with the broad objective of protecting the State's environment. **Department of Industry and Resources** • *Explosives and Dangerous Goods Act, 1961 - 1986* Scope: Regulates the manufacture, use and storage of explosives and dangerous goods. **Department of Health** • *Health Act, 1911* Scope: Regulation for the protection of public health. **Native Title Tribunal** • *Native Title Act, 1993* Scope: Deals with aboriginal claims for native title to land. **WA Planning Commission** • *State Planning Commission Act, 1976* Scope: Controls the State's land development. **Water and Rivers Commission (now DoE)** • *Waterways Conservation Act, 1976* Scope: Conservation and management of waters and the associated land and environment. **Department for Planning and Infrastructure** • *Town Planning and Development Act 1928* Scope: Legislative framework for the preparation of Local Town Planning Schemes and Amendment to Schemes. **Shire of Collie** • *Shire of Collie Town Planning Scheme Number One* Scope: Zoning of land, classification of land uses and development control provisions to assess new land developments.
Applicable Legislation – Commonwealth
Department of Environment and Heritage • *Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)* Scope: Protects matters of national environmental significance, including National Heritage Places.

3 Project Justification

The prosperity of Western Australia is built mostly on the utilisation of its natural resources. In 2002, resource sector exports were valued at an estimated $27.4 billion, which represents around 70 percent of Western Australia's gross exports (Chamber of Minerals and Energy Annual Report, 2003). In most cases, energy, and in particular electricity, is a crucial ingredient in our natural resource development. The cost and reliability of electricity is therefore critical for the continued development of the State.

Electricity is an essential strategic service, fundamental to Western Australia's growing economy and the quality of life in the community. The safe, reliable and environmentally friendly provision of electricity in support of the economy is essential for the long-term well-being of Western Australia. Supply of electricity at the lowest price commensurate with satisfactory quality and reliability is fundamental for Western Australian competitiveness in the global market.

Western Australia encompasses an immense area and has a number of widely separated development centres. Population and industry is concentrated, to a large degree, in the South West. Western Power Corporation's ("Western Power") current generating capacity is approximately 3255 MW with 3150 MW of that capacity generated within the SWIS grid (Western Power, 2001).

According to Western Power's recent predictions, the electricity demand on the SWIS grid will continue to grow by 3 - 4 percent every year. This is the equivalent of an annual growth of 80 – 120 MW, resulting in demand for an additional 1200 MW of power generating capacity, by the end of this decade. Importantly, this estimate does not allow for any significant new industry.

Figure 1 illustrates the growth in generator capacity required to meet demand.

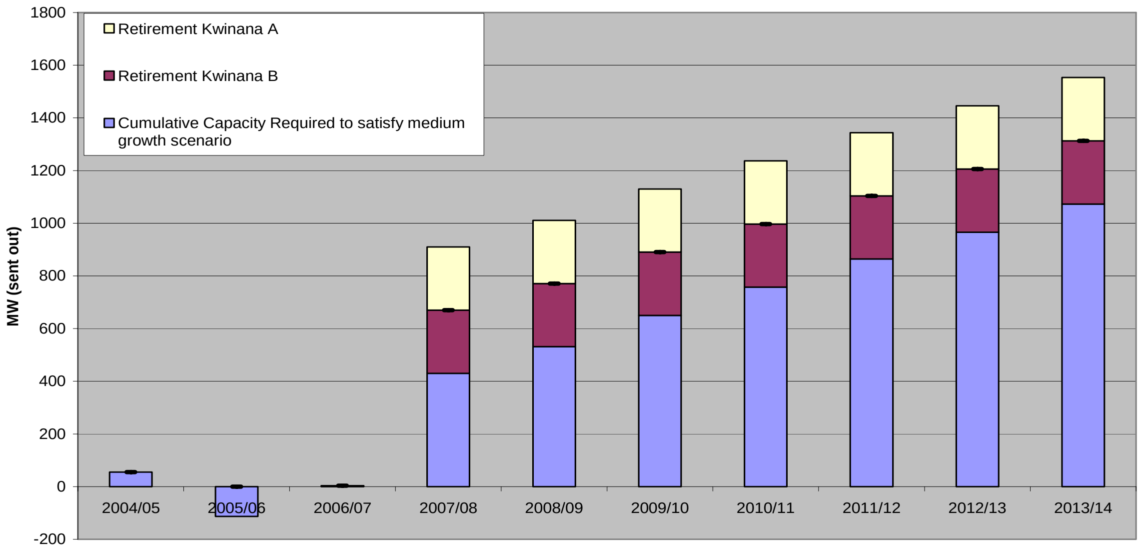

Figure 1– Capacity required to maintain Western Power Target Reserve MW

The SWIS, therefore, faces a dual challenge. It must not only satisfy the predicted growth in demand but must also upgrade ageing equipment. By 2005, over 900 MW (about 30 percent) of Western Power's generating equipment will have been in service for more than 30 years. Western Power has previously stated that the replacement of old equipment with more efficient plant is the most cost-effective way to reduce the cost of electricity and lessen its greenhouse emissions.

3.1 Regional Development and Benefits

On-going industrial development is important for the future well being of the State's development. This project is an integral part of a responsible development program.

The South West has a combination of mineral and energy based industries. Energy is provided from the coalfields at Collie and electricity is supplied to the region and Perth to support numerous industries. Coal and electricity from Collie also support local world-class industrial developments of alumina and mineral sand industries.

Until now, only power generation has been developed close to the coalmines with little or no industrial development in the same close proximity. The ideal use of the coal resource comes from locating industrial complexes close to power generation facilities. Such optimisation of the coal resource can lead to a new industrial centre in the area. This will underpin much needed local development and significantly improve the longer-term prosperity of the community.

In a competitive and deregulated market, coal based power generation can produce the lowest cost electricity. Lower electricity prices will attract new industry. The delivered price of gas to Perth is close to $3.00/GJ. Coal for power generation can be delivered for around $1.75/GJ.

In summary, this proposal for a new coal based generation plant at Collie will contribute to Western Australia's energy solution and economic development by:

- utilisation of a resource that can sustain electricity generation in Western Australia for the next 100 years;
- continuation of coal as a major contributor to the economy of the South West (700 direct employees, 1,500 indirect employees, $272 million per annum - 6 percent of the South West GNP);`
- production of energy at world competitive prices leading to an expansion of local industrial activity;
- helping to optimise the use of the State's energy resources;
- contributing to a balanced and secure energy supply through diversification of primary energy sources;
- stimulating regional development and nurturing associated local communities;
- increasing the reliability of electricity supply by reducing reliance on a 1,500 km gas pipeline from the Burrup Peninsula in the State's Northwest;
- replacing an ageing electricity generating infrastructure;
- maintain and increase royalty revenue to the State from coal mining activity, and
- maintain increase revenue to the State from payroll and other taxes.

Bluewaters II will require approximately 700,000 tonnes of coal per annum for the life of the station (25 years) to operate at an 80% capacity factor. Coal will be sourced for the power station from the adjacent Ewington I mine which has a projected annual mining rate of 3 million tonnes per annum for 25 years. Griffin Coal has reserves in place for 100 years at current mining rates. Thus Bluewaters II fits neatly into an overall resource management structure that utilises available resources responsibly to the benefit of the region and the State.

If the power station is not built the benefits described above are lost to the State.

3.2 Environmental and Social Benefits

The construction and operation of Bluewaters II will aim to minimise environmental impact by:

- using existing infrastructure;
- maximising shared services with Bluewaters I;
- utilising an existing, proven coal resource; and
- locating Bluewaters II on cleared agricultural land immediately adjacent to the proposed Bluewaters I.

Assessment of emissions has demonstrated (refer Section 7.8) that air quality in Collie will not be compromised and noise from Bluewaters II will be well within accepted standards. Saline water from the cooling system will be disposed of via the existing Collie Power Station ocean discharge line; fly ash will be combined with overburden from the coal mine and retained in the mine.

Bluewaters II will have minimal impact on environmental values because it is located on existing cleared land, maximises the use of currently installed infrastructure and will maximise the efficient use of shared services with Bluewaters I.

The construction and operation of Bluewaters II will bring benefits to Collie through the retention of jobs and the flow-on from construction and maintenance requirements.

In the longer term, the power station will attract new investment to the town. This will be achieved through the availability of a competitively priced and secure electricity supply, readily available to new industries in the purpose-designed Coolangatta Industrial Estate.

3.3 Evaluation of Alternatives

When considering Bluewaters II, a number of decisions had to be made. This section looks at the options between coal and gas, subcritical or supercritical technology, as well as which site to use and the consequences of not proceeding with Bluewaters II.

3.3.1 Coal or Gas

Griffin Energy's decision to build Bluewaters II in its proposed location is based firmly on the proximity and reliability of the coal supply. This in turn will go a long way to help guarantee a reliable supply of electricity. As a State issue, the choice is one of coal or gas. However, in a local context, locating a power plant at Collie means the decision to use coal is already made.

Griffin Energy proposes to utilise Collie coal as the energy source for Bluewaters II because:

- no new infrastructure is required to source it;
- an existing labour force is available;
- the power plant will contribute to the sustainability of Collie, especially once Muja A & B power stations are decommissioned;
- coal is cheaper than gas at the proposed location;
- coal is a proven available resource, the extraction of which is already approved; and
- Bluewaters II is immediately adjacent to the proposed Bluewaters I which is committed to using coal as a fuel.

Using gas for this proposal is not a viable option because:

- there is no supply of gas in Collie;
- such a provision would require the installation of new infrastructure; and
- even if such an installation were viable, the existing DBNGP pipeline is currently operating at maximum capacity and supply cannot be guaranteed in the short to medium term.

Whilst gas is available at Worsley approximately fifteen kilometres west of Collie, the supply is dedicated to the Alumina refinery with the capacity in that line fully allocated to the refinery. Extending the line to Collie to supply a power station would require the provision of a new feeder line from the DBNGP, or an increase in the existing feeder line capacity and extension of the line to Collie. With the availability of coal at Collie, the extension of gas supply to Collie for power generation is not a practical proposition, given that gas fired power stations are best located closer to the major users of the electricity produced.

Bluewaters II, as proposed by Griffin Energy, is a sustainable solution to delivering necessary base to medium load power to meet energy demands in Western Australia's South West region.

Consistency with Contemporary Government Policy

Commonwealth Government Policy

On 15 June 2004 the Prime Minister of Australia released the White Paper *Securing Australia's Energy Future*, which defines the long-term policy framework for the production and use of energy in Australia (Commonwealth of Australia, 2004). The Energy White Paper sets out a comprehensive and integrated approach to meeting the government's energy objectives of prosperity, security and sustainability**.**

As outlined in the White Paper, coal which produced 78 % of Australian electricity in 2000-01, will remain the main energy source for electricity generation despite substantial growth in natural gas and renewables (Commonwealth of Australia 2004, p.37). It is noted that Australia is well endowed with vast reserves of coal that are relatively easy to mine and located close to energy load centres. As a result, our nation is the world's fourth largest producer and largest exporter of coal (IEA 2003, cited in Commonwealth of Australia 2004).

Bluewaters is fully consistent with the objectives and strategies delivered by the Prime Minister in the White Paper. A stated aim of the Australian Government is to "…provide consumers with reliable supplies of competitively priced energy, ensure an appropriate return to the community for the development of its depletable resources, and meet environmental and social objectives (Commonwealth of Australia 2004, p.51).

Consumers and energy-intensive industries will continue to require competitively priced and reliable energy supplies. In June 2001, the Council of Australian Governments (COAG) agreed on national energy policy objectives to guide future energy policy decision-making by jurisdictions. Consistent with agreed COAG objectives, a competitive national energy market is important for longer-term energy security, enhanced energy efficiency, increased greenhouse gas abatement and progressive commercialisation of renewable and low-emission technologies. Therefore, the implementation of the Griffin Bluewaters Project is in accordance with this long-term transition of energy reform.

State Government Policy

The Government of Western Australia has in place a Policy Statement *Fuel Diversity in Power Generation* (Government of Western Australia, 2004).

Through this Project, Griffin endorses the objectives set in this Policy, including facilitation of the sustainable supply of reliable, competitively priced electricity. The proposed development of the Bluewaters Project is fully consistent with the fundamental principles of the Fuel Diversity Policy including:

- Competition;
- Fairness and Consistency;
- Environmental Sustainability;
- Security of Supply;
- Robust and Adaptable Fuel Industries; and
- Employment.

In addition, the development of Bluewaters II is consistent with the intent of the *Western Australian Energy Policy,* with one of its stated aims to "…encourage and supplement where appropriate investment in energy infrastructure to provide for reliable and sustainable energy supply" (Office of Energy, 2002).

Security of Supply

The use of existing Collie coal represents a relatively cheap and reliable power source to existing and new customers in the region. Black and brown coal accounts for around 55 per cent of the identified fossil fuel energy resources of the State and will last for around 1,200 years at the current level of production (Office of Energy, 2004). According to the latest annual *Energy Western Australia* report (Office of Energy 2003), of the total 6.1 million tonnes (or 120 PetaJoules (PJ)) of coal production in 2000-01, over 80 % was used for power generation**.**

There is an obvious need to maintain diversity in fuel supply for the State, as the Dampier to Bunbury natural gas pipeline is operating at maximum capacity. This was demonstrated in early 2004 when the South West region experienced widespread power restrictions.

Acceptance by the Local Community

Griffin Coal has mined coal in the region for over 75 years, and owns and operates the Muja and Ewington II open cut mines. This industry has been an integral element of the local economy and livelihood in the Collie region for many years, and is accepted as an important means of maintaining economic and social viability of the town in the future.

In summary, Collie is accepted by the social and business community as a place for coal mining and power generation for the foreseeable future. The Bluewaters Project can be implemented with evident benefits of using under-utilised local infrastructure, further maintaining the commercial viability of the area.

Environmental Performance

The replacement of ageing units with new state-of-the-art coal-based technology will improve environmental performance and reduce electricity generation costs on the SWIS (Office of Energy, 2003). Bluewaters II offers advantages over existing old coal-fired power stations in terms of higher thermal efficiencies and lower CO_2 emissions per GJ of energy produced.

The Bluewaters II site is existing cleared grazing land, and it will be built within the proposed Coolangatta Industrial Estate. Field surveys for terrestrial vegetation confirmed that no species of threatened flora were located in the project area and the overall condition of remnant vegetation is very poor (Maunsell, 2003). Therefore the proposal does not pose an adverse threat to existing ecological values of the surrounding environment.

The Bluewaters II design incorporates state-of-the-art technology for plants of its size, including a high efficiency combustion process and highly advanced process controls. Mine mouth electricity generation is very efficient in terms of energy utilisation, and cumulative air emissions from existing and new sources have been modelled to show that there is negligible health risk. In summary, the improved environmental performance of the highly efficient Bluewaters Project is considered acceptable in providing a sustainable solution to meet growing energy demands of the SWIS.

Renewable Energy Constraints

Whilst wind power and solar power are attractive from an emissions perspective, the reality is that these technologies have not developed to the point of being able to produce large quantities of electricity in the economies of scale required to satisfy demand. Two major factors severely constrain renewable energy, namely availability and area required to produce large amounts of electricity. For example the availability of wind power is 33% compared to 95% offered by coal-fired power generation. The area required for wind power generation is 12 ha/MW compared with 0.3 ha/MW for coal-fired power plants. Most importantly, however, is that typically wind power plants provide up to 20 MW of capacity, which is significantly less than current demand. Coal-fired power generation easily meets demand typically providing between 120 - 2000 MW. Furthermore, Western Power (2002) concluded that "wind energy technologies came closest to providing a cost competitive renewable energy source, however, there were technical and commercial constraints upon the use of wind power", for example, wind generators operate intermittently and "are not able to reliably produce their rated output when required to meet demand" (Western Power 2002).

3.3.2 Choice of Site

There are a number of suitable locations for a coal fired power station in the South West of the State. The three most appropriate areas are at:

- Collie
- Bunbury
- Kwinana

Collie is the preferred site because it is:

- in close proximity to the coalmine, which means reduced supply costs and greenhouse emissions;
- adjacent to the electricity network making supply connection simple and reasonably priced;
- in a relatively unpopulated area;
- in an air shed not fully allocated with regard to air emissions; and

- co-located with Bluewaters I resulting in little or no loss of environmental value as a consequence of placing the power station at this location.

3.3.3 Choice of Technology

The 200 MW unit size is an appropriate size for the reliability of the South West Interconnected System. The minimum Reserve Margin for the SWIS is 304 MW (Western Power 2003); this is set by the sent-out capacity of the largest unit of the system being the Collie Power Station Unit. 200 MW represents the approximate 2 year load growth under average conditions. The Bluewaters II generator size matches the unit size at Muja C & D and Kwinana C and is an appropriate fit for the proposed 240 MW retirement of Muja A & B.

Conventional pulverised coal fired power stations are Rankine cycle plants (closed steam / water circuit for working fluid) and are described as either subcritical or supercritical units. The term supercritical describes steam conditions above the steam triple point at 22 MegaPascals (MPa). Raising steam conditions into the supercritical area with elevated pressure and temperatures improves the Rankine cycle efficiency [advanced supercritical plant are currently up to 30 MPa and 600°C]. At supercritical steam conditions there is no density differential between the water and steam phases and this requires a “once through boiler” design.

A significant limitation for supercritical plant is the minimum unit size. Currently the minimum standard commercially available unit size supported by manufacturers (Siemens, Alstom, Foster Wheeler, Babcock & Wilcox etc) is approximately 350 MW. This reflects the trend in developed countries to very large unit sizes of 800 – 1000 MW with 600 – 800 MW plants becoming the norm. The largest supercritical coal-fired boiler in operation is 1300MW. The trend in commercial development of supercritical plant is within Organisation for Economic Development (OECD) countries where environmental compliance, high fuel cost and electricity charges foster the plant investment in leading edge technologies. The grid sizes for these countries are encouraging new investment in increasingly larger unit sizes to achieve economies of scale. With increasingly larger unit sizes the capital costs for incremental improvements in performance are more easily realised.

The Australian experience with Supercritical power station developments on the east coast is summarised in Table 2 below.

The 200 MW unit size proposed for Bluewaters II is not within the typical commercially supported size range for supercritical coal fired technology, therefore, there is no commercial basis for it to be anything other than a sub-critical plant.

For steam cycles with subcritical conditions (typically a maximum of 18 MPa, 540°C / 560°C reheat), boiler design and operation is simplified, but overall efficiency is limited to about 36 - 37% (net generation, and higher heating value (HHV)). However a modern subcritical technology power station will share the same design advance of current state of the art steam turbine isentropic efficiency similar to supercritical plant.

Table 2- Australian Supercritical experience

	Callide C	Millmerran	Tarong North	Kogan Creek
Main Steam Pressure	25 MPa	24.2 MPa	25 MPa	25 MPa
Main Steam Temperature	566°C	565.5°C	566°C	540°C
Reheat Temperature	566°C	595°C	566°C	560°C
Nominal Net Output	2 x 400 MW	2 x 400 MW	1 x 425 MW	1 x 750 MW

The Queensland supercritical power plant, Callide C, Millmerran, Tarong North, and Kogan Creek, have all been designed for a continuous overload operation with 2 High Pressure (HP) feed water heaters out of service and have historically operated in overload due to high demand. The overload operation increases the nominal 400 MW output to approximately 450 MW but at the expense of a higher heat rate (lower efficiency). The most efficient plant operation is with all feed heaters in service.

The following table illustrates the increasing size of supercritical power station units in China.

Table 3 - Supercritical Power Station Units in China

Project	Province	Capacity (MW)	Manufacturer	Commissioning date
Shidongkou No. 2 Power Plant	Shanghai	2×600	Boiler: Sulzer Turbine: ABB	1992.06 1992.12
Huaneng Nanjing Power Plant	Jiangsu	2×300	Russia	1994.03 1994.01
Panshan Power Plant	Tianjin	2×500	Russia	1996
Yimin Power Plant	Inner Mongolia	2×500	Russia	1998.04 1999.08
Houshi Power Plant	Fujian	6×600	Mitsubishi	1999.12 2000.07 2001.10
Suizhong Power Plant	Liaoning	2×800	Russia	2000.06 2000.01
Waigaoqiao Power Plant	Shanghai	2×900	Boiler: Alstom Turbine: Simens	Under construction
Huaneng Qinbei Power Plant	Henan	2×600	Boiler: Dongfang Turbine: Harbin	Designed
CRP Changshu Power Plant	Jiangsu	2×600	Boiler: Harbin Turbine: Dongfang	Under construction

It is important to note that currently there are no standard commercial supercritical plants offered in the size 300 – 350 MW by major equipment manufacturers; this may change if the market for "small" machines increases. However, below 350 MW it is expected that subcritical technology will prevail.

A supercritical plant less than 350 – 400 MW would carry a premium for a one off design cost and may have financing issues for proven design / performance. This situation is unlikely to change in the short term unless there is sufficient market demand for supercritical plant in the 300 – 400 MW size range.

There are practical limitations on the boiler and steam turbines that will limit the minimum supercritical unit sizes to 350 – 400 MW. Below these unit sizes, the efficiency advantages of the supercritical cycle can not be realised due to effects of scale such as high blade path losses in the HP turbines. The effect of both steam leakage and blade inefficiencies can be reduced by the adoption of a larger unit size, so that the leakage paths become proportionally smaller and the blade heights increase.

As unit size increases, the incremental cost of efficiency enhancements becomes economic. The typical cycle enhancements that may be included with increasingly larger units are as follows.

- High temperature materials for advanced supercritical and ultra supercritical cycles for boiler and steam turbine.
- Increasing the number of feed water heaters to optimise heat recovery.
- Double reheat cycle.

- Reducing the condenser vacuum conditions with reduced approach temperatures on the cooling water system and heat rejection technology.
- Large steam turbines minimise the gland steam, seal and blade tip losses.
- HP turbine efficiency increases with size of HP blading.
- High efficiency low pressure blading.
- Variable speed drives for auxiliary plant.

3.3.4 Low Emission Technology options

The Griffin Group through Griffin Coal is a contributor to the CRC for Coal in Sustainable Development and therefore supports a range of Research and Development (R&D) projects that have the ultimate aim of improving the technologies available to coal fired power generation. Griffin Energy believes that support of this kind is more appropriate than attempting research and development activities on a sole risk basis. By supporting collective R&D efforts more resources can be applied to specific problems and issues that require resolution across the industry.

While Bluewaters II will use so-called 'conventional technology', it will nevertheless utilize modern, state-of the-art equipment and components. The 4 x 60 MW Muja A & B units were commissioned in 1965, and use equipment that is now well over 40 years old in design terms. In those 40 years there have been improvements in the design and efficiency of the energy intensive, so-called "conventional technology" plant items such as electric motors, fans, pumps and, in particular, steam cycle (higher conditions and reheat cycle), steam turbine and generator. In addition, the increase in size from the 60 MW units at Muja, to the 200 MW unit proposed for Bluewaters II would in itself result in an increase in efficiency even if nothing else was changed.

Nevertheless, because conventional technology is mature, the efficiency gains made over the past 40 years are relatively modest. Consistent with expectations, further gains in efficiency from conventional technology would come at significantly increased cost. As a result, what is now state-of-the-art represents a balance between what is theoretically achievable and what is practical and affordable.

This issue has become a perpetual challenge to industry and governments; that is, the challenge of bringing first-of a-kind or non-conventional technology to maturity. Dr David Brockway, Chief Executive Officer of The Cooperative Research Centre for Clean Power from Lignite, in his submission to the Victorian Government's Greenhouse Challenge for Energy in August 2003 puts it this way:

"*It is well known in many industries involving large capital-intensive plant that the first-of-a-kind have a relatively high capital cost and initially, at least, suffer from low availability. It is only after several installations and a number of years of operational experience that sufficient developments have progressed for the technology to be mature, with substantially reduced capital and operating costs. Clearly any Independent Power Producer [IPP] operating in a competitive market will be extremely reluctant to disadvantage itself relative to its competitors by accepting the additional costs that its competitors will not suffer and from which its competitors may in fact benefit in the future.*

This difficulty is compounded by the fact that IPPs are seldom in a position to fund construction of a new plant from internal sources. Almost invariably power station projects involve substantial debt funding with funds raised from financial institutions. These institutions are similarly very risk-averse. They are simply not prepared to provide loan funds that are at risk when applied to economically and technically uncertain investments for the first-of-a-kind plant.

The issue is further compounded by the fact that, due to the high capital intensity of the power generation industry, many Independent Power Producers (IPPs) are heavily leveraged already. Hence, additional loan funds come at a premium (if available) and further increase the real cost of new plant (and therefore their position in a competitive market).

It is abundantly clear that under the existing world power generation industry's structure, financial institutions will play a determining role in the implementation of large-scale advanced cycle technologies."

Dr Brockway's submission illustrates this issue with the following figure.

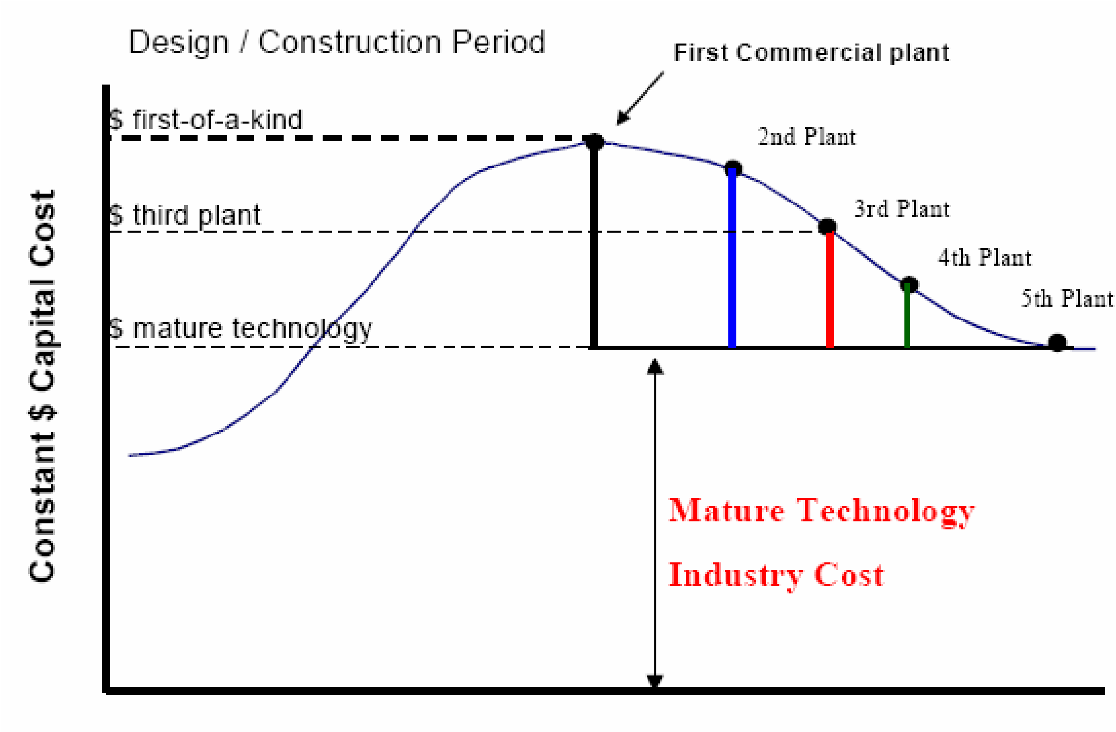

Figure 2- Technology versus cost constraints.

The obvious question that must be addressed is: who provides the risk capital to bring the non-conventional, significantly more efficient, advanced cycles to maturity?

Our view is that it requires more than the "determining role' of financial institutions. It requires the collective and collaborative efforts of government, industry, and the financial institutions of the world and other stakeholders. This issue is therefore much bigger than the Bluewaters II proposal.

In summary, in the context of converting coal to electricity at the 200 MW scale, all the non-conventional technology options available are simply not yet "bankable" (considered too risky for lenders). This is because they are not yet fully proven and/or not yet commercially mature technologies.

It is acknowledged that both CHP (cogeneration) and biomass co-firing have lower greenhouse gas intensities than the Bluewaters II proposal and are reasonably mature technologies.

However, CHP requires a host or consumer for the heat. While Bluewaters II will be constructed on an industrial estate, and the potential to sell heat may exist in the future, it does not exist now. For the project to proceed it requires a robust expectation of its revenue streams. This will typically be provided in the form of the Electricity Sales Agreement (or Power Purchase Agreement) and Steam Sales/Purchase Agreement. For this reason, CHP projects are either developed after or in parallel to the development of the host industry.

Biomass co-firing is a real opportunity, provided that a source of suitable biomass is available. However, it is limited to 5 – 10% of the overall heat input. An issue with biomass is that it is not a commodity fuel and its price is uncertain. It can have a negative value for someone who has to pay to dispose of it but this can quickly change once a commitment to, say co-firing, is made. There is then a risk that its value will attract opportunists, leading to destructive harvesting of forestry resource.

Integrated Gasification Combined Cycle (IGCC) is considered a developing technology in the worldwide electricity utility industry. Existing projects with project costs reported in the public domain are demonstration projects that typically have pricing that is "first of a kind". There are few examples of IGCC plants that are coal fired and operated for electricity generation only.

The following table lists current coal fired demonstration plants. These have all received significant subsidies for research development funding.

Table 4- Commercial Scale Coal / Petroleum Coke Based IGCC Power Plants

PLANT NAME	PLANT LOCATION	OUTPUT (MWe)	FEEDSTOCK	GASIFIER TYPE	POWER ISLAND	OPERATION STATUS
U.S. IGCC PLANTS						
Texaco Cool Water	Daggett, CA, USA	125	Bituminous Coal (1,000 tpd)	Texaco	CCGT – GE 7FE	1984 - 1988
Dow Chemical/Destec LGTI Project	Plaquemine, LA, USA	160	Subbituminous Coal (2200 tpd)	E-Gas (formerly Destec)	CCGT – Westinghouse 501	1987 – 1995
Tampa Electric Polk Plant	Polk County, FL, USA	250	Bituminous Coal (2200 tpd)	ChevronTexaco	CCGT – GE 7FA	1996 - Present
PSI Energy/Global Energy Wabash River Plant	West Terre Haute, IN, USA	262	Bituminous Coal and Petroleum Coke (2544 tpd)	E-Gas (formerly Destec)	CCGT – GE 7FA	1995 - Present
FOREIGN IGCC PLANTS						
NUON/Demkolec/ Willem-Alexander	Buggenum, The Netherlands	253	Bituminous Coal	Shell	CCGT – Siemens V94.2	1994 - Present
ELCOGAS/ Puertollano	Puertollano, Spain	298	Coal and Petroleum Coke (2500 tpd)	Prenflo®	CCGT – Siemens V94.3	1998 - Present

CCGT – Combined Cycle Gas Turbine, tpd – short tons per day

(Source: "Major Environmental Aspects of Gasification Based Power Generation Technologies", Final Report Dec 2002 NETL Table 1-4)

Most current gasification developments are associated with Refinery industries where there are issues with the disposal of refinery bottoms. A list of international IGCC projects currently operating or under construction is provided in Table 5.

Table 5 - Global IGCC Plants

Facility	Commercial Operation Date	MW	Application	Gasifier
SCE Cool Water USEA	1984	120	Power/Coal	Texaco – O_2
LGTI – USA	1987	160	Cogen/Coal	Destec – O_2
Demkolec	1994	250	Power/Coal	Shell – O_2
PSI/Global – USA	1995	260	Repower/Coal	Destec – O_2
Tampa Electric – USA	1995	260	Power/Coal	Texaco – O_2
Texaco El Dorado – USA	1995	40	Cogen/Pet Coke	Texaco – O_2
SUV Czech	1996	360	Cogen/Coal	ZUV – O_2
Schwarze Pumpe – Germany	1996	40	Power/Methanol Lignite	Noell – O_2
Shell Pemis – Netherlands	1997	120	Cogen/H_2//Oil	Shell – O_2
Puertollano – Spain	1998	320	Power/Coal/Pet Coke	Prenflow – O_2
Sierra Pacific – USA	1998	100	Power/Coal	KRW – Air
ISAB – Italy	1999	500	Power/H_2/Oil	Texaco – O_2
API – Italy	2000	250	Power/H_2/Oil	Texaco – O_2
Motiva – Delaware	2000	240	Repower/Pet Coke	Texaco – O_2
Sarlux/Enron – Italy	2000	550	Cogen/H_2/Oil	Texaco – O_2
Exxon – Singapore	2000	180	Cogen/H_2/Oil	Texaco – O_2
Fife – Scotland	2001	120	Power/Sludge	BGL – O_2
EDF/Total Gonfreville	2003	400	Power/H_2/Cogen/Oil	Texaco – O_2
Fife Electric – Scotland	2003	400	Power/Coal/RDF	BGL – O_2
Nihon Sekiyu – Japan	2004	350	Power/Oil	Texaco – O_2
Citgo Lake Charles	2005	500	Cogen/Pet Coke	Texaco – O_2
PIEMSA	2006	800	Power/H_2/Oil	Texaco – O_2

Source: General Electric

IGCC costs are still highly variable as the IGCC technologies are still not considered to be commercially proven by Utility companies. Current studies have costs ranging from US$1,100 to US$1,700 /kW. Current studies show significant pricing differences between the three primary gasification technologies. (Texaco Quench, E Gas, Shell Gasifiers). This illustrates that IGCC is not a mature technology with consistent costs. It is important to recognise that lower construction costs are typically associated with low plant efficiency. Economies of scale are being applied to large scale IGCC to reduce the capital cost; hence size of plant in the Australian context needs to be considered.

A significant impact on the IGCC costs will be any requirement for redundancy of the gasification plant to ensure that the IGCC plant availability remains similar to competing clean coal technologies. The plant size of the studies is trending to large plant in the 800+ MW size range.

Griffin Energy requires non-recourse financing to fund Bluewaters II. Financial institutions do not consider that the capital costs for IGCC are mature. Firm prices are not yet being offered by EPC contractors. Financial institutions consider that there is not enough plant experience for risks to be fully understood and managed. O&M costs are relatively predictable with operating information from demonstration plants. There is a significant penalty for refractory O&M. Life cycle costs are not currently competitive with other technologies.

IGCC reliability suffers from still being a "first of a kind" plant with the power plant not always operating when it is needed. The start up times for IGCC are very long compared with other coal based technologies due to extensive preheating of refractory in the gasifiers. Inspection and maintenance access to the gasification plant is slow during forced outages due to the large amount of refractory requiring cooling.

Financial risk hedges have not been adequate to date. Guarantees and warranties on a plant are still difficult to manage with an affordable single performance wrap as there are many contractors in the supply chain. IGCC is still vulnerable to regulatory changes for CO_2 emissions and carbon taxes. However IGCC is probably better able to hedge this with higher plant efficiency (when mature) and the potential for lower costs of CO_2 capture. Plant costs are reducing and as the technology matures the cost of electricity for a merchant plant will be competitive with other technologies.

The current economic status of IGCC has been assessed in the USA in the Final Environmental Impact Statement for the "Elm Road Generating Station" Public Service Commission of Wisconsin Department of Natural Resources, Docket 05-CE-130, Date Issued July 2003, which notes that "*there is little historical information to determine the estimated IGCC cost and the 2011 operation date is too far into the future to develop a more reliable estimate with increased price certainty. IGCC technology has been demonstrated commercially at only two sites within the US both for a nominal 250MW size plant. The cost for one of those plants, the Wabash River Plant in Indiana was US$417 million for a 262 MW facility (in 1995 dollars) or US$1,591/kW*".

3.3.4.1 Low Emission Technology Option Summary

IDGCC is a development of the gasification process intended specifically for use with high moisture, low rank lignite coals. This is not applicable for the Griffin Energy proposed sub-bituminous coal. The technology is not commercial. There is only a 5 MW pilot scale gasification plant at the Morwell Coal Gasification Development Facility.

Emerging technologies such as IGCC, IDGCC and MTE are not yet commercially well proven.

In respect of IGCC and IDGCC technology, the gasification technologies have had little entrance using coal as a fuel primarily due to the solid content, as opposed to gasification processes on liquid rich fuels (e.g. oil refinery by products). On an international basis, there are a handful of coal-based gasification plants as outlined below:

- Pinon Pine IGCC Power Project
- Tampa Electric IGCC Project
- Wabash River Coal Gasification Repowering Project

In respect of these gasification projects, the following should be noted:

- the projects are heavily funded by the US Department of Energy
- the projects are IGCC projects only, as opposed to IDGCC

- they are not yet sufficiently proven for commercial application

In respect of MTE (and other similar dewatering concepts), the research is targeting high moisture coals (greater than around 50%), and especially coals with a propensity to hold moisture, such as lignite. In general, the dewatering technologies reduce moisture levels to around 30% which is still greater than the Ewington coal deposit fuel properties. On this basis, these technologies are not physically or technically appropriate for the Bluewaters project.

Use of biomass on its own to provide sufficient energy for a 200MW power station is currently unrealistic. The Western Power trial plant at Narrogin is a 2MW plant ($1/100^{th}$ the size of Bluewaters II) and is reliant on Commonwealth subsidies to make it viable.

It is doubtful that sufficient tonnages of biomass would be available at economic prices to make a 200MW biomass plant viable.

Biomass co-firing is possible up to about 5%, however, the availability of sufficient quality, reliable supply is not guaranteed. The option for biomass co-firing will be kept open and should it become technically and economically possible, will be pursued.

3.3.5 Best Practice in Design

The proponent has sought to adopt Best Practicable Measures to minimise atmospheric emissions from Bluewaters II in accordance with EPA Guidance Statement No. 55. It is noted that, in relation to emissions of SO_2, NO_x and particulates, the EPA's view expressed in this Guidance Statement is that:

1. All relevant environmental quality standards must be met;
2. Common pollutants (including SO_2) should be controlled by proponents adopting Best Practicable Measures (BPM) to protect the environment;
3. There is a responsibility for proponents not only to minimise adverse impacts, but also to consider improving the environment through rehabilitation and offsets where practicable.

European Union Directive 2001/80/EC was evaluated for relevance by Griffin Energy for Bluewaters II, however given the particular circumstances of the Collie region, it was determined not to be relevant for the project. The EC directive was initiated to curb Sulphur Dioxide emissions in a region where the sulphur content of coal is generally higher than that of Collie and where acid rain is an issue. The directive is more applicable to a highly industrialised region.

In contrast, the south-west of Western Australia is hardly industrialised at all, and does not suffer from problems associated with acid rain. Collie coal has low sulphur content by global standards, and a significant part of the industrial energy in the South West of the State comes from natural gas. Oxides of sulphur do not form and do not threaten to become an environmental problem in the Collie area. Monitoring undertaken by Western Power has indicated that effects from sulphur dioxide emissions from the existing coal fired power plants at Collie are negligible and almost impossible to quantify (Morris 2004, pers comm.).

Additional measures to remove oxides of sulphur consistent with Directive 2001/80/EC are commercially available and are developed to a mature stage. Such methods involve the adsorption of the oxides of sulphur either in a slurry of calcium hydroxide or calcium carbonate. However, this process has a significant environmental footprint. Emissions of carbon dioxide will be increased by 5% due to gas released in the process, and increased electrical power used in the process. This would result in an extra 60,000 tpa of CO_2e to be emitted from Bluewaters II.

In addition, quarrying and transport of 12,000 tonne/year of limestone would be required for the desulphurisation process. The desulphurisation process also requires the consumption of a significant amount of additional water. In the case of Bluewaters II, this extra water requirement would be in the range of 15 to 34 GL of water per year depending on the technology, 5 to 10 times more than the 3.25 GL required to operate Bluewaters II in its current configuration.

The use of the directive, therefore, would not be without environmental cost.

The capital cost of the project would also be increased by about 10% if a desulphurisation process was used. The fuel cost would be increased by 1 or 2 percent. Other operating and maintenance costs would also increase. Tariff increases, to cover the increased costs, would make coal uncompetitive with gas as a fuel for power generation.

Therefore, taking into account:

1. Demonstration through modelling that cumulative emissions of SO_2 are predicted to be within acceptable environmental standards, and best practicable measures have been adopted by Bluewaters II;
2. Vegetation monitoring by Western Power has not demonstrated any measurable impact from sulphur dioxide emissions from the existing Collie or Muja power stations; and
3. The additional environmental impacts (including increase in GHG emissions, water use and disposal, and land disturbance from quarrying and transport of limestone) that would be incurred from additional desulphurisation;

it is concluded that there is no net environmental benefit to be derived through the application of Directive 2001/80/EC at Bluewaters II.

The overall net environmental benefit from the application of Directive 2001/80/EC at Bluewaters II is less than not applying it, because of additional CO_2 emissions, loss in efficiency from Bluewaters, a requirement to find an additional disposal facility for another waste product and increased use of water through its use. This approach is consistent with the principles of EPA Guidance Statement 55. Bluewaters II will operate on the philosophy of continual improvement in its operations, and will continue to evaluate measures for improving efficiency and minimising atmospheric emissions during the lifetime of the project.

3.3.6 The Consequences of Not Proceeding

In recent years the population of Collie has declined from 9,800 in the 1986 Census to 8,400 in the 2001 Census. This represents a 12 percent decline in the town's population. This population decline has accompanied a parallel decline in local economic activity.

Bluewaters II is of significant importance to the long-term viability of Collie and the surrounding area. Not proceeding with the project will result in:

- loss of future employment opportunities;
- loss of an opportunity for regional development;
- increased risk to electricity supply in WA;
- missed opportunity for royalty revenue to the state; and
- continued movement of the rural population into the metropolitan area with a subsequent increase in pressure on infrastructure and services.

4 Project Description

4.1 Existing Environment

The Bluewaters II location is cleared agricultural land currently used for grazing and cropping. There is no requirement for any vegetation clearing in order to site the plant. A full description of the existing environment is found in the flora and fauna survey report (Attachment 1). The existing environment is also described for each of the management issues described in section 8.

4.2 Bluewaters II Location and Layout

Bluewaters II will be located on the proposed Coolangatta Industrial Estate approximately 4 km northeast of Collie (Figure 2). Figure 3 shows the proposed layout of Bluewaters II.

4.3 Historical Context

In September 2002 Griffin Energy sought Strategic Environmental Advice from the EPA for the South West Power Project (SWPP) which was a proposal comprising of the following elements:

- 800 MW coal fired power station;
- 80 MW wind farm north of Perth;
- A water management strategy involving diversion of high saline flows from the East Collie River;
- Use of wood wastes for up to 10% of co-firing with coal in the power station; and
- Carbon sequestration on pastoral land and tree farming.

The EPA provided advice on the project in February 2003 through the publication of Bulletin 1090.

The SWPP was proposed as Griffin Energy's initial bid for the base load component of the State Power Procurement Process (PPP) managed by Western Power. The concept has been refined and the SWPP has been dropped as a formal proposal by Griffin Energy.

Bluewaters II, in terms of scale, is only one quarter the size of the SWPP. Nonetheless the advice in Bulletin 1090 can be reviewed and applied in part to Bluewaters II.

In Bulletin 1090 the EPA advised:

> *"the EPA's objectives would be met (for the SWPP) provided… a substantial package of mitigation measures to adequately address greenhouse gas emissions, which could include alternative water supply and renewable energy options that will demonstrably result in significant environmental benefits".*

Since then Griffin Energy has progressed the wind farm to the point that it will proceed subject to the finalisation of network agreements with Western Power. In addition the water management proposal for the Collie River Basin, with the active support of Griffin Energy, has progressed to the point where it has been demonstrated to be viable. Griffin Energy has not held up the development of either of these environmentally positive initiatives in order for them to be 'credited' against any particular project.

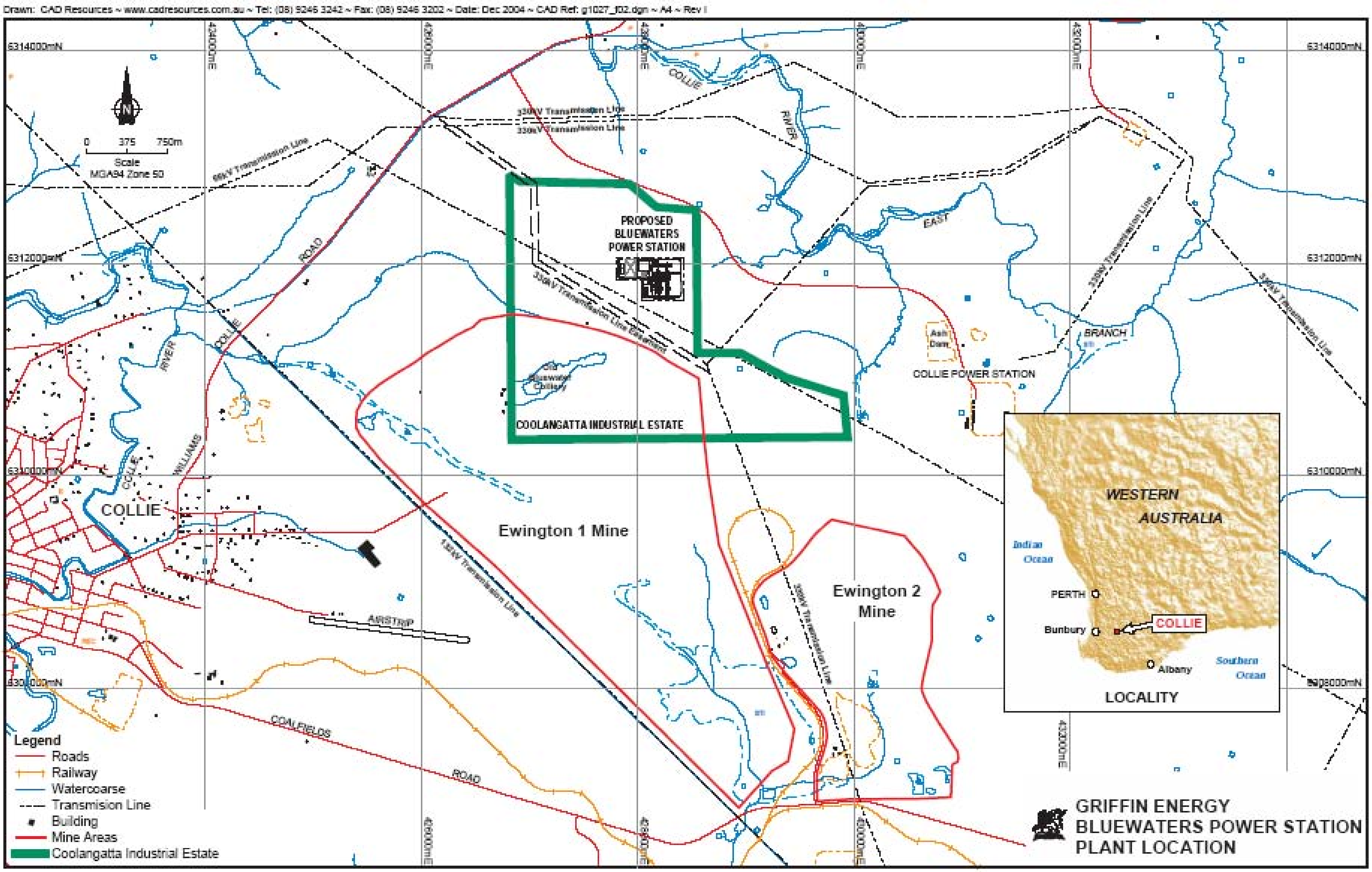

Figure 3- Bluewaters II Power Station Plant Location.

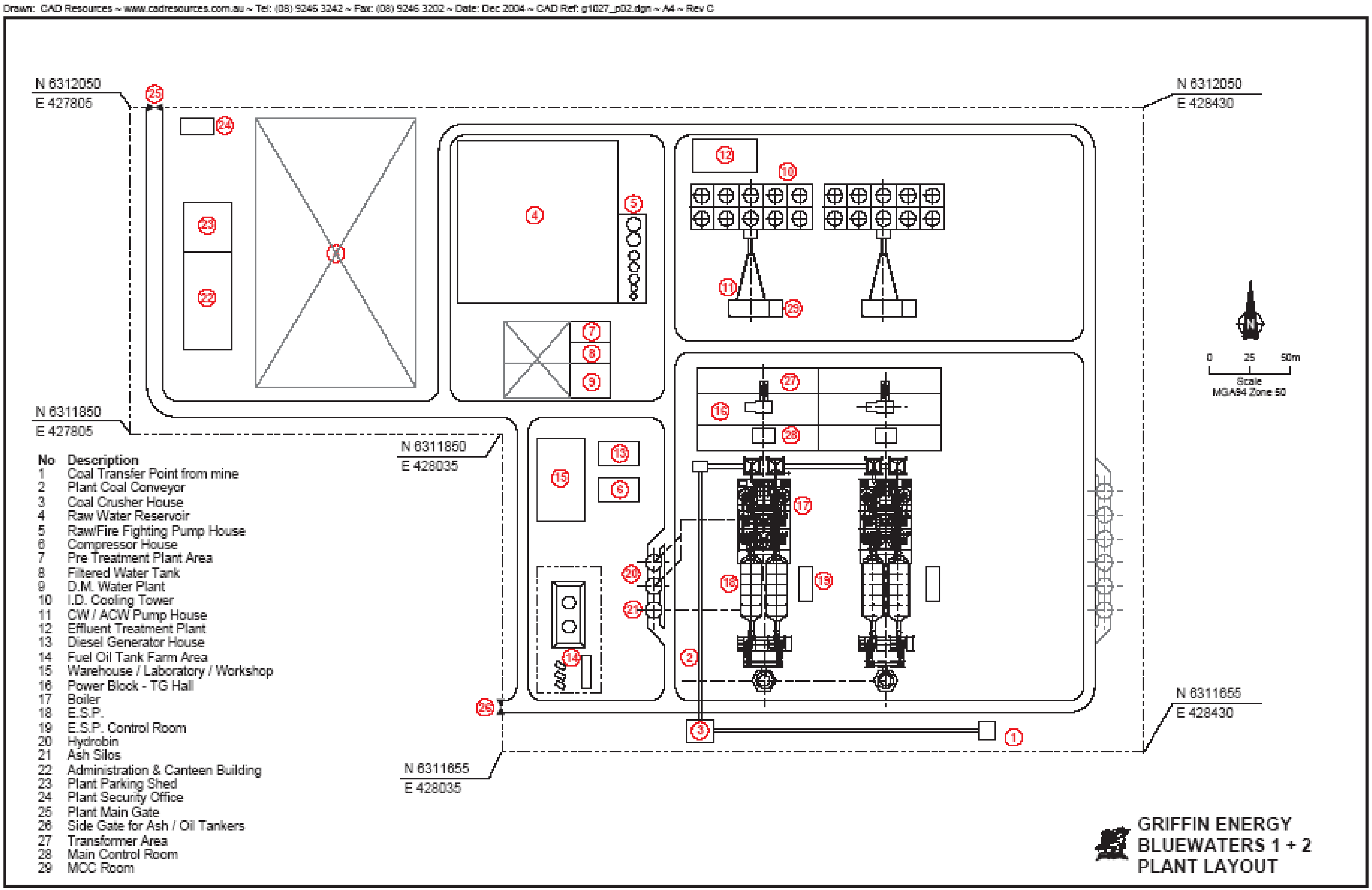

Figure 4- Bluewaters II Power Station - Plant Layout.

4.4 Land Tenure

The land on which Bluewaters II is to be built is currently cleared agricultural land used for cropping and grazing purposes. The land is owned by WRCA a member of the Griffin Group of companies. Figure 1 shows the land and proposed location of Bluewaters II. The land is currently being rezoned to “Development Investigation Area” and will be known as the Coolangatta Industrial Estate.

4.5 Plant Design Standards

Building and operating a safe, secure, reliable and environmentally responsible power station can only be achieved by adopting best practice standards appropriate to the technology that will be used in the plant. With these objectives in mind, Griffin Energy has chosen to use the Australian Greenhouse Office Generator Efficiency Standards, Technical Guidelines, January 2001, (see www.greenhouse.gov.au/ges/guide_app2.html) as the primary design guidance note for Bluewaters II. In addition, Bluewaters II design team will be guided by the WA EPA’s Guidance Statement Number 55 ‘Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process’, when selecting standards to apply to the project design.

4.6 Plant Components

The proposed Bluewaters II development will include the following components:

- boiler and turbine power block
- mechanical draft cooling tower
- flue gas cleaning equipment
- generator transformer switchyard

The following components will be used by Bluewaters II, however these will be substantially in place to support Bluewaters I.

- 100 metre stack
- ash and dust disposal plant
- water treatment plant
- transmission line connection to Western Power Corporation switchyard
- buildings for administration, stores, water, sewage treatment and chemical storage
- liquid fuel storage facilities (typically for start-up purposes)
- communications and control systems
- water supplies
- electrical supplies
- drainage systems
- roads and fencing
- saline discharge via existing ocean outfall

Table 6 - Bluewaters II Power Station – Key Proposal Characteristics

ELEMENT	DESCRIPTION
General	
• Project Purpose:	To produce electricity to supply to the SWIS grid or direct to customers
• Construction Period:	30 months to commercial operation
• Project Life:	30 years
• Project Value:	Approximately A$200 Million
• Power Plant Type:	Subcritical coal fired power station
• Power Generating Capacity:	Up to 200 MW_e nominal, 202.3 MW design
• Plant Thermal Efficiency:	HHV 36.4% - LHV 38.6%
• Plant Operation:	Base load operation 24 hours per day, 365 days per year
• Shutdown Time:	Plant maintenance shutdowns may be scheduled annually
• Maximum Facility Footprint:	350 m x 150 m area
• Maximum Total Area:	15 hectares
Plant Facilities	
• Stacks:	1
• Height of Stack:	100 m
• Diameter of Stack	4.13 m
• Cooling Towers:	1 set
• Liquid Fuel Storage Tanks:	2 x 100,000 litres and 1 x 10,000 litres
• Boiler:	Balanced draft pulverised coal steam generator matched to steam turbine capacity
• Steam Turbine:	Tandem compound reheat steam turbine with synchronous alternator – 200 MW_e
• Wastewater collection	Package treatment plant
Utilities	
• Water Supply:	3.25 GL/yr sourced from mine dewatering at Ewington 1
• Coal Supply:	0.7 Mtpa via conveyor owned and operated by Griffin Coal Mining Company
• Transmission Line Length:	100 m up to 3 km depending on interconnection point as required by Western Power
Emissions	
• Noise:	Less than 60 dB(A) at 150 metres from the plant. Less than 29 dB(A) at nearest residence in Collie
• Flue Dust:	47 mg/Nm^3 at 7% O_2 dry basis; 9 g/s; 227 tpa
• Nitrogen Oxides:	606 mg/Nm^3 at 7% O_2 dry basis; 121g/s; 3050 tpa
• Sulphur Oxides:	1490 mg/Nm^3 at 7% O_2 dry basis; 296 g/s; 7470 tpa
• Greenhouse Gases:	1,300,000 tpa CO_2 e
• Carbon Monoxide:	500 mg/Nm^3 at 7% O_2 dry basis 93g/s; 2350 tpa
• Volatile Organic Compounds:	32 kg/yr
• PAH:	6.0 kg/yr
• Arsenic	6.7 kg/yr
• Cadmium	8.5 kg/yr
• Chromium compounds	1.5 kg/yr
• Lead compounds	31 kg/yr
• Mercury:	31 kg/yr
• Fluorides:	17,000 kg/yr (instantaneous rate estimated to be 590 mg/s)
• POPs inc Dioxins and Furans:	Less than 0.5 grams per year
Waste	
• Ash:	175,000 tpa disposed to the adjacent mine
• Septage:	Packaged treatment plant
• Saline Water:	1.2 GL/yr
Workforce	
• Construction:	Approximately 150 personnel at the peak of construction
• Operations	Up to 30 full time operations and maintenance personnel

Abbreviations used in Table

CO_2 e	*Carbon dioxide equivalents*
dB(A)	*decibels A weighted*
g/s	*grams per second*
GL/yr	*Gigalitres per year*
HHV	*Higher Heating Value*
kg	*Kilograms*
kg/yr	*Kilograms per year*
m	*metre*
mg/Nm^3	*milligrams per normal cubic metre, at 1 atm, 0°C*
Mtpa	*Million tonnes per annum*
MW	*Megawatt*
O_2	*Oxygen*
pa	*per annum*
PAH	*Polycyclic Aromatic Hydrocarbons*
POPs	*Persistent Organic Pollutants*
SWIS	*South West Interconnected System*
tpa	*tonnes per annum at 0.8 capacity factor*
%	*percent*

4.7 Technology

Early coal fired power stations used stoker arrangements to burn the coal in a similar way to locomotives. As the boiler sizes increased and there was a need to increase plant efficiency, power station operators started to burn pulverised coal. Today, pulverised coal technology remains the most widely employed technology for new coal-fired generation world wide.

In most modern pulverised fuel-fired plants, a single boiler is used to generate steam for a dedicated turbo-alternator set. Coal is transported from ground stock, dried and milled to form a pulverised fuel. A heated air stream then moves the fuel through pipes to the burners. The fuel is then blown into the boiler furnace and combusted. The released heat is absorbed in the water-cooled furnace walls in which the majority of the steam is generated. The resultant flow of water and steam, through the furnace wall tubing, is either recirculated using a steam separation drum or is passed through the system only once.

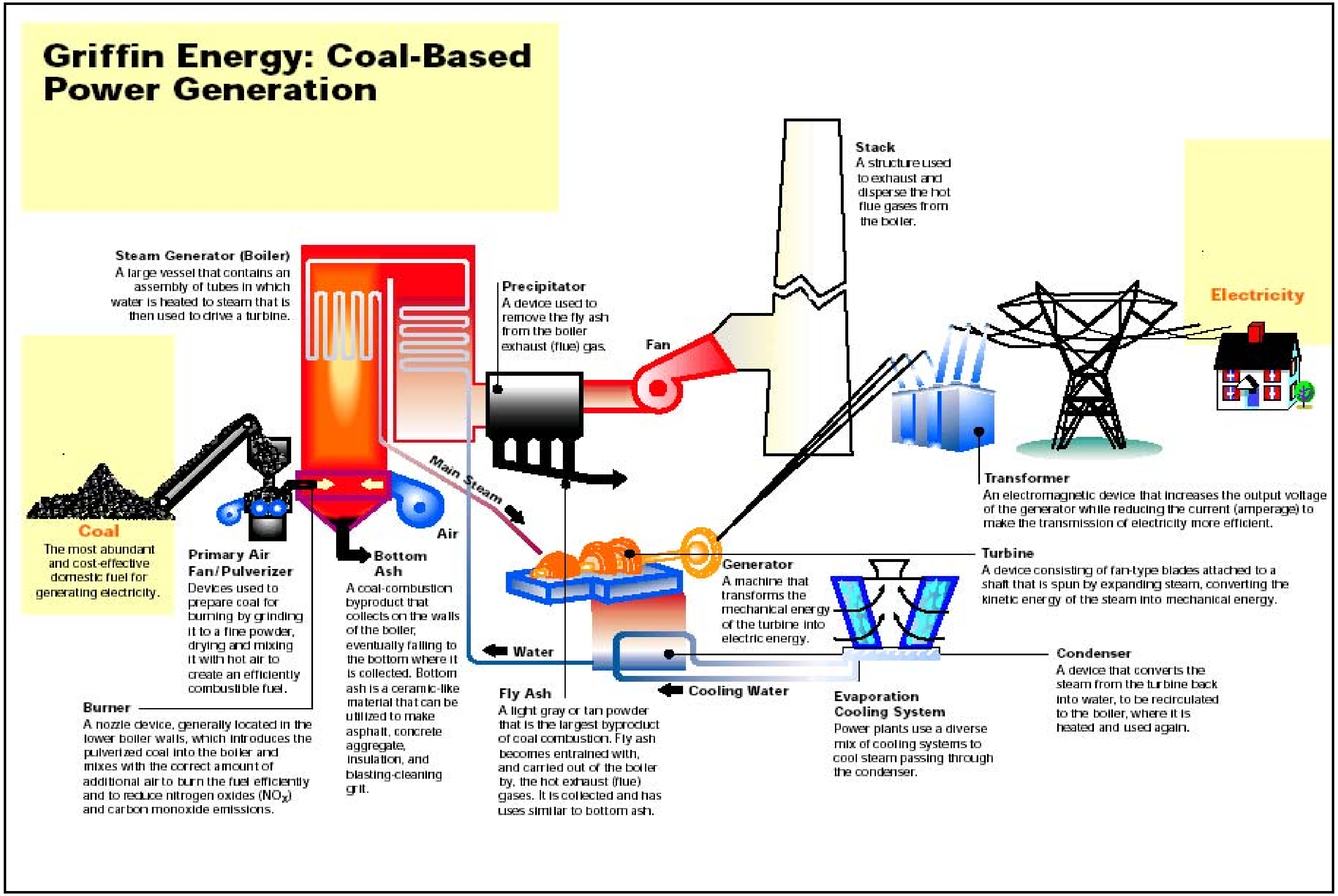

Figure 5- Coal Based Power Generation - Typical Plant.

The steam generated in the furnace is then superheated in further stages of heat exchanger tubing, before being fed to the turbine. After passing through a water condenser, the resultant condensate is pumped back to the boiler through a series of regenerative feed heaters fed by steam tappings from the main turbine.

The products of combustion are usually cooled in an economiser section by incoming feed water to the boiler and in air pre-heaters by the incoming combustion air. The gases are then cleaned by a series of downstream processes. Precipitators or fabric filters remove any particulates.

Subcritical pulverised fuel is the predominant coal combustion technology used worldwide, and is well proven with over forty years of operational experience.

The plant configuration chosen for Bluewaters II is based on the current latest technology and commercially available components.

Figure 6 details Bluewaters II 200MW inputs and outputs.

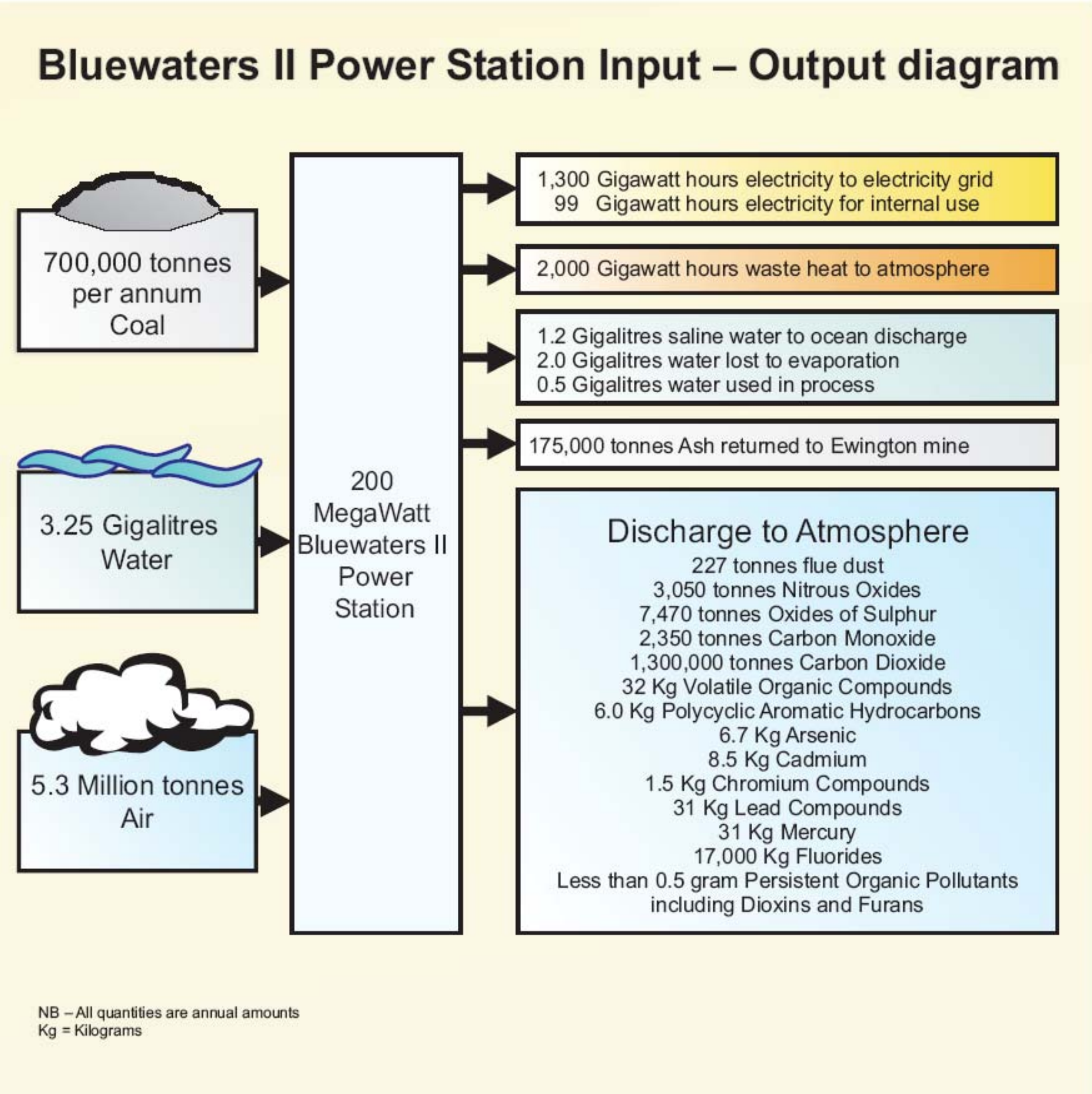

Figure 6 – Bluewaters II Input Output Diagram.

4.7.1 Steam Generation

To enable the combustion of the pulverized coal, air is supplied to the steam generator furnace through a combination of induced and forced draft fans. The control and combustion protection system regulates the mixture of fuel and air for stable and safe combustion. Steam is produced by heating water with the combustion process. The resultant steam is delivered to the steam turbine at approximately 16 MPa pressure and a temperature of 540°C.

4.7.2 Electricity Generation

The energy contained in the steam, piped from the steam generator to the steam turbine, is released in the steam turbine. The mechanical energy of the rotating steam turbine is converted into electricity by the generator. The output of the generator is then converted to a higher voltage (330 kV) by step up transformers, before transmission through the state transmission system, via the station switchyard.

4.7.3 Cooling System

Exhaust steam from the steam turbine is passed through a condenser where it is cooled. The resultant condensate is returned to the steam generator to complete the cycle. The heated cooling water from the condenser is cooled by evaporation in the cooling tower.

4.7.3.1 Cooling System options

4.7.3.1.1 Saline water use for cooling.

Griffin Energy will keep this option under consideration for future operations, however, the use of lower grade water for cooling will result in increased capital and running costs for the plant. The level of dissolved minerals in the water circulating through the condenser has an upper limit, beyond which mineral deposition occurs on the heat-exchange surfaces and reduces plant efficiency. If the make-up water has a high mineral content, it can undergo fewer cycles of recirculation before being discharged to waste. Therefore, there is a significant increase in the amount of water demand and waste water requiring disposal.

4.7.3.1.2 Dry-type cooling systems such as air cooled condensers

In dry-type cooling systems the heat is transferred by convection and radiation instead of evaporation as with wet towers as proposed. The major drawbacks of these systems are higher turbine back pressure, decreased turbine efficiency and higher fuel and internal power consumption rates, when compared to a typical wet cooling tower system. Also the capital costs of a dry type system are significantly higher than those for an evaporative system. This factor and excessive unit fuel and energy costs have made these towers practical only where extreme environmental conditions have necessitated their use. Dry air coolers, or hybrid type air coolers, require much more installation space and generate more noise than the proposed cooling tower.

Table 7 gives an indicative comparison between dry and evaporative cooling systems under Collie conditions.

Table 7 - Comparison between Dry and Evaporative Cooling Systems

Items	Evaporative Cooling	Dry Condenser
Footprint area	$800m^2$	$5,000m^2$
Capital cost	$5,000,000	$19,000,000
Lost generator output	0	13.8MW
Excess CO_2 output	0	12.6t/h

The wet cooling tower system chosen for Bluewaters II is the same as for Bluewaters I and is the same as is currently installed at the Collie Power Station. It is a proven and efficient system.

4.7.4 Flue Gas

Flue gases produced by the combustion process pass through the economiser and air heater where further heat is removed. The flue gas cleaning system removes the dust from the flue gas using either precipitator or bag filter technology. The removed dust will be stored in hoppers and then transferred, via the ash handling system, to storage for sale or disposal. The cleaned flue gas then exhausts to the atmosphere through the stack.

4.8 Utilities

The following utilities will be required to support the operation of Bluewaters II.

4.8.1 Fuel Supply

Griffin Coal will supply coal from the Ewington 1 mine as the primary source of fuel for Bluewaters II. With the plant running in base load operation, it is estimated that up to 700,000 tonnes will be required each year. In addition, storage facilities shared with Bluewaters I will provide for 210,000 litres of fuel oil required for black starts and service facilities.

4.8.2 Water Supply and Usage

Water will be required for the steam cycle and cooling water. The primary demand will be for cooling water. Potable water will be required for steam cycle makeup, staff amenities, safety showers and an emergency firewater system. The water will be sourced from mine dewatering activities at the nearby Ewington 1 mine. Approximately 3.25 GL/yr will be sourced from mine dewatering activities at the Ewington 1 mine.

4.9 Support and Infrastructure

Bluewaters II will incorporate the facilities detailed in this section.

No major new infrastructure is required to support Bluewaters II. The project area is cleared grazing land on the proposed Coolangatta Industrial Estate. Griffin Energy notes that the potential exists for some minor indirect impacts on fauna during operations. Management of such impacts will be dealt with in the Operations Environmental Management Plan which will cover Fauna impacts. A Fauna Management Plan may include employee and contractor awareness training of fauna that may be encountered near the project area, and specific measures to minimise direct/indirect disturbance to fauna.

4.9.1 Fire Protection Systems

These will consist of fire hydrant water systems, inert gas flooding and fire extinguishers together with the necessary detection, alarm and initiation systems.

4.9.2 Communication and Control Systems

Bluewaters II will be largely automatic. Personnel on site will monitor and adjust all operations as necessary.

4.9.3 Workshop and Maintenance Facilities

The workshop built to support Bluewaters I will be used to maintain and repair power plant equipment. There may be reciprocal sharing arrangements of these facilities with some of the other power stations in the area.

4.9.4 Switchyard

Electrical power will be transferred to the grid via a 330 kV switchyard.

4.9.5 Transmission Line

The transmission line for Bluewaters I will also be used connect Bluewaters II to the SWIS grid. The line may be 100 metres up to 3 kilometres in length depending on the interconnection point required by Western Power.

The connection points available for Bluewaters II are characterised by cleared agricultural land used primarily for the grazing of cattle.

Bluewaters II will access the existing SWIS distribution network. It is not anticipated that additional network infrastructure is required to distribute Bluewaters produced electricity to customers. Over time it may be that the distribution network could require upgrading, however, this should be able to be accomplished within the existing network distribution corridors. Ultimately, management of environmental impacts of the distribution network is the responsibility of the network provider.

4.9.6 Drainage Systems

The site will include the necessary drainage, collection and treatment systems for oily and contaminated water spills or leaks.

4.9.7 Liquid Fuel Storage Facility

This facility will have been constructed to service Bluewaters I. It will be used to store hydrocarbons and other cleaning products necessary for efficient plant operation. It will also be used to provide fuel for any emergency start-ups.

4.9.8 Administration Building

The Bluewaters I administration building will be used to service Bluewaters II

4.9.9 Roads and Fencing

Sealed roads and a security fence will have been constructed within the site boundary for Bluewaters I and will be adequate to prevent unauthorized access to Bluewaters II.

4.9.10 Electrical Supplies

Electrical supply will be provided to the overall power station from its own turbine generator and, if necessary, back-up supply from the Western Power SWIS grid.

5 Sustainability

In 1978, the notion of sustainable development was first outlined by the United Nations Commission on Environment in a document referred to as the "Brundtland Report". This report was endorsed by Australia at the Earth Summit in Rio de Janeiro in 1992. Since then, Governments of both the Commonwealth and Western Australia have released Sustainability Strategies that set out a number of core objectives and guiding principles which broadly follow the original concept of sustainable development.

A definition of sustainability is given in the Sustainability Strategy of Western Australia as:

> *"Sustainability is meeting the needs of current and future generations through the integration of environmental protection, social advancement and economic prosperity."*

This provides for the view that the key to sustainable development lies in the integration of environmental, social and economic development objectives.

Griffin Energy has declared its own position on sustainability and maintains the view of a common goal for, and not conflict between, economic development and environmental protection for the present and into the future. To this end Griffin Energy has adopted four Principles of Fairness, which are centred around economic, environmental, social and resources values (see Section 5 'Sustainability' on page 41).

When Griffin Energy's sustainability strategy is applied to Western Australia, the South West and the town of Collie, construction of the Bluewaters II should produce the following positive benefits:

- The State is provided with a cheaper, secure and reliable alternative source of electricity as well as a royalty revenue stream.
- Real competition between fuel suppliers is promoted.
- Enhanced potential to attract industry to the South West.
- Towns and communities of the South West are maintained.
- Existing jobs are retained and more long term positions created thus reducing the drift to the larger population centres.
- A vibrant, healthy population results in better protection of environmental values in the region.
- Community values are upheld through maintenance of community infrastructure such as roads, schools and hospitals.

The Commonwealth Government's National Strategy for Ecologically Sustainable Development, 1992, included the following core objectives and guiding principles.

Core Objectives

- To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations.
- To provide for equity within and between generations.
- To protect biological diversity and maintain essential ecological processes and life-support systems.

Guiding Principles

- Decision making processes will effectively integrate both long and short-term economic, environmental, social and equity considerations.
- Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty will not be used as a reason for postponing measures to prevent environmental degradation.

- The global dimension of environmental impacts of actions and policies should be recognised and considered.
- The need to develop a strong, growing and diversified economy which will enhance the capacity for environmental protection should be recognised.
- The need to maintain and enhance international competitiveness in an environmentally sound manner will be recognised.
- Cost effective and flexible policy instruments will be adopted, such as improved valuation, pricing and incentive mechanisms.
- Decisions and actions will provide for broad community involvement on issues which affect them.

- In September 2003, the Western Australian Government released the Western Australian State Sustainability Strategy. The State Strategy proposes Foundation and Process Principles for Sustainability.
    - Long-term Economic Health
    - Equity and Human Rights
    - Biodiversity and Ecological Integrity
    - Settlement Efficiency and Quality of Life
    - Community, Regions, 'Sense of Place' and Heritage
    - Net Benefit from Development
    - Common Good from Planning
    - Integration of the Triple Bottom Line
    - Precaution
    - Accountability, Transparency and Engagement
    - Hope, Vision, Symbolic and Iterative Change

Using all of the above objectives and principles Griffin Energy has declared its own position on sustainability.

Griffin Energy is of the view that there will be a common goal for, not conflict between, economic development and environmental protection, for the present and into the future.

With this in mind, Griffin Energy has adopted the following Principles of Sustainability.

- The Principle of Economic Fairness
- The Principle of Environmental Fairness
- The Principle of Social Fairness
- The Principle of Resource Fairness

5.1 Economic Fairness

The Principle of Economic Fairness allows the economic impact assessment of a development on a community, a region or a state to be judged equally against other factors.

Economic fairness is to be applied equally to all stakeholders. In evaluating whether a particular development decision has merit, the alternative options should be assessed in terms of the economic impact on a particular community, region or state.

Economic fairness acknowledges that development and associated economic growth, provides the fundamental conditions under which environmental protection is best achieved.

5.1.1 Local Perspective

From a local perspective, economic fairness translates into continuity of employment for the local population and the ability of Collie to survive and grow as a viable community in Western Australia.

Bluewaters II will contribute to local economic fairness through its ability, in combination with Bluewaters I, to attract new industry to Collie by making attractive electricity tariffs available to prospective industries.

5.1.2 Regional Perspective

The region around Bunbury and Wellington is important to continued prosperity of Western Australia. Developments, such as Bluewaters II, will contribute to the growth of the area and ensure the continuing viability of the region.

5.2 Environmental Fairness

Environmental values and protection, at local, regional or state level, constitute an integral component of any development decision.

The Principle of Environmental Fairness requires organisations to minimise environmental harm through programs which are aligned with their business and which help conserve, protect and restore the health and integrity of local ecosystems impacted by the business activities of the organisation.

Environmental fairness requires a whole of project comparison and assessment of environmental benefits and impacts.

5.2.1 Group Environmental policy

The Griffin Group's environmental policy supports the concept of environmental fairness. In implementing this policy Griffin Energy will use ISO 14001 as the guiding standard for all Environmental Management plans produced for the project.

POLICY

> *"It is Griffin Energy's Policy to promote environmental awareness to all its employees and strive for continuous improvement in reducing the impacts of its operations on the environment."*

Griffin Energy will:

- Comply with all laws, regulations and standards deemed to be applicable.
- Ensure that it has appropriate management systems to identify, evaluate and mitigate the impacts of its operations.
- Undertake research to resolve specific environmental problems.
- Maintain open dialogue with Government and community regarding environmental performance and plans.
- Review the outcomes from the annual environmental audit with the view to assessing and implementing alternate products into its business, which are both environmentally and commercially responsible.

5.2.2 Local Perspective

Bluewaters II represents less than an additional ten percent capacity to the total coal fired generating capacity of the state. However, in terms of local sustainability, it represents the promise of a sustainable future for Collie. Bluewaters II will be built on cleared land being adjacent to Bluewaters I and will be the centre piece for an Energy Park within the proposed Coolangatta

Industrial Estate. The land is currently used for agricultural purposes. Bluewaters II will be more efficient than the existing aging Muja plant, therefore increasing the SWIS efficiency.

5.2.3 Regional Perspective

Bluewaters II will add to the loading of the Collie air shed. However, because of the efficient technology and emission controls used in Bluewaters II, the total addition to the air shed will be proportionally less than the addition to generating capacity. The estimated addition of some emissions is in the order of eight percent using National Pollutant Database figures as the basis for comparison. A comparison of the incremental emissions, as deduced for Bluewaters II by using data from the National Pollutant Inventory and extrapolating from the Collie A emission profile, is outlined in Table 8. The table demonstrates that Bluewaters II is a benign addition to the region's environment and will be a positive addition if it hastens the replacement of older and less efficient electricity generating plants in the region.

Table 8 - Potential Gross Emissions from Bluewaters II compared with existing Collie emissions

Emission	Current Estimated Gross Emission in Collie Area per Annum (1)	Estimated Annual Incremental Emission from Bluewaters II (2)	Estimated Annual Incremental Emission from Bluewaters I & II in combination (2)
Arsenic	2000 kg	6.7kg (0.34%)	13.4kg (0.67%)
Cadmium	1100 kg	8.5 kg (0.77%)	17.0 kg (1.6%)
Chromium	2210 kg	1.5 kg (0.07%)	3.2 kg (0.14%)
Fluoride compounds	360,000 kg	17,000 kg (4.7%)	34,000 kg (9.4%)
Lead compounds	35,000 kg	31 kg (0.09%)	62 kg (0.18%)
Mercury	1,500 kg	31 kg (2.1%)	62 kg (4.1%)
Oxides of Nitrogen(3)	30,000,000 kg	3,050,000 kg (10.2%)	6,100,000 kg (20.3%)
Respirable particles	32,000,000 kg	227,000 kg (0.7%)	454,000 kg (1.4%)
Dioxins and Furans (4)	4.7 g	0.5 g (10.6%)	1.0 g (22.0%)
Polycyclic Aromatic Hydrocarbons (PAH)	3,500 kg	6.0 kg (0.17%)	12.0 kg (0.34%)
Total Volatile Organic compounds (VOC)	11,000,000 kg	32 kg (negligible)	64 kg (negligible)
Carbon Monoxide (3)	12,000,000 kg	2,350,000 kg (19.6%)	4,700,000 kg (39.2%)
Sulphur Dioxide (3)	61,000,000 kg	7,470,000 kg (12.3%)	14,940,000 kg (24.5%)

Abbreviations: *kg = kilograms*
g = grams
% = percent

(1) Gross figures are the sum of several point sources as obtained from http://www.npi.gov.au/index.html for 2001-02.
(2) Bluewaters II will be a point source which will contribute data to the national pollutant inventory.
(3) Gross emission data for Collie obtained from the NPI database appears to be under reported for some sites.
(4) Rounding error introduces large errors to these numbers.

5.3 Social Fairness

Social fairness requires meaningful community consultation in which the views of the community, particularly the local community, are listened to and addressed.

In today's society, one cannot contemplate a development of this nature without due consideration of its impact on the population. Social fairness must be part of the decision making process. The principle of social fairness requires, as a minimum, consideration of the effects of Bluewaters II on:

- community infrastructure – including road, rail, shops, hospitals;
- demographic structure; and
- community well-being - including security and reliability of essential services.

Development decisions require that social impacts (either positive or negative) to be assessed. Decisions taken at the regional level will have local impacts. If the decisions are not considered in terms of social fairness, then the aims of sustainability will not have been met. An outcome of implementing social fairness will be more resilient communities.

5.3.1 Local Perspective

Bluewaters II will create a small, long-term demand for skilled personnel in the management and maintenance areas. Development of Bluewaters II will do much to improve the local area in terms of services, infrastructure and local business.

Griffin Energy, as part of the Griffin Group is committed to equal employment opportunity and to the employment of locals.

The Griffin Coal workforce at Collie is drawn from the following locations:

- Collie 85%
- Perth/Mandurah 2%
- Bunbury region 11%
- Donnybrook/Busselton/ Darkan 2%

It is anticipated that a similar employment profile will exist at Bluewaters in the long term. The skills required to operate Bluewaters are already present and available in the Collie area as Collie is the only town in the state where the skills are currently required.

The impact of Bluewaters II on Collie is best summarised in the following submission to the EPA made by the Shire of Collie on the Bluewaters I proposal.

"The township of Collie is extremely well serviced with community infrastructure including medical, schools, business and commercial, and social and leisure facilities. The town is able to cope with an industrial expansion of this magnitude and will not require Government assistance towards the provision of additional infrastructure. The Collie community is welcoming and accepting of its industrial base and would be only too pleased to see its expansion in major projects such as the proposed Bluewaters power station project."

The Council also made the following comments with respect to the economic impact of the project:

"The Council has a good economic reason to fully support the Bluewaters power station project. The project will not only provide employment (during construction and late operational) but will also provide opportunities for local businesses to supply goods and materials. Collie has a vibrant light industrial sector that may well grasp the many opportunities that will inevitably arise. The purchasing power of the additional workforce will also help to stimulate and provide additional business opportunities within the general retail sector."

With respect to employment opportunities Collie Shire's submission states:

"There will be obvious benefits to the Collie district through the development of the proposed power station. The construction phase will employ skilled tradespersons and their associated trades' assistants and once completed, there will be a need for on-going management and support staff. The Council will be welcoming of all employment aspects associated with the project."

As Bluewaters II is an extension of the Bluewaters I proposal it can only be seen as having a similar impact on the local community as Bluewaters I.

In addition Griffin Energy commissioned a report on Economic and Social Impacts of Bluewaters I from ACIL Tasman. The report summary states:

"*The Bluewaters Power Station represents a considerable boost to the economy, particularly that of the South West. It also adds to the social sustainability of the South West in the form of job creation, long term employment opportunities, training and development opportunities, greater use of social infrastructure and the general long term well being of the community"*.

The impacts of Bluewaters II when combined with Bluewaters I are beneficial from a local social perspective, especially when viewed in the light of the announcement by Western Power that Muja A and B will be closed towards the end of 2007.

5.3.2 Regional Perspective

Bluewaters II will not have an immediate social impact on the region apart from increased job security for some power station operators. In the longer term, the industries attracted to the Coolangatta Industrial Estate, supported by Bluewaters II, will have a positive impact through job creation and an economic multiplier effect.

The Griffin Group through Griffin Coal is in its 77^{th} year of operation in the Collie area. It has supported and continues to support the community in which it operates and dedicates substantial funds each year to support local activities and groups. These include sports, cultural events (including the annual Griffin Festival), educational scholarships, community service groups and heritage preservation.

A highlight of the Collie calendar is the Griffin Festival, a week long celebration of local achievement in art, craft, literature, public speaking, music and dance. The Festival has been held every year since 1989 and enjoys a high level of participation by local schools and the artistic community.

The Griffin Continuing Education Scholarships are highly prized by the local school community.

The State's steam heritage is supported through donations of coal to the operators of steam railways. These presently include the Hotham Valley Tourist Railway, Kalgoorlie-Boulder Loop Line Railway, Pemberton Tramway, Carnarvon Tramway and miniature railways as far afield as Perth and Esperance. The Hotham Valley train normally visits Collie twice a year, coincident with the Griffin Festival and Rally Australia.

Griffin employees add to this community spirit by volunteering as members of business, schools, sporting, environmental, local government and other community groups within the South West.

With a stable workforce of 300 employees, Griffin Coal has a regular intake of apprentices and work experience students for career and training opportunities.

Griffin Coal has been instrumental in promoting and securing funding for a Centre of Excellence to research sustainable mine lakes.

Griffin Coal has also pioneered a regional salinity management scheme and established the Centre of Excellence in partnership with the DoE (formerly Waters and Rivers Commission and DEP), Water Corporation, CALM, and WA Universities. The Centre will undertake four main research streams to investigate possible options with respect to water filled mining voids. These options include bio-remediation, prediction modelling and pH neutralization.

The centre will also investigate ways to improve water quality in the Wellington Dam, one of the State's largest sources of surface water.

Griffin Energy as part of the Griffin Group will be building on and contributing to the initiatives of Griffin Coal in its support of the Collie and South West communities.

5.4 Resource Fairness

Resource fairness means maximising the benefits from each stock of resources and the application of technologies which will ensure the most efficient use of resources.

The allocation of resources in a fair and equitable manner is the key to a sustainable future. Consideration of all factors must be given when allocating resources. No single factor should be given an unfair preference against another. Resource allocation that results in a diminished capacity for the State to support the community interest is unsustainable.

5.4.1 Local Perspective

By making use of the coal reserves at Collie, Bluewaters II will continue to support the existing infrastructure and population for at least another 25 years. This will ensure the fair and equitable allocation of the total suite of resources available to the community.

The choice of alternative fuel source over the use of coal resources at Collie means a lost opportunity for the local area. The knock-on effect would mean the allocation of other scarce resources to support increasing populations in other local areas that, by necessity, will need to absorb the diminishing population of Collie.

5.4.2 Regional Perspective

The Bunbury Wellington Economic Alliance (BWEA) consisting of representation from the Local Government areas of Bunbury, Harvey, Collie and Dardanup denotes the regional area affected by the Bluewaters II proposal.

From a resource allocation perspective, the Bluewaters II proposal will facilitate economic development within the BWEA region, especially by helping to attract industries capable of using the co-generation opportunities that will flow on from the establishment of Bluewaters II.

5.5 Application of the Sustainability Principles

When the sustainability principles are applied in a regional context to Collie and the South West, construction of Bluewaters II should produce the following positive benefits.

- Existing jobs are retained and more long term positions created thus reducing the drift to the larger population centres.
- Towns and communities of the South West are maintained.
- Enhanced potential to attract industry to the South West.

- The State is provided with a cheaper, reliable alternative source of electricity.
- Real competition between fuel suppliers is promoted.
- A vibrant, healthy population results in better protection of environmental values in the region.
- The state gains a royalty revenue stream.
- Increased security of electricity supply is provided.
- Community values are upheld through maintenance of community infrastructure such as roads, schools and hospitals.

5.5.1 Community Involvement

In support of the sustainability approach, Griffin Energy maintains an active dialogue with the community. The consultation process for Bluewaters II commenced with the development of the Strategic Environmental Review ("SER") for the South West Power Project ("SWPP") and has continued through the development of the Public Environmental Review ("PER") for Bluewaters I.

Bluewaters I has been discussed with local, regional and state stakeholders and has been the subject of a workshop in Collie on 12th December 2003. In addition newspaper advertisements were placed in local, regional and state newspapers calling for contributions from the community for inclusion in the Bluewaters I PER. The community consultation program will continue throughout the development of Bluewaters II. Further details of the Community consultation program are to be found in Section 8.

