Bluewaters Power Station

Griffin Energy Pty Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 1160
January 2005

Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
08/09/03	**Level of Assessment set (following any appeals upheld)**	**2**
31/05/04	**Proponent Document Released for Public Comment**	**38**
26/07/04	**Public Comment Period Closed**	**8**
2/12/04	**Final Proponent response to the issues raised**	**19**
17/01/05	**EPA report to the Minister for the Environment**	**6**

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Summary and recommendations

Griffin Energy Pty Ltd proposes to construct and operate the 200 megawatt (MW) Bluewaters Power Station on a site located approximately 4km north-east of Collie. This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal.

Section 44 of the *Environmental Protection Act, 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

Relevant environmental factors

The EPA decided that the following environmental factors relevant to the proposal required detailed evaluation in the report:

(a) Greenhouse gas emissions;

(b) Atmospheric emissions;

(c) Liquid and solid waste disposal;

(d) Surface water and groundwater; and

(e) Noise.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

Conclusion

The EPA has considered the proposal by Griffin Energy Pty Ltd to construct and operate the 200 MW Bluewaters Power Station on a site located approximately 4km north-east of Collie.

The EPA considers that combined cycle, gas fueled power plants represent best practice for large scale power generation. The proposed 200MW coal fired plant will produce an extra 620,000 tonnes of carbon dioxide per year compared to a combined cycle gas turbine plant of equivalent capacity. The EPA has previously advised that it expects proponents to mitigate all or part of the extra greenhouse gases produced.

The EPA is satisfied that the proponent has investigated mitigation actions and notes that the quantity of greenhouse gases to be directly offset is about 201,000 tonnes per annum which is a worthwhile and useful package. It is, however, about 419,000 tonnes per annum less than the additional greenhouse gases produced by this proposal compared to a combined cycle gas turbine plant of equivalent capacity.

If a decision is made so that the proposal may be implemented, the EPA considers that the offsets offered by the proponent should be made legally enforceable and tied to this proposal for the life of the proposal. The EPA recognises that the issue of greenhouse gas management is a matter for judgment and that decisions about this proposal will include consideration of broader economic, regional development and strategic issues which are outside the scope of the EPA. From an environmental perspective, the EPA advises that a coal fired power station without full offsets will not deliver the best environmental outcome.

The EPA also considers that the proposal does not represent best practice for sulphur dioxide emissions management and recommends that European Directive 2001/80/EC for outer regions be considered as the standard if the proposal proceeds to the Department of Environment licensing stage.

With the exception of greenhouse gas management, the EPA has therefore concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4, and summarised in Section 4.

The EPA also wishes to draw attention to the advice provided in Section 5 of this report in relation to air quality, offsets and the equitable internalisation of full environmental costs when considering proposals of this nature.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the proposal being assessed is for construction and operation of the 200 MW Bluewaters Power Station on a site located approximately 4km north-east of Collie.
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3.
3. That the Minister notes that the EPA has concluded that, with the exception of greenhouse gas management, it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4, and summarised in Section 4.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Griffin Energy Pty Ltd to construct and operate the 200 MW Bluewaters Power Station on a site located approximately 4km north-east of Collie is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;

(b) preparation and implementation of a greenhouse gas Emissions management plan;

(c) preparation and implementation of a stack emissions management plan; and

(d) compliance audit and performance reviews and a decommissioning plan.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors relevant to the proposal by Griffin Energy Pty Ltd, to construct and operate the 200 MW Bluewaters Power Station on a site located approximately 4km north-east of Collie.

The proposal was referred to the EPA on 25 August 2003, and on 8 September 2003 the level of assessment was set at Public Environmental Review (PER) under Section 38 of the *Environmental Protection Act, 1986*. The PER document was made available for a public review period of 8 weeks commencing on 31 May 2004 and ending on 26 July 2004.

The EPA's decision to assess the proposal at the level of PER was based on 5 main factors, namely greenhouse gas emissions, atmospheric emissions, liquid and solid waste disposal, surface water and groundwater, and noise.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the environmental factors relevant to the proposal. The Conditions and Commitments to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides Other Advice by the EPA, Section 6 presents the EPA's Conclusions and Section 7, the EPA's Recommendations. Appendix 5 contains a summary of submissions and the proponent's response to submissions. It is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.

2. The proposal

Griffin Energy Pty Ltd, proposes to construct and operate the 200MW Bluewaters Power Station on a site located approximately 4km north-east of Collie (Figure 1). It will be a subcritical coal fired base-load generation facility with a nominal generating capacity of up to 200MW. The Bluewaters Power Station will supply electricity to customers in the proposed Coolangatta Industrial Estate, or via the South West Interconnected System (SWIS).

The proposed Bluewaters Power Station will comprise the following components:

- boiler and turbine power block;
- mechanical draft cooling tower;
- flue gas cleaning equipment;
- a 100m stack;
- ash and dust disposal plant;

- water treatment plant;
- generator transformer switchyard;
- 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; and
- saline wastewater discharge via the existing Collie Power Station ocean outfall.

The plant layout of the Bluewaters Power Station is shown in Figure 2. A diagram which illustrates the input and output flows for the Bluewaters Power Station is shown in Figure 3. The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 4 of the PER document (Griffin Energy Pty Ltd 2004).