6 Environmental Factors

Environmental Factors for the Bluewaters II have been drawn up using previous studies and studies carried out in support of the project.

Table 9 - Environmental Factors

Environmental Factor	EPA Objective	Existing Environment	Potential Impacts	Management Strategies
Biological Diversity				
Terrestrial Flora: • Vegetation Communities • Declared Rare Flora and Priority Flora • Flora of Conservation Significance	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities. Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*. Protect other flora species of conservation significance.	The majority of the power station site is cleared land with only isolated groves of native vegetation occurring. Native vegetation occurs to the south of the site. The site is currently being used for grazing. Flora surveys of the general area have been conducted to support approvals for Ewington I and II mines. No rare flora species are known from the study area. Several Priority species have been located.	Given the limited amount of clearing required it is unlikely that the project will impact on flora species of significance. No anticipated impacts to Declared Rare or Priority Flora.	Clearing will be minimised where possible through appropriate location of the power station and associated infrastructure. The project will maximise the use of existing cleared land. Avoidance of significant flora during the detailed design stage. **Management Outcome:** Maintenance of floristic quality in local area.
Terrestrial Fauna: • All Fauna • Specially Protected (Threatened) Fauna	Maintain the abundance, diversity and geographic distribution of terrestrial fauna. Protect Specially Protected (Threatened) Fauna consistent with the provisions of the *Wildlife Conservation Act* 1950.	Fauna surveys of the general area have been conducted to support approvals for Ewington I and II mines.	Given the limited amount of clearing required it is unlikely that the project will impact on fauna species of significance. No anticipated impacts to Specially Protected (Threatened) Fauna.	Avoidance of significant fauna habitats during the detailed design stage. **Management Outcome:** Minimal impact on local flora.
Water Courses (Surface Water Flows)	Maintain the integrity, functions and environmental values of rivers, creeks, wetlands and estuaries.	The dominant drainage system within the area is the East Collie River (located to the north of the plant site), which feeds into the Collie River and flows into Wellington Dam.	There will be no impact on riverine vegetation.	Implement a surface water management plan as part of the Construction and Operational Environmental Management plans. **Management Outcome:** Maintenance of local surface water qualities.
Groundwater Quantity	Maintain sufficient quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	The site area is North of the northern boundary of the Collie basin therefore there are no unconfined aquifers present .	There will be no impacts on the groundwater resource.	Implement a surface water management plan as part of the Construction and Operational Environmental Management plans. **Management Outcome:** Maintenance of local groundwater quality.

Pollution Management				
Surface Water Quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC 2000 and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy).	Surface water resources within the Collie River catchment are affected by salinity, with TDS concentrations varying widely. Average salinity level in the Collie River East in the vicinity of the proposed power station site is 1737 mg/L Total Dissolved Solids (TDS), while total inflow to the Wellington Dam averages 880 mg/L TDS.	Because of the very limited clearing involved, the proposed power station will not contribute to increased salinisation within the Collie River catchment. Salt will be concentrated (by evaporation) in cooling water discharge from the proposed power station. Contamination of surface water resources via runoff from the site could potentially occur.	Cooling water discharge will not be directed to the surface water system. The plant will be designed to ensure that contaminants are not released to the environment. Contamination of surface water will be minimised by methods such as: • suitably designed drainage areas and settling basins; • appropriate design of areas to contain hazardous material such as hydrocarbons; • washdown water will be collected in drains and passed through sediment traps and oil separation systems prior to transfer to settling ponds. **Management Outcome:** Maintenance of local surface water qualities.
Groundwater Quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC 2000 and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy).	Twenty bores sampled in 1984 ranged in salinity from 125 - 832 mg/L TDS. Typically the groundwater in coal measures is <500mg/L TDS and slightly acidic.	Contamination of groundwater due to leaks and spills of chemicals and hydrocarbons.	The plant will be designed to ensure that contaminants are not released into the environment. All potentially hazardous materials will be stored in accordance with relevant legislation and regulations. **Management Outcome:** Maintenance of local groundwater qualities.
Water Supply	Minimise the impact on natural water resources by minimising water consumption or requirements.	A number of water supply options have been investigated for the site. These include mine dewater and Wellington Dam water.	Potential impacts depend on the cooling option selected for the power station.	Develop and implement an appropriate water supply and management strategy that will satisfy requirements during both the construction and operation phases of the project. **Management Outcome:** Maintenance of local surface water qualities.

Marine Environment	Maintain marine water quality and protect Environmental Values of coastal waters	The Collie Power Station ocean outfall discharges into the ocean offshore from the Leschenault Peninsula. The pipeline extends approximately 700m offshore and lies in 10m of water. The area around the outfall consists of a gently sloping, predominantly sandy seabed and there are no well developed reefs in the area. The nearshore habitat is dominated by bare sand overlying limestone pavement. Further offshore predominantly sand and pavement habitat has patches of low relief reef and sparse, but dense, patches of seagrass (*Posidonia angustifolia*). The seagrass patches are generally confined to offshore areas (>600m). Occasional patches of exposed limestone support macro algae and filter feeding animals (sponges, ascidians etc.). A benthic habitat survey indicates that the existing outfall appears to have had little affect on the adjacent seagrasses. Millennium Inorganic Chemicals also discharges wastewater through an ocean outfall proximal to Collie Power Station outfall.	The volume of wastewater generated from the proposed Collie Power Station expansion would depend on the quality of supply water. However, It has been assumed for this study that the wastewater, consisting mainly of saline blowdown from the cooling towers, would be via the existing ocean outfall. The existing saline water disposal pipeline and outfall was designed and constructed for a 600MW power station and has capacity to accommodate additional discharge within the present operating and license framework. Dispersion modelling of the wastewater discharged into the marine environment has determined that adequate dilution would be achieved at the edge of the Zone of Initial Dilution to meet environmental guidelines based on the 95-99% level of species protection.	The Collie Power Station presently undertakes a comprehensive monitoring program of the existing wastewater ocean discharge as part of its operating license conditions. A similar monitoring program would be undertaken to cover the combined discharge from the expanded Collie Power Station. **Management Outcome:** Maintenance of marine water quality
Contamination **(Oil and chemical spills)**	Minimise the impacts of fuel or oil spillage during operations.	No hazardous or potentially contaminating materials currently storage on site.	Contamination of surface water and groundwater due to leaks and spills of chemicals/hydrocarbons during construction or operation of the proposed power station.	During the construction phase, potentially contaminating materials and activities will be stored and conducted in accordance with relevant regulatory requirements and operational practices. Containment of any spillages or leakage will be a priority. The plant will be designed such that all spillages of chemicals or hydrocarbons are contained and collected. During operation of the plant, all potentially contaminating or hazardous materials will be stored in accordance with relevant legislation and regulations. **Management Outcome:** Maintenance of local ground and surface water qualities.

Solid and Liquid Wastes	Ensure that waste products are disposed of in an acceptable manner.	No solid or liquid wastes are currently generated or stored on site.	Potential release of wastes to the environment. Disposal of fly ash. Cooling water discharge.	During both the construction and operation phases of the project, solid and liquid wastes will be minimised through resource recovery, reuse and recycling programmes. All materials requiring disposal will be managed in accordance with the requirements of the relevant authorities and regulations. Waste hydrocarbons will be contained, collected and disposed off-site by an approved method. Domestic wastewater will be managed on site via a packaged treatment plant. Fly ash requiring disposal will be mixed with claystone prior to disposal within the Ewington I pit. Cooling water discharge will be directed to the existing Collie Power Station Ocean outfall **Management Outcome:** Maintenance of local ground and surface water qualities.
Noise and Vibration: • Construction Phase • Operations Phase	Ensure that noise impacts emanating from construction activities comply with statutory requirements and acceptable (and appropriate) standards (eg. *Environmental Protection (Noise) Regulations* 1997). Ensure that noise impacts emanating from the proposed plant during operation comply with statutory requirements specified in the *Environmental Protection (Noise) Regulations* 1997. Ensure that vibration impacts emanating from the proposed plant are acceptable.	Noise in the area is currently dominated by the Collie Power Station and nearby mining operations.	Potential for cumulative noise emissions from the power station and nearby operations to exceed criteria. Vibration is not expected to be an issue. Generators will be installed on large concrete foundations such that any vibrations are damped out.	Appropriate noise abatement technology will be installed to ensure the proposed power station meets the relevant noise criteria. **Management Outcome:** Noise levels kept to a level that do not impact on the local communities
Air Emissions: • Construction Phase (Particulate / Dust) • Operations Phase (Particulate / Dust (PM_{10}), Oxides of Sulphur (SO_x), Oxides of Nitrogen (NO_X), VOC's, etc.)	Protect the surrounding land users such that dust and particulate emissions will not adversely impact upon their welfare and amenity or cause health problems, in accordance with EPA *Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites*. Ensure that particulate/dust and gaseous emissions, both individually and cumulatively, meet acceptable criteria for ambient ground level concentrations, and ensure that all reasonable and practicable measures are taken to minimise emissions (e.g. NO_x, SO_x and particulates).	Other air pollution emitters in the Collie area include Collie Power Station (A and B (proposed) plants), Muja Power Station (A, B, C & D plants) and Worsley Alumina Refinery. Dust emissions from mining operations are managed through standard dust abatement technology.	Increased ground level concentrations of SO_2, NO_X CO, VOCs, PAHs and PM_{10}. Increased photochemical smog (ozone) levels in the region. Dust emissions during construction.	Best practice management in the design and construction of coal handling (conveyance and stockpiling). Installation of low NO_x burners to minimise NO_x emissions. Continuous monitoring of emissions and condition monitoring to ensure low NO_x burners retain design tolerances. Installation of either an electrostatic precipitator or baghouse in the system to collect dust. Fugitive dust levels managed by minimising vegetation clearing, the use of dust suppression equipment and appropriate site management. **Management Outcome:** No increased health risks due to air emissions. Maintenance of local and regional environmental values

Greenhouse Gas Emissions	Minimise greenhouse gas emissions for the project and reduce emissions per unit product to as low as reasonably practicable, and mitigate greenhouse gas emissions in accordance with the Framework Convention on Climate Change 1992, and with established Commonwealth and State policies.	Major sources of greenhouse gas emissions are Collie Power Station, Muja Power Station and Worsley Alumina Refinery.	Emission of up to 0.85 Mtpa of carbon dioxide equivalents.	Management of emissions will comply with the EPA guidance for the assessment of environmental factors No. 12, Guidance Statement for Minimising Greenhouse Emissions. Thermal efficiency design and operating goals will be implemented. **Management Outcome:** Maximum efficiency for type of technology employed. Minimised Greenhouse emissions from plant

Social Surroundings				
Recreational Activity	Ensure that the environmental value of recreational activities is maintained	The site is not used for recreation activity. Forest areas adjoin the site. A pistol range is located about 4 km northwest of the power station site.	Reduction (loss) in the aesthetics and recreational enjoyment (bushwalking, birdwatching, etc.) of the adjoining bush.	Visual and noise impact will be minimised through planning design and screening strategies (eg. noise bunds and natural barriers). Access to adjoining bush will not be affected. **Management Outcome:** Maintenance of local recreational values.
Visual Amenity	Ensure visual impact is minimised.	The proposed power station site is on cleared land. Forest exists immediately to the south - South West, and approximately 5 km northwest of the site. The general area is dominated by industrial (power stations) and mining operations.	Potential visual and aesthetic impacts.	Potential impacts on visual amenity will be minimised through planning design and screening strategies (eg. natural barriers). Vegetation management and landscape strategies will be developed as appropriate. **Management Outcome:** Maintenance of local visual amenity
Aboriginal Culture and Heritage	Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	The site has previously been extensively cleared for grazing and it is unlikely that any sites of significance occur.	Potential damage to sites of Aboriginal significance.	Previous surveys have provided extensive coverage of the site from an archaeological perspective. The work undertaken to date indicates that the possibility of any aboriginal sites occurring on the project site is negligible. The construction EMP will cater for the remote possibility of artefacts being discovered during construction. **Management Outcome:** Protection of local Indigenous cultural values
European Heritage	Comply with statutory requirements in relation to areas of cultural or historical significance. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	No known sites of post-European heritage significance occur within the project area.	Given the level of clearing, it is unlikely that any sites of significance occur within the site.	Comply with the *Heritage of Western Australia Act* 1990 and *Australian Heritage Commission Act* 1975 if any heritage sites are found within or near to the proposed site. **Management Outcome:** Maintenance of European Heritage values
Public Risk	Ensure that public risk is assessed and managed to meet the EPA's criteria for off-site individual fatality risk. Ensure public risk associated with the construction and operation of the project is as low as reasonably practicable.	Low level of risk from the adjacent Collie Power Station.	Health Risk assessment workshop held with local community. Assessment shows that risks from Bluewaters II can be managed effectively The potential for increased off-site individual fatality risk from the proposed power station is low.	Hazardous materials will be stored and handled according to Department of Industry and Resources (DoIR) regulations. **Management Outcome:** No increased risk to local community.

6.1 Effects Summary

The preparation of this PER included the commissioning of several independent reports which examined differing aspects of the impact of Bluewaters II on the local and regional area. The reports commissioned included air emission modelling by CSIRO, Economic and Social Impact report from ACIL Tasman, a Health Assessment report from BenchMarch Toxicology Services, Flora and Fauna survey by Maunsells and a community profile survey undertaken by Coakes Consultancy. The combined result of these surveys indicates that Bluewaters II will have an overall positive effect on the local community and economy and a negligible impact on the local environment. The health impact is detailed in section 6.6. The air emissions summary is detailed in section 7.9.

Bluewaters II will have the following impacts:

- Biological
- Physical
- Community

6.2 Identification

The following methods were used to identify the effects of Bluewaters II:

- A literature search of studies undertaken in the project area, including studies for Ewington 1 coal mine, Collie A Power Station, Bluewaters I and the SWPP.
- Site visits to inspect and identify issues and verify the effects identified from the literature search.
- Workshops, as part of the Stakeholder consultation process.

6.3 Regional Effects

Regional biological impacts are related to the cumulative effects from air emissions from Bluewaters II, Greenhouse emissions, Saline discharge and drawdown of the Collie Basin water table.

6.3.1 Air emissions

Air emissions were modelled by the CSIRO using the TAPM air emission model. Several scenarios were modelled, with a scenario that included Muja A,B,C&D, Collie A and the planned Collie B, Worsley upgraded to 4.4 Mtpa, Bluewaters I and Bluewaters II used to assess air quality against accepted national and international standards.

This scenario is a worst case scenario, as it has been announced by Western Power that Muja A & B will be decommissioned in 2007. Bluewaters II is competing with other proposals to supply Western Power with electricity under the Power Procurement Process (PPP). If a gas proposal wins the PPP, then neither Collie B nor Bluewaters II will be built at this time. If Bluewaters II wins the PPP, then Collie B will not be built at this time. If Collie B wins the PPP then Bluewaters II will not be built at this time. If the Wesfarmers bid to build a plant at the Worsley Alumina refinery wins the PPP, then neither Collie B nor Bluewaters II will be built at this time.

Therefore the scenario that assumes all of the proposals in the modelling is a best estimate of the cumulative effect of air emissions in the Collie air shed. Using this scenario it was shown that the air quality in the town of Collie and at residences near to the Bluewaters location would be within NEPM standards. Section 7.9.2 provides more detail on the results of the air emission modelling.

6.3.2 Greenhouse Emissions

An estimated 1.3Mtpa greenhouse gases will be emitted from Bluewaters II. Griffin Energy has committed to a Greenhouse Management Strategy which is detailed in section 7.9.3.

6.3.3 Saline Discharge

The proposed method for disposal of saline water from Bluewaters II is via the current licenced Collie A ocean discharge facility. The use of this licensed facility raises two issues, namely capacity and marine impact.

The line has a design capacity of 92.5 L/sec and is currently used by Collie A at the rate of 16 L/sec. If the assumption is made that Collie A requires 25 L/sec (Collie A has used up to 23 L/sec in the past) and the next PPP power plant requires an equivalent amount (25 L/sec). The required utilisation of the line is then 50 L/sec. Griffin Energy has agreement in principle from Western Power to access the line for Bluewaters I. If Bluewaters I requirement is assumed to be 25 L/sec, then the total requirement of the existing line will be 75L/sec. On these assumptions, there will be 17L/sec spare capacity in the line after the addition of Bluewaters I and the PPP winner to the line.

In addition to the existing Collie A Power Station and the present, Bluewaters II proposal, there are two further 300 MW power station proposals (Bluewaters I and Collie B) currently under review. The three proposed additional power stations have the potential to impact on the marine environment through the cumulative effects of increased discharge volumes, increased size of mixing zone and increased total loading of contaminants.

All of the proposals are based on discharging water and at the same rate and of the same quality as that discharged from the existing Collie A Power Station. Hence the concentrations of all constituents of the effluent will remain the same and only the volume of water discharged will increase. However, the total volume of discharge will not exceed the 92.5 L/sec initially proposed for a 600 MW power station at Collie (subsequently replaced by the existing 300 MW station), and upon which all dispersion modelling has been undertaken. Thus the impacts on the marine environment discussed in this report (section 7.8) reflect the cumulative impact of the existing plus the three currently proposed stations, rather than being a consideration of the impact of the proposed Bluewaters II power station in isolation.

6.3.4 Groundwater Drawdown

Bluewaters II will not have any additional impact on regional water tables. It will not be drawing water for cooling from any bore fields. The water supply will be provided from mine dewatering activities associated with coal mining activities. Bluewaters II will require 3.25 GL of water per year. Mine dewatering from the Ewington I mine is expected to produce in excess of this amount (I Brunner pers comm. 2004).

6.4 Local Biological Effects

Local biological effects are minimal due to the project being located on previously cleared land, while no regional effects were identified.

Bluewaters II is to be located on land that is already cleared and currently being used for grazing. The project may possibly require the removal of some individual trees.

A review of the conservation significance of flora and vegetation (see attachment 13.1) recorded at and adjacent to the Bluewaters II site concluded that:

- no species of threatened flora occur within or were adjacent to the Bluewaters II site;
- no Threatened Ecological Communities (TECs) or Associations of Conservation Significance were located within the study area; and

- with the exception of an area in the extreme south-west of the project area, which is unlikely to be impacted by Bluewaters II, the condition of stands of remnant vegetation was poor to completely degraded.

6.5 Local Physical Effects

In terms of this environmental review, physical effects are limited to construction, visual and operational impacts associated with gaseous and particulate emissions, noise emissions, liquid and solid waste disposal.

The local physical impact will come mainly from construction of Bluewaters II. This will involve some cut and fill on the site and the possible removal of a few individual trees on the grazing property. These are not large physical impacts and are consistent with the proposed land use for the Coolangatta Industrial Estate.

The visual amenity of the local area will not be impacted except by the placement of a one hundred metre high stack, which is similar in height to the existing Collie Power Station stack. This will only be visible from parts of the Collie – Williams road immediately to the north of Collie.

There are some air emissions associated with the operation of Bluewaters II that have been addressed in Section 7.9 of this report. However, studies undertaken by CSIRO and analysis of the air modelling results by CSIRO and BenchMark Toxicology Services have demonstrated that these emissions will not have an adverse -impact on the town and are well within acceptable and regulatory standards as detailed in section 6.6.

6.6 Community and Health Effects

As part of the Public Environmental Review process, Griffin Energy commissioned a number of studies and reports on several of aspects of the potential impacts of the Bluewaters power station in the Collie region.
Griffin energy contracted BenchMark Toxicology Services to conduct a health assessment based on information contained in the following reports:

- Collie Health Impact Assessment. Social Profile. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.
- Collie Basin Health Impact Assessment Survey. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.
- Economic and social impacts of Bluewaters Power Station. A report on the assessment of the economic, social and strategic impacts of the proposed Bluewaters Power Station. ACIL Tasman Pty Ltd, September 2004.
- A modelling assessment of the air quality impact in the Collie region of 1 x 200 and 2 x 200 MW power stations at Bluewaters. CSIRO Atmospheric Research Report C/0896, November 2004.

6.6.1 Overview of Health Impact Assessment

The information available for the assessment included demographic information on Collie from the Australian Bureau of Statistics as well as information on current infrastructure, results of a telephone survey on community attitudes towards the establishment of additional coal-fired power stations in the Collie region, results of a social and economic impact assessment, and estimates of ground level concentrations of emissions from the proposed additional power stations as well as the existing power generating facilities in the region.

The social study has identified that the Collie community consists of a slightly higher proportion of young residents and young couples with small children than the Western Australian average, has a higher unemployment rate and a lower socioeconomic status than the state average.

Individuals identify strongly with the local community and local industry and generally support the establishment of additional coal-fired power generating facilities.

Preschools, primary and secondary schools, aged care facilities and the hospital have been identified as potential areas of exposure of more susceptible individual to the coal-fired power stations emissions.

Compared with national trends, the Collie community appears to feel more empowered about environmental risks, although less aware about some environmental issues.

The infrastructure is currently adequate to support the township, although the influx of additional workers from outside the Collie area, particularly during the construction phases of additional facilities may put additional demand on the facilities. Management options have been identified to minimise any adverse impacts from the additional demand.

The predicted social and economic impacts were mainly positive, generally relating to increased employment opportunity, development and sustainability of the local area and opportunities for up skilling the local workforce. This was also reflected in the attitudes of the Collie community.

Whilst the majority of residents did not feel that the current or proposed power generating facilities would impact on their health or that of the community in general, a small proportion of the community has concerns about air quality and the impacts of their health, mainly related to dust, smoke and flyash from power generation and coal mining in the area. The degree of concern and the perception of the severity of the health risks appear to be inversely correlated with the extent to which they feel they have control over environmental health issues in the region as well as age, a common outcome of surveys of this type.

The major emissions of concern were identified from currently operating facilities or from the National Pollutants Inventory database. For the Bluewaters II proposal, the emissions of concern included PM_{10}, SO_2, NO_2, CO, O_3, PAH, arsenic, cadmium, chromium, fluoride, lead, mercury, VOC and POPs. Ground level concentrations were estimated for the Collie Township and two modelling area domains (22 x 22 km^2 and 220 x 220 km^2) using the TAPM air-quality model developed by CSIRO for 5 different exposure scenarios designed to assess the current and additional impacts of coal-fired power stations in the region. The modelling was based on hourly-average concentrations of SO_2 collected by Western Power in 2001 and meteorological information for the same year.

VOC, POP, arsenic, chromium, cadmium and lead were not modelled because of the small quantities of the annual emissions.

Appropriate averaging times for the modelled ground level concentrations were used, consistent with averaging times for reference health values. Reference ambient air quality values were used to assess the impacts of the emissions on public health, since inhalation was considered the most important route of exposure.

Multi-exposure pathways were also considered for emissions with the potential to deposit on soil and water collecting surfaces, such as roofs for the collection of rainwater. Although estimates based on very conservative assumptions were used in the calculations, the results indicate that deposition to soil or water is highly unlikely to pose a public health risk.

The results of the modelling undertaken by CSIRO using the TAPM model (section 7.9.2 and attachment 13.4) indicate that ground levels concentrations of the emissions from Bluewaters I and Bluewaters I and II in combination at the Collie Township are well below national and international reference values for the protection of human health, including for the most sensitive individuals in the community, such as asthmatics, the elderly, children and people suffering from respiratory diseases.

The impact of emissions from the proposed Bluewaters I and II on the existing environmental emissions load in the region is minimal. The major contributors to the environmental load appear to be the Muja A & B power stations, which are scheduled to be decommissioned in 2007. A small number of exceedances of the SO_2 reference values are predicted in the innermost modelling domain - areas adjacent to the power stations (one per annum for the 24-h average and 27 per annum for the I-h average concentrations for the existing power station or existing and proposed combined). One exceedance per year (up to about 9% higher than NHMRC goal) is also predicted for the maximum 10-min average SO_2 concentrations at the Collie Township for emissions from the existing power stations plus Collie B alone (scenario 5) or in combination with the proposed Bluewaters I and II (combined exposure scenarios).

Exceedances of the PM_{10} reference values are also predicted for all combined emission scenarios, particularly around the Muja power stations location. These, however, are unlikely to impact on public health as there are no residents in the affected areas. Employees commuting to their work place may experience transient irritant effects.

Given that the Muja power stations are to be decommissioned, the emissions and ground level concentrations are likely to be much lower once the proposed facilities are operational. Consequently there is likely to be an improvement in the air quality within the region.

6.6.2 Conclusions of Health Assessment

Results of air modelling of emissions from the proposed Bluewaters I and II suggest that ground levels concentrations in the Collie Township as well as in the vicinity of the power stations is highly unlikely to impact adversely on public health. Maximum predicted concentrations are well within relevant ambient air health reference values. In addition, the proposed power stations appear to contribute minimally (generally in the order of a few percent) to the existing environmental load of emissions from power generating activities.

A small number of exceedances are predicted for short-term SO_2 concentrations ($\leq$ 1-h averaging times) when emissions from all power generating facilities are modelled. Exceedances of 10-min and 3-min average concentrations in the Collie Township are unlikely to impact adversely on public health, except for temporary, reversible discomfort or irritation even in sensitive individuals. The majority of exceedances are predicted for the innermost modelling domain, particularly in the area around the Muja power stations where exceedances of PM_{10} levels are also predicted.

Overall, the Collie community is supportive of the proposed expansion of power generating facilities in the region. Predominantly positive social and economic impacts were identified and appropriate management options proposed to mitigate the few adverse effects identified. There is some concern in the community about adverse health impacts and risks with mining of coal and power generating activities. Air modelling data results indicate that emissions from the proposed developments are unlikely to impact adversely on the health Collie residents. In the main, adverse effects from combined emissions are unlikely, except minor transient effects in some case. Any likelihood of adverse effects will be reduced once the Muja power stations A & B are decommissioned.

The full Health Impact Assessment report is included as attachment 13.2.

7 Assessment & Management of Environmental Issues

Bluewaters II is not a significant development in terms of its physical scale. It only represents approximately an eleven percent increase in the installed coal fired generating capacity at Collie and a four percent increase in the total installed generating capacity of the SWIS grid. Nonetheless it does have impacts in several areas that will require active management by Griffin Energy.

This section details the assessment and management of the following issues:

- Hazard Identification and Management
- Flora and Fauna
- Surface and Ground Water including fly ash management
- Saline Water Discharge to the marine environment
- Air Emissions (including Greenhouse Emissions)
- Dust
- Noise and Vibration
- Hazardous Materials management
- Visual amenity
- Aboriginal and European Heritage

7.1 Quantitative Risk Assessment

A Hazard Identification (HAZID) study was undertaken to identify and assess the Major Accident Events (MAEs) associated with Bluewaters II. Only those MAEs which could have impacts on members of the public and the environment at or beyond the power station boundary were considered.

The risk assessment framework applied to the study was in line with the Australian Standard AS/NZS 4360:1999. The process systematically identified possible MAEs by concentrating on hazard identification, risk assessment and risk mitigation. The consequences and safeguards for each type of hazard were also identified and reported.

The two hazards identified as posing the highest risk to society or environment both fell into the rating of a "Managed" risk as follows:

- Ignited spill within bunded area, and
- Overflow or leakage from the retention pond.

The controls for these hazards include the following items which will be part of the operations management procedures;

- Regular inspection and maintenance of bunds
- Double skinned tank bottoms
- Float switches in bunded areas
- Control of ignition sources
- Compliance with relevant legislation (refer section 2.6)
- Fire protection system
- Boundary fire breaks around Bluewaters II
- Level monitoring
- Lined construction for short term retention ponds
- Monitoring bores

With appropriate safeguards in place, these hazards will be manageable. Although these events are heard of in industry and could occur at any time, the workshop group agreed upon an "Unlikely" probability for both risks.

7.1.1 HAZID Conclusions

The development of the project will introduce management schemes to ensure potential environmental impacts, waste and hazardous materials are minimised.

The output of the HAZID study was a total of 19 hazards resulting from major accident risk events. Of these, only two hazards were assessed as potentially impacting significantly on the community and environment, with ratings in the 'Managed' category as described above.

Safeguards and management strategies were identified to reduce these risks to As Low As Reasonably Practical (ALARP) and hence place them in the "Tolerable" category.
The summary findings of the HAZID workshop are found in attachment 13.5.

7.2 Landform and Geology

The proposed site is situated within the Collie landform unit (low-relief lateritic ridges and hills) formed through weathering of the Permian Coal Measures and the younger Nakin Formation. The unit is characterised by gently undulating duricrust-capped, lateritic uplands, interspersed with well drained grey silty sands of low natural fertility.

A low diagonal NW – SE ridge runs through the area containing the proposed Bluewaters II site. Although the site is topographically moderate, some earthworks will be required for development preparation and, as a result, direct disturbance will occur. However, significant impact on landform is not anticipated because the extent of the required earthworks is limited. Additionally, any areas that are disturbed by earthworks, but are not required for construction or safe operation of Bluewaters II and associated facilities will be stabilised during site development.

7.3 Local and Regional Biodiversity

Biodiversity, the variety of living things, is usually considered in terms of genetic, species and ecosystem diversity. Western Australia is recognised as one of 25 global biodiversity 'hotspots'. The south-west of the state is the centre of a large proportion of this biodiversity.

The Collie Basin contains a diverse assemblage of flora, vegetation and fauna as detailed in Attachment 1.

The distribution of vegetation is largely governed by underlying soils and geology. The predominance of moist sandy soils of the Collie Basin leads to differences in the distribution of flora species in comparison with adjoining areas on the Darling Ranges. The diversity of geology and landform in turn increase the biodiversity of the Collie Basin and adjoining areas.

Three vegetation complexes have been previously defined in the Collie Basin:

- Collie Complex: Open forest of jarrah, marri and sheoak with a range of understorey species that reflect the relative proportion of sand and gravel in the soils.
- Cardiff Complex: Open woodland of Banksia attenuata, B. ilicifolia and Nuytsia floribunda with a range of distinctive understorey species that reflect levels of soil moisture.
- Muja Complex: Open woodland of Melaleuca preissiana and Banksia littoralis with some admixture of yarri (Eucalyptus patens) dominating moister areas, replaced by a woodland of Banksia spp. on drier sites. Understorey composition is largely determined by moisture levels.

Surveys of the Ewington coal deposits defined 18 vegetation communities and recorded 287 plant taxa from 56 families. Fauna surveys in the vicinity recorded six native mammal, seven introduced mammal, 99 avifauna (Collie Basin) and 58 herpetofauna (Collie Basin) species.

A considerable proportion of the Collie Shire's biodiversity is maintained in State forests and areas set aside for conservation ensuring the long term maintenance of the areas biodiversity.

The Bluewaters II site is relatively disturbed (due to a history of mining, farming and grazing) and as a result much of the biodiversity of the site is lost. The proposed development footprint will not require the clearing of any good quality native vegetation and largely avoids remnant native vegetation altogether. The area of remnant native vegetation to be cleared for the construction of Bluewaters II is minimal. The likely direct impact of the construction of Bluewaters II on local biodiversity is therefore negligible.

7.4 Flora

Management Objectives

- Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.
- Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act, 1950.*
- Protect other flora species of conservation significance.

7.4.1 Existing Environment

Introduction

Bluewaters II will have a small footprint (15 hectare) within the area shown in Figure 2 on page 31 ensuring that little or no vegetation will be disturbed in the construction of the plant.

A flora and fauna report was commissioned in support of Bluewaters I. The same report provides coverage for Bluewaters II. The report covered a larger area than that which is impacted by Bluewaters. The purpose of the report was twofold, namely to provide information on a regional context and on site specific information. As Bluewaters II is to be built on cleared agricultural land immediately adjacent top Bluewaters I there will be no disturbance to any natural ecosystems.

Bluewaters II was referred under the requirements of the EPBC Act and the decision handed down as required under the Act, was that the proposed action was not a controlled action (EPBC 2004/1632).

Vegetation

Regional Vegetation Associations

For the Collie Basin, three vegetation complexes have been defined - Collie, Cardiff and Muja (*Heddle et al., 1980*).

The **Collie Complex** consists of an open forest of jarrah-marri-sheoak with a range of understorey species that reflect the relative proportion of sand and gravel in the soils. Those species commonly associated with gravely soils include Banksia grandis, *Persoonia longifolia, Hibbertia hypericoides, Leucopogon capitellatus, Bossiaea ornata, Acacia browniana, Hakea lissocarpha* and *Astroloma pallidum*. On sandier soils common plant species include *Xylomelum occidentale, Daviesia incrassata, Bossiaea eriocarpa, Lyginia barbata, Dasypogon bromeliifolius* and species of *Calytrix.*

The **Cardiff Complex** consists of an open woodland of *Banksia attenuata – B. ilicifolia* and *Nuytsia floribunda* with a distinctive understorey and range of species that reflects the levels of soil moisture. On the drier soils the understorey plant species include Ku*nzea ericifolia, Banksia meissneri, Calothamnus* spp., *Lepidosperma angustatum, Xylomelum occidentale, Leucopogon glabellus, Jacksonia furcellata, Bossiaea eriocarpa* and *Daviesia incrassata*. On moister soils common understorey species include *Pericalyma ellipticum, Adenantos obovatus, Hypocalymma angustifolium* and *Schoenus brevifolius*.

The **Muja Complex** consists of an open woodland of *Melaleuca preissiana – Banksia littoralis* with some admixture of yarri (*Eucalyptus patens*) dominating the moister areas, and replaced by a woodland of *Banksia spp*. on the drier sites. The understorey species reflect the level of soil moisture. On the drier soils common plant species include *Lepidosperma angustatum, Dasypogon bromeliifolius, Lyginia barbata* and *Xylomelum occidentale*. Common plant species on moister soils include *Hakea ceratophylla, Agonis lineraifolia, Pericalymma ellipticum, Hypocalymma angustifolium, Adenanthos obovatus* and *Meeboldina scariosa*.

The Project Area

The vegetation associations of the Bluewaters II site were mapped from aerial photographs and verified on the ground in May 2002. Bluewaters II site was found to have five areas of remnant vegetation of the association EmCcAf (open forest of *Eucalyptus marginata – Corymbia calophylla – Allocasuarina fraseriana* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on sandy gravel) and two smaller areas of association SS (seasonal sedge swamp). The remaining area is comprised of cleared farmland.

Vegetation Conservation Significance

Two vegetation associations occurred within the Bluewaters II site, EmCcAf and SS. Neither of these associations are Threatened Ecological Communities (TECs) that is, a community considered 'presumed totally destroyed', 'critically endangered', 'endangered', or 'vulnerable' (English and Blyth, 1999). The association EmCcAf is generally considered by CALM as having high regional significance and conservation value. However the remnant areas of this vegetation community were significantly degraded with little understorey and infested with weedy species and therefore its value is diminished.

7.4.2 Local Floristic Composition

A total of 56 families, 172 genera, and 287 plant taxa (including varieties and subspecies) have been recorded in the area. Species representation in these areas was greatest among the families *Myrtaceae, Proteaceae, Papilionaceae, Cyperaceae* and *Epacridaceae*, a flora composition characteristic of the Collie, Cardiff and Muja complexes as described by Heddle et al., 1980. Of the 287 plant taxa, 16 were introduced weed species. A list combining all species found at Ewington I and Ewington II has been compiled and is presented in Attachment 1.

7.4.3 Field Investigations

Methodology

A survey for threatened flora was undertaken by botanists from Maunsell on September 10, 2003. Proposed locations for Bluewaters II and adjoining areas of remnant vegetation were searched for threatened flora during a series of foot traverses.

Where field identification of plant taxa was not possible, specimens were collected in a systematic manner and information such as location (using a GPS receiver), vegetation type and site characteristics were recorded. Collections were later identified at the West Australian Herbarium by comparison with the reference collection and use of identification keys.

Field Survey Results

No species of threatened flora were located during the field investigation. With the exception of the south-western extremity of the site (alignment to previously mixed areas) where the remanent vegetation is relatively undisturbed, the overall condition of remnant vegetation within the project area is very poor. Remnants are subject to grazing by stock and as a result the native understorey is almost completely destroyed. Native over storey tree species were present with dominant species *Eucalyptus marginata, Corymbia calophylla* and in places *Allocasuarina fraseriana*. Additional over-storey/ mid-storey species included *Banksia grandis, Persoonia longifolia* and *Xylomelum occidentalis.*

The relatively large remnant to the immediate east of Bluewaters II 'location two', in the south-east of the project area did contain some scattered understorey species including *Trymalium ledifolium, Kennedia coccinea, Drosera spp., Bossiaea ornata, Lagenifera huegelii, Stylidium piliferum, Xanthothia atkinsoniana, Hibbertia communtata, Tetraria capillaris, Hakea lissocapha* and *Tetrahena laevis.* However, the densities of native understorey species were very low and the overall condition of the vegetation very poor.

In comparison, remnant vegetation to the south of the old Bluewaters II Mine site adjoining State Forest is intact and in excellent condition.

Conservation Significance of Vegetation

During the September 2003 survey, the vegetation community boundaries were confirmed for previously mapped areas and mapped for previously unsurveyed areas.

The vegetation communities previously mapped for the project area and confirmed during the September 2003 survey are well represented in adjoining areas of State forest. Furthermore, the very poor condition of the majority of remnants negates any conservation significance in terms of flora and vegetation.

The area of remnant vegetation to the south of the old Bluewaters Mine site is of greater conservation significance given its intact understorey and excellent condition. The vegetation communities represented in this area extend south into the adjoining State forest. This area is unlikely to be directly or indirectly impacted by the Bluewaters II project.

Dieback

Phytophthora cinnamomi is a soil-borne pathogen readily dispersed by the movement of infected soil, roots or water and has been commonly linked to watercourses, tracks and roads where rainfall exceeds 400mm per annum and human activity is frequent (*Podger et al, 1996*). In the wider Collie region, dieback is prevalent and, whilst not designated a disease risk area, the majority of bush tracks in and adjacent to Ewington I are not effectively quarantined, i.e. roads are traversed in all weather conditions and have no known hygiene management boundaries. Dieback boundaries within Ewington I (west of the Bluewaters site) were surveyed and mapped during October/November 2000 (*Halpern Glick Maunsell, 2002a*). Throughout Ewington I, dieback was consistently associated with seasonally wet environments and adjacent lower slopes. In addition to dieback, a significant level of physiological stress caused by fire and the jarrah leaf miner, *Perthida glyphopa,* was also observed for jarrah, sheoak and Banksia spp.

Weeds

Weeds are disturbance opportunists that aggressively compete with native plants and can eventually lead to the degradation and simplification of bushland ecosystems (*Hussey et al, 1997*). Introduced weed species comprised 5.5 percent (16 taxa) of the total flora recorded for the Ewington I and Ewington II sites. Weeds were most abundant in the Poaceae (6 taxa) and Asteraceae (5 taxa) families (Attachment 1). Weeds were prevalent at the Bluewaters site as a result of significant historical disturbance of the area. South of the Bluewaters site in bush adjoining the power-line easement, the area was in significantly better condition and weeds were not as dominant. The composition of weeds in both areas will be similar to the weeds occurring in the adjacent previously surveyed areas. Some species can be particularly aggressive and may require active management if not adequately controlled (*Hussey et al, 1997*). These include African Love Grass (*Eragrostis curvula*) and Cape Weed (*Arctotheca calendula*).

7.4.4 Potential Impacts

The Bluewaters site is on cleared grazing land, therefore, there will be no significant impact on significant stands of vegetation, Declared Rare Flora (DRF) or Priority Flora. However, potential impacts that need to be considered include:

- the introduction or spread of dieback during construction activities;
- the introduction or spread of weeds during construction activities;
- the disturbance of surface hydrology;

- the contamination of surface water; and
- fire and dust.

Introduction or Spread of Dieback during Construction Activities

The plant disease *Phytophthora cinnamomi* (dieback) and pest *Perthida glyphopa* (Jarrah Leaf Miner) potentially occur within the project area. Movement of soil and/or cleared vegetation during construction may introduce or spread the soil borne dieback fungus, and aid movement of the jarrah leaf miner within the project site and surrounding uninfected areas.

Introduction or Spreading of Weeds during Construction Activities

The presence of weeds at the Bluewaters site and within surrounding areas means that earthworks have the potential to introduce additional weeds to the area and to spread the existing populations of introduced flora.

Disturbance of Surface Hydrology

Indirect loss of vegetation may occur due to an interruption of existing surface water flows. There are no major drainage channels that occur within the Bluewaters site thus impacts on surface hydrology are likely to be restricted to sheetflow movement. Possible impacts on vegetation related to changes in sheetflow are:

- ponding of water resulting in flooding of vegetation;
- drainage shadow effects. Construction may result in drainage shadow on the lower slope of the area; and
- scour and erosion.

Contamination of Surface Water

Accidental discharge of saline wastewater or waters containing coal sediments, fly ash or chemicals may enter local drainage systems in the State forest south of the site potentially harming vegetation communities. However, given the location of the power station this is not considered to be a realistic scenario.

Fire

The construction and operation of Bluewaters present a fire risk to the State forest, south of the site. This risk will be addressed in the Construction Phase EMP and Operations Phase EMS.

Dust

Dust may be generated by construction activities and has the potential to negatively affect native vegetation to the south of the Bluewaters area. However, dust generation is likely to be short term (construction only) and with appropriate dust suppression techniques is not likely to be a significant issue.

7.4.5 Management of Impacts

A range of management measures will be implemented as part of the design, construction and operation of Bluewaters II, to reduce the potential direct and indirect impacts to the vegetation and flora of the area. These measures will be incorporated into the Construction Phase and Operations Phase Environmental Management Plans. Management will include:

- The design phase will take into account any adjacent significant vegetation types and the locations of any DRF or Priority Flora populations. The objective of this will be to protect these locations from disturbance.
- The design phase will take into account local hydrological patterns that may have ecological significance. This will include adequate provision for drainage line habitats and dispersal of sheet flow to ensure that downstream vegetation is not adversely affected.
- Vegetation clearing will be kept to the minimum necessary for safe operations. Clearing limits will be marked on all design drawings and pegged in the field prior to any clearing works commencing.

- Off-road driving over vegetated areas will be strictly prohibited, with all staff to be informed of this, and other significant environmental issues generally, as part of an onsite induction program.
- Weed control measures will be implemented to ensure that weed species identified from the project area are not spread as part of the construction.
- A Construction and Operations Fire Management Plan will be prepared to reduce the risk of unplanned fires and provide contingency measures to minimise any associated impacts. This will include measures to address normal construction activities including the use of heavy plant and equipment in dry vegetated areas, welding, grinding and other activities with the potential to start fires. This plan will include a contingency and response plan in the event of any bushfires that commence as a result of the construction works.
- A Rehabilitation and Topsoil Management Plan will be prepared prior to construction commencing. This plan will include, but not be limited to, strategies such as:
  - use of locally collected seed (i.e. within 50km) of native species during reseeding;
  - respreading of cleared vegetative material over disturbed areas;
  - clearing and appropriate stockpiling of topsoil;
  - sensitive location and design of borrow pits and other disturbance areas; and
  - standard dust suppression measures (use of a water cart etc) will be implemented across the site during construction to minimize effects on surrounding vegetation.
- The site will be designed to ensure that contaminants are not released into the environment and all potentially hazardous material will be stored in accordance with current standards.

7.5 Fauna

Management Objectives

- Maintain the abundance, diversity and geographic distribution of terrestrial fauna.
- Protect Specially Protected (Threatened) Fauna consistent with the provisions of the *Wildlife Conservation Act 1950.*

7.5.1 Existing Environment

Bluewaters II is located in the zoogeographic region of South West Australia within the Jarrah Forest IBRA region, a habitat characterised by jarrah marri woodlands with occasional swampy areas and a warm Mediterranean climate (Thackway and Creswell, 1995; Beard, 1980). Fauna surveys undertaken in the vicinity of the Bluewaters II site include a systematic and non-systematic survey (Ecologia 1991, Halpern Glick Maunsell, 2002a) for the adjacent Ewington I proposed open-cut coal mine proposal and an opportunistic survey in the nearby Ewington II area (Halpern Glick Maunsell, 1994). The similarity in landform and vegetation between Ewington I, Ewington II and the Bluewaters II site suggests that the species composition of fauna at all three sites will be similar. The close proximity of these areas (all within a 5 km radius) and the mobility of fauna (especially mammals and birds) mean that the overlap of fauna between these areas may even extend to individual fauna utilising all three areas.

Fauna Habitat

Remnant patches of vegetation adjacent to the Bluewaters II site are characterised by a degraded jarrah-marri-sheoak habitat. However, the site is unlikely to contain the richness of species that would be observed in uncleared areas such the Ewington I mine area because of the high level of disturbance and lack of understorey

Mammals (Native)

Six species of mammal from five families have been recorded in the area, either by trapping or opportunistic sightings. The most common species in the area are the Yellow-footed Antechinus, *Antechinus flavepes*, the Southern Brown Bandicoot, *Isoodon obesulus* and the Common Brushtail Possum, *Trichosurus vulpecula* (Halpern Glick Maunsell, 2002a). Previous advice from the

CALM Regional Office at Collie indicates that two other native mammals are likely to occur within the project area, the Chuditch (*Dasyurus geoffroii*) and the Brush-tailed Phascogale (*Phascogale tapoatafa*) (Halpern Glick Maunsell, 2002a). Both of these dasyurids are unlikely to have been trapped given the bait type that was used in previous surveys, and both animals are not trap friendly. It is possible that another 20 species (including bats) occur in the vicinity of the project area (Ecologia, 1991). However, as the population densities of most native mammal species in the South West are relatively low (with the exception of macropods) it is unlikely that all species present will be recorded within the time constraints of a field survey.

Mammals (Introduced)

Seven species of introduced mammal have been recorded in the general area. These are the pig (*Sus scrofa*), the dog (*Canis familiaris*), the rabbit (*Oryctolagus cuninculus*) the horse (*Equus caballus*), the black rat (*Rattus rattus*), the fox (*Vulpes vulpes*) and the house mouse (*Mus musculus*).

Avifauna

99 species of bird have been recorded in the Collie Basin and may potentially occur in the project area (Halpern Glick Maunsell, 2002a). A total of 51 species of bird, represented by 742 individuals, were recorded in the adjacent Ewington I mining area during the 1991 survey by Halpern Glick Maunsell. A 1990 survey in the same area recorded 34 species (Ecologia, 1991) and 31 species of bird were recorded from the Ewington II site in 1994 (Halpern Glick Maunsell, 1994). This totals 61 species from 29 families that have recently been recorded in the general area. The most commonly recorded birds in the general area are the Striated Pardelote (*Pardalotus striatus*), Australian Raven (*Corvus coronoides*), the Splendid Fairy-wren (*Malurus splendens*), the Western Gerygone (*Gerygone fusca*) and the White Winged Triller (*Lalage tricolor*).

Herpetofauna

58 species of herpetofauna have been recorded in the Collie Basin and may potentially occur in the immediate area of the Bluewaters II site. The 2001 fauna survey in the Ewington I area recorded four frogs and 17 reptiles. The reptiles comprised one gecko, three pygopodids, one agamid, one varanid, ten skinks and one blind snake species for a total of 140 individuals. A previous survey of the same area in 1990 recorded two frogs and 12 reptiles (Ecologia, 1991). A total of 5 frogs and 19 reptiles have recently been recorded for the general area. CALM Collie has previously suggested that other species are likely to occur in the general area, not recorded in the 2001 or 1990 surveys include the Tiger snake (*Notechis scutatus*) and King's Skink (*Egernia kingii*) (Halpern Glick Maunsell, 2002a).

Threatened Fauna

Native fauna species which are rare, threatened with extinction or have high conservation value are specially protected by Federal law under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC) and State law, under the Western Australian Wildlife Conservation Act 1950. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). The Wildlife Conservation (Specially Protected Fauna) Notice 1998 recognises four distinct schedules of taxa:

- Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
- Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
- Schedule 3 taxa are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection; and
- Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in schedules (1), (2) and (3).

In addition to the above, fauna are also classified under four different Priority codes:

- Priority One Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Two Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Three Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- Priority Four Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa that are declining significantly but are not yet threatened.

Consultation with CALM in a 2001 desktop fauna survey identified 8 Schedule and 13 Priority Fauna species likely to occur in the general area and the conservation status of these species has been updated (Orell pers. comm., 2002).

7.5.2 Potential Impacts

Potential impacts on fauna from Bluewaters II relate mainly to the direct and indirect impacts of Bluewaters II on vegetation. The site for Bluewaters II is within the proposed Coolangatta Industrial Estate and is open grazing land devoid of trees. Therefore, it is highly unlikely that any vegetation removal will be required for the construction of Bluewaters II. The following sections are included to cover for the remote possibility Bluewaters II may require some vegetation removal for construction.

Loss of Habitat through Clearing

An impact of the proposed development on fauna could be the loss of habitat associated with clearing vegetation. The principal habitat lost as a result of construction of the Bluewaters II site is remnant areas of *Eucalyptus marginata – Corymbia calophylla – Allocasuarina fraseriana* with some *Banksia grandis* and *Persoonia longifolia*. This habitat is significantly degraded and therefore of little conservation significance. The remnant areas of vegetation are characterised by either a sparse or complete absence of understorey, a dominance of weeds and evidence of considerable disturbance (the area is used for grazing). However, there will be local impacts associated with the destruction of this habitat, loss of sedentary species and relocation of mobile species towards habitats to the south. The vegetation to be impacted is at the northern edge of State forest and, as such, there is not expected to be any significant impact on species (such as birds) that may use the vegetation as ecological linkages between regionally significant areas.

Threatened Fauna

The lack of understorey within the proposed Coolangatta Industrial Estate significantly reduces the value of the site to terrestrial vertebrates. Given the low numbers of threatened fauna identified from the adjacent Ewington I deposit, it is highly unlikely that any threatened terrestrial fauna occur on the Bluewaters II site. However, the jarrah and marri trees provide a habitat for birds and bats. Threatened birds and bats that may use the jarrah-marri woodland on the Bluewaters II site for nesting or foraging include:

- Baudin's Cockatoo;
- Carnaby's Cockatoo;

- Forest Red-tailed Black Cockatoo;
- Barking Owl;
- Masked Owl; and
- Western False Pipistrelle.

Fire

Increasing activity in the area increases the risk of fire to fauna habitat. Griffin Energy intends to manage the risk by preparation and implementation of a Construction and Operations Fire Management Plan.

Noise and Dust

Noise will be noticeable to some highly mobile species such as macropods and birds. For the majority of species it will act as a local deterrent in the immediate vicinity of the site. Dust can potentially impact on fauna through reduced palatability and localised mortality of the vegetation adjacent to the Bluewaters II site. However dust emissions are not expected to be high and with appropriate management can be considered a minor impact.

7.5.3 Management of Impacts

The potential for the Ewington I opencut coal mine to impact on Carnaby's Cockatoo and Baudin's Cockatoo, both listed as threatened fauna under the EPBC Act, 1999 required that project to be referred to Environment Australia. The Commonwealth designated the project a 'Controlled Action' and requested the provision of additional information in relation to the distribution of Baudin's Cockatoo and also on the Red-tailed Black Cockatoo in the South West. As a consequence of providing this information, Environment Australia determined that assessment of the Ewington 1 mining proposal, based on the provision of preliminary information, was appropriate. Management strategies developed for Ewington I will ensure the impact on these species is minimised.

Bluewaters II was referred to Environment Australia and assessed under the EPBC Act 1999. Consequently, on December 15th, 2003 Environment Australia issued a decision stating that Bluewaters II was not a controlled action (Attachment 3).

Bluewaters II will be using coal sourced from the Ewington 1 coal mine immediately adjacent to Bluewaters II and will be supporting the activities of the mining operation in ensuring the impact on the Cockatoo population in minimised. It is not intended that Bluewaters II will mount a separate management strategy with respect to the Cockatoos as this is seen to be a duplication of effort. A better outcome will be obtained by supporting the efforts of the mining operation.

The provision of nesting boxes by the mining operations and the timing of clearing will also facilitate in minimising the impacts on this species. Environmental Management Plans will be prepared for the construction and operations phases of Bluewaters II to minimise fauna impacts. These plans will include:

- The presence of and potential impact on, any known populations or individuals of threatened fauna within and adjacent to the proposed power station site will be managed in consultation with CALM.
- The location of Bluewaters II and infrastructure will be chosen to minimise the clearance of fauna habitat. Bluewaters II and infrastructure will be located on cleared grazing land within the existing boundaries of Bluewaters farm.
- Clearing of any vegetation, that may have to be cleared for Bluewaters II, will be undertaken between January and June, whenever possible, to avoid disturbing the breeding seasons of species such as the Chuditch, Southern Brown Bandicoot, Brush-tailed Phascogale, Brush Wallaby, Yellow-footed Antechinus.
- A Construction and Operations Fire Management Plan will be prepared to reduce the risk of unplanned fires and provide contingency measures to minimise any associated impacts. The

plan will include a contingency and response plan in the event of any bushfires that commence as a result of the construction works.

- The introduction of potential feral species will be prevented by banning all pets from the project area.
- Firearms will be prohibited from the Bluewaters II site.

7.6 Surface Water

Management Objectives

- Maintain the integrity, functions and environmental values of rivers, creeks, wetlands and estuaries.
- Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC 2000 and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy).

7.6.1 The Existing Environment

The hydrogeology of the Collie Basin is a complex multi-layered sedimentary aquifer system in which groundwater flows are controlled by lithology, sub-crop zones and fault structures. Large scale dewatering, associated with open-cut mining operations and abstraction for power station water supply requirements, have led to a significant lowering of groundwater levels in parts of the coal basin. Increased abstraction from the deeper aquifer system would compound existing stresses on the system.

It is intended that water for Bluewaters II will come from mine dewatering activities and no extra water, such as bore-fields, will be required to supplement the water supply. Accordingly, there will be no additional impact beyond that caused by mine dewatering activities from abstraction. Bluewaters II and associated facilities will be designed to ensure containment of potential contaminants in accordance with accepted practices. During the construction phase and ongoing operation of Bluewaters II, all potentially hazardous and/or contaminating materials will be stored and handled in accordance with relevant legislation and regulations, as well as accepted operating and contingency practices. These practices will be documented in project environmental management procedures as part of the environmental management plans, for construction and operations.

Fly ash from Bluewaters II, if incorrectly managed, has the potential to impact groundwater quality. Although opportunities for reuse of the fly ash, have been and will continue to be considered, disposal is currently an unavoidable requirement. The proposed disposal method for this material requires its incorporation with over burden in the mine.

7.6.2 Potential Impacts

Construction activities may increase surface water and sediment run-off to nearby wetlands. Furthermore, there is a possibility that saline wastewater or water contaminated with coal sediments, fly ash or on-site chemicals will flow off-site and enter the local surface drainage.

Wastewater discharges from Bluewaters II along with hazardous or contaminating materials used during its construction or operation could represent a potential threat to the quality of the regional surface water resources. Measures to safeguard against the release of potential contaminants will be implemented and incorporated into project environmental management procedures as part of the Environmental Management Plans for construction and operations.

Indirect loss of vegetation may occur due to an interruption of existing surface water flows. There are no major drainage channels that occur within the Bluewaters II site thus impacts on surface hydrology are likely to be restricted to sheetflow movement. Possible impacts on vegetation related to changes in sheetflow are:

- ponding of water resulting in flooding of vegetation;
- drainage shadow effects. Construction may result in drainage shadow on the lower slope of the area; and
- scour and erosion.

7.6.3 Management of Impacts

A Sediment and Erosion Control Plan will be prepared as part of the Construction Phase Environmental Management Plan. This plan will cover the construction, maintenance and monitoring of drainage control structures, water quality monitoring and ultimate rehabilitation.

The site will be designed to ensure that contaminants are not released into the environment. The surface water flows will be altered to create an internally draining site. Water currently flowing into the site will be diverted to flow around the perimeter, and rainfall within the site will be collected for treatment, reuse or disposal as appropriate.

Rainfall run-off and any water flows generated on site will be directed into settling ponds for treatment and re-use. Washdown water and water used in sprays for dust suppression will be collected and passed through sediment traps and oil separation systems prior to transfer to settling ponds.

Monitoring the quality of surface water will be a part of an overall water management strategy for the site. A “Water Management Plan” will be developed following finalisation of water supply, treatment, usage and disposal methods. The management plan will outline volumes, treatment objectives, efficiency targets, compliance requirements, monitoring programme, data management and quality assurance.

All potentially hazardous materials will be stored in accordance with relevant legislation and regulations. Any areas containing hazardous material, such as hydrocarbons, will be designed so as to prevent run-off into general areas. Oils and cleaning wastes will be disposed of to a licensed off-site facility. Fly ash will be disposed of into the Ewington I mining void, above the water table, through incorporation with backfill.

7.7 Ground Water

Management Objectives

- Maintain sufficient quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.
- Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC 2000 and the NHMRC / ARMCANZ Australian Drinking Water Guidelines - National Water Quality Management Strategy).
- Minimise the impact on natural water resources by minimizing water consumption and maximizing reuse.

7.7.1 Existing Environment

Surface Hydrogeology

The Bluewaters II site is set within an area that is topographically moderate and does not contain any significant natural surface water features. Surface drainage is to the north-east (Collie River East Branch) and south (Ewington 1 coalmine pit). Surface hydrology of the broader region is dominated by seasonal rainfall and run-off to the Collie River (East and South branches). Annual rainfall in the region is 950mm a year but this volume has been trending downwards since the 1970s. This is reflected in the flow of the Collie River with the East and South branches being highly seasonal.

The Collie River catchment is characterised by salinity problems although salinity levels vary throughout. As a result, the discharge of water, with a Total Dissolved Salts (TDS) concentration exceeding 550 g/m^3, within the catchment is now prohibited.

Widespread clearing within the catchment area has compounded the existing salinity problems. Building of Bluewaters II has the potential to interrupt surface drainage patterns and contribute to erosion and sedimentation of off-site surface water features. In addition, wastewater discharges from Bluewaters II, along with hazardous or contaminating materials used during its construction or operation could represent a potential threat to the quality of the regional surface water resources. Measures to safeguard against the release of potential contaminants will be implemented and incorporated into project environmental management procedures as part of the Environmental Management Plans for construction and operations.

There is some surface water movement across the site of Bluewaters II, notwithstanding its moderate topography. Site works will therefore include construction of a drainage system to redirect these flows around the site and minimise any down-hydraulic gradient impacts. As the area is already extensively cleared, construction of Bluewaters II will not result in any significant disturbance of native vegetation and will not, therefore, contribute to further salinisation within the Collie River catchment.

Saline water will be discharged through the existing ocean outfall line used by the Collie A Power Station. There is sufficient capacity in the disposal line for Bluewaters II as well as other industrial projects that may have to dispose of saline water from industrial developments in the Collie area.

Past Issues and Strategies of the Collie Basin Water Management

The hydrology of the Collie Basin has been influenced by the coal mining industry since 1903 when underground mining started and dewatering was needed. By the 1940s around 9.5 GL of mine dewatering water was being discharged into the Collie River each year.

In 1982, the West Australian Government made a strategic commitment to coal as a source of energy and deemed coal mining to be the primary land use of the Collie Basin. The first Collie Coal Basin Water Resources Strategy was prepared in 1988. Since the 1960s, a sixteen percent decline in average annual rainfall has caused a decrease in the groundwater recharge rate and surface flows. By the summer of 1994/95, regional groundwater drawdown caused a reduction in the well levels of adjoining land users, and permanent pools in the Collie River dried out. Around this time, due to increased farm land clearing activity to the east of the Collie Basin, around Darkin, the inflow salinity into Wellington Reservoir increased from 250 mg/L to 1030 mg/L. This resulted in the dam water becoming too saline for potable use. Groundwater drawdown has the potential to:

- impact on existing groundwater use by others;
- impact on surface water including the pools in the East and South Collie Rivers;
- affect vegetation; and
- cause the loss of wetland areas.

7.7.2 Potential Impacts

Water Balance

The use of water in the cooling process and the disposal of saline water via the saline water pipeline, mean an increase in the net export of water from the system. Under the Collie Water Advisory Group (CWAG) criteria, supply to power stations is given as the priority use for water from mine dewatering.

Bluewaters II will use the water from dewatering at Ewington 1 as the source of cooling water. There will be sufficient water available from this dewatering (Section 6.3.4), consequently no additional water will be required. This means that Bluewaters II will have no additional impact on the groundwater levels in the Collie Basin.

Pollution of Groundwater

The operation of Bluewaters II has the potential to affect the quality of groundwater in the following ways:

- run-off from plant hard stand and storage areas;
- saline water leakage from storage ponds;
- contamination from hydrocarbons and other chemicals used on site; and
- fly ash disposal.

Plant hard stand and storage areas run off

The design of the plant and hardstand areas will be such that all water will be captured and directed to storage areas and treatment, if required, before disposal off site.

Saline Water Disposal

The cooling process in a power station results in the concentration of salts in cooling water. Design criteria require cooling water to be replaced on a regular basis to prevent a build-up of scaling compounds. The main environmental impact associated with the handling and storage of saline water on-site is the potential for the water to escape to the environment. The consequence of a release would be localized contamination of soil and groundwater and the potential loss of vegetation. Although, it should be remembered that this site does not contain significant stands of vegetation.

On-site Chemical Storage and Use

The power station will require the storage and use of a number of potentially hazardous substances including sulphuric acid, sodium hydroxide, anhydrous ammonia (or hypochlorate), quicklime, liquid nitrogen, gaseous chlorine, and fuels such as LPG and diesel. These substances will be stored in a manner that minimises the likelihood of release to the environment. With correct storage and handling, there is little risk that the resultant hazardous materials from a liquid spill will move offsite.

Two levels of containment will be provided to all areas were petroleum products are to be stored on the site. All tanks will be bunded and any spills that overflow these bunds will flow to the internal drainage system and to sumps. Spills from delivery vehicles will also be contained in the proposed on-site retention pond(s).

Ash Disposal Effects on Groundwater

Without any economically viable alternatives, return of the non-combustible portion of the coal to the mining voids is a realistic and sensible solution to the ash disposal issue. Coal is a naturally occurring part of the subsurface environment and returning the ash to the mine site will not add any elements that were not initially present. Combustion processes will however concentrate naturally occurring elements from the coal in the ash and, by the nature of their deposition onto the glassy silica ash surface, make some elements more mobile. The co-disposal of overburden with the ash will however have a significant dilution effect thereby lessening the overall impact of the ash.. At expected mining ratios the dilution will be up to 100:1 overburden to ash. The clays in the overburden are also expected to reduce the release of metals from the ash producing a clay stabilised product. Test work is underway to verify this. The in pit disposal method of ash in a clay stabilised form is currently used successfully at the 2600 MW Mae Moh Station at Lampang, Thailand and the Bayswater Power Station in New South Wales.

The concept of coal fired power station ash disposal into coal mine voids is not unique in Australia, having been successfully utilised at Mt Piper Power Station (NSW) for over 10 years, Bayswater Power Station and more recently Wallerwang Power Station (NSW) and Millmerran Power Station (QLD). Utilisation of coal mine voids for disposal of coal combustion products is common practice in the United States.

The ash disposal method proposed for Bluewaters utilises a dry emplacement technique above the water table similar to Mt Piper Power Station near Lithgow in the central west of NSW. Like Collie coal ash, the ash produced at Mt Piper generates an acidic leachate when mixed with water.

The Mt Piper ash storage area is also located within Sydney water catchment area and hence environmentally sensitive. Water added to the ash for conditioning purposes is kept to a minimum (<15%) and leachate to the groundwater has not become an issue. The ash storage site has been progressively capped with soil and revegetated.

Rainfall runoff from freshly placed ash will be managed by normal overburden drainage management practices as described in the Ewington I Environmental Management Plan. Water intercepted by the drainage systems will be recycled for dust suppression. Compaction of the ash after placement will result in a low permeability of the ash bed thereby minimising rainfall ingress.

In the absence of fly ash sales or the development of alternative uses for flyash, the utilisation of flyash for mine backfill purposes alleviates the need to excavate a separate site for ash disposal. Such sites, while usually contained by liner materials, present rehabilitation challenges due to ponded water, concentrated waste and maintenance to ensure liner integrity which all limit future land re-usage.

Coal and Ash Composition

A blended Ewington I coal, deemed typical of customer supply quality, prepared by ACIRL for combustion testing in a Boiler Simulation Furnace was extensively analysed giving the chemical composition detailed in **Error! Reference source not found.**. The coal is characterised by a particularly low phosphorous content which along with sulphur contributes to the acidity of ash-water leachates. Trace metals in the Ewington coal blend are regarded as low in comparison to other Australian and U.S. coals. Table 10 shows the trace metal composition of Ewington I coal is at the lower end of the range for Australian Coals.

Table 10 - Ewington Coal and Flyash Composition.-

	Coal % as received	**Laboratory Ash**	**Range for Australian Coals**
Ash	11.6		
Sulphur	0.41		
Ash Analysis		**% of ash**	
SiO_2		64.6	
Al_2O_3		25.6	
Fe_2O_3		6.24	
CaO		0.61	
MgO		0.65	
Na_2O		0.24	
K_2O		0.52	
TiO_2		1.75	
Mn_3O_4		0.10	
SO_3		0.34	
P_2O_5		0.07	
Loss on Ignition		-	
Trace Metals		**µg/g of air dried coal**	
Arsenic		0.62	1-55
Mercury		0.02	0.03-0.4
Selenium		0.01	0.2-2.5
Cadmium		<0.02	0-0.2
Lead		18	1.5-60
Boron		<5	1.5-300
Zinc		15	15-500
Antimony		0.2	0-20
Beryllium		1.4	0.4-8
Fluorine		50	50-500
Chlorine		0.03	

Acidity of ash itself is not generally measured, however, when the ash from Collie coal is mixed with water an acidic aqueous phase is typically produced. Leachate from the Ewington I combustion test coal fly-ash had a pH of 4.

Acidic leachate has the potential to mobilise metallic species from the ash and surrounding materials. Ash leaching tests according to ASTM 11.04 D3987 indicate the presence of sulphate, fluoride, nickel, manganese, cadmium and chromium in quantities above the latest Australian drinking water standard as shown in Table 11. However solid waste leachates are more commonly compared against 10-100 times the drinking water guidelines under the premise that interactions with soil and ground water dilution will reduce any levels of contaminant and that leachate will not be used directly for drinking. In comparison with the DEP Leachable Concentration limits for disposal of solid waste to a Class 1 unlined landfill, only nickel exceeds the limit. Further work is in progress to better simulate the leaching characteristics of the ash in relation to co-disposal with overburden (see "Further Studies" section below). Additionally, standard laboratory leaching tests agitate a saturated quantity of material which is unlikely to occur in situ with the proposed dry ash disposal method and thereby overestimating leaching in the field.

Table 11- Leachate from Ewington I Coal compared with Relevant Guidelines.

Element	**Ewington I**	**Blended Collie Coal Fly-Ash***	**Australian Drinking Water Guidelines (2004)**	**DEP Class I Leachable Concentration Limit**
	mg/L		mg/L	mg/L
Ag	<0.01		0.100	1
As	0.002		0.007	0.5
Ba	0.3		0.7	
Be		0.06		0.1
Cd	0.03		0.002	0.1
Cl	1		250[a]	
Cr	0.06		0.05	0.5
Cu	0.16		2	
F	2.5		1.5	15
Fe	0.32		0.3[a]	
Hg	<0.00001		0.001	0.010
Mn	1.2		0.5	
Mo		0.02	0.05	0.5
Na	11		180[a]	
Ni	1.8		0.02	0.2
Pb	<0.01		0.01	0.5
SO4	545		500	
Sb		0.001	0.003	
Se	0.002		0.01	0.5
Zn	2.0		3[a]	

* Results from ACARP Report C8051 included where no data for Ewington I coal

[a] Guideline value is for aesthetic rather than health reasons.

Ground water monitoring

Fly ash has the capacity to hold up to 30% moisture. It is proposed to add approximately 15% water for dust suppression and to facilitate handling. The ash therefore, has additional moisture holding capacity to accommodate water ingress from rainfall infiltration before saturation and leaching. In addition rainfall ingress will be minimised by rolling and grading the working face of the laid down ash and progressive capping with stored topsoil and revegetation. Laying the ash in such a manner along with the small particle size of the ash results in low permeability of the ash bed. Studies on other ashes indicate permeabilities as low as 10^{-7}m/s, often much lower than the surrounding overburden. Water will thus preferentially travel through the overburden rather than the ash. Keeping the ash bed above the groundwater table will, also minimise water contact and the potential for leachate production.

An earlier request for strategic advice was made to the EPA regarding the South West Power Project proposal for a coal fired plant in the Collie region. The response (Bulletin 1090) required the commitment by Griffin to prepare and implement an operation phase environmental management plan to monitor groundwater quality to ensure potential impacts from the power station are managed. Griffin's Environmental Management Plan for the Ewington I mine details the groundwater monitoring program including the construction of several new multipiezometers and dewatering installations around the mine site. Along with existing local and regional State and Griffin owned piezometer network, the monitoring program will provide substantial data for groundwater flow modelling.

Sampling of runoff, local water courses and wetlands is also proposed. The sampling program will commence prior to mining and power station development in order to establish baseline conditions. Annual assessments and reporting on water resource management and mining impacts will be made. The sampling program will target species known to emanate from coal ash leachate such as sulphate and strontium as well as discharge water quality parameters defined in the Collie Coal Basin Water Resources Management Strategy (1988) and trace metals of concern. A hydrogeological study currently underway will establish the optimum placement of bores and surface water monitoring sites to ensure effects on ground and surface water quality and quantity are monitored appropriately.

Acidic Mine Water Interaction with Ash

Coal mine voids are often left open after mining, resulting in ground and surface water influx forming a void lake. Interaction of water and air results in oxidation of the void surfaces from Collie coal open cut mines and the production of acidic mine void lakes such as Stockton, Muja 5B, 5H and others.

Closure of open cut mines in the Collie region has left a number of acidic mine void lakes. The acidic water restricts the potential for recreational or aquatic re-use and poses an environmental hazard through seepage and overflow. pH amelioration has proved difficult due to the strong buffering capacity of the water constituents. The proposal to utilise ash to assist in back filling the mined areas will reduce the volume of any remaining void thereby reducing the amount of acidic mine water. Approximately 16% by weight of the mined coal will be returned as ash. The ash disposal zone will be kept above the ground water level hence, provided the water level in any remaining void is kept at or below groundwater level, acidic void water will not contact the ash directly. If acidic mine void water were to contact the ash bed the potential for leaching of metallic species does exist.

Fixation of Ash

The interaction of ash with the over / inter burden claystones has not been established at this stage though it is the subject of a current laboratory study. Some clays have cationic exchange properties that have potential to fix metals in place thereby limiting their environmental availability. A literature search is currently underway to establish historical work on Collie coal ash interactions with other materials. There have been previous studies on interactions of ash with mineral sand waste, red mud from bauxite mining and soil for soil improvement purposes. The laboratory study underway, however, will provide definitive data on what effect the overburden from the actual Ewington I mine site will have on ash leachate.

Ash Disposal Practices

Historically combustion products from coal fired power stations are pumped as low density slurries to custom built lined disposal areas. This method requires considerable water resources, poses disposal area water management and leaching problems and increases the space required for disposal. Rehabilitation of the disposal area is also delayed until surface waters are removed and the ash bed dries out. More recently dense phase slurries or paste disposal methods are utilised, reducing both the water requirements, leaching propensity and volume necessary for disposal as well as speeding up the rehabilitation process. Dry disposal method is the other alternative. The operating cost is generally considered greater; however the water management and leaching issues are reduced. Griffin Coal already has the equipment for laying down and carting the ash through mine site operations as well as the disposal site and infrastructure for dry placement operations.

Further Studies

Griffin is committed to an environmentally responsible ash disposal solution. Further studies incorporating hydrogeological work, leachate testing and further clarification of coal quality have been commissioned.

The hydrogeological study focuses on determining which areas are conducive to ash disposal in order to maintain separation from the water table both during and after mining and any mine void that will remain post-mining. In addition, the potential plume flow of any leachate that may emanate from the site will be modelled so that appropriate contingency planning can be incorporated into strategic planning for the mine site. The current and proposed ground water monitoring network is to be examined to determine its suitability, both in location and targeted aquifers, for leachate detection in the ground water. If necessary, additional groundwater monitoring bores will be installed. The study will also take into account future rehabilitation issues to ensure an environmentally sound long term solution results.

Following recommendations from the hydrogeological study, a ground and surface monitoring program for baseline water quality including trace metals is to be implemented using NATA registered sampling and analysis techniques as soon as practical. The proposed suite of target species will include chloride, sulphate and strontium, which are good markers of ash leachate in groundwater, as well as trace metals and general bulk characteristics. This monitoring program will operate in conjunction with groundwater level monitoring and modelling. Monitoring will continue throughout the life of the mine and beyond if necessary. Data will be collated into a database providing a valuable resource for assessing groundwater quality, groundwater resource management and future modelling in the region.

In parallel with the hydrogeological studies, simulated testing of rainfall ingress into the ash - overburden beds is underway. The tests will provide information as to the effectiveness of the overburden in attenuating trace metal mobility. In practice the ash will be mixed with brackish waste water from the power station before disposal to reduce dust problems and enable ease of handling. The leaching study examines the use of such water in comparison to other sources. Information derived from the leachate tests on the relative permeabilities of overburden and ash will influence the final strategy for conditioning and laying down the ash beds. Combined with the hydrogeological study the optimum ash placement location and methodology will be established.

Further testing of the Ewington I coal for trace metals has also been instigated. The tests will establish the variability in the low levels of trace metals previously detected in the combustion test sample as well as a reliable basis for predicting ash composition.

In addition to the comprehensive test work, Griffin is committed to consultation with stakeholders throughout the development of the ash disposal process. Community groups, the Collie Coal Mines Environment Committee, CALM, DoE, and other interested parties will be consulted in regard to the ash disposal process as well as discussions on how the ash may be utilised in the region. This document is the initial step in the public consultative process. The consultative action will follow through the progression to Works Approval and licensing. Issues identified will be documented and submitted with the Works Approval application.

Options for Alternative uses of Fly-Ash

Current market for fly-ash in WA

Approximately 10%, or ca 50,000 tonnes, of the fly-ash from Collie coal being used for power generation is effectively utilised. There is only one company currently exploiting the commercial use of this ash, with about 5%, or 25,000 to 30,000 tonnes used in cement blends and the rest in bulk fills, including road base applications.

Technically, the use of fly-ash in cement and many bulk fills has many advantages. Depending on the application, concrete structures may take as much as 10 – 30% fly-ash to improve the setting time, water consumption and mechanical strength.

However, use of fly-ash in WA is severely impeded by the relatively high transport cost to bring the "low-value" ash to the major markets near Perth.

The use of fly-ash in bulk fills is seasonal and dependent on the opportunities for utilisation projects that become available from time to time.

In using fly-ash from Western Power utilities at Collie A and Muja power stations, a quality standard is imposed by the company taking it, that is, the unburnt carbon content needs to be less than 3% and the particle size is such that 80% passes a 45μm sieve. While this standard is used as the reason to reject the rest (ca 90%) of the ash, it is more a commercial decision (to keep the price of fly-ash low) rather than a technical issue. Note that the industry standard is 6% unburnt carbon and 70% passing 45μm.

Future potential for market growth

Reliable figures indicated that the amount of fly-ash utilised in cement and other construction work was only 1,500 tonnes in 1992 and increased to about 50,000 tonnes in 2003. Although the potential market for fly-ash utilisation in cement is much greater than it is, the future growth may be slow, primarily due to the transport cost. Potential fly-ash marketers will need further commercial incentives to increase fly-ash intake, such as large construction projects, cement price, and specific (technical) requirements of the concrete work.

Other low-value markets for fly-ash include mine backfills, soil stabilisation, engineered fills, roads, and barrier materials. However, these options have not been fully explored in WA. Again, this is due to the transport costs and locally available project opportunities for the fly-ash to be utilised.

Technically, if one assumes that all cement takes 10% fly-ash, it is possible for all WA fly-ash to be utilised. However, the current low values of fly-ash means that it is uneconomic to transport it more than 100 to 150 km.

A potential exists for the majority, if not all, of the fly-ash produced to be utilised in agricultural applications in the South West region of the state. However, the direct use of fly-ash in agriculture is faced with legislative and public perception barriers and requires further research to prove the application, provided that transport costs allow the uses once other barriers have been overcome.

Value-adding Potential for fly-ash

Clearly, the transport costs (or the low values of fly-ash in the present form of utilisation) are the key barrier to wide spread utilisation of fly-ash in WA (and in Australia in general, due to our low population density). The future growth of fly-ash utilisation relies on value-adding (so that the fly-ash can be transported over greater distances). The following are several potential options identified in WA.

Zeolite for agricultural applications has the potential to utilise a significant proportion of fly-ash produced in WA in the long term. Processed hydro-thermally zeolite from fly-ash contains no or little undesirable trace elements and heavy metals, thus overcoming the legislative and public perception barriers. Fly-ash zeolite can improve the efficiency of fertilisers and water by holding them in its micro pore structures and only releasing them when the plant requires them, thus improving the economic and environmental performance of the agricultural industry. Fly-ash zeolite can also be used in the residential market for potting mix for gardens and flower beds. The price of such zeolite is estimated to be from several hundred dollars to over $1000 per tonne, depending on the application.

Manufacturing of aggregates from coal ash (including bottom ash) is another option with potential. The supply of natural aggregates for construction work is decreasing nationwide, pushing up the price (and cost). This offers a great opportunity for coal ash aggregates.

Cenospheres, used in high strength, light weight, refractory applications are a very high value product that could be easily derived from fly-ash, valued at $1,000 - $2,000 per tonne. Although the yield of cenospheres is generally low (a few percent at best), its high value encourages its commercial exploitation. The good economic return from cenospheres can also help other utilisation options, for example, by subsidising the transport cost.

Masonry is yet another (though small) option feasible in WA, including pave blocks (more likely) and bricks (less likely for residential houses).

Another value-adding option is to make geo-polymers from coal ash. There are significant mechanical and structure performance questions to be answered before its realisation. There are significant research activities at Melbourne University looking into making geo-polymers from a range of feedstocks, including fly-ash.

Timeline for realisation of value adding opportunities

There are probably two timelines for realisation of the above value-adding opportunities, one being technical and the other commercial. The latter one is more difficult to estimate than the former. The zeolite option is estimated to take about 3-5 years to develop a commercially feasible manufacturing process, based on good science and engineering research which is currently being undertaken at Curtin’s Centre for Fuels and Energy.

It will probably take slightly less time (3–4 years) for aggregate manufacturing process to be developed. However, in the longer term, in 10–15 years, fly-ash aggregates have the potential to displace natural aggregates.

Cenospheres from WA power stations can be readily harvested and marketed. However, this option has not been exploited commercially.

Likewise, masonry making from fly-ash has little technical barrier but has not been exploited commercially, due largely to the lack of a developed market. In any event the market is considered to be quite small in WA.

Research activities supporting value-adding potential

Curtin’s Centre for Fuels and Energy is undertaking research into zeolite and aggregate manufacturing, funded by CCSD. However, the progress of the research has been limited affected by the low levels of funding.

The hydro-thermal treatment of fly-ash to produce zeolite is currently under investigation at Curtin. The process mixes fly-ash with a caustic solution and subjects the slurry to a temperature in the range between 70 to 180 ^{o}C for a certain time (expected to be from a couple of days up to a week or so), for the zeolite crystals to grow from the silica and alumina elements within the ash. The impurities in the coal ash are not thought to be a problem as the aim is agricultural uses of the zeolite. Obviously, the ratio of ash/caustic solution, the processing temperature and “curing” time are the key subjects of the current research, together with the characterisation of both the ash (the feedstock) and the zeolite (product) produced. It is difficult to give a realistic estimate of the processing cost but the simplicity of the process ensures relatively low costs of manufacturing. Collie coal ash has been identified to be suitable for zeolite making.

A new Task which has recently been approved by the CCSD is to undertake research into aggregate manufacturing from coal ash. One of the intended processes is to mix coal ash with waste coal (as the fuel) with or without lime additive, agglomerate the mix into granules and fire (sinter) the granules at a high temperature (between 800–1000^{o}C). This will produce the aggregates. An alternative is to blend the coal ash with a caustic solution, with or without lime additive, granulate the blend into particles of desired sizes, and then steam-cure the granules at ca. 200–400^{o}C for a certain amount of time. Again, the blending ratios, the use of lime additive, the temperature and time for firing or curing and process optimisation are the subjects of the current research effort.

Ash Disposal Summary

The proposal to dispose flyash back into the mine was initially proposed by Griffin Energy in the Strategic Environmental Review for the South West Power Project. In its report (Bulletin 1090) on the proposal the EPA made the following statement "*The EPA considers that further investigation may be required to demonstrate the effectiveness of disposing of overburden above the water table in preventing groundwater pollution. The EPA encourages Griffin Energy to pursue its research efforts towards finding a beneficial use for the flyash that does not have any significant impact on the environment, such as in cement manufacture or similar uses.*

The EPA considers that a commitment by the proponent to prepare and implement an Operations Phase Environmental Management Plan to monitor groundwater quality to ensure that potential impacts from the power station on groundwater quality are managed would be capable of adequately dealing with this issue."

Griffin Energy will cooperate with the operator of the coal mine (Griffin Coal) to ensure that this commitment is fulfilled. Flyash management will be a component of the Operational Phase Waste Management Plan referred to in Commitment 10 in Table 9 of the PER document. The plan will include a groundwater monitoring program which will be agreed in consultation with the mine operator, DoE and other stakeholders.

Griffin Energy is committed to keeping under review all potential alternative uses for fly-ash.

7.7.3 Management of Impacts

The site will be designed to ensure that contaminants are not released into the groundwater.

Fly ash will be initially held on-site in silos prior to being transported to Ewington I for disposal within the returned overburden in the mine.

There is an option to use the fly ash in the cement and other industries and this will be pursued in preference to inpit disposal. Saline water will be disposed of through the existing saline water ocean outfall used by Western Power. Washdown water and water used in dust suppression will be collected and passed through sediment traps and oil separation systems, prior to transfer to settling ponds. All potentially hazardous material will be stored in accordance with relevant legislation and regulations. Any areas containing hazardous material such as hydrocarbons will be designed to prevent run-off into general areas. Oils and cleaning wastes will be disposed of to a licensed off-site facility.

7.8 Saline Water

The preferred method of saline water disposal is through the existing, licensed operating ocean outfall used by the Collie Power Station. In the event that this option is not technically or economically feasible, disposal will be into an evaporation pond system.

Assuming that the Bluewaters II saline wastewater is disposed via the existing wastewater discharge, the wastewater has the potential to impact on the marine environment through the cumulative effects of an increase in discharge volumes and resulting increased size of the mixing zone, and increased total loading of contaminants. The saline discharge is essentially a concentrated form of the source water, with the cooling process removing a proportion of the water via evaporation. Chemicals used in the pre-treatment of water used in the plant will also be present in the effluent. Biocides such as hypochlorite and hydrobromide may be present as would low concentrations of corrosion and scale inhibitors.

7.8.1 Marine Environment – Management Objectives

- Maintain the ecological function, abundance, species diversity and geographic distribution of marine biota and habitat in order to protect ecosystem health, in accordance with the principles identified in Perth Coastal Waters Environmental Values and Objectives (EPA, 2000a).
- Maintain or improve marine water and sediment quality to protect Environmental Values (EVs) and Environmental Quality Objectives (EQOs) defined in Perth Coastal Waters Environmental Values and Objectives (EPA, 2000a) and sediment and water quality guidelines documented in Australian and New Zealand Water Quality Guidelines (ANZECC 2000).

7.8.2 Existing Environment

The preferred disposal option for the saline water from Bluewaters II is to use the existing Collie Power Station pipeline to the ocean. Collie Power Station disposes of saline water via a 68 km long pipeline to the coast, north of Leschenault Inlet, near Buffalo Road. The design capacity of the saline discharge line is 92.5 litres per second. This design was based on an original proposal for a 600 MW station at Collie. Collie A is a 300 MW capacity station and its design discharge is half the amount of saline water allowed for in the original proposal. Further improvements to the system at Collie A have resulted in the line being significantly under-utilised, with a present discharge of only 16 litres per second. It is now possible to share the line with other developments such as the proposed Bluewaters II.

There is capacity in the line for the addition of outflows from an expanded Collie Power Station and Bluewaters II given that the current use is less than 20% of design capacity. As Bluewaters II is a competitor with Collie B to supply electricity to the SWIS, only one will be accessing the line in the short to medium term, therefore sufficient capacity exists for current water disposal needs for power stations that are likely to require connection to the disposal facility within the next five or more years.

The final design of the existing saline discharge line resulted in a 92 metre linear diffuser with 23 ports of 50mm diameter. Discharge commenced in January 1999. The area of the existing discharge consists of a gently sloping seabed which increases to a depth of 20 metres, at approximately 6 km offshore, and remains at that depth to the edge of the continental shelf 90 km or so offshore.

Benthic Habitat

The marine environment into which the discharge occurs is a high energy environment characterised by high turbidity and shifting sands. Sediments in the area are generally very coarse sands and gravels in the range of 850 to 4,000 µm diameter (Pacific Power International, 2000). The habitat in the vicinity of the outfall consists predominantly of:

- bare sand with ripples up to 15cm high overlying limestone pavement (at depths of 6 m; approximately 150 – 250 m offshore);
- scattered low rocky limestone outcrops with macroalgal assemblages of sparse to moderate density (250 – 650 m offshore);
- small dense clumps of the seagrass *Posidonia* sp. in off-shore areas (> 600 m from shore); and
- deeply rippled bare sand (650 – 750 m offshore).

A benthic survey (Western Power Corporation, 2002) identified a seagrass community (of 35 percent to 50 percent cover) to the west of the existing outfall. The dominant species was identified as *Posidonia angustifolia*.

Fisheries Significance

Seagrass areas are generally recognised as being of significance as nursery areas for commercial species (Walker and McComb, 1992). Although not to be discounted in terms of its benthic infauna, the bare sand habitat is typically of low productivity and of limited interest for commercial or recreational fishing. Commercial fishing in the area is based on beach netting for small fish such as whitebait (*Atherinid* or *Clupeid* species) and mullet (*Mugil caphalus*) and some potting for western rock lobsters (*Panulirus cygnus*) in reef areas. Some trawling for scallops and wet-lining or gill netting for shark occurs further offshore (SECWA, 1994). Recreational fishing in the area generally consists of beach fishing, with a low level of boat-based crayfishing and crabbing.

Existing Water Quality and Effluent Discharges

Water quality in the region is influenced by inputs from the Leschenault Inlet. The estuary discharges to the south and northerly currents carry the brackish, turbid, nutrient enriched water towards the discharge location. Stratification of the water column is known to occur, whereby warmer salty water (of higher density) is trapped below cooler brackish water of lower density (Western Power Corporation, 2002).

The salinity of the existing Collie Power Station discharge is low compared to that of seawater, with a predicted total salinity of up to 5.0 ppt (SECWA, 1994). Current discharges have salinities ranging between 2.5 ppt and 2.8 ppt (Pers Comm Pacific Western, Dec 2000). The salinity of the receiving environment is in the order of 35 ppt, and thus the plume is buoyant. The current discharge licence condition allows the discharge water to have salinity up 32 ppt.

The rate of discharge from the outfall presently averages 16 L/sec. This rate of discharge potentially allows other users, such as Collie B, to make use of the saline discharge line.

The Millennium Chemicals outfall is 500 metres to the north of the Collie Power Station outfall. The discharge rate for the Millennium outfall is 33 L/sec to 39 L/sec, temperature is around 25°C and salinity of 25 to 30 ppt.

Existing Outfall Monitoring Programme

The proposed saline wastewater outfall for the Bluewaters II is the existing Collie Power Station outfall, a currently licensed, operating facility. Under the terms of the operating licence, monitoring of the outfall has included the following:

- measurement of physical and chemical water quality parameters;
- measurement of physical and chemical sediment quality parameters;
- a description of the marine flora and fauna in the area;
- biomonitoring (sentinel mussels) data; and
- issues of seasonality and neighbouring outfalls (LeProvost Dames and Moore, 2000).

Current DoE licence conditions require monitoring of the discharge pipeline input water quality on a weekly (physical parameters) and quarterly (metals) basis, and monitoring of the receiving marine waters at four monitoring points located six metres either side of the diffuser on an annual basis.

The licence conditions stipulate the following input water quality limits for water discharged into the pipeline from the saline water discharge tank:

- pH: 6.5 to 8.5 (6.0 and 8.5 during plant maintenance)
- TDS: <32,000 mg/L
- Total Suspended Solids: <50 mg/L for 90% of samples and never to exceed 150 mg/L
- Dissolved Oxygen: >5 mg/L

- Sodium: <10,500 mg/L
- Potassium: <280 mg/L
- Calcium: <400 mg/L
- Magnesium: <1,400 mg/L
- Iron: <5 mg/L
- Manganese: <5 mg/L
- Chloride: <19,000 mg/L
- Sulphate: <2,450 mg/L
- Bicarbonate: <140 mg/L
- Silica: <100 mg/L
- Phosphate P: <2 mg/L
- Nitrate N: <5 mg/L
- Arsenic: <0.1 mg/L
- Cadmium: <0.02 mg/L
- Chromium: <0.1 mg/L
- Cobalt: <0.1 mg/L
- Copper: <0.25 mg/L
- Lead: <0.1 mg/L
- Mercury: <0.002 mg/L
- Nickel: <0.3 mg/L
- Vanadium: <1.0 mg/L
- Zinc: <0.5 mg/L

Monitoring at the outfall is to be conducted annually for pH, temperature, total dissolved solids, dissolved oxygen, arsenic, cadmium, chromium, copper, lead, mercury, vanadium and zinc. The results are to be reported, for information purposes only, against the '*ANZECC & ARMCANZ Guidelines for Fresh and Marine Water Quality 2000*'.

The Collie Power Station is presently meeting its discharge licence conditions. High Limits of Reporting (LORs) (i.e. the detection limits associated with the analytical methods used), and modification to diffuser design complicate review of the marine water quality data. However, application of a 100-fold dilution to the concentrations measured in the saline dam indicates that the marine water quality guidelines (ANZECC & ARMCANZ 2000) would also have been met (P. Collins pers comm. 2004).

Environmental Values and Objectives

In keeping with the current position of the EPA and the draft Environmental Protection (Cockburn Sound) Policy (EPA, 2002), all ecological and social environmental values apply generally to the marine environment, unless specifically exempted. Accordingly the Environmental Quality Objectives for the marine waters surrounding the discharge are:

EQO 1: Maintenance of Ecosystem Integrity

EQO 2: Maintenance of Aquatic Life for Human Consumption

EQO 3: Maintenance of Primary Contact Recreation Values

EQO 4: Maintenance of Secondary Contact Recreation Values

EQO 5: Maintenance of Aesthetic Values

EQO 6: Maintenance of Industrial Water Supply Values

A small zone (mixing zone) around the outfall may be afforded only moderate level of protection, and moderate changes from natural variation would be acceptable within this area.

Water Quality Criteria

In comparison to the receiving environment, the current discharge contains slightly increased levels of total suspended solids, nutrients, heavy metals and hydrocarbons. Of these, the heavy metals were generally less than 100 times more concentrated than in typical seawater (Pacific Power International, 2000). An exception is chromium, which is 400 times more concentrated. In relation to the ANZECC & ARMCANZ (2000) guidelines for the protection of marine ecosystems, the heavy metal concentrations present in the cooling water generally meet the 80% trigger values for marine water at the point of discharge and the 99% at the edge of the zone of initial dilution. Some uncertainty exists in the case of some metals due to concentrations in the effluent being less than the level of detection used in their analysis. Trigger values for temperature and salinity are also included in the ANZECC & ARMCANZ 2000 guidelines. Trigger values are set at the 20th and 80th percentile of ambient conditions. At concentrations outside of this range they have the potential to become non-toxic direct effect stressors, affecting the species composition and abundance of the receiving environment. However, in this case, the low salinity of the effluent is considered a benefit, as it is significant in aiding mixing and dilution of the effluent.

Biomonitoring

Biomonitoring is used to determine whether metals associated with the discharge are entering the food chain. Monitoring of sentinel mussels at four sites is stipulated in the Collie Power Station operating license. Biomonitoring has been carried out over a ten-week period in each year of operation of the station. Results of the most recently reported biomonitoring exercise showed no significant difference in concentrations of heavy metals between outfall and control sites (HGM 2004), suggesting that the discharge does not lead to the bioaccumulation of metals in filter feeding mussels.

Potential Impacts

Bluewaters II has the potential to impact on the marine environment through the discharge of low salinity cooling water containing low concentrations of a number of metals and small amounts of water treatment additives. The saline discharge is essentially a concentrated form of the source water, obtained from mine dewatering, with the cooling process removing a proportion of the water via evaporation. The metals are those present in the groundwater, with their concentrations increased as a result of evaporation. Chemicals used in the pre-treatment of water used in the plant, including biocides such as hypochlorite and hydrobromide, and corrosion and scale inhibitors, would also be present in the effluent in reduced concentration. Biocides are likely to be maintained at a concentration of around 0.5ppm within the cooling system, but would decompose to 0.1ppm by the time the effluent reaches the outfall. Dilution factors for achieving guideline values are around 33 times (Western Power Corporation, 2002).

Cumulative Impacts

In addition to the existing Collie Power Station and the present, Bluewaters II proposal, there are two further 300 MW power station proposals (Bluewaters I and Collie B) currently under review. The three proposed additional power stations have the potential to impact on the marine environment through the cumulative effects of increased discharge volumes, increased size of mixing zone and increased total loading of contaminants.

All of the proposals are based on discharging water and at the same rate and of the same quality as that discharged from the existing Collie Power Station. Hence the concentrations of all constituents of the effluent will remain the same and only the volume of water discharged will increase. However, the total volume of discharge will not exceed the 92.5 L/sec initially proposed for a 600 MW power station at Collie (subsequently replaced by the existing 300 MW station), and upon which all dispersion modelling has been undertaken. Thus the impacts on the marine environment discussed in this report reflect the cumulative impact of the existing plus the three currently proposed stations, rather than being a consideration of the impact of the proposed Bluewaters II power station in isolation.

Dilution and Dispersion characteristics

An initial assessment of the dilution capability of the existing Collie Power Station ocean outfall configuration was undertaken using the United States Environmental Protection Authority model known as *PLUMES* (Baumgartner *et al*, 1994) for the Strategic Environmental Review (Sinclair Knight Merz 2002) The modelling indicated that the increased discharge through the existing outfall diffuser, to its design capacity of 92.5 L/sec, would be adequately diluted to meet environmental guidelines.

Predicted Effluent Volume and Quality

The effluent volume is expected to double, with its current average discharge rate of 16 L/sec doubling to 32 L/sec, with the addition of the saline discharge water from Bluewaters II. This rate is still well below the original design flow rate of 92.5 L/sec.

Whilst the precise quality of the saline wastewater has yet to be fully characterised, it is expected to be similar to that currently discharged by the Collie Power Station. The following table details the discharge water characteristics.

Table 12 - Content of Discharge Water from Collie A Power Station.

Parameter	Concentration
• PH	7.3*
• Dissolved Oxygen	8.1 mg/L+
• Total Dissolved Solids	1500 mg/L+
• Suspended solids	23 mg/L+
• Phosphate	0.002 mg/L+
• Nitrate	0.55 mg/L*
• Sodium	815 mg/L*
• Potassium	29 mg/L*
• Calcium	231 mg/L*
• Iron	0.3 mg/L*
• Chloride	1,732 mg/L*
• Sulphate	244 mg/L*
• Silica	78 mg/L*

+ Pacific Power International (2000)
* EPA (1995)

Abbreviations: *mg/L = milligrams per litre*

Heavy Metals

Predicted metal concentrations in the combined wastewater discharge from the Collie A and Bluewaters II Power Stations are presented in Table 13 based on weekly operational data for two three-month periods of operation of the Collie A Power Station in 2000 and 2001-2002. In accordance with ANZECC & ARMCANZ (2000) water quality assessment procedures, the figures quoted are the 95th percentile values of data taken from the input to the seawater discharge pipeline. As noted above, it is not anticipated that the combined effluent will differ markedly in concentration; rather it is the volume of effluent that will increase.

The Zone of Initial Dilution (to achieve a minimum dilution of 1 in 100 throughout the water column) of the discharge was modelled under assumed worst-case conditions (winter). The modelled zone of initial dilution was calculated to be an area 15 m in width and 92 m in length (an area of 1,380 m^2). The length is a function of diffuser length, which is also 92 m. Modelled dilution throughout the water column at the edge of this zone will exceed 190:1 (Figure 8-1, Collie Power Station Expansion, Strategic Environmental Review. Sinclair Knight Merz, June 2002). The flow rate modelled was 92.5 L/sec, which is the nominal maximum discharge rate for the outfall. The salinity of the discharge water used in the modelling was 5,000 mg/L, which is a conservative value, the actual discharge salinity being typically less than 2,500 mg/L and hence more buoyant.

The modelling indicated that a dilution of 1 in 100, both horizontally and vertically, will be achieved within four metres of the diffuser under the above conditions (SKM 2002).

For the purposes of the present assessment a conservative dilution factor of 1 in 100 was applied in calculating contaminant concentration and physical characteristic of the discharge at the edge of a dilution zone extending 7.5 m on either side of the diffuser.

Table 13 - Predicated Heavy Metal Concentration

Parameter (concentration expressed in µg/L)	**Background marine water quality[1]**	**Effluent (95th percentile of 26 samples)**	**Concentration following 100-fold dilution**	**ANZECC 99% species protection**	**ANZECC 80% species protection**
Cadmium	0.0045	<1	0.014	0.7	36
Chromium (total)	0.2 (total)	<2 (total)	0.218 (total)	7.7 (CR^{III})	90.6 (CR^{III})
Cobalt	0.013	<50	0.512	0.005	150
Copper	0.085	<20	0.284	0.3	8
Lead	<0.019	<3	0.049	2.2	12
Mercury (total)	0.0004	<0.1	0.0014	0.1 (Inorg.)	1.4 (Inorg.)
Nickel	2[2]	<30	2.28	7	560
Zinc	0.502	90	1.397	7	43

Values preceded by a 'lesser than' sign are assumed to be the maximum value for the purpose of calculation
1 McAlpine et al (in press)
2 taken from licence number 6637/4
ID insufficient information available to derive a reliable guideline

With the exception of cobalt, for which there is no accurate data as to actual discharge concentrations (the concentration of cobalt measured at the discharge has always been below the analytical level of detection) the concentrations of metals in the diluted wastewater at the edge of the Zone of Initial Dilution (mixing zone) meet the relevant guideline water quality concentration (99% species protection guideline concentrations).

Biocides

Biocides are likely to be maintained at a concentration of around 0.5 ppm within the cooling system, but would decompose to 0.1 ppm by the time the effluent reaches the outfall. Dilution factors for achieving guideline values are around 33 times (Western Power Corporation, 2002). This dilution is achieved within the Zone of Initial Dilution as specified for the existing wastewater outfall.

Potential Impacts

Monitoring to date and calculations detailed in the above table show that impacts on the marine environment adjacent to the discharge point are very low to zero (P. Collins pers comm. 2004). Monitoring will be maintained to ensure that the impact from the disposal line is minimal. In effect the discharge line is adding dilute salt water to seawater. In addition the composition of the dilute saltwater has below seawater levels of contaminants in it. Therefore it is highly unlikely for any detrimental impact to be recorded, provided the quality of the discharge water is maintained.

7.8.3 Management Strategies

Management of the saline wastewater discharge aims to ensure that the Environmental Quality Objectives of the receiving environment are met, insofar as they may be impacted by the wastewater discharge, and there are no significant impacts on the ecology and biodiversity of the marine environment.

Once the final details of the wastewater quality and quantity have been determined, a detailed modelling assessment of the ocean outfall discharge will be undertaken (with the existing operator of Collie A) to demonstrate the dilution criteria that can be achieved with the additional saline water discharge from Bluewaters II. This will also include an assessment of the levels of other contaminants (such as biocides) discharged into the ocean to ensure that they meet the ANZECC & ARMCANZ 2000 Water Quality Guidelines at the edge of the mixing zone.

Strict control of the input water quality into the discharge system will be the crucial element in managing any potential impacts of the marine ocean discharge. Water in the cooling water circuit will be kept separate from other water streams to avoid any likely contamination.

Based on current discharge rates from the existing Collie Power Station, the saline water pipeline has sufficient capacity designed in it to be able to accommodate the discharge from additional power stations.

7.8.3.1 Monitoring

The existing Collie Power Station saline discharge water monitoring program will be reviewed to confirm its adequacy, and revised as necessary to address the changing circumstances of the discharge line as detailed in commitment 9.7.

7.9 Air Emissions

There are already a number of significant sources of atmospheric and Greenhouse emissions associated with the use of coal as a fuel within the broader region, these being:

- the currently operating Collie A Power Station (and the adjacent proposed Collie B Station);
- the proposed Bluewaters I Power Station;
- the Muja Power Stations; and
- the Worsley Alumina Refinery.

Additionally, because of the extensive coal mining operations within the region, agricultural development and other human activities, dust emissions also occur.

Bluewaters II will contribute to increased concentrations of ozone (O_3), sulphur oxides (SO_x) Oxides of Nitrogen (NO_x), and particulates within the regional air shed.

Bluewaters II will also emit Carbon Monoxide (CO), Volatile Organic Compounds ("VOC"s), Polycyclic Aromatic Hydrocarbons ("PAH"s), heavy metals, dioxins, furans and possibly other persistent organic pollutants ("POP"s), however modelling and emission calculations indicate the levels of these emissions will be well within recommended limits and in the case of POP at levels almost impossible to detect (see the report on modelling in Attachment 4).

7.9.1 Management of Air Emissions

Air emissions from Bluewaters II will be controlled and managed using a combination of best practice design, best practicable technology appropriate to the size of plant and best practice monitoring and management practices during the operation of the plant.

Low NO_x burners will be installed to minimise the emissions of Nitrous oxides. The design of the burners will reflect the objectives of EPA Guidance Statement Number 55 – Implementing Best Practice in proposals submitted to the Environmental Impact Assessment Process. Once the burners are installed and operational, NO_x emissions will be managed by a combination of continuous monitoring and regular maintenance of the burners. A program of condition monitoring will ensure they operate within design tolerances.

Collie coal, and in particular the coal from Ewington 1 coal mine which will be used to fire the Bluewaters II boiler, is low in sulphur (typically 0.5 – 0.6% as received). Air emission modelling undertaken by CSIRO has shown that SO_x emissions from Bluewaters II will be well within National Environment Protection Measures (NEPM) standards. There would be a net environmental loss incurred from the installation of sulphur recovery units on the plant (section 3.3.5), therefore none are proposed.

Dust emissions will be controlled through the installation of either an Electrostatic Precipitator or a baghouse in the exhaust system. Final selection of the preferred technology for dust collection will be made at the final design stage and will be based upon the most appropriate technology for the coal that will be used in Bluewaters II taking into consideration the objectives of EPA Guidance Statement Number 55 – Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process.

7.9.2 Air Quality

The air-quality model TAPM was used by CSIRO to evaluate the separate impacts on air quality of proposed 200 megawatt (MW) and 2 x 200 MW power stations in the Collie mining and power generation area. The proposed site at Bluewaters is 4 km north-west of Collie power station. A 12-month period (2001) was simulated by TAPM using four nested grids down to a grid spacing of 0.5 km for prediction of pollutant concentrations.

Hourly-varying emissions of sulfur dioxide (SO_2) for each day of the year were used for Muja and Collie power stations (obtained from Western Power). For the same sources, hourly-varying emission files for nitrogen oxides (NO_x), carbon monoxide (CO), mercury (Hg), polycyclic aromatic hydrocarbons (PAH), fluoride and particulate matter with aerodynamic diameter less than 10 microns (PM_{10}) were calculated by scaling the hourly SO_2 rates by the ratio of the annual emission of each pollutant to the annual SO_2 value. Emissions from Worsley power station, taking into account the proposed upgrade, were considered constant. Constant emission rates for all pollutants for the proposed power stations were assumed.

POPs were not modelled because the very small rates of emission expected from Bluewaters II (less than 0.5 gram per year) would result in statistically insignificant results. An assessment of the impact of POPs in rainwater collected in rainwater tanks on nearby rural residences was undertaken by BenchMark Toxicology Services (attachment 13.2). The conclusion was that the concentration of deposited POP emissions was unlikely to pose a health risk.

The proposed sources were evaluated under a worst-case scenario that included emissions from the four stages of Muja power station (A, B, C and D), Worsley power station, Collie power station, and an expanded (or additional) Collie power station with identical characteristics to the existing station. The following findings arise from an examination of the highest SO_2 concentrations over a 12-month period.

- Scenario 1 (proposed 200 MW Bluewaters I power station in isolation) produced *hourly-averaged* concentrations below the NEPM standard at all times.
- Scenario 2 (proposed 2 x 200 MW Bluewaters I + II power station in isolation), produced *hourly-averaged* concentrations below the NEPM standard on all days except one.
- For scenario 3 (sources Muja A, B, C and D, Collie, Collie expansion (identical to Collie), Worsley and Bluewaters I), there were exceedances of the NEPM standard for hourly-averaged concentrations on 27 days, associated with both Collie and Muja power stations.

- For scenario 4 (scenario 3 sources plus Bluewaters II), there were also 27 exceedance days. Comparison with scenario 5 (sources Muja A, B, C and D, Collie, Collie expansion, and Worsley) shows that Bluewaters I and II do not lead to any additional exceedance days.

Interpretation of the air modelling results by BenchMark Toxicology Services concluded that there was no additional health impact in Collie or surrounds as a consequence of the incremental impact of Bluewaters II. The health assessment is addressed in section 6.6.

7.9.2.1 Sulfur dioxide

The following findings arise from an examination of the highest concentrations over a 12-month period for the four emissions scenarios.

- Scenario 1 produced *hourly-averaged* concentrations below the NEPM standard at all times.
- Scenario 2 produced *hourly-averaged* concentrations below the NEPM standard on all days except one.
- For scenario 3 there were exceedances of the NEPM standard for hourly-averaged concentrations on 27 days, associated with both Collie and Muja power stations.
- For scenario 4 there were also 27 exceedance days. Comparison with scenario 5 shows that the proposed sources do not lead to any additional exceedance days.

For 24-hour averaged concentrations of SO_2 only one exceedance occurred for scenarios 3 and 4. For annual-averaged concentrations, the NEPM limit was exceeded for scenarios 3 and 4, though with no contribution from the proposed Bluewaters sources.

For all scenarios, NEPM standards were not exceeded at Collie township or at any residences nearby the Bluewaters II plant location for any of the averaging periods.

For short term exposures (10 min) there was one exceedance within the town limits over the one year modelling period. This exceedance occurred during the running of scenario 5.

7.9.2.2 Carbon monoxide, mercury, PAH and fluoride

Concentrations of carbon monoxide were well below the NEPM 8-hourly-averaged concentration standard, while annual- averaged concentrations of mercury and PAH were orders of magnitude smaller than WHO guidelines for the protection of human health. 24-hourly-averaged fluoride concentrations were below the ANZEC goals for vegetation relating to General Land Use.

7.9.2.3 Nitrogen dioxide, ozone and particulate matter

NO_x emissions in the Collie region are dominated by those from the Muja power station (six times larger than those of Collie or Griffin power stations). Consequently, the largest concentrations of NO_2 are associated with Muja though the highest hourly- and annual-averaged concentrations predicted by TAPM are below the NEPM standard.

Maximum ozone concentrations are often found far from the sources of the precursor gases, and for this reason ozone statistics were examined over a larger region (220 x 220 km^2) than for the other pollutants. Highest concentrations predicted were 53 ppb for hourly-averaged and 50 ppb for four-hourly-averaged ozone well below the NEPM standards of 100 ppb and 80 ppb respectively. The major component of these concentrations could be attributed to background ozone and precursor emissions from natural sources (soil, vegetation). There is no difference in the concentration statistics from scenarios 3 and 4, suggesting that NO_x emissions from the proposed station would have no effect on the higher regional ozone concentrations.

Regional PM_{10} levels (highest 24-hour concentration of 106 µg m^{-3}) are well above the NEPM standard (50 µg m^{-3}) for as far as 6 km from Muja power station, but are well below the standard near Collie and Bluewaters stations. The higher concentrations are not affected by additional emissions from the Bluewaters sources and highest concentrations at the Collie township are less than half of the NEPM standard.

In summary, the TAPM modelling shows that emissions from both Bluewaters I and II do not lead to an increase in the number of days on which the NEPM standard for hourly-averaged SO_2 is exceeded. This is under a scenario that includes the existing Muja A,B,C&D, Collie A and proposed Collie B and the expanded Worsley operations operating in conjunction with Bluewaters I and II. In reality the final scenario is one which will consist of Muja C&D, Bluewaters I, the expanded Worsley operations and either Bluewaters II or Collie B. This will occur following the closure of Muja A & B (announced by Western Power to occur in December 2007) and the commissioning of Bluewaters I and one only of Bluewaters II, Collie B or the Wesfarmers Worsley cogeneration proposal..

The full CSIRO report is attached to this PER as attachment 13.4.

7.9.3 Greenhouse Gas

Bluewaters II is expected to have an operational load factor of approximately 75 percent.

The load factor used in calculating greenhouse gas emissions is 80%. Using an 80% load factor the greenhouse emissions from Bluewaters II will be of the order of 1,300,000 tonnes per annum. The greenhouse intensity of Bluewaters II will be 933kg of Carbon Dioxide per MWh produced.

7.9.3.1 Greenhouse Gas Intensity

The implications of new power generation on the carbon intensity of the SWIS were considered in the *Strategic Environmental Review – Strategic Planning for Future Power Generation* (WPC, 2002). It is noted that Scenario B presented in the SER (including 300 MW base load to be provided by coal-fired plant) predicted the SWIS carbon intensity to decrease from 0.89 tonnes CO_{2e} per MWh in 2000 to 0.76 tonnes CO_{2e} per MWh by 2010 (see Figure 3-6 in WPC 2002).

One way of examining Greenhouse intensity is to examine the impact of Bluewaters II on the intensity of coal fired electricity into the grid. Given that Bluewaters II will have an efficiency greater than 36% and parts of the existing Muja power plant have efficiencies less than 30%, it is logical to conclude that the intensity of coal fired electricity will reduce upon the introduction of Bluewaters II to the SWIS.

The load supplied to the SWIS by Bluewaters II will be of three kinds:

- New Load
- Load displaced from Western Power generators
- Load displaced from other generators.

New load will be taken by the new high efficiency Bluewaters II plant. Western Power will always, whether Bluewaters II exists or not, to the greatest extent possible reduce the capacity factor of its lowest merit (least efficient, highest operating cost) plant. Other generators will do the same. The increased average efficiency of the coal-fired fleet will result in lower CO_2 emissions per unit of power output from coal-fired generation. However if some of the load displaced from other generators had been met by a gas-fired plant, then that will involve an increase in CO_2 emissions per unit of power output. Such an issue depends upon commercial considerations and cannot be quantified at this stage.

There is a fundamental difficulty in accounting for greenhouse contributions from various sources into a network such as the SWIS, especially when some producers may be able to claim credits from non-electricity generating initiatives.

Notwithstanding the above, it is clear that the introduction of Bluewaters II into the system will reduce the Greenhouse intensity of coal fired electricity produced in the Collie region, albeit by only a small percentage (of the order of 1 - 2%), due to the better efficiencies used by Bluewaters II when compared to the aging Muja fleet. The exact reduction is difficult to quantify as it will be a calculation that will be reliant upon the production profile of Bluewaters II and all of the other coal fired plants being available at the time of calculation.

7.9.3.2 Greenhouse Gas Management Options

Griffin Energy is committed to participating in the Greenhouse Challenge (www.greenhouse.gov.au/challenge) and has adopted a sustainable approach to Bluewaters II. The company views the management of carbon dioxide as part of the project's sustainability. Bluewaters II proposes best available coal fired technology appropriate to the size of the plant, complements the Griffin Group's adopted strategy for the Collie River Basin and will, therefore, contribute to the long term and ultimate rehabilitation of Wellington Dam, as further detailed below.

Griffin Energy does not propose any formal mitigation of greenhouse gas for the project down to any arbitrary target level, as to do so could adversely affect the economic viability of Bluewaters II, however, the commitment to the Greenhouse Challenge means that the potential offsets, detailed below, will be evaluated as part of an ongoing management plan aimed at reducing greenhouse gases over the life of the project.

The imposition of arbitrary sequestration targets on Bluewaters II or any similar project will have the effect of disadvantaging such projects and the State, contrary to the terms detailed in the Premiers letter of 8th Oct, 2003 to the Chamber of Commerce and Industry WA on the subject which stated that the Government did not intend to introduce State-based abatement targets.

Notwithstanding the above, Griffin Energy in a letter to the EPA on 2 December 2004 made the following Commitments in relation to the Bluewaters I, Bluewaters II and Collie B proposals. The commitments apply to the combination of power stations that Griffin Energy will ultimately be managing post the Power Procurement Process.

Griffin's Commitments

- Griffin Energy will commit to participate in the Australian Greenhouse Office Greenhouse Challenge in 2005. Participation in the Challenge will be a joint initiative of the Group with The Griffin Coal Mining Company Pty Ltd (Griffin Coal) and WR Carpenter Agriculture Pty Ltd (WRCA), both sister companies of Griffin Energy participating with Griffin Energy.

- As part of the Greenhouse Challenge, Griffin Energy will prepare a Greenhouse Gas Management Plan for each of our proposals. The first step in this plan has been implemented with a commitment to using the AGO Technical Efficiency Guidelines by the design teams for the power station proposals.

- In addition we will initiate several offset and research measures to address greenhouse gas emissions over the life of each project. This demonstrates Griffin Energy's commitment to addressing the EPA's principle requirement to first adopt an On-Site Impact Mitigation Program that avoids, minimises, rectifies, reduces or eliminates the impact of greenhouse gases over time.

- Specifically Griffin Energy commits to implement the following measures:

  1. Continued planting of eucalypt trees on former mined areas owned freehold by Griffin Coal and WRCA. This ongoing program is designed to initially sequester 1,000 tonnes per annum of GHG with the program extending over 5 years. 5,000 tonnes of GHG have

been sequestered since planting began on land cleared before 1990. This calculation is based on the AGO National Carbon Accounting system and is capable of external verification.

2. Griffin Energy proposes to plant approximately 2000 hectares of mallees on Joanna Plains and other farming properties owned by WRCA in the WA agricultural regions, during the construction and commissioning period of the power station. This action will extend over a 3 year period and is designed to initially sequester 90,000 tonnes per annum of GHG and is again capable of external verification.

3. Commitment to the construction of an 80 MW wind farm (40 MW net interest) near Cervantes, WA at a total capital cost of $165 million. The farm is expected to produce 280,000 MWhrs annually resulting in GHG savings of 220,000 tonnes across the SWIS system. This commitment would of course be subject to agreement regarding the valuation of the GHG benefits of the wind farm with the EPA.

4. Initiation and development of other projects to the point where they can be included as offsets in the program. These projects include research into commercial uses of ash, contributions to the CRC for Coal in Sustainable Development (CCSD) and investigations into sequestration potential in rangelands.

In addition to those commitments outlined above Griffin will continue to support and provide access to Griffin owned land and facilities to enable the diversion of the East Collie River. This will facilitate the diversion of each season's first flush flows of salt water away from Wellington Weir. This project is anticipated to lead to the return of Wellington Weir to a potable condition within a three year time frame. The GHG credit from this project is calculated to be 480,000 tonnes per annum. This is based on a future sustainable yield of 80GL per annum from Wellington Weir calculated by the Waters and Rivers Commission and the equivalent amount of water passing through the proposed Kwinana desalination plant. While Griffin can facilitate this commitment, and must do so for it to proceed, Water and Rivers Commission are the project sponsors and managers. Discussions on the allocation of the resulting GHG benefits have not yet commenced between the parties, the priority to date has been the development of the project to a point where the feasibility can be tested.

7.9.3.3 Geosequestration Potential

The Perth Basin was included in a study which evaluated gesequestration options in Australia (*Rigg et al (2001)* and *Brayshaw et al (2002)*). The Perth Basin extends from the Murchison in the North to the south coast and out to sea. Whilst the Collie basin is near the Perth basin it was not included in the study. In the study, the Perth Basin was assessed as having a 20% chance of containing a suitable geosequestration site. The significant offshore component of the basin means the likelihood exists that a suitable geosequestration site may only be available offshore.

Herzog (1999) has given a minimum cost for the capture of flue gases from power stations to be $US20 per tonne rising to approximately $US70 per tonne depending on the extraction process. This equates to an annual operating cost in the range $US26.0 to $US91.0 million per year for a plant the size of Bluewaters II. When this is added to the cost of delivering the gas to a suitable geosequestration location, it can be seen that the cost is prohibitive. Griffin Energy will continue to monitor the potential for geosequestration.

Notwithstanding the above, the plant layout is such that collecting CO_2 at some time in the future will be a relatively easy exercise to facilitate, should geosequestration become a viable option.

7.9.3.4 Greenhouse Gas Management Plan

Prior to commencement of construction of Bluewaters II, Griffin Energy will prepare a Greenhouse Gas Emissions Management Plan to:

- ensure that greenhouse gas emissions from Bluewaters II are adequately addressed;
- ensure that appropriate technologies are used to minimise total net greenhouse gas emissions and/or greenhouse gas emissions per unit of electricity output; and
- mitigate greenhouse gas emissions in accordance with the Framework Convention on Climate Change, 1992, and consistent with the National Greenhouse Strategy.

The Plan will comprise:

- participation in the Commonwealth Government's *Greenhouse Challenge* Programme that focuses on continuous improvement in reducing emissions of greenhouse gases
- an inventory of GHG emissions from the Bluewaters II, and benchmarking of GHG efficiency with other comparable projects;
- an action plan with specific actions to minimise emissions where practicable, and performance measures to measure progress;
- evaluation of the options detailed in section 7.8.4;
- continued investigation of options for greenhouse minimisation during the life of the project;
- the calculation of greenhouse gas emissions associated with Bluewaters II, as indicated in Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors, No. 12, published by the EPA;
- specific measures to minimise the total net greenhouse gas emissions and/or the greenhouse gas emissions per unit of electricity produced by Bluewaters II;
- monitoring of greenhouse gas emissions;
- an analysis of the extent to which Bluewaters II meets the requirements of the National Greenhouse Strategy using a combination of the following measures:
  - **'No regrets'** measures are those that can be implemented, which are effectively cost-neutral and provide Griffin Energy with returns in savings that offset the initial capital expenditure that may be incurred.
  - **'Beyond no regrets'** measures are those that can be implemented but which involve some additional cost that is not expected to be recovered.
  - Land use change or forestry offsets.
  - International flexibility mechanisms;
- a target set by Griffin Energy for the reduction of total net greenhouse gas emissions and/or greenhouse gas emissions per unit of electricity over time, and annual reporting of progress made in achieving this target.

The Greenhouse Gas Emissions Management Plan will be made publicly available.

7.9.3.5 Management of Carbon Dioxide

The Australian Government's position on Greenhouse is reflected in the Prime Minister's Statement of 20 November 1997, titled "*Safeguarding the Future: Australia's Response to Climate Change*". In the statement the Prime Minister said:

> "*The Commonwealth will work with the States to achieve movement toward best practice in the efficiency of electricity generation conversion by implementing efficiency standards for different fossil fuel classes so as to deliver reductions in the greenhouse gas intensity of energy supply. Standards will apply to new electricity generation projects, significant refurbishment and existing generation.*
>
> *This will ensure the adoption of best practice in each fossil fuel* class. *Standards will also be phased in to encourage emissions reductions in existing plants*".

The Prime Minister's statement was designed to:

- Recognise different fuel classes, including brown and black coal and gas fired plant; and
- Apply to new, significantly refurbished and existing generation.

Subsequently, the Australian Greenhouse Office (AGO) produced technical guidelines, in January 2001, including the Generator Efficiency Standards. In Section 4 of the Application of Greenhouse Efficiency Standards, Section 4.1 Principles states, inter alia:

(i) Standards shall not discriminate between fossil fuels.

The AGOs non discriminatory position means that no one type of fossil fuel is required to compare with another's greenhouse performance in any configuration of electricity generation.

The aim of the AGO is to reduce overall greenhouse gas intensity through the application of efficiency standards for each class of fuel in a range of electricity generation configurations. The AGO works with the electricity generation industry, so better decisions can be made, by industry members, about increasing the efficiency of each type of fossil fuel. The AGO does not demonstrate any preference ranking for fossil fuels in the generation of electricity (*www.greenhouse.gov.au*).

Bluewaters II will be using the AGO's Generator Technical Efficiency Standards to monitor and report on its performance. Griffin Energy is committed to implementing these standards at Bluewaters II and contributing to the overall reduction of greenhouse intensity in electricity generation in WA.

The AGO's Generator Technical Efficiency Standards indicate a nominal cut-off point of 250 MW generation for the transition from supercritical to subcritical. Bluewaters II, at 200 MW (net), is well below the nominal cut off point and therefore subcritical technology is considered the most appropriate. In practice, the accepted technical cut off point is 350 MW as detailed in section3.3.3.

7.9.3.6 Carbon Management Summary and Commitments

Griffin Energy is committed to participating in the Greenhouse Challenge (www.greenhouse.gov.au/challenge). As part of the Greenhouse Challenge, Griffin Energy proposes to undertake an innovative tree supply initiative to landcare groups in the South West. Griffin Energy intends to negotiate agreements with the landcare groups to supply trees for planting out on land for salt reclamation, habitat rejuvenation, conservation projects and farm shelter belts.

Griffin Energy has adopted a sustainable approach to Bluewaters II and views the management of carbon dioxide as part of the project's sustainability. The project proposes best available coal fired technology appropriate to the size of the plant, complements the Griffin Group's adopted strategy for the Collie River Basin and will, therefore, contribute to the long term and ultimate rehabilitation of Wellington Dam.

Griffin Energy has made the following commitments in a letter to the EPA dated 2nd December 2004:

1 Continued planting of eucalypt trees on former mined areas owned freehold by Griffin Coal and WRCA. This ongoing program is designed to initially sequester 1,000 tonnes per annum of GHG with the program extending over 5 years. 5,000 tonnes of GHG have been sequestered since planting began on land cleared before 1990. This calculation is based on the AGO National Carbon Accounting system and is capable of external verification.

2 Griffin Energy proposes to plant approximately 2000 hectares of mallees on Joanna Plains and other farming properties owned by WRCA in the WA agricultural regions, during the construction and commissioning period of the power station. This action will extend over

a 3 year period and is designed to initially sequester 90,000 tonnes per annum of GHG and is again capable of external verification.

3 Commitment to the construction of an 80 MW wind farm (40 MW net interest) near Cervantes, WA at a total capital cost of $165 million. The farm is expected to produce 280,000 MWhrs annually resulting in GHG savings of 220,000 tonnes across the SWIS system. This commitment will be subject to agreement regarding the valuation of the GHG benefits of the wind farm with the EPA.

4 Initiation and development of other projects to the point where they can be included as offsets in the program. These projects include research into commercial uses of ash, contributions to the CRC for Coal in Sustainable Development (CCSD) and investigations into sequestration potential in rangelands.

In addition to those commitments outlined above Griffin will continue to support and provide access to Griffin owned land and facilities to enable the diversion of the East Collie River. This will facilitate the diversion of each season's first flush flows of salt water away from Wellington Weir. This project is anticipated to lead to the return of Wellington Weir to a potable condition within a three year time frame. The GHG credit from this project is calculated to be 480,000 tonnes per annum. This is based on a future sustainable yield of 80GL per annum from Wellington Weir calculated by the Waters and Rivers Commission and the equivalent amount of water passing through the proposed Kwinana desalination plant. While Griffin can facilitate this commitment, and must do so for it to proceed, Water and Rivers Commission are the project sponsors. Discussions on the allocation of the resulting GHG benefits have not yet commenced between the parties, the priority to date has been the development of the project to a point where the feasibility can be tested.

7.10 Dust

It is a management objective of Griffin Energy to protect the health, welfare and amenity of surrounding land users from adverse impacts of dust and particulate emissions in accordance with the EPA's *Guidance Statement No.18 'Prevention of Air Quality Impacts from Land development Sites'*.

7.10.1 Existing Environment

Dust emissions do occur in the area from mining operations, land clearing and off-road vehicle use, but are generally low.

The following graph shows the results of dust monitoring in Palmer Road Collie. The data indicates no excursions over the PM_{10} standard.

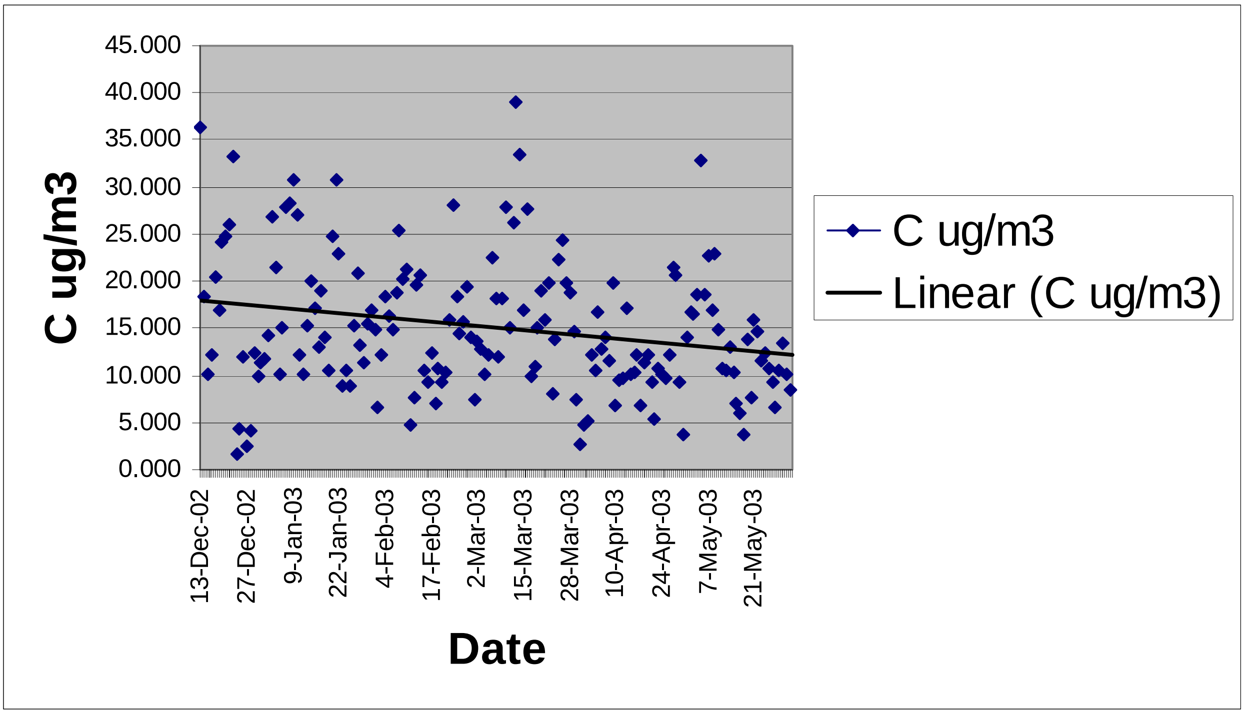

Figure 7 - PM10 Monitoring Results Palmer Road Collie.

7.10.2 Potential Impacts

Dust may be generated during construction of Bluewaters II through the following activities:

- vegetation clearing;
- earthworks;
- materials handling; and
- vehicle movements.

Dust generated by the operation of Bluewaters II will be limited due the high efficiency dust collection system proposed to be installed.

7.10.3 Management of Impacts

The Construction Phase Environmental Management Plan will provide details about dust management on site during the construction phase of Bluewaters II. Strategies to minimise dust will include:

- minimising site clearing, with rehabilitation occurring as soon as practicable to minimise the length of time surfaces are exposed;
- regular watering of unsealed roads, exposed surfaces and stockpiles;
- employee induction; and
- preparation and implementation of the Construction Phase Dust Management Plan.

Dust management, during the operation of Bluewaters II, will be detailed in the *Operations Phase Environmental Management Plan.* Strategies to minimise dust will include:

- sealing of main site roads;
- regular watering of stockpiles;
- application of dust suppression technology to transfer points and other materials handling activities;

- a programme of ongoing housekeeping which prevents the build up of material that could lead to dust generation; and
- regular maintenance of the dust collection system installed in the stack.

The performance of dust control measures will be monitored to ensure compliance with a limit of 1000 $\mu g/m^3$ over a fifteen minute period. Any complaints will be recorded and investigated and corrective action implemented where necessary.

7.11 Noise and Vibration

The following are management objectives of Griffin Energy.

- To ensure that noise impacts emanating from construction and operational activities comply with statutory requirements and acceptable (and appropriate) standards (e.g. Environmental Protection (Noise) Regulations 1997).
- To ensure that vibration impacts emanating from Bluewaters II are acceptable.

7.11.1 Existing Environment

Noise in the project area originates from coal mining and handling activities and from the neighbouring Collie Power Station. The plant site is located within the proposed Coolangatta Industrial Estate as shown in **Error! Reference source not found.**. A buffer will be established around the Coolangatta Industrial Estate defined by the 30dB(A) sound level emanating from the Bluewaters I and II operating in tandem. There are no residences within the buffer, except for a residence on Bluewaters farm which is owned by WRCA. The residence will be demolished in anticipation of mining activities associated with the Ewington I mine development.

7.11.2 Noise and Vibration Sources

Noise, specific to the proposal, will be generated from power station construction and operations, including:

- earth moving equipment and power plant assembly during construction;
- construction vehicles;
- coal pulverising mill;
- air plant;
- steam generators and turbines; and
- coal conveyor.

Modelling has been undertaken to predict noise level contours for the Collie area from Bluewaters II operations (Attachment 5) with the exclusion of the coal conveyor. Once the preferred alignment for the conveyor has been determined, an assessment will be made on the need for additional modelling. However, given the distance to the closest noise sensitive premise (4.5 km), additional modelling is probably unnecessary.

Vibration is likely to originate during the construction phase through the use of compaction equipment. However, given the distance between the site and the closest sensitive residence (4.5 km) it is unlikely that vibration will be a significant issue. Griffin Energy is not aware of any specific complaints relating to vibration during construction of the Collie Power Station.

7.11.3 Noise Criteria

Noise from construction works is covered by Regulation 13 of the Environmental Protection (Noise) Regulations, 1997. These require construction activities to be carried out between 7am and 7pm on any day which is not a Sunday or public holiday to which the following will apply:

- construction works must be carried out in accordance with Australian Standard 2436-1981 'Guide to Noise Control of Construction, Maintenance and Demolition Sites';
- equipment used for construction must be the quietest reasonably available; and
- the Chief Executive Officer of the DoE may require that a Noise Management Plan be submitted for construction work at any time. If construction work is undertaken outside of these hours, the following will also be required:
- a Noise Management Plan will need to be submitted to the DoE at least seven days prior to the commencement of works;
- any nearby occupants who are likely to receive noise in excess of the limits specified under Regulation 7, must be advised of the work at least 24hrs before it commences; and
- it must be reasonably shown that it is necessary for the work to be done out of hours.

Modelling Methodology

The SoundPLAN Model

Modelling of noise emission propagation from Bluewaters II was carried out by Herring Storer Acoustics using an environmental noise modelling computer program, SoundPLAN. The SoundPLAN model is a specialist noise modelling package developed by Braunstein and Berndt International, a leading firm of transportation and environmental engineers in Germany. SoundPLAN includes a number of international standards detailing calculation methods for industry noise.

Model Set up

The objective was to predict the noise level propagation to all noise sensitive premises located around the site under worst case propagation conditions. Both overall noise level contour plots and single point calculations were performed. Noise contours show the overall noise level at any location due to the various activities carried out, whereas single point calculations show the influence of individual items on the overall noise resulting at a specific location.

Sound Power Levels

Calculations were based on information obtained from Pacific Power International, that noise emissions would be 60 dB (A) at a radius of 150 metres from a 400 MW power unit. In the absence of noise data from a similar 200MW plant to Bluewaters II, the sound power levels from the 400MW unit were used in the model to ensure that the results were conservative. As sound is added in a logarithmic manner this assumption was assessed by the acoustic engineers performing the modelling to be realistic and could be used in the model to calculate noise levels from the 200MW plant.

When determining sound levels from the Bluewaters I and Bluewaters II operating in tandem, the same input data was used for both stations in the model.

Meteorology

Weather conditions for the modelling were as stipulated within the Environmental Protection Authority's 'Draft Guidance for Assessment of Environmental Factors No. 8 - Environmental Noise' for the night-time period.

7.11.4 Modelling Results

The resultant noise contour map is provided in Attachment 5. Noise levels at the closest residence within the town of Collie will be less than 30 dB (A) at all times meeting legislative requirements. The greatest noise source is from the top of the stack, and hence noise contours are not affected by ground level and surrounding vegetation. Based on the calculated levels the resultant noise at the residences within the town of Collie would not be tonal or contain any other annoying characteristics. Therefore, no penalties would be applied to the calculated value.

Noise emissions from Bluewaters II would be considered as not 'significantly contributing' to any excess at a residence and would be deemed to comply with the Environmental Protection (Noise)

Regulations, 1997 at all times. No specific management is required. A copy of the noise report is attached (Attachment 5).

The modelling carried out by Herring Storer Acoustics shows that the noise level at all undeveloped premises is less than 60dB(A). This is shown in figures 01 and 02 in attachment 6.

Cumulative Noise Impact.

As Bluewaters stages I and II are effectively on the same premises, the cumulative noise impact from both stages needs to comply with the requirements of the Regulations. As there are other industries contributing or are likely to contribute to the noise received at the neighbouring premises, noise received from both stages of Bluewaters, to comply with the Regulations, needs to be considered as not significantly contributing to the noise received at the neighbouring noise sensitive premises. To be considered as not being a significant contributor to the noise received at the neighbouring premises, noise received from Bluewaters needs to be less than 30 dB(A).

The modelling of the Bluewaters I was based on noise levels from a 400MW power station. Therefore, we believe that the modelling of Bluewaters I is conservative. The addition of Bluewaters II has been subsequently modelled using the same inputs, and the results show that the combined noise level received at the neighbouring residential premises will comply with the requirements of the Environmental Protection (Noise) Regulation 1997 in that at the closest noise sensitive premises the cumulative noise would be 29 dB(A) under Environmental Protection Authority (EPA) standard weather conditions as described in EPA Draft Guidance for Assessment of Environmental Factors No. 8 - Environmental Noise. There is no measurable noise impact within the town of Collie.

7.12 Hydrocarbon and Hazardous Materials

7.12.1 Management Objectives

Ensure that hydrocarbons and hazardous materials are handled and stored in a manner that minimises the potential for impact on the environment through leaks, spills and emergency situations.

7.12.2 Potential Impacts

The proposed expansion will result in increased transportation, storage and handling of hydrocarbon products and hazardous materials.

The potential impacts associated with these activities include:

- Discharge of hydrocarbons to the environment contaminating surface and ground waters, the atmosphere and soil;
- Creation of acute and/or chronic toxic hazards; and
- Creation of flammable or explosive hazards.

7.12.3 Management Strategies

A Hydrocarbon Management Plan will be developed as part of the Operational Environmental Management Plan based around a framework that:

- Reduces the volume of hydrocarbon waste materials produced;
- Segregates hydrocarbons from stormwater to reduce the volume of waste materials;
- Ensures appropriate transport, storage and handling procedures;
- Ensures appropriate clean-up procedures for spills; and
- Defines environmentally acceptable methods for the disposal of waste.

This management plan will include specific project design features and management practices to minimise the generation of hydrocarbon waste and to manage clean up and disposal.

A framework for an activity-based Hydrocarbon Management Plan is summarised in the following table. This will be further refined an incorporated into operational procedures prior to construction.

Table 14- Conceptual Liquid Hydrocarbon Management Plan

Activity	Issue	Management Actions
Import of raw materials Product to be shipped using road tanker and then off loader at purpose built discharge bay.	Potential for vehicle collision and general road accidents	• Driver to be fully inducted in the general health and safety procedures at the site, and procedure if a road accident occurs. • Driver to know road network system on site, particularly one way roads.
	Discharge of product during delivery	• Delivery to be performed in designated area(s) only, which will bunded and consist of sealed drainage system which can be isolated and will hold sufficient volume if relatively minor spills occur during delivery • Driver will be fully trained in procedures for the delivery of product and to wear appropriate personnel protective equipment. • All pipes, valves and connections to be compatible, and made of suitable materials to prevent degeneration and maintain integrity. • Driver will be fully trained in procedure if spillage occurs and personnel required to be informed once initial control of spillage is obtained. • Delivery area to be under cover to limit stormwater run which is impacted with petroleum hydrocarbons or drain will be fitted with appropriate interceptors so that discharge does not exceed license levels.
Storage	Products to be stored in above ground storage tanks.	• Utilisation of storage inventories to identify losses, if any to ground. • Baseline soil and groundwater survey to be performed to identify conditions prior to storage and set up groundwater monitoring well regime which will be used on a regular basis to identify impact, if any. • All tanks to be constructed within secondary containment of sufficient volume to prevent losses to ground if a minor or major spill occurs. Secondary containment material to be compatible with product stored so that integrity is maintained. • No pipe work to pass through containment walls so that bund integrity is maintained. • All stormwater interceptors and other discharge traps to be inspected at least every 6 months (especially prior to wet season) to remove product which may be flushed through during storm events.
Spillage of product	Emergency response procedures	• All personnel will be aware through training the nature of the product stored so that spillages can be easily identified. • Personnel will know procedure for addressing spills, if practical and safe, and personnel to contact to record the spill. • Hydrocarbon absorbent booms, pads and powders to be maintained in vicinity of storage tanks and personnel trained in their use. • Stormwater shut off valves will be installed in secondary

		containment and all parties to know their location and use. • Appropriate Regulators will be informed of spills and measures performed to address spillage and extent of residual impacts, if any.

7.12.4 Monitoring

The Hydrocarbon Management Plan will include an ongoing monitoring program which will include regular audits of storage and management practices.

7.13 Visual Amenity

The proposed site for Bluewaters II occurs in an area where farming, forestry and the coal and power industries are the primary land users. There is a significant area of State Forest to the south of the site. Bluewaters II and its associated infrastructure will not be visible from Collie and is screened from Coalfields Road by stands of vegetation and a gently undulating landscape. There are no publicly accessible scenic vantage points. A water vapour plume from the cooling towers will be visible on occasions.

There are a number of industries either proposed or currently operating in the area surrounding the Bluewaters II site. These include the Collie Power Station which is immediately to the east, Ewington II coalmine to the south-east and the proposed Ewington I minesite to the south-west. The area to the north is primarily farmland with few remnant stands of vegetation. Bluewaters II in association with Bluewaters I will not result in significant loss of visual amenity to the area.

7.14 Aboriginal Heritage

Before Bluewaters II can be built, Aboriginal heritage values must be identified in accordance with the requirements of the Aboriginal Heritage Act 1972 and the Heritage of Western Australia Act 1990. These requirements include:

- specific site surveys with recognised Aboriginal informants;
- consultation with informants to assess the cultural and heritage values of any sites identified; and
- should a significant site be identified and deemed to be unavoidable, appropriate approvals are required to disturb site(s) from the Minister for Aboriginal Affairs.

7.14.1 Background Information

Much of the surrounding area has been previously surveyed with a number of archaeological and ethnographic surveys undertaken since 1980. These include:

- Brown 1984;
- Harris 2001;
- McDonald Hales and Associates 1991;
- Novak 1980;
- Novak and Brown 1979;
- O'Connor 1989;
- Pearce 1981, 1982, 1983;
- Veth 1983;
- Veth et al. 1983;
- O'Connor Bodney and Little 1985;
- Green Iguana 2001

In the wider Collie Basin approximately forty archaeological sites have been previously recorded (Harris, 2001), six of which are located adjacent to the Bluewaters II site and within the Ewington I mining lease (Harris, 2001; Green Iguana, 2001).

Aboriginal Heritage sites in the Collie area are generally small stone artefact scatters, quarries and stone arrangements and stratified archaeological deposits, the latter of which provides evidence of intensive use of the jarrah forest in the area (McDonald Hales and Associates, 1991). Most sites occur near to, or are closely associated with water sources, and are of small scale and low significance (Harris, 2001; Green Iguana, 2001; McDonald Hales and Associates, 1991).

No sites of ethnographic significance have been recorded in the immediate area surrounding the Bluewaters II site (Harris, 2001; McDonald Hales, 1991). When the Collie area became settled by Europeans, the Aboriginal population of the south-west had already been decimated by conflict, disease and limited access to resources (MacDonald Hales and Associates, 1991), leaving little knowledge of the indigenous use of the area.

The Project Area

When consideration is given to prior surveys of the area it is possible that small artefact scatters of low significance could occur on the Bluewaters II site or within the conveyor corridor. However, it is unlikely that sites of high significance will occur. A search of the site register in the Department of Indigenous Affairs did not reveal any sites of significance within the Bluewaters II site. The nearest site of significance is an artefact scatter, registered as unreliable, about one kilometre south-west of the Bluewaters II site (SOO960). Aboriginal groups of the south-west region that have an association with the Collie area will be consulted, prior to construction of the power station, to determine any sites of ethnographical significance

Bluewaters II is co-located with Bluewaters I, consequently Griffin Energy has fully explored Indigenous and Archaeological issues associated with the site. Copies of applicable Ethnographic and Archaeological reports have been supplied to the DIA covering the site. In a letter to the EPA dated 22 June 2004 the DIA stated "*The DIA is satisfied that Aboriginal Heritage surveys have been undertaken within the proposed project area*". However in the event that any items or sites of significance are discovered at the site the DIA and any other appropriate authority will be notified.

Native Title

The Bluewaters II site is freehold land and not subject to Native Title.

7.15 European Heritage

A search of the Heritage Council of Western Australia's database and the Australian Heritage Commission's Register of the National Estate were conducted for the Bluewaters II site. No registered sites of European heritage significance will be disturbed by Bluewaters II or its associated infrastructure.

The following Heritage items are listed for the Collie area:

- P00540 Railway Goods Shed and Footbridge, Railway Reserve north of Coalfields Highway, Collie;
- P00541 Round House with Turntable, Railway Reserve north of Coalfields Highway, Collie;
- P03551 Suspension Bridge, Collie River, Collie

None of these Heritage items will be impacted by Bluewaters II.

8 Community and Stakeholder Consultation

The Griffin Group has been mining coal and supplying fuel to Western Australians for over 70 years, and has been a strong supporter of the local community through a range of initiatives (e.g. sponsorship and participation in the Griffin festival). The Griffin Group's commitment to maintain an open dialogue with the Collie community is ongoing.

Griffin Energy is committed to an ongoing process of open community consultation for the life of Bluewaters II. The community will be kept informed about the status of the project through formal and informal contact and the release of any significant information during the construction and operation of Bluewaters II. The latest information meeting was held in the town of Collie on the evening of 30th November which was attended by 55 people from the town and surrounding areas.

Bluewaters II is designed to maximise technological benefits, the benefits associated with the proximity of the coal source and to minimise environmental impacts. Bluewaters II will be an addition to the current power supply infrastructure in the South West and as such will provide the impetus for a revitalised future for the region.

To ensure that the community is aware of the Bluewaters proposals, and to inform all stakeholders about the Bluewaters, Griffin Energy conducted extensive community consultation including:

- Press advertisements
- The provision of brochures, via local newspapers, to residents of Bunbury and Collie
- Distributed press releases to regional and metropolitan media outlets
- Participation in the Collie Coal Taskforce
- Information posted on the company web site
- Face to face presentations with local Collie community groups

Feedback collated from the consultative sessions indicated that 84% of the respondents either agreed or strongly agreed that the sessions were positive and participants were able to voice opinions, ask questions and apply the information supplied, to their issues and concerns. 11% of the respondents indicated a neutral view.

All of the questions asked during the community consultation process were recorded and a questions and answer document was developed for distribution.

Summary of Community Consultation Process

The community consultation workshops have provided positive feedback to the establishment of Bluewaters. Despite some concerns about water management in the Collie Basin in the future, there was no verbal opposition to the proposed project elicited during the community consultation process. The impact on employment opportunities was an issue that was raised in a positive sense by the community.

Griffin remains committed to maintaining a consistent community consultation process to ensure residents and stakeholders have continuing opportunities for input and feedback on Bluewaters II.

9 Consolidated Management Commitments

The following pages provide detail of the commitments made by management for the Bluewaters II Power Station. They are a consolidation of all the commitments made during the environmental review process.

Table 15 - Consolidated Management Commitments

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
One	Biodiversity	Minimise clearing to establish power station. Examine all environmental factors and implementation of mitigation plans and activities.	Develop and implement an EMS for Bluewaters that meets AS/NZS ISO 14001:1996. The EMS will cover all elements in the standard as a minimum as well as the action items listed in this table:	Prior to construction and ongoing.	Various stakeholders as indicated below.
			1.1 Develop and implement a construction phase EMP.	Prior to construction.	Various stakeholders as indicated below.
			1.2 Develop and implement an operational phase EMP.	Prior to commissioning and ongoing.	Various stakeholders as indicated below.
Two	**Terrestrial Flora:** • Vegetation Communities • Declared Rare Flora and Priority Flora • Flora of Conservation Significance	Removal of vegetation will be minimised where possible through appropriate location of the power station and associated infrastructure. The project will maximise the use of existing cleared land.	2.1 Preparation and implementation of a Vegetation and Flora Management Plan addressing identification of areas not to be disturbed, site clearance procedures to manage construction works so as to avoid disturbance to native vegetation, and weed management practices.	Prior to construction.	CALM.
		Manage construction works to minimise disturbance to significant vegetation communities and priority flora. Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	2.2 If any clearing of native vegetation is determined to be required, the area will be surveyed and mapped prior to the commencement of construction, and the significance of impacted vegetation will be detailed.	Prior to construction.	CALM.
Three	**Terrestrial Fauna:** • All Fauna • Specially Protected (Threatened) Fauna	Maintain the abundance, species diversity, geographic distribution of terrestrial fauna. Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act*.	3.1 Preparation and implementation of a Fauna Management Plan to ensure off-site and indirect fauna impacts are minimised. This may include: - ensuring physical disturbance is kept within designated areas, - establishment of procedures, monitoring requirements, workforce training and responsibilities to minimise disturbance of significant terrestrial fauna, - regular liaison with local CALM office to maintain acceptable management practices, - development and implementation of fire prevention and contingency measures.	Prior to construction.	CALM.

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Four	**Surface Water Quality**	To minimise erosion and impacts on local surface water or downstream environments.	4.1 Cooling water discharge will not be directed to the surface water system.	Prior to construction.	DoE – Water & Rivers Commission.
			4.2 The plant will be designed to ensure that contaminants are not released to the environment.	Prior to commissioning and ongoing.	DoE – Water & Rivers Commission.
			4.3 Contamination of surface water will be minimised by methods such as: • suitably designed drainage areas and settling basins; • appropriate design of areas to contain hazardous material such as hydrocarbons; • washdown water will be collected in drains and passed through sediment traps and oil separation systems prior to transfer to settling ponds.	Prior to construction.	DoE – Water & Rivers Commission.
			4.4 Develop and implement construction phase surface water management plan as part of construction phase EMP.	Prior to construction.	DoE – Water & Rivers Commission.
			4.5 Develop and implement operational phase surface water management plan as part of operational phase EMP.	Prior to commissioning	DoE – Water & Rivers Commission.
			4.6 Document the existing surface water quality in the project area.	Prior to construction.	DoE – Water & Rivers Commission.
Five	**Groundwater Quality**	Maintain the quality of local and regional groundwater to ensure that existing and potential uses, including ecosystem maintenance, are protected.	5.1 The plant will be designed to ensure that contaminants are not released into the environment.	Prior to construction.	DoE – Water & Rivers Commission.
			5.2 All potentially hazardous materials will be stored in accordance with relevant legislation and regulations.	Prior to commissioning and ongoing.	DoE – Water & Rivers Commission.
			5.3 Develop and implement construction phase groundwater management plan as part of construction phase EMP.	Prior to construction.	DoE – Water & Rivers Commission.
			5.4 Develop and implement operational phase groundwater management plan as part of operational phase EMP.	Prior to commissioning	DoE – Water & Rivers Commission.
Six	**Water Supply**		6.1 Develop and implement an appropriate water supply and management strategy that will satisfy requirements during both the construction and operation phases of the project.	Prior to construction	DoE – Water & Rivers Commission.
			6.2 Develop and implement construction phase water management plan as part of Construction EMP.	Prior to construction.	DoE – Water & Rivers Commission.
			6.3 Develop and implement operational phase water management plan as part of operational EMP.	Prior to commissioning and ongoing .	DoE – Water & Rivers Commission.

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Seven	**Marine Water Quality**	Maintain marine ecological integrity and biodiversity and ensure that any impacts on locally significant marine communities are avoided.	7.1 Cooperate with operator of Collie A disposal line to ensure that effluent water meets discharge licence conditions prior to introduction into line. 7.2 Determine final details of the wastewater quality and quantity and conduct a detailed modelling assessment of the ocean outfall discharge (with the existing operator of Collie A) to demonstrate the dilution criteria that can be achieved with the additional saline water discharge. An assessment of the levels of other contaminants (such as biocides) discharged into the ocean will be included to ensure that they meet the ANZECC/ARMCANZ 2000 Water Quality Guidelines at the edge of the mixing zone. 7.3 Design and implement a Saline Water Management Plan incorporating a saline wastewater monitoring programme and wastewater management contingency plan, as part of the Operations EMP.	Prior to commissioning and ongoing. Prior to commissioning Prior to commissioning	DoE South West Region Office and operator of Collie A discharge line. DoE South West Region Office and operator of Collie A discharge line. DoE South West Region Office and operator of Collie A discharge line.
Eight	**Contamination** **(Oil and chemical spills)**	To minimise potential adverse effects, risk and liability associated with management of oils and chemicals.	8.1 During the construction phase, potentially contaminating materials and activities will be stored and managed in accordance with regulatory requirements and good practice. Containment of any spillages or leakage will be a priority. 8.2 The plant will be designed to ensure spillages of chemicals or hydrocarbons are contained and collected. 8.3 During operation of the plant, all potentially contaminating or hazardous materials will be stored in accordance with relevant legislation and regulations 8.4 Develop and implement construction phase contamination management (spills) plan as part of construction phase EMP. 8.5 Develop and implement operational phase contamination management (spills) plan as part of operational phase EMP.	Prior to construction. Prior to commissioning and ongoing. Ongoing Prior to construction. Prior to commissioning	DoE – Land and Water Quality Branch. DoE – Land and Water Quality Branch. DoE, DoIR DoE DoE

Commitment Number	Environmental Factor	Management Objective	Action		Timing	Advice From
Nine	**Solid and Liquid Wastes**	To minimise potential contamination to the receiving environment.	9.1	During both the construction and operation phases of the project, solid and liquid wastes will be minimised through resource recovery, reuse and recycling programmes.	Prior to construction and ongoing.	Shire of Collie.
			9.2	All materials requiring disposal will be managed in accordance with the requirements of the relevant authorities and regulations.	Prior to commissioning and ongoing.	Shire of Collie.
			9.3	Waste hydrocarbons will be contained, collected and disposed off-site by an approved method.	Prior to construction	DoE
			9.4	Domestic wastewater will be managed on site via a packaged treatment plant.	Prior to commissioning and ongoing	DoE
			9.5	Fly ash requiring disposal will be conditioned with water prior to transport to disposal within the Ewington I overburden disposal areas.	Prior to commissioning and ongoing	DoE
			9.6	Cooling water discharge will be directed to Western Power's saline Water Pipeline.	Prior to construction and ongoing	DoE
			9.7	Revise and revise the marine monitoring program in consultation with the pipeline operator	Prior to commissioning	DoE
			9.8	Develop construction phase waste management plan as part of the construction phase EMP.	Prior to construction	DoE
			9.9	Develop and implement construction phase waste management plan	Prior to commissioning	DoE
			9.10	Develop and implement operational phase waste management plan as part of the operational phase EMP.	Prior to commissioning	DoE

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Ten	**Noise and Vibration:** • Construction Phase • Operations Phase	To minimise noise emissions and comply with Noise Regulations during construction and operations.	10.1 Appropriate noise abatement technology will be installed to ensure the power station meets relevant noise criteria. 10.2 Develop and implement construction phase Noise management plan as part of the construction phase EMP. 10.3 Develop and implement operational phase Noise management plan as part of the operational phase EMP, including periodic monitoring to ensure compliance with Noise Regulations.	Prior to construction. Prior to construction Prior to commissioning and ongoing.	DoE – Noise Branch. DoE – Noise Branch . DoE – Noise Branch
Eleven	**Air Emissions:** • Construction Phase (Particulate / Dust) • Operations Phase (Particulate / Dust (PM_{10}), Oxides of Sulphur (SO_2), Oxides of Nitrogen (NO_X), VOC's, etc.)	To minimise environmental or human health effects or significantly impact on amenity.	11.1 Dust levels will be managed by minimising vegetation clearing, the use of dust suppression equipment and appropriate site management. 11.2 Best practice management will be used in the design and construction of coal handling. 11.3 Develop and implement construction phase dust management plan as part of construction phase EMP. 11.4 Develop and implement operational phase dust management plan as part of operational phase EMP. 11.5 Develop and implement an operational emissions monitoring and management plan. 11.6 Use EPA Guidance note Number 55 to assist design.	Prior to construction. Prior to commissioning and ongoing. Prior to construction Prior to commissioning and ongoing. Prior to commissioning and ongoing. Design phase.	Shire of Collie. DoE Shire of Collie. DoE DoE – South West Region office. DoE. DoE DoE

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Twelve	**Greenhouse Gas Emissions**	To minimise atmospheric emissions where practicable and comply with relevant guidelines.	12.1 Management of emissions will comply with the EPA guidance for the assessment of environmental factors No. 12, Minimising Greenhouse Gas Emissions.	Prior to construction and ongoing.	Australian Greenhouse Office. DoE
			12.2 Thermal efficiency design and operating goals will be implemented. Use AGO Technical Efficiency guidelines in design and operational management.	Prior to construction and ongoing.	Australian Greenhouse Office. DoE
			12.3 Sign on to the Greenhouse Challenge which will involve the following: ➢ provide an estimate of greenhouse gas emissions over the lifetime of the project, and using annual CO_2 equivalent quantities, provide a comparison with other electricity generation plants/technology in WA as required by the Greenhouse Challenge; ➢ provide information on mechanisms to reduce greenhouse gas emissions to best practicable levels in terms of energy efficiency and tonnes of greenhouse gas per unit of product during the design, construction and operation of the plant; and ➢ provide recommendations & suggestions on the implementation of measures to offset greenhouse gas emission.	Prior to commissioning	Australian Greenhouse Office, DoE
			12.4 Based on outcomes from the above, a framework for a greenhouse gas management plan for the proposed power station will be developed and agreed with the relevant regulatory authorities. Once agreement on this framework has been reached, the plan will be prepared and implemented as part of the operational phase EMP for the plant.	Prior to construction and ongoing.	Australian Greenhouse Office. DoE

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
			12.5 Continued planting of eucalypt trees on former mined areas owned freehold by Griffin Coal and WRCA to sequester 1,000 tpa of GHG.	Commenced in 1999, with 5,000 tonnes sequestered to date. 10 hectare per year to be planted for next five years.	AGO. DoE
			12.6 Plant 2000 hectares of oil mallees on rural properties owned by WRCA to sequester 90,000 tpa of GHG.	Three years commencing during construction of the power plant.	AGO. DoE
			12.7 Construct an 80MW wind farm (40MWnet interest) near Cevantes, resulting in GHG savings of 220,000 tpa across the SWIS.	2005.	AGO. DoE
			12.8 Contribute financial and in kind support valued at $140,000pa to the CRC for Coal in Sustainable Development for further investigation into clean coal technologies.	Ongoing.	CCSD.
			12.9 Initiation and development of other research and development projects to the point where they can be included as offsets in the GHG program.	Ongoing.	CSIRO, AGO, OOE, DoE, CALM, WA Department of Agriculture and other relevant stakeholders.
			12.10 Establish and implement an internal GHG trading system within the Griffin group of companies to maximise benefits from the Greenhouse Gas Management Program.	Upon signing the commitment to the Greenhouse Challenge.	AGO.

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Thirteen	**Recreational Activity**	Maintain recreational values for the local community as far as practicable.	13.1 Visual and noise impact will be minimised through planning design and screening strategies (eg. noise bunds and natural barriers). 13.2 Access to adjoining bush will not be affected. 13.3 Liaise with local community, produce and implement landscape and access management plan to reduce impact.	Prior to construction and ongoing. Prior to construction and ongoing Prior to construction and ongoing	Shire of Collie. Local community Shire of Collie. Local community Shire of Collie. Local community DoE
Fourteen	**Visual Amenity**	To maintain visual amenity	14.1 Potential impacts on visual amenity will be minimised through planning design and screening strategies (eg. natural barriers). 14.2 Vegetation management and landscape strategies will be developed as appropriate. 14.3 Liaise with local community, produce and implement landscape and access management plan to reduce impact.	Prior to construction and ongoing. Prior to construction and ongoing. Prior to construction and ongoing.	Shire of Collie. Local community Shire of Collie. Local community Shire of Collie. Local community DoE
Fifteen	**Aboriginal Culture and Heritage**	To minimise disturbance to areas of Aboriginal and cultural significance.	15.1 Develop and implement Heritage and Culture awareness program for employees. 15.2 If sites of aboriginal significance are found during construction, application for clearance under Section 18 of the *Aboriginal Heritage Act* 1972 will be sought from the Minister for Indigenous Affairs before disturbance.	Prior to construction. During construction and ongoing	Local Indigenous community. DIA Shire of collie. Department of Indigenous Affairs.
Sixteen	**Public Risk**	To ensure that the risk to public safety is as low as reasonably practicable (ALARP) and to minimise the potential creation of hazardous working environments.	16.1 Develop and implement local community liaison program. 16.2 Hazardous materials will be stored and handled according to DoIR regulations. 16.3 Develop and implement hazardous materials management plan	Prior to construction. During construction and ongoing. Prior to construction.	Shire of Collie. Local community. DoIR DoIR DoE

Table 16 - Other Management Commitments – Internally Audited

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
Seventeen	**Sustainability**	Integration of environmental management objectives within an overarching set of sustainable management objectives into project development objectives.	Develop a policy and strategic framework of sustainability management objectives and programs linked directly to Bluewaters.	Prior to construction and ongoing.	All stakeholders.
Eighteen	**Other GHG Initiatives**	Contribution to the overall reduction of GHG in the State and enhancement of Environmental values of the Collie River whilst assisting in the rehabilitation of the Wellington Weir water source.	In addition to those commitments outlined above (Commitment 13), Griffin will continue to support and provide access to Griffin owned land and facilities to enable the diversion of the East Collie River. This will facilitate the diversion of each season's first flush flows of salt water away from Wellington Weir. This project is anticipated to lead to the return of Wellington Weir to a potable condition within a three year time frame. The GHG credit from this project is calculated to be 480,000 tonnes per annum.	Ongoing	DoE – Water & Rivers Commission.

10 Conclusion

The 200 MW Bluewaters II proposal is needed to maintain the viability of the town of Collie should the replacement for Muja A & B not use coal as a fuel source. It will result in some air emissions which have been demonstrated to be manageable.

The project maintains environmental values in the local area and the larger region because it is to be located on land that is already cleared of vegetation, therefore, it will have minimal impact on flora and fauna. Discharges such as fly ash and saline water will be managed responsibly through utilisation of the mine void for fly ash and the existing saline water disposal line, currently used by the Collie Power Station.

The town of Collie benefits through the preservation of employment opportunities and maintenance of social infrastructure.

Bluewaters II is an environmentally acceptable proposal that will add to the economic well-being of the Collie area. It maximises benefits to the community and comes with minimal environmental disturbance. It is part of the sustainable future of Collie.

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"IGCC – Leadership in Clean Power from Solid Fuels"

12 Abbreviations

AGO	Australian Greenhouse Office
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BWEA	Bunbury Wellington Economic Alliance
BPM	Best Practicable Measure
CALM	Department of Conservation and Land Management (WA Government)
CAMBA	China and Australia Migratory Bird Agreement
CCMEC	Collie Coal Mines Environment Committee
CCSD	Cooperative Research Centre for Coal in Sustainable Development
CHP	Combined Heat and Power
CO	Carbon monoxide
CO_2e	Carbon Dioxide equivalents
CO2CRC	Cooperative Research Centre for Greenhouse Technologies
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWAG	Collie Water Advisory Group
dB	decibel
dB(A)	decibel (A weighted)
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DEFRA	Department of Environment Food and Rural Affairs
DEP	Department of Environmental Protection
DIA	Department of Indigenous Affairs
DoE	Department of Environment
DoH	Department of Health
DOIR	Department of Industry and Resources
DPI	Department of Planning and Infrastructure
DRF	Declared Rare Flora
EC	European Commission
EPA	Environmental Protection Authority
EPASU	Environmental Protection Authority Service Unit
EPBC	Environmental Protection and Biodiversity Conservation

EMP	Environmental Management Plan
EMS	Environmental Management System
EPA	Environmental Protection Authority
EPBC	Environmental Protection and Biodiversity Conservation
EQOs	Environmental Quality Objectives
EVs	Environmental Values
g	Grams
GHG	Greenhouse Gases
GJ	Gigajoule
GLpa	Gigalitres per annum
GL/yr	Gigalitres per year
GNP	Gross National Product
g/s	Grams per second
ha	Hectare
HCWA	Heritage Council of Western Australia
Hg	Mercury
HHV	Higher Heating Value
HP	High Pressure
hr	hours
IBRA	Interim Biogeographic Regionalisation for Australia
IDGCC	Integrated Drying Gasification Combined Cycle
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IPP	Independent Power Producer
JAMBA	Japan and Australia Migratory Bird Agreement
kg	Kilogram
kg/yr	Kilograms per year
km	Kilometre
kV	Kilo Volts
LHV	Lower Heating Value
lpg	liquid petroleum gas
L/sec	Litres per second
m	Metre
m^2	Square metre
m^3	Cubic metre

m^3/hr	Cubic metres per hour
min	Minute
mg	milligrams
mg/L	Milligrams per litre
mg/Nm^3	Milligrams per standard cubic metre
MPa	Mega Pascal
MTE	Mechanical Thermal Expression
Mtpa	million tonnes per annum
MW	Megawatt
MW_e	Megawatts sent out
MWh	Megawatt hours
na	No Standard Set
NA	Not Applicable
NEPM	National Environment Protection Measures
NHMRC	National Health and Medical Research Council
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NPI	National Pollutant Inventory
NSW	New South Wales
O_2	Oxygen (as Oxygen dioxide found in the atmosphere)
O_3	Ozone
OECD	Organisation for Economic Cooperation and Development
pa	Per annum
P & C	Parents and Citizens
PAH	Polycyclic Aromatic Hydrocarbons
PER	Public Environmental Review
$PM_{2.5}$	Particulate matter less than 2.5 microns
PM_{10}	Particulate matter less than 10 microns
POP	Persistent Organic Pollutant
POPs	Persistent Organic Pollutants
ppm	Parts per Million
PPP	Power Procurement Process
ppt	parts per thousand
R&D	Research and Development
SOx	Oxides of Sulphur

SO_2	Sulphur dioxide
SECWA	State energy Commission of WA
SER	Strategic Environmental Review
SWDC	South West Development Commission
SWIS	South West Interconnected System
SWPP	South West Power Project
TAPM	The Air Pollution Model
TDS	Total Dissolved Salts
TEC	Threatened Ecological Community
t/h	tonnes per hour
tpa	Tonnes per annum
tpd	Short (US) tons per day
µg/L	micrograms per Litre
µgm	micrograms
µm	micrometre
US$	United States Dollar
VOC	Volatile Organic Compounds
WA	Western Australia
WHO	World Health Organisation
WPC	Western Power Corporation
WRC	Waters and Rivers Commission
WRCA	W.R. Carpenter Agriculture Pty Ltd
ZID	Zone of Initial Dilution
$	Australian Dollar
%	Percent
^oC	Degrees centigrade
µg m^{-3}	micrograms per cubic metre
µg/L	micrograms per Litre

13 Attachments

13.1 Flora and Fauna

Bluewaters Power Station Flora and Fauna Survey

Griffin Energy

November 2003

AN AECOM COMPANY

Bluewaters Power Station Flora and Fauna Survey

Prepared for

Griffin Energy

Prepared by

Maunsell Australia Pty Ltd

Level 1, 629 Newcastle Street

PO Box 81

Leederville 6902

Western Australia

ABN 20 093 846 925

Tel +61 8 9281 6100

Fax +61 8 9281 6295

perth@maunsell.com

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Report

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Originator
Mike Braimbridge

Checked
Paul Holmes

Approved
Paul Holmes
Senior Environmental Planner

Table of Contents

1.0 Introduction

1.1 Project Background

Maunsell Australia Pty Ltd was commissioned by Griffin Energy to conduct a flora and fauna survey of the proposed Bluewaters Power Station site north-east of Collie. Griffin Energy is in the process of preparing a Public Environmental Review (PER) document for the proposed power station development and this study has been conducted for inclusion in the PER.

The project area (Figure 1) covers approximately 363 Ha of predominantly cleared agricultural land with approximately 54 Ha of remnant vegetation and 71 Ha of previously mined and rehabilitated land.

1.2 Previous Biological Surveys

Three previous surveys have been undertaken in or adjoining the current project area (HGM 1994; 2001; Mattiske *et al*. 1991) for the Ewington I and Ewington II Coal-mine proposals and a brief survey of the power station site was undertaken by HGM in May 2002. This report presents the results from the Spring 2003 survey incorporating results of previous surveys and relevant literature.

2.0 Vegetation and Flora

2.1 IBRA Region

The Interim Biogeographic Regionalisation for Australia (Thackway & Cresswell 1995) categorises the Australian continent into 85 regions of similar geology, landforms, vegetation, fauna and climate. The power station site and conveyor corridor occurs in the Jarrah Forest IBRA region.

This bioregion is described as "duricrusted plateau of the Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, Marri-Wandoo woodlands clayey soils. Eluvial and alluvial deposits support Agonis shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. Warm Mediterranean climate".

2.2 Vegetation Mapping

2.2.1 Regional Vegetation Mapping

Heddle *et al.* (1980) used landform – soil units mapped by Churchward and McArthur (1980) to define and map vegetation complexes for the Collie Basin at a scale of 1:250,000. Three vegetation complexes, Collie, Cardiff and Muja, were defined for the Collie Basin in which the current project is located (Heddle *et al*. 1980).

The **Collie Complex** consists of an open forest of jarrah-marri-sheoak with a range of understorey species that reflect the relative proportion of sand and gravel in the soils. Those species commonly associated with gravely soils include *Banksia grandis, Persoonia longifolia, Hibbertia hypericoides, Leucopogon capitellatus, Bossiaea ornata, Acacia browniana, Hakea lissocarpha and Astroloma pallidum*. On sandier soils common plant species include *Xylomelum occidentale, Daviesia incrassata, Bossiaea eriocarpa, Lyginia barbata, Dasypogon bromeliifolius* and species of Calytrix.

The **Cardiff Complex** consists of an open-woodland of *Banksia attenuata – B. ilicifolia* and *Nuytsia floribunda* with a distinctive understorey and range of species that reflects the levels of soil moisture. On the drier soils the understorey plant species include *Kunzea ericifolia, Banksia meisneri, Calothamnus spp., Lepidosperma angustatum, Xylomelum occidentale, Leucopogon glabellus, Jacksonia furcellata, Bossiaea eriocarpa and Daviesia incrassata*. On moister soils common understorey species include *Pericalyma ellipticum, Adenanhos obovatus, Hypocalymma angustifolium and Schoenus brevifolius*.

The **Muja Complex** consists of an open-woodland of *Melaleuca preissiana – Banksia littoralis* with some admixture of yarri (*Eucalyptus patens*) dominating the moister areas, and replaced by a woodland of *Banksia* spp. on the drier sites. The understorey species reflect the level of soil moisture. On the drier soils common plant species include *Lepidosperma angustatum, Dasypogon bromeliifolius, Lyginia barbata and Xylomelum occidentale*. Common plant species on moister soils include *Hakea ceratophylla, Agonis lineraifolia, Pericalymma ellipticum, Hypocalymma angustifolium, Adenanthos obovatus and Meeboldina scariosa.*

2.2.2 Local Vegetation Associations

The increased development of coal mining in the area has led to a number of site specific vegetation surveys being undertaken in the Collie area. The power station site lies adjacent to two previously surveyed areas, Ewington I (Mattiske *et al* 1991; HGM 2002) and Ewington II (HGM 1994), and was expected to have a similar array of vegetation types and species composition as these areas.

A total of 11 and 13 vegetation associations have been mapped for the Ewington I deposit and the Ewington II deposit respectively (HGM 1994; Mattiske *et al* 1991; HGM 2002). Field surveys in these areas found similar vegetation associations and an almost identical species composition (HGM 1994). The vegetation associations defined during the Ewington surveys comprise a total of 18 vegetation units (Table 2.1). Association codes were assigned on the basis of dominant species.

Table 2-1 Vegetation Associations Recorded for Ewington I and Ewington II

Vegetation Association	Description
$MpBl_1$	Low open woodland of *Melaleuca preissiana* – *Banksia littoralis* over dense understorey of shrubs and sedges on wet sands and peaty soils.
$MpBl_2$	Open woodland of *Melaleuca preissiana* – *Eucalyptus rudis* – *Banksia littoralis* over dense understorey of shrubs and sedges on seasonally wet clay soils.
$MpBl_3$	Low open woodland of *Melaleuca preissiana* – *Banksia littoralis* over open understorey of shrubs and low sedges on clays over shallow exposed secondary laterisation.
$MpBl_4$	Low open woodland of *Melaleuca preissiana* – *Banksia littoralis* over dense understorey of shrubs and sedges on creek-beds with variable soils (sandy peats-sandy clays).
EmMp	Open woodland of *Eucalyptus marginata* – *Melaleuca preissiana* – *Nuytsia floribunda* – *Xylomelum occidentale* with occasional stands of *Banksia littoralis* and *Banksia attenuata* over low shrubs and sedges on seasonally moist grey sands.
$EmCc_1$	Woodland of *Eucalyptus marginata* – *Corymbia calophylla*, with scattered *Banksia grandis* and *Persoonia longifolia* over mixed shrub layer on seasonally moist grey sandy-loams to sandy-clays.
EmCcBi	Open woodland to open forest of *Eucalyptus marginata* – *Corymbia calophylla* – *Banksia ilicifolia* with some *Allocasuarina fraseriana, Xylomelum occidentale* and *Nuytsia floribunda* over low understorey of shrubs and sedges on deep grey sands on lower to mid-valley slopes.
$EmAf_1$	Open forest of *Eucalyptus marginata* – *Allocasuarina fraseriana* with scattered *Banksia grandis* and *Persoonia longifolia* over mixed shrub layer on deep grey sands on mid to upper valley slopes.
EmCcAf	Open forest of *Eucalyptus marginata* – *Corymbia calophylla* – *Allocasuarina fraseriana* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on sandy gravels.

Vegetation Association	Description
$EmCc_2$	Open forest of *Eucalyptus marginata – Corymbia calophylla* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on shallow sandy gravels over lateritic outcropping.
$EmAf_2$	Open forest of *Eucalyptus marginata – Allocasuarina fraseriana* over shrubs and sedges on shallow sandy gravels over lateritic outcropping.
KaXp	Open woodland *E.marginata* over dense *Kingia australis / Xanthorrhoea preissii* mixed sedge and shrub layer.
HtAp	Dense shrub layer of sedges *Hakea trifurcata / Acacia pulchella / Hakea* spp. with occasional *E.marginata* / *M.preisiana* overstorey.
ErSS	Scattered *Eucalyptus rudis* over drainage line sedges and shrubs.
Ec	Moderately dense forest of *Corymbia calophylla* with no understorey.
ET	Exotic trees including fig trees and grape vines.
EmMt	Sparse *E. marginata* over heavily grazed *Mesomalaena tetragona.*
SS	Seasonal Sedge Swamp.
Mining	Abandoned Ewington I Open-cut.
Cleared	Agriculture.

The vegetation associations of the current project area were partially mapped during surveys conducted by Maunsell (then HGM) in May of 2002 (HGM 2002). The associations recorded were described using previously defined vegetation community descriptions to allow comparison with previous work. Areas of remnant vegetation of the following communities were recorded:

- EmCcAf - Open forest of *Eucalyptus marginata – Corymbia calophylla – Allocasuarina fraseriana* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on sandy gravel;
- SS - seasonal sedge swamp;
- $MpBl_4$ – Low open woodland of *Melaleuca preissiana – Eucalyptus rudis – Banksia littoralis* over dense understorey of shrubs and sedges on creek-beds with variable soils (sandy peats – sandy clays); and
- cleared farmland.

2.2.3 Threatened Ecological Communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (Government of Western Australia 2000). English and Blyth (1997, 1999) have developed a procedure for identifying and assigning TEC to one of four categories depending on the threat to the community (Table 2.2).

Table 2-2 Conservation categories for Threatened Ecological Communities recognised by CALM and the WA Minister for the Environment (English and Blyth 1997)

Code	Definition
Presumed Totally Destroyed	An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future
Critically Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Commonwealth legislation also protects vegetation communities classified as threatened. Under the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999*, a person must not take an action that is likely to have a significant impact on a listed threatened ecological community without approval from the Minister for the Environment and Heritage. The definitions of the three categories of Threatened Ecological Communities (TEC) are summarised in Table 2.3.

Table 2-3 Conservation categories for Threatened Ecological Communities under the *EPBC Act 1999*

Code	Definition
Critically Endangered	A community can be included in the Critically Endangered category if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	A community can be included in the Endangered category if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	A community can be included in the Vulnerable category if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future

Possible TEC that do not meet survey criteria or that are not adequately defined are added to CALM's Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as a TEC. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

No known TEC have been recorded within the search area.

2.3 Flora

2.3.1 Local Floristic Composition

A total of 56 families, 172 genera, and 287 plant taxa (including varieties and subspecies) have been recorded in the Ewington I/Ewington II areas. Species representation in these areas was greatest among the families Myrtaceae, Proteaceae, Papilionaceae, Cyperaceae and Epacridaceae, a flora composition characteristic of the Collie, Cardiff and Muja complexes as described by Heddle *et al.* (1980). Of the 287 plant taxa, 16 were introduced weed species.

A combined list of all species found at Ewington I and Ewington II has been compiled and is presented in Appendix A.

2.3.2 Threatened Flora

While all native plants are protected under the *Wildlife Conservation Act 1950-1979*, a number of plant species are assigned an additional level of protection where populations are geographically restricted or perceived to be threatened by local processes (Table 2.4). Species of highest conservation value are classified Declared Rare Flora, either extant or presumed extinct. Declared Rare Flora are protected by both State and Commonwealth legislation and it is not permissible for companies or individuals to "take" these flora without Ministerial Approval. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation value are assigned to one of four Priority categories.

Table 2-4 Conservation Categories for Endangered Flora (Atkins 2000)

Declared Rare Flora - Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction or otherwise in need of special protection.
Declared Rare Flora - Presumed Extinct. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
Priority 1 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
Priority 2 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
Priority 3 - Poorly Known Taxa. Taxa which are known from several populations and the taxa are not believed to be under immediate threat.
Priority 4 - Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare (in Australia), are not currently threatened by any identifiable factors.

In addition, some species are listed under the *EPBC Act 1999*. In the Jarrah Forest IBRA region 105 species are currently listed under the *EPBC Act 1999*.

Database Search Results

Previously reported (HGM 2002) searches of CALM's Threatened Flora Database and WA Herbarium Specimen Database identified three DRF and twenty priority species recorded from the wider region encompassing the current project area.

An updated search was conducted for a refined area (bound by points 424000mE/6315000mN 432000mE/6305000mN) (GDA '94 Zone 50). No populations of threatened flora were recorded for this search area on either of the databases searched, CALM's Threatened Flora Database and WA Herbarium Specimen Database.

2.3.3 Field Investigations

Methodology

A survey for threatened flora was undertaken by botanists from Maunsell on September 10, 2003. Proposed locations for the Bluewaters Power Station and adjoining areas of remnant vegetation were searched for threatened flora via a series of foot traverses.

Where field identification of plant taxa was not possible specimens were collected in a systematic manner and information such as location (using a GPS receiver), vegetation type and site characteristics were recorded. Collections were later identified at the West Australian Herbarium by comparison with the reference collection and use of identification keys.

Field Survey Results

No species of threatened flora were located during the field investigation. With the exception of the south-western extremity of the site (alignment to previously mixed areas) where the remanent vegetation is relatively undisturbed, the overall condition of remnant vegetation within the project area is very poor. Remnants are subject to grazing by stock and as a result the native understorey is almost completely destroyed. Native over storey tree species were present with dominant species *Eucalyptus marginata, Corymbia calophylla* and in places *Allocasuarina fraseriana*. Additional over-storey/ mid-storey species included *Banksia grandis, Persoonia longifolia* and *Xylomelum occidentalis*.

The relatively large remnant to the immediate east of power station 'location two', in the south-east of the project area did contain some scattered understorey species including *Trymalium ledifolium, Kennedia coccinea, Drosera* spp., *Bossiaea ornata, Lagenifera huegelii, Stylidium piliferum, Xanthothia atkinsoniana, Hibbertia communtata, Tetraria capillaris, Hakea lissocapha* and *Tetrahena laevis*. However, the densities of native understorey species were very low and the overall condition of the vegetation very poor.

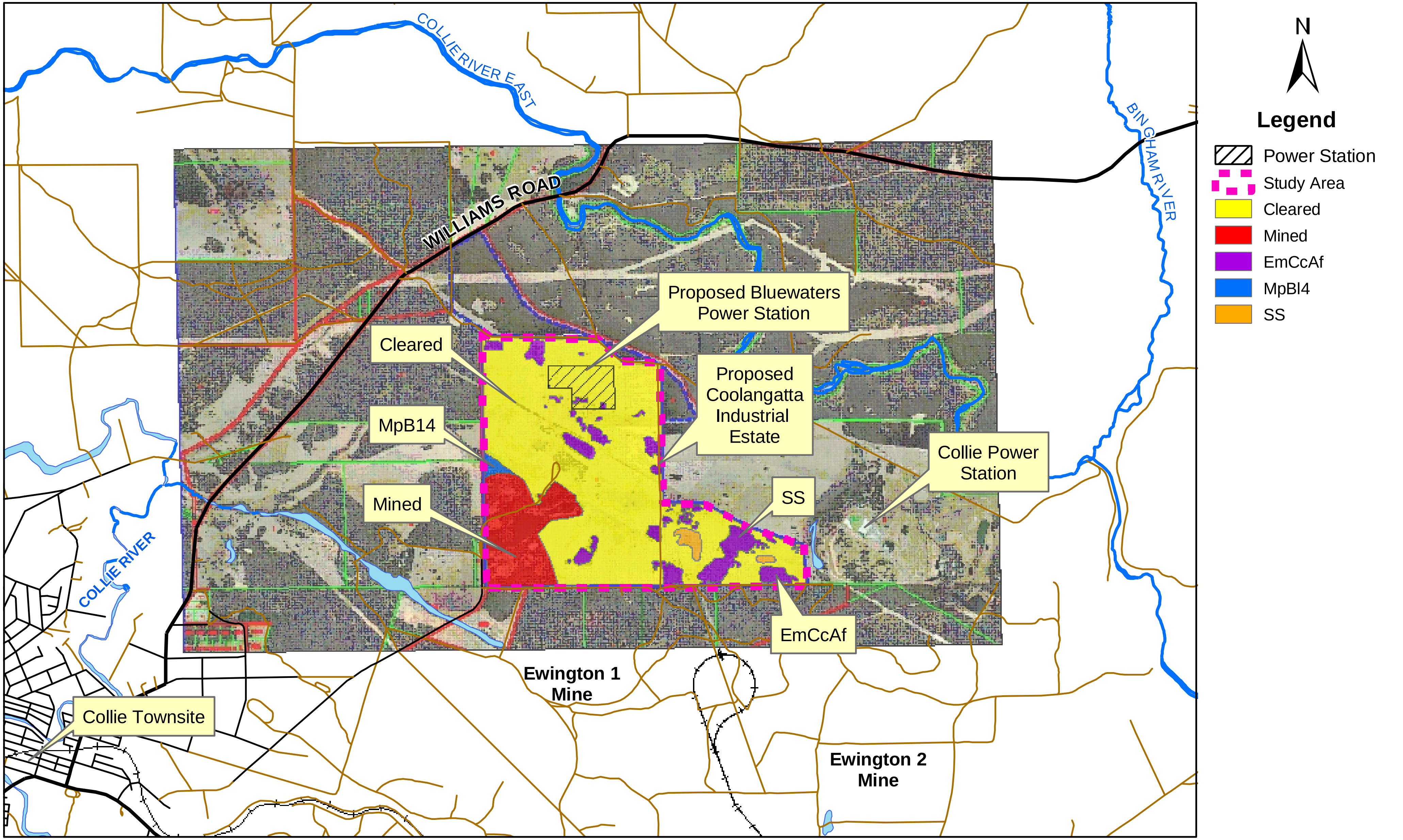
In comparison, remnant vegetation to the south of the old Bluewaters Mine site adjoining State Forest is intact and in excellent condition.

Conservation Significance of Vegetation

During the September 2003 survey the vegetation community boundaries were confirmed for previously mapped areas and mapped for previously unsurveyed areas (Figure 1).

The vegetation communities previously mapped for the project area and confirmed during the September 2003 survey are well represented in adjoining areas of State forest. Furthermore, the very poor condition of the majority of remnants negates any conservation significance in terms of flora and vegetation.

The area of remnant vegetation to the south of the old Bluewaters Mine site is of greater conservation significance given its intact understorey and excellent condition. The vegetation communities represented in this area extend south into the adjoining State Forest. This area is unlikely to be directly or indirectly impacted by the Blue Water Power Station project.



Date	Project Name	Projection
13/10/03	Bluewaters Power Station	AGD66 Zone 50
Design by	Drawing Title	Drawing size
MJB	**Vegetation Associations**	A4
Drawn by		Figure No
DHK		1
	Storage Location E:\74400803\dwg\drawings\ArcGIS\VegMap.mxd	maunsell

3.0 Fauna

3.1 Introduction

The proposed coal-fired power station occurs in the zoographic region of south-western Australia within the Jarrah Forest IBRA region (see section 2.1) (Thackway and Creswell 1995; Beard 1980). Fauna surveys undertaken within the vicinity of the project area include a systematic and non-systematic survey (*ecologia* 1991; HGM 2001) for the adjacent Ewington I coal mine proposal and an opportunistic fauna survey in the nearby Ewington II area (HGM 1994).

The observed similarity in landform and vegetation between Ewington I, Ewington II and the project area (section 2.1.2) suggest that the species composition of fauna at all three sites will be similar. The close proximity of these areas (all are within a 5.5km radius) and the mobility of fauna (especially large mammals and certain birds) mean that the overlap of fauna between these areas may even extend to individual fauna utilising all three areas.

The fauna habitat occurring within the general area, and the fauna recorded in previous surveys and therefore likely to occur within the project area, is summarised in the following sections.

3.2 Fauna Habitat

Four fauna habitat types were identified in the Ewington I area. These were:

1. Open *Melaleuca preissiana* woodland over low shrubs and sedges on seasonally moist wet clays;
2. Jarrah/Marri Woodland over *Persoonia longifolia* on laterite;
3. Jarrah/Sheoak over *Xylomelum occidentalis* and *Persoonia longifolia* over mixed shrubs and sedges on deep grey soils; and
4. *Melaleuca priessiana* over *Hypoleama exsulca* and *Calothamnus* sp. and sedges on seasonally moist grey sands

Habitat type 2 was found to have the greatest species richness (HGM 2001).

3.3 Fauna

Mammals (native)

Six species of mammal from five families have been recorded in the area, either by trapping or opportunistic sightings (Table 3.1). The most common species in the area are the Yellow-footed Antechinus, *Antechinus flavepes*, the Southern Brown Bandicoot, *Isoodon obesulus* and the Common Brushtail Possum, *Trichosurus vulpecula* (HGM 2001).

Previous consultation the CALM District Officer at Collie indicate that two other native mammals are likely to occur within the project area, the Chuditch (*Dasyurus geoffroii)* and the Brush-tailed Phascogale (*Phascogale tapoatafa)* (HGM 2001). Both of these species are unlikely to be trapped given the bait type that was used in previous surveys and as both are likely to be trap-shy.

It is possible that another 20 species (including bats) occur in the vicinity of the project area (*ecologia* 1991). However, as the population densities of most native mammal species in the southwest are relatively low (with the exception of macropods) it is unlikely that all species present will be recorded within the time constraints of a field survey. Appendix B1 contains a comprehensive list of mammals that may occur within the project area.

Table 3-1 Native Mammals likely to occur within the project area

Scientific Name	Common Name
Dasyuridae	
Antechinus flavipes	Yellow-footed Antechinus or Mardo
Paramelidae	
Isoodon obesulus	Southern Brown Bandicoot
Phalangeridae	
Trichosurus vulpecula	Brush-tailed Possum
Macropodidae	
Macropus fuliginosus	Western Grey Kangaroo
Macropus irma	Western Brush Wallaby
Tachyglossidae	
Tachyglossus aculeatus	Echidna

Mammals (Introduced)

Seven introduced species of mammal have been recorded in the general area, these are the pig (*Sus scrofa*), the dog (*Canis familiaris*), the rabbit (*Oryctolagus cuninculus*), the horse (*Equus caballus*), the black rat (*Rattus rattus*), the fox (*Vulpes vulpes)* and the house mouse (*Mus musculus*).

Avifauna

99 species of bird have been recorded in the Collie Basin and may potentially occur in the project area (Appendix B2).

A total of 51 species of bird, represented by 742 individuals, were recorded in the adjacent Ewington I area during the 1991 survey by HGM. A 1990 survey in the same area recorded 34 species (*ecologia*, 1991) and 31 species of bird were recorded from the Ewington II site in 1994 (HGM, 1994). A list of avifauna identified as potentially occurring within the project area is provided in Appendix B2.

The most commonly recorded birds in the general area are the Striated Pardalote, (*Pardalotus striatus)*, Australian Raven (*Corvus coronoides)*, the Splendid Fairy-wren (*Malurus splendens)*, the Western Gerygone (*Gerygone fusca)* and the White Winged Triller (*Lalage tricolor)*.

The following species were observed within the project area during the September 2003 survey: Port Lincoln Parrot (*Platycercus zonarius*), Laughing Kookaburra (**Dacelo novaeguineae*), Australian Magpie Lark (*Grallina* *cyanoleuca*), Willie Wagtail (*Rhipidura leucophrys*), Australian Raven (*Corvus coronoides),* Australian Magpie (*Craticus tibicen*), Tree Martin (*Hirundo nigricans*) and the Welcome Swallow (*Hirundo neoxena*).

Herpetofauna

58 species of herpetofauna, have been recorded in the Collie Basin and may potentially occur in the project area (Appendix B3).

The 2001 fauna survey in the Ewington I area recorded four frogs and 17 reptiles. The reptiles comprised one gecko, three pygopodids, one agamid, one varanid, ten skinks and one blind snake species (common names after Cogger, 2000 or Bush *et al.,* 1995), a total of 140 individuals. A previous survey of the same area, conducted in 1990, recorded two frogs and 12 reptiles (*ecologia*, 1991). Therefore, a total of 5 frogs and 19 reptiles have been recorded for the project and adjoining areas in recent surveys (1991 to current) (table 3.2).

Table 3-2 Herpetofauna recorded during recent surveys in the immediate vicinity of the project area

Scientific Name	Common Name	Scientific Name	Common Name
Myobatrachidae		**Scincidae**	
Crinia georgiana	Red-thighed Froglet or Quacking Frog	*Acritoscincus trilineatum*	Southwestern Cool Skink
Crinia glauerti	Glauert's Froglet	*Cryptoblepharus plagiocephalus*	Fence skink
Heleioporus inornatus	Whooping Frog	*Ctenotus impar*	
Heleioporus eyrei	Moaning Frog	*Ctenotus delli*	
Limnodynastes dorsalis	Bullfrog or Banjo Frog	*Egernia napoleonis*	
Gekkonidae		*Glaphyromorphus gracilipes*	
Diplodactylus polyophthalmus	Speckled Stone Gecko	*Lerista distinguenda*	
Pygopodidae		*Menetia greyii*	Grey's skink
Aprasia pulchella	Granite Worm Lizard	*Morethia obscura*	
Aprasia repens	Sandplain Worm Lizard	*Tiliqua rugosa*	Bobtail
Lialis burtonis		**Typhlopidae**	
Agamidae		*Ramphotyphlops australis*	
Pogona minor minor		**Elapidae**	

Scientific Name	Common Name	Scientific Name	Common Name
		Parasuta gouldii	Gould's Snake
Varanidae			
Varanus gouldii	Gould's Monitor	*Pseudonaja affinis*	Dugite

The district officer at CALM has previously suggested that other species that are likely to occur in the general area and haven't been recorded in the 2001 or 1990 survey include the Tiger snake (*Notechis scutatus)* and King's Skink (*Egernia kingii)* (HGM 2001).

3.4 Threatened Fauna

Native fauna species which are rare, threatened with extinction or have high conservation value are specially protected by Federal law under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC) and State law under the *Wildlife Conservation Act 1950.* In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA).

The *Wildlife Conservation (Specially Protected Fauna) Notice 1998* recognises four distinct schedules of taxa:

- **Schedule 1** taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
- **Schedule 2** taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
- **Schedule 3** taxa are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection; and
- **Schedule 4** taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in schedules (1), (2) and (3).

In addition to the above classification, fauna are also classified under four different Priority codes:

- **Priority One** Taxa with few, poorly known populations on threatened lands.

  Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- **Priority Two** Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.

  Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- **Priority Three** Taxa with several, poorly known populations, some on conservation lands.
- Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- **Priority Four** Taxa in need of monitoring.

Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

A search of the DCLM Threatened Fauna Database (for a search area bound by the points grid :50 6305000 mN, 424000mE / 6315000 mN, 432000 mE) identified 2 Schedule 1 and 5 Priority Fauna species likely to occur in the general area (Table 3.3). This information has been combined with the previous list of threatened presented for the general area in HGM (2002).

Table 3-3 Threatened fauna

Species name	CALM/EPBC listing	Habitat/Previous sightings	
Chuditch *Dasyurus geoffroii*	**Schedule 1 and EPBC listed**	This species is becoming more common in the forested areas around Collie as a result of broadscale fox baiting	*
Western Ringtail Possum *Pseudocheirus occidentalis*	**Schedule 1 and EPBC listed**	This species occurs in the higher rainfall areas along the Darling Scarp and has also benefited from fox baiting. It requires tree hollows and/or dense canopy for refuge and nesting.	
Quokka *Setonix brachyurus*	**Schedule 1 and EPBC listed**	This species is currently restricted to a few densely vegetated swamps and riverine habitats where it is less vulnerable to predation.	
Carnaby's-Cockatoo *Calyptorhynchus latirostris*	**Schedule 1 and EPBC listed**	This species prefers Proteaceous scrubs and heaths and adjacent eucalypt woodlands but also feeds in pine forest. Although they mainly nest in smooth barked eucalypts, they are also known to occasionally nest in marri, which was a co-ominant species within the project area.	

Species name	CALM/EPBC listing	Habitat/Previous sightings	
Baudin's Cockatoo *Calyptorhynchus baudinii*	**Schedule 1 and EPBC listed**	This species is largely restricted to the forested areas of the south-west. It nests in hollows of marri and wandoo and feeds on the seeds of eucalypts and various proteaceous species. This species is most common in the far south west of Western Australia where it breeds. Baudin's Cockatoo typically forms vagrant flocks and utilises the taller, more open, jarrah/marri woodlands where it feeds predominantly on marri seeds, but also takes wood boring grubs (Blakers *et al*., 1984). Several flocks were recordee flying over and feeding within the Ewington I area, adjacent to the project area (HGM 2001).	*
Peregrine Falcon *Falco peregrinus*	**Schedule 1**	This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses or open woodland. It primarily inhabits wooded watercourses and lakes, and coastal cliffs, rivers and ranges, none of which are prevalent in the project area. However, this species has been recorded in the general area.	
Noisy Scrub-bird *Atrichornis clamosus*	**Schedule 1 and EPBC listed**	This species has been reintroduced to several sites in the Darling Scarp between Waroona and Harvey. It inhabits dense long-unburnt riparian vegetation. Given the Noisy Scrub-bird primarily occurs along major drainage lines in dense vegetation it is unlikely to occur in the project area.	
Carpet Python *Morelia spilota imbricata*	**Schedule 4**	This species occurs in forested areas, particularly where there are small to medium size mammals present. It occurs across much of the south west, but has been given its conservation status due to the fact that it is not common anywhere in its range. The Carpet Python occupies a wide range of habitats (Wilson and Knowles, 1985), and may occur in the study area but this would only be at very low	

Species name	CALM/EPBC listing	Habitat/Previous sightings	
		density if the species is present.	
Water Rat ***Hydromys chrysogaster***	**P4**	This species occurs along watercourses where there are freshwater molluscs and crustaceans (its main diet) present. It has been recorded from the shores of most fresh water bodies and rivers in the region (HGM, 1998). Given the hydrology of the project area, it is unlikely that this species would occur within the project area.	
Brush-tailed Phascogale ***Phascogale tapoatafa***.	**P3**	This species occurs in forest and woodland where suitable tree hollows are available and occurs within the vicinity of the project area.	
Southern Brown Bandicoot ***Isoodon obesulus fusciventer***	**P4 and EPBC listed**	The Southern Brown Bandicoot is a solitary-living, medium sized peramelid marsupial. The species occurs widely throughout southern Australia in sclerophyll forests, grasslands and heathlands (HGM, 1998). Bandicoots are nocturnal and omnivorous, with a varied diet including fungi, ants, insect larvae, roots and frogs (Claridge, *et al*., 1991). This species is moderately common in parts of the forest where dense understorey vegetation occurs, particularly along riverine gullies. The species has become more abundant as a result of fox baiting and occurs in more open habitat where fox baiting has been implemented. Two individuals were captured in cage traps in the *Melaleuca* sp. wetland during the 2001 Ewington I survey.	*
Brush-tailed Bettong ***Bettongia penicillata ogylbii***	**P4**	This species has been reintroduced to a number of sites in the vicinity of the project area. It generally occupies open jarrah forest with a moderately dense low understorey and is becoming more abundant as a result of fox baiting and translocation programs. CALM (Collie) have indicated that the Brush-tailed Bettong is unlikely to occur within the project	

Species name	CALM/EPBC listing	Habitat/Previous sightings	
		area, however as part of the translocation programme, Brush-tailed Bettongs have been released in the vicinity of the Muja Power Station, located approximately 10 km south east of the project area.	
Tammar Wallaby ***Macropus eugenii derbianus***	**P4**	This species has been reintroduced to two sites east of the project area. It prefers thickets of *Melaleuca* sp., sheoak or other large shrubs associated with an understorey of grasses and herbs.	
Western Brush Wallaby ***Macropus irma***	**P4**	This species occurs in areas of forest and woodland supporting a dense shrub layer, and may also becoming more abundant with fox baiting. It is considered to be uncommon over much of its range (Christensen, 1995). One individual was identified during the 2001 Ewington I fauna survey during spotlighting in a jarrah/marri/sheoak woodland.	*
Western False Pipistrelle ***Falsistrellus mackenziei***	**P4**	This species of bat occurs in the high rainfall jarrah forest in the western part of the project area. It roosts in small colonies in tree hollows and forages in the cathedral-like spaces between trees.	
Little Bittern ***Ixobrychus minutus***	**P4**	This cryptic species inhabits dense reeds and rushes bordering swamps, lakes and watercourses. As the Little Bittern is often associated with open water (Allan Burbidge, pers. comm.), it is very unlikely that this species would occur within the project area.	
Square-tailed Kite ***Lophoictinia isura***	**P4**	A nomadic species thinly distributed through forests and woodlands in the south-west. Square-tailed Kites are often found in areas which contain a mixture of forest canopy and heath (Allan Burbidge, pers. comm.). Although it is unlikely that it would be a resident of the project area, there is potential for the Square-	

Species name	CALM/EPBC listing	Habitat/Previous sightings	
		tailed Kite to occasion use the project area, due to its high mobility.	
Bush Stonecurlew ***Burhinus grallarius***	**P4**	A well camouflaged, ground nesting bird which prefers to 'freeze' rather than fly when disturbed. It is found throughout much of the state in lightly wooded habitats (Johnstone and Storr, 1998). In the 1960s, it was reported to occur in the Allanson area, some 15 km west of the project area. Given that the project area does not support lightly wooded area and is not subject to fox baiting, it is unlikely that it would occur within the project area (Allen Burbidge, pers. comm.).	
Barking Owl ***Ninox connivens connivens***	**P2**	This species inhabits forest and woodland and is becoming increasingly rare in the south-west. It preys on invertebrates and small mammals.	
Masked Owl ***Tyto novaehollandiae***	**P4**	This species is also an inhabitant of forests and woodlands and has also declined in the south-west. According to Johnstone and Storr (1998) it is locally common in the deep south-west (Karridale and Manjimup). It preys on small to medium size mammals.	
Forest Red-tailed Black Cockatoo ***Calyptorhynchus banksii naso***	**P3**	This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west. It requires tree hollows to nest and breed. The Forest Red-tailed Black Cockatoo has seriously declined in numbers since European settlement (Saunders & Ingram, 1995). Causes included clear-felling and 80 year cut rotation forestry practices which can significantly reduce the number of large tree hollows (Saunders & Ingram, 1995). Storr (1991) reports that the species was formerly common and is now uncommon and patchily distributed. Several groups totalling 24 individuals were recorded within Jarrah/Marri woodlands during the 2001 Ewington I fauna survey.	*

Species name	CALM/EPBC listing	Habitat/Previous sightings	
Darling Range Heath Ctenotus ***Ctenotus delli***	**P4**	Although this species was not listed on the CALM Schedule and Priority Fauna database search for the project area, one individual was recorded in a previous survey (HGM 2001). This small member of the *labillardieri* group is associated with jarrah and marri woodlands that have a shrub-dominated understorey on laterite, sand or clay soils (Storr *et al*, 1999; Bush *et al*, 1995).	*
Pachysaga munggai	**P3**	A species of cricket found in slightly open vegetation where it lives in leaf litter by day and emerges at night to feed and sing from low vegetation.	†

NB: * denotes species identified during 2003 database search and 2001 desktop review,
† denotes species identified during 2003 database search only.

4.0 Conclusion and Recommendations

The review of conservation significance of the flora and vegetation recorded at and adjacent to the proposed power station sites concluded that:

- no species of threatened flora occur within or adjacent to the proposed power station sites;
- no Threatened Ecological Communities (TEC's) or associations of conservation significance were located within the study area; and
- with the exception of the an area in the extreme south west of the project area which is unlikely to be impacted by the proposed power station the condition of stands of remnant vegetation was poor to completely degraded.

The review of conservation significance of fauna was primarily conducted as a desktop exercise. The lack of understorey at the power station site significantly reduces the value of the site to terrestrial vertebrates. Given the low numbers of threatened fauna identified from the adjacent Ewington I deposit, it is unlikely that any threatened terrestrial fauna occur on either power station site.

However, the jarrah and marri trees provide a habitat for birds and bats. Threatened birds and bats that may use the jarrah-marri woodland on the power station site for nesting or foraging include:

- Baudin's Cockatoo (Schedule 1);
- Carnaby's Cockatoo (Schedule 1);
- Forest Red-tailed Black Cockatoo (P3);
- Barking Owl (P2);
- Masked Owl (P3); and
- Western False Pipistrelle (P4).

To assess the extent of impact from clearing there is a need to determine whether these species are using the power station site for breeding purposes. This will involve conducting a targeted survey to identify nesting hollows and breeding pairs.

Carnaby's Cockatoo and Baudin's Cockatoo are both listed as threatened fauna under the *EPBC Act 1999*. The potential for impact on these species require the project to be referred to Environment Australia. The Ewington I open cut coal mine similarly had the potential to impact on these two species and therefore the project was referred to Environment Australia. The Commonwealth designated the project a "Controlled Action" and requested the provision of additional information in relation to the distribution of Baudin's Cockatoo but also the Red-tailed Black Cockatoo in the South West.

The information provided for the Ewington I project is attached as Appendix C. As a consequence of providing this information, Environment Australia determined that assessment of the project based on the provision of preliminary information was appropriate. Management strategies developed for Ewington I will ensure the impact on these species is minimised. It is recommended that the same approach is adopted for the Bluewaters Power Station.

The potential to impact on Baudin's Cockatoo and the Red-tailed Black Cockatoo within and adjacent to the project area should be managed in consultation with the CALM Nature Conservation Division and the WA Museum. The primary concern voiced by CALM and the WA Museum for Ewington I (which equally applies to this project) is the possible loss of breeding sites. The WA Museum (Mr Ron Johnstone pers. comm.) has indicated that there is a need to determine whether the species are using the site for breeding purposes. This will involve the WA Museum conducting a targeted survey to identify nesting hollows and breeding pairs.

Should breeding pairs or nesting hollows be identified, management measures will be developed to ensure that there is no net loss of suitable nesting sites within the area. Where necessary the provision of nesting boxes will be organised in consultation with CALM and the WA Museum to ensure that nest box design and location are suitable and are not likely to be utilised by other animals such as feral bees or bats.

To minimise the potential impact on the breeding of Baudin's Cockatoo, clearing should be restricted to the non-breeding season, January to June.

As the general area (including Ewington I) has only recently been identified as being a potential breeding site and any individuals are not part of an "important population", the impact to Baudin's Cockatoo is considered to be minimal. The provision of nesting boxes and the timing of clearing will also facilitate in minimising the impacts on this species.

5.0 References

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Appendix A Flora List

Family		Species
Dennstaedtiaceae		*Pteridium esculentum*
Lindsaeaceae		*Lindsaea linearis*
Zamiaceae		*Macrozamia riedlei*
Pinaceae	*	*Pinus ?pinaster*
Cupressaceae		*Actinostrobus pyramidalis*
Poaceae	*	*Aira caryophyllea*
		Amphipogon amphipogonoides
		Amphipogon avenaceus
		Austrodanthonia ?caespitosa
		Austrostipa semibarbata
	*	*Avena fatua*
	*	*Briza maxima*
	*	*Briza minor*
		Danthonia?caespitosa
	*	*Eragrostis curvula*
		Neurachne alopecuroidea
		Tetrarrhena laevis
	*	*Vulpia myuros*
Cyperaceae		*Baumea articulata*
		Cyathochaeta avenacea
		Gahnia trifida
		Lepidosperma angustatum
		Lepidosperma scabrum
		Lepidosperma squamatum
		Lepidosperma tenue
		Lepidosperma tetraquetrum
		Mesomelaena graciliceps
		Mesomelaena tetragona
		Schoenus curvifolius
		Schoenus efoliatus
		Schoenus lanatus
		Schoenus rodwayanus
		Schoenus subbulbosus
		Schoenus subflavus

Family	Species
	Tetraria capillaris
	Tetraria octandra
Restionaceae	*Desmocladus fasciculatus*
	Hypolaena exsulca
	Leptocarpus coangustatus
	Leptocarpus scariosus
	Lepyrodia macra
	Loxocarya cinerea
	Loxocarya fasciculata
	Lyginia barbata
	Meeboldina coangustata
	Meeboldina scariosa
	Melanostachya ustulata
	Restio tremulus
	Restio ustulatus
	Tremulina tremula
Juncaceae	*Juncus pallidus*
Dasypogonaceae	*Dasypogon bromeliifolius*
	Kingia australis
	Lomandra caespitosa
	Lomandra effusa
	Lomandra hermaphrodita
	Lomandra nigricans
	Lomandra purpurea
	Lomandra sericea
	Lomandra sonderi
	Lomandra spartea
Xanthorrhoeaceae	*Xanthorrhoea gracilis*
	Xanthorrhoea preissii
Phormiaceae	*Dianella revoluta*
Anthericaceae	*Agrostocrinum scabrum*
	Corynotheca micrantha
	Thysanotus ?sparteus
	Thysanotus teretifolius

Family		Species
		Tricoryne elatior
Colchicaceae		*Burchardia monantha*
		Burchardia umbellata
Haemodoraceae		*Anigozanthos humilis*
		Anigozanthos manglesii
		Conostylis aculeata
		Conostylis setigera
		Conostylis setosa
		Haemodorum laxum
		Haemodorum paniculatum
		Haemodorum spicatum
		Phlebocarya ciliata
Iridaceae		*Orthrosanthus laxus*
		Patersonia occidentalis
		Patersonia pygmaea
		Patersonia rudis
Orchidaceae		*Caladenia longicauda* subsp. *longicauda*
		Elythranthera brunonis
		Pyrorchis nigricans
		Thelymitra aff. *pauciflora*
		Thelymitra flexuosa
Casuarinaceae		*Allocasuarina fraseriana*
		Allocasuarina humilis
		Allocasuarina microstachya
Cannabaceae	*	*Cannabis sativa*
Proteaceae		*Adenanthos cygnorum*
		Adenanthos obovatus
		Banksia attenuata
		Banksia grandis
		Banksia ilicifolia
		Banksia littoralis
		Conospermum capitatum
		Dryandra bipinnatifida

Family	Species
	Dryandra nivea *Hakea amplexicaulis* *Hakea ceratophylla* *Hakea lissocarpha* *Hakea marginata* *Hakea prostrata* *Hakea ruscifolia* *Hakea sulcata* *Hakea undulata* *Hakea varia* *Persoonia elliptica* *Persoonia longifolia* *Petrophile linearis* *Petrophile striata* *Stirlingia simplex* *Synaphea petiolaris* *Synaphea reticulata* *Xylomelum occidentale*
Santalaceae	*Leptomeria cunninghamii*
Loranthaceae	*Nuytsia floribunda*
Amaranthaceae	*Ptilotus manglesii*
Caryophyllaceae	*Polycarpaea longiflora*
Ranunculaceae	*Clematis pubescens*
Lauraceae	*Cassytha glabella*
Droseraceae	*Drosera neesii* subsp. *neesii* *Drosera platystigma* *Drosera stolonifera* subsp. ?*compacta*
Crassulaceae	*Crassula colorata*
Pittosporaceae	*Billardiera drummondiana* *Billardiera ?floribunda* *Billardiera variifolia*

Family	Species
	Marianthus drummondianus
	Sollya heterophylla
Mimosaceae	*Acacia alata*
	Acacia drummondii
	Acacia extensa
	Acacia huegelii
	Acacia nervosa
	Acacia preissiana
	Acacia pulchella
	Acacia stenoptera
Caesalpiniaceae	*Labichea punctata*
Papilionaceae	*Aotus cordifolia* **P3**
	Aotus gracillima
	Bossiaea eriocarpa
	Bossiaea ornata
	Burtonia conferta
	Daviesia costata
	Daviesia decurrens
	Daviesia hakeoides
	Daviesia incrassata
	Daviesia preissii
	Euchilopsis linearis
	Gompholobium confertum
	Gompholobium knightianum
	Gompholobium marginatum
	Gompholobium ovatum
	Gompholobium polymorphum
	Gompholobium tomentosum
	Hovea chorizemifolia
	Hovea trisperma
	Jacksonia furcellata
	Kennedia carinata
	Kennedia coccinea
	Latrobea tenella
	Nemcia capitata
	* *Trifolium angustifolium*
	Viminaria juncea

Family	Species
Rutaceae	*Boronia crenulata*
	Boronia fastigiata
	Boronia molloyae
Tremandraceae	*Platytheca galioides*
	Tetratheca hirsuta
Polygalaceae	*Comesperma flavum*
	Comesperma virgatum
Euphorbiaceae	*Monotaxis ?occidentalis*
Stackhousiaceae	*Stackhousia huegelii*
	Stackhousia monogyna
	Stackhousia pubescens
	Tripterococcus brunonis
Rhamnaceae	*Cryptandra* sp.
	Trymalium ledifolium
Sterculiaceae	*Lasiopetalum floribundum*
	Thomasia pauciflora
	Thomasia purpurea
	Thomasia aff. *purpurea*
Dilleniaceae	*Hibbertia amplexicaulis*
	Hibbertia commutata
	Hibbertia ferruginea
	Hibbertia huegelii
	Hibbertia hypericoides
	Hibbertia racemosa
	Hibbertia rhadinopoda
	Hibbertia silvestris **P4**
	Hibbertia stellaris
	Hibbertia vaginata
Thymelaeaceae	*Pimelea ?angustifolia*
	Pimelea ciliata
	Pimelea lehmanniana subsp. *nervosa*

Family	Species
Myrtaceae	*Actinodium cunninghamii*
	Agonis linearifolia
	Astartea fascicularis
	Baeckea aff. *preissiana*
	Baeckea camphorosmae
	Callistemon phoeniceus
	Calothamnus lateralis
	Calothamnus planifolius
	Calothamnus sanguineus
	Calytrix ?similis
	Calytrix flavescens
	Corymbia calophylla
	Eremaea pauciflora
	Eucalyptus marginata
	Eucalyptus rudis
	Homalospermum firmum
	Hypocalymma angustifolium
	Hypocalymma cordifolium
	Kunzea ericifolia
	Kunzea recurva
	Melaleuca ?pauciflora
	Melaleuca incana subsp. *incana*
	Melaleuca lateritia
	Melaleuca preissiana
	Melaleuca polygaloides
	Melaleuca scabra
	Melaleuca viminea
	Pericalymma ellipticum
	Scholtzia involucrata
	Verticordia var. *densiflora*
Haloragaceae	*Glischrocaryon aureum*
	Gonocarpus cordiger
Apiaceae	*Pentapeltis peltigera*
	Xanthosia atkinsoniana
	Xanthosia huegelii
Epacridaceae	*Andersonia involucrata*
	Astroloma ciliatum
	Astroloma drummondii

Family		Species
		Astroloma pallidum
		Leucopgon aff. *pulchellus*
		Leucopogon ?oxycedrus
		Leucopogon australis
		Leucopogon capitellatus
		Leucopogon conostephioides
		Leucopogon nutans
		Leucopogon propinquus
		Lysinema ciliatum
		Sphenotoma gracile
		Styphelia tenuiflora
Loganiaceae		*Logania serpyllifolia*
Gentianaceae	*	*Centaurium erythraea*
Menyanthaceae		*Villarsia* sp.
Chloanthaceae		*Lachnostachys albicans*
Lamiaceae		*Hemiandra pungens*
		Hemigenia pritzelii
Orobanchaceae	*	*Orobanche minor*
Rubiaceae		*Opercularia apiciflora*
Lobeliaceae		*Isotoma hypocrateriformis*
		Lobelia tenuior
Goodeniaceae		*Dampiera alata*
		Dampiera cuneata
		Dampiera linearis
		Goodenia filiformis **P3**
		Lechenaultia biloba
		Scaevola calliptera
		Velleia sp.
Stylidiaceae		*Levenhookia pusilla*
		Stylidium amoenum

Family		Species
		Stylidium brunonianum
		Stylidium bulbiferum
		Stylidium junceum
		Stylidium piliferum
Asteraceae	*	*Arctotheca calendula*
	*	*Dittrichia graveolens*
		Hyalosperma cotula
	*	*Hypochaeris glabra*
		Olearia paucidentata
		Podolepis gracilis
		Podotheca ?angustifolia
	*	*Pseudognaphalium luteoalbum*
		Pterochaeta paniculata
		Rhodanthe citrina
		Senecio hispidulus
		Trichocline spathulata
	*	*Ursinia anthemoides*
		Waitzea citrina
		Waitzea paniculata

Vegetation Associations as defined in this document		Corresponding vegetation associations as defined by other authors.			
Veg. Assoc.	**Description**	**HGM (2002)**	**HGM (1995)**	**HGM (1994)**	**(Mattiske et al 1991)**
Mp	Moderately low woodland of *Melaleuca preissiana* over sedges and shrubs on drainage lines	-	Moderately low woodland of *Melaleuca preissiana* over sedges and shrubs on drainage lines	-	**-**
$MpBl_1$	Low open woodland of *Melaleuca preissiana – Banksia littoralis* over dense understorey of shrubs and sedges on wet sands and peaty soils.	$MpBl_1$			**A1**
$MpBl_2$	Open woodland of *Melaleuca preissiana – Eucalyptus rudis – Banksia littoralis* over dense understorey of shrubs and sedges on seasonally wet clay soils.	$MpBl_2$	Open woodland of *Melaleuca pressiana/Eucalyptus marginata* with some *Eucalyptus rudis* over seasonally wet sedges and shrubs.	Sparse woodland of *Melaleuca pressiana/Banksia littoralis* over seasonally wet sedges and low shrubs.	**A2**
$MpBl_3$	Low open woodland of *Melaleuca preissiana – Banksia littoralis* over open understorey of shrubs and low sedges on clays over shallow exposed secondary laterisation.	$MpBl_3$			**A3**
$MpBl_4$	Low open woodland of *Melaleuca preissiana – Banksia littoralis* over dense understorey of shrubs and sedges on creek-beds with variable soils (sandy peats-sandy	$MpBl_4$			**C**

Vegetation Associations as defined in this document		Corresponding vegetation associations as defined by other authors.			
Veg. Assoc.	**Description**	**HGM (2002)**	**HGM (1995)**	**HGM (1994)**	**(Mattiske et al 1991)**
	clays).				
EmMp	Open woodland of *Eucalyptus marginata – Melaleuca preissiana – Nuytsia floribunda – Xylomelum occidentale* with occasional stands of *Banksia littoralis* and *Banksia attenuata* over low shrubs and sedges on seasonally moist grey sands.	EmMp			**B**
$EmCc_1$	Woodland of *Eucalyptus marginata – Corymbia calophylla*, with scattered *Banksia grandis* and *Persoonia longifolia* over mixed shrub layer on seasonally moist grey sandy-loams to sandy-clays.	$EmCc_1$	Open woodland to forest of *E. marginata/E. calophylla* with some Banksia *littoralis* over low, sparse shrubs on sandy laterite.	Open woodland to forest of *E. marginata/E. calophylla* with some Banksia *littoralis* over mixed shrub layer on sandy substrates	**D**
EmCcBi	Open woodland to open forest of *Eucalyptus marginata – Corymbia calophylla – Banksia ilicifolia* with some *Allocasuarina fraseriana, Xylomelum occidentale* and *Nuytsia floribunda* over low understorey of shrubs and sedges on deep grey sands on lower to mid-valley slopes.	EmCcBi		Open woodland to open forest of *E. marginata/E. calophylla/Allocasurina fraseriana* with some *Banksia attenuata* over dense shrubs and sedges.	**J**
$EmAf_1$	Open forest of *Eucalyptus marginata – Allocasuarina*	$EmAf_1$			**P**

Vegetation Associations as defined in this document		Corresponding vegetation associations as defined by other authors.			
Veg. Assoc.	**Description**	**HGM (2002)**	**HGM (1995)**	**HGM (1994)**	**(Mattiske et al 1991)**
	fraseriana with scattered *Banksia grandis* and *Persoonia longifolia* over mixed shrub layer on deep grey sands on mid to upper valley slopes.				
EmCcAf	Open forest of *Eucalyptus marginata – Corymbia calophylla – Allocasuarina fraseriana* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on sandy gravels.	EmCcAf			**S1**
$EmCc_2$	Open forest of *Eucalyptus marginata – Corymbia calophylla* with some *Banksia grandis* and *Persoonia longifolia* over low understorey of shrubs and sedges on shallow sandy gravels over lateritic outcropping.	$EmCc_2$	Open Forest of *E. marginata/E. calophylla* with some Banksia grandis and Persoonia longifolia over low, sparse shrubs on sandy laterite	Open Forest of *E. marginata/E. calophylla* with some Banksia grandis and Persoonia longifolia over low shrubs on sandy laterite	**S2**
$EmAf_2$	Open forest of *Eucalyptus marginata – Allocasuarina fraseriana* over shrubs and sedges on shallow sandy gravels over lateritic outcropping.	$EmAf_2$			**S3**
KaXp	Open woodland *E.marginata* over dense *Kingia australis / Xanthorrhoea preissii* mixed sedge and shrub layer.	-	-	Open woodland *E.marginata* over dense *Kingia australis / Xanthorrhoea*	

Vegetation Associations as defined in this document		Corresponding vegetation associations as defined by other authors.			
Veg. Assoc.	**Description**	**HGM (2002)**	**HGM (1995)**	**HGM (1994)**	**(Mattiske et al 1991)**
				preissii mixed sedge and shrub layer.	
HtAp	Dense shrub layer of sedges *Hakea trifurcata / Acacia pulchella / Hakea* spp. With occasional *E.marginata* / *M.pressiana* overstorey.			Dense shrub layer of sedges *Hakea trifurcata / Acacia pulchella / Hakea* spp. With occasional *E.marginata* / *M.pressiana* overstorey.	
ErSS	Scattered *Eucalyptus rudis* over drainage line sedges and shrubs		Scattered *Eucalyptus rudis* over drainage line sedges and shrubs		
Cc	Moderately dense forest of *Corymbia.calophylla* with no understorey		Moderately dense forest of *Corymbia.calophylla* with no understorey		
ET	Exotic trees including fig trees and grape vines		Exotic trees including fig trees and grape vines		
EmMt	Sparse *E. marginata* over heavily grazed *Mesomalaena tetragona*		Sparse *E. marginata* over heavily grazed *Mesomalaena tetragona*		
SS	Seasonal Sedge Swamp		Seasonal Sedge Swamp	Seasonal Sedge Swamp	

Appendix B Fauna List

Mammals of the Collie Basin

Mammals

Family and Species		Common name
Monotremata		
Tachyglossidae		
	Tachyglossus aculeatus	Echidna
Marsupialia		
Dasyuridae		
	Antechinus flavipes	Mardo
	Dasyurus geoffroii	Chuditch
	Phascogale calura	Red-tailed Wambenger
	Phascogale tapoatafa	Brush-tailed Wambenger
	Sminthopsis griseoventer	Grey Bellied Dunnart
Burramyidae		
	Cercartetus concinnus	South-western Pygmy Possum
Petauridae		
	Pseudocheirus occidentalis	Western Ringtail*
Phalangeridae		
	Trichosurus vulpecula	Brush-tailed Possum
Tarsipedidae		
	Tarsipes rostratus	Honey Possum
Peramelidae		
	Isoodon obesulus	Southern Brown Bandicoot
Myrmecobiidae		
	Myrmecobius fasciatus	Numbat*
Macropodidae		
	Bettongia penicillata	Woylie*
	Macropus eugenii	Tammar
	Macropus fuliginosus	Western Grey Kangaroo
	Macropus irma	Brush Wallaby

Mammals of the Collie Basin

Mammals

Family and Species		Common name
	Setonix brachyurus	Quokka
Chiroptera		
Molossidae		
	Mormopterus planiceps	Southern Freetail-Bat
	Tadarida australia	White-striped Mastiff Bat
Verspertilionidae		
	Chalinolobus gouldii	Gould's Wattled Bat
	Chalinolobus morio	Chocolate Wattled Bat
	Vespadelus regulus	Southern Forest Bat
	Nyctophilus geoffroyi	Lesser Long-eared Bat
	Nyctophilus timoriensis	Greater Long-eared Bat
	Falsistrellus mackenziei	Western False Pipstrelle
Rodentia		
Muridae		
	Hydromys chrysogaster	Water Rat
	Rattus fuscipes	Bush Rat
Introduced Mammals		
	Mus musculus	House Mouse
	Rattus rattus	Black Rat
	Bos taurus	Cow
	Ovis aries	Sheep
	Equs caballus	Horse
	Oryctolagus cuniculus	Rabbit
	Vulpes vulpes	Fox
	Sus scrofa	Pig
	Cervus elephas	Red Deer
	Felis cattus	Cat

* denotes historical records – unlikely to occur based on current distributions

Birds of the Collie Basin

Birds

Family and Species		Common name
Casuariidae		
	Dromaius novaehollandiae	Emu
Anatidae		
	Anus gracilis	Grey Teal
	Anas superciliosa	Pacific Black Duck
	Biziura lobata	Musk Duck
	Chenonetta jubata	Wood Duck
	Cygnus atratus	Black Swan
	Tadorna tadornoides	Australian Shelduck
Podicipedidae		
	Tachybaptus novaehollandiae	Australasian Grebe
	Poliocephalus poliocephalus	Hoary-headed Grebe
Phalacrocoracidae		
	Phalacrocorax melanoleucos	Little Pied Cormorant
Ardeidae		
	Ardea pacifica	White-necked Heron
	Ardea novaehollandiae	White-faced Heron
Accipitridae		
	Accipiter cirrocephalus	Collared Sparrowhawk
	Accipiter fasciatus	Brown Goshawk
	Aquila audax	Wedge-tailed Eagle
	Aquila morphnoides	Little Eagle
	Circus approximans	Swamp Harrier
	Elanus caeruleus	Black-shouldered Kite
	Haliastur sphenurus	Whistling Kite
	Hamirostra isura	Square-tailed Kite
	Hamirostra malanosternon	Black-breasted Buzzard
Falconidae		
	Falco berigora	Brown Falcon
	Falco cenchroides	Australian Kestrel
	Falco longipennis	Australian Hobby
	Falco peregrinus	Peregrine Falcon
Rallidae		
	Porphryio porphryio	Purple Swamphen

Birds of the Collie Basin

Birds

Family and Species		Common name
Turnicidae		
	Turnix varia	Painted Button-quail
Charadriidae		
	Charadrius melanops	Black-fronted Dotterel
	Vanellus tricolor	Banded Lapwing
Columbidae		
	Phaps chalcoptera	Common Bronzewing
Psittacidae		
	Calyptorhynchus banksii	Red-tailed Black Cockatoo
	Calyptorhynchus latirostris	Carnaby's Cockatoo
	Calyptorhynchus baudinii	Baudin's Cockatoo
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet
	Neophema elegans	Elegant Parrot
	Platycercus zonarius	Australian Ringneck
	Platycercus spurius	Red capped Parrot
	Platycercus icterotis	Western Rosella
Cuculidae		
	Cacomantis flabelliformis	Fan-tailed Cuckoo
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo
	Chrysococcyx lucidus	Shining Bronze-Cuckoo
	Cuculus pallidus	Pallid Cuckoo
Strigidae		
	Ninox novaeseelandiae	Boobook Owl
Tytonidae		
	Tyto alba	Barn Owl
Podargidae		
	Podargus strigoides	Tawny Frogmouth
Aegothelidae		
	Aegotheles cristatus	Australian Owlet-nightjar
Halcyoaidae		
	Dacelo novaeguinaea	Laughing Kookaburra
	Todiramphus sanctus	Sacred Kingfisher
Meropidae		
	Merops ornatus	Rainbow Bee-eater
Climacteridae		
	Climacteris rufa	Rufous Tree Creeper

Birds of the Collie Basin

Birds

Family and Species		Common name
Maluridae		
	Malurus splendens	Splendid Fairy-wren
	Malurus elegans	Red-winged Fairy Wren
Pardalotidae		
	Pardalotus punctatus	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Acanthizidae		
	Acanthiza apicalis	Broad-tailed Thornbill
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza inornata	Western Thornbill
	Gerygone fusca	Western Gerygone
	Sericornis frontalis	White-browed scrubwren
	Smicrornis brevirostris	Weebill
Meliphagidae		
	Acanthorhynchus superciliosus	Western Spinebill
	Anthochaera lunulata	Western Little Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Ephthianura albifrons	White-fronted Chat
	Lichmera indistincta	Brown Honeyeater
	Lichenostomus virescens	Singing Honeyeater
	Manorina flavigula	Yellow-throated Minor
	Melithreptus chloropsis	Western White-naped Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris nigra	White-cheeked Honeyeater
	Phylidonyris melanops	Tawny-crowned Honeyeater
Petroicidae		
	Eopsaltria australis	Yellow Robin
	Eopsaltria georgiana	White-breasted Robin
	Petroica multicolor	Scarlet Robin
	Petroica goodenovii	Red-capped Robin
	Petroica cucullata	Hooded Robin
Neosittidae		
	Daphoenositta chrysoptera	Varied Sittella
Pachycephalidae		
	Colluricincla harmonica	Grey Shrike Thrush
	Pachycephala pectoralis	Golden Whistler

Birds

Family and Species		Common name
	Pachycephala rufiventris	Rufous Whistler
Dicruridae		
	Grallina cycanoleuca	Magpie-lark
	Myiagra inquieta	Restless Flycatcher
	Rhipidura fuliginosa	Grey Fantail
	Rhipidura leucophrys	Willie Wagtail
Campephagidae		
	Coracina novaehollandiae	Black-faced Cuckoo-shrike
	Lalage tricolor	white-winged Triller
Artamidae		
	Artamus cyanopterus	Dusky Woodswallow
Cracticidae		
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Corvidae		
	Corvus bennetti	Little Crow
	Corvus coronoides	Australian Raven
Ptilonorhynchidae		
	Ptilonorhynchus maculatus	Spotted Bowerbird
Hirundinidae		
	Hirundo neoxena	Welcome Swallow
	Hirundo nigricans	Tree Martin
Zosteropidae		
	Zosterops lateralis	Grey-breasted White-eye
Dicaeidae		
	Dicaeum hirundinaceum	Mistletoebird
Passeridae		
	Stagonopleura oculata	Red-eared Firetail
Motacillidae		
	Anthus australis	Australian Pipit

Reptiles and Amphibians of the Collie Basin

Reptiles and Amphibians

Family and Species		Common name
Hylidae		
	Litoria adelaidensis	Slender Tree Frog
	Litoria moorei	Motorbike Frog or Bell Frog
Leptodactylidae		
	Crinia georgiana	Quacking Frog
	Crinia glauerti	Glauert's Froglet
	Crinia pseudinsignifera	Bleating Froglet
	Geocrinia leai	Lea's Frog
	Heleioporus barycragus	Western Marsh Frog
	Heleioporus eyrei	Moaning Frog
	Heleioporus inornatus	Whooping Frog
	Heleioporus psammophilus	Sand Frog
	Limnodynastes dorsalis	Banjo Frog
	Neobatrachus pelobatoides	Humming Frog
Chelidae		
	Chelodina oblonga	Western Long-necked Tortoise
Gekkonidae		
	Christinus marmoratus	Marbled Gecko
	Crenadactylus o. ocellatus	Clawless Gecko
	Deiplodactylus granariensis	Wheatbelt Stone Gecko
	Diplodactylus polyopthalmus	Speckled Stone Gecko
	Gehyra variegata	Tree Dtella
	Underwoodisaurus milii	Barking Gecko
Pygopodidae		
	Aprasia pulchella	Granite Worm Lizard
	Aprasia repens	Sandplain Worm lizard
	Delma fraseri	Fraser's Delma
	Lialis burtonis	Burton's Legless Lizard
	Pygopus lepidopodus	Common Scaly-foot

Reptiles and Amphibians

Family and Species		Common name
Agamidae		
	Pogona m. minor	Western Bearded Dragon
Scincidae		
	Acritoscincus trilineatum	Southwestern Cool Skink
	Cryptoblepharus plagiocephalus	
	Ctenotus fallens	
	Ctenotus labillardieri	Red-legged Skink
	Ctenotus impar	
	Ctenotus delli	
	Egernia kingii	King’s Skink
	Egernia napoleonis	Southwestern Crevice Skink
	Egernia p. pulchra	Spectacled Rock Skink
	Glaphyromorphus gracilipes	
	Hemiergis i. initialis	Five-toed Earless Skink
	Hemiergis p. peronii	Four-toed Earless Skink
	Lerista distinguenda	
	Lerista m. microtis	
	Menetia greyii	Common Dwarf Skink
	Morethia obscura	Woodland Fleckled Skink
	Morethia lineoocellata	
	Tiliqua r. rugosa	Bobtail
Varanidae		
	Varanus gouldii	Gould's Sand Monitor
	Varanus rosenbergi	Southern Heath Monitor
Typhlopidae		
	Ramphotyphlops australis	
	Ramphotyphlops bituberculatus	
	Ramphotyphlops pinguis	
Boidae		
	Morelia spilota imbricatus	Southern Carpet Python
Elapidae		
	Elapognathus coronatus	Crowned Snake

Reptiles and Amphibians

Family and Species		Common name
	Echiopsis curta	Bardick
	Notechis scutatus	Tiger Snake
	Parasuta gouldii	Little Whip Snake or Gould's Snake
	Pseudonaja a. affinis	Dugite
	Rhinoplocephalus bicolor	
	Simoselaps bertholdi	Jan's Banded Snake
	Simoselaps fasciolatus	
	Simoselaps semifasciatus	Southern Shovel-nosed Snake

Appendix C Review of Baudin's Cockatoo and the Red-tailed Black Cockatoo

13.2 Health Impact Assessment

BenchMark Toxicology Services

As Trustee for the P & K Family Trust (ABN 72 217 434 679)

Empowering Through Knowledge

Health Assessment of Emissions from Proposed Power Stations at Bluewaters in the Collie Region

Prepared for:

Griffin Energy

Prepared by:

Dr Peter N Di Marco, PhD, Fellow ATS
Principal Consultant
BenchMark Toxicology Services Pty Ltd

Peter N Di Marco PhD, Fellow ATS
BENCHMARK TOXICOLOGY SERVICES

PO Box 1301
Canning Bridge
Western Australia 6153
Phone/Fax: 08 9315 9628

E-mail: pdimarco@bigpond.net.au

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HEALTH ASSESSMENT OF EMISSIONS FROM PROPOSED POWER STATIONS AT BLUEWATERS IN THE COLLIE REGION

1. Executive summary

1. Griffin Energy Pty Ltd proposes to establish two identical coal-fired power station each of 200 MW capacity in the Bluewater area of the Collie region.

2. The Collie community supports the development, perceiving predominantly positive impacts from the development mainly relating to economic benefits for the Collie Township and increased employment opportunities. A social and economic impact study for the region additionally identifies sustainability for the township and opportunities for training and better uses of the existing infrastructure.

3. Adverse impacts of development, such as additional demands on the infrastructure, have been identified and appropriate management options proposed to mitigate the impacts.

4. A small percentage of the Collie community expressed concerns about adverse health impacts on their health and that of the community, mainly from dust, smoke and flyash from power generating and mining activities in the region. The concerns and the perception of the health risks appeared correlated with the age of the respondents and their perception of the degree of control they have over environmental risks in the region.

5. Results of air modelling of emissions from the proposed Bluewaters I and II suggest that ground levels concentrations in the Collie Township as well as in the vicinity of the power stations is highly unlikely to impact adversely on public health. Maximum predicted concentrations are well within relevant ambient air health reference values. In addition, the proposed power stations appear to contribute minimally (generally in the order of a few percent) to the existing environmental load of emissions from power generating activities.

6. A small number of exceedances are predicted for short-term SO_2 concentrations ($\leq$ 1-h averaging times) when emissions from all power generating facilities are modelled. Exceedances of 10-min and 3-min average concentrations in the Collie Township are unlikely to impact adversely on public health, except for temporary, reversible discomfort or irritation even in sensitive individuals. The majority of exceedances are predicted for the innermost modelling domain, particularly in the area around the Muja power stations where exceedances of PM_{10} levels are also predicted.

7. Overall, the Collie community is supportive of the proposed expansion of power generating facilities in the region. Predominantly positive social and economic impacts were identified and appropriate management options proposed to mitigate the few adverse effects identified. There is some concern in the community about adverse health impacts and risks with mining of coal and power generating activities. Air modelling data results indicate that emissions from the proposed developments are unlikely to impact adversely on the health Collie residents. In the main, adverse effects from combined emissions are unlikely, except minor transient effects in some case. Any likelihood of adverse effects will be reduced once the Muja power stations are decommissioned.

HEALTH ASSESSMENT OF EMISSIONS FROM PROPOSED POWER STATIONS AT BLUEWATERS IN THE COLLIE REGION

2. Background and Scope

Griffin Energy Pty Ltd proposes to establish two identical coal-fired power stations, Bluewaters I and Bluewaters II, each with a generating capacity of 200 MW in the Collie region. As part of the Public Environmental Review process, it has commissioned a number of studies and reports on several of aspects of the potential impacts of the proposal in the Collie region.

Griffin energy has requested BenchMark Toxicology Services to conduct a health assessment based on the information contained in the following reports:

- Collie Health Impact Assessment. Social Profile. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.
- Collie Basin Health Impact Assessment Survey. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.
- Economic and social impacts of Bluewaters Power Station. A report on the assessment of the economic, social and strategic impacts of the proposed Bluewaters Power Station. ACIL Tasman Pty Ltd, September 2004.
- A modelling assessment of the air quality impact in the Collie region of 1 X 200 and 2 x 200 MW power stations at Bluewaters. CSIRO Atmospheric Research Report C/0896, November 2004.

3. Overview / general comments

The information available for the assessment included demographic information on Collie from the Australian Bureau of Statistics as well as information on current infrastructure, results of a telephone survey on community attitudes towards the establishment of additional coal-fired power stations in the Collie region, results of a social and economic impact assessment, and estimates of ground level concentrations of emissions from the proposed additional power stations as well as the existing power generating facilities in the region.

The social study has identified that the Collie community consists of a slightly higher proportion of young residents and young couples with small children than the Western Australian average, has a higher unemployment rate and a lower socioeconomic status than the state average. Individuals identify strongly with the local community and local industry and generally support the establishment of additional coal-fired power generating facilities.

Preschools, primary and secondary schools, aged care facilities and the hospital have been identified as potential areas of exposure of more susceptible individual to the coal-fired power stations emissions.

Compared with national trends, the Collie community appears to feel more empowered about environmental risks, although less aware about some environmental issues.

The infrastructure is currently adequate to support the township, although the influx of additional workers from outside the Collie area, particularly during the construction phases of additional facilities may put additional demand on the facilities. Management options have been identified to minimise any adverse impacts from the additional demand.

The predicted social and economic impacts were mainly positive, generally relating to increased employment opportunity, development and sustainability of the local area and opportunities for up skilling the local workforce. This was also reflected in the attitudes of the Collie community.

Whilst the majority of residents did not feel that the current or proposed power generating facilities would impact on their health or that of the community in general, a small proportion of the community has concerns about air quality and the impacts of their health, mainly related to dust, smoke and flyash from power generation and coal mining in the area. The degree of concern and the perception of the severity of the health risks appear to be inversely correlated with the extent to which they feel they have control over environmental health issues in the region as well as age.

The major emissions of concern were identified from currently operating facilities or from the National Pollutants Inventory database. For the Bluewaters proposal, the emissions of concern included PM_{10}, SO_2, NO_2, CO, O_3, polycyclic aromatic hydrocarbons (PAH), arsenic, cadmium, chromium, fluoride, lead, mercury, volatile organic compounds (VOC) and persistent organic pollutant (POP). Ground level concentrations were estimated for the Collie Township and two modelling area domains (22 x 22 km^2 and 220 x 220 km^2) using the TPAN air-quality model developed by CSIRO for 5 different exposure scenarios designed to assess the current and additional impacts of coal-fired power stations in the region. The modelling was based on hourly-average concentrations of SO_2 collected by Western Power in 2001 and meteorological information for the same year.

VOC, POP, arsenic, chromium, cadmium and lead were not modelled because of the small quantities of the annual emissions.

Appropriate averaging times for the modelled ground level concentrations were used, consistent with averaging times for reference health values. Reference ambient air quality values were used to assess the impacts of the emissions on public health, since inhalation was considered the most important route of exposure.

Multi-exposure pathways were also considered for emissions with the potential to deposit on soil and water collecting surfaces, such as roofs for the collection of rainwater. Although estimates based on very conservative assumptions were used in the calculations, the results indicate that deposition to soil or water is highly unlikely to pose a public health risk.

The results of the modellings indicate that ground levels concentrations of the emissions from Bluewaters I and Bluewaters I and II at the Collie Township are well below national and international reference values for the protection of human health, including for the most sensitive individuals in the community, such as asthmatics, the elderly, children and people suffering from respiratory diseases.

The impact of emissions from the proposed Bluewaters I and II on the existing environmental emissions load in the region is minimal. The major contributors to the environmental load appear to be the Muja power stations, which are scheduled to be decommissioned. A small number of exceedances of the SO_2 reference values are predicted in the innermost modelling domain - areas adjacent to the power stations (one per annum for the 24-h average and 27 per annum for the I-h average concentrations for the existing power station or existing and proposed combined). Exceedances of the PM_{10} reference values are also predicted for all combined emission scenarios, particularly around the Muja power stations location. These, however, are unlikely to impact on public health as there are no residents in the affected areas. Employees commuting to their work place may experience transient irritant effects.

Given that the Muja power stations are to be decommissioned, the emissions and ground level concentrations are likely to be much lower once the proposed facilities are operational. Consequently there is likely to be an improvement in the air quality within the region.

Specific comments and summaries of the study findings are provided in the sections that follow.

Conclusions

Overall, the Collie community is supportive of the proposed expansion of power generating facilities in the region. Predominantly positive social and economic impacts were identified and appropriate management options proposed to mitigate the few adverse effects identified. There is some concern in the community about adverse health impacts and risks with mining of coal and power generating activities. Air modelling data results indicate that emissions from the proposed developments are unlikely to impact adversely on the health Collie residents. In the main, adverse effects from combined emissions are unlikely, except minor transient effects in some case. Any likelihood of adverse effects will be reduced once the Muja power stations are decommissioned.

4. Social Profile

Sheridan Coakes Consulting (2004a)[1] has prepared a social profile for the Collie Township and the Shire of Collie to define the social context for the proposed expansion of coal-fired power generation facilities in Collie, part of the South West Interconnected System (SWIS) Power Procurement Process (PPP) for Western Power.

The report presents information on geographical location, local history, socio-demographic statistics, historical and contemporary development issues. Of interest for the Bluewaters proposal are the socio-demographic statistics and contemporary community issues. The major findings of the study are summarised below.

4.1. Socio-demographic

The study has identified the following key issues from census data collected in 1991, 1996 and 2001:

- A decline in population size since 1991 (7.3%);
- A high percentage of home ownership suggesting high levels of place and community attachment;
- A relatively low number of young people and the elderly compared to the number of people of working age, in comparison to the state average;
- A decline, since 1991, in the number of young people and an increase in the number of elderly in the population;
- Lower levels of schooling completed when compared to the State average;
- A high percentage of one-parent families and families without children in the population when compared to the state average; and,
- An unemployment rate of 11% in 2001, which was above the state average of 8%.
- An increase in the indigenous population from 216 (2.4%) in 1991 to 245 (2.9%) in 2001, with 242 of the latter living in the Collie Township (3.5% of population).
- Slightly more households on low and middle household incomes and slightly fewer households on higher incomes when compared to the state average.

4.2. Facilities

Collie Township has five primary schools (with 4- and 5-year-old preschools attached), one high school and a TAFE centre. It has 2 aged care facilities and one child health centre in addition to an 83-bed hospital and a number of shopping, sporting and recreational facilities.

4.3. Community issues

Contemporary community issues were identified from articles in the local newspaper as well as the contents of the “Community Comment” section of the newspaper. These included concerns for the environment, specifically

[1] Sheridan Coakes Consulting (2004). Collie Health Impact Assessment. Social Profile. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.

environmental protection, and the impacts of dust and noise from the coal industry on the community.

5. Community attitudes

Sheridan Coakes Consulting (2004b)[2] has undertaken a household telephone survey over the period 6 to 14 November 2004 of 350 households older than 15 years of age (1241 households contacted; 71 - refusals, 820 – no answer after two follow up calls) in the Shire of Collie. The survey was designed to examine community attitudes and beliefs in relation to the establishment of a new coal fired power station in the Collie area. The age groups between 15 and 30 years was slightly underrepresented in the survey compared with the demographic distribution from the 2001 census data.

The survey included questions which identified (a) community awareness and knowledge of the proposal to establish a coal fired power station, (b) attitudes and beliefs about current air quality and the impacts of existing power stations on family, community and environment, (c) attitudes and beliefs about the impacts of any new coal fired power station on air quality and impacts to family, community and environment and (d) the social and demographic characteristics of respondents. The major findings of the study are summarised below.

5.1. Key findings

The social and demographic aspects of the survey indicated that respondents had a strong attachment to community and place as well as strong work associations with the coal and power generation industries.

A high proportion of respondents (93%) were aware of proposals to establish additional power generation facilities in Collie, although only about 10% of surveyed population had any specific knowledge on any specific proposal.

About 19% of respondents (66/350) reported having experienced health effects from air pollution at their current residence (cf 81% who had not). Of these, about one third (7% of total respondents) perceived the health risk from pollutants in air to be moderate to high. Almost all (61/66) indicated they could identify the type of air pollutants from which they had suffered - dust smoke and flyash were the most frequent pollutants identified. Coal mining, Muja power station, Worsley Aluminium refinery and bush fires were identified as the major source of the pollutants. Twelve percent of respondents believed that health risks from air pollutants would increase after the establishment of a new coal fired power station, while the majority considered that they would stay the same (70%) or decrease (8%).

Concerns about impacts of current power stations (very concerned or somewhat concerned) were restricted to environmental impacts such as greenhouse gas emissions (24%), contamination of groundwater (19%), contamination of rivers and wetlands (18%) and discharge of water to the oceans (18%).

Over 80% of respondents had no concerns about additional impacts either on themselves or the community from new power stations operating in the future. When identified, impacts were mainly positive impacts, with employment (90%) and support for local businesses and the local economy of the region (74%) the

[2] Sheridan Coakes Consulting (2004). Collie Basin Health Impact Assessment Survey. Sheridan Coakes Consulting Pty Ltd. Draft November 2004.

two most frequently reported impacts. Twelve respondents (3.4%) identified negative impacts, such as increased traffic (5/350) and increased pollution (3/350).

Similar results were reported about perception of health risks associated with existing and proposed power stations, with a high correlation between the two scenarios. For existing activities, about 7% of respondents considered the risks were moderate to high, 12% considered them minor, 23%slight and 58% did not consider them a risk. The ranking of health risk tended to be higher and increase with age with people in the age group of 15 to 47 years and decreased with age in the older groups. For future power generation, about 4% reported that the risks would be high to moderate. Families with children tended to rate the risks higher than those without children.

Reponses to questions designed to assess attitudes towards environmental issues indicate that, compared with national results, the Collie community attitude to environmental risks are the same (risks are not a central issue of concern to them), they feel they have more control over risks that are occurring in their community than national trends, but appear to have a lesser awareness than their national counterparts about risk, although 60-65% of the respondents had a high score for risk awareness.

Further analysis of the data suggested that individuals who believe they have little control over environmental risks tended to rate risks higher from existing and future power stations in Collie. Conversely, individuals who believe they have some control over environmental risks tended to rate risks lower for the same scenarios.

The respondents preferred to be kept informed through information dissemination in the local newspaper (45% first preference, 30% second preference) and by letter drop (23% first preference; 30% second preference). Only 16% of respondents preferred public meetings (9% second preference).

5.2. Comments

The Collie community appears to have similar attitudes about environmental health risk as the Australian population in general, although they might have a lower awareness of some environmental health risks and they tend to feel they have more control over environmental health risks than their national counterparts.

The community is aware of proposed expansion of power generating facilities and support the proposals. Perception of current and future impacts focus mainly on positive impacts, such as employment opportunities and economic growth for the region, rather than negative impacts. Notwithstanding, some members of the community, albeit a small percentage, consider that their health and that of the community is at risk from existing and future power generating facilities mainly from pollutants such as dust, smoke and flyash. The concerned group appears to be younger (up to 47 years of age) and includes couples with small children. Their perception of the severity of health risks appears to be inversely correlated with the degree of control they feel they have over the management of environmental risks. This is consistent with other findings on risk perception.

6. Economic and social impacts

ACIL Tasman (2004)[3] has undertaken an assessment of the social and economic impacts associated with the establishments of the Bluewaters power stations and the adjacent Ewington I coal mine at Collie using standard desktop methods computer modelling.

6.1. Key findings and comments

Both the construction and operation phases of the projects will provide significant economic and social benefit to the local, regional, state and national economies through direct, indirect or flow on impacts from the increased economic activity.

In addition to the broader regional, state and national impacts, the major economic impact identified for the Collie community is the increased employment opportunity and the associated flow on effects for local businesses and the community.

Construction of the Bluewaters Power Station is expected to cost around $200 million and take 3 years to complete. Approximately 250 personnel will be required during the peak construction period. In operation up to 50 full time personnel will be employed in the power station.

The majority of workers are likely to be residents of Collie and surrounding areas consistent with the current Griffin workforce profile. Eighty five percent of the current Griffin workforce at Collie lives in Collie, with 13 per cent living in Bunbury, Donnybrook, Busselton and Darkan. The greatest local economic impact in operation will come from those workers who relocate to Collie

The Bluewaters power station is also likely to result in long-term social benefits to Collie and the South West, mainly as greater opportunities for and enhanced sustainability of the local community. These include:

- Increased employment opportunities.
- Enhanced education and training opportunities.
- Better use of existing infrastructure.
- Maintenance of Collie as an economic and viable sustainable town.

ACIL Tasman has also identified some negative impacts, mainly associated with changing demographics and increased demands on current infrastructures. These are common among similar developments and include:

- Temporary population increases in construction phase;
- Social pressures from the introduction of transient populations;
- Modest permanent population increases likely in the operational phase;
- Increase in population in under 35 age group, and people with young families;
- Pressures on local and regional health and welfare services, emergency response facilities, education transport and the other services could be increased, particularly during the construction phase.

3

ACIL Tasman (2004). Economic and social impacts of Bluewaters Power Station. A report on the assessment of the economic, social and strategic impacts of the proposed Bluewaters Power Station. ACIL Tasman Pty Ltd, September 2004.

- Some local businesses may not participate due to lack of capacity;
- Some businesses may be affected adversely by construction and associated activities (for example, tourism).

The only potential visual impact identified is the water vapour plume from the cooling towers that will be visible occasionally.

ACIL Tasman identifies a range of management measures that will need to be implemented by government and non-government organisations to ensure that the opportunities presented by the Bluewaters project deliver the potential benefits and that the adverse impacts are minimised or eliminated through mitigating management measures.

7. Health Risk Assessment

7.1. Hazard identification

Bluewaters 1 and Bluewaters II are identical 200 MW power stations. The environmental stressors identified with the proposed project are typical emissions from coal-fired power stations as outlined in the following table.

Environmental stressors	
• Noise:	Less than 60 dB(A) at 150 metres from the plant. Less than 29 dB(A) at nearest residence in Collie
• Flue Dust:	47 mg/Nm^3 at 7% O_2 dry basis; 9 g/s; 227 tpa
• Nitrogen Oxides:	606 mg/Nm^3 at 7% O_2 dry basis; 121g/s; 3050 tpa
• Sulphur Oxides:	1490 mg/Nm^3 at 7% O_2 dry basis; 296 g/s; 7470 tpa
• Greenhouse Gases:	1,300,000 tpa CO_2 e
• Carbon Monoxide:	500 mg/Nm^3 at 7% O_2 dry basis 93g/s; 2350 tpa
• Volatile Organic Compounds:	32 kg/yr
• PAH:	6.0 kg/yr
• Arsenic	6.7 kg/yr
• Cadmium	8.5 kg/yr
• Chromium compounds	1.5 kg/yr
• Lead compounds	31 kg/yr
• Mercury:	31 kg/yr
• Fluorides:	17,000 kg/yr (instantaneous rate estimated to be 590 mg/s)
• POPs inc Dioxins and Furans:	Less than 0.5 grams per year

Abbreviations used in Table

CO_2 e	*Carbon dioxide equivalents*	*O_2*	*Oxygen*
dB(A)	*decibels A weighted*	*pa*	*per annum*
g/s	*grams per second*	*PAH*	*Polycyclic Aromatic Hydrocarbons*
kg	*Kilograms*		
kg/yr	*Kilograms per year*	*POPs*	*Persistent Organic Pollutants*
m	*metre*	*tpa*	*tonnes per annum at 0.8 capacity factor*
mg/Nm^3	*milligrams per normal cubic metre, at 1 atm, 0°C*	*%*	*percent*

From a health risk assessment perspective, the criteria pollutants PM_{10}, SO_2, NO_2, O_3 (respiratory effects, acute) and CO (tissue hypoxia, acute and chronic) are the major substances of concern. Commonwealth Scientific & Industrial Research Organisation (Physick and Edwards, 2004)[4] have estimated ground level concentrations of these emission components as well as PAH (lung cancer, chronic) fluoride (irritation, acute) and mercury (CNS and renal effects, chronic) using the TAPM V 2.6 air quality model developed by CSIRO. BenchMark Toxicology Services has not evaluated the model as it is outside its area of expertise. An analysis of modelled SO_2 concentrations (1-h average) and actual 1-h average SO_2 concentrations at 3 monitoring sites (including the town of Collie) indicated that the modelling tends to overestimate the SO_2 concentrations, particularly at concentrations > 50 µg/^{m3} (Physick and Edwards, 2004)[5].

[4] Physick WL & Edwards M (2004). A modelling assessment of the air quality impact in the Collie region of 1 X 200 and 2 x 200 MW power stations at Bluewaters. CSIRO Atmospheric Research Report C/0896, November 2004

[5] Physick WL & Edwards M (2004). *Ibid*, p 7

Based on advice from the Department of Environment (DoE), concentrations of volatile organic compounds (VOC) emissions were not modelled by CSIRO since the emission rate from coal combustion in the Collie region is very small (32 kg/year). In addition, the contribution by background biogenic VOC compounds from the area is likely to be considerable. BenchMark Toxicology Services has undertaken a basic risk calculation for VOC emissions (Section 7.3.9), the results of which suggest that the impacts of the VOC on air quality in the region would be negligible.

Similarly, arsenic, cadmium, chromium, lead and dioxins were not modelled because of the low emission quantities and are not considered further as air quality contaminants, except with respect to possible deposition to soil or water (Section 7.5).

Since buffer zones based on noise levels have been established, noise will no longer be considered in this assessment.

7.1.1. Dose response assessment

Reference ambient air values (standards and guidelines) are available for all substances considered to pose a hazard, except PAH, from national or international regulatory or advisory bodies and listed in the following table. The modelled emissions and averaging times are also summarised in the table.

Emission	Averaging time	Reference Values		Source
		µg/m³*	ppm	
SO_2	3 min			
	10 min	700		NHMRC[6]
	10 min	500#	0.175	WHO[7]
	1 h	570	0.20	NEPM[8]
	24 h	228	0.08	NEPM
	Annual	57	0.02	NEPM
CO	8 h	10,400	9.0	NEPM
Mercury	Annual	1		WHO[9]
PM_{10}	24 h	50		NEPM
PAH	Annual	0.000012**		WHO[10]
Fluoride	1 h	600##		WHO[11]
	Annual (?)	1@		WHO
	24 h	2.9		ANZEC§
Total VOC	1 h	500		NHMRC[12]

*: Concentrations in µg/m³ for gases are converted variably from ppm and can vary slightly because of approximations

#: Provided for comparison only

**: Concentration estimated to be associated with excess lifetime risk of 10^{-6}.

##: WHO describes this as a reference exposure level to protect against any respiratory irritation (presumably from a once in a lifetime release)

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[6] NHMRC (1996). Ambient air quality goals recommended by the National Health and Medical Research Council. www.nhmrc.gov.au/publications/pdf/rec1-2.pdf (Accessed 4 December, 2004).

[7] WHO (2000) Air Quality Guidelines for Europe. WHO Regional Publications, European Series, No 91, Second Edition, pp 194-198

[8] National Environment Protection Council (NEPM) (2003). Ambient Air Quality NEPM. http://www.ephc.gov.au/nepms/air/air_nepm.html (Accessed 4 December 2004).

[9] WHO (2000). *Ibid*, pp 157-161

[10] WHO (2000). *Ibid*, pp 92-96

[11] WHO (2000). *Ibid*, pp 143-145

[12] NHMRC (1996). *Ibid*

@: Recommended level for the protection of livestock and plants
§: Quoted by CSIRO as protective of vegetation

As no ambient air quality is available for PAH, the cancer unit risk will be used to determine the level of risk associated with the predicted ground level concentrations.

7.2. Exposure assessment

7.2.1. Receptors

Residents of Collie Townsite are the largest and most heterogenous receptors identified. Bluewaters I and II are to be located approximately 4 km east, northeast of Collie.

One additional occupied residence has been identified at 3 km directly north of the proposed location for the power stations, about 0.5 Km outside the noise buffer zone.

Other non-residential buildings are located outside the buffer zone at least 6 km northeast and 11 km south east of the proposed location.

Occupational exposure is not considered in this assessment.

7.2.2. Sensitive subpopulations

The priority pollutant and fluoride identified as stressors mainly exert acute effects on the respiratory system and irritation of mucous membranes and eyes. Clearly identified sensitive subgroups are asthmatics, the elderly and very young and people suffering from respiratory disease.

The socio-demographic statistics on the Collie community indicate that younger people are slightly over represented, including preschool children, but under represented by people older than 50 years compared with the state average.

The town has 4 preschools, 2 aged care centres and a hospital where sensitive subgroups are likely to be located.

No specific sensitive subgroups have been clearly identified for the effects of PAH and mercury, although fetal development appears to be particularly sensitive to methyl mercury WHO (2000)[13].

However, consistent with a precautionary approach, the developing fetus, young children, the elderly and the infirm are considered to comprise a sensitive subgroup to emissions from the power stations.

7.2.3. Exposure routes

Inhalation of the volatile emission components and PM_{10} is the most important exposure route.

For some of the other emission components oral and dermal exposure following deposition on soil or in water can also be important depending on their physical and chemical properties.

Office of Environmental Health Hazard Assessment (OEHHA, 2000)[14] of the California Environmental Protection Agency has identified substances for which multi-pathway exposure should be considered.

[13] WHO (2000). *Ibid* p 157.

These include PAH, arsenic, chromium, cadmium, lead and mercury and POP. Estimates of deposition of these substances in soil and water in rain water tanks is provided in Section7.5.

7.2.4. Emission scenarios

Five exposure scenarios were considered for the modelling based on conservative, worst-case, approach for existing and proposed sources. Existing sources include the Muja A and B sources as well as Muja C and D, an expansion of Collie power station to double its current capacity and Worsley (including proposed upgrade of the facility). Proposed sources include Bluewaters I and Bluewaters II.

The five exposure scenarios for which ground-level concentrations were modelled are summarised in the following table.

Scenario	Emission Sources
1	1. Proposed Bluewaters I
2	1. Proposed Bluewaters I 2. Proposed Bluewaters II
3	1. Existing sources • Muja A, B, C, D, Worsley (including proposed upgrade) • Collie (denoted as Collie A) • An expansion of Collie A with the same characteristics (denoted Collie B), 2. Bluewaters I
4	1. Existing sources • Muja A, B, C, D • Worsley (including proposed upgrade) • Collie (denoted as Collie A) • An expansion of Collie A with the same characteristics (denoted Collie B), 2. Bluewaters I 3. Bluewaters II
5	1. Existing sources only • Muja A, B, C, D • Worsley (including proposed upgrade) • Collie (denoted as Collie A) • An expansion of Collie A with the same characteristics (denoted Collie B)

Only scenarios 3, 4 and 5 are simulated for the secondary pollutants NO_2, O_3 and PM_{10}.

7.2.5. Ground Level Concentrations

Actual SO_2 emissions for Muja A, Muja B, Muja C, Muja D and Collie A for 2001 were used in this study to model ground level concentrations (provided by Western Power). The emissions consist of hourly-averaged SO_2 data from these five power station point sources, and a constant emission rate from the Worsley power station stack.

Short-term concentrations of 10- and 3-min averages for SO_2 were extrapolated from the 1-h average concentrations using a power law equation and estimated only for the Collie Township.

[14] OEHHA (2000). Air Toxics Hot Spots Program Risk Assessment Guidelines. Part IV Technical Support Document for Exposure Assessment and Stochastic Analysis. September 2000

Total annual emissions for the existing sources of NO_2, PM_{10}, CO, Hg, PAH and fluoride were obtained from the national pollutant inventory (NPI) website. Hourly emission rates for these emissions were estimated by extrapolation using the SO_2 hourly-average emission data.

Ground level concentrations were modelled for the Collie Township, the innermost modelling domain area (22 x 22 km^2) and a wider domain area (O_3 only, 220 x 220 km^2) and based on operations at 100% capacity, except for the Collie power station (reduction of 11.4%; no operation between September and November 2001) and Muja (increased output of 11.9%).

For each of the averaging times used, the highest and 9th highest concentrations are reported for each of the exposure scenarios modelled by Physick and Edwards (2004)

7.3. Risk characterisation

7.3.1. Sulfur Dioxide

Exposure scenarios 1 and 2

The estimated ground level concentrations for SO_2 from emissions from Bluewaters I and Bluewaters I & II are summarised in the following table.

Scenario	**Averaging Time**	**Ground level Conc (µg/m³)**			**Exceedance /year**	
		Highest		Reference		
		Collie	Inner Domain		No	% of Ref
1 Bluewaters I	3 min	487		NA		
	10 min	301		700	0	
	1 h	147	391	570	0	
	24 h	15	81	228	0	
	Annual	0.6	6	57	0	
2 Bluewaters I Bluewaters II	3 min	633		NA		
	10 min	391		700	0	
	1 h	191	583	570	1	2.3
	24 h	27	111	228	0	
	Annual	0.9	7	57	0	

NA: None available; no reference value identified

Concentrations at the Collie Township are estimated to be well within reference values for all averaging times considered and both exposure scenarios.

The highest 10-min average concentration is about 56% of the NHMRC (1996)[15] goal with both power stations operating (scenario 2). A 3-min average reference value for SO_2 could not be identified. However, the estimated 3-min average concentrations at the Collie Township are less that the NHMRC 10-min average. The highest 1-h, 24-h and annual averages are about 33%, 12% and 2% respectively of the NEPM (2003)[16] standards.

The estimated concentrations of SO_2 for ≤ 1-h averaging estimated for the Collie Township are highly unlikely to affect the health of residents, including the most sensitive receptors – individuals who suffer from asthma – and most sensitive

[15] NHMRC (1996). Ambient air quality goals recommended by the National Health and Medical Research Council. www.nhmrc.gov.au/publications/pdf/rec1-2.pdf (Accessed 4 December, 2004)

[16] NEPM (2003). *Ibid*

exposure – during exercise. The exact duration of short-term exposure to SO_2 is not critical because responses occur very rapidly, within the first few minutes from commencement of inhalation; continuing the exposure further does not increase effects (WHO, 2000)[17].

Ground level concentrations of SO_2 estimated for the innermost modelling domain are all within reference values, except for one. An exceedance in the 1-h average was predicted to occur in a 12-month period for exposure scenario II. This however, is only marginally higher than the NEPM standard for SO_2 (2.3%) and appears to occur within the industrial estate close to the Bluewaters power stations.

Overall emissions - Exposure scenarios 3, 4 and 5

The proposed Bluewaters I and Bluewaters II power stations do not contribute significantly, individually or in combination, to the SO_2 environmental load in the Collie regional air shed.

Predicted emissions for scenarios 3, 4 and 5 are the same when considering the annual or 24-h averaging times both for the Collie Township and the innermost modelling domain, with concentrations predicted at the Collie Township reaching about 19% and 10% of the NEPM standard (24-h and annual averages, respectively). However, the concentrations at both averaging time for the innermost modelling domain are predicted to exceed the NEPM standard by about 9% (one day per year, within 2 km of Muja power station).

Some exceedances of reference values are predicted for the SO_2 concentrations averaged over shorter periods of ≤ 1 h. The maximum 10-min average concentrations for the three exposure scenarios marginally exceed the NHMRC goal (up to about 9%) and the highest 3-min averages are about 1.7 times the 10-min average goal set by NHMRC. The 9th highest concentrations, however, are well within the reference values. Bluewaters I and II combined contribute about 9% in both cases to the maximum SO_2 concentrations predicted from scenario 5.

The maximum predicted 1–h average concentrations for the Collie Township are within the NEPM standard (up to about 35% of the standard). In the innermost modelling domain, however, the 1-h average concentrations are predicted to exceed the NEPM standard 27 times in one year (up to 2 fold), with the highest contribution from the Muja power station.

The proposed Bluewaters power stations do not appear to contribute to the SO_2 environmental load when annual averages are considered.

The exceedance of the 10-min average and the 3-min average concentrations are unlikely to lead to any serious adverse effects, although mild discomfort might result from the high 3-min average concentrations for any exposed individual passing through the area. WHO (2000)[18] refers to a study by Linn et al. (1987) who measured reductions in respiratory function (FEV1) after a 15-minute exposure in asthmatics.

WHO states:

> *"Only small changes, not regarded as of clinical significance, were seen at 572 µg/m^3 (0.2 ppm); reductions representing about 10% of baseline FEV1*

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[17] WHO (2000). *Ibid*, pp 194-198

[18] WHO (20002). *Ibid* pp194-197

> *occurred at about 1144 µg/m³ (0.4 ppm); and reductions of about 15% occurred at about 1716 µg/m³ (0.6 ppm). The response was not greatly influenced by the severity of asthma. These findings are consistent with those reported from other exposure studies. In one early series, however, a small change in airway resistance was reported in two of the asthmatic patients at 286 µg/m³ (0.1 ppm)".*

Thus the highest predicted levels of SO_2 for averaging times ≤ 1 h in the Collie region are, at worst, likely to have only marginal effects even in the most sensitive receptors.

Given that the Muja power stations are the main contributors to the SO_2 environmental load in the area and that they are to be decommissioned, the SO_2 concentrations during the operations of the proposed Bluewaters I and Bluewaters II power stations are likely to be greatly reduced.

7.3.2. Carbon monoxide

All maximum predicted concentrations of CO (8-h averages) for all production scenarios are well within the NEPM standard.

7.3.3. Mercury

The highest predicted annual average concentrations of mercury (innermost domain wide) for each of the exposure scenarios were at least three orders of magnitude lower than the annual average guideline recommended by WHO for inorganic mercury vapour of 1 µg/m³. Concentrations at the Collie Townsite are about one order of magnitude lower than in the innermost modelling domain.

7.3.4. Polycyclic aromatic hydrocarbons (PAH)

The predicted annual average concentrations of PAH in the innermost modelling domain were in the range of 3.7 to 6.1 pg/m³, with those predicted for the Collie Township being about one order of magnitude lower. Bluewaters I and Bluewaters II do not contribute significantly to the environmental load in the Collie air shed resulting from exposure scenario 5 (< 10%).

Based on the cancer unit risk of 8.7×10^{-3} $(\mu g/m^3)^{-1}$ estimated by WHO (2000)[19] and assuming that benzo(a)pyrene is the only PAH present, a lifetime exposure to PAH at 6.1×10^{-5} µg/m³ (highest concentration, scenarios 3 and 4 innermost modelling domain) and 6×10^{-7} µg/m³ (scenario 2, Collie Township) would result in excess lifetime cancer risks of 5.3×10^{-6} and 5.2×10^{-9}, respectively. The level of risk at the Collie Townsite is over 2 orders of magnitude lower than the *de minimis* level of risk used by the US EPA of 10^{-6}, which is considered a trivial or insignificant level of risk.

7.3.5. Fluoride

The highest predicted fluoride concentration (24-h average) in the innermost modelling domain for Bluewaters I and II is 0.2 µg/m³, for the other exposure scenarios they are 1.7 µg/m³, within 2 km of the Muja power stations. These levels are highly unlikely to cause any adverse health effects.

7.3.6. Nitrogen dioxide

Annual and 1-h average concentrations of nitrogen dioxide for the Collie Township and the innermost modelling domain are well within NEPM standards. Bluewaters

[19] WHO (2000). *Ibid* pp 92-96

I and II do not contribute to the overall environmental load of NO_2 in the Collie region resulting from exposure scenario 5.

7.3.7. Ozone

The predicted 1-h and 4-h average concentrations of O_3 are well within NEPM standards for the three exposure scenarios considered. Bluewaters I and II do not contribute significantly to the overall environmental load of O_3 in the Collie region resulting from exposure scenario 5.

7.3.8. PM_{10}

The highest regional levels of PM_{10} concentrations (innermost modelling domain, 106 µg/m^3) are about twice as high as the NEPM standards. On the other hand, levels in the Collie Township are less than half the NEPM values. Emissions from the Muja power stations are apparently about 50-100 times higher than those from the proposed Bluewaters I and II power stations.

7.3.9. Volatile Organic Compounds

Although ground level concentrations of VOC emissions were not modelled because of the low annual quantities, BenchMark Toxicology Services has undertaken a basic preliminary assessment of VOC by extrapolating the concentrations directly from the SO_2 concentrations.

Using the SO_2 annual emissions and the highest 1-h average SO_2 ground level concentration estimated by CSIRO (1212 µg/m^3 for exposure scenario 4, Table 3.1, page 10 of the CSIRO report), 32 kg/year total VOC emissions is estimated to result in a 1-h average concentration of 5.2 ng/m^3. This is about 100 times lower than the National Health and Medical Research Council (NHMRC, 1996)[20] goal (Section 7.1.1). Similarly, the annual average VOC concentration is estimated to be 0.26 ng/m^3, using the highest annual SO_2 concentration of 62 µg/m^3 for exposure scenarios 3, 4 and 5 (Table 3.5, page 10 of the CSIRO report). Assuming that the benzene concentration is equal to the total VOC concentration and using the WHO (2000)[21] unit cancer risk for benzene of 6×10^{-6} (µg/m^3)$^{-1}$, the excess lifetime risk of leukaemia at an air concentration of 0.26 ng/m^3 is estimated to be 1.6×10^{-9}. The level of risk is around 3 orders of magnitude lower than the *de minimis* level of risk used by the US EPA of 10^{-6}, which is considered a trivial or insignificant level of risk.

7.4. Comments

Predicted ground level concentrations of estimated emissions from the proposed Bluewaters I and II power stations only contribute a small and insignificant amount to the existing emissions in the Collie region air shed. The major contributors to the environmental load are the old and apparently, inefficient Muja power stations which are due for decommissioning.

The predicted impacts on the air quality of the Collie Township are imperceptible. The only identifiable impact of the emissions from current activities in the area is short-term exposure ($\leq$ 1 averages concentrations) of SO_2 on the Collie Townsite and the region in excess of the NEPM standards. The proposed Bluewaters I and II power stations, however, only contribute marginally.

[20] NHMRC (1996). *Ibid*

[21] WHO (2000) *Ibid* pp 62-65.

7.5. Deposition to soil and water

7.5.1. Deposition to soil

Deposition to soil was estimated using the annual out put and calculations based on the following assumptions:

- The annual output is deposited evenly in an area equal to 10% of the innermost modelling domain (22 x 22 km^2), ie, 48.4 km^2
- The material is deposited in the top 1 mm of soil accumulating over 12 months
- No mixing of the soil occurs during the 12 month period
- For the PAH fraction, only benzo(a)pyrene, the reference congener, is present
- For POP fraction, only TCDD, the reference congener, is present
- The weight of soil is based on the lower value of bulk density estimates for soil of 0.8 – 1.9 mg/m^3.

The results summarised in the following table and compared with reference values from the sources indicated indicate that the levels likely to be deposited to soil are around 3 orders of magnitude or more lower than soil guidelines. From this, it can be inferred that it would take about a 100 years or more for the coil levels to reach the reference values.

Emission	Annual output (Kg)	Area (km^2)	Depth of soil (mm)	Soil Conc (mg/kg)	Reference value (mg/kg)
PAH	6.0	48.4	1	1.5×10^{-4}	1*#
As	6.7	48.4	1	1.7×10^{-4}	100#
Cd	8.5	48.4	1	2.2×10^{-4}	20#
Cr	1.5	48.4	1	3.9×10^{-5}	100#
Pb	31.0	48.4	1	8.0×10^{-4}	300#
Hg	31.0	48.4	1	8.0×10^{-4}	15#
POP	5.0×10^{-4}	48.4	1	1.3×10^{-8}	3×10^{-5}**

*: Health-based investigation level for benzo(a)pyrene

#: Health-based investigation levels (enHealth, 2001)[22]

**: Estimated using standard approach used in Australia (Appendix I)

7.5.2. Deposition water

The amounts of emissions that would deposit on roofs of houses and hence be collected in rain water tanks was estimated from the annual and calculations based on the following assumptions:

- The annual output is deposited evenly in an area equal to 10% of the innermost modelling domain (22 x 22 km^2), ie, 48.4 km^2
- The average area of the roof is 200 m^2
- The average size of water tanks used for collecting rain water is 50,000 L.
- The material is deposited on the roof and washed into the water tank

[22] enHealth (2001). Health-based soil investigation levels. http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-pubhlth-publicat-document-env_soil-cnt.htm (accessed 6 December 2004)

- For the PAH fraction, only benzo(a)pyrene, the reference congener, is present
- For POP fraction, only TCDD, the reference congener, is present

The results are summarised in the following table

Emission	Annual output (Kg)	Area (km^2)	Roof area (m^2)	Tank Vol (KL)	Water Conc (µg/L)	Reference value (µg/kg)
PAH	6.0	48.4	200	50	0.5	0.7*
As	6.7	48.4	200	50	0.6	7#
Cd	8.5	48.4	200	50	0.7	2#
Cr	1.5	48.4	200	50	0.1	50#
Pb	31.0	48.4	200	50	2.6	10#
Hg	31.0	48.4	200	50	2.6	1#
POP	5.0×10^{-4}	48.4	200	50	4.1×10^{-5}	8.2×10^{-6}**

*: Health-based investigation level for benzo(a)pyrene (WHO, 1993)[23]. Australian guideline set at the limit of determination

#: Australian Drinking Water Guidelines (NHMRC/ARMCANZ, 2001)[24]

**: Estimated using standard approach used in Australia (Appendix I)

The results suggest that the concentrations of emissions in rain water collected for drinking would not exceed drinking water guidelines, except in the case of POP emissions where the concentration of POP is estimated to be about 5 times the estimated tolerable concentration in water. Given the extremely conservative assumptions used in the calculations and the fact that any accumulated depositions over the dry period would be discarded with the first rains, the concentrations of deposited emissions is unlikely to pose a health risk.

[23] WHO (1993). Guidelines for Drinking Water Quality. Second edition, Vol 1 Recommendations

[24] enHealth (2001). Health-based soil investigation levels. NHMRC/ARMCANZ (1996). Australian Drinking Water Guidelines and Framework for Management of Drinking Water Quality. http://www.nhmrc.gov.au/publications/pdf/eh19.pdf (accessed 6 December 2004)

Appendix I

Estimation of an acceptable level for dioxins in soil and water

There are guidelines for POP or dioxins in soil or water available from Australian sources or the WHO.

For the purposes of this assessment estimates of tolerable levels of dioxin in soil and water will be derived using the recently published tolerable monthly intake published by the National Health and Medical Research Council (NHMRC, 2002)[1], and established methods for setting guidelines in soil and water in Australia.

Tolerable concentration in soil

The default method for setting health based soil investigation levels (enHealth, 2001)[2] is based on the method first described by Taylor (1991)[3] as follows:

Soil Concentration
(mg/kg) = TDI (mg/kg/day) x Body weight (kg) ÷ soil intake (kg/day)

= TDI (mg/kg/day) x body weight (kg) ÷ soil intake x 10^6 (mg/day)

Therefore

Soil concentration
(mg/kg) = (70 pg/kg/month x 13.2 kg x 10-^{9}) ÷ (30 x 100 mg x 10^6)

= 30 x 10^{-6} mg/kg

= 30 ng/kg

Where

- 70 pg/kg body weight per month is the tolerable monthly intake (NHMRC, 2002);
- 30 days/month used to covert to a tolerable daily intake
- 13.2 kg is the average weight of a child
- 10^{-9} is the conversion from pg to mg
- 0.1 is the proportion of total daily intake attributed to the intake from soil
- 100 mg/day is the is the soil ingestion rate for a child
- 106 is the conversion factor from kg to mg

Tolerable concentration in drinking water

An estimate of the tolerable concentration of dioxin in water derived using the method for setting drinking water guidelines used by the NHMRC (2001)[4] as follows:

[1] NHMRC (2002). Dioxins: Recommendation for a Tolerable Monthly Intake for Australians. http://www.nhmrc.gov.au/publications/synopses/eh26syn.htm (accessed 6 December 2004)

[2] enHealth (2001). Health-based soil investigation levels. http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-pubhlth-publicat-document-env_soil-cnt.htm (accessed 6 December 2004)

[3] Taylor ER (1991). How much soil do children eat. The health risk assessment am\nd management of contaminated sites. Proceedings of a National workshop on the Health Risk Assessment and Management of Contaminated Sites. El Saadi o & Langley A (Eds). South Australian Health Commission.pp 72-83 (Appendix I).

8.2 pg/L = (70 pg/kg body weight per month x 70 kg x 0.1) ÷ (2 L/day x 30 days/month

where:

- 70 pg/kg body weight per month is the tolerable monthly intake (NHMRC, 2002);
- 30 days/month used to covert to a tolerable daily intake
- 70 kg is the average weight of an adult;
- 0.1 is the proportion of total daily intake attributable to the consumption of water;
- 2 L/day is the average amount of water consumed by an adult.

[4] NHMRC/ARMCANZ (1996). Australian Drinking Water Guidelines and Framework for Management of Drinking Water Quality. http://www.nhmrc.gov.au/publications/pdf/eh19.pdf (accessed 6 December 2004)

13.3 EPBC Decision

COMMONWEATLH OF AUSTRALIA

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

DECISION THAT ACTION IS NOT A CONTROLLED ACTION

Pursuant to section 75 of the *Environment Protection and Biodiversity Conservation Act 1999*, I, MARK FLANIGAN, Assistant Secretary, Policy and Compliance Branch, Department of the Environment and Heritage, decide that the proposed action, set out in the Schedule, is not a controlled action.

SCHEDULE

The proposed action by Griffin Energy Pty Ltd to construct and operate the Bluewaters II Power station, a coal fired power station of up to 200 MW capacity on a site located 4.5 km north east of Collie, WA, and as described in the referral received under the Act on 14 July 2004 (EPBC 2004/1632).

Dated this 10 day of August 2004

....

ASSISTANT SECRETARY
POLICY AND COMPLIANCE BRANCH
DEPARTMENT OF THE ENVIRONMENT AND HERITAGE

13.4 Air Emissions

A modelling assessment of the air quality impact in the Collie region of 1 x 200 and 2 x 200 MW power stations at Bluewaters

prepared for

Griffin Energy

by

W.L. Physick and M. Edwards

CSIRO Atmospheric Research
Private Bag 1
Aspendale Vic 3195

tel: (03) 9239 4636
fax: (03) 9239 4444
email: bill.physick@csiro.au

FINAL REPORT

Report C/0896 **November 2004**

Executive Summary

The air-quality model TAPM has been used to evaluate the separate impacts on air quality of proposed 200 megawatt (MW) and 2 x 200 MW power stations in the Collie mining and power generation area. The proposed site at Bluewaters is 4 km north-west of Collie power station. A 12-month period (2001) was simulated by TAPM using four nested grids down to a grid spacing of 0.5 km for prediction of pollutant concentrations.

Hourly-varying emissions of sulfur dioxide (SO_2) for each day of the year were used for Muja and Collie power stations (obtained from Western Power). For the same sources, hourly-varying emission files for nitrogen oxides (NO_x), carbon monoxide (CO), mercury (Hg), polycyclic aromatic hydrocarbons (PAH), fluoride and particulate matter with aerodynamic diameter less than 10 microns (PM_{10}) were calculated by scaling the hourly SO_2 rates by the ratio of the annual emission of each pollutant to the annual SO_2 value. Emissions from Worsley power station, taking into account the proposed upgrade, were considered constant. Constant emission rates for all pollutants for the proposed power stations were obtained from Griffin Energy.

The proposed sources were evaluated under a worst-case scenario that included emissions from the four stages of Muja power station (A, B, C and D), Worsley power station, Collie power station, and an expanded (or additional) Collie power station with identical characteristics to the existing station. The following findings arise from an examination of the highest SO_2 concentrations over a 12-month period.

- Scenario 1 (proposed 200 MW Bluewaters I power station in isolation) produced *hourly-averaged* concentrations below the NEPM standard at all times.
- Scenario 2 (proposed 2 x 200 MW Bluewaters I + II power station in isolation), produced *hourly-averaged* concentrations below the NEPM standard on all days except one.
- For scenario 3 (sources Muja A, B, C and D, Collie, Collie expansion (identical to Collie), Worsley and Bluewaters I), there were exceedances of the NEPM standard for hourly-averaged concentrations on 27 days, associated with both Collie and Muja power stations (Figure A.3).
- For scenario 4 (scenario 3 sources plus Bluewaters II), there were also 27 exceedance days. Comparison with scenario 5 (sources Muja A, B, C and D, Collie, Collie expansion, and Worsley) shows that the proposed sources do not lead to any additional exceedance days.

For 24-hour averaged concentrations of SO_2 (Figures A.11 to A.15), only one exceedance occurred for scenarios 3 and 4 (no contribution from Bluewaters), and for annual-averaged concentrations (Figures A.16 to A.20), the NEPM limit was exceeded for scenarios 3 and 4, though with no contribution from the proposed Bluewaters sources.

For all scenarios, SO_2 NEPM standards were not exceeded at Collie township for any of the averaging periods.

Predicted concentrations of carbon monoxide, mercury, PAH, fluoride, nitrogen dioxide and ozone were all below NEPM standards or World Health Organisation

guidelines, while exceedances of PM_{10} NEPM standards were due to emissions from Muja power station and occurred in the near vicinity.

In summary, the TAPM modelling shows that emissions from both the proposed 200 MW and 2 x 200 MW power station do not lead to an increase in the number of days on which the NEPM standard for hourly-averaged SO_2 is exceeded. This is under a scenario that includes the existing Muja, Collie and Worsley power stations plus an expansion of the Collie station.

Table of Contents

1 Introduction

This report presents results from an air-pollution modelling study in the Collie mining and power-generation area, located about 150 km south-south-west of Perth. The study for Griffin Energy Pty Ltd evaluates the separate impacts of a 200 MW and 400 (2 x 200) MW proposed power stations at Bluewaters on the proposed Coolangatta industrial estate. An annual simulation, for 2001, is carried out with the air-pollution model TAPM and various concentration statistics for a number of pollutants were calculated and assessed against NEPM standards and health guidelines. Previous studies were done for Griffin Energy by Physick and Edwards (2004a, 2004b) for 150 and 200 MW power stations.

In this study, TAPM is used in tracer mode to model ground-level concentrations of

- SO_2, CO, mercury, PAH, and fluoride,

and in reactive chemistry mode to predict ground-level concentrations of

- PM_{10}, NO_2 and O_3.

Emissions are modelled from existing point sources in the region, from natural sources (soil nitrogen oxides (NO_x) and biogenic volatile organic compounds (VOC) emissions), and from the proposed power station sources.

2 Emissions Data and Modelling Setup

The locations of the Collie and Muja power stations, the power station associated with the refinery at Worsley, the proposed site at Bluewaters for the Griffin Energy power station and the Collie township, are shown on the topographic map in Figure 2.1.

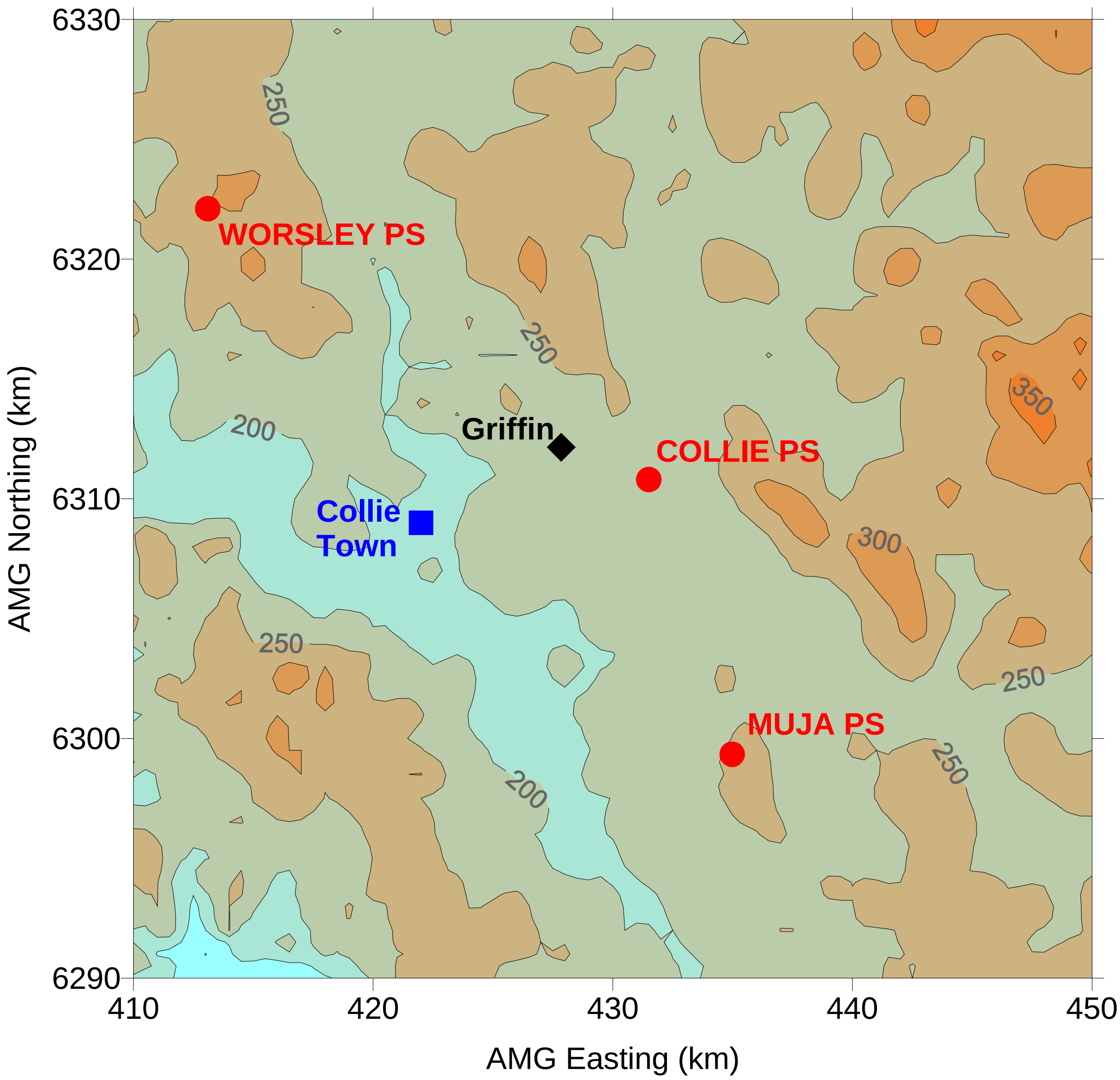

Figure 2.1 Topographic map of the study region showing the location of the Collie, Muja and Worsley power station sources (●), the Collie township (■) and the proposed Griffin Energy site at Bluewaters (♦). Contours indicate terrain height above sea level (m).

2.1 Sulfur dioxide emissions

2.1.1 Existing sources

In this report, the existing Collie power station is referred to as Collie A, as three of the emission scenarios include an addition (Collie B) to Collie A. The expanded Collie power station (A+B) is modelled as one source, with double the emissions of Collie A, but the increased buoyancy from the two flues within the one stack is taken into account by increasing the stack radius (by the square root of 2). Collie A+B has the same hourly profile of emissions as Collie A (but double the mass). The emissions file for 2001, used in this study with the kind permission of Western Power, for Muja A, Muja B, Muja C, Muja D and Collie A, consists of hourly-averaged SO_2 data from the five power station point sources, and a constant emission rate from the Worsley power station stack. The Muja sources lie approximately in a straight line (oriented $300^o/120^o$) with a separation of 55 m between A and B, 122 m between B and C, and

116 m between C and D. Collie power station, which came online at the end of 1998, is 13 km north-north-west of Muja, and Worsley power station is 32 km north-west of Muja (Figure 2.1). Locations of these sources and emission parameters at maximum continuous rating are listed in Table 2.1. *Actual emission parameters vary hour by hour and are contained in the emissions files used in the modelling.* Note that the Worsley stack contains three flues, each with a diameter of 2.3 m. Combining them into a single stack for the modelling, and maintaining the same flow rate, gives an effective diameter of 4.0 m for this stack. The Worsley emission rate for SO_2 in Table 2.1 includes the proposed upgrade, and consequently is 10% higher than that used in previous work for Griffin Energy (Physick and Edwards, 2004a).

Hourly exit temperatures were calculated using relations between temperature and MW load for each unit, developed in Section 4.1.1 of Pitts (2002) – note that each stage at Muja (i.e. A, B, C and D) consists of two units. Hourly exit velocities for each stage were taken to be proportional to load.

Table 2.1 Locations, in Australian Map Grid (AMG) coordinates, and emission parameters at maximum continuous rating for the six existing power station stacks (from Pitts 2002), and for the proposed sources (Bluewaters I, II and Collie B).

Source (stack)	AMG Easting (km)	AMG Northing (km)	Stack Height (m)	Stack tip diameter (m)	Exit temp. (deg C)	Exit velocity ($m\ s^{-1}$)	SO_2 ($g\ s^{-1}$)
Muja A	435.785	6298.979	98	3.94	200	19.0	297
Muja B	435.734	6299.001	98	3.94	200	19.0	297
Muja C	435.636	6299.074	151	5.91	133	20.4	784
Muja D	435.525	6299.109	151	5.91	133	19.0	746
Collie A	431.227	6310.439	170	5.23	152	24.4	550
Collie A+B	431.227	6310.439	170	7.40	152	24.4	1100
Worsley	413.074	6322.109	76	4.00	130	23.7	374
Bluewaters I	427.850	6312.150	100	4.13	130	24.0	296
Bluewaters I+II	427.850	6312.150	100	5.84	130	24.0	592

2.1.2 Proposed sources

This study evaluates the impact on air quality of a 200 MW power station (Bluewaters I) and a 2 x 200 MW power station (Bluewaters I+II). Source characteristics and site location are listed in Table 2.1. Bluewaters I is a 200 MW station powered by a turbine, and Bluewaters II is identical to Bluewaters I. However the combined two-turbine 400 MW power station, denoted Bluewaters I+II in Table 2.1, consists of two flues within one stack. The exit temperature and exit velocity are the same as for Bluewaters I, but the emissions are double and the stack diameter (equivalent) increases to 5.84 m, from 4.13 m for Bluewaters I. For the TAPM simulation, there is no hourly variation in emissions from these sources; for each hour, SO_2 is emitted at the maximum rate.

2.2 Emissions of NO_x, PM_{10}, CO, Hg, PAH and fluoride

Total annual emissions of these pollutants for the existing sources were obtained from the national pollutant inventory (NPI) website and are listed in Table 2.2. Hourly-varying emission rates were calculated by scaling the hourly SO_2 rates by the ratio of the annual emission of each pollutant to the annual SO_2 value. Annual emissions for the proposed Griffin source at Bluewaters are also listed in Table 2.2, and the constant hourly emission rate is used for the simulations.

Following advice from DEP, concentrations of VOCs are not considered in this study as the emission rate from coal combustion in the Collie region is very small.

Table 2.2 Annual emissions (kg) from existing power stations in the Collie area, and from the proposed Griffin energy power station Bluewaters I. Emissions for Bluewaters I+II are double those for Bluewaters I. The corresponding emission rate in g/s is shown in parentheses for NO_x, PM_{10} and SO_2, although only Worsley and Bluewaters are modelled as emitting at these constant rates. Existing data are sourced from NPI website for year 2001-2002.

Emission	Muja	Collie	Worsley	Bluewaters I
NOx	23,000,000 (729)	3,900,000 (124)	4,025,000 (124)	3,815,000 (121)
PM_{10}	17,000,000 (539)	180,000 (5.7)	1,000,000 (32)	283,800 (9)
Carbon Monoxide	870,000	3,500,000	1,500,000	2,933,000
Mercury	250	41	690	30.5
PAH	35	9.8	18	6
Fluoride	260,000	36,000	60,000	18,600
SO_2	36,000,000 (1142)	14,000,000 (444)	11,795,000 (374)	9,335,000 (296)

It should be noted that for Collie power station, the actual total SO_2 emissions used in the modelling for 2001 was 12,400,000 kg, a reduction of 11.4% from the NPI website value in Table 2.2. This was mainly due to a total of 5 weeks when the power station was not operating in the period September through November. The same reduction applies to emissions of the other pollutants in Table 2.2. Muja actually put out 40,843,000 kg of SO_2, an increase of 11.9% over the value in Table 2.2.

2.3 Soil and biogenic emissions

VOC emissions at 30^{o}C and a photosynthetic active radiation (PAR) level of 1000 µ mol m^{-2} s^{-1}, calculated according to vegetation type, are input on a 3-km spaced grid covering the total modelled region. Similarly, gridded NO_x emissions from the soil are input at 30^{o}C. Throughout a simulation, TAPM adjusts the emissions according to temperature (VOC and NO_x) and PAR level (VOC).

2.4 Background emissions

A single value of background O_3 (20 ppb) was used for all months of the year. It is also necessary to assign a background value for R_{smog}, partly to account for a general background concentration of VOCs but also to compensate for the omission of some inorganic radical-producing reactions in the GRS photochemical mechanism. Following the Pilbara work of Hurley et al. (2003b), a value of 0.2 ppb was chosen as most suitable for our situation, i.e. dominant point sources emitting into a relatively pristine background environment. This contrasts to the R_{smog} value of 1.0 deemed appropriate for the urban environment of Perth, a city of 1 million people and associated area sources (Physick *et al*. 2002).

In the absence of any local monitoring data, the background value of PM_{10} was set to zero. However, it should be noted that emissions from activities associated with mining operations have not been included in this study.

2.5 Emission scenarios

The impact of the Bluewaters sources is evaluated against the worst-case situation for existing and proposed sources. This includes the Muja A and B sources as well as Muja C and D, and an expansion of Collie power station to double its current capacity. Ground-level concentrations are evaluated for

scenario 1 - the proposed Bluewaters I source in isolation,
scenario 2 - the proposed Bluewaters I and II sources in isolation,
scenario 3 - existing sources Muja A, B, C, D, Worsley (including proposed upgrade), Collie (denoted as Collie A) and an expansion of Collie A with the same characteristics (denoted Collie B), and Bluewaters I,
scenario 4 - sources from scenario 3 plus Bluewaters II,
scenario 5 - existing sources Muja A, B, C, D, Worsley (including proposed upgrade), Collie (denoted as Collie A) and an expansion of Collie A with the same characteristics (denoted Collie B)

The various scenarios are outlined in Table 2.3.
Only scenarios 3, 4 and 5 are simulated for the secondary pollutants NO_2, O_3 and PM_{10}.

Table 2.3. Scenarios to be modelled.

	Scenario				
	1	**2**	**3**	**4**	**5**
Muja A, B			x	x	x
Muja C, D			x	x	x
Collie A			x	x	x
Collie B			x	x	x
Worsley			x	x	x
Bluewaters I	x	x	x	x	
Bluewaters II		x		x	

2.6 Modelling

As part of their study of monitoring data and model verification in the Collie region, Hibberd and Physick (2003) examined wind data at 10 m above the ground for Collie monitoring station for 6 years (1996 – 2001) and concluded that, though there are some year-to-year variations in the speed and direction distributions, with 1996 having noticeably fewer south-easterlies than other years, the variations are small. The years 1997, 1998, and 2001 selected for modelling in that study represent "typical" years.

We feel that it is not necessary to take annual variability into account for this region by modelling more than one year and for our study we have chosen to model 2001.

2.6.1 TAPM

TAPM (Hurley, 2002) was developed at CSIRO Atmospheric Research and consists of prognostic meteorological and air pollution modules that can be run for multiple-nested domains. The meteorological module is an incompressible, non-hydrostatic, primitive equation model for three-dimensional simulations. It predicts the three components of the wind, temperature, humidity, cloud and rainwater, turbulent kinetic energy and eddy dissipation rate, and includes a vegetation/soil scheme at the surface and radiation effects. The model is driven by six-hourly analysis fields (on an approximately 100-km spaced grid) of winds, temperature and specific humidity from the Bureau of Meteorology's Global Assimilation and Prediction system (GASP). These analyses contain the larger-scale synoptic variability, while TAPM is run for much finer grid spacings and predicts the meteorology at smaller scales.

The air pollution module solves prognostic equations for pollutant concentration using predicted wind and turbulence fields from the meteorological module. It includes gas- and aqueous-phase chemical reactions based on an extended version of the Generic Reaction Set (GRS) developed at CSIRO Energy Technology, a plume-rise module, and wet and dry deposition effects.

TAPM has been used by CSIRO in previous studies involving assessment of new or expanding industries in the Pilbara region (Noonan 1999, 2002a, b, Hurley et al. 2003a, b), as well as in verification studies for the Pilbara region (Physick and Blockley, 2001, Physick et al. 2002, Hurley et al. 2004) and for Collie (Hibberd and Physick, 2003a, b). For TAPM Version 2.6 (used in this study), ranked plots of modelled SO_2 concentrations against observed concentrations at three sites in the Collie monitoring network for 2001 are shown in Figure 2.2. A ranked plot consists of paired modelled and observed concentrations after the hourly values in each annual set have been ranked from highest to lowest, and can easily identify whether a model is predicting too high or too low, and whether this occurs at the low, medium or high end of the concentrations. Figure 2.2 shows that TAPM slightly overpredicts in the low and medium concentration ranges, but that over prediction is more marked at the higher end, especially at Shotts and Bluewaters. Model predictions are best at the site furthest from the sources, Collie.

2.6.2 Grids

The meteorological simulations were carried out on four nested grids (each 35 x 35 x 25 gridpoints) with grid spacings of 30, 10, 3 and 1 km. The grid spacings for the corresponding air quality simulations (45 x 45 x 25) over smaller domains were 15, 5, 1.5 and 0.5 km. All grids were centred at ($33^o23'$ S, $116^o15.5'$ E) – between Collie monitoring site, Collie power station and Muja power stations - and corresponding to (431017, 6305957) metres in AMG coordinates. All sources and monitoring stations are situated on the innermost grid, except the Worsley power station which is on the 1.5-km spaced grid.

Emissions from Collie A and B and Bluewaters sources were dispersed using the Lagrangian particle module on the innermost grid. For this 0.5-km spaced grid, the Lagrangian technique provides greater accuracy than the Eulerian approach in estimating ground-level concentrations near the source (within 5 km).

The land-use classification was obtained from the dataset accompanying the TAPM modelling package. Terrain elevation was obtained from AUSLIG data (250-m resolution). The monthly values of deep soil moisture were assigned according to some preliminary meteorological simulations in which temperatures at 10 m were compared to observations. A value of 0.10 was used for November to April, 0.20 May to August and 0.15 for September and October. As determined in Hibberd and Physick (2003a, b), buoyancy enhancement factors N_E of 1.8 for Muja stacks A and B, and 2.0 for Muja stacks C and D were assigned.

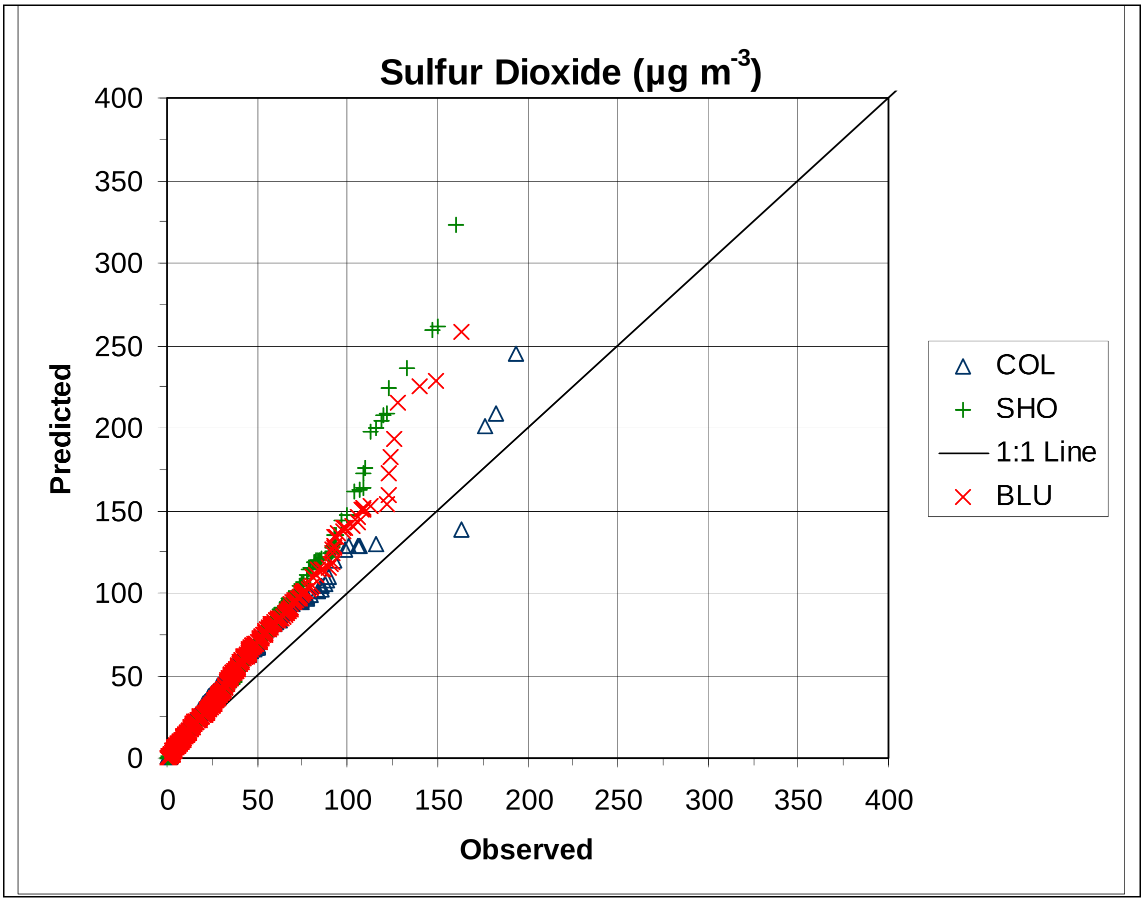

Figure 2.2 Plot of ranked model predictions (TAPM V2.6) against ranked observations of hourly-averaged SO_2 concentrations for 2001 at three monitoring sites, Collie (Δ), Shotts (+) and Bluewaters (×).

2.6.3 Summary of TAPM Configuration

The configuration for TAPM version 2.6 used in this study is:

- four nested grids (each 35 x 35 x 25 gridpoints) for the meteorology with grid spacings of 30, 10, 3 and 1 km;
- grid spacings for the corresponding air quality simulations (45 x 45 x 25 gridpoints) of 15, 5, 1.5 and 0.5 km (Note that that the meteorology and air quality grids do not cover exactly the same area, though they are centred at the same point.);
- all grids centred at (33°23´ S, 116°15.5´ E), corresponding to (431017, 6305957) metres in AMG coordinates;
- land-use classification obtained from the data set accompanying the TAPM modelling package;
- terrain elevation obtained from AUSLIG data (250-m resolution);

- deep soil moisture values of 0.10 for November to April, 0.20 for May to August and 0.15 for September and October;
- buoyancy enhancement factors N_E of 1.8 for Muja stacks A and B, and 2.0 for Muja stacks C and D;
- background values of 20 ppb and 0.2 ppb for ozone and R_{smog} respectively;
- Lagrangian particle mode used for emissions from Collie A, B and Bluewaters in all scenarios;

The TAPM input files (including the emission files) for 2001 and the various scenarios are included on a CD prepared with this report.

3 Results

Concentration statistics from the annual simulations are presented for the various averaging times associated with the NEPM standards for each pollutant. During post-processing of a simulation, gridded fields of the highest and the ninth-highest concentration at each gridpoint of the innermost grid (22 x 22 km^2) are calculated. The maximum value on each of these grids is presented here in tabular form for most pollutants. The highest and the ninth-highest concentration at the Collie township are also shown. Also listed is the NEPM standard and the number of days on which it is exceeded. Contours of the highest concentrations over the innermost grid are plotted for all pollutants except O_3 which is plotted on the second outermost grid, and the distribution of the ninth-highest concentration is also plotted for SO_2, NO_2, O_3 and PM_{10}.

3.1 Sulfur dioxide

3.1.1 Hourly-averaged concentrations

Hourly-averaged concentration statistics from scenario 1 (Bluewaters I in isolation) and scenario 2 (Bluewaters I and II in isolation) are presented in Table 3.1. The highest predicted concentration for scenario 1 for the year (391 µg m^{-3}) throughout the domain does not exceed the NEPM standard of 570 µg m^{-3}. For scenario 2, the standard is exceeded (583 µg m^{-3}), though on only one day. Although the emissions in scenario 2 are double those of scenario 1, the ground-level concentrations are less than double because of the greater initial buoyancy flux associated with scenario 2, and hence higher plume-rise height. Examination of the contour distributions in Figure A.1 for scenario 1 in Appendix A shows that the annual highest concentration in the region occurs about 2 km to the east of the proposed site, as the elevated plume is convectively mixed (fumigated) to the ground. Similar areas of high concentration are also evident elsewhere and for scenario 2 in Figure A.2, illustrating the importance of morning fumigation in producing high concentrations relatively far from the source. In scenario 2, the maximum occurs 7 km to the northwest of the site.

Also shown in Table 3.1 are the concentration statistics from scenario 3 (existing sources plus Collie B plus Bluewaters I) and scenario 4 (sources from scenario 3 plus Bluewaters II). The NEPM standard for SO_2 is predicted to be exceeded in the region on 27 days for both scenarios. However the additional source in each scenario does not add any extra exceedance days over the total for the Muja, Collie A and B and Worsley combination (scenario 5).

The maximum concentration in scenarios 3, 4 and 5 occurs about 2 km east of Muja power station (Figures A.3 – A.5), with small contributions from Bluewaters I (41 µg m^{-3}) and Bluewaters I+II (149 µg m^{-3}). There is also a small exceedance area northeast of Collie power station (Figure A.5), which is unaffected by either of the proposed power stations. The addition of Bluewaters I does not lead to an increase in the number of exceedance areas (Figure A.3), but emissions from Bluewaters II, in concert with Collie, lead to small areas 5 km southwest of Bluewaters and 8 km northwest of the proposed station (Figure A.4).

Contour plots of the 9^{th}-highest concentration distribution can be found in Figures A.6 to A.10, and agree with the general findings above, although there is barely any contribution from the Bluewaters sources to the domain-wide maximum just east of Muja.

The concentration statistics shown in Table 3.2 for Collie township show that predicted concentrations for all scenarios are well below the NEPM standard. Contributions from Bluewaters I to the highest concentration at Collie are negligible, but Bluewaters II emissions increase it by 9%.

Table 3.1 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of sulfur dioxide (μg m^{-3}) over the innermost modelling domain (22 x 22 km^2).

Scenario	1	2	3	4	5
Highest	391	583	1104	1212	1063
9^{th}-highest	198	245	596	602	594
NEPM standard	570	570	570	570	570
Exceedance days	0	1	27	27	27

Table 3.2 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of sulfur dioxide (μg m^{-3}) at the Collie township.

Scenario	1	2	3	4	5
Highest	147	191	345	373	343
9^{th}-highest	79	141	148	169	147
NEPM standard	570	570	570	570	570
Exceedance days	0	0	0	0	0

3.1.2 Short-term concentrations

Estimates of the annual highest and 9^{th}-highest 10-minute and 3-minute averages of SO_2 at Collie township (Tables 3.2a and 3.2b) have been made using a power law dependence of the concentration on averaging time of the form:

$$\frac{c_a}{c_m} = \left(\frac{t_m}{t_a}\right)^p , \qquad (1)$$

where c_a is the concentration for an averaging time t_a, estimated from the concentration c_m for an averaging time t_m (here 1 hour), and p is the exponent. This procedure is included as an approved method in the NSW EPA Modelling Guidance (NSW EPA, 2001).

Equation (1) has been derived from data for maximum annual concentrations. However, an analysis of the data given by Hibberd (1998) shows that the exponent is approximately the same for the 9th-highest values.

For tall stack emissions, Katestone (1998) recommends a value of *p* = 0.4. The uncertainty in the exponent is quoted by Hibberd (1998) as ±10%, which translates to an uncertainty of about ±10% in the estimated concentrations.

The best guideline for concentrations shorter than 1 hour is the NHMRC goal of 715 µg m^{-3} (250 ppb) for 10-minute average concentrations, which is used in a number of jurisdictions as a guideline in licensing applications.

The predicted 10-minute concentrations at Collie in Table 3.2a show that the NHMRC guideline value is only exceeded in scenario 4, by 49 µg m^{-3}.

Table 3.2a Statistics from the TAPM simulation for 2001 for 10-minute-averaged concentrations of sulfur dioxide (µg m^{-3}) at the Collie township.

Scenario	1	2	3	4	5
Highest	301	391	706	764	702
9th-highest	162	289	303	346	301
Old NHMRC Guideline (250 ppb for 10-minute avg)	715	715	715	715	715

Table 3.2b Statistics from the TAPM simulation for 2001 for 3-minute-averaged concentrations of sulfur dioxide (µg m^{-3}) at the Collie township.

Scenario	1	2	3	4	5
Highest	487	633	1143	1236	1137
9th-highest	262	467	491	560	487

3.1.3 24-hour and annual-averaged concentrations

Tables 3.3 and 3.4 show that SO_2 emissions from either of the proposed sources in isolation would not lead to any exceedances of the 24-hour NEPM standard (228 µg m^{-3}). The highest concentrations (81 and 111 µg m^{-3} respectively) occur at about 4 km to the northwest of the site for each scenario (Figures A.11 and A.12). For scenarios 3 and 4, the NEPM standard is exceeded on one day (Table 3.3), and Figures A.13 - A.15 show that the exceedance occurs within 2 km of Muja, with no contribution from the proposed Bluewaters sources.

The highest annual-averaged concentrations for scenarios 1 and 2 (Table 3.5 and Figures A.16 and A.17) are 4 µg m^{-3} and 5 µg m^{-3}, well below the NEPM standard of 57 µg m^{-3}. The highest annual-averaged concentrations for the region for scenarios 3, 4 and 5 are predicted to be 62 µg m^{-3} (Table 3.5), with the small exceedance area occurring at Muja power station (Figures A.18 - A.20).

Table 3.3 Statistics from the TAPM simulation for 2001 for 24-hourly-averaged concentrations of sulfur dioxide (µg m^{-3}) over the innermost modelling domain (22 x 22 km^2).

Scenario	1	2	3	4	5
Highest	81	111	234	234	234
9th-highest	47	58	177	177	177
NEPM standard	228	228	228	228	228
Exceedance days	0	0	1	1	1

Table 3.4 Statistics from the TAPM simulation for 2001 for 24-hourly-averaged concentrations of sulfur dioxide (µg m^{-3}) at the Collie township.

Scenario	1	2	3	4	5
Highest	15	27	44	44	44
9rd-highest	7	11	26	29	25
NEPM standard	228	228	228	228	228
Exceedance days	0	0	0	0	0

Table 3.5 Annual-averaged concentrations of sulfur dioxide (µg m^{-3}) from the TAPM simulation for 2001, over the innermost modelling domain (22 x 22 km^2) and at the Collie township.

Scenario	1	2	3	4	5
Domain-wide	6	7	62	62	62
Collie township	0.6	0.9	5	5	4
NEPM standard	57	57	57	57	57

The World Health Organisation (2000) provides guideline concentrations, above which SO_2 is considered to have a detrimental effect on vegetation. The guidelines are in the form of annual averages and are listed in Table 3.5a for different vegetation types. While comparison to model values in Table 3.5 shows that the guideline values are exceeded for scenarios 3, 4 and 5, examination of the contour plots for the annual-average SO_2 concentrations in Figures A.18 - A.20 shows that the exceedance area for crops, forest and natural vegetation is only within a 2 km radius of Muja power station and that emissions from the proposed Bluewaters sources and Collie power station do not contribute to these concentrations. For lichen, the distance extends to 3.5 to 4 km from Muja. Figures A.18 and A.19 show that the addition of the Bluewaters sources, in combination with Collie A and B, produces an exceedance area for lichen of about 3 km^2 for Bluewaters I and 8 km^2 for Bluewaters II, in the near vicinity of those sources.

Table 3.5a WHO guidelines for SO_2 and vegetation for Europe

Vegetation Category	Guideline (μg/m^3)	Time Period
Agricultural Crops	30	Annual and winter mean (6 month winter)
Forests and Natural Vegetation	20	Annual and winter mean (6 month winter)
Lichens	10	Annual Mean

3.2 Carbon monoxide

Eight-hourly-averaged concentrations of CO are considerably lower than the NEPM standard throughout the region (Table 3.6). The contour distributions (Figures B.1 to B.5 in Appendix B) show that the highest concentrations actually occur in the Bluewaters and Collie power station area. This suggests that the annual CO emissions on the NPI website for Muja (Table 2.2) are too low, as it is likely that the highest concentrations actually occur close to Muja power station, as seen for other pollutants in this Report.

Table 3.6 Statistics from the TAPM simulation for 2001 for 8-hourly-averaged concentrations of carbon monoxide (μg m^{-3}) over the innermost modelling domain (22 x 22 km^2).

Scenario	1	2	3	4	5
Highest	53	74	80	91	49
9^{th}-highest	47	60	69	80	37
NEPM standard	10,400	10,400	10,400	10,400	10,400

3.3 Mercury

Mercury is injurious to human health (renal tubular effects), with the World Health Organisation recommending an annual-averaged concentration of 1 μg m^{-3} as a recommended upper limit for mercury concentrations in air. The highest annual-averaged concentrations in the region and at Collie township (Table 3.7) are three orders of magnitude smaller than the WHO guideline value. A plot of the regional distribution can be seen in Figures C.1 to C.5 of Appendix C.

Table 3.7 Annual-averaged concentrations of mercury (µg m^{-3}) from the TAPM simulation for 2001, over the innermost modelling domain (22 x 22 km^2) and at Collie township.

Scenario	1	2	3	4	5
Domain-wide	1.9E-05	2.2E-05	4.5E-04	4.5E-04	4.5E-04
Collie township	2.0E-06	3E-06	6.4E-05	6.5E-05	6.2E-05
WHO guideline	1	1	1	1	1

3.4 PAH

Polycyclic aromatic hydrocarbons (PAH) are considered an air toxic and are associated with lung cancer. The WHO guidelines discuss the concentrations of benzo [a} pyrene (BaP) in terms of an excess lifetime cancer risk. For example, lifetime exposure to a BaP concentration of 1.2 ng m^{-3} is 1 in 10,000. Table 3.8 shows that concentrations in the region and at Collie are two to three orders of magnitude smaller than the 1 in 10,000 risk guideline concentration. A plot of the regional distribution can be seen in Figures D.1 to D.5 of Appendix D.

Table 3.8 Annual-averaged concentrations of PAH (µg m^{-3}) from the TAPM simulation for 2001, over the innermost modelling domain (22 x 22 km^2) and at Collie township. The WHO guideline value is the concentration that produces an excess lifetime cancer risk of 1 in 10,000.

Scenario	1	2	3	4	5
Domain-wide	3.7E-06	4.4E-06	6.1E-05	6.1E-05	6.0E-05
Collie township	4E-07	6E-07	4.6E-06	4.8E-06	4.2E-06
WHO guideline	1.2E-03	1.2E-03	1.2E-03	1.2E-03	1.2E-03

3.5 Fluoride

Fluoride damage to vegetation was first recognised during the middle of the nineteenth century. The Australian and New Zealand Environment Council published the National Goals for Fluoride in Ambient Air and Forage in 1990 (ANZEC 1990). For our study, we compare modelled concentrations to the ANZEC maximum acceptable 24-hour average ambient fluoride concentration for General Land Use, a value of 2.9 µg m^{-3}. For Specialised Land Use, taking into account sensitive commercially valuable plants (e.g. grape vines), ANZEC recommend a value of 1.5 µg m^{-3}. For further background information and a discussion of the impact of fluoride emissions on grape vines in the Hunter Valley region, see Taylor et al. (2003).

The highest modelled concentration for all four scenarios (1.7 µg m^{-3} – see Table 3.9) occurs within 2 km of Muja power station (Figures E.1 to E.5 of Appendix E). The highest value in the vicinity of Collie power station and the Bluewaters site is about 0.4 µg m^{-3} (Figure E.4).

Table 3.9 Statistics from the TAPM simulation for 2001 for 24-hourly-averaged concentrations of fluoride (µg m^{-3}) over the innermost modelling domain (22 x 22 km^2).

Scenario	1	2	3	4	5
Highest	0.2	0.2	1.7	1.7	1.7
9th-highest	0.1	0.1	1.3	1.3	1.3
ANZEC goal	2.9	2.9	2.9	2.9	2.9

3.6 Nitrogen dioxide

Table 3.10 shows that the highest hourly-averaged concentration of 100 ppb (associated with Muja power station) is below the NEPM standard of 120 ppb for both proposed scenarios, as is the highest value of 21 ppb at Collie township (Table 3.11). The maximum annual-averaged value is 6 ppb at Muja power station (Table 3.12). The proposed power stations Bluewaters I or I+II do not contribute to any of these values.

The contour plots of the highest, 9th-highest and annual-averaged concentrations in Appendix F illustrate that the largest values occur in the vicinity of Muja power station. They also show that for both scenarios the higher hourly-averaged NO_2 concentrations in the general vicinity of the Collie and Griffin power stations are typically 30-40 ppb, and well below the NEPM standard of 120 ppb, although Bluewaters I+II does combine with Collie A+B to produce concentrations exceeding 70 ppb about 3 km east of Collie power station (Figures F.4 and F.5.

Table 3.10 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of nitrogen dioxide (ppb) over the innermost modelling domain (22 x 22 km^2).

Scenario	3	4	5
Highest	100	100	100
9th-highest	54	54	54
NEPM standard	120	120	120
Exceedance days	0	0	0

Table 3.11 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of nitrogen dioxide (ppb) at the Collie township.

Scenario	3	4	5
Highest	24	24	24
9th-highest	21	21	21
NEPM standard	120	120	120
Exceedance days	0	0	0

Table 3.12 Annual-averaged concentrations of nitrogen dioxide (ppb) from the TAPM simulation for 2001, over the innermost modelling domain (22 x 22 km^2) and at Collie township.

Scenario	3	4	5
Domain-wide	6	6	6
Collie township	1	1	1
NEPM standard	30	30	30

3.7 Ozone

Ozone forms from the precursor gases NO_x and VOCs under warm temperatures and in the presence of sunlight. Formation takes a few hours, and continues as long as there is sunlight and NO_x, and in this time the air mass can travel far from the precursor source. For this reason, we have chosen to examine concentration statistics and plot contours over the 5-km spaced grid, covering an area of 220 x 220 km^2, one hundred times larger than the area of the innermost 0.5 km-spaced grid. Comparison of ozone concentrations on the sub-region of the 5-km grid that corresponds to the 0.5 km grid shows that there is negligible difference (up to 2 ppb) between the ozone values for the two different grid spacings.

The statistics for hourly-averaged and 4-hourly-averaged ozone concentrations for the region and at Collie township are tabulated in Tables 3.13 to 3.16. A striking feature is the narrow range of concentrations. This occurs because the VOC sources (vegetation and a general background source) are spread evenly throughout the region, and are not large. The contour distribution in the plots of Appendix G suggests that the background plus natural emissions (VOC, NO_x) may be responsible for up to 40 ppb of ozone and that the additional NO_x from the power stations may contribute up to 12 ppb.

The maximum hourly-averaged concentration (53 ppb) is the same for each scenario and occurs within a broad band of concentrations over 50 ppb stretching for 100 km to the north of the power stations (see plots in Appendix G). Concentrations are well below NEPM standards, with only three ppb difference between the hourly and 4-hourly maximum. Comparison with the plots from scenario 5 in Appendix G shows that the addition of extra NO_x from either of the proposed Bluewaters stations has a negligible effect on ozone concentrations.

Table 3.13 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of ozone (ppb) over the 5-km spaced modelling domain (220 x 220 km^2).

Scenario	3	4	5
Highest	53	53	53
9th-highest	47	47	47
NEPM standard	100	100	100
Exceedance days	0	0	0

Table 3.14 Statistics from the TAPM simulation for 2001 for hourly-averaged concentrations of ozone (ppb) at the Collie township.

Scenario	3	4	5
Highest	47	48	47
9th-highest	42	42	42
NEPM standard	100	100	100
Exceedance days	0	0	0

Table 3.15 Statistics from the TAPM simulation for 2001 for 4-hourly-averaged concentrations of ozone (ppb) over the 5-km spaced modelling domain 220 x 220 km^2).

Scenario	3	4	5
Highest	50	50	50
9th-highest	46	46	46
NEPM standard	80	80	80
Exceedance days	0	0	0

Table 3.16 Statistics from the TAPM simulation for 2001 for 4-hourly-averaged concentrations of ozone (ppb) at the Collie township.

Scenario	3	4	5
Highest	47	47	47
9th-highest	40	40	40
NEPM standard	80	80	80
Exceedance days	0	0	0

3.8 PM_{10}

Total PM_{10} emissions from the Muja power station are 50-100 times larger than those from the proposed Griffin power stations, and 75 times larger than those from Collie A or B. Hence, it is to be expected that there will be negligible difference between the higher concentrations from the two scenarios and this is borne out in Table 3.17. The contour plots in Appendix H show that the highest PM_{10} concentration in the vicinity of the Griffin and the Collie power stations is between 10 and 20 µg m^{-3} for each scenario.

The highest regional concentration of 106 µg m^{-3} easily exceeds the NEPM standard for a 24-hour average of 50 µg m^{-3} and occurs within 2 kms of the Muja power station. Exceedances are found out to a distance of about 6 km from the source (Figures H.1 and H.2). At the Collie township, highest concentrations are at levels that are less than half of the NEPM standard (Table 3.18).

Table 3.17 Statistics from the TAPM simulation for 2001 for 24-hourly-averaged concentrations of PM_{10} (µg m^{-3}) over the innermost modelling domain (22 x 22 km^2).

Scenario	**3**	**4**	**5**
Highest	106	106	106
9th-highest	80	80	80
NEPM standard	50	50	50
Exceedance days	141	141	141

Table 3.18 Statistics from the TAPM simulation for 2001 for 24-hourly-averaged concentrations of PM_{10} (µg m^{-3}) at the Collie township.

Scenario	**3**	**4**	**5**
Highest	21	21	21
9th-highest	11	11	11
NEPM standard	50	50	50
Exceedance days	0	0	0

4 Summary

4.1 Sulfur dioxide

The following findings arise from an examination of the highest concentrations over a 12-month period for the four emissions scenarios.

- Scenario 1 (proposed 200 MW Bluewaters I power station in isolation) produced *hourly-averaged* concentrations below the NEPM standard at all times.
- Scenario 2 (proposed 2 x 200 MW Bluewaters I + II power station in isolation), produced *hourly-averaged* concentrations below the NEPM standard on all days except one.
- For scenario 3 (sources Muja A, B, C and D, Collie, Collie expansion (identical to Collie), Worsley and Bluewaters I), there were exceedances of the NEPM standard for hourly-averaged concentrations on 27 days, associated with both Collie and Muja power stations (Figure A.3).
- For scenario 4 (scenario 3 sources plus Bluewaters II), there were also 27 exceedance days. Comparison with scenario 5 (sources Muja A, B, C and D, Collie, Collie expansion, and Worsley) shows that the proposed sources do not lead to any additional exceedance days.

For 24-hour averaged concentrations of SO_2 (Figures A.11 to A.15), only one exceedance occurred for scenarios 3 and 4.

For annual-averaged concentrations (Figures A.16 to A.20), the NEPM limit was exceeded for scenarios 3 and 4, though with no contribution from the proposed Bluewaters sources.

For all scenarios, NEPM standards were not exceeded at Collie township for any of the averaging periods.

4.2 Carbon monoxide, mercury, PAH and fluoride

Concentrations of carbon monoxide (Appendix B) were well below the NEPM 8-hourly-averaged concentration standard, while annual- averaged concentrations of mercury (Appendix C) and PAH (Appendix D) were orders of magnitude smaller than WHO guidelines for the protection of human health. 24-hourly-averaged fluoride concentrations (Appendix E) were below the ANZEC goals for vegetation relating to General Land Use.

4.3 Nitrogen dioxide, ozone and particulate matter

NO_x emissions in the Collie region are dominated by those from the Muja power station (six times larger than those of Collie or Griffin power stations). Consequently, the largest concentrations of NO_2 are associated with Muja (see plots in Appendix F), though the highest hourly- and annual-averaged concentrations predicted by TAPM are below the NEPM standard.

Maximum ozone concentrations are often found far from the sources of the precursor gases, and for this reason ozone statistics were examined over a larger region (220 x 220 km^2) than for the other pollutants. Highest concentrations predicted were 53 ppb for hourly-averaged and 50 ppb for four-hourly-averaged ozone (Appendix G), well below the NEPM standards of 100 ppb and 80 ppb respectively. The major component of these concentrations could be attributed to background ozone and precursor emissions from natural sources (soil, vegetation). There is no difference in the concentration statistics from scenarios 3 and 4, suggesting that NO_x emissions from the proposed station would have no effect on the higher regional ozone concentrations.

Regional PM_{10} levels (highest 24-hour concentration of 106 $\mu g\ m^{-3}$) are well above the NEPM standard (50 $\mu g\ m^{-3}$) for as far as 6 km from Muja power station, but are well below the standard near Collie and Bluewaters stations (Appendix H). The higher concentrations are not affected by additional emissions from the Bluewaters sources and highest concentrations at the Collie township are less than half of the NEPM standard.

In summary, the TAPM modelling shows that emissions from both the proposed 200 MW and 2 x 200 MW power station do not lead to an increase in the number of days on which the NEPM standard for hourly-averaged SO_2 is exceeded. This is under a scenario that includes the existing Muja, Collie and Worsley power stations plus an expansion of the Collie station.

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Appendix A Contour plots for TAPM SO_2 concentrations

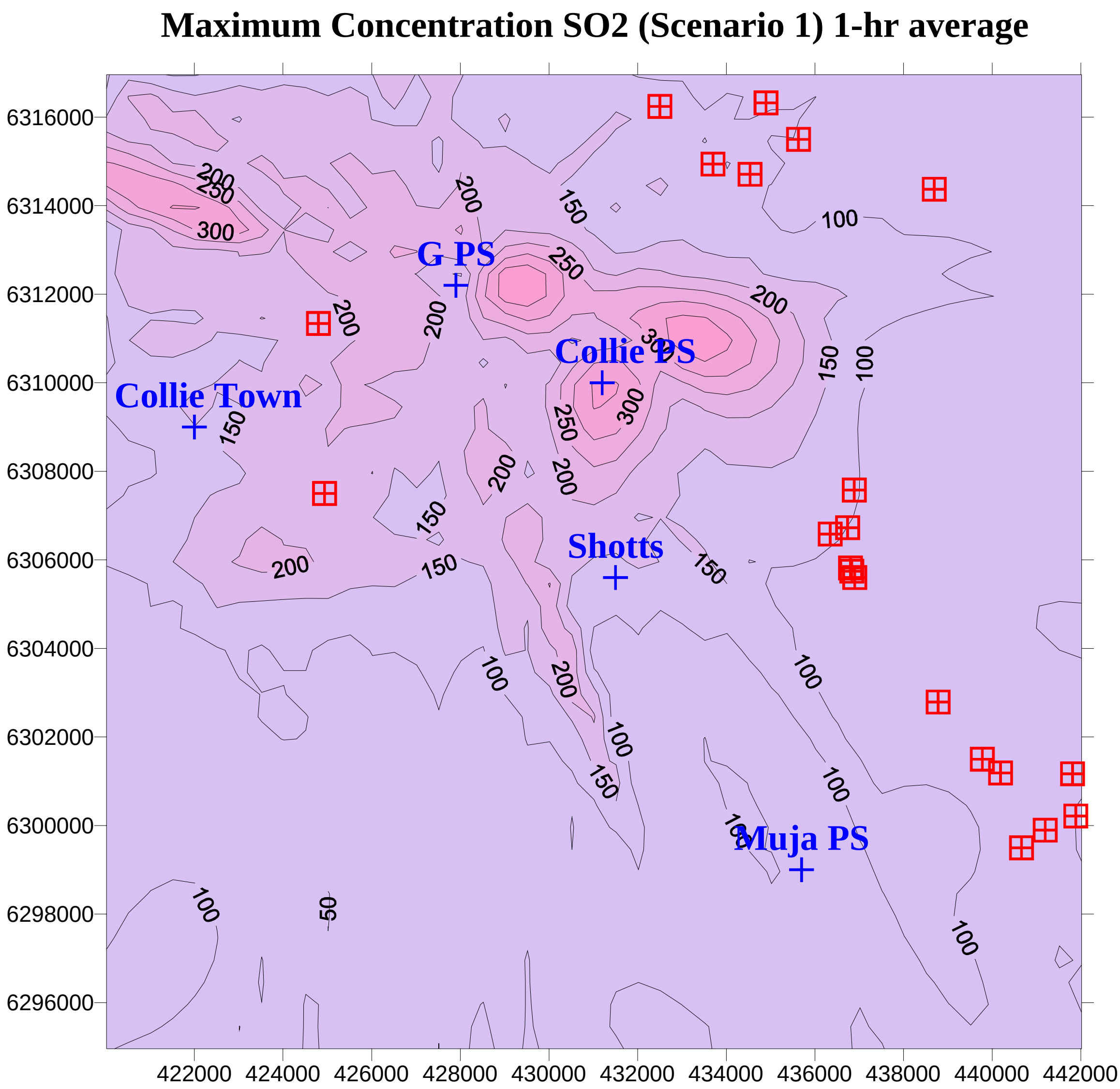


Figure A.1 For Scenario 1 (Bluewaters I), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Maximum Concentration SO2 (Scenario 2) 1-hr average

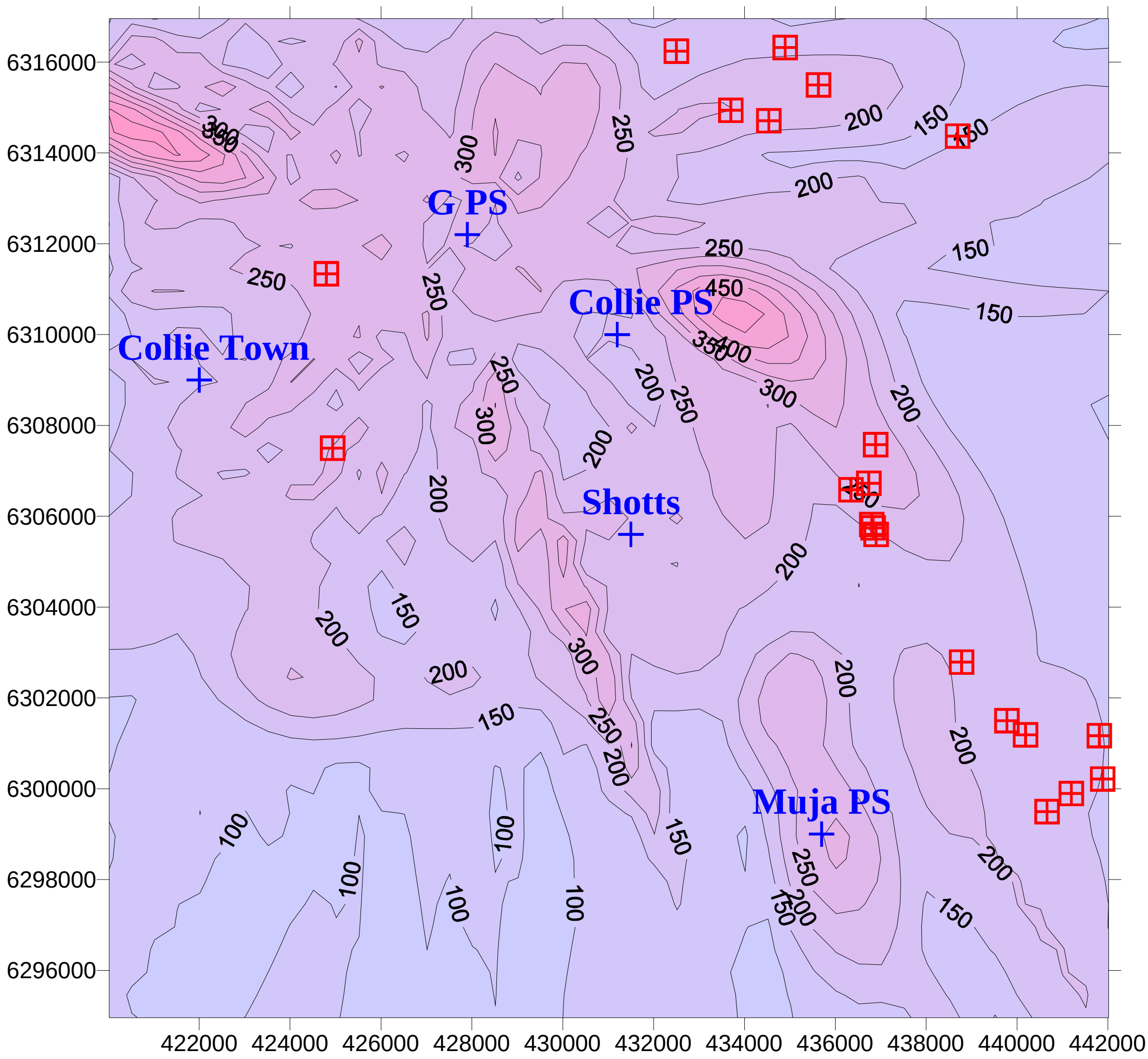


Figure A.2 For Scenario 2 (Bluewaters I + II), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

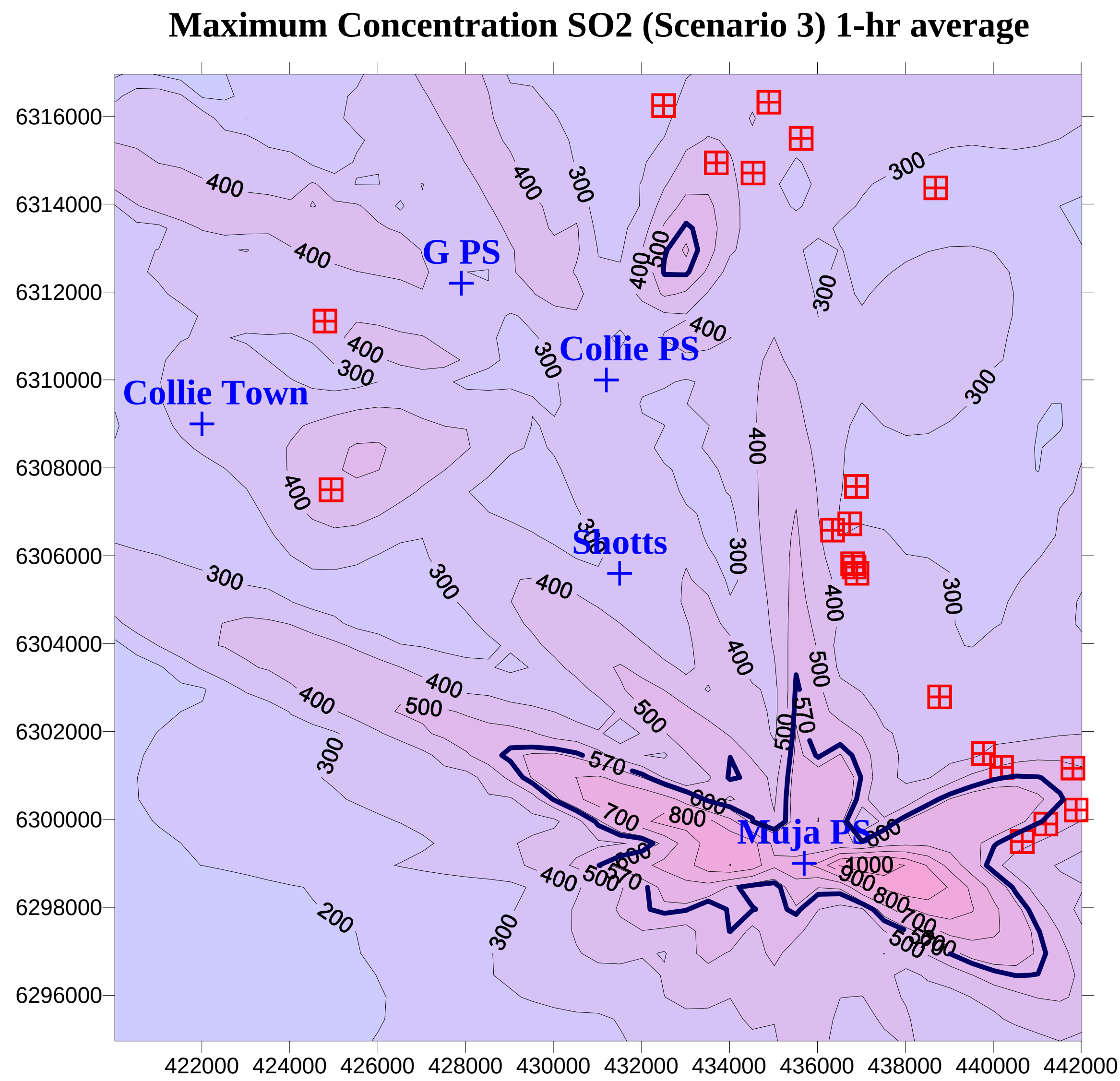


Figure A.3 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

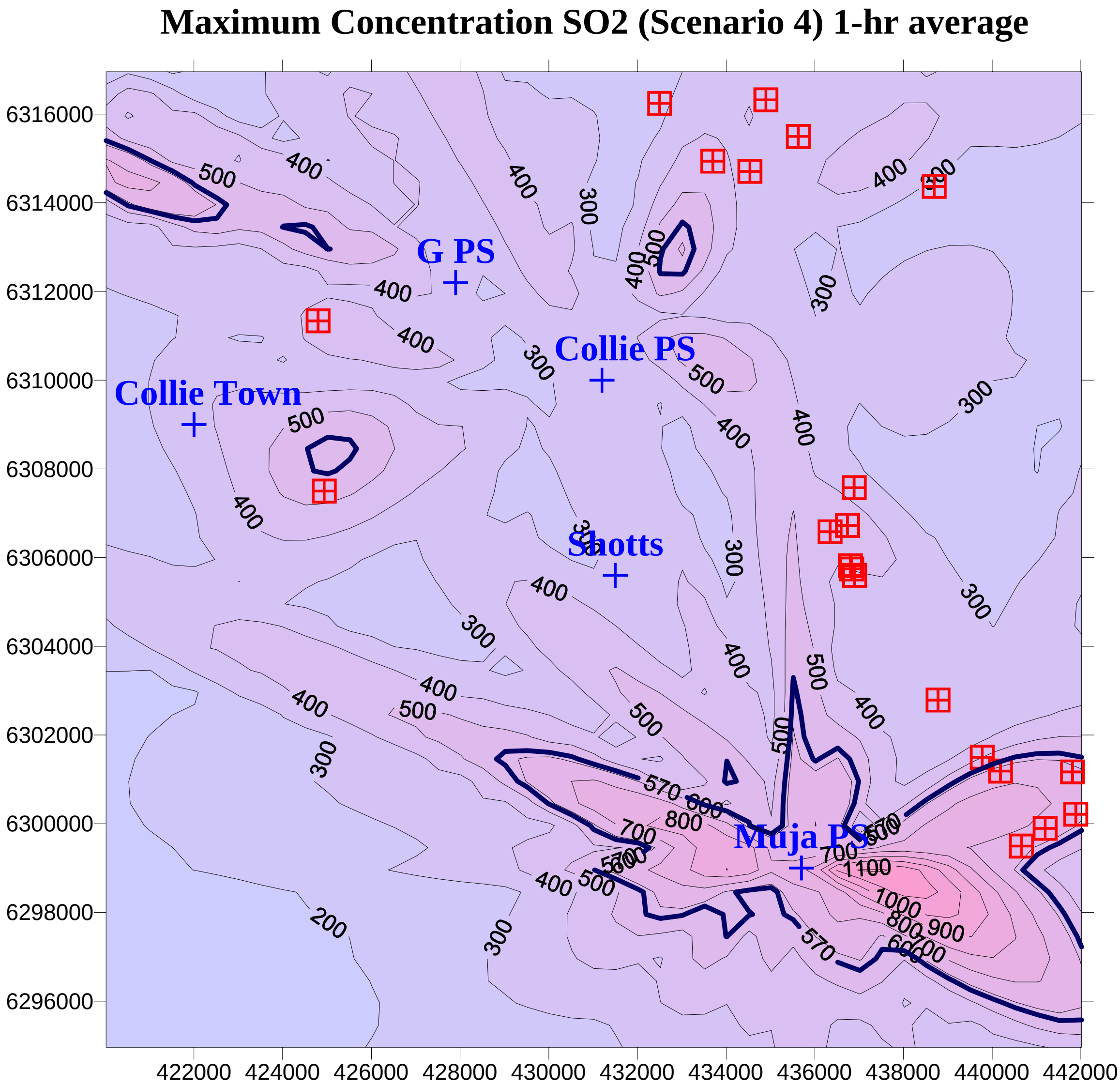


Figure A.4 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

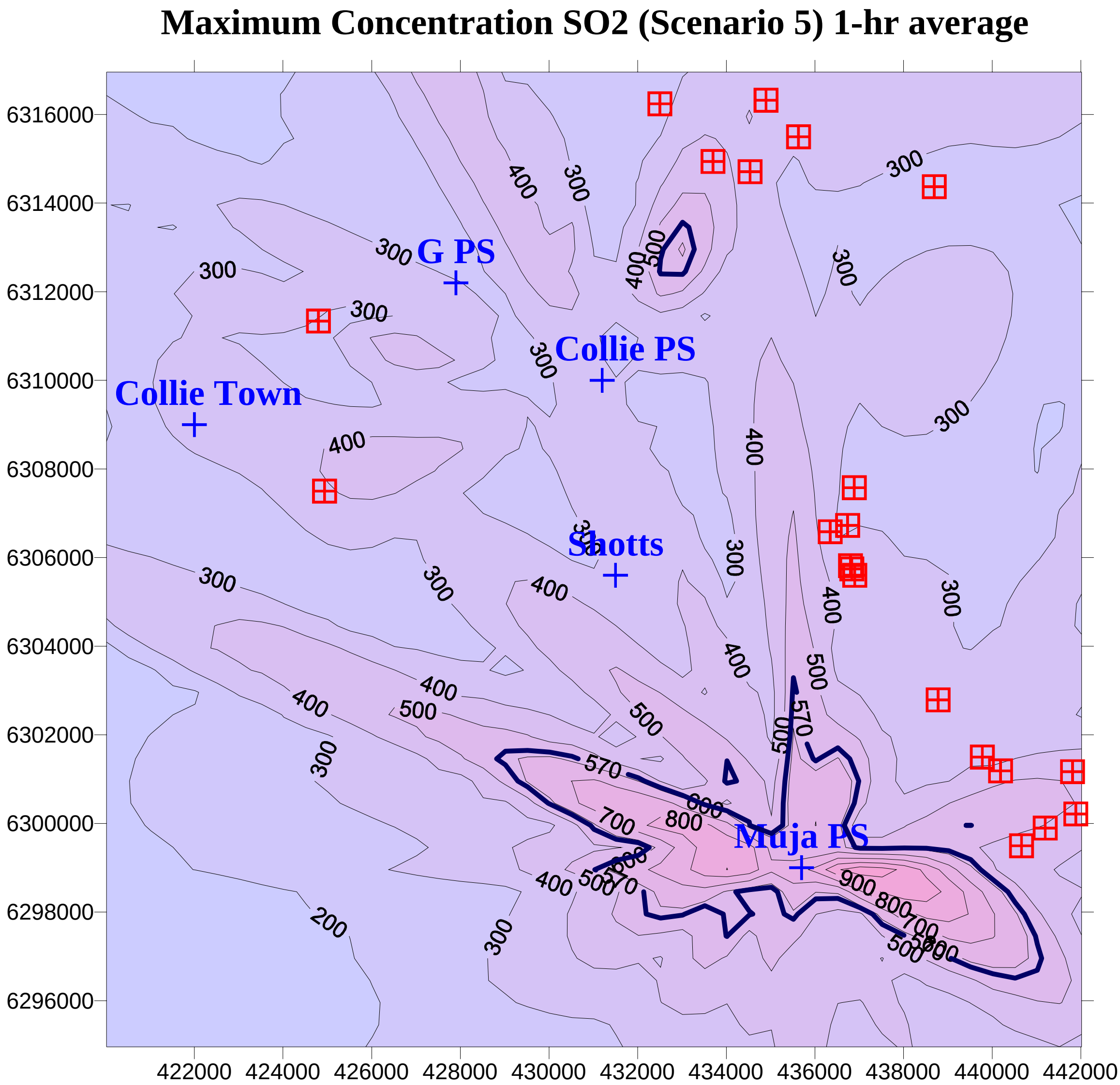


Figure A.5 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

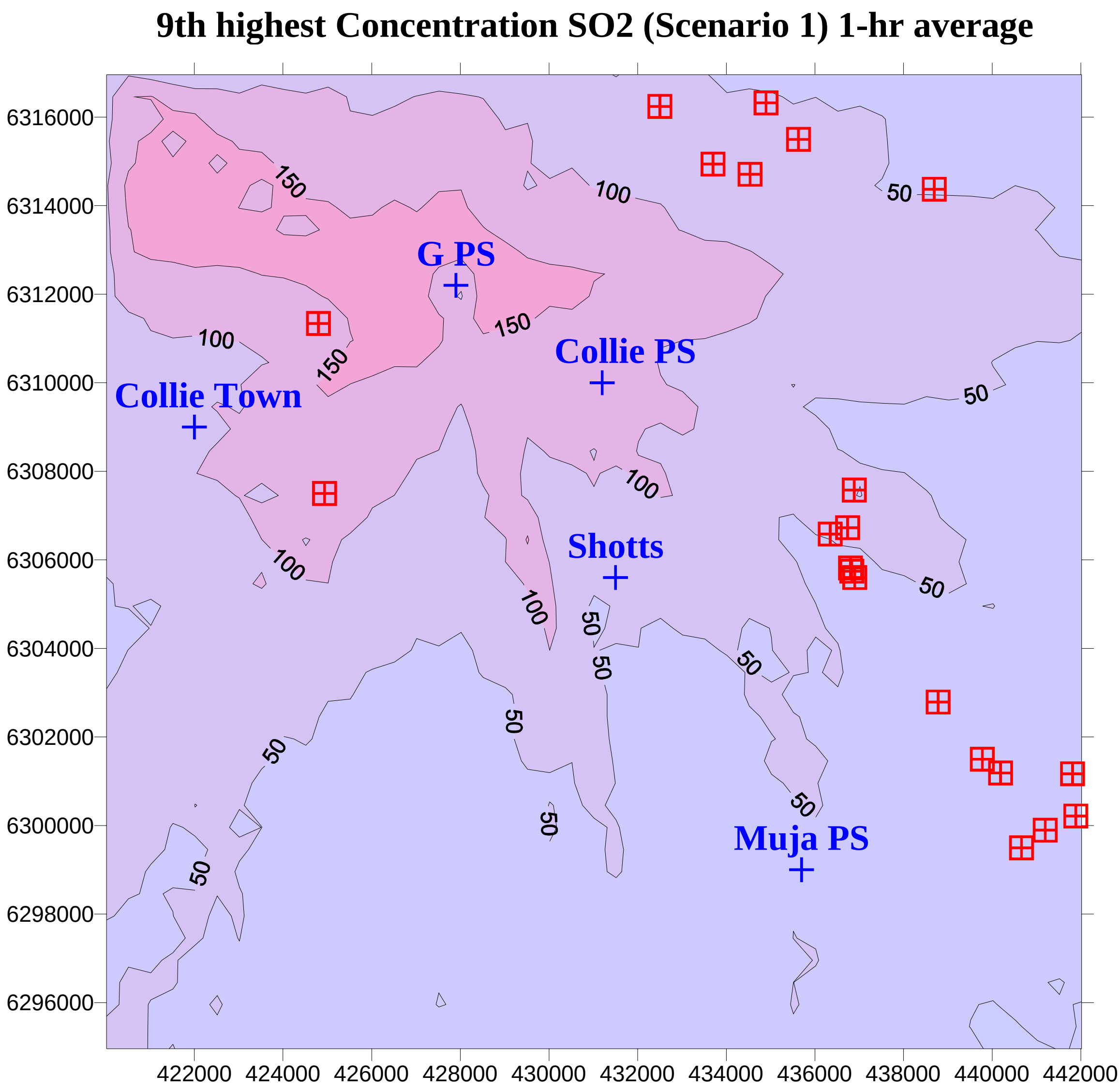


Figure A.6 For Scenario 1 (Bluewaters I), contours of 9^{th}-*highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

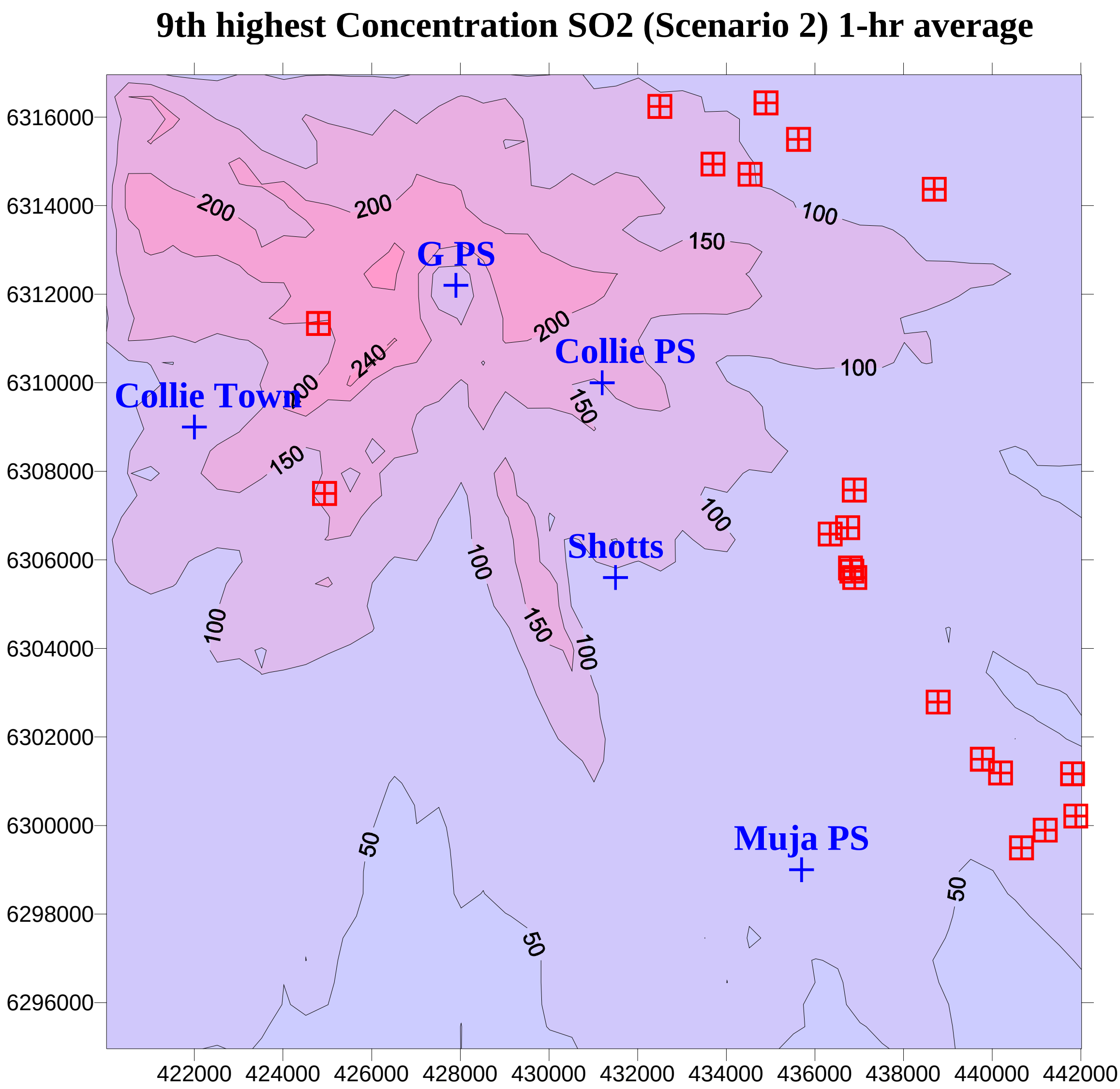


Figure A.7 For Scenario 2 (Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

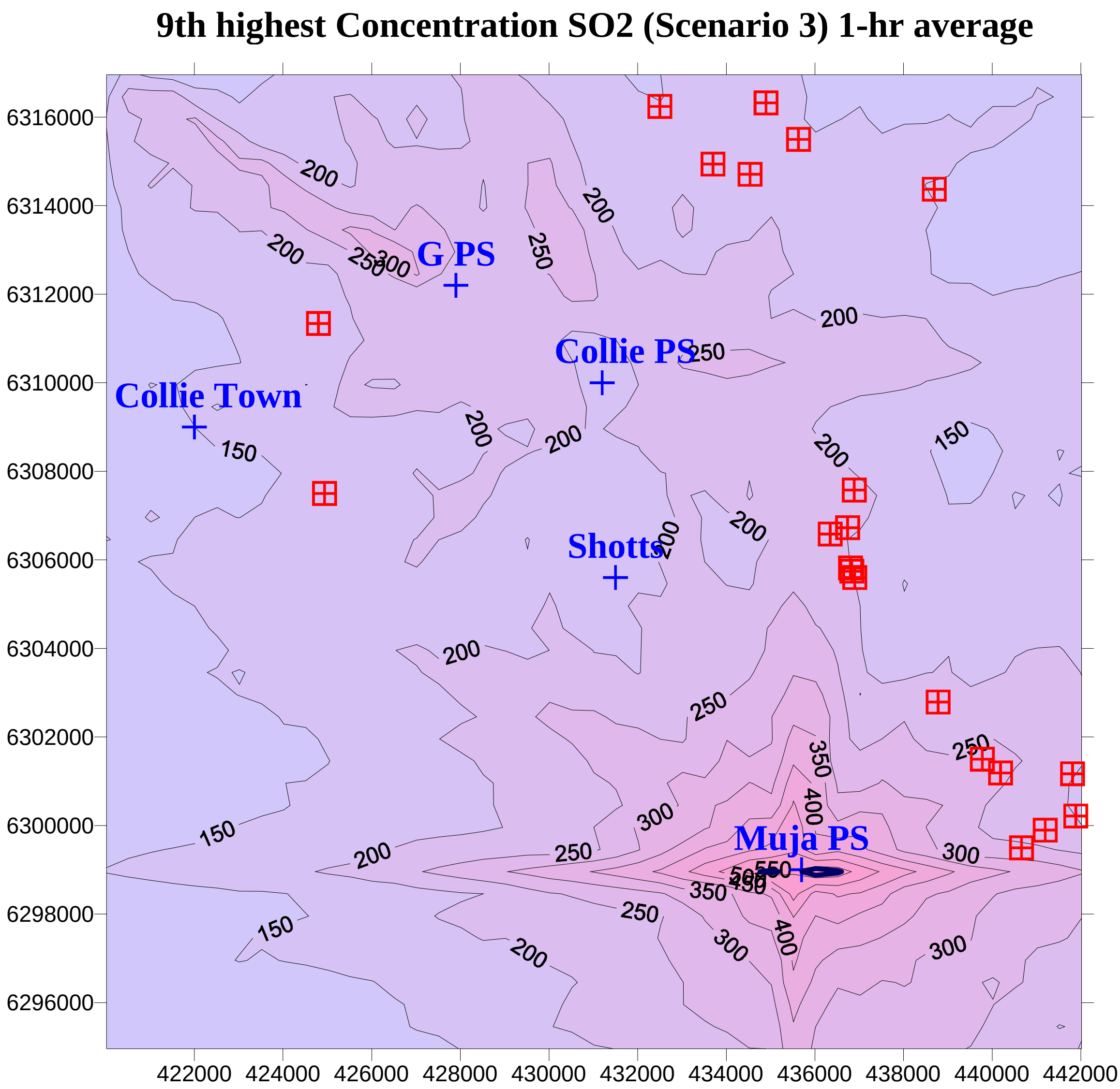


Figure A.8 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th-highest* hourly-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

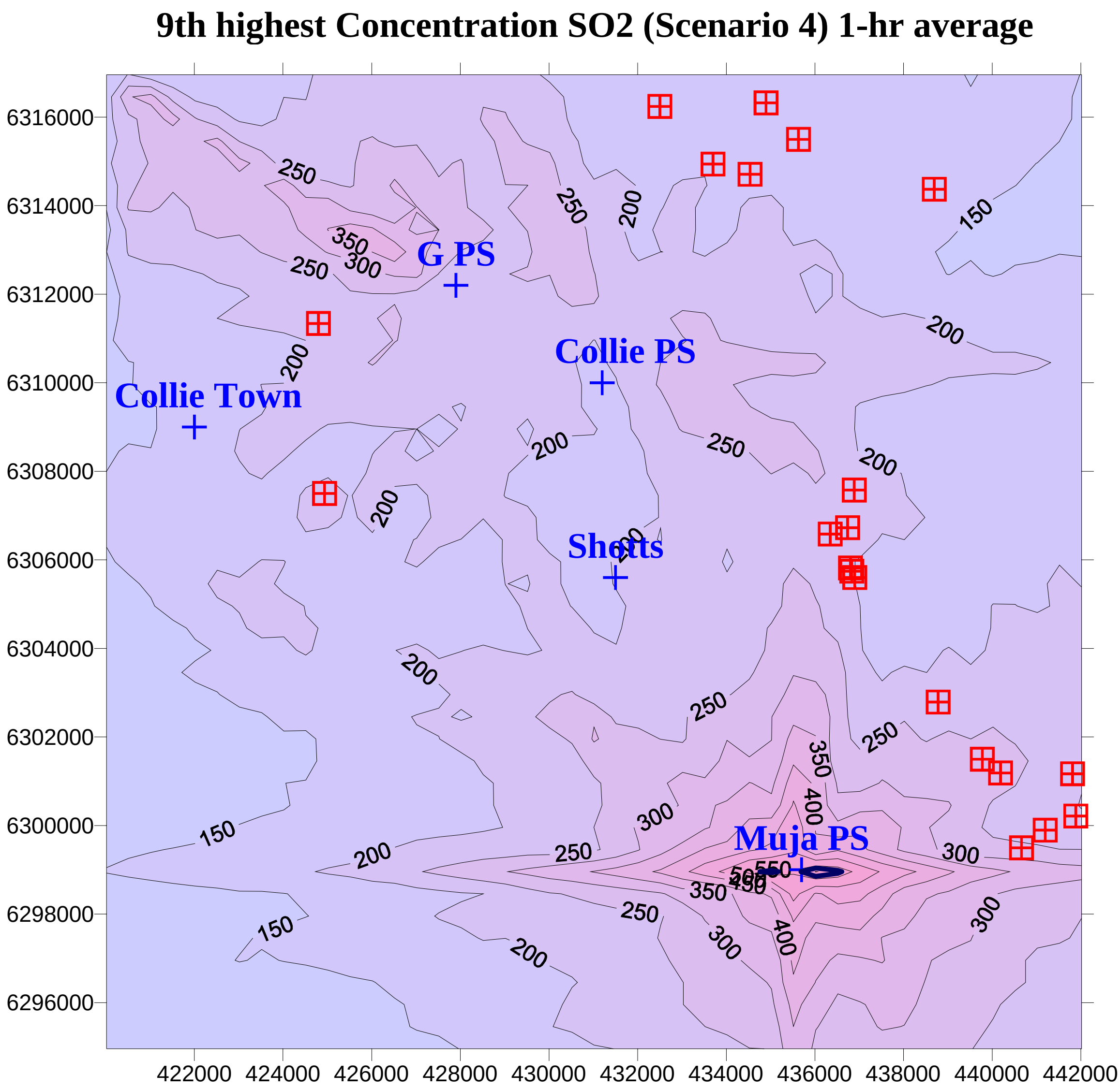


Figure A.9 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9^th^-highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

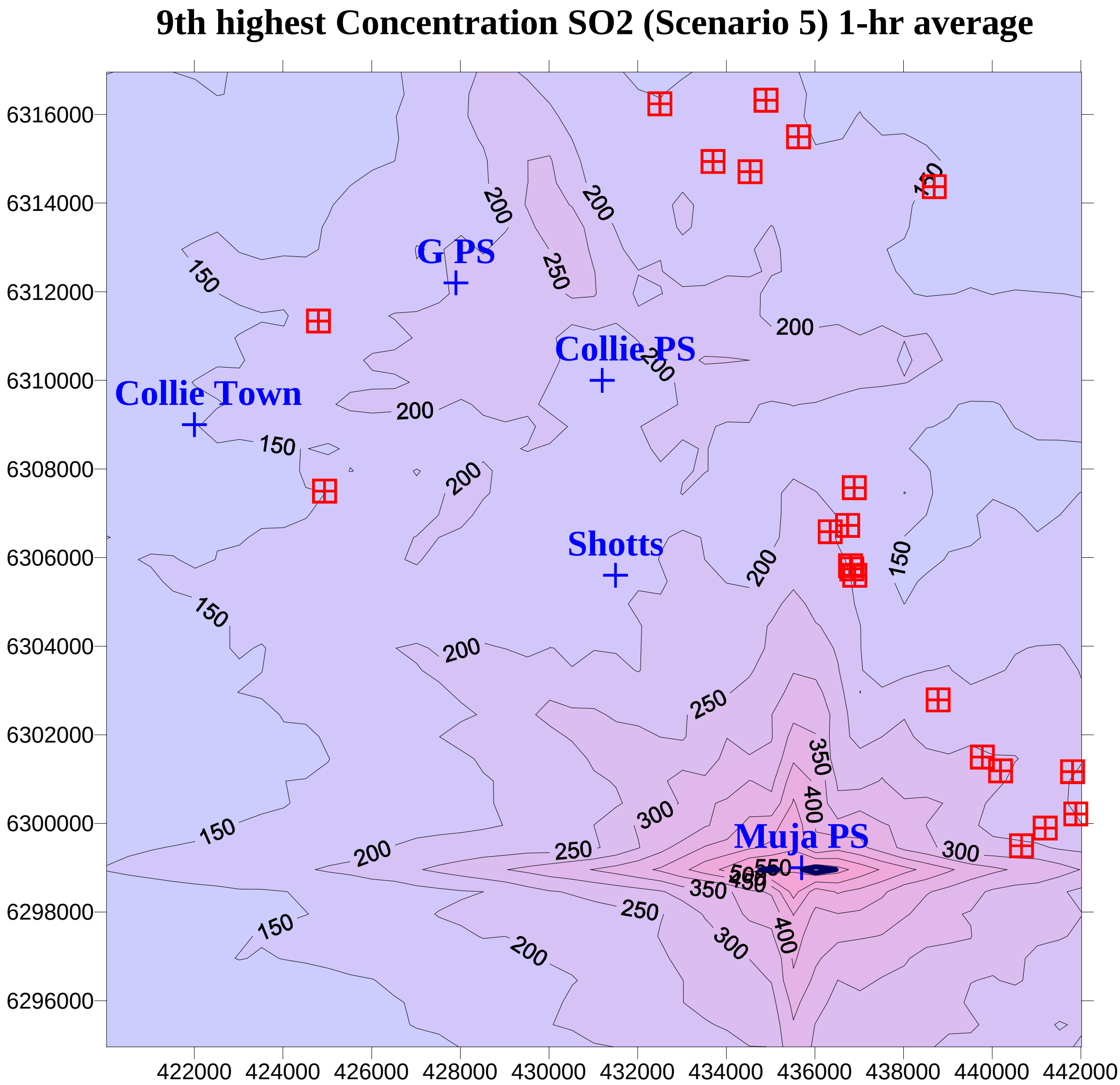


Figure A.10 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of 9^{th}-*highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

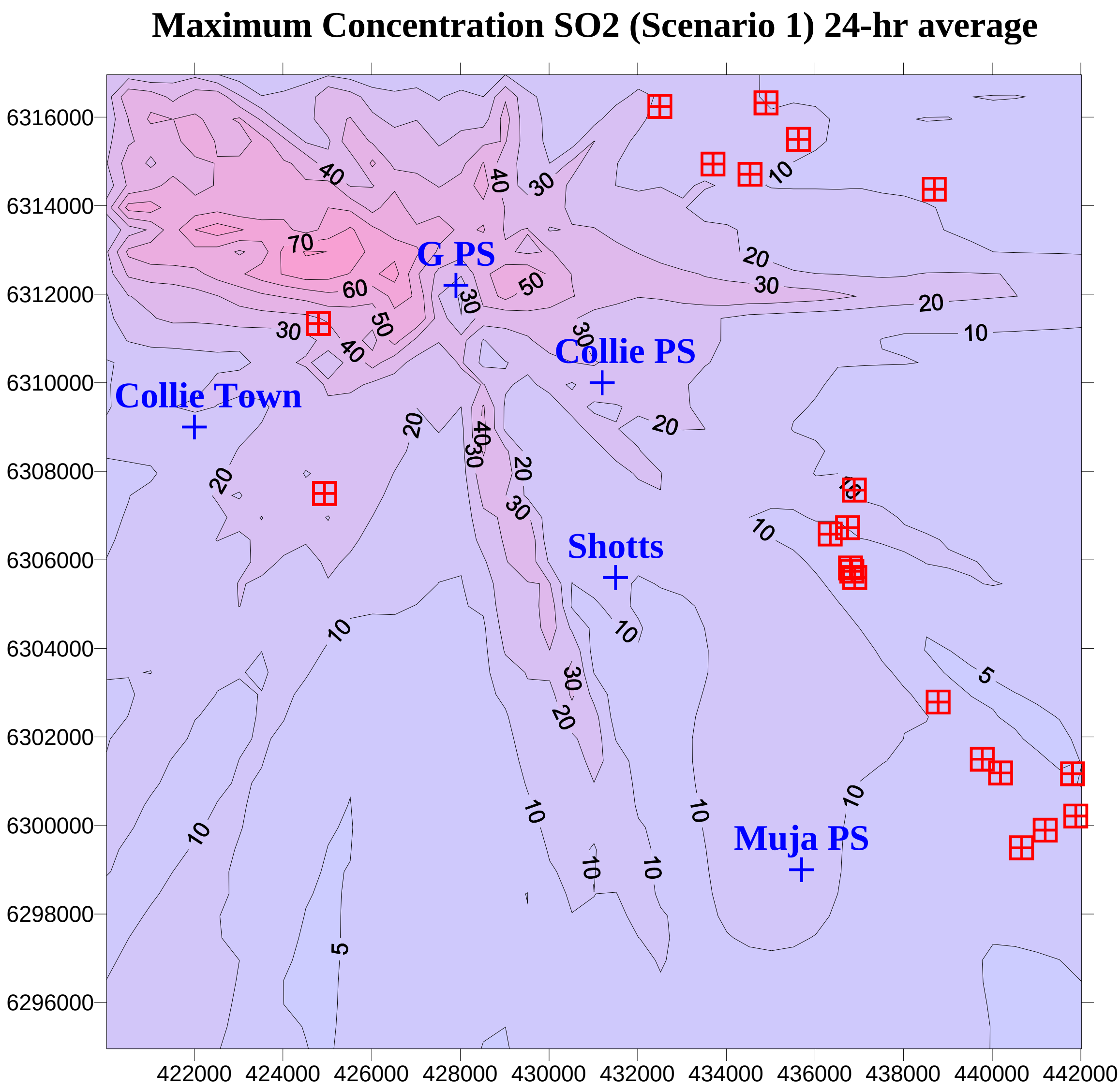


Figure A.11 For Scenario 1 (Bluewaters I), contours of *highest* 24-hour-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

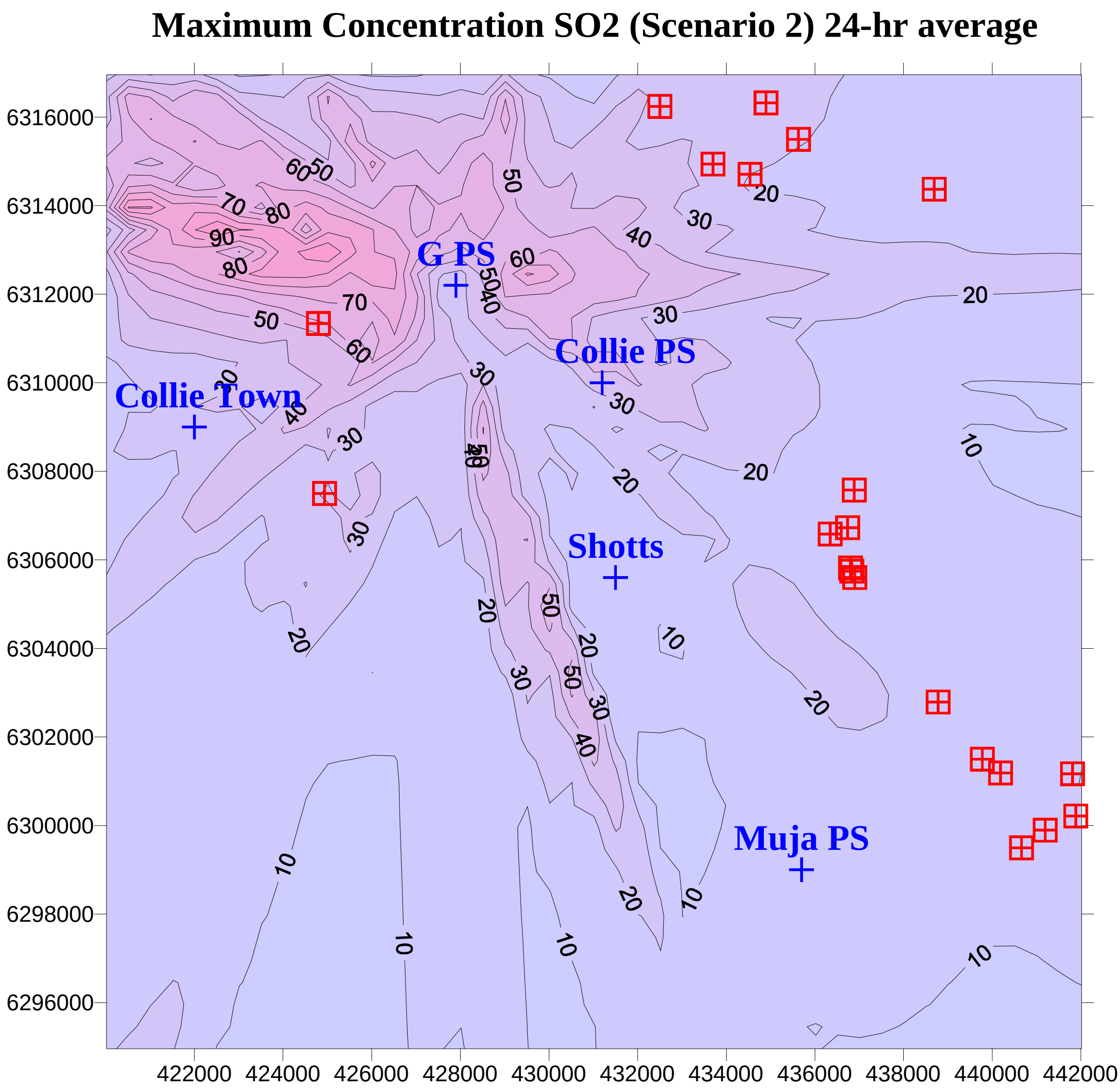


Figure A.12 For Scenario 2 (Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

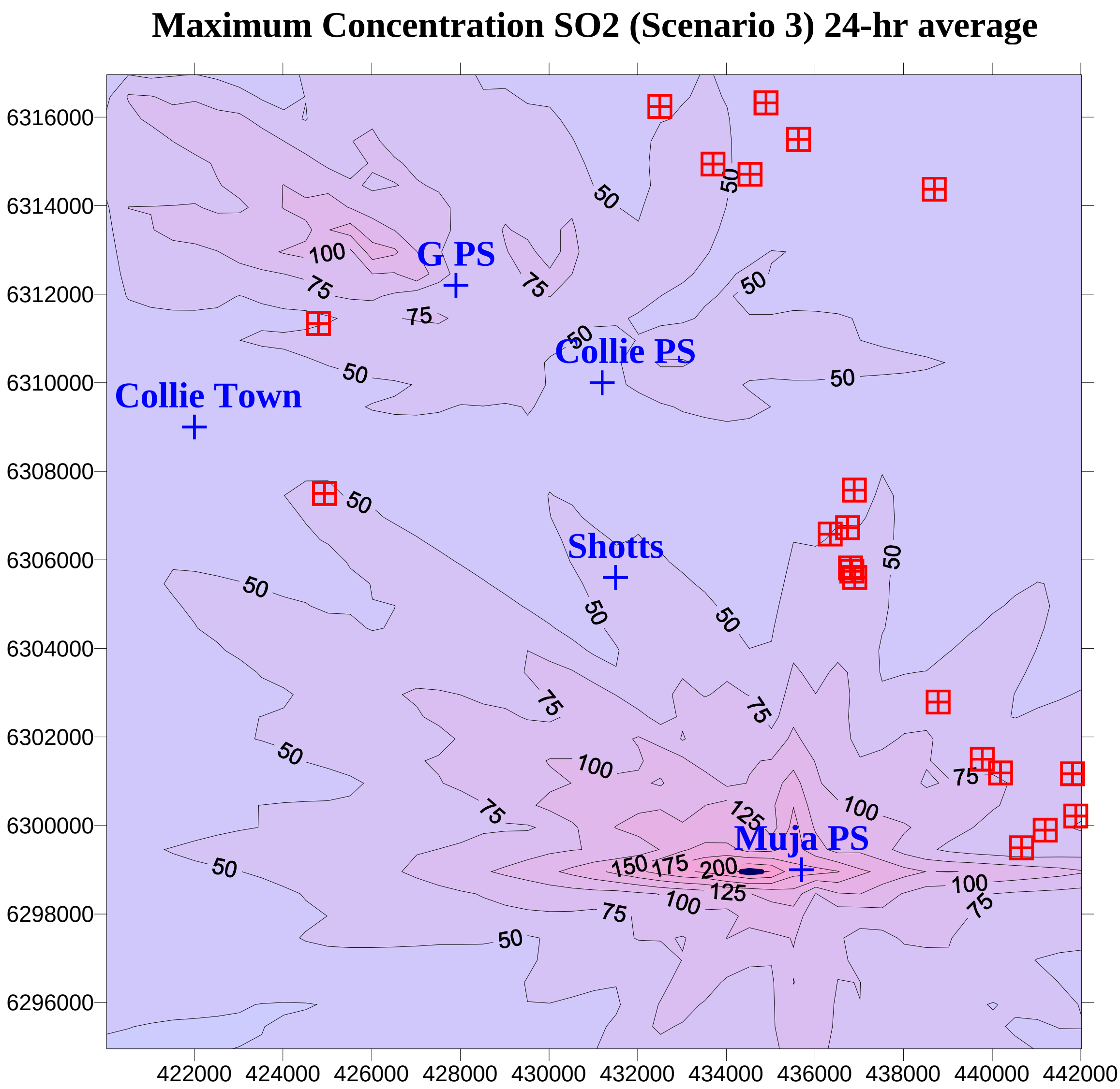


Figure A.13 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

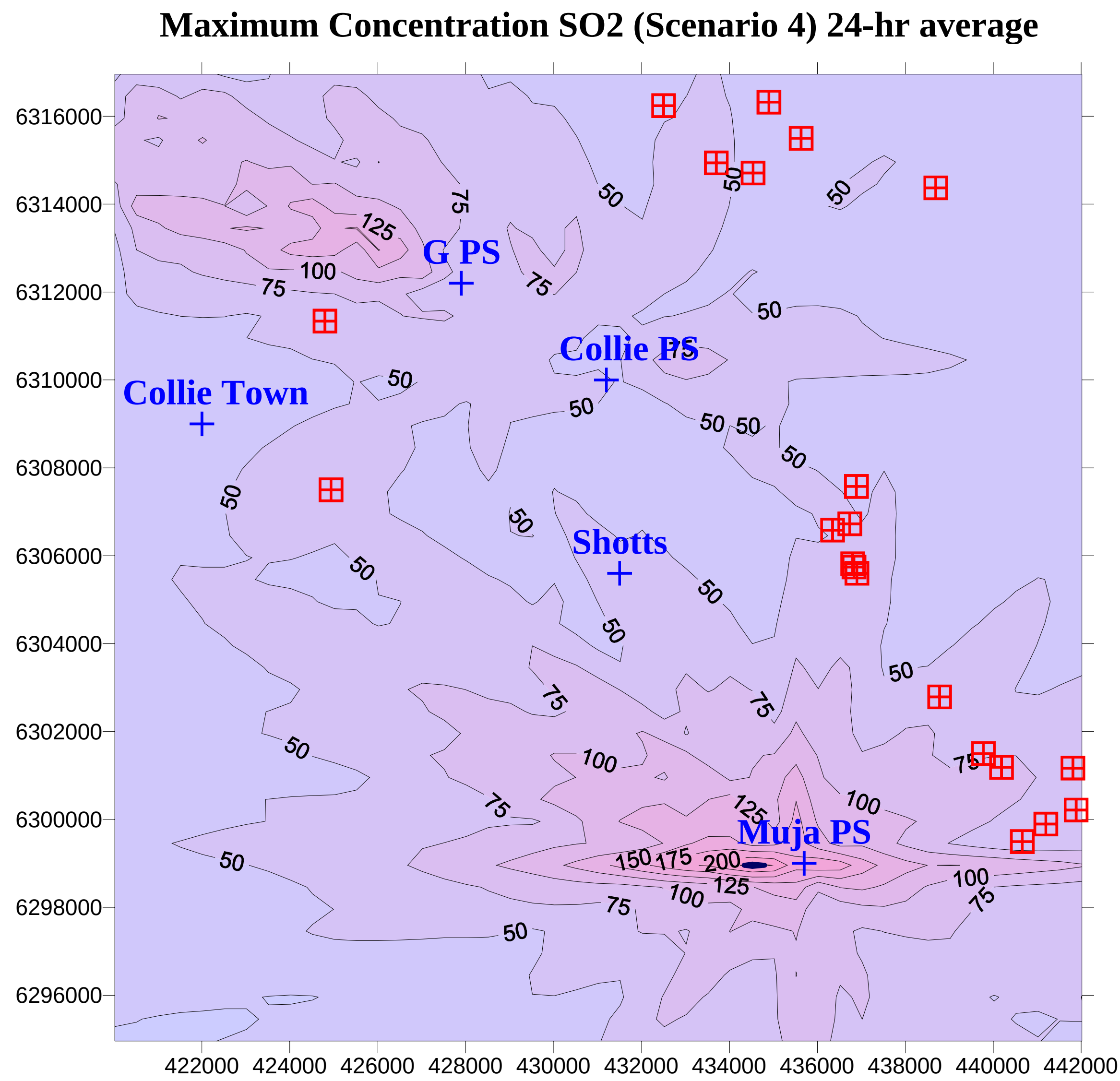


Figure A.14 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

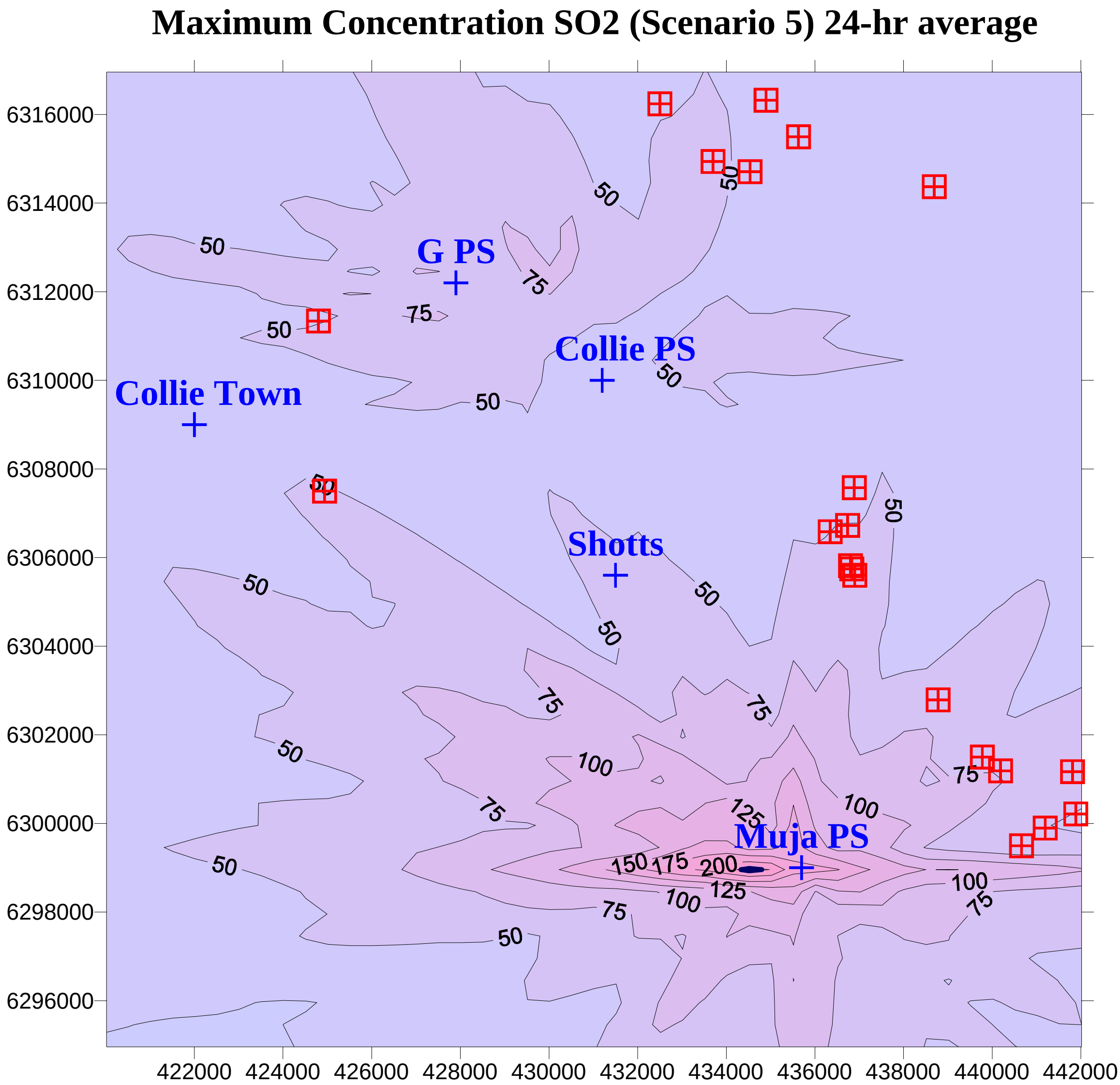


Figure A.15 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

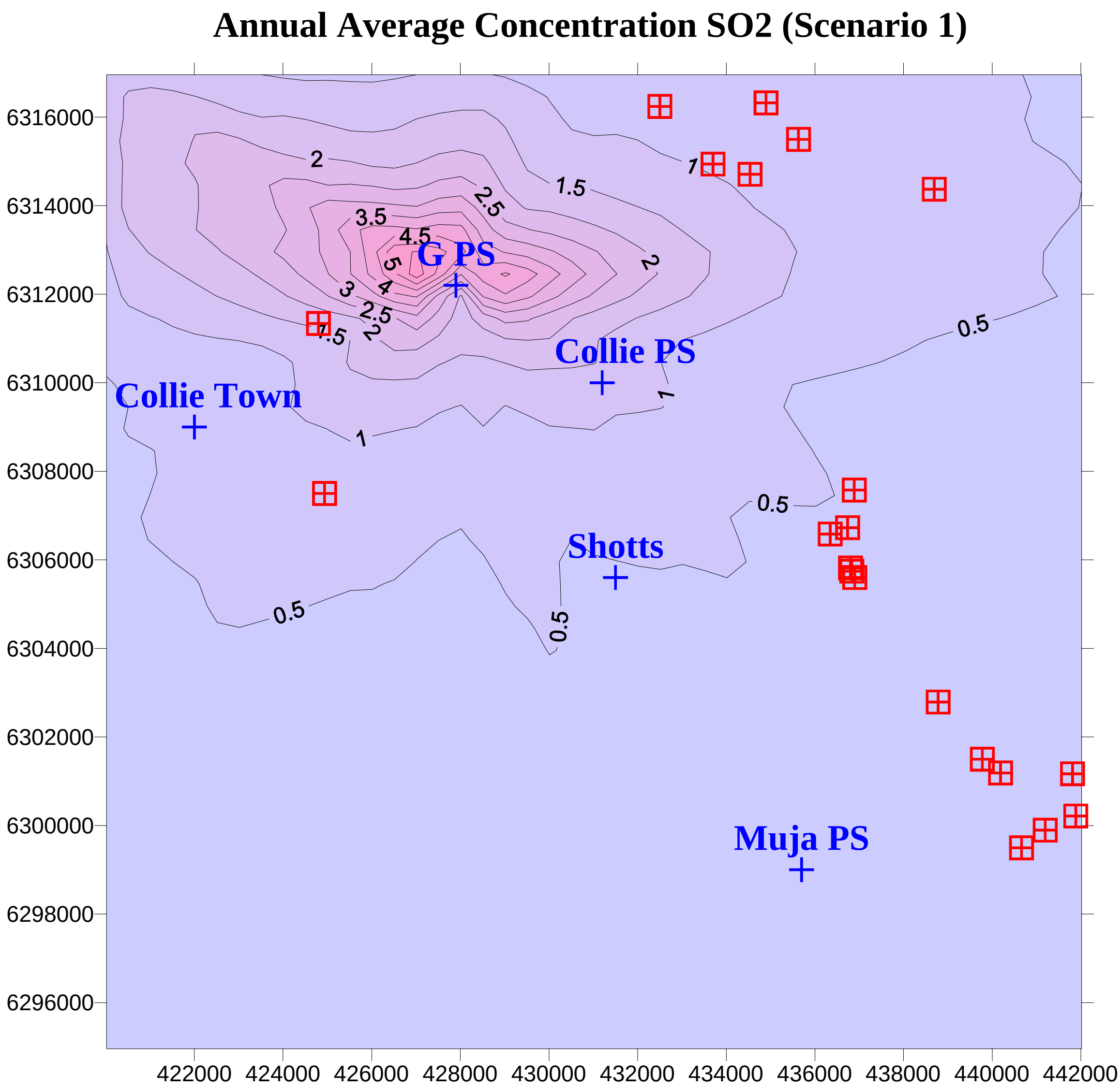


Figure A.16 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

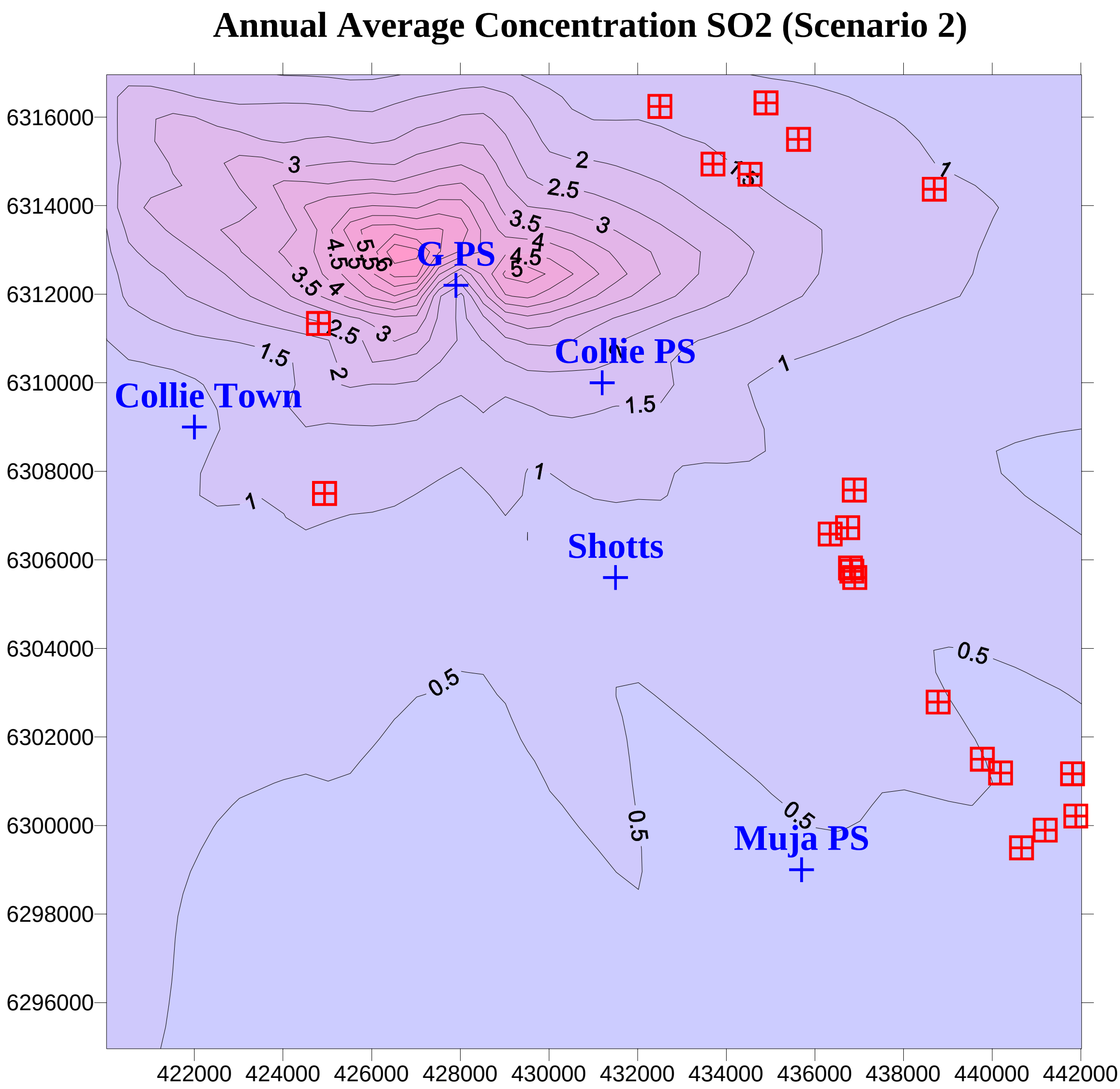


Figure A.17 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

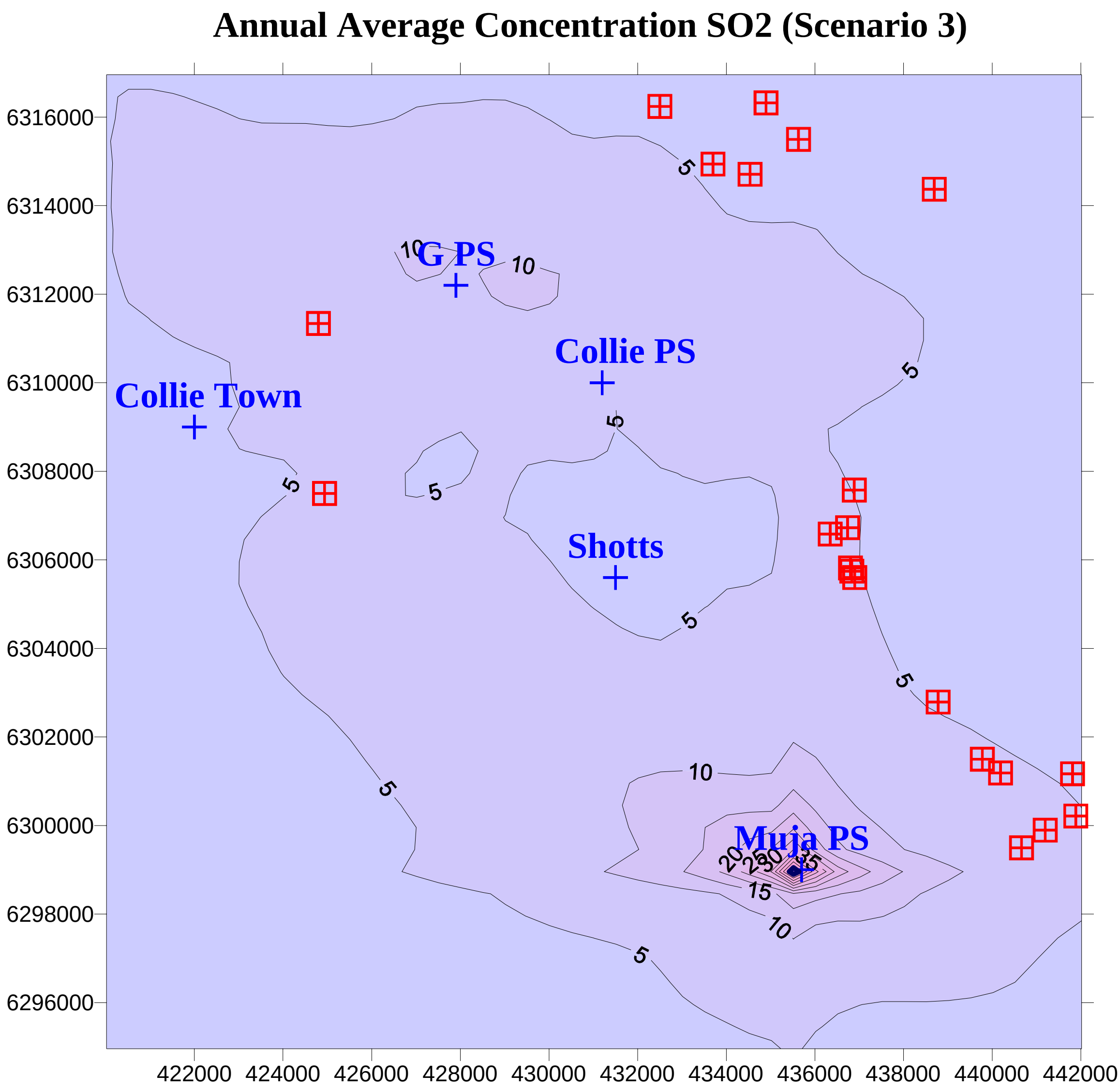


Figure A.18 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

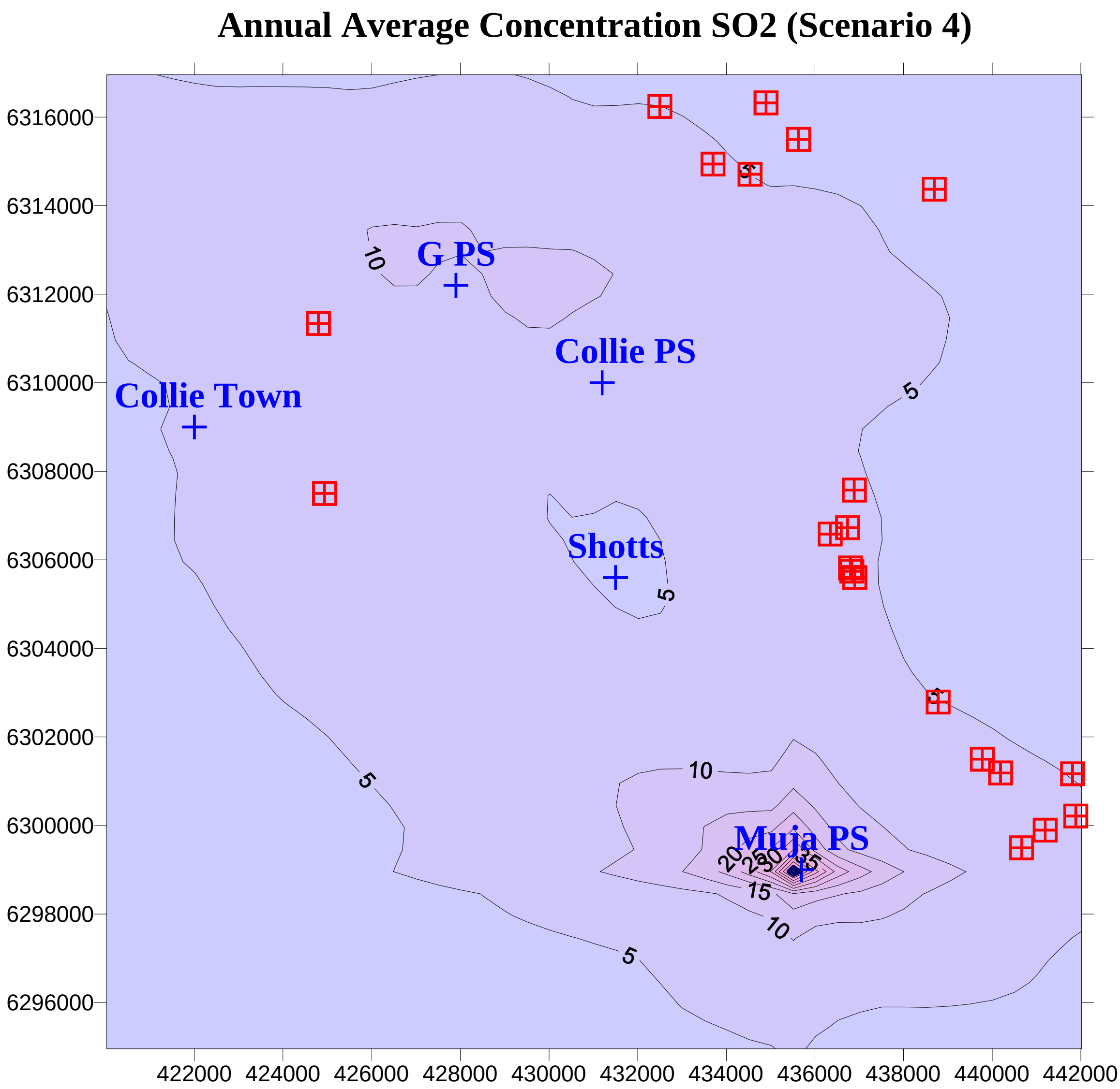


Figure A.19 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

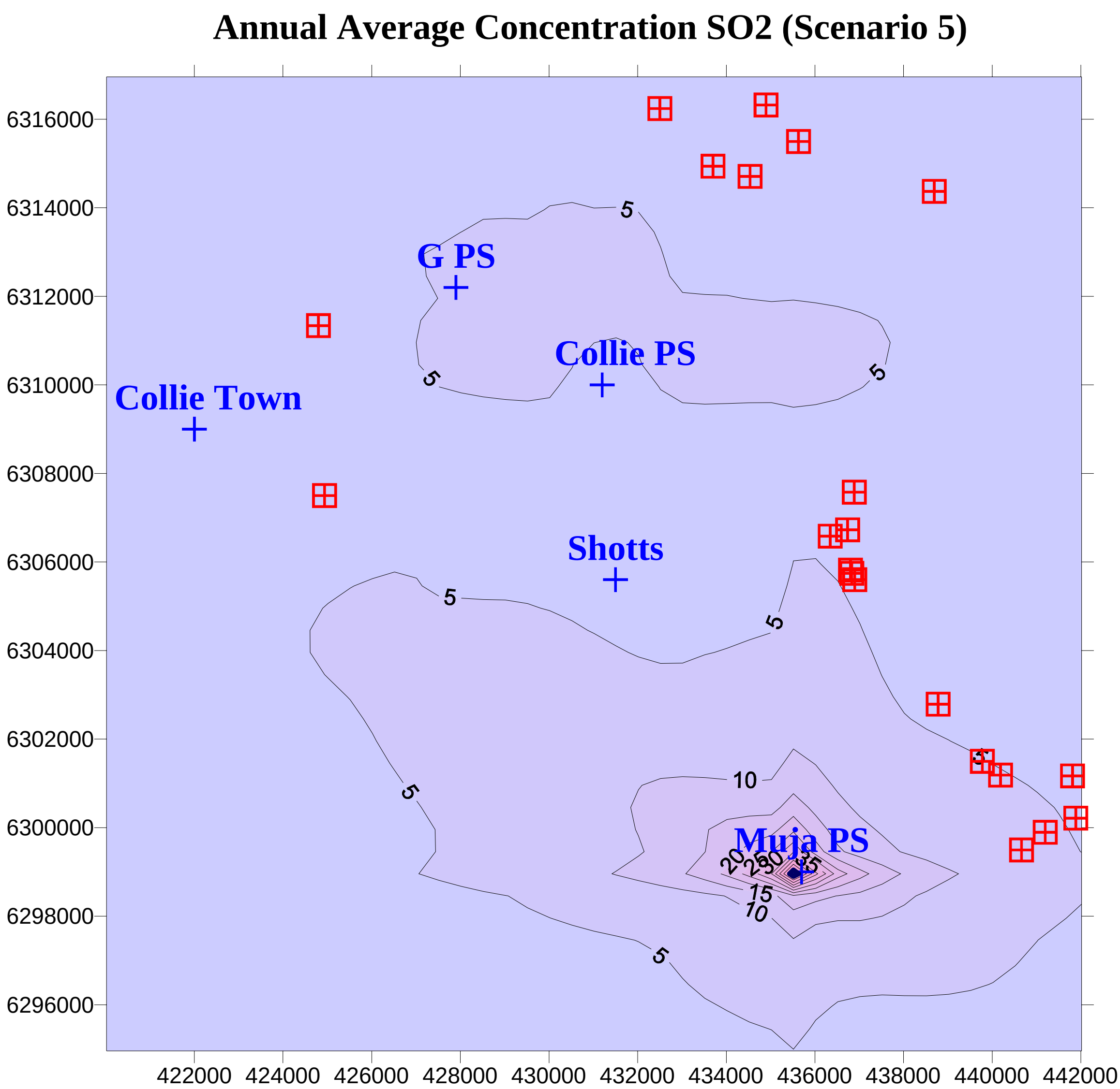


Figure A.20 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix B Contour plots for TAPM CO concentrations

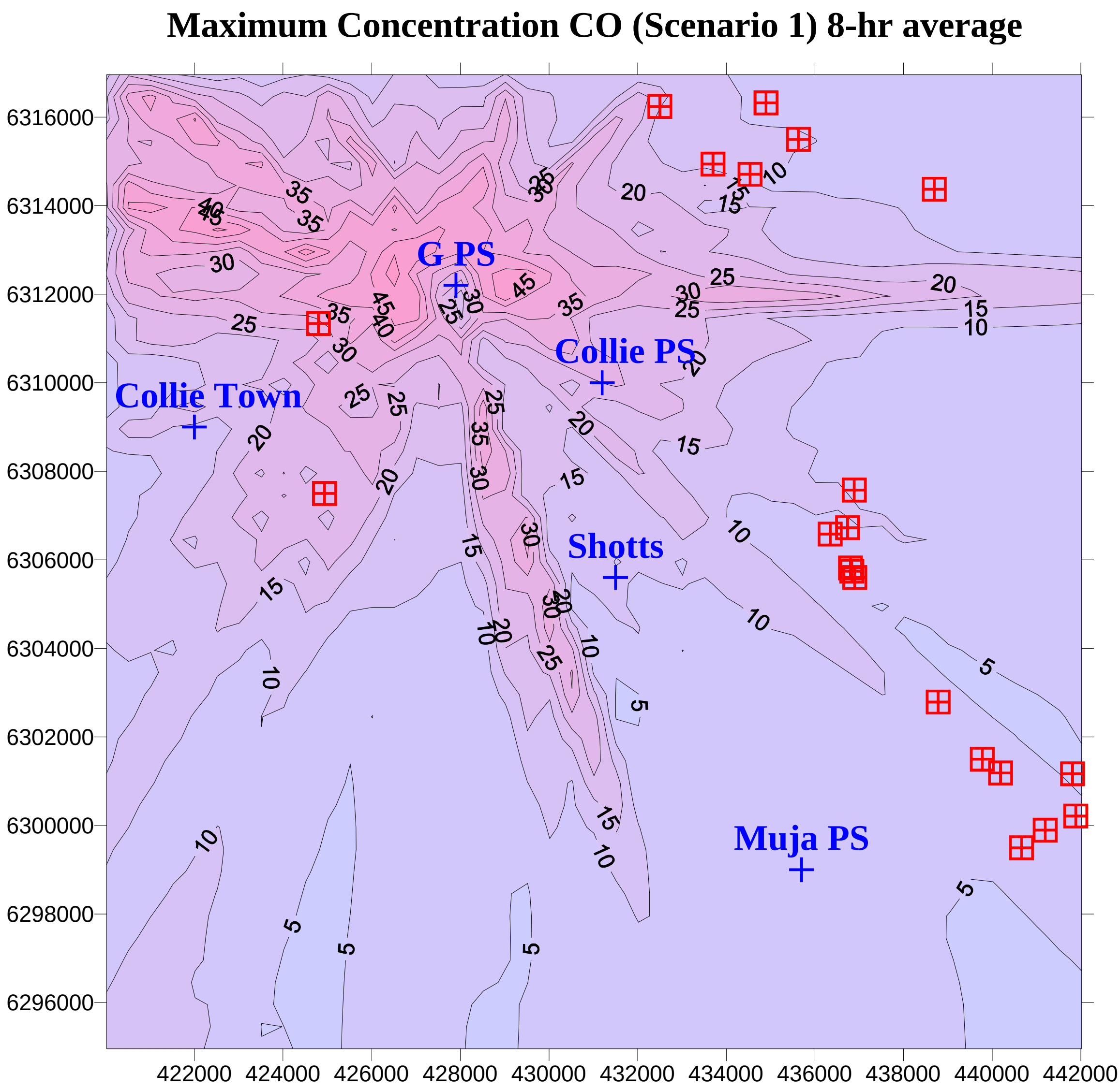


Figure B.1 For Scenario 1 (Bluewaters I), contours of *highest* 8-hour-averaged concentration of CO (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

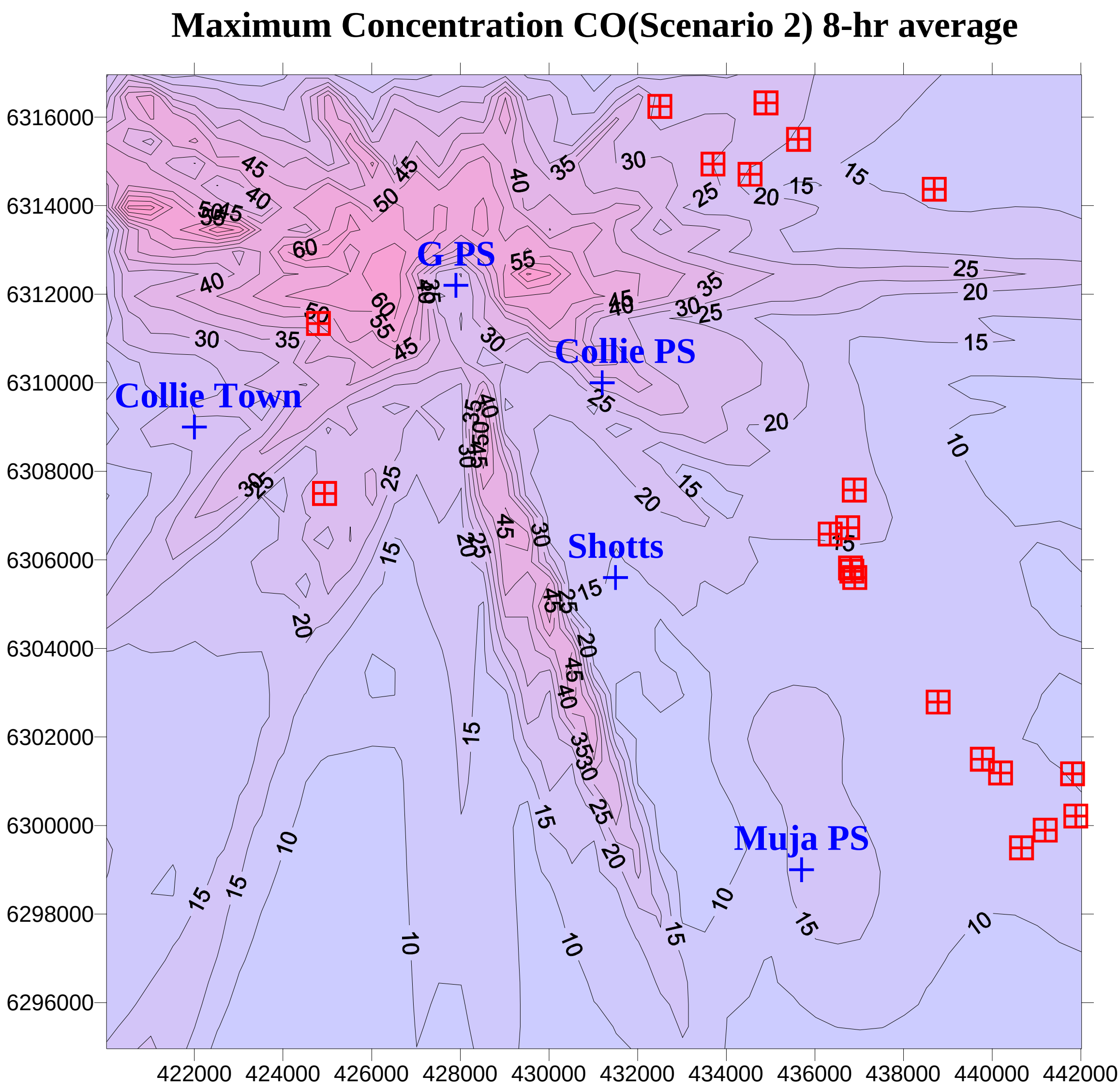


Figure B.2 For Scenario 2 (Bluewaters I + II), contours of *highest* 8-hour-averaged concentration of CO (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

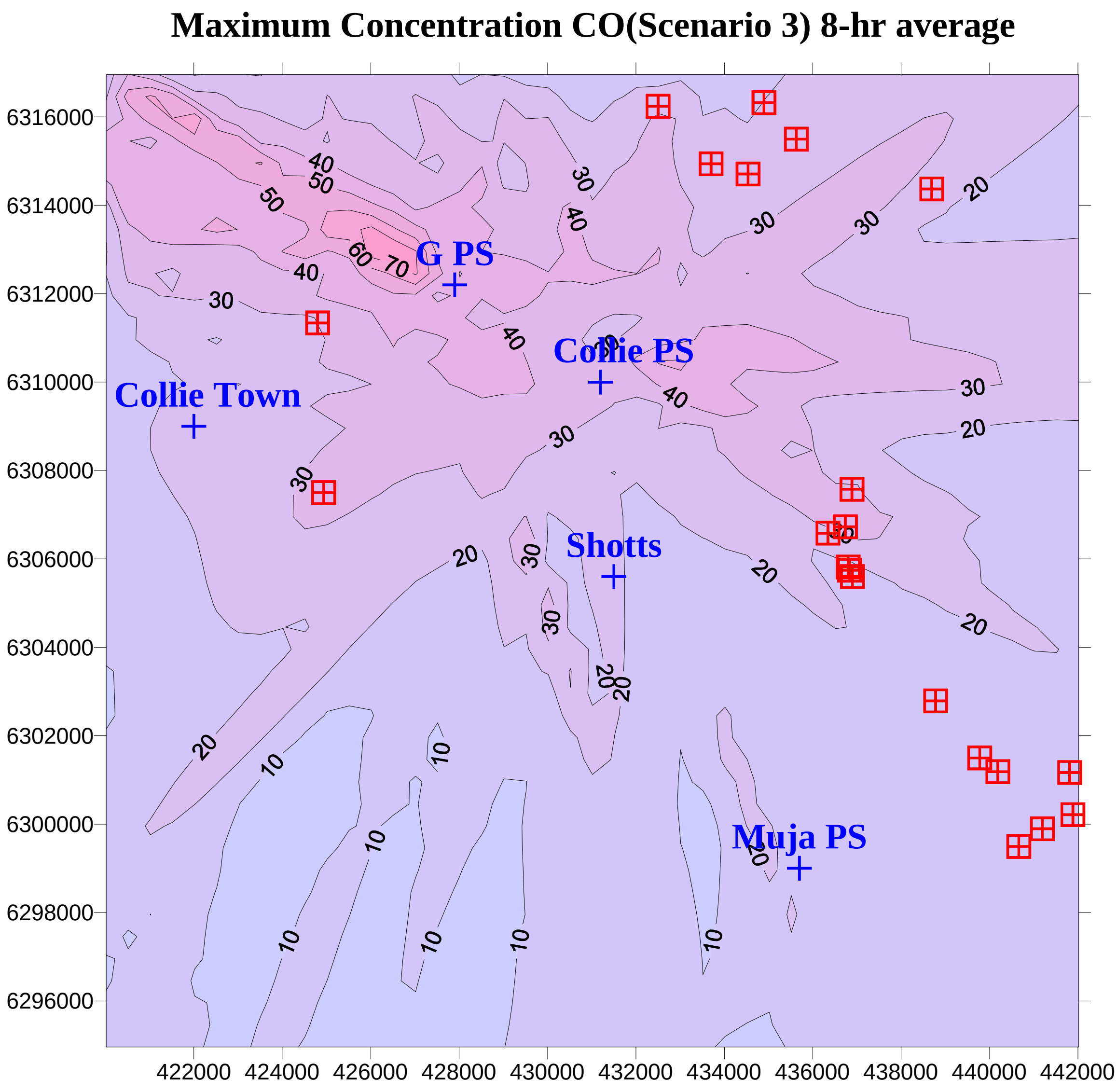


Figure B.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 8-hour-averaged concentration of CO (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

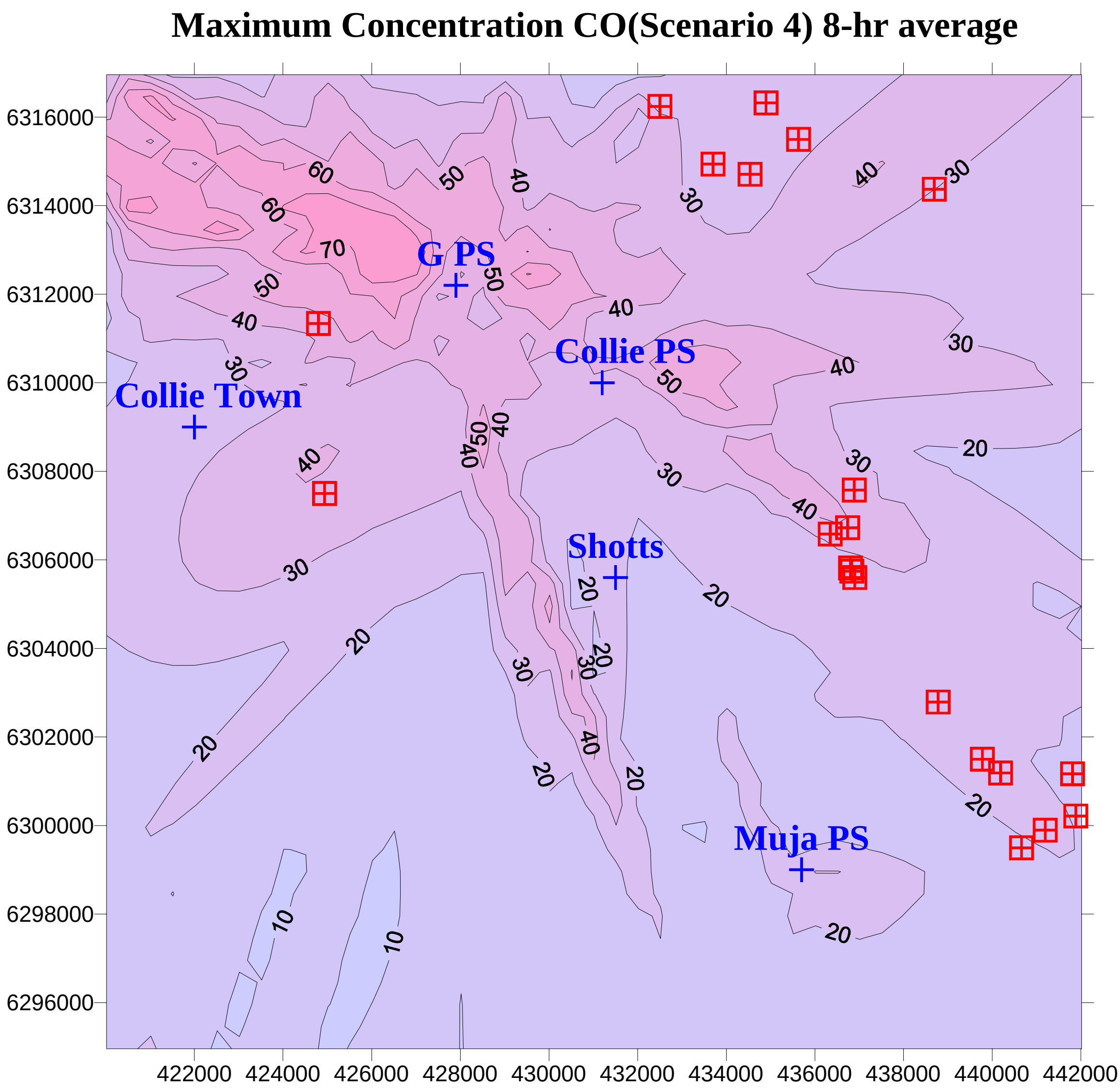


Figure B.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 8-hour-averaged concentration of CO (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

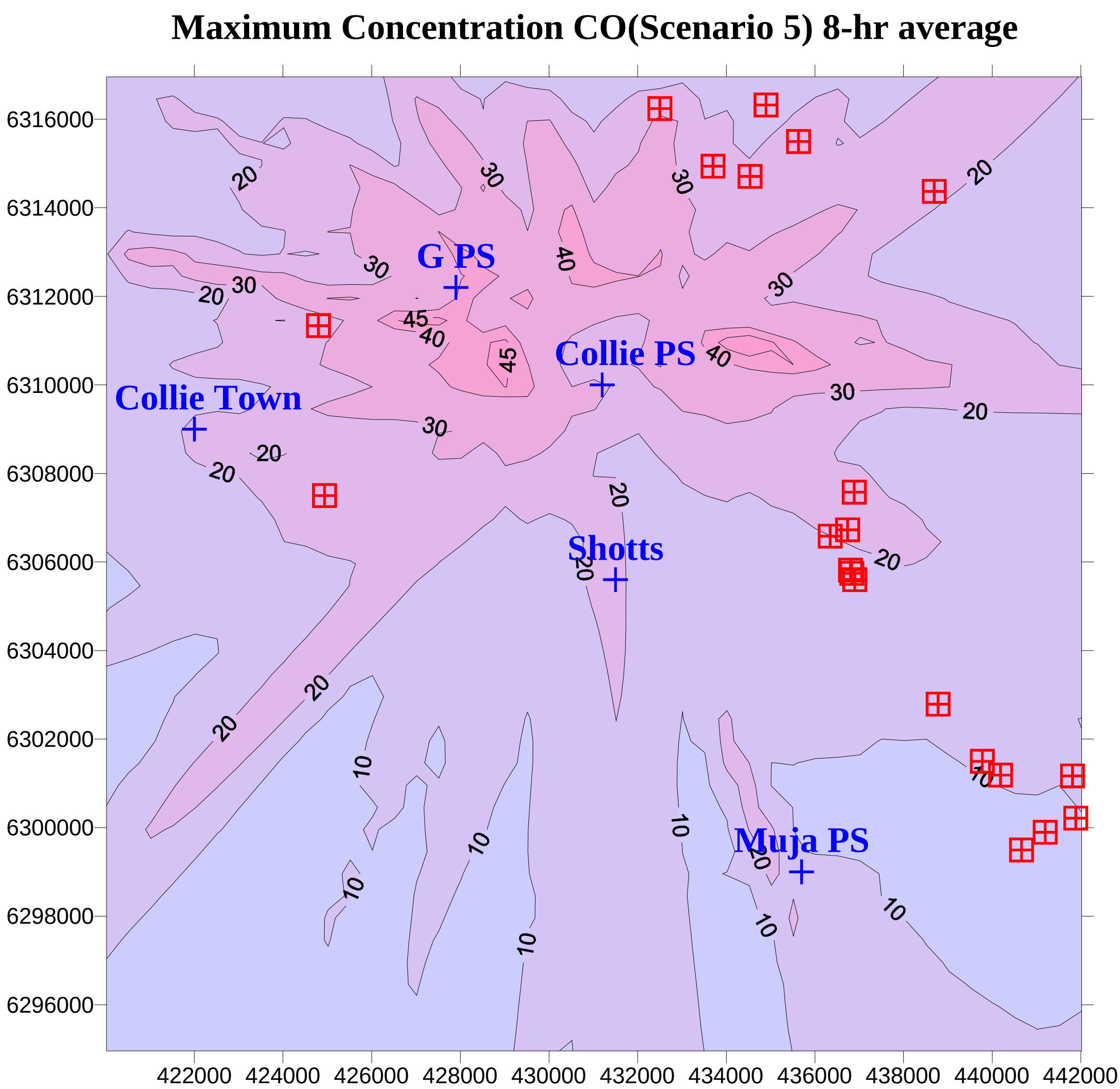


Figure B.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 8-hour-averaged concentration of CO (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix C Contour plots for TAPM Hg concentrations

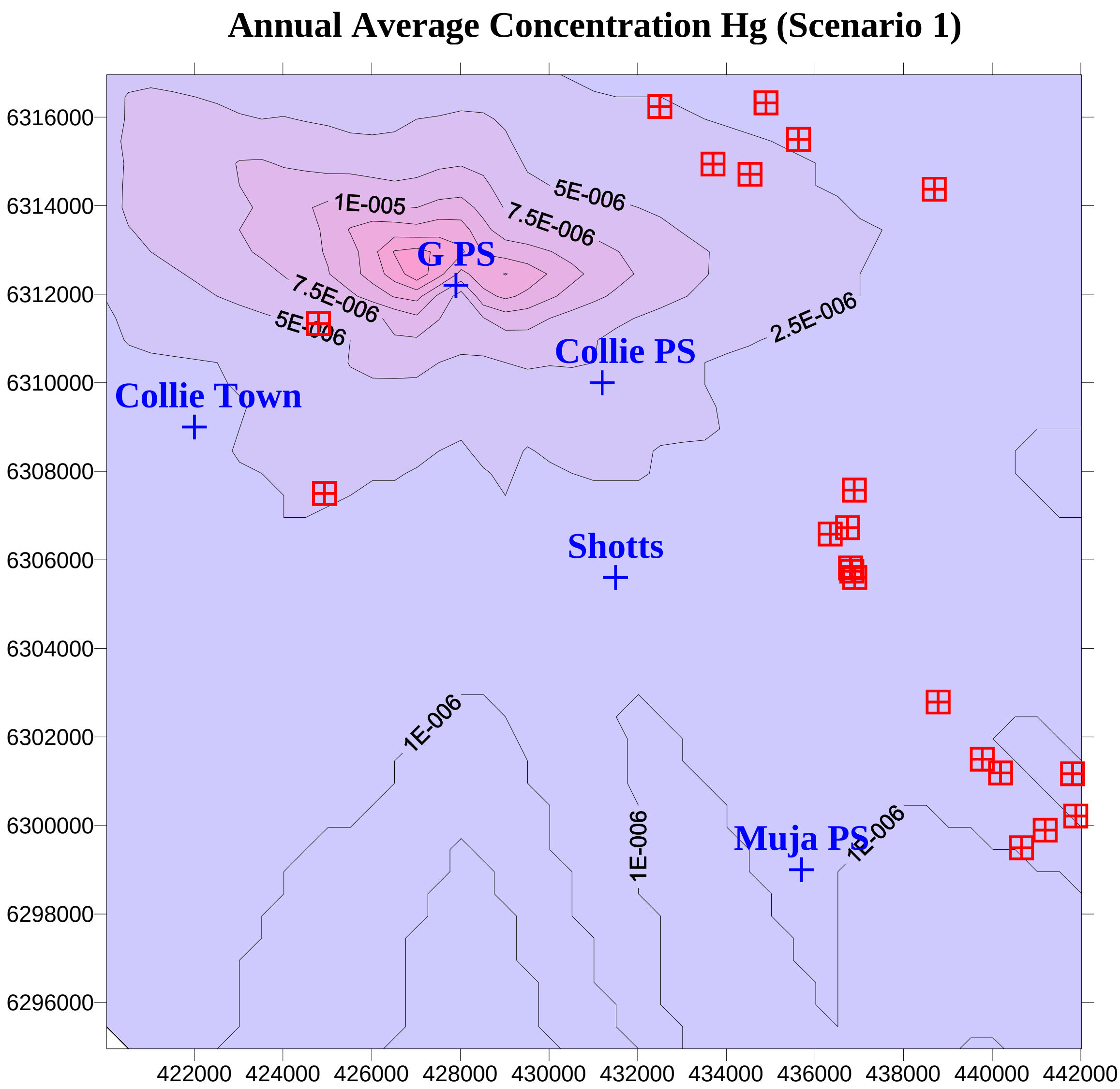


Figure C.1 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

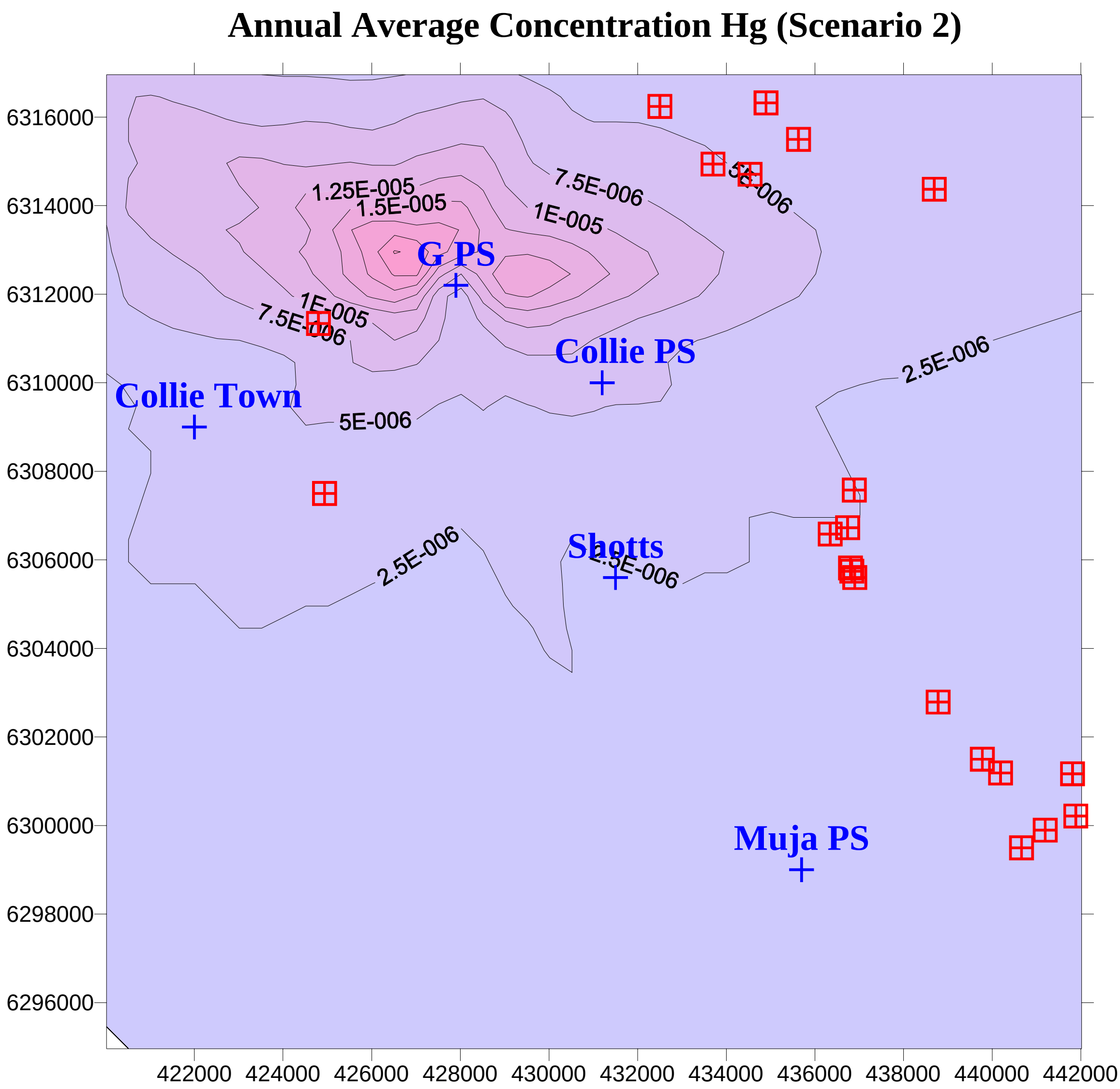


Figure C.2 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

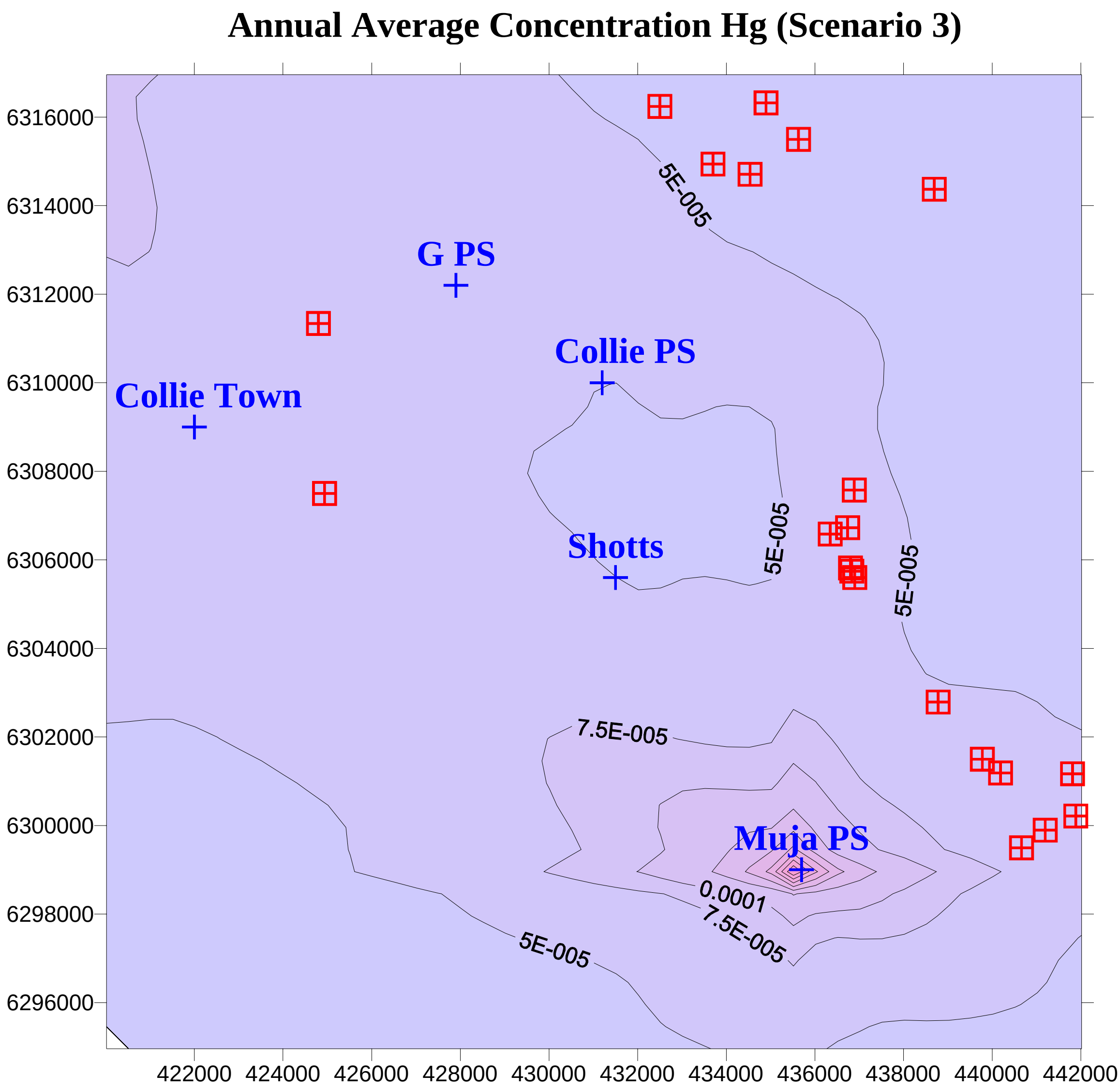


Figure C.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

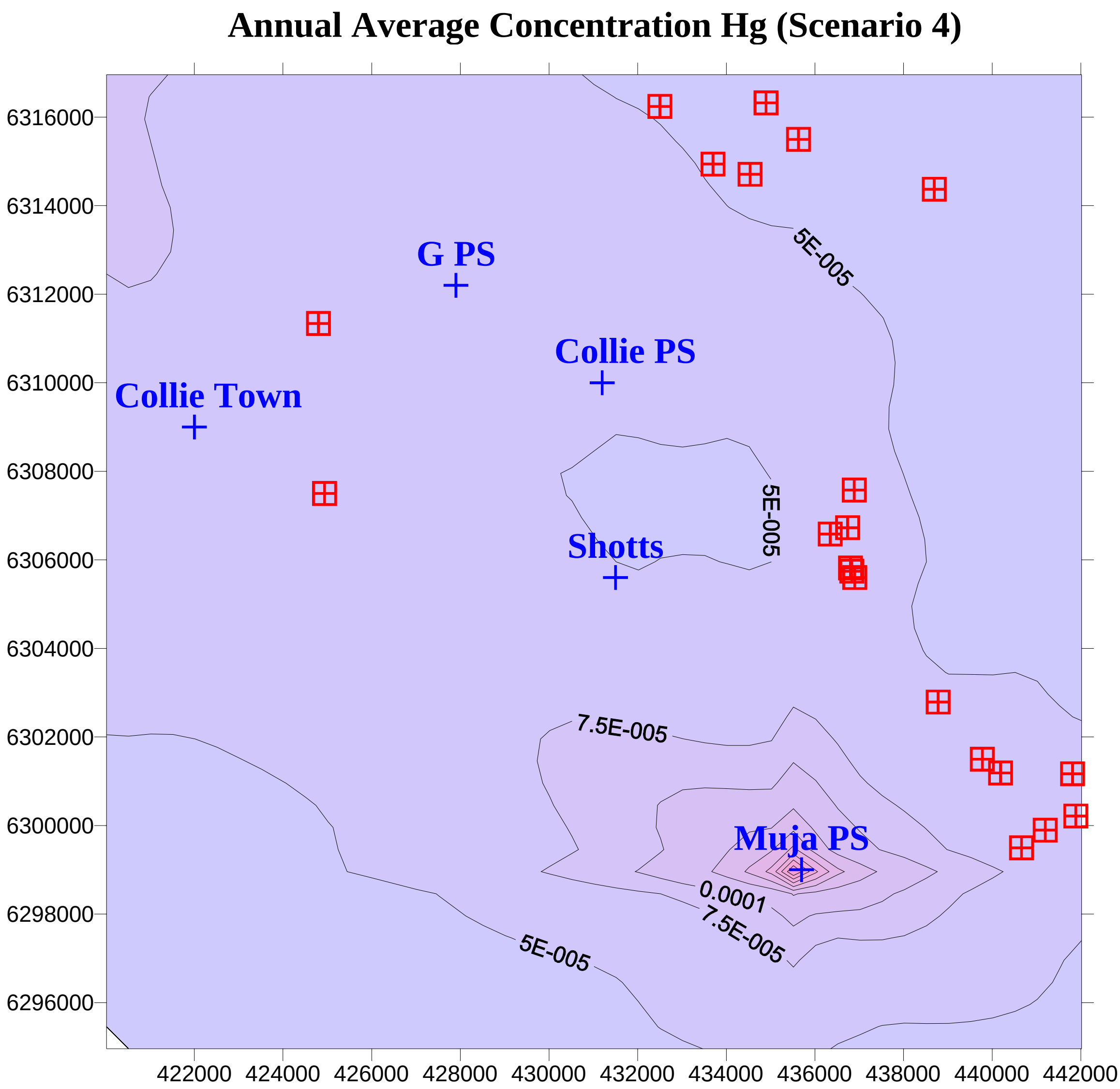


Figure C.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

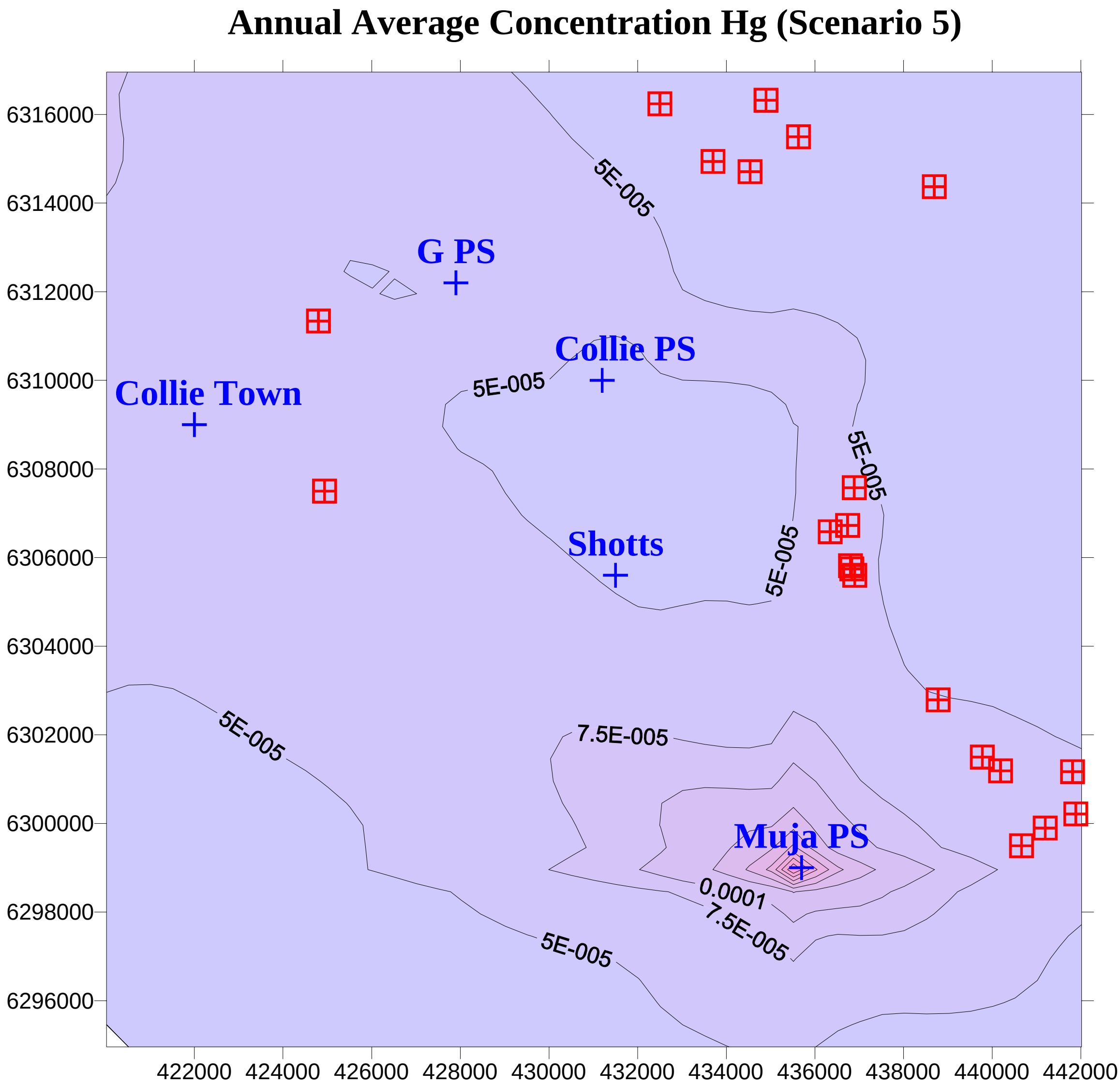


Figure C.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix D Contour plots for TAPM PAH concentrations

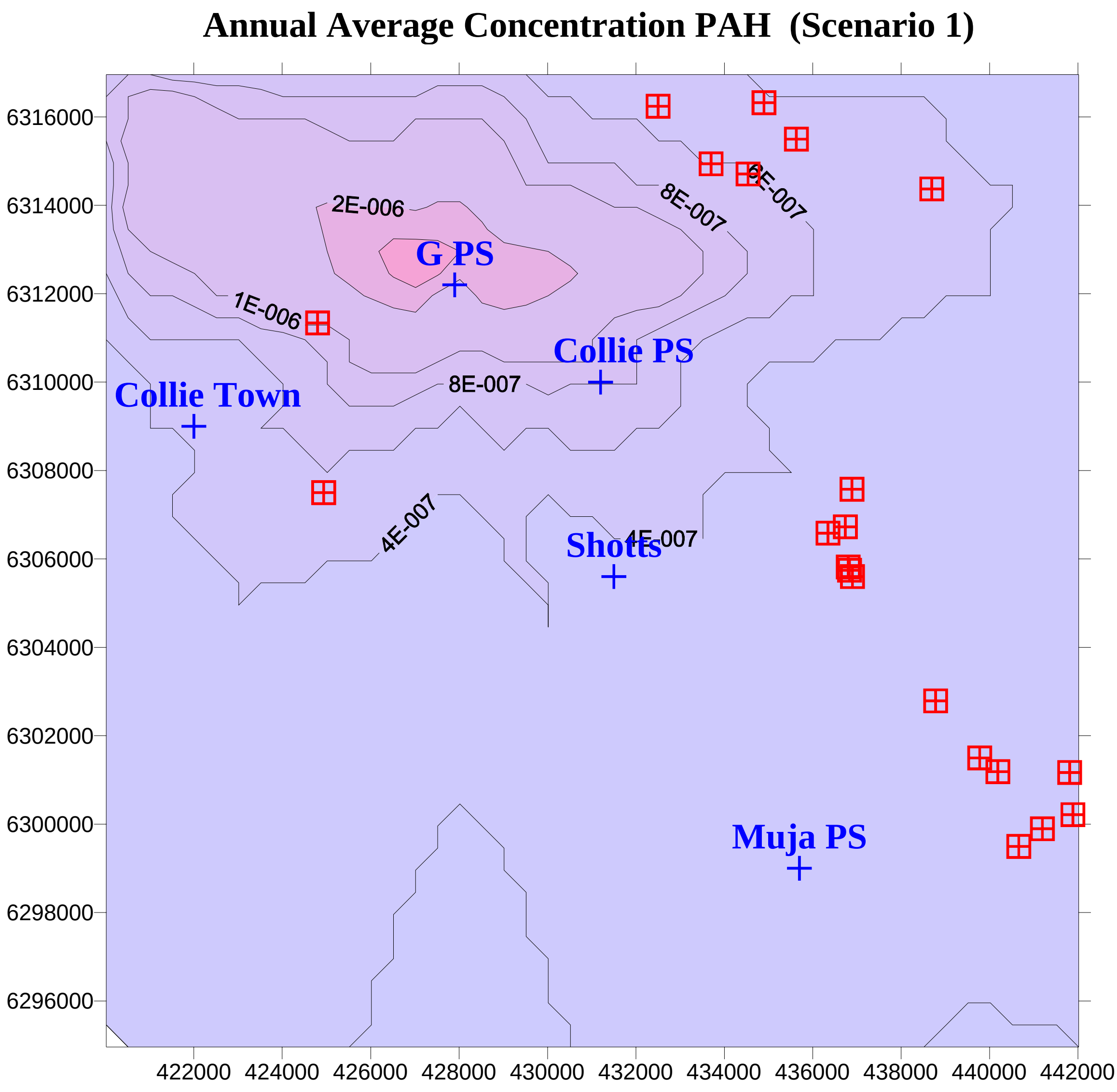


Figure D.1 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

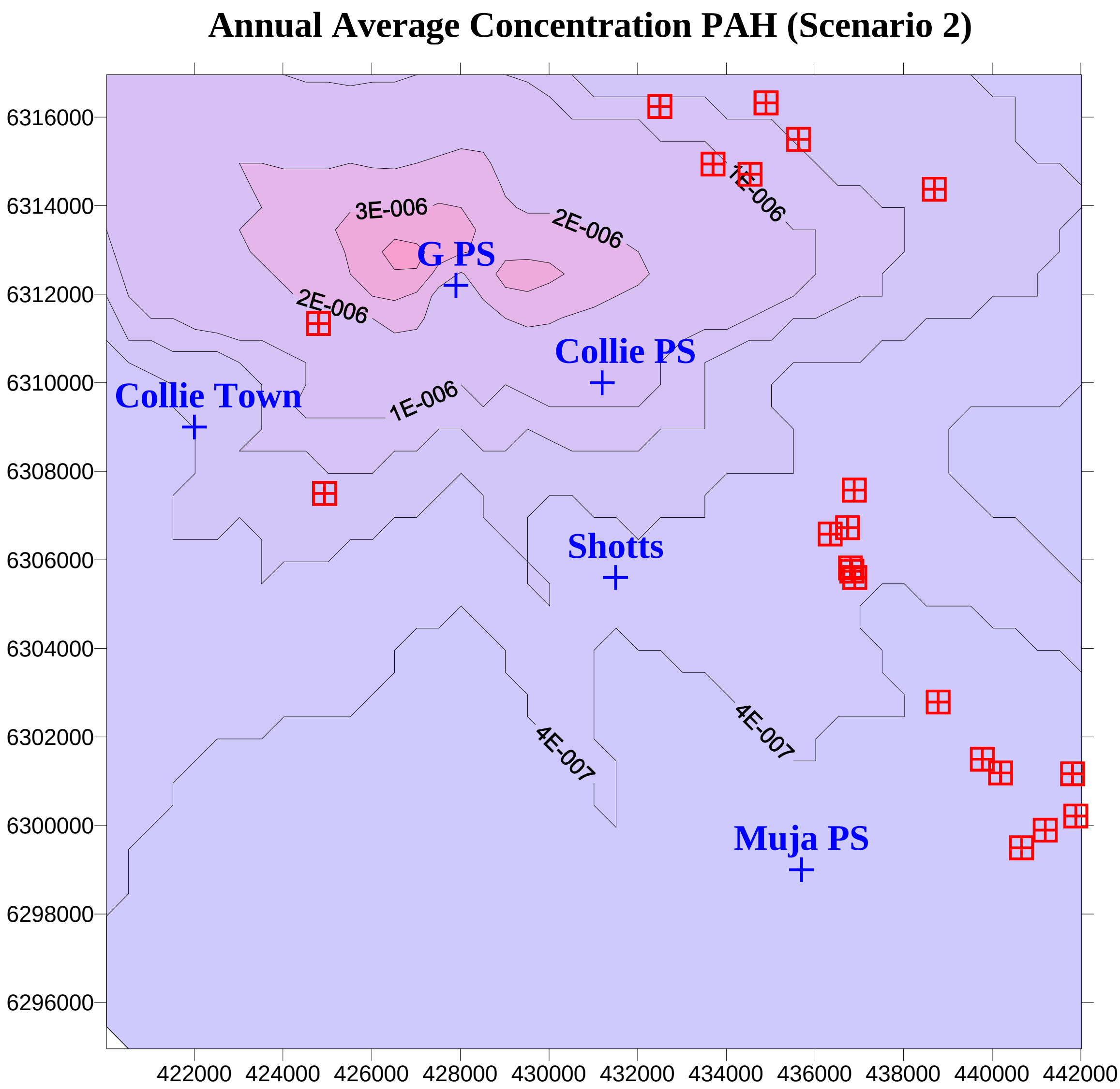


Figure D.2 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of PAH (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Annual Average Concentration PAH (Scenario 3)

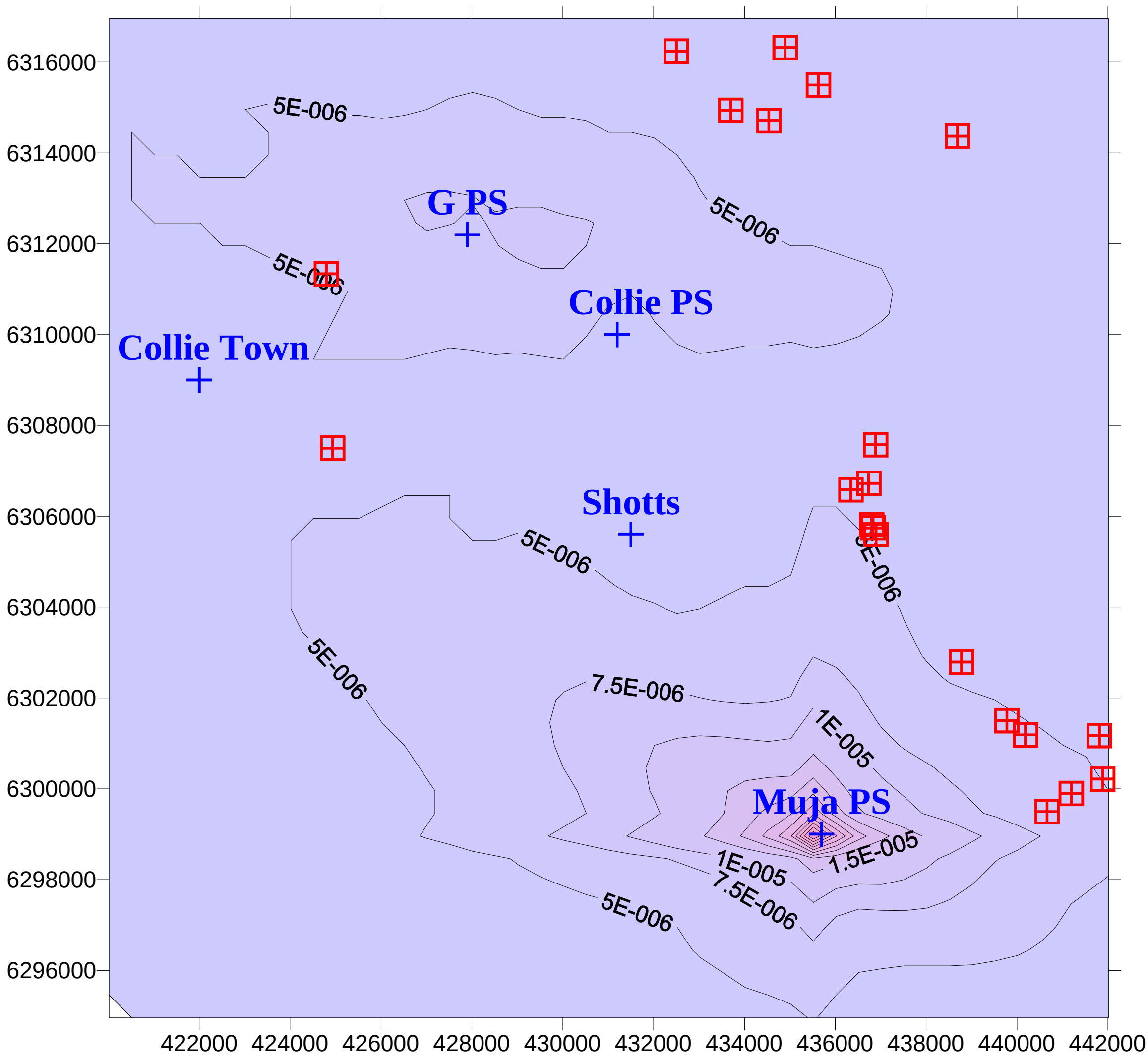


Figure D.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

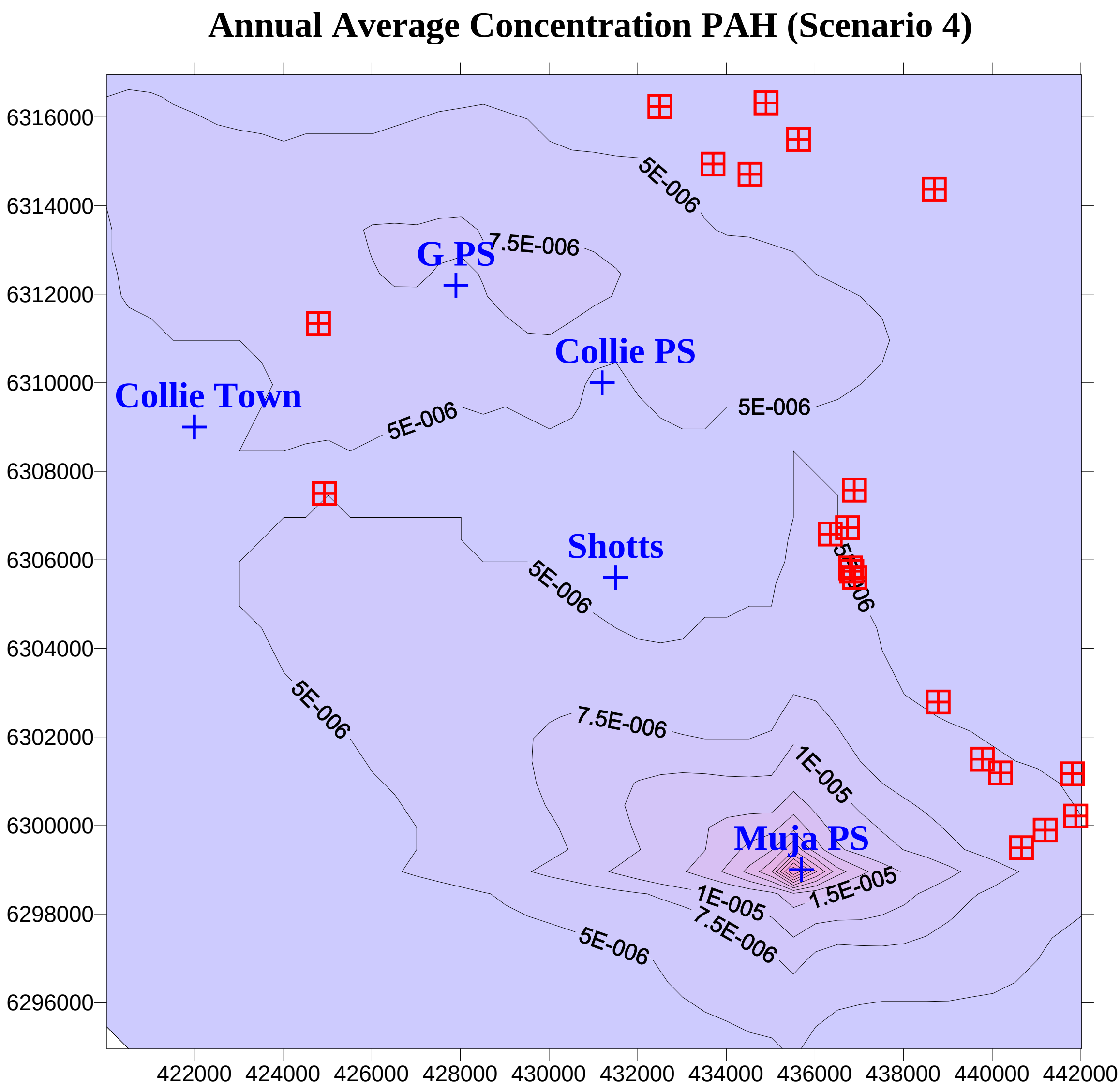


Figure D.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

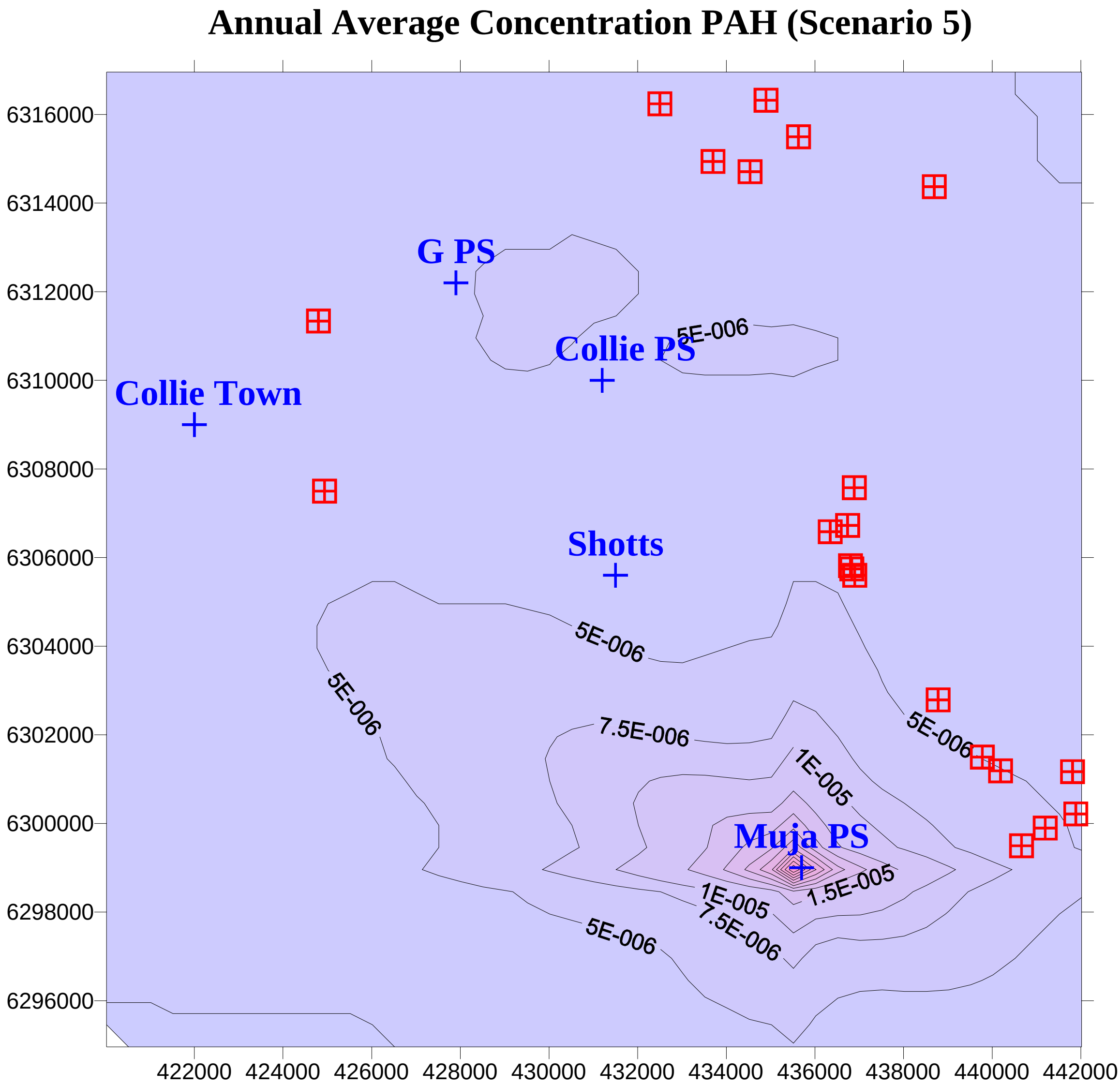


Figure D.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of PAH (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix E Contour plots for TAPM Fl concentrations

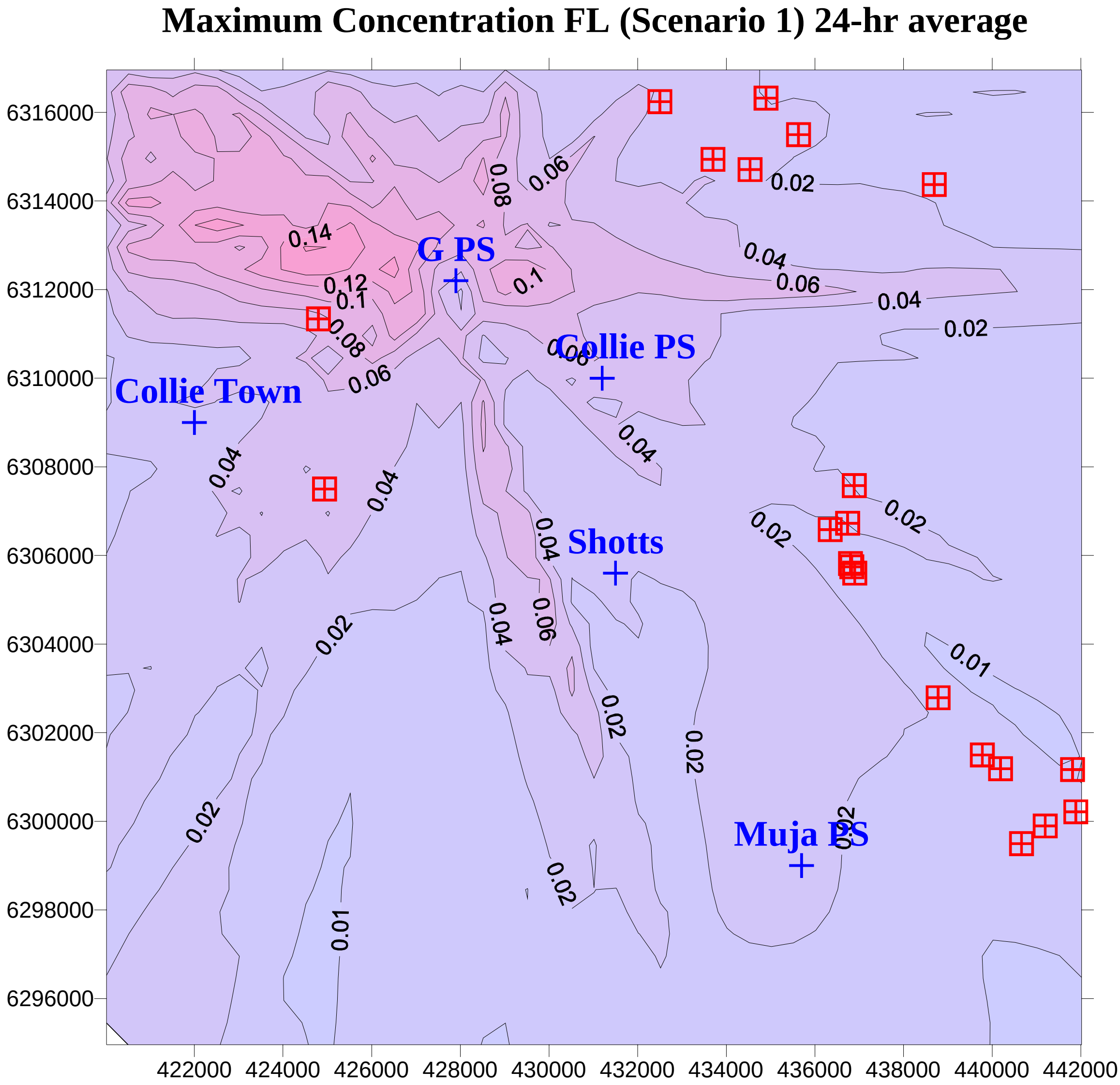


Figure E.1 For Scenario 1 (Bluewaters I), contours of *highest* 24-hour-averaged concentration of fluoride (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

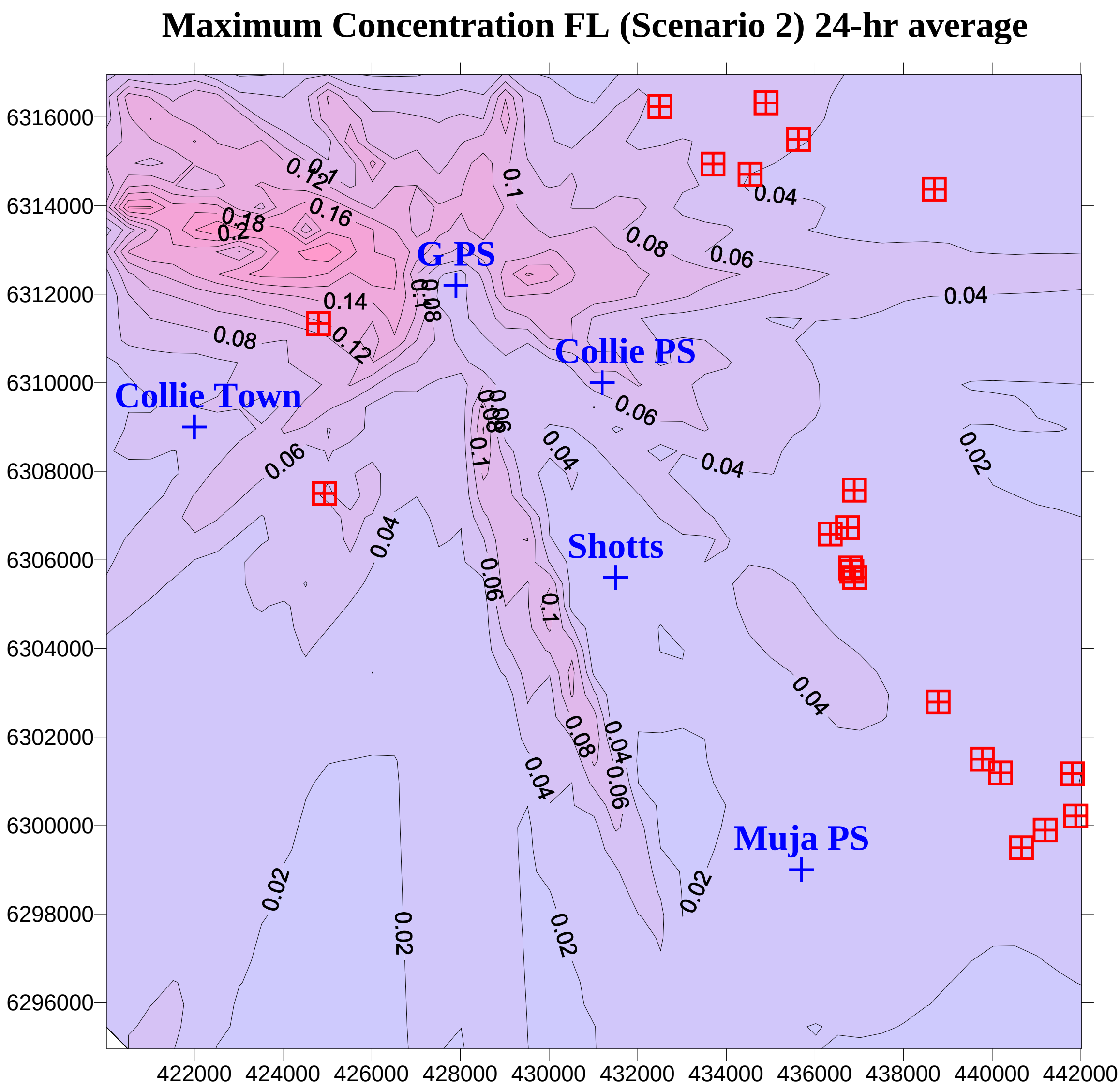


Figure E.2 For Scenario 2 (Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of fluoride (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

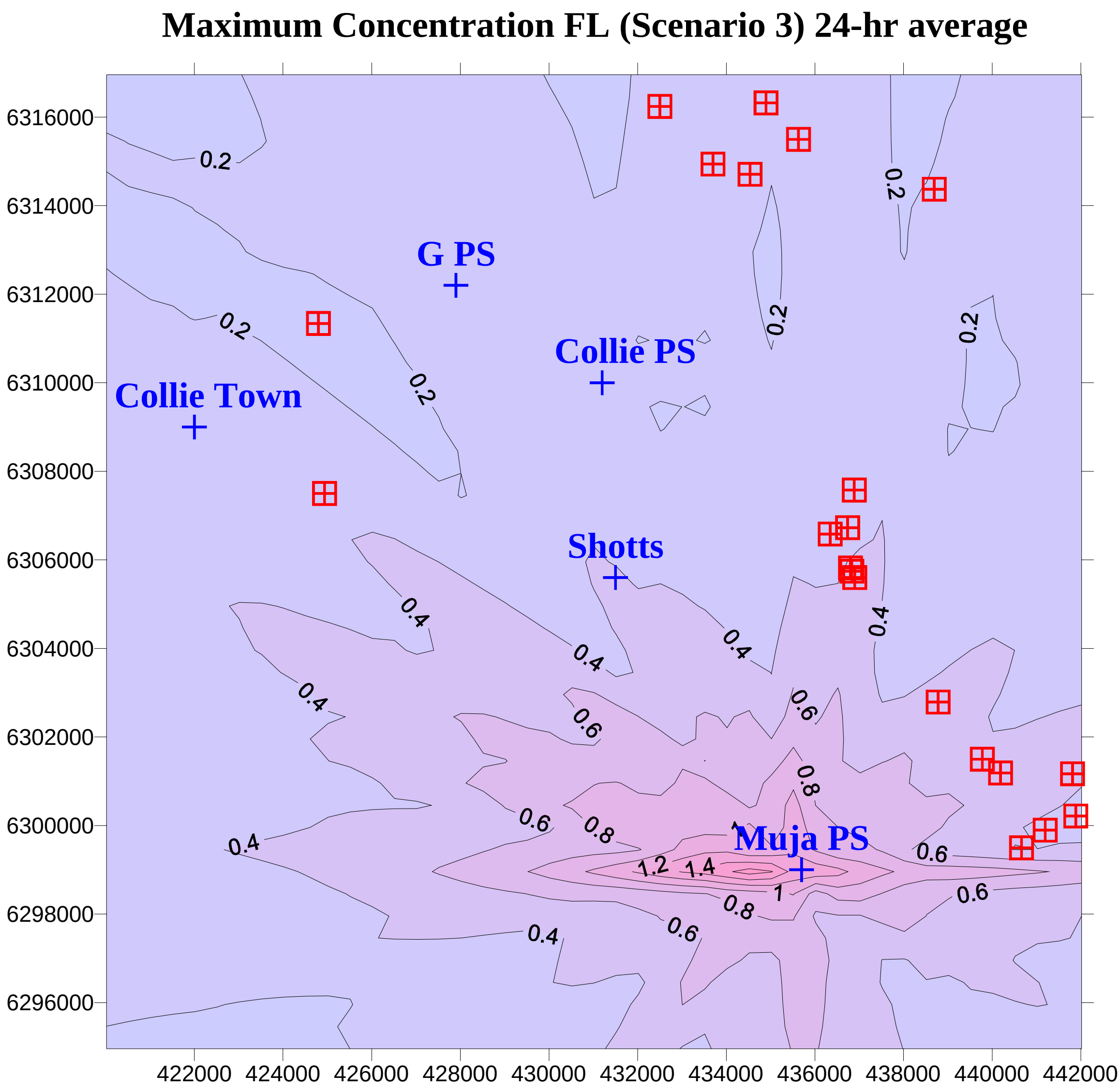


Figure E.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of fluoride (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

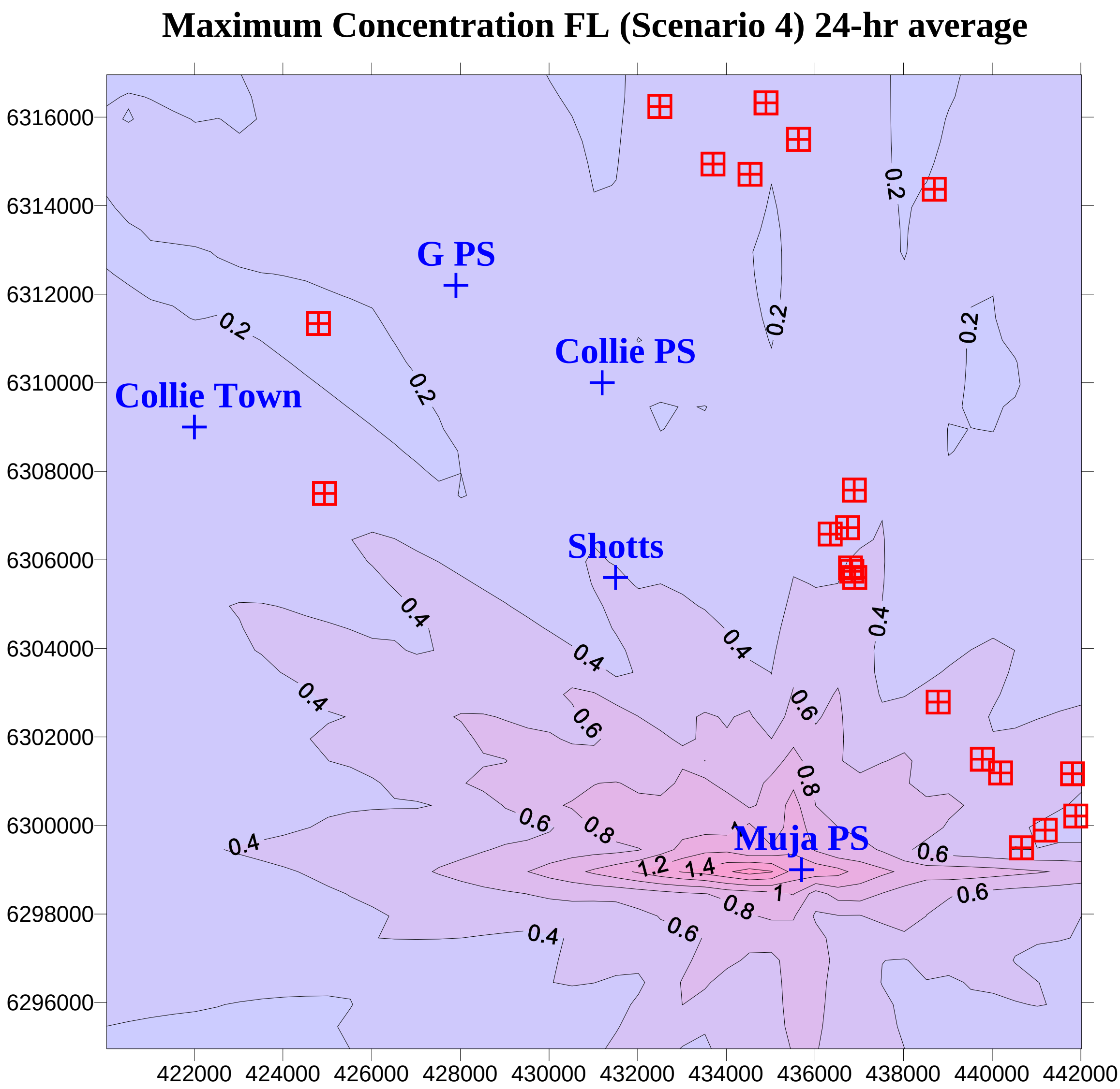


Figure E.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of fluoride (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

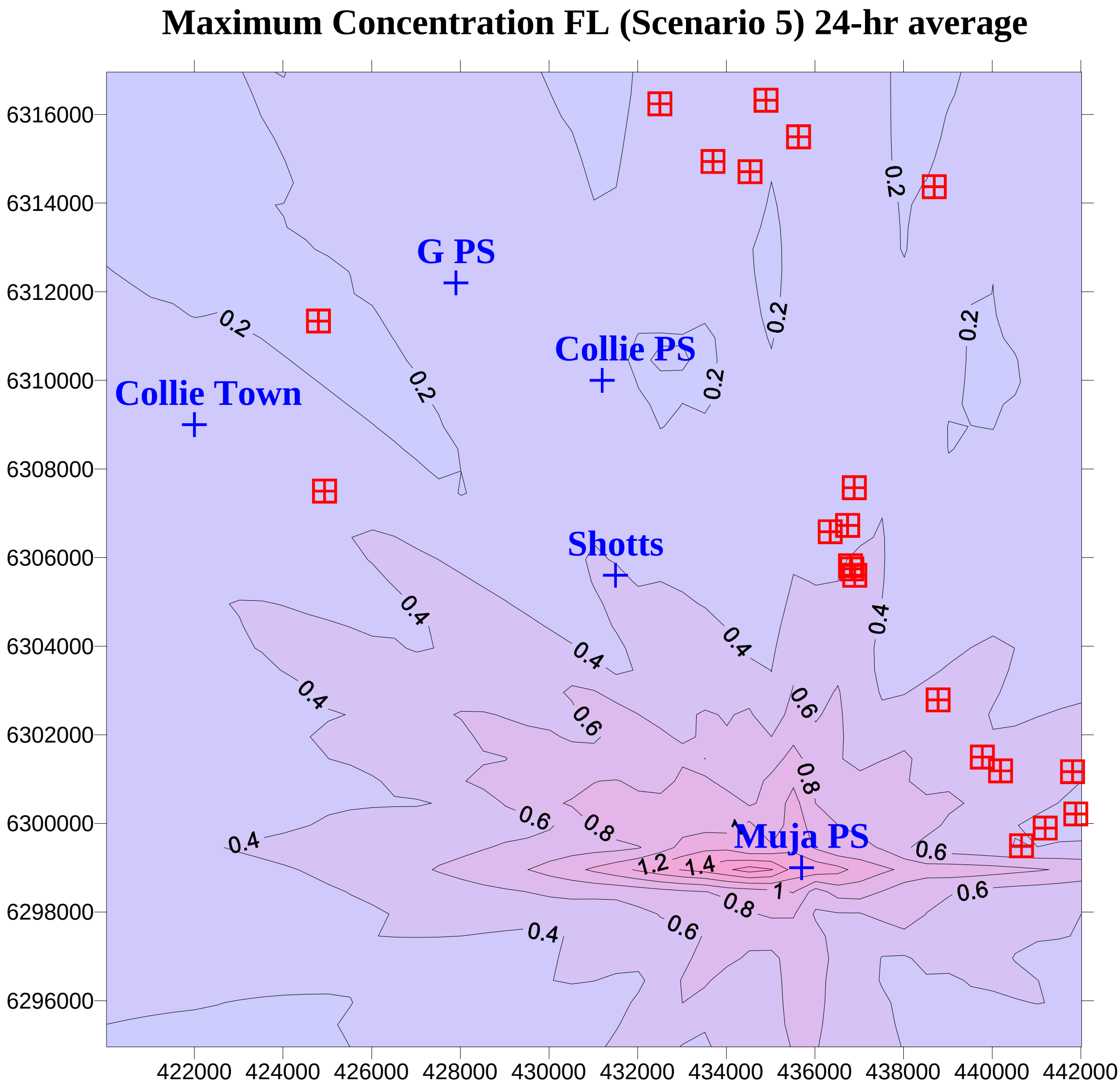


Figure E.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of fluoride (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix F Contour plots for TAPM NO_2 concentrations

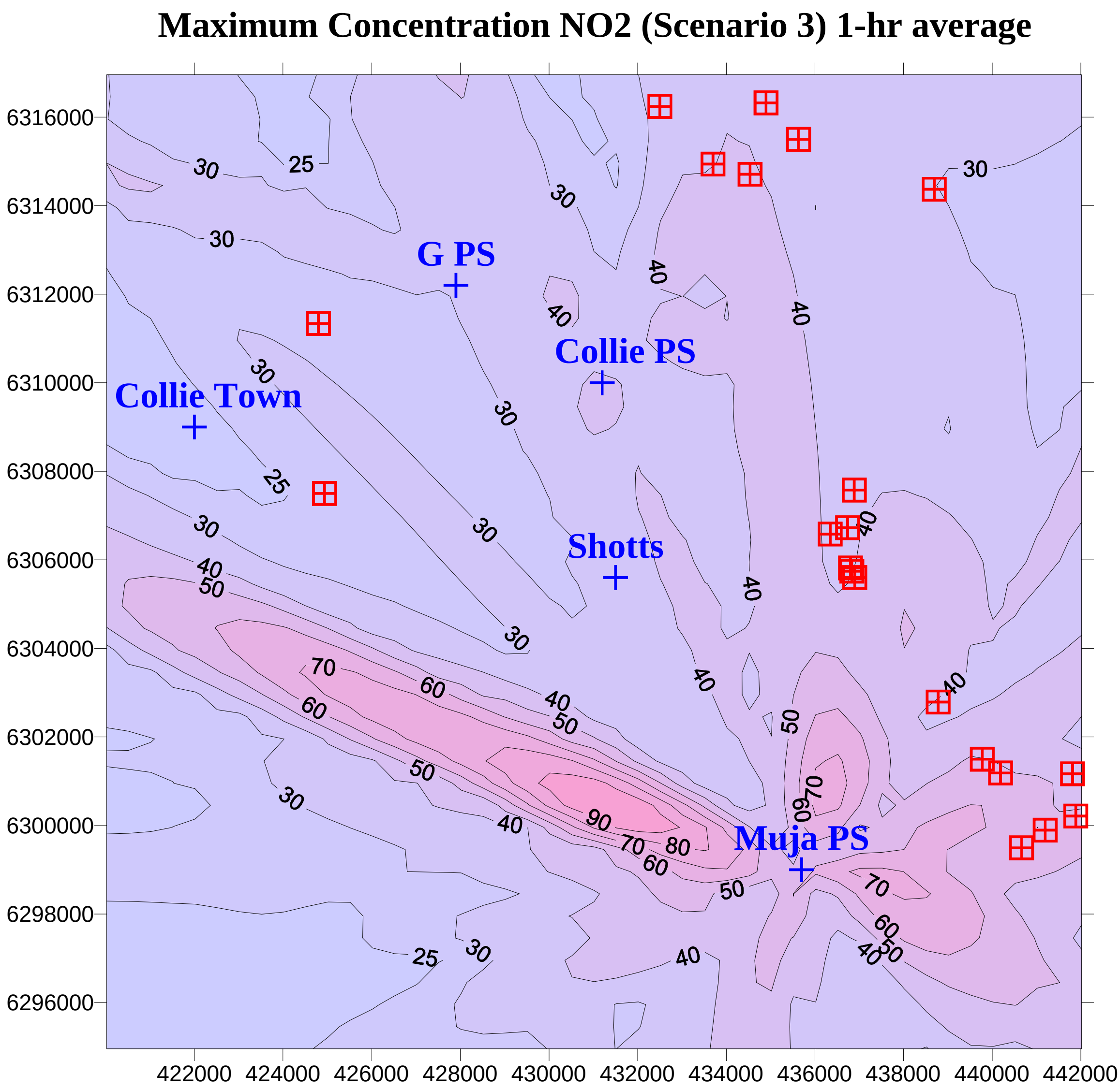


Figure F.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

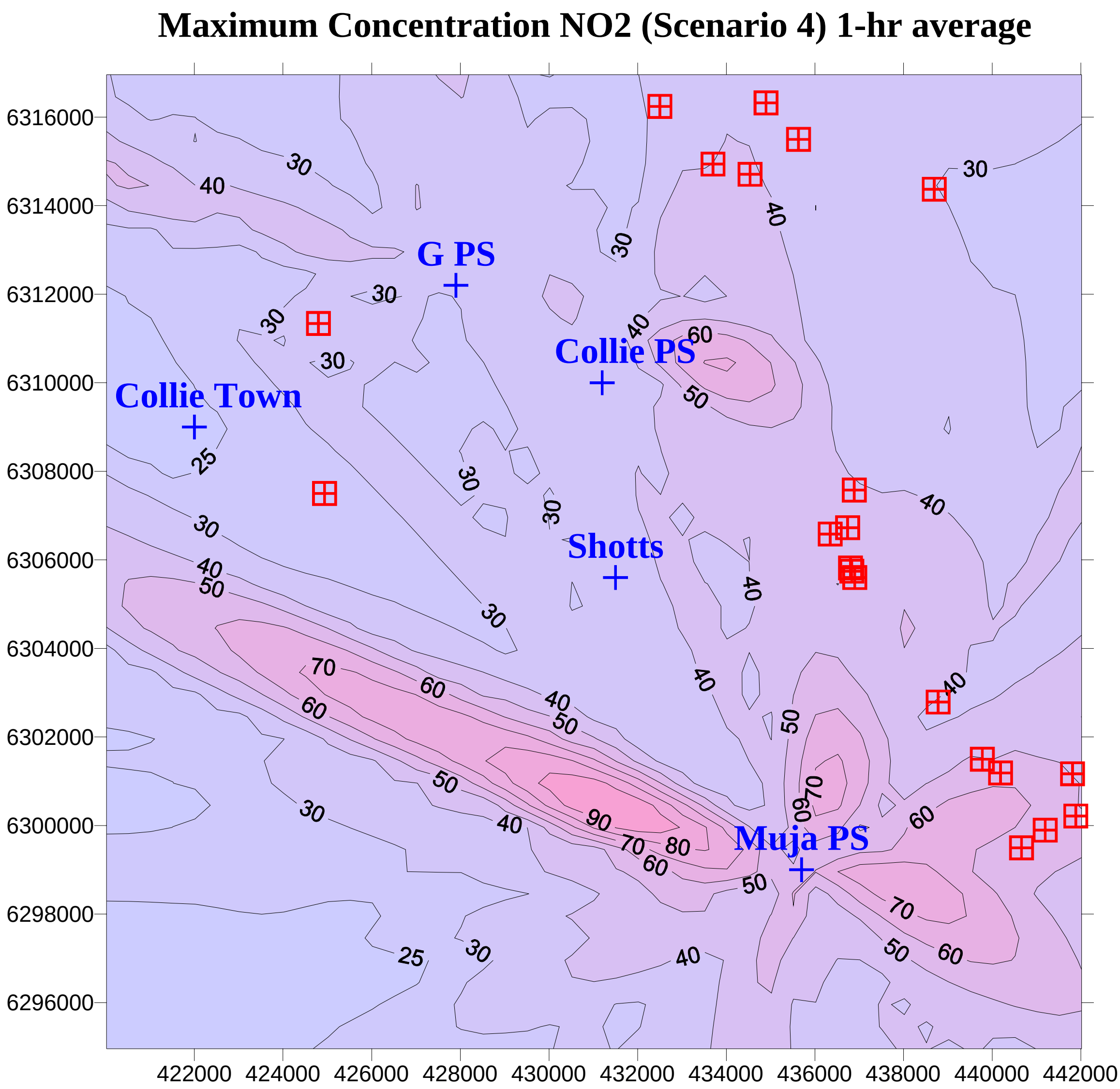


Figure F.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

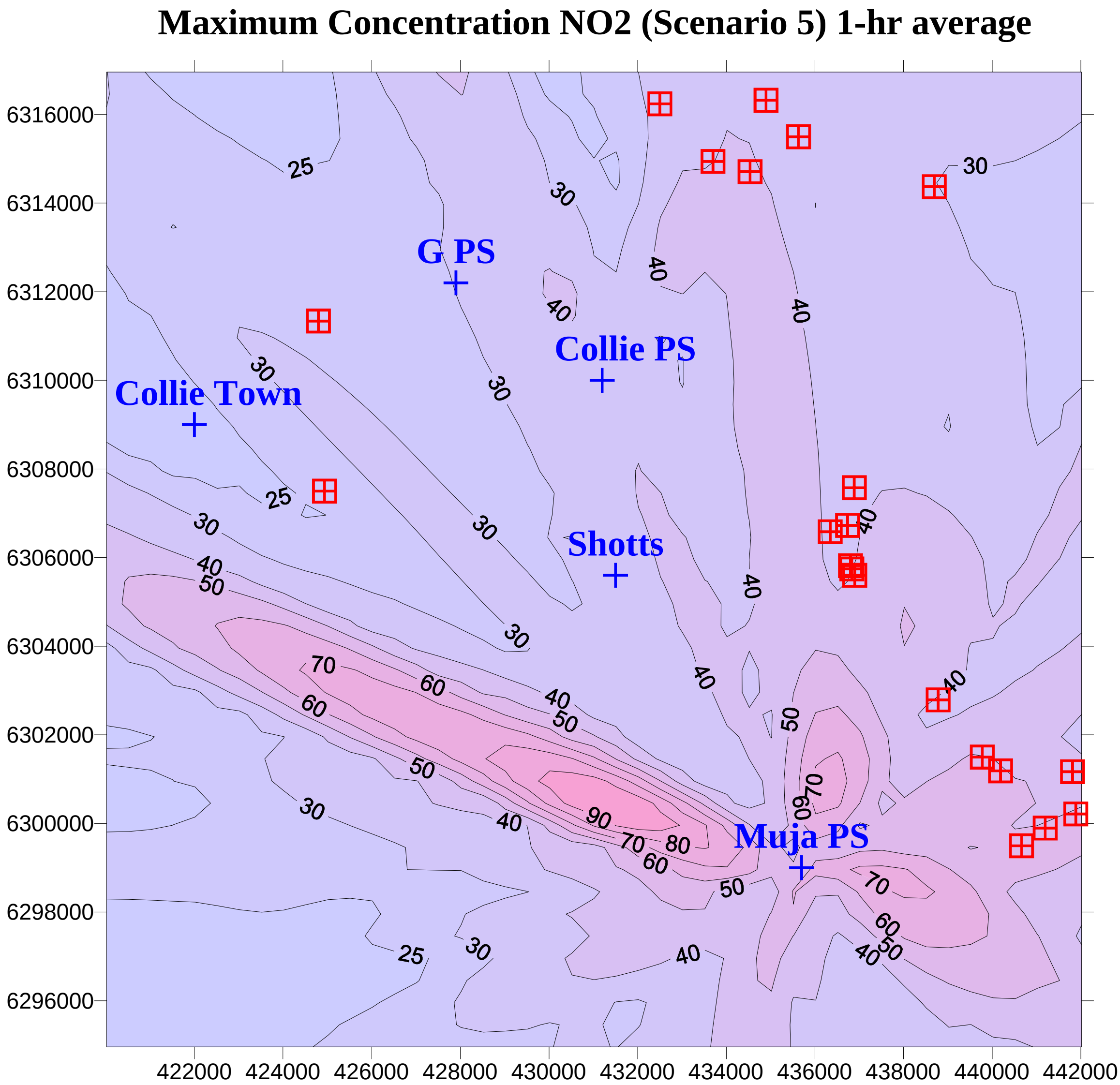


Figure F.3 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

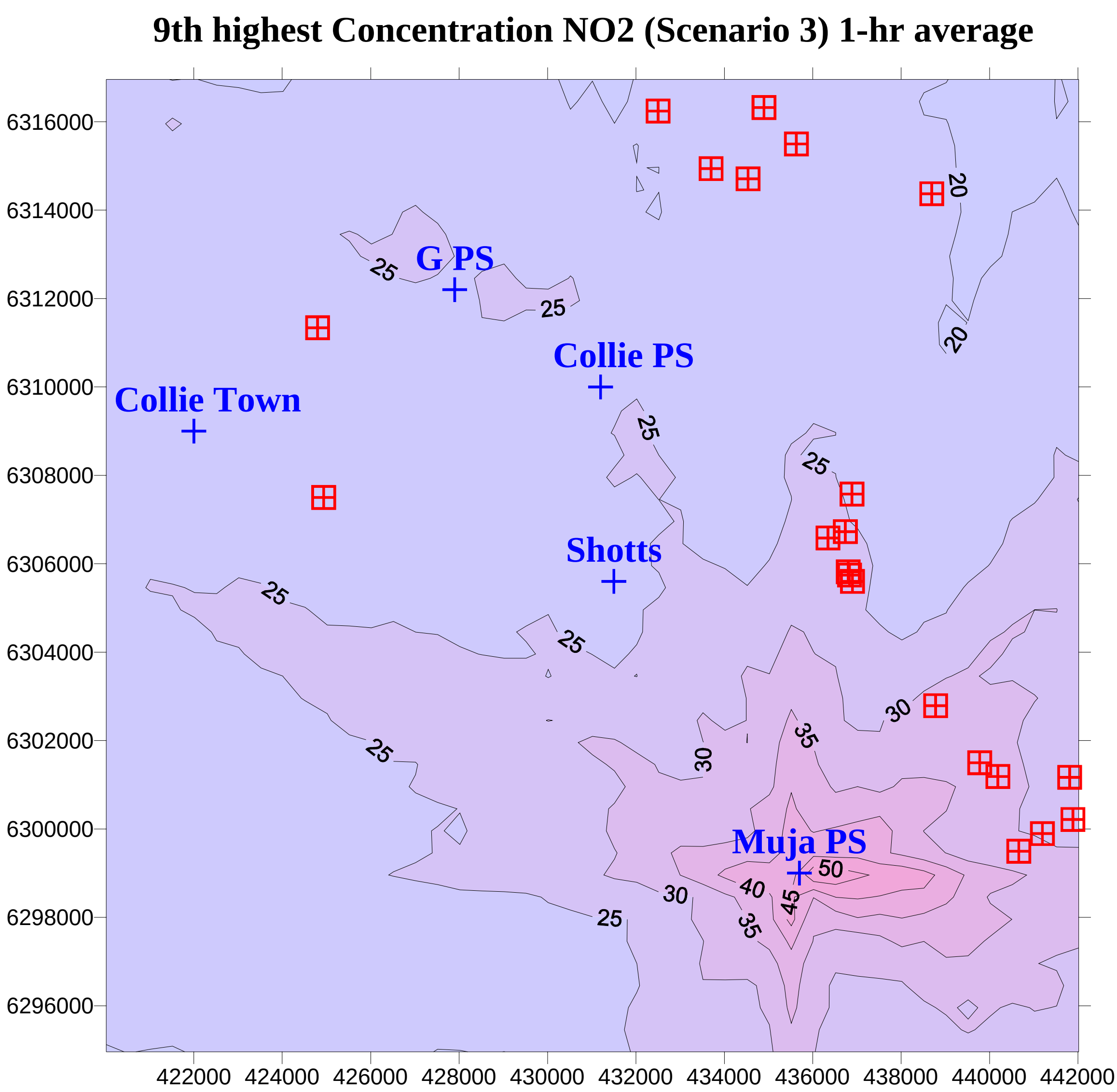


Figure F.4 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

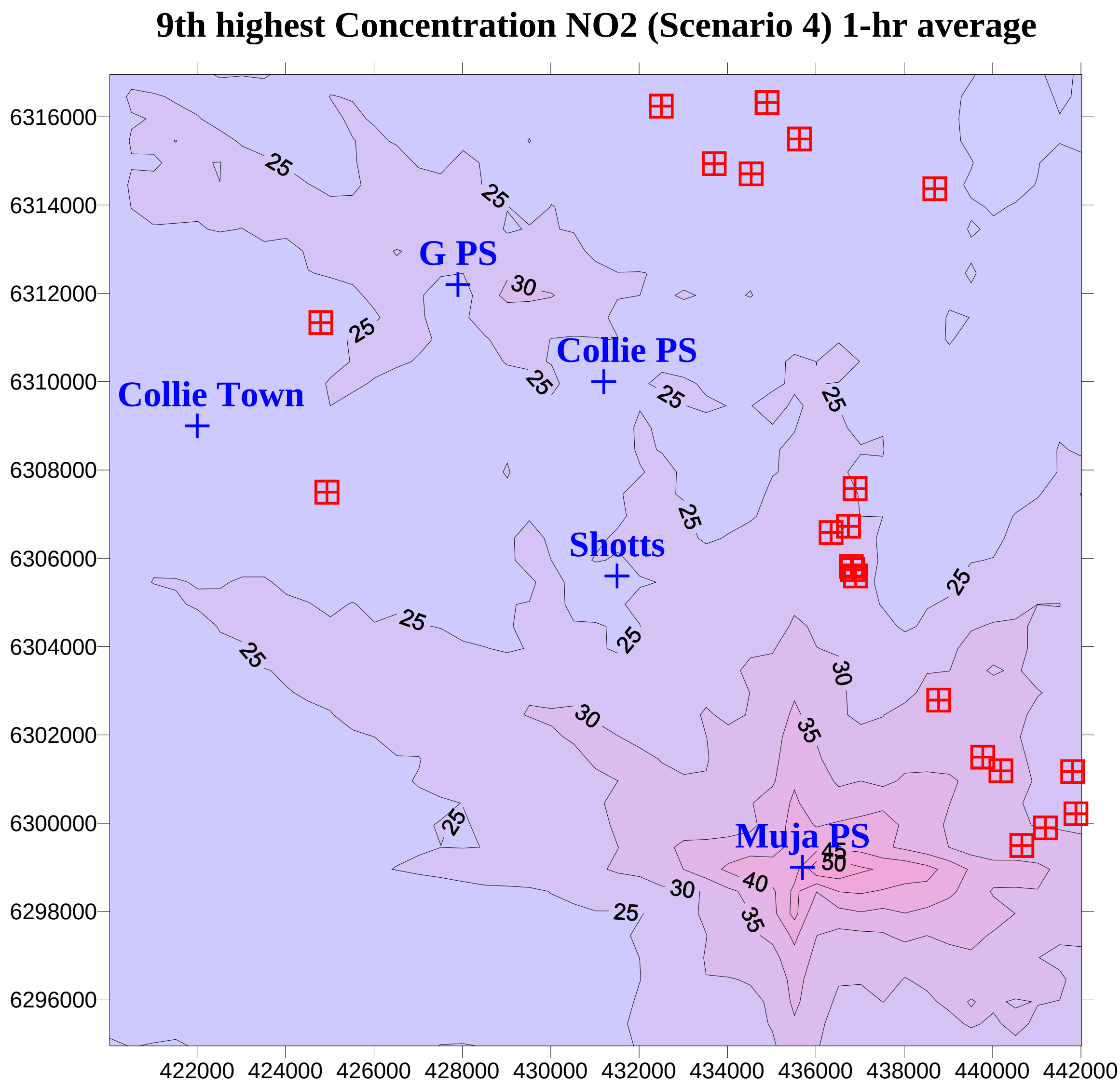


Figure F.5 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

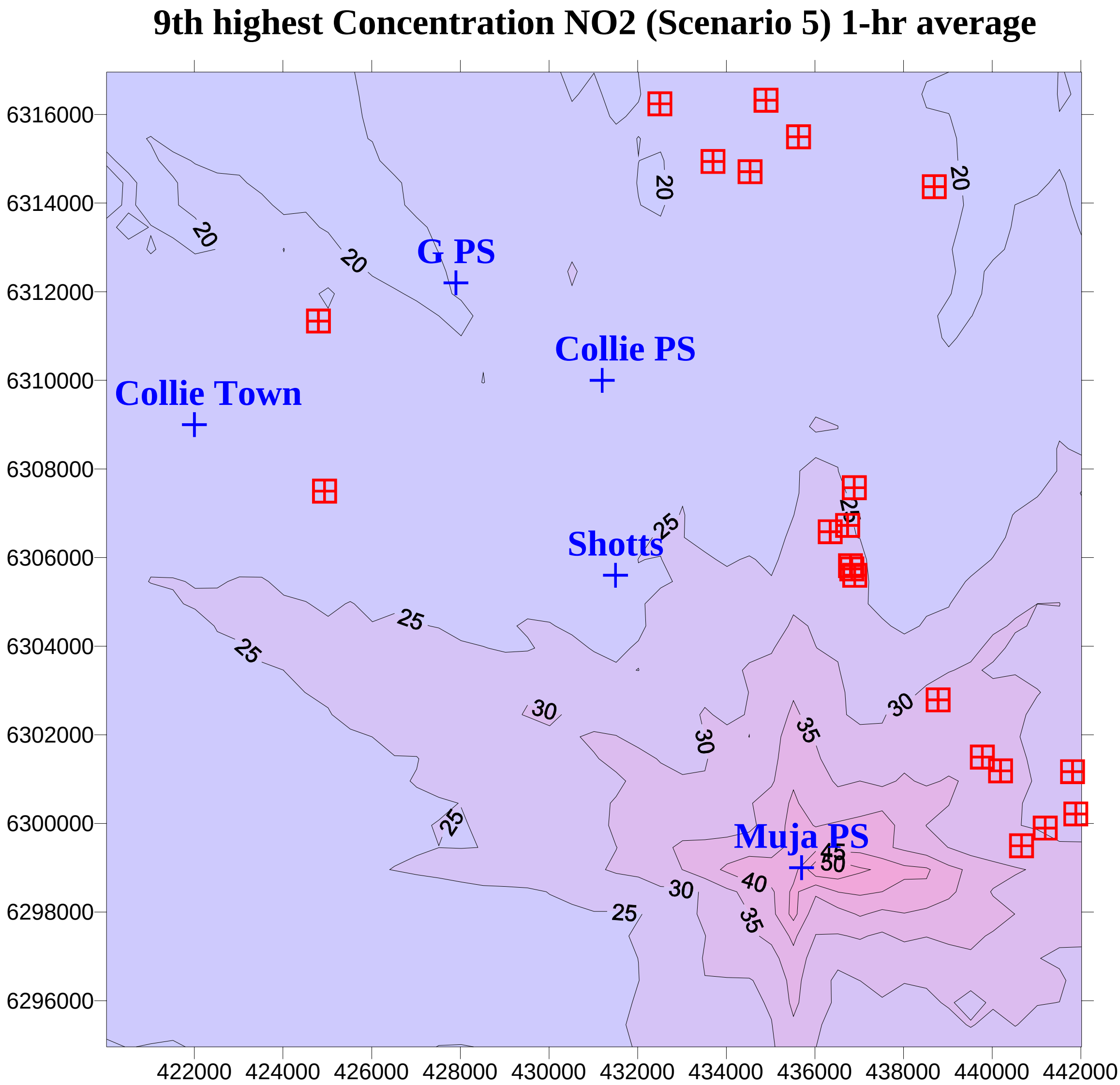


Figure F.6 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

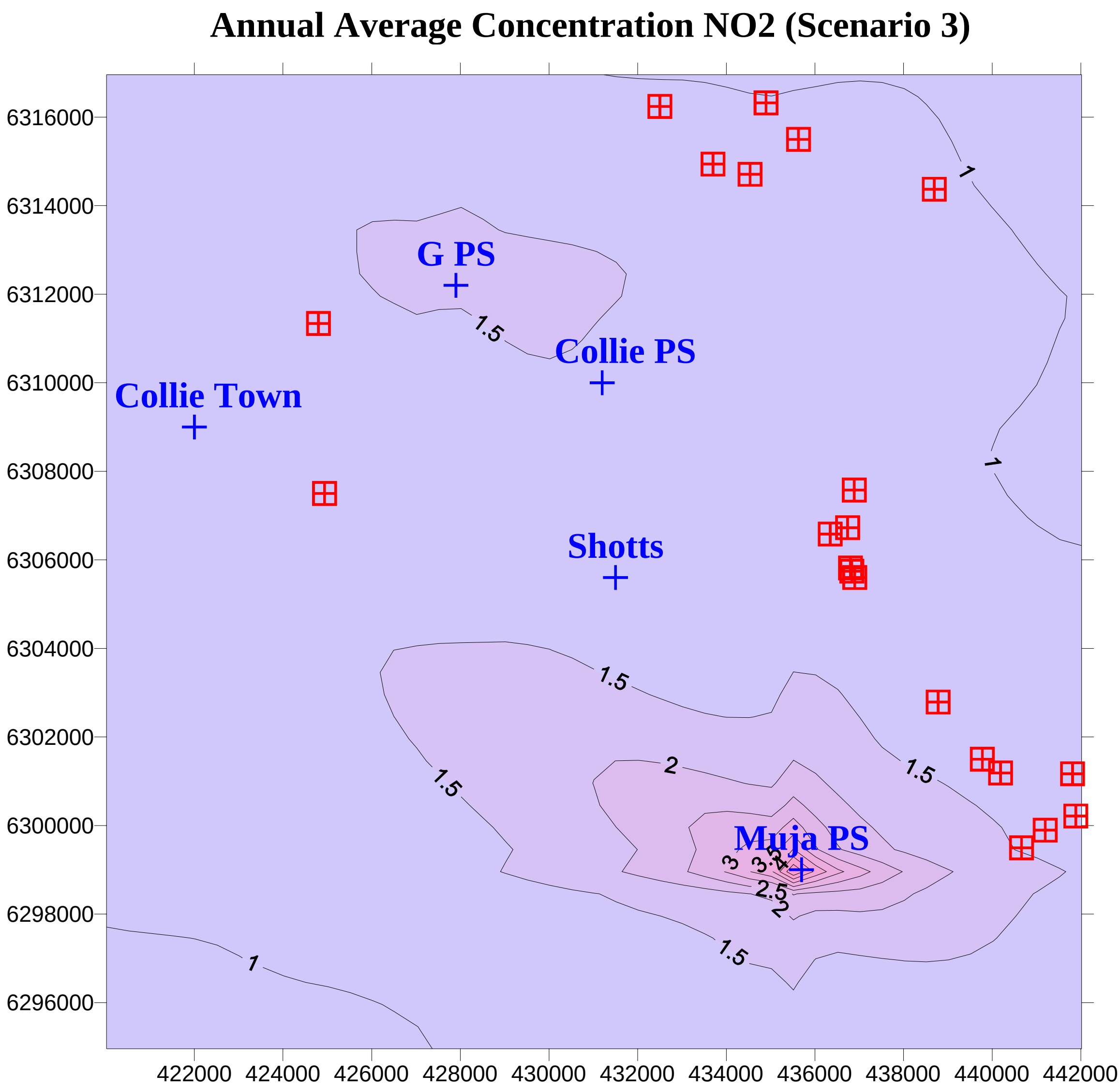


Figure F.7 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

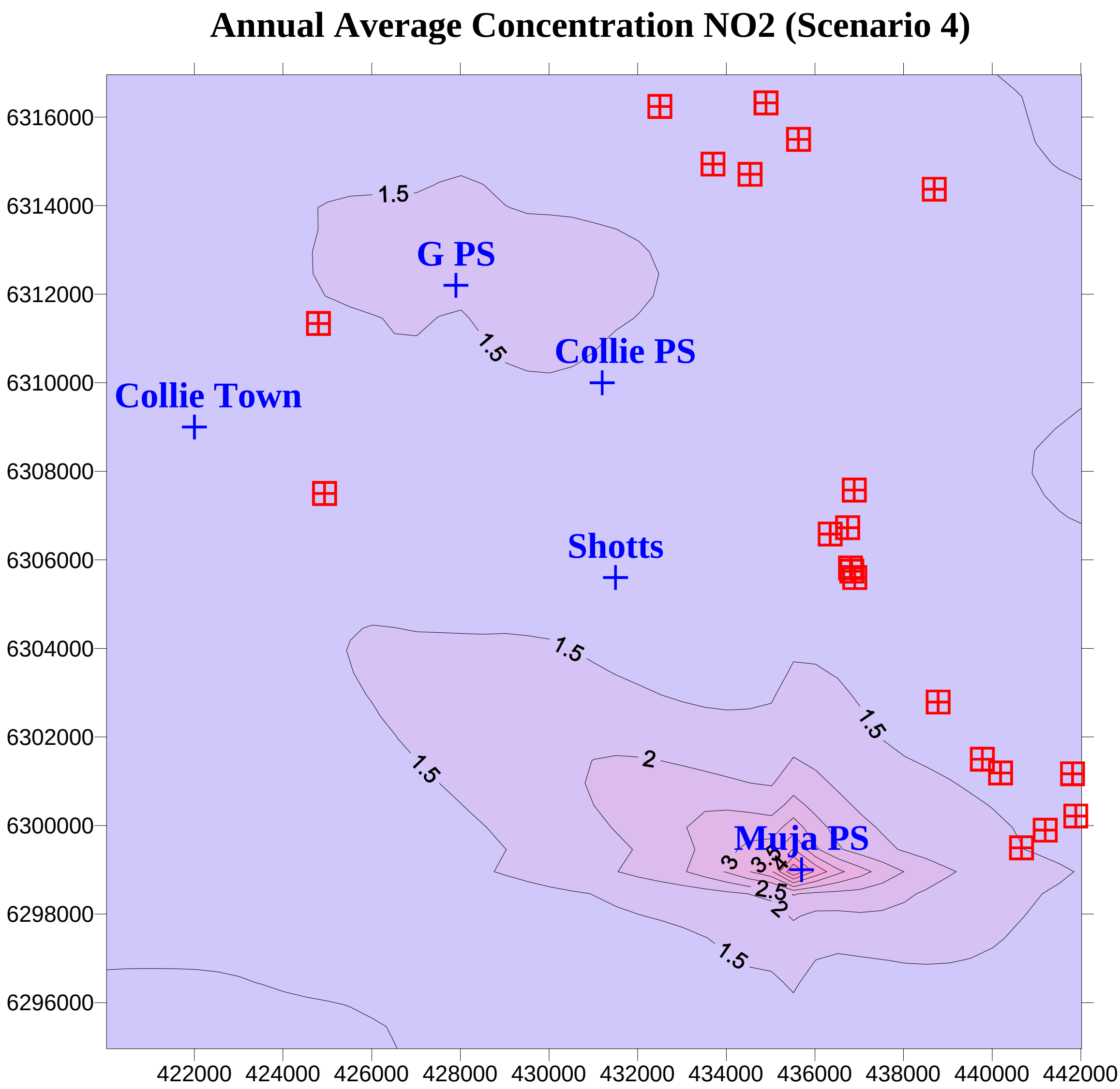


Figure F.8 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

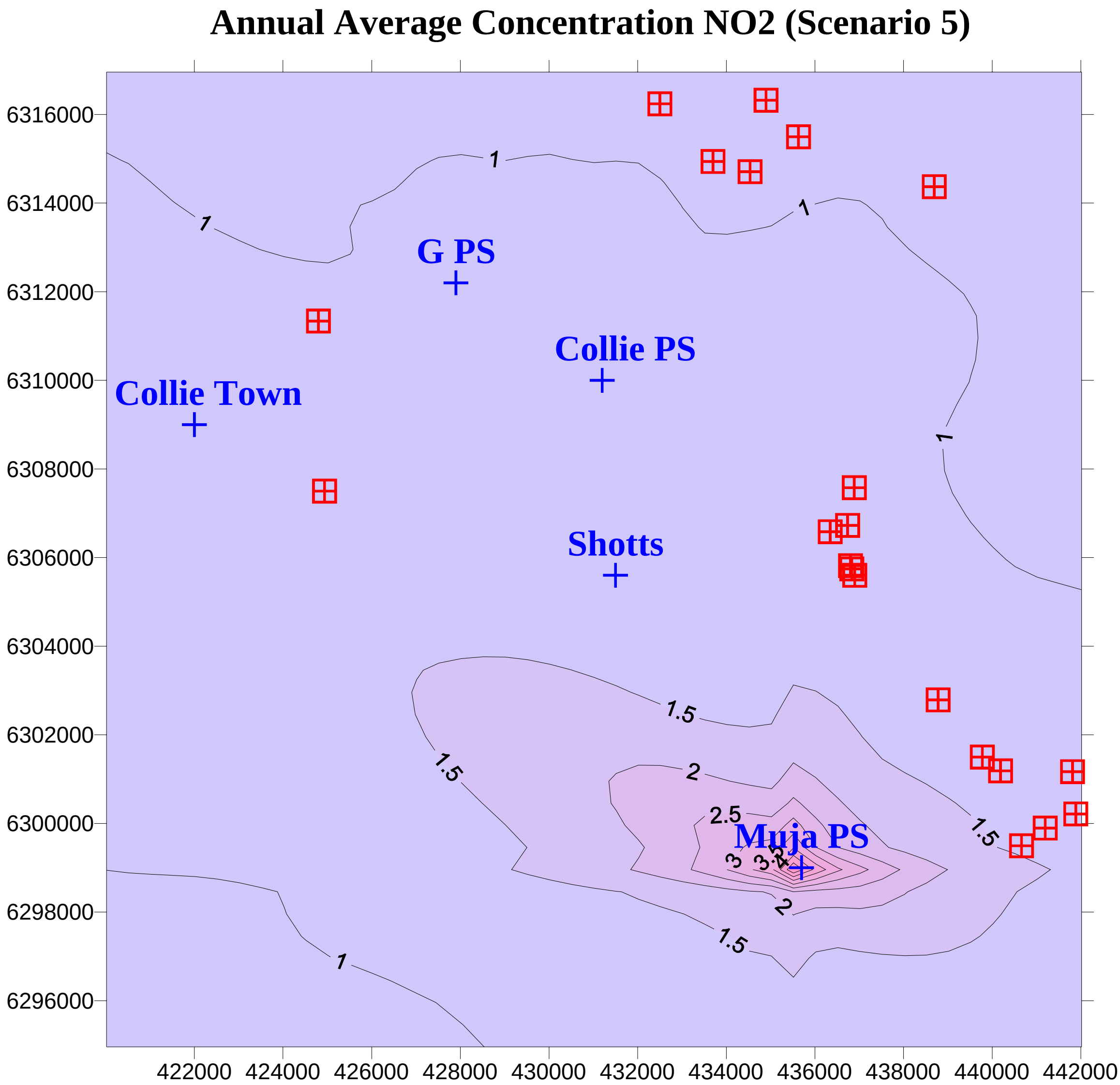


Figure F.9 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix G Contour plots for TAPM O_3 concentrations

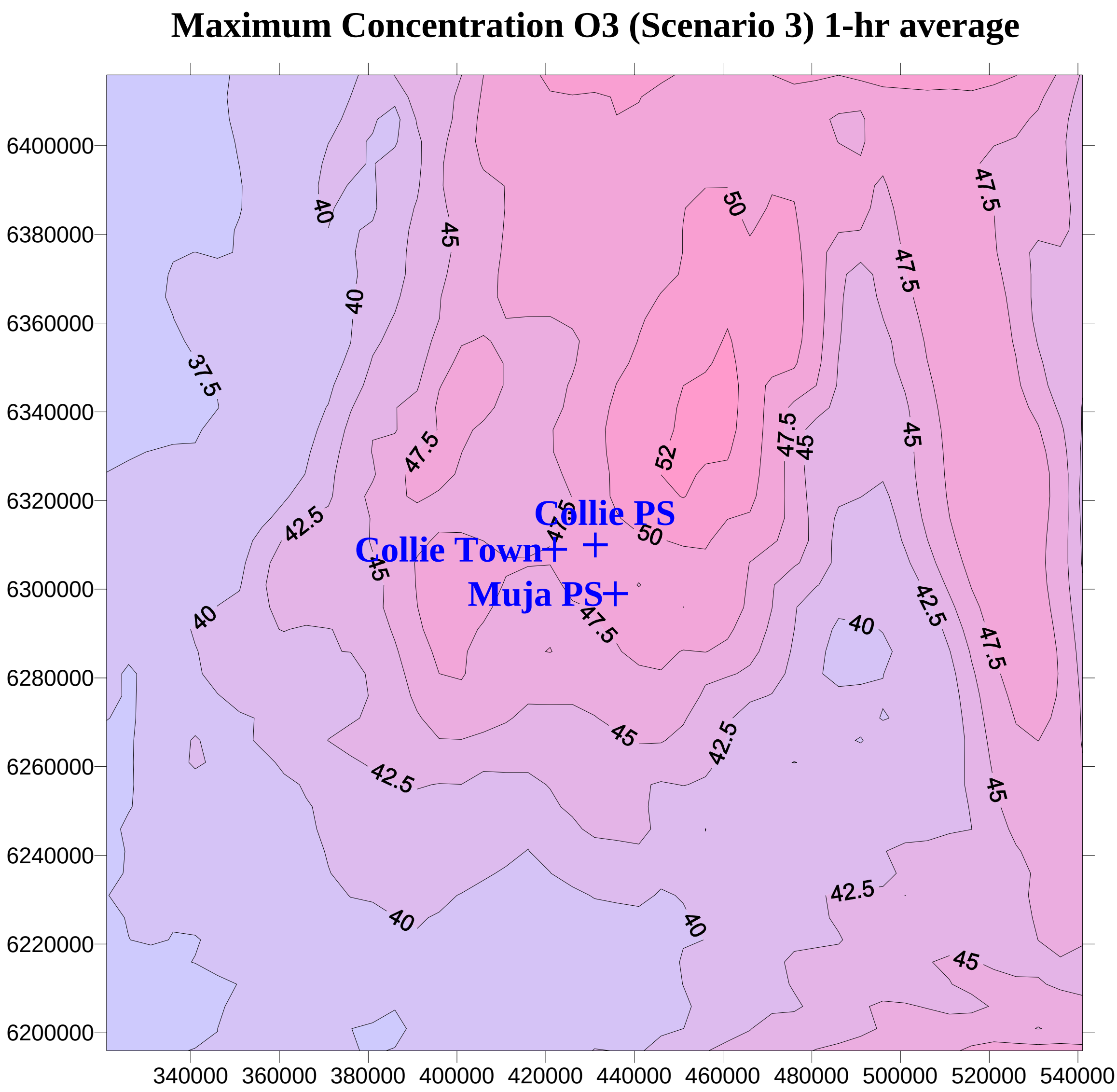


Figure G.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

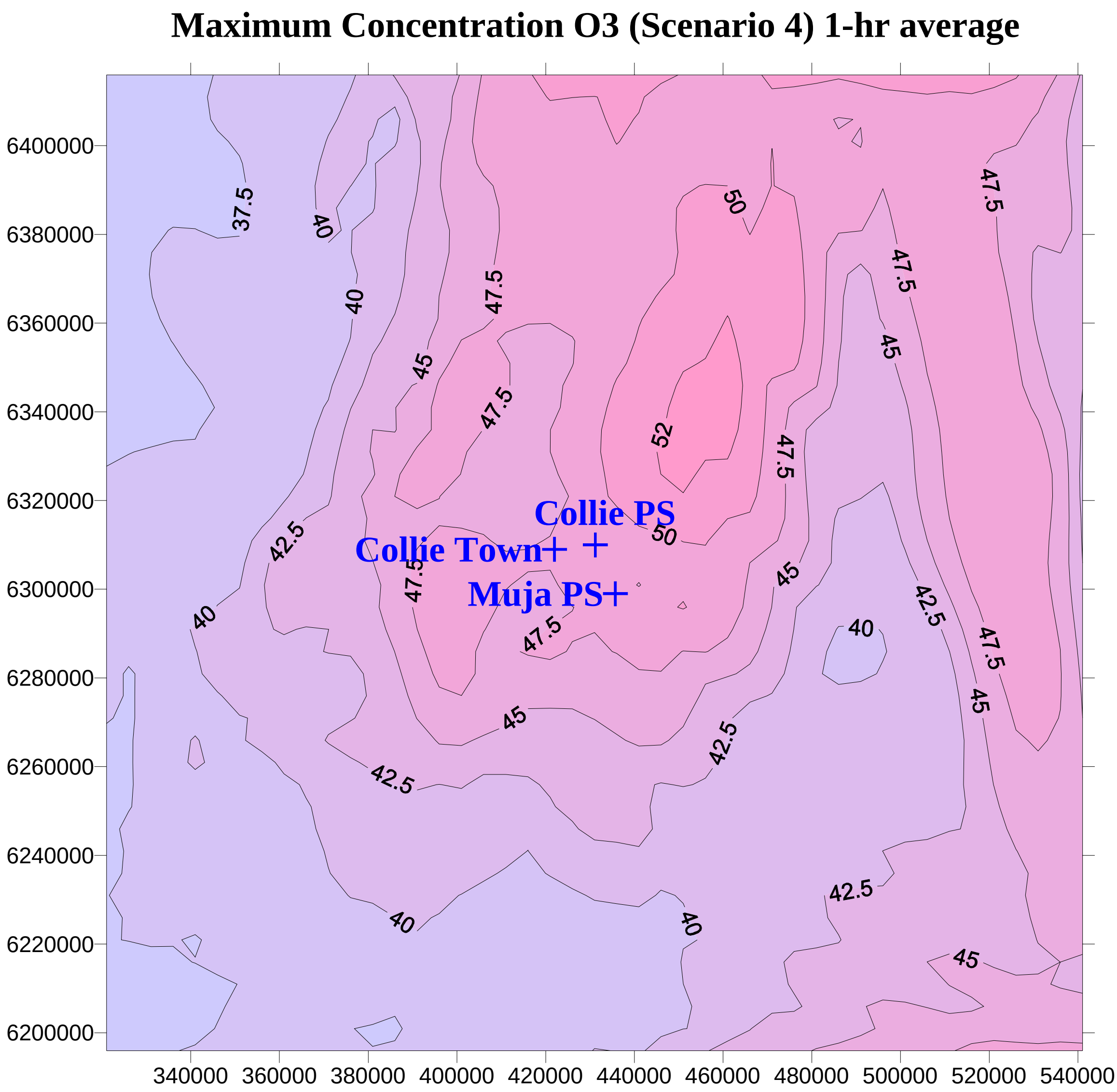


Figure G.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

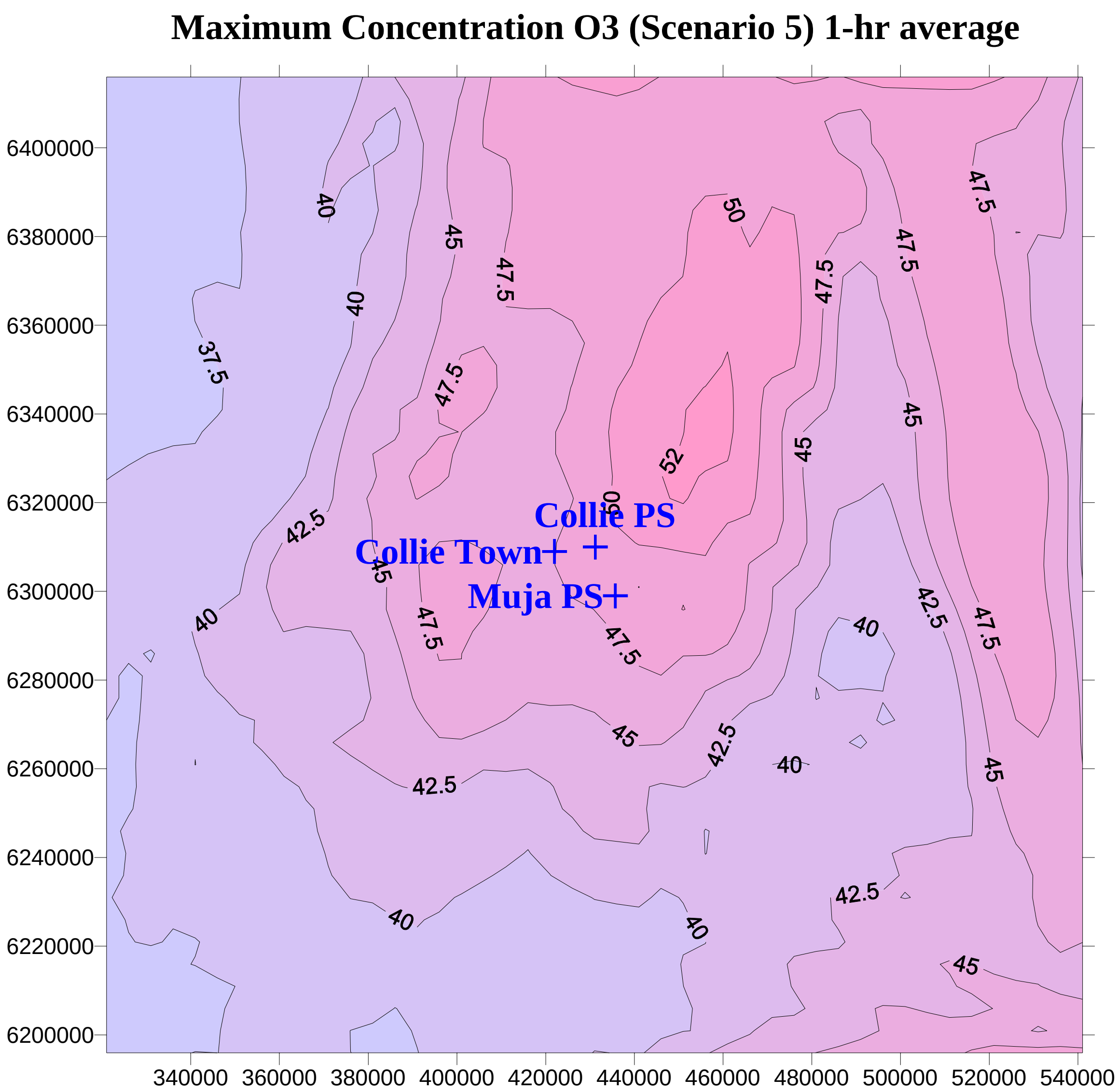
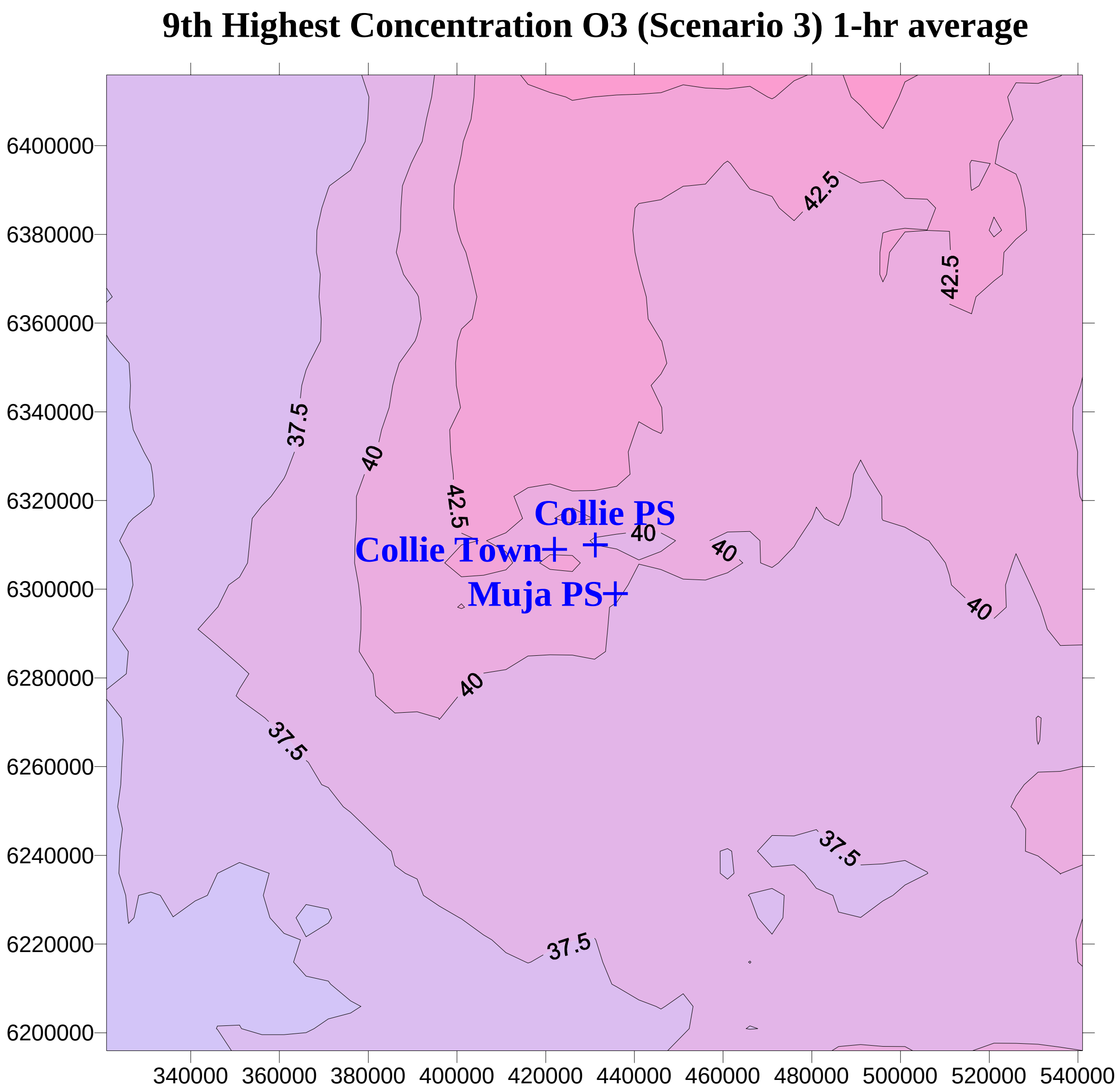


Figure G.3 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.



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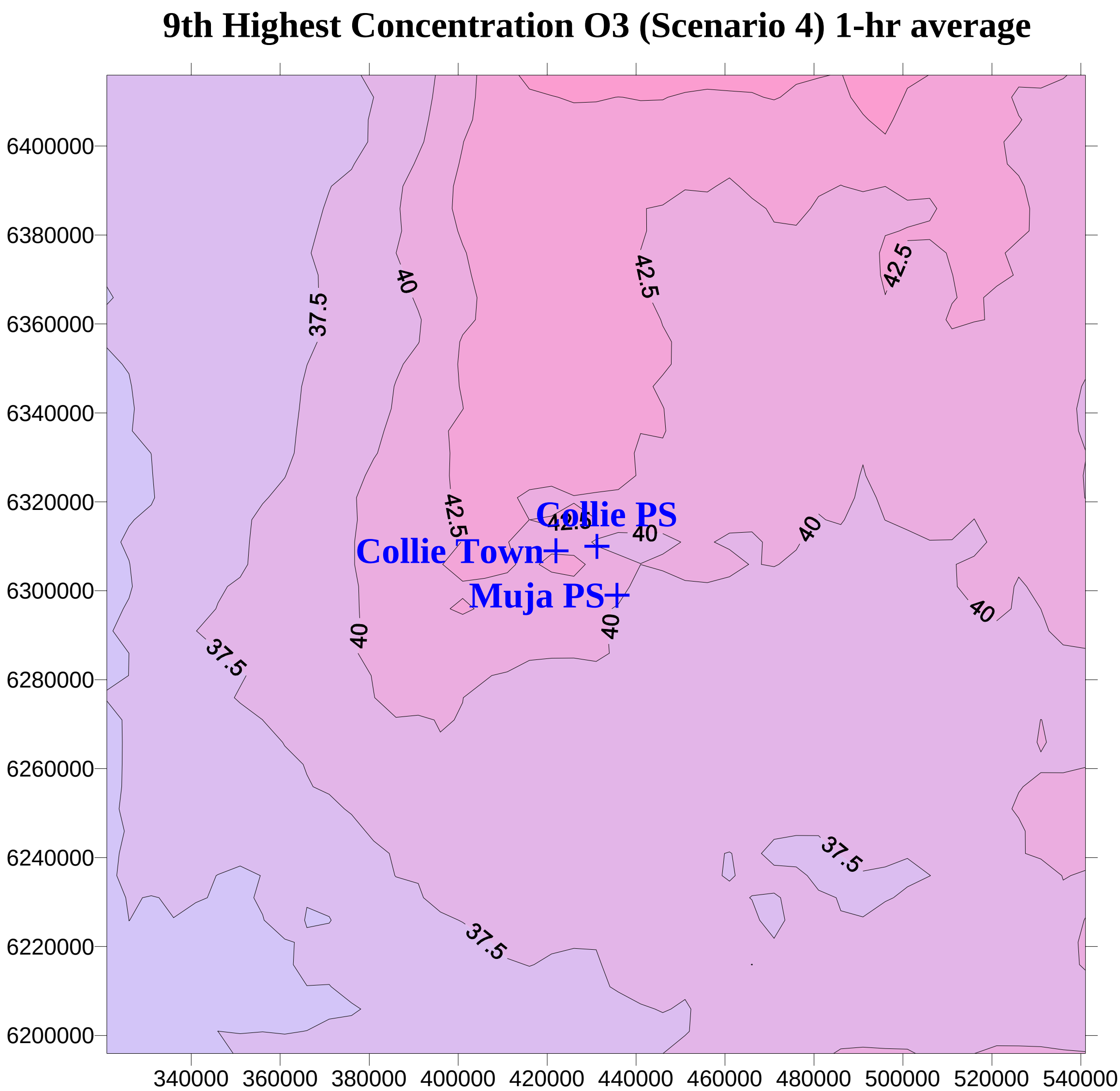


Figure G.5 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

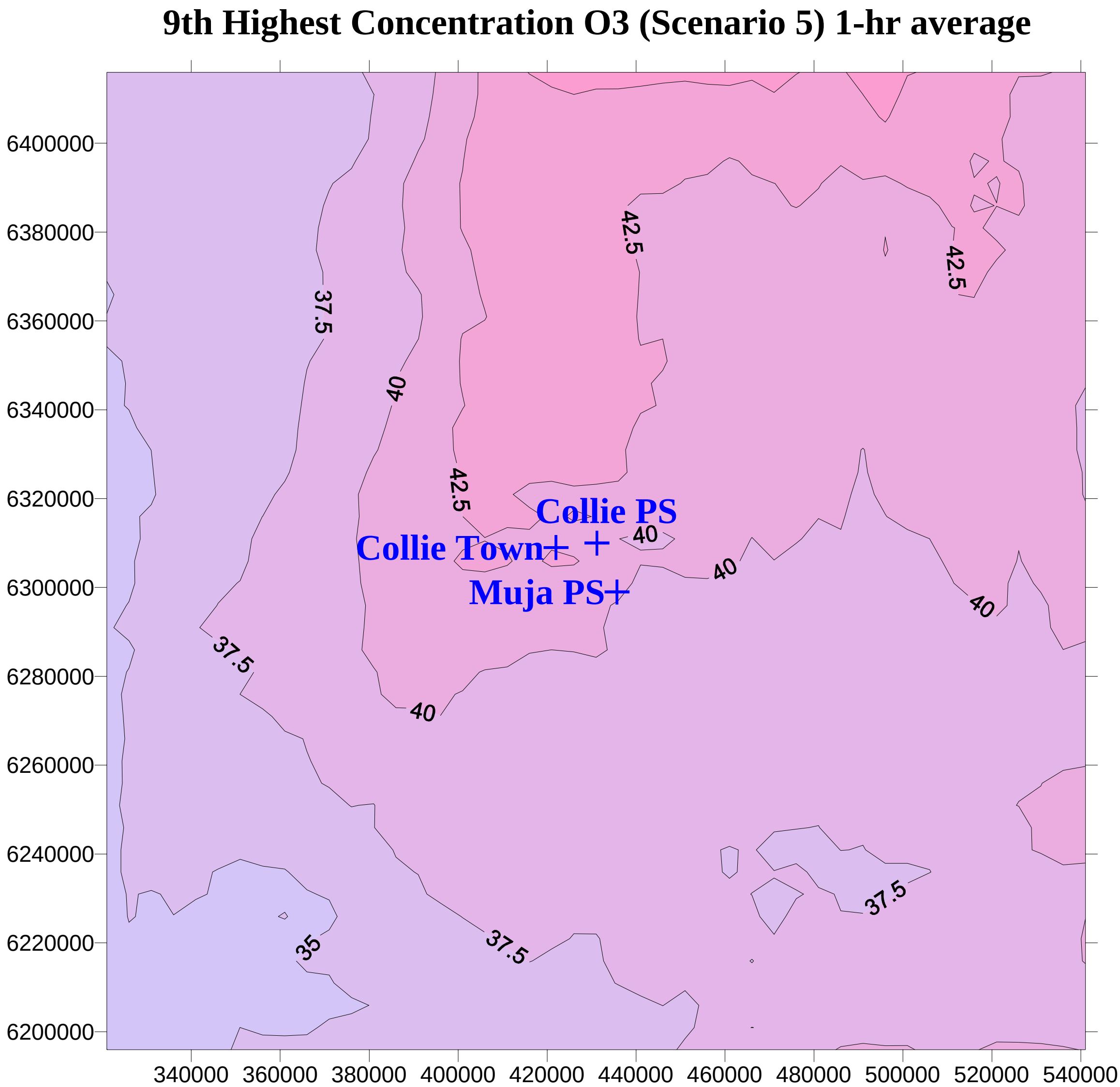


Figure G.6 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9^th^-highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

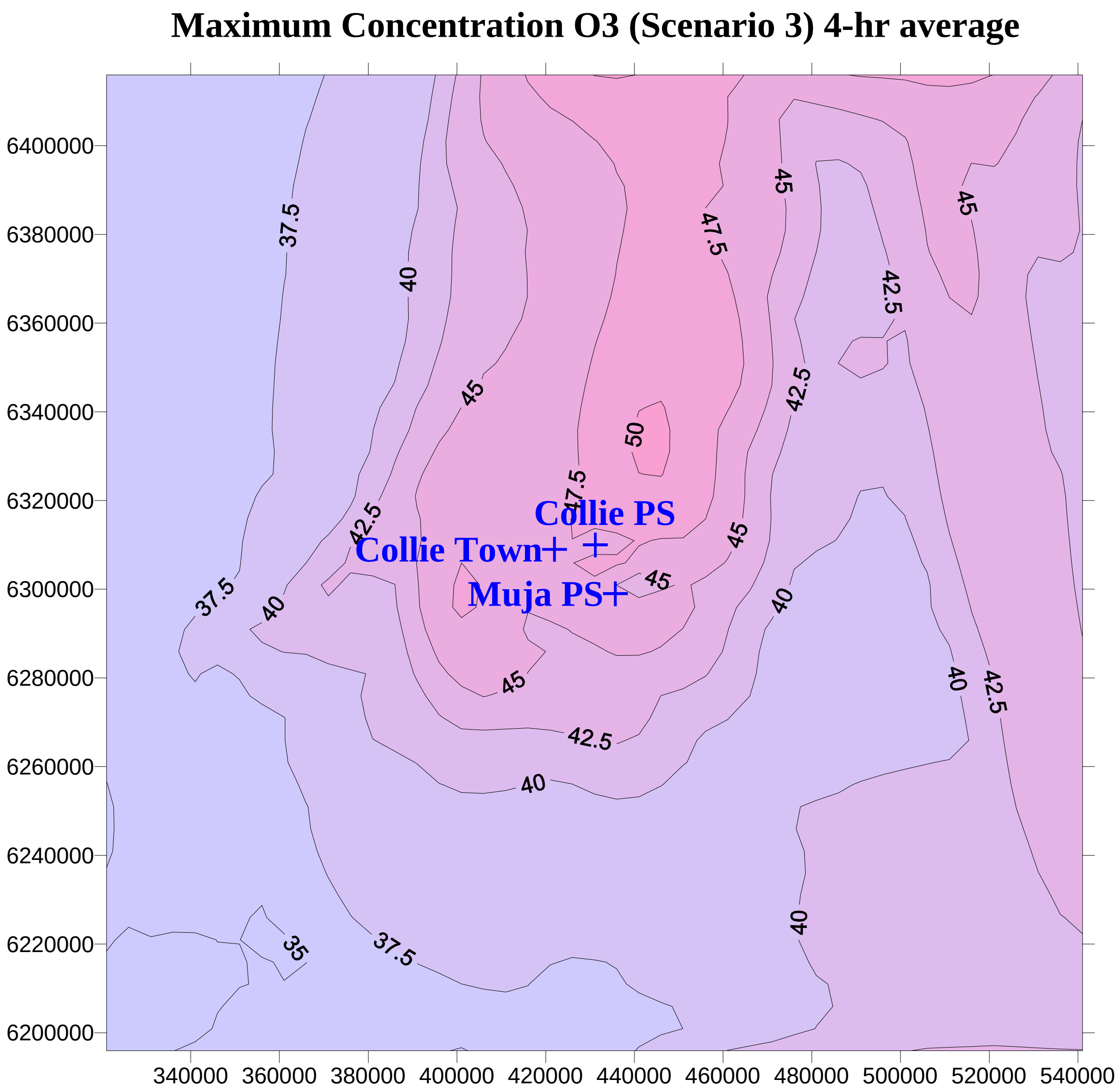


Figure G.7 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

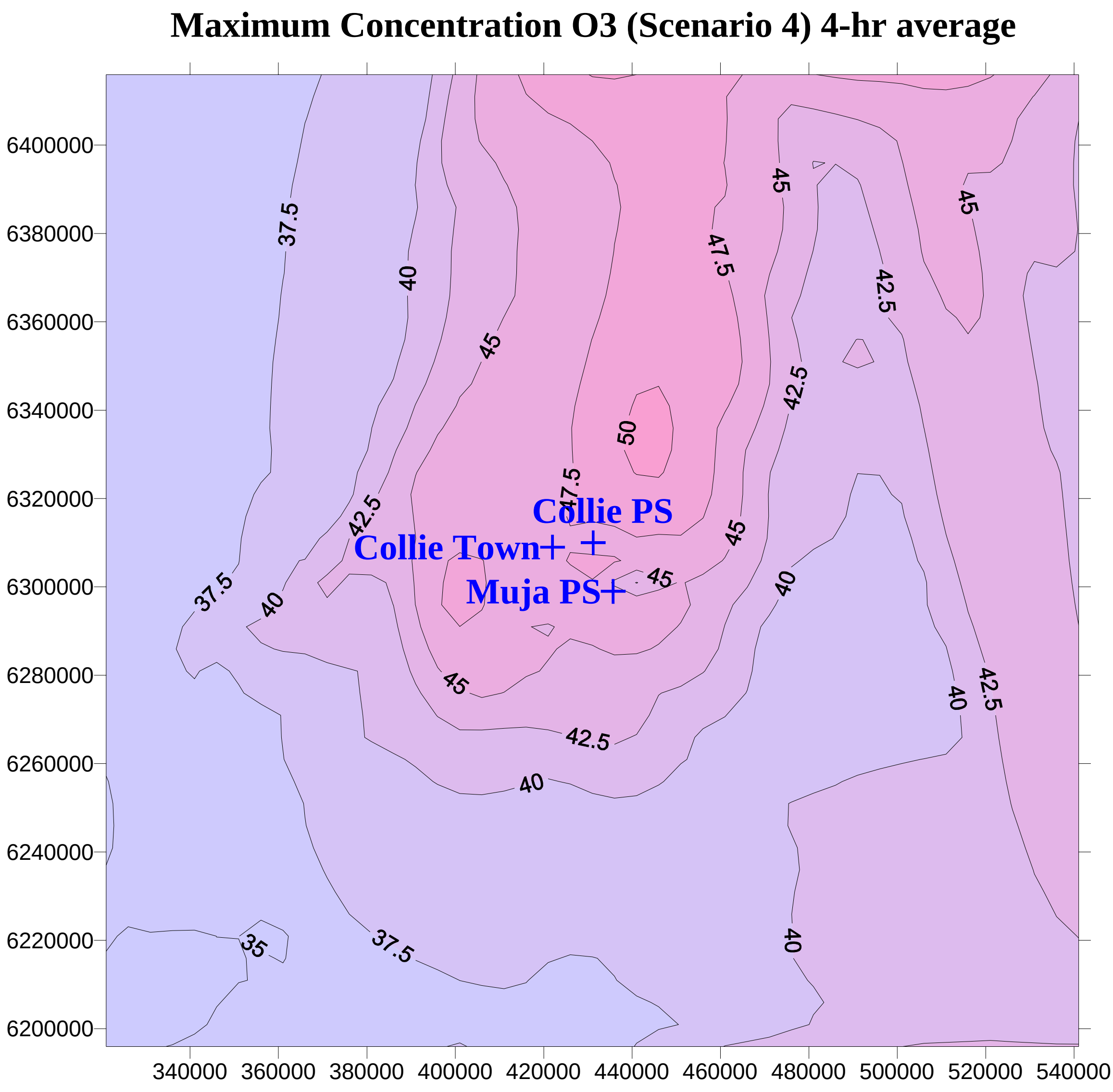


Figure G.8 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

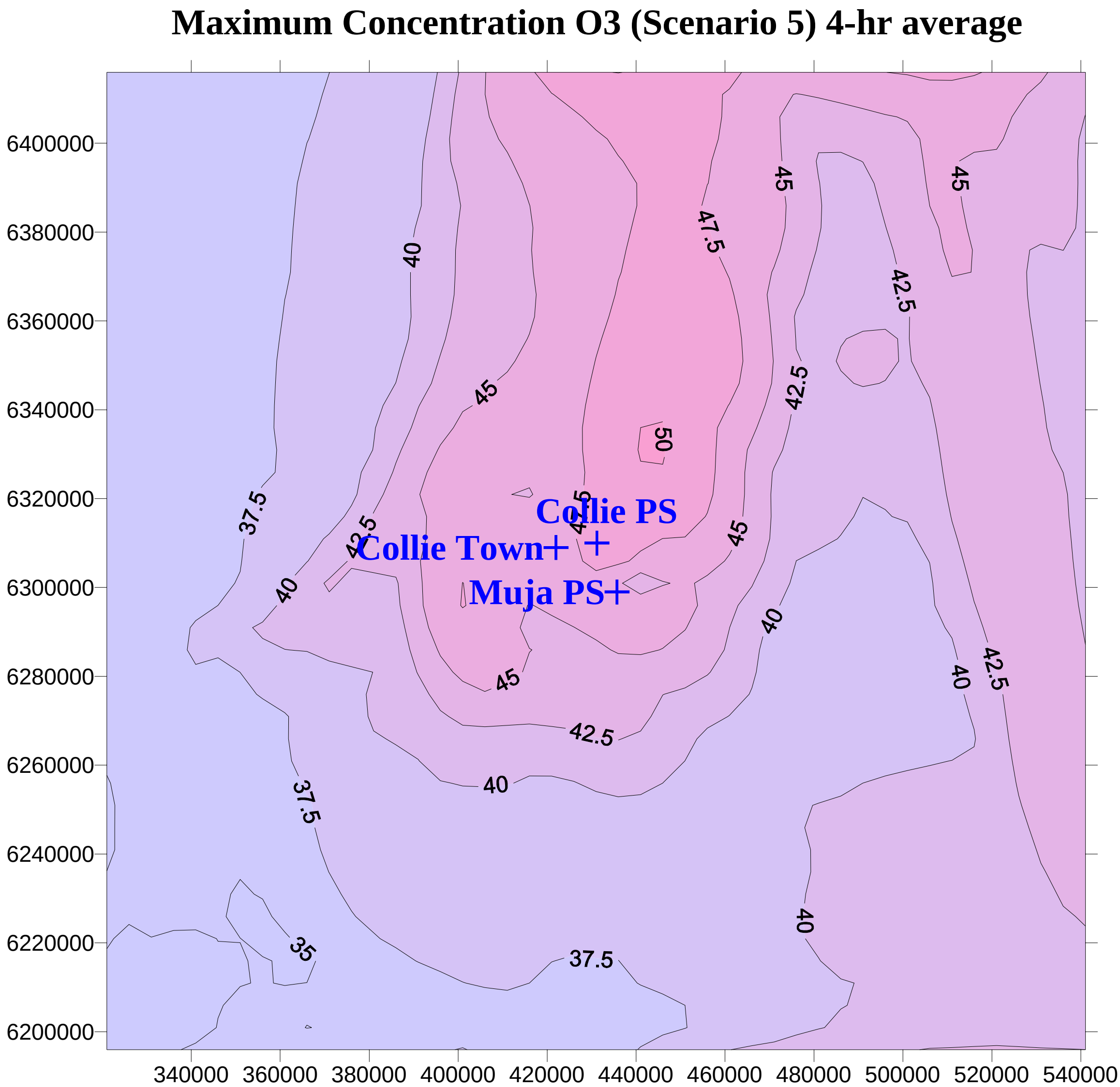


Figure G.9 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

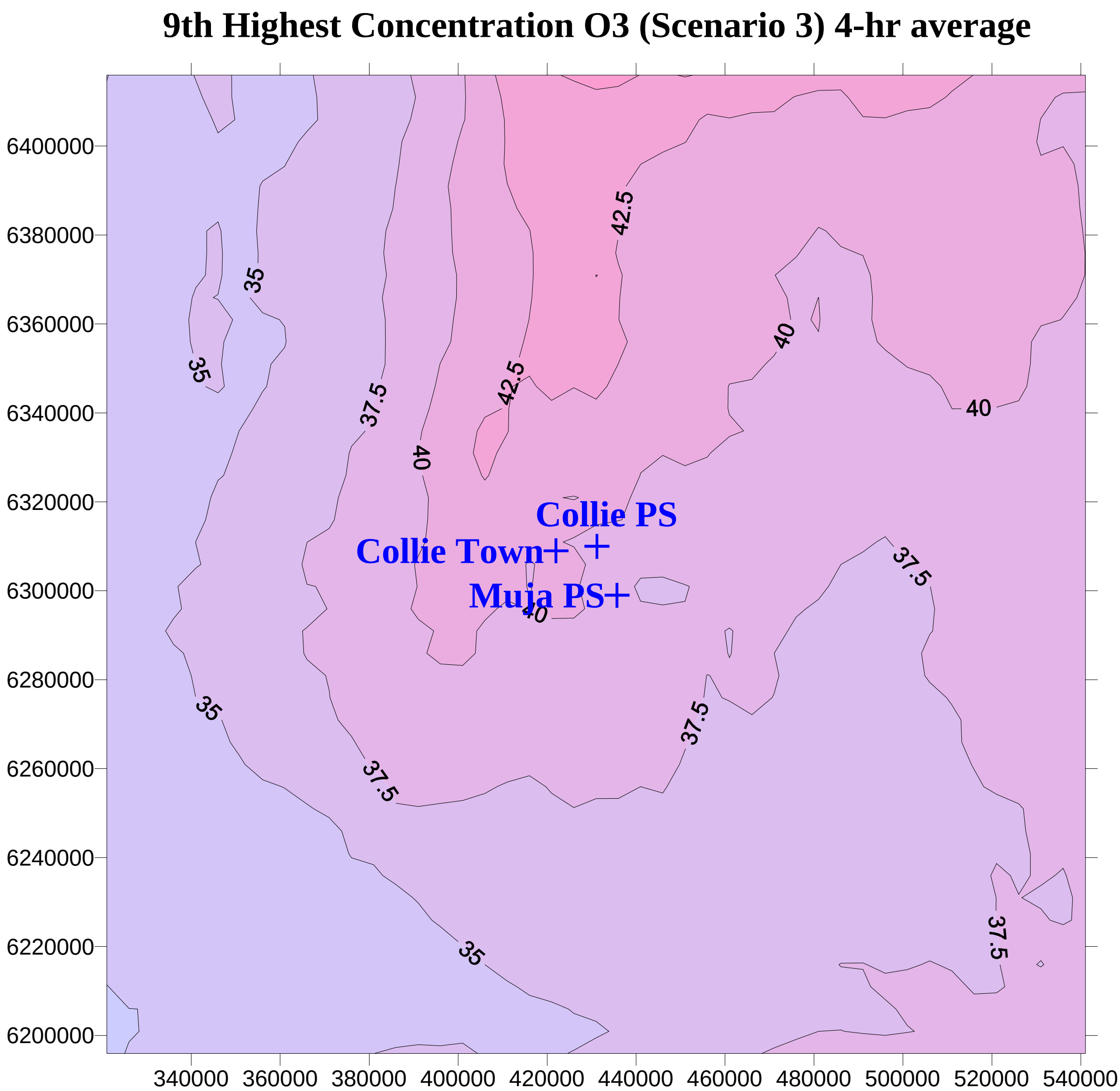


Figure G.10 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

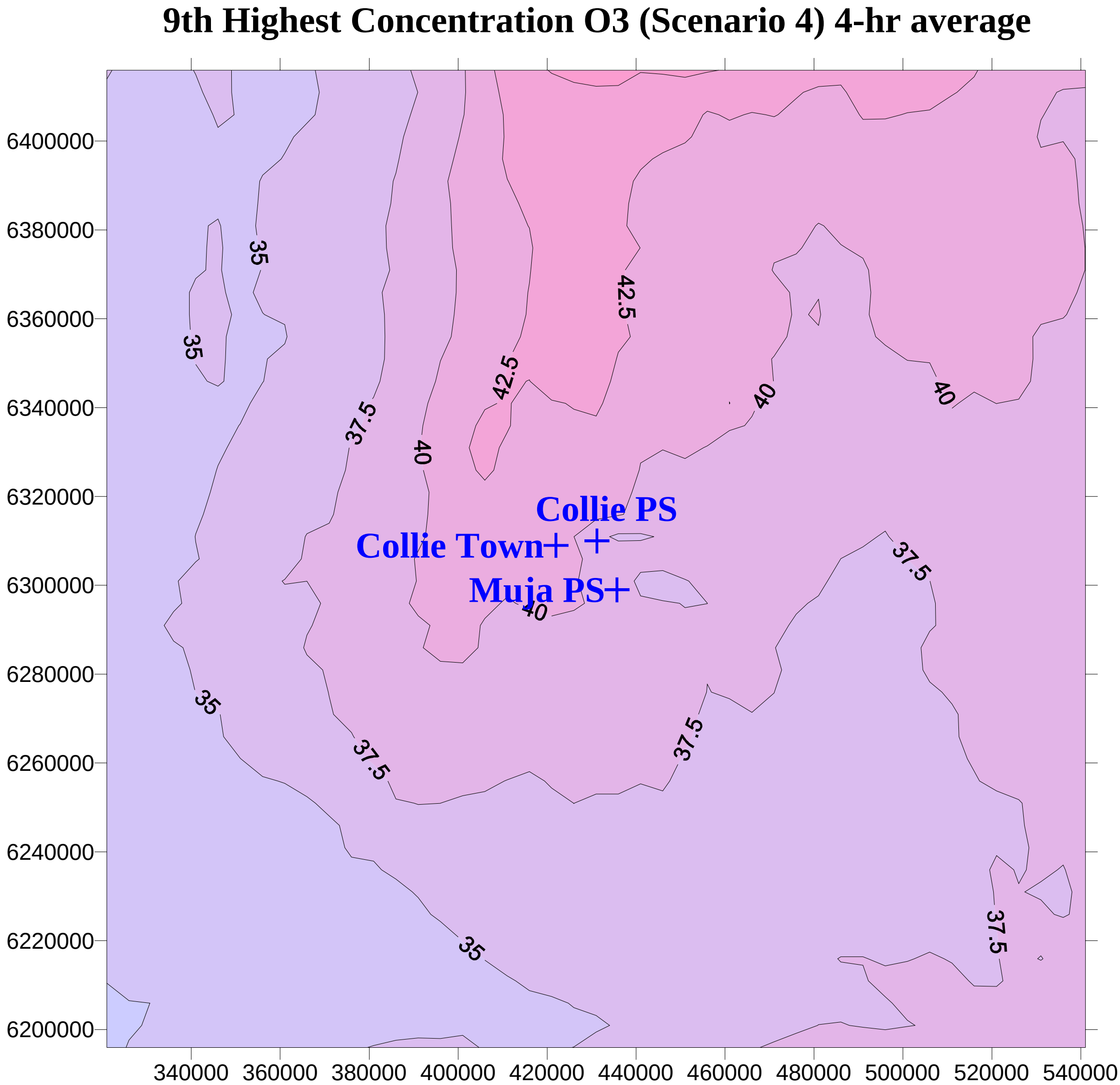


Figure G.11 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9^th^ highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

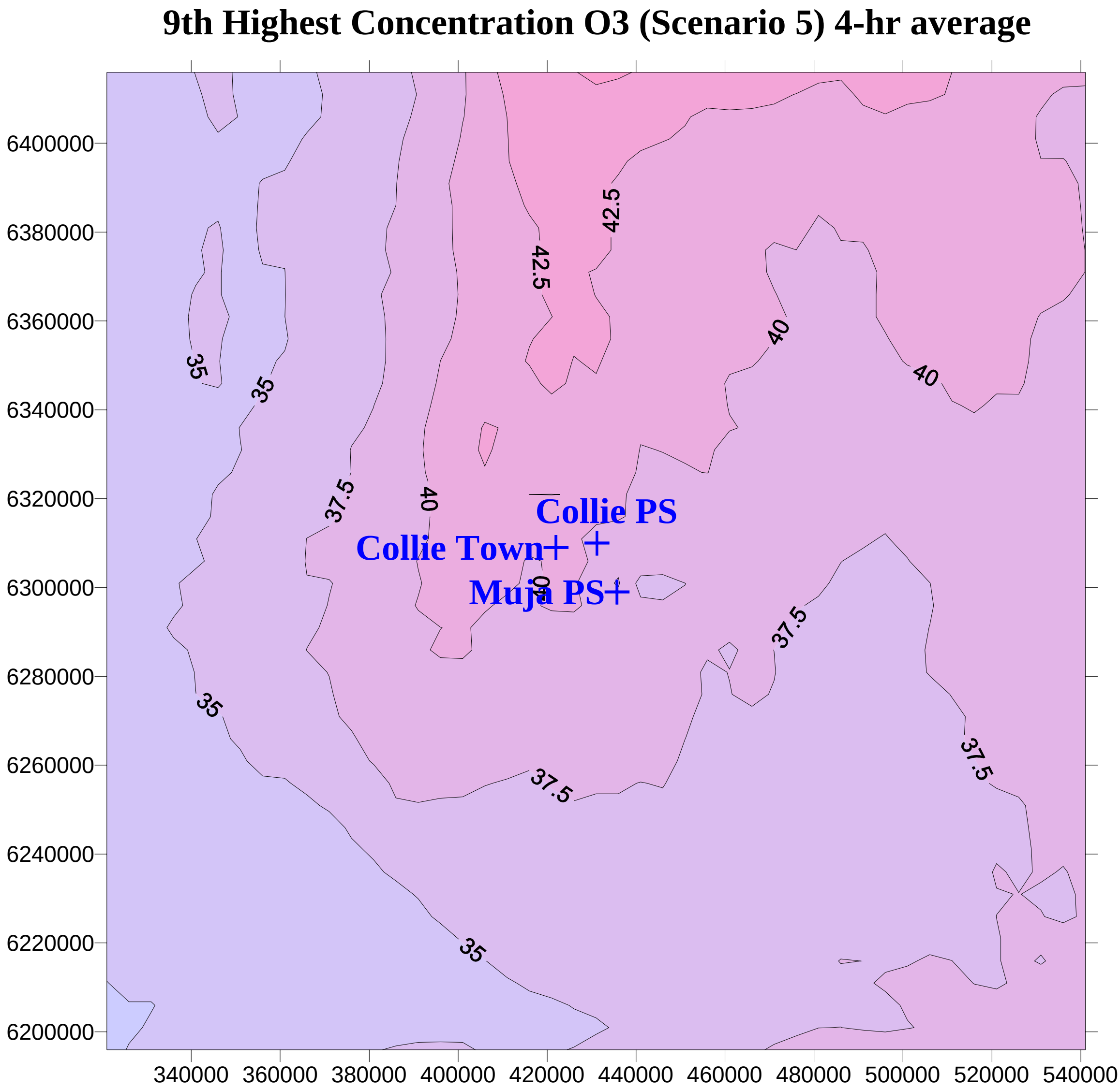


Figure G.12 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9[th] highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

Appendix H Contour plots for TAPM PM_{10} concentrations

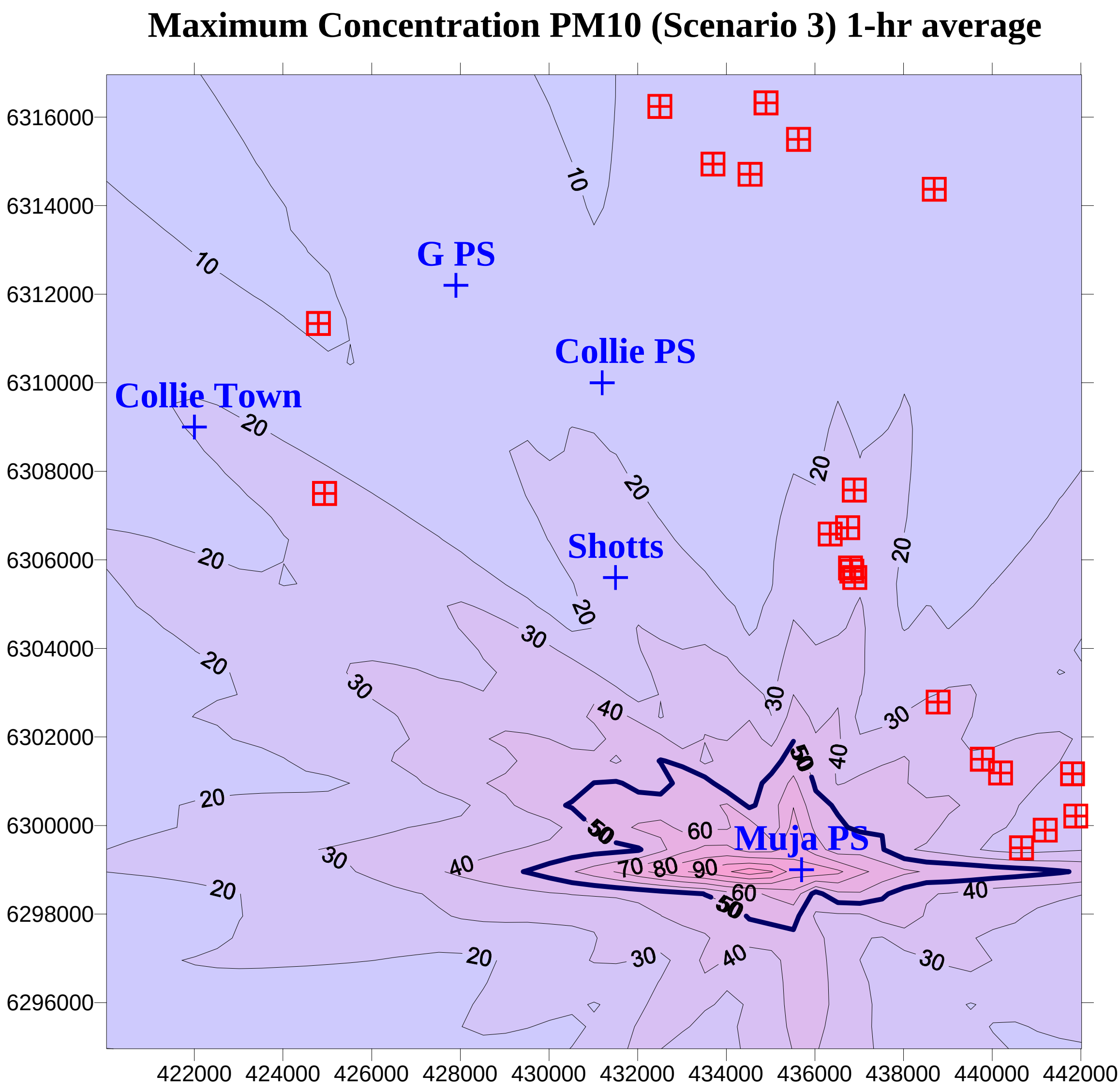


Figure H.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of PM10 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

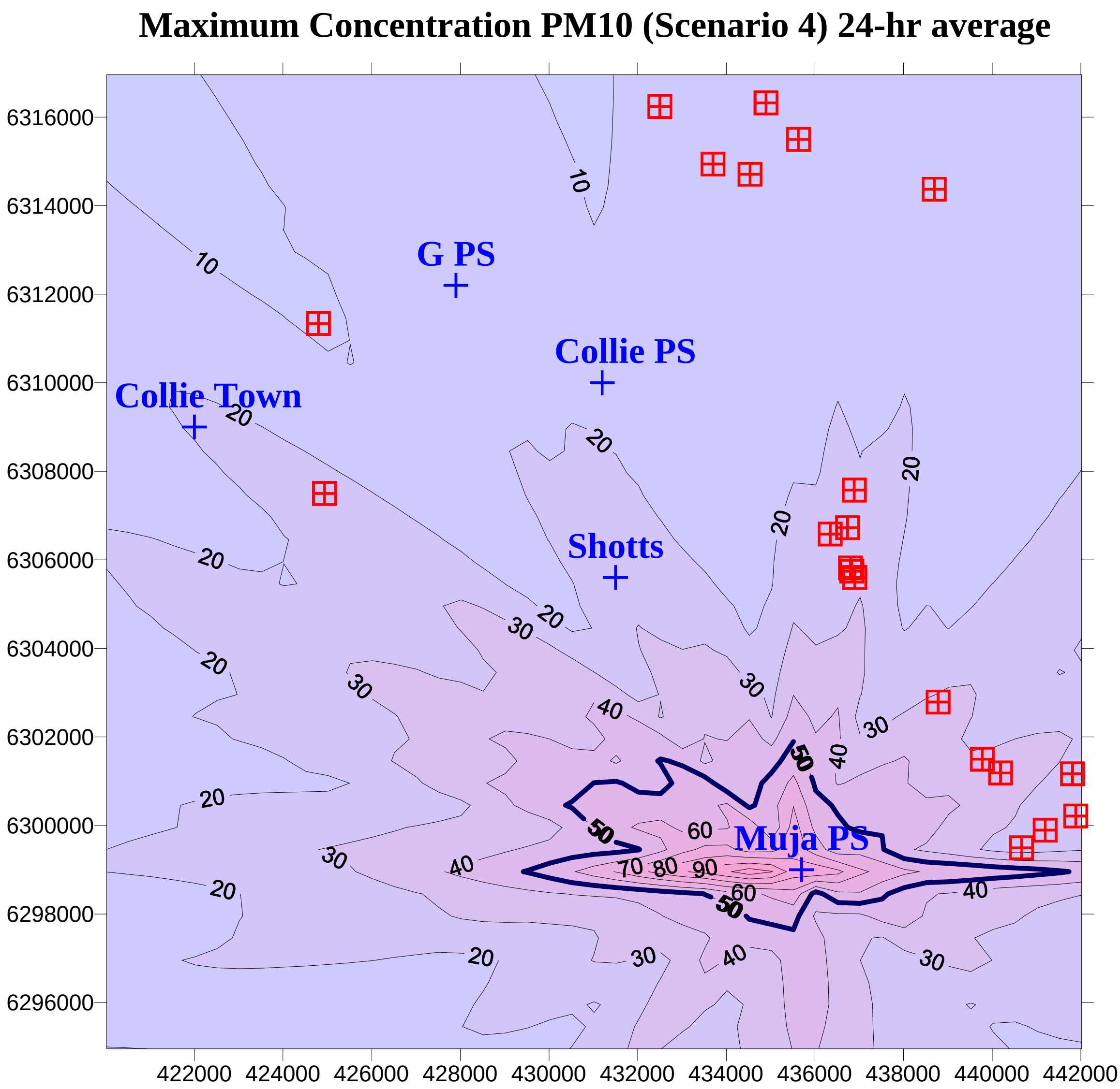


Figure H.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

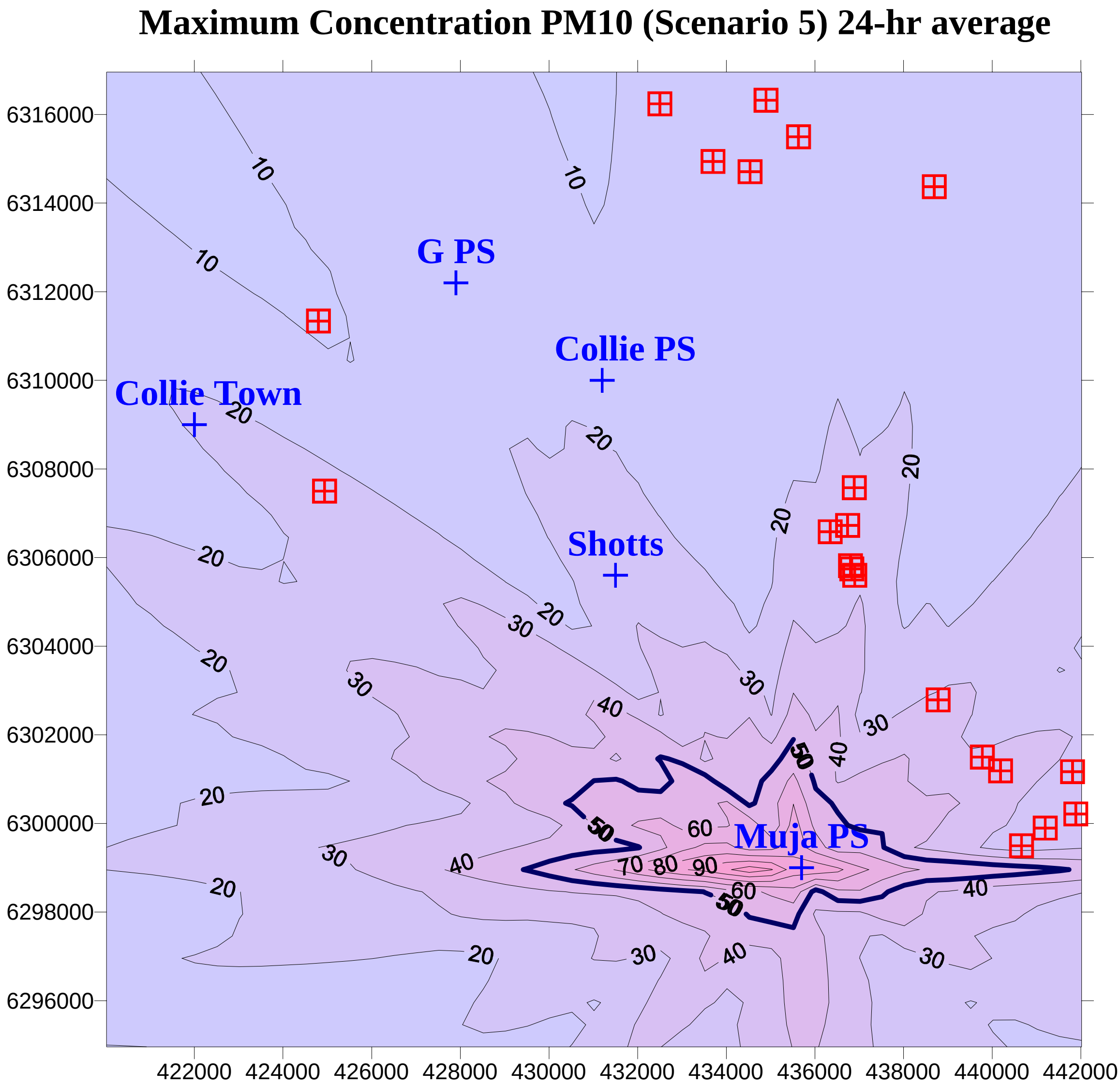
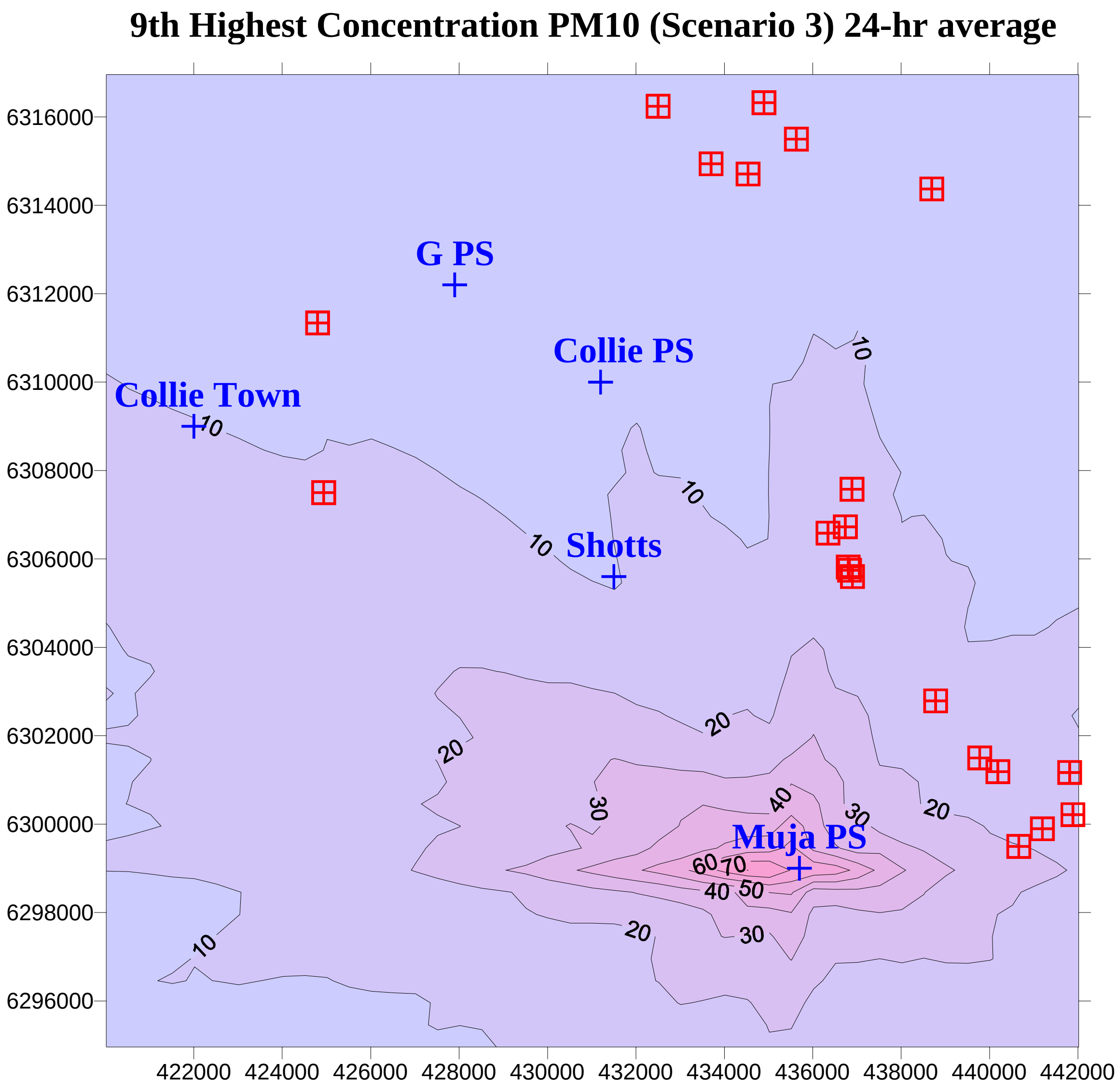


Figure H.3 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.



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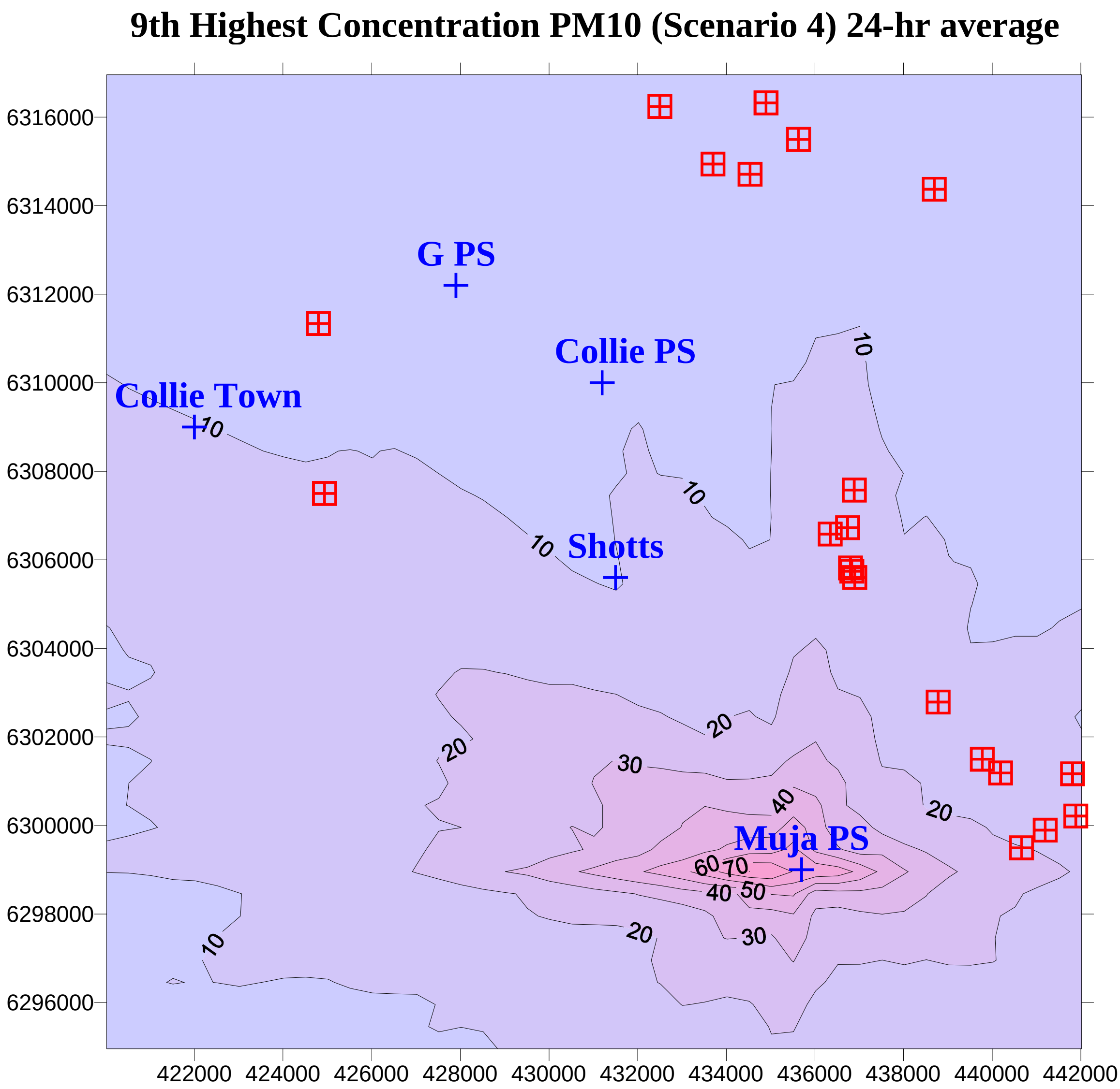

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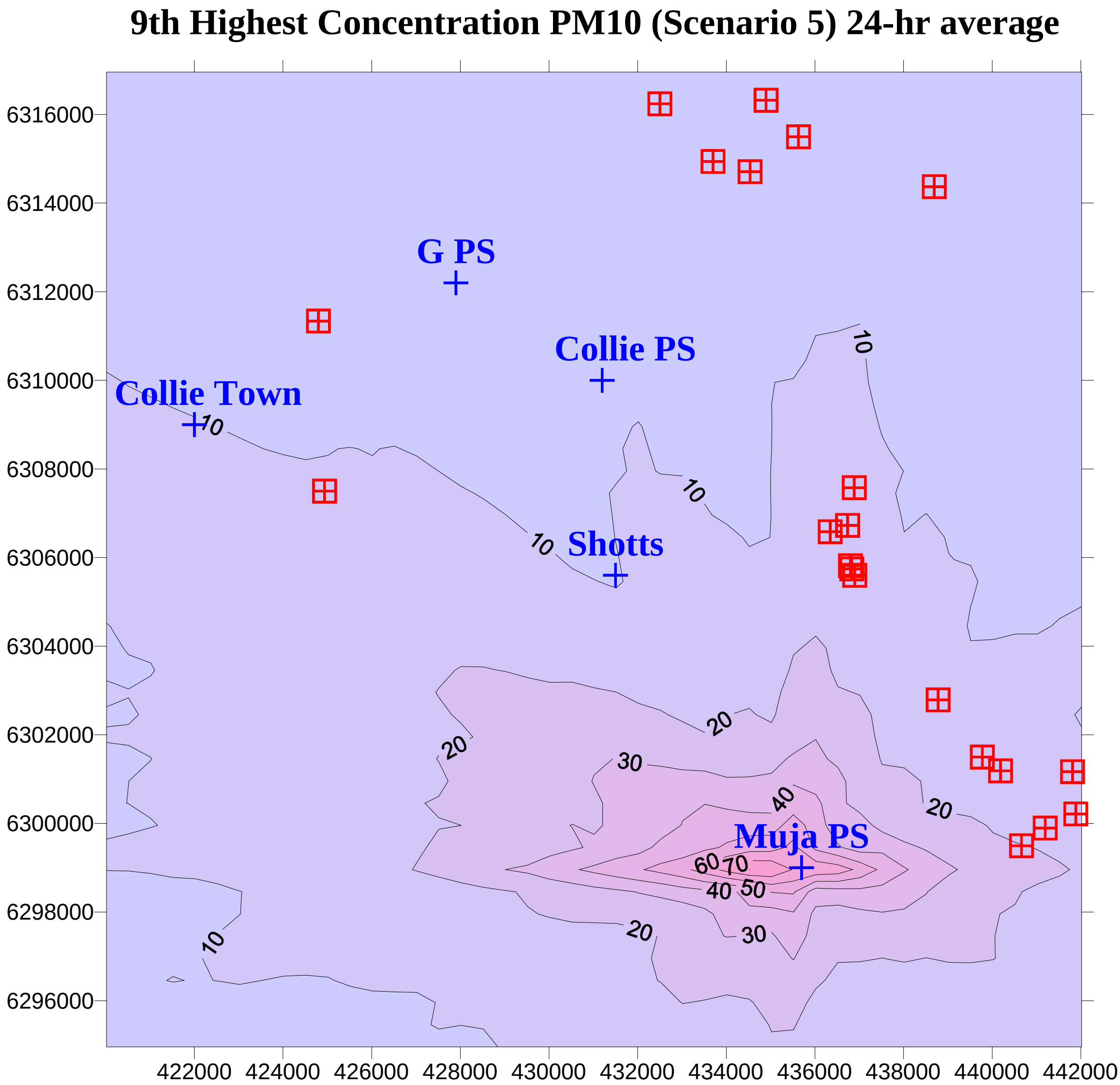

Figure H.6 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of 9*th* *highest* 24-hour-averaged concentration of PM10 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

13.5 HAZID Workshop Summary

Worley

GRIFFIN ENERGY PTY LTD

Bluewaters 2 Power Station

Qualitative Risk Assessment Summary

450-06862-00-RM-RP002-B

17-Sep-04

Level 6, QV1
250 St Georges Terrace
Perth, Western Australia 6000
Tel: +61 8 9278 8111
Fax: +61 8 9278 8110
Web: http://www.worley.com.au
Worley Pty Ltd
ABN 61 001 279 812

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PROJECT 450-06862-00-RM-RP002-B - BLUEWATERS 2 POWER STATION

REV	DESCRIPTION	ORIG	REVIEW	WORLEY APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for internal review	M Rispoli	M Karyagina	N/A	13-Sep-04	N/A	
B	Issued for client review	M Rispoli	M Karyagina		17-Sep-04		

CONTENTS

Appendices

1. INTRODUCTION

Worley's Safety and Risk Management (WS&RM) services group has been contracted by Griffin Energy Pty Ltd (Griffin) to conduct a Hazard Identification (HAZID) study to identify and assess the Major Accident Events (MAEs) associated with a second coal fired power station, entitled Bluewaters 2. Only MAEs which could have impacts on members of the public and the environment at or beyond the power station boundary are considered.

The Bluewaters 2 Power Station is to be located immediately adjacent to Bluewaters 1 power station (also 200MW) and will share infrastructure with Bluewaters 1. It will have a capacity of 200MW and will be located on freehold land 4.5km north east of Collie Western Australia (WA) utilising coal from the adjacent Ewington 1 coal mine as the fuel source for the power plant.

The development of the project will introduce highly regarded management schemes to ensure potential environmental impacts, waste and hazardous materials are minimised. The electricity generated at the plant will be exported via the State owned South West Interconnected System (SWIS) electricity grid to customers or sold directly to customers located within the proposed Coolangatta Industrial Park.

WS&RM facilitated a workshop comprising of one session on the 10th of August 2004 at the Griffin Office in Perth.

The objectives of the HAZID study were to:

- Systematically identify MAEs which could have impacts on members of the public and the environment at or beyond the power station boundary;
- Assess the risks associated with each of the identified issues;
- Identify existing safeguards to prevent, detect, protect or mitigate the risk; and
- Rank the likelihood and severity of each MAE according to the Griffin Risk Criteria (see Appendix 1).

This report summarises the findings of the Bluewaters 2 Power Station Qualitative Risk Assessment 450-06862-00-RM-RP001-0 (Rev 0).

2. METHODOLODY

The risk assessment framework that has been applied to this study was in line with the Australian Standard AS/NZS 4360:1999. The risk management process concentrated on the hazards identification, risk assessment and risk mitigation components.

2.1 System Breakdown

The categories discussed in the HAZID workshop included:

A. Boiler flue gas system (including the combustion air system);

B. Pulverised Fuel & Firing system;

C. High Voltage (HV) electrical system;

D. Boiler auxiliary diesel fuel system, including storage;

E. Control room, administrative areas, workshop and stores;

F. Cooling water system, including potable water;

G. High pressure steam system;

H. Feed water and condensate system;

I. Dust and ash disposal system;

J. Turbo generator system;

K. Waste water disposal system;

L. Sewage treatment system;

M. Hazardous material storage;

N. Oily waste disposal system;

O. Fire protection systems; and

P. Other.

2.2 HAZID Identification

Hazard identification was based on possible MAEs that may have consequences beyond the power station site boundary. It involved the brainstorming and identification by the study participants of the issues that could affect:

- Society (Health and Safety);
- Equipment;
- Production;

- Environment; and
- Reputation.

The likelihood for each risk associated with the MAEs for each of the identified systems was ranked and the severity of each was identified using the Griffin Risk Criteria (see Appendix 1).

In assigning a level of likelihood, the study group took into consideration the likelihood of the consequence being realised given the preventative safeguards currently in place.

Consequence and likelihood are combined to produce an estimated level of risk associated with the particular hazardous event in question. It should be noted that this workshop identified likelihood and consequence values prior to any possible actions being implemented.

The risk associated with each category is highlighted in Table 1.

Table 1: Risk Descriptions

Unacceptable	Intolerable; engineering required to reduce risk level
Managed	Tolerable; with safeguards, monitor and review to reduce risk to As Low As Reasonably Practicable (ALARP)
Insignificant	Acceptable; manage with procedures, continuous improvement

For inclusion into the Bluewaters 2 Public Environmental Review (PER) it is necessary to focus on the hazards identified for the issues that could impact society and the environment.

2.2.1 Consequence

In determining the consequence of the hazard, the study group took into consideration the following factors:

- The present status of safeguards and controls;
- Existing physical and working environment conditions;
- Existing procedures, administration, documentation and management systems; and
- Existing levels of training, experience, skills, education, etc. of personnel.

2.2.2 Safeguards

The study identified the existing safeguards for each hazard. The types of safeguards included:

1. Preventative safeguards, which aim to prevent the event cause from occurring;
2. Detective safeguards, which aim to improve the response time to an event;
3. Protective safeguards, which aim to protect from the escalation consequences and are always used regardless of whether the event cause has occurred; and
4. Mitigative safeguards, which aim to reduce the severity of the escalation consequences and are activated once the event cause and escalation consequences have occurred.

3. RESULTS

3.1 Results & Discussion

The Risk Summary sorted by risk (in descending order) is shown in Appendix 2.

A number of hazards have risk ratings that are "Insignificant" for issues that impact society and environment. For those hazards that have "Managed" or "Unacceptable" risk ratings, appropriate procedures and engineering practices must be in place to reduce them to As Low As Reasonably Practicable (ALARP). The Risk Summary shows that Hazards 16 and 7 have unacceptable risk ratings for the Equipment and Production categories and are therefore of the highest priority. However, these risks and subsequent others, have insignificant risk ratings for issues that impact society and the environment and therefore will not be discussed any further in this summary.

For those hazards with a managed risk rating, safeguards and regular monitoring and reviewing must be in place to reduce them to ALARP. Hazards with an unacceptable risk rating require re-engineering in order to reduce the risk.

The hazards with the highest risks to society and environment fall into the managed risk rating and include:

- Category D (Hazard Number 8) – Ignited spill within bunded area; and
- Category K (Hazard Number 18) – Overflow or leakage from the retention pond.

Table 2 below shows the safeguards that are currently implemented in order to control the risks from these two hazards:

Table 2: Identified Safeguards

Hazard No.	Safeguards
8	- Regular inspection and maintenance. - Double skinned tank bottom. - Float switch in bunded area. - Hazardous area classification around bunds (control of ignition sources). - Compliance with explosive and dangerous good storage requirements. - Fire protection systems. - Boundary fire break maintained around plant.
18	- Level monitoring. - Lined construction. - Monitoring bores.

	- Operational controls to reduce waste water generation.

The workshop group agreed upon an “Unlikely” probability for both risks. The events are heard of in industry and could occur at any time. In the event of an ignited spill within the bunded area (Hazard 8), it is assumed that a fire outside the power station boundary may occur, resulting in minor occupational illness (moderate risk rating). The probability of this event is conservatively ranked as unlikely because under normalised circumstances, smoke is directional with the wind. Thus, the likelihood of an ignited spill causing fire outside the boundary is minimal, but it is still possible.

Hazard 18 has a managed risk rating for the environment risk category and may result in short-term environmental damage. The probability of this event occurring given the safeguards in place (Table 2) was considered unlikely by the workshop group.

4. CONCLUSION

The workshop was conducted in a positive and constructive manner, with valuable contributions made by the workshop group.

The participants of the workshop possessed the appropriate skills, experience and knowledge required to conduct an effective HAZID Study. The output of the HAZID was a total of 19 hazards resulting from major accident risk events. The major accident events associated with the Bluewaters 2 Power Station project also apply to Bluewaters 1.

Two hazards impact significantly on the society and environment risk rating categories with ratings in the managed description. Assuming the appropriate safeguards are in place, these hazards will need to be monitored and reviewed such that they are reduced to ALARP.

It is concluded that the risk ratings for each identified hazard do not constitute a quantitative risk assessment.

Appendix 1. – Griffin Risk Matrix Criteria

Griffin Risk Criteria

Rating	Consequences					Probability				
	A	B	C	D	E	Rare	Unlikely	Moderate	Likely	Almost Certain
	Society (Health & Safety)	Equipment	Production	Environment	Reputation	[Event may occur only in exceptional circumstances]	[Heard of in industry and could occur at some time]	[Incident has occurred in industry and is expected to occur at some time]	[Incident occurs at irregular intervals and is probable]	[Incident occurs at regular intervals and is expected to occur]
						1	2	3	4	5
1 Insignificant	No injury or illness	No damage, no cost	No noticeable impact; <$10K	No noticeable effect	No impact			Insignificant Risk		
2 Minor	First aid treatment	Slight damage, minor financial loss; <$100K	Short term interruption; upto 24 hours; <$100K	Slight effect; minor environmental damage; readily repaired and/or requiring <$10K to correct and/or in penalties [not exceeding internal standards]	Slight impact; sitewide publicity					
3 Moderate	Minor occupational illness [recoverable]	Localised damage, moderate financial loss; $100K to $1M	Medium term interruption; 1-7 days; $100K to $1M	Localised effect; short-term [<1 month] environmental damage or requiring $10-250K to correct and/or in penalties [exceeding internal standards]	Limited impact; local media coverage			Managed Risk		
4 Major	Disabling injury or occupational illness [non-recoverable]	Major damage, major financial loss; $1-5M	Prolonged interruption for section of plant; 1-12 weeks; $1-10M	Major effect; medium-term [1-12months] environmental damage or requiring $250K-$2M to correct and/or in penalties [exceeding statutory standards]	Considerable impact; statewide media coverage			Unacceptable Risk		
5 Catastrophic	Death; or multiple disabling injuries or occupational illness [non-recoverable]	Extensive damage, large financial loss; >$5M	Longterm interruption; >12 weeks; >$10M	Massive effect; long-term [1yr or greater] environmental damage or requiring >$2M to correct and/or in penalties [exceeding statutory standards]	National and/or international impact and media coverage					

Unacceptable	Intolerable; engineering required to reduce risk level
Managed	Tolerable; with safeguards, monitor and review to reduce risk to As Low As Reasonably Practicable
Insignificant	Acceptable; manage with procedures, continuous improvement

Appendix 2. – Risk Summary

Risk Summary

				Before				
No.	**Category**	**Rank**	**Hazard**	Society	Equipment	Production	Environment	Reputation
16	Turbo Generator system	1	Rotating equipment failure causing ruptures	Insignificant	Unacceptable	Unacceptable	Insignificant	Managed
7	High Voltage (HV) electrical system	2	Transformer/circuit breaker explosion	Insignificant	Managed	Unacceptable	Insignificant	Insignificant
1	Boiler flue gas system (incl. combustion air system)	3	Ignition of gas build-up after burner flame out event	Insignificant	Managed	Managed	Insignificant	Managed
8	Boiler auxiliary diesel fuel system, incl. storage	4	Ignited spill within bunded area	Managed	Managed	Insignificant	Insignificant	Managed
13	High pressure steam system	5	Rupture of high pressure steam piping or steam drum/headers	Insignificant	Managed	Managed	Insignificant	Managed
11	Control room, administrative areas, workshop and stores	6	Human error or deliberate act	Insignificant	Managed	Managed	Insignificant	Insignificant
17	Turbo Generator system	7	Ignited lube oil spill within bunded area	Insignificant	Managed	Managed	Insignificant	Insignificant
24	Other	8	Wind borne dust	Insignificant	Insignificant	Insignificant	Insignificant	Managed
10	Boiler auxiliary diesel fuel system, incl. storage	9	Burner front fire	Insignificant	Managed	Insignificant	Insignificant	Insignificant
18	Waste water disposal system	10	Overflow or leakage from the retention pond	Insignificant	Insignificant	Insignificant	Managed	Managed
3	Boiler flue gas system (incl. combustion air system)	11	Rotational equipment failure	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
15	Dust and ash disposal system	12	Excessive dust emissions from collection or storage systems	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

Risk Summary

No.	Category	Rank	Hazard	Before: Society	Before: Equipment	Before: Production	Before: Environment	Before: Reputation
19	Waste water disposal system	13	Leakage from the waste water disposal line	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
2	Boiler flue gas system (incl. combustion air system)	14	Undetected failure of bag filter	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
4	Boiler flue gas system (incl. combustion air system)	15	Undetected failure of the low NOx burner	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
5	Boiler flue gas system (incl. combustion air system)	16	Spillage of flue gas side wash down products	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
6	Pulverised Fuel & Firing System	17	Uncontrolled bunker fire	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
9	Boiler auxiliary diesel fuel system, incl. storage	18	Spill outside bunded area (eg overflow of bund, pipe work rupture, spill during unloading)	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
22	Oily waste disposal system	19	Leakage from oily waste tank	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
12	Cooling water system, including potable water	20	No major accident events identified Note: Noise is out of the scope of this study.	?	?	?	?	?
14	Feed water and condensate system	21	No major accident events identified	?	?	?	?	?
20	Sewage treatment system	22	No major accident events identified	?	?	?	?	?
21	Hazardous material storage	23	No major accident events identified	?	?	?	?	?
23	Fire protection systems	24	No major accident events identified	?	?	?	?	?

Risk Summary

				Before				
No.	Category	Rank	Hazard	Society	Equipment	Production	Environment	Reputation
25	Other	25	Terrorism or sabotage	?	?	?	?	?

13.6 Noise Report

Rochdale Holdings Pty Ltd A.C.N. 009 049 067 trading as:
HERRING STORER ACOUSTICS
Suite 34, 11 Preston Street, Como, W.A. 6152
P.O. Box 219, Como, W.A. 6952

Telephone: (08) 9367 6200
Facsimile: (08) 9474 2579
Email: hsa@hsacoustics.com.au

ALLAN HERRING M.I.E. AUST. M.A.A.S.
LYNTON STORER M.A.I.E.A. M.A.A.S.
TIM REYNOLDS M.I.E. AUST. M.A.A.S.

GRIFFIN ENERGY

BLUEWATERS POWER STATION
COLLIE, WESTERN AUSTRALIA

ENVIRONMENTAL ACOUSTIC ASSESSMENT

BY

HERRING STORER ACOUSTICS

DECEMBER 2004

OUR REFERENCE: 4065-2-04193-2

CONTENTS

APPENDICES

1.0 INTRODUCTION

Herring Storer Acoustics (HSA) was commissioned by Griffin Energy Pty Ltd (Griffin) to undertake a noise level impact assessment of noise immissions at Collie residential areas associated with a proposal to develop a coal fired power station. The Bluewaters Power Station (BPS) would be developed in 2 stages. The first having a capacity of 200MW and the second also having a capacity of 200MW (see Appendix A for Locality Plan).

The objective of the study is to assess the likely impact of noise from the BPS at noise sensitive premises surrounding the proposed site and at the boundary of the proposed 'Special Control Area'.

Impact is taken to the minimal if the noise immissions of the BPS are within the regulatory criteria of the Environmental Protection Act 1986 and specifically the *Environmental Protection (Noise) Regulations 1997.*

2.0 SUMMARY

The predicted noise immission levels at noise sensitive premises, within the Collie area are within the criteria stipulated in the *Environmental Protection (Noise) Regulations 1997* and therefore are considered to be minimal in terms of acoustic impact.

The applicable worst case regulatory criteria to be NOT "significantly contributing", noise immission from an industry is not to exceed 30dB(A). Compliance with this requirement can be achieved with the sound power level for each stage of the BPS being limited to 118 dB(A) for general plant and 111 dB(A) for the stack.

To comply with the acoustic requirements for the proposed 'Special Control Area', the sound power level for each stage of the BPS being limited to 116 dB(A) for general plant and 111 dB(A) for the stack. However, if the required overall sound power levels of 116 dB(A) cannot be achieved by noise amelioration to the plant, then the use of barriers or bunding would be an acceptable alternative to achieve the required noise level at the boundary of the 'Special Control Area'.

3.0 CRITERIA

The *Environmental Protection (Noise) Regulations 1997* stipulate the allowable noise levels at any noise sensitive premises from another premises. The allowable noise level is determined by the calculation of an influencing factor, which is added to the baseline criteria set out in Table 1 of the Regulations. At noise sensitive premises located within the town of Collie, the influencing factor would be 0. Therefore, the assigned noise level at the various times of the day would be as listed in Table 1 below.

TABLE 1 - ASSIGNED NOISE LEVELS AT RESIDENCE

Time of Day	Assigned Noise Level		
	L_{A10}	L_{A1}	L_{max}
0700 - 1900 hours - Monday to Saturday	45	55	65
0900 - 1900 hours - Sunday & Public Holidays	40	50	65
1900 - 2200 hours - All Days	40	50	55
2200 - 0700 hours - Monday to Saturday	35	45	55
2200 - 0900 hours - Sunday & Public Holidays	35	45	55

Note: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.

In accordance with Regulation 7, noise emissions from the power station would be considered as not "significantly contributing" to any exceedance of the Regulatory criteria assigned level at any noise sensitive premises, if the noise received at the premises is 5 dB(A) below the assigned noise level. Therefore, to comply with Regulation 7, noise immissions due to the BPS at the nearest noise sensitive premises would need to be 30 dB(A) or less.

The assigned noise levels are also conditional on no annoying characteristics existing such as tonal components etc. If such characteristics exist and cannot be practicably removed, then any measured level is adjusted accordingly. The adjustments that apply are shown in Table 2.

TABLE 2 - ADJUSTMENTS

Tonality	Modulation	Impulsiveness
+5 dB	+5 dB	+10 dB

4.0 METHODOLOGY

Determination of the noise level Modelling of noise emission propagation from the BPS was facilitated using an environmental noise modelling computer program, "SoundPlan" Version 6.1. Both overall noise level contour plots and single point calculations were performed. Noise contours show the overall noise level at any location due to the operations of the BPS, where as single point calculations show the same overall level at any selected location but indicate the contribution (ranking) of individual sources within the BPS.

Input data for computer modelling included:

- Topographical data.
- EPA standard weather condition for the night period (see Table 3).
- Octave band sound power levels.

The ground topography used in this model includes ground absorption, which in this case was taken to be predominantly rural on an undulating terrain. It has been noted that the area to the north of the industrial estate is plantation timber and the noise reduction across this area would be higher than for the rural terrain used in the model.

Weather conditions for the modelling were generally in accordance with the Environmental Protection Authority's *"Draft Guidance for Assessment of Environmental Factors No.8 - Environmental Noise"* for the night period and as listed in Table 3.

TABLE 3 - WEATHER CONDITIONS

Condition	Night Period
Temperature	15 ^{o}C
Relative humidity	50%
Pasquil Stability Class	E
Wind speed	3 m/s

The initial sound power level information used in modeling noise emissions from the power station was based on file data of a 800MW coal fired power station. Specifically the sound pressure level of a 400MW unit is stated to be 60 dB(A) at 150 metres which, by reverse propagation calculation, relates to an overall sound power level of 121 dB(A). Previous modelling of the power station was based on a sound power level of 118 dB(A) for the each stage of the plant, with noise emissions from the stack being limited to a sound power level of 111 dB(A).

To comply with the acoustic requirements at the boundary of the 'Special Control Area', the sound power levels used in the acoustic model for each stage of the BPS are as listed in Table 4.

TABLE 4 – SOUND POWER LEVELS

Source	SWL
Source 1 General	116 dB(A)
Source 2 Stack	111 dB(A)

Acoustic modelling was carried out for the following configuration of the proposed Bluewaters Power Station:

(a) Stage 1 of power station (200MW)
(b) Both stages of power station (each stage 200MW)

Given the above factors, the acoustic modelling would be considered to have been undertaken for worst case conditions.

5.0 RESULTS & DISCUSSION

The predicted overall noise levels at the nearest residential premises are shown in Table 5. Noise contour plots are attached as Figures B1 and B2 in Appendix B.

TABLE 5 – RESULTANT NOISE LEVEL AT RESIDENTIAL LOCATIONS

Resultant Noise Level, dB(A)	
Location 1	**Location 2**
23	21

The most likely characteristic of noise emissions from the BPS is tonality due to various rotational equipment such as fans. The resultant noise levels due to the BPS at noise sensitive premises under 3m/s wind conditions is shown to be less than 30 dB(A). As the background noise during wind conditions of 3m/s is likely to be greater than 30 dB(A) (refer to the attached levels versus wind speed graph in Appendix C) the noise will not be tonal at the receiver locations.

6.0 CONCLUSION

Noise emissions from the power station would comply with regulatory requirements at the closest neighbouring premises at all times. The resultant levels within the town of Collie and other neighbouring would be less than 30 dB(A) and therefore, noise emissions from the power station would be considered as NOT "significantly contributing" to any excess at a residence and would be deemed to comply with the *Environmental Protection (Noise) Regulations 1997* at all times. Compliance with this requirement can be achieved with the sound power level for each stage of the BPS being limited to 118 dB(A) for general plant and 111 dB(A) for the stack.

To comply with the acoustic requirements for the proposed 'Special Control Area', the sound power level for each stage of the BPS being limited to 116 dB(A) for general plant and 111 dB(A) for the stack. However, if the required overall sound power levels of 116 dB(A) cannot be achieved by noise amelioration to the plant, then the use of barriers or bunding would be an acceptable alternative to achieve the required noise level at the boundary of the 'Special Control Area'.

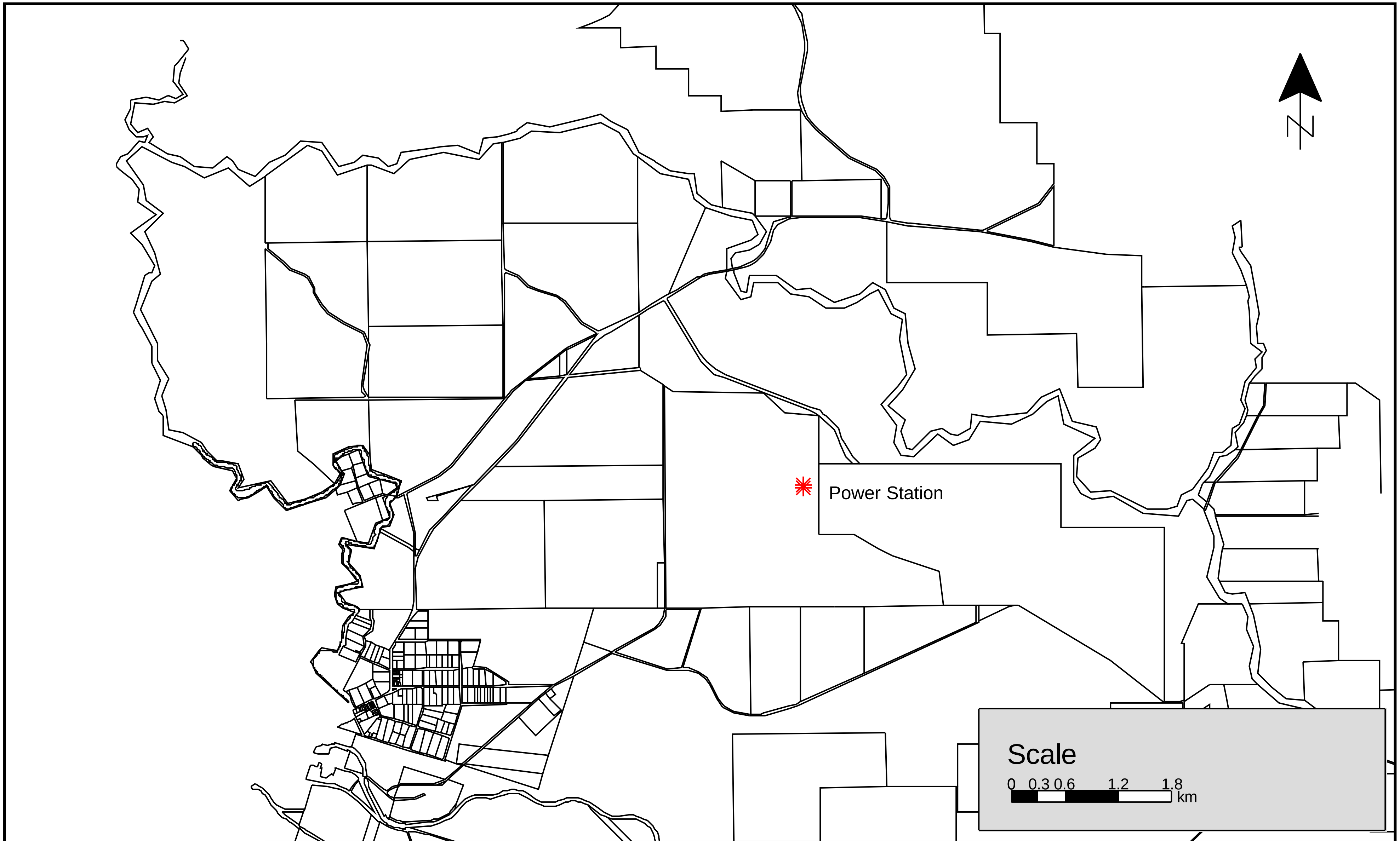
For: **HERRING STORER ACOUSTICS**

Tim Reynolds

03 December 2004

APPENDIX A

LOCALITY PLAN



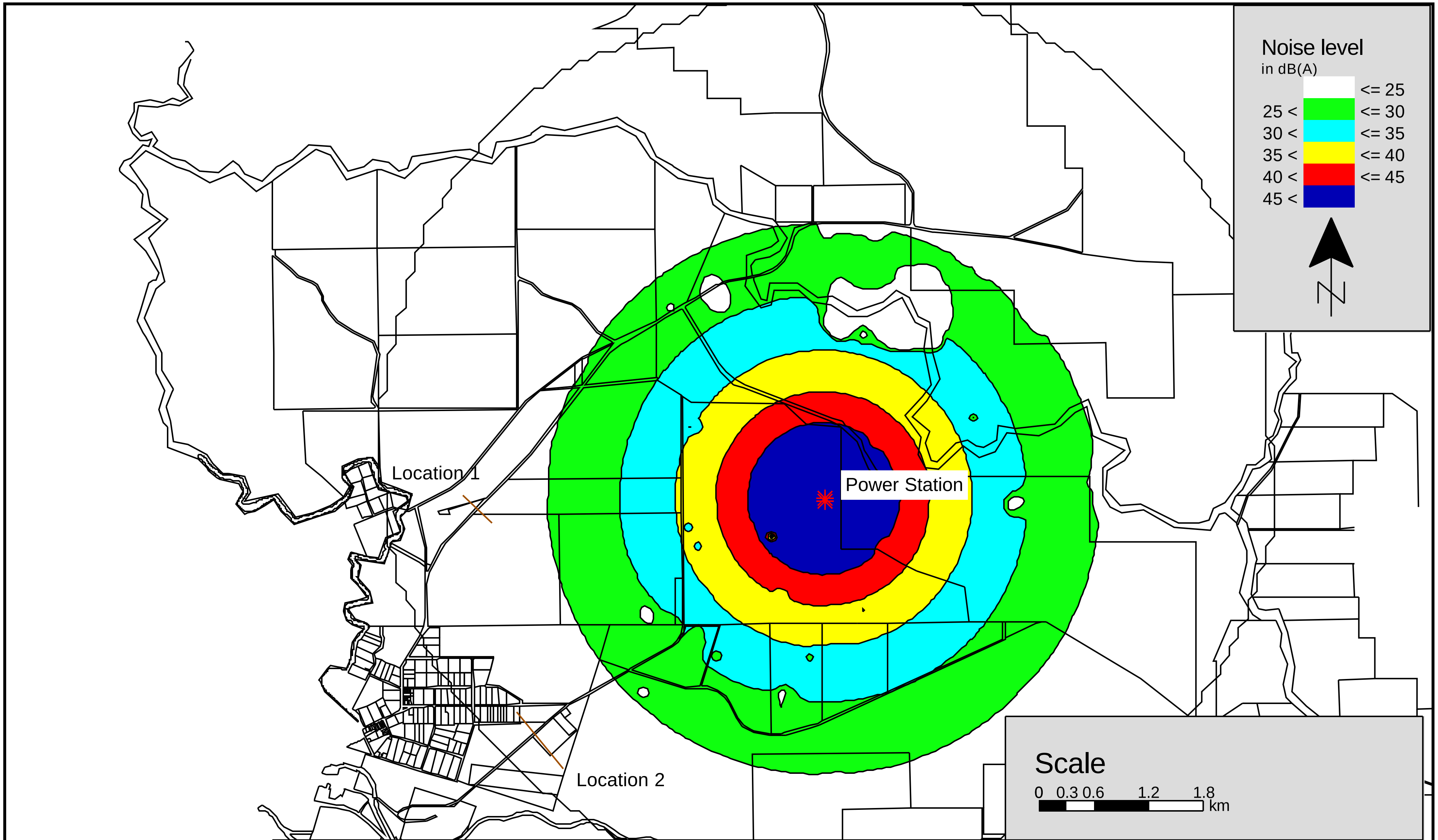
Herring Storer Acoustics
Job No : 04193-2
File :Pow Loc 03 12
Date : 03 December 2004

GRIFFIN ENERGY PTY LTD
BLUEWATERS POWER STATION - PLANT LOCATIONS

Figure A1

APPENDIX B

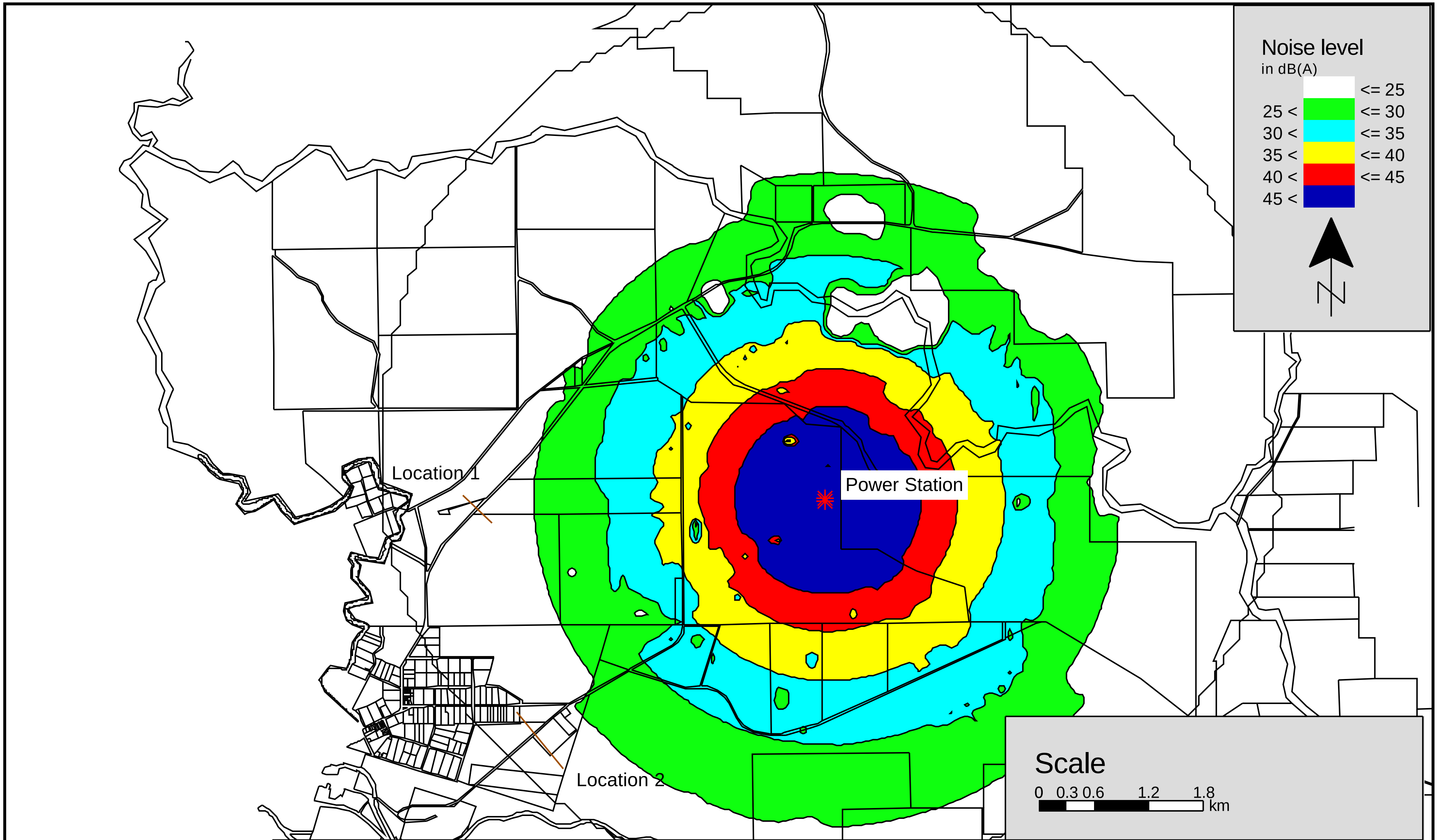
SOUNDPLAN NOISE CONTOUR MAP
FIGURE B1 – STAGE 1
FIGURE B1 – STAGES 1 and 2



Herring Storer Acoustics
Job No : 04193-2
File :Pow St1 03 12
Date : 03 Decemeber 2004

GRIFFIN ENERGY
STAGE 1 OF BLUEWATERS POWER STATION
AT PREFERRED LOCATION WITH NOISE CONTROL TO STACKS
and PLANT NOISE EMISSIONS REDUCED BY 2dB(A)

Figure B1



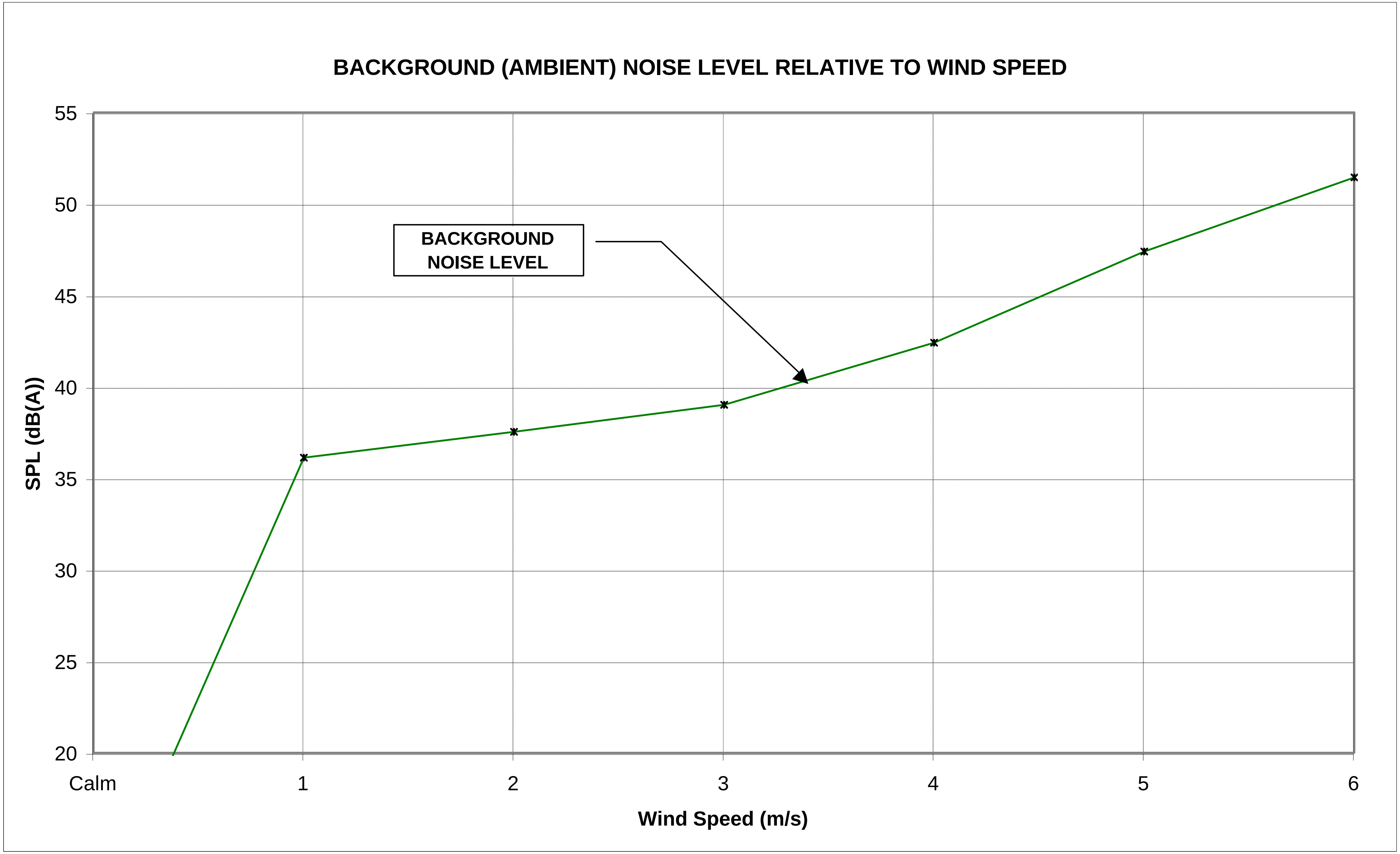
Herring Storer Acoustics
Job No : 04193-2
File :Pow St12 03 12
Date : 03 Decemeber 2004

GRIFFIN ENERGY
BOTH STAGES OF BLUEWATERS POWER STATION
AT PREFERRED LOCATION WITH NOISE CONTROL TO STACKS
and PLANT NOISE EMISSIONS REDUCED BY 2dB(A)

Figure B2

APPENDIX C

WIND SPEED V's BACKGROUND NOISE


BACKGROUND (AMBIENT) NOISE LEVEL RELATIVE TO WIND SPEED
SPL (dB(A))
55
50
45
40
35
30
25
20
BACKGROUND
NOISE LEVEL
Calm
1
2
3
4
5
6
Wind Speed (m/s)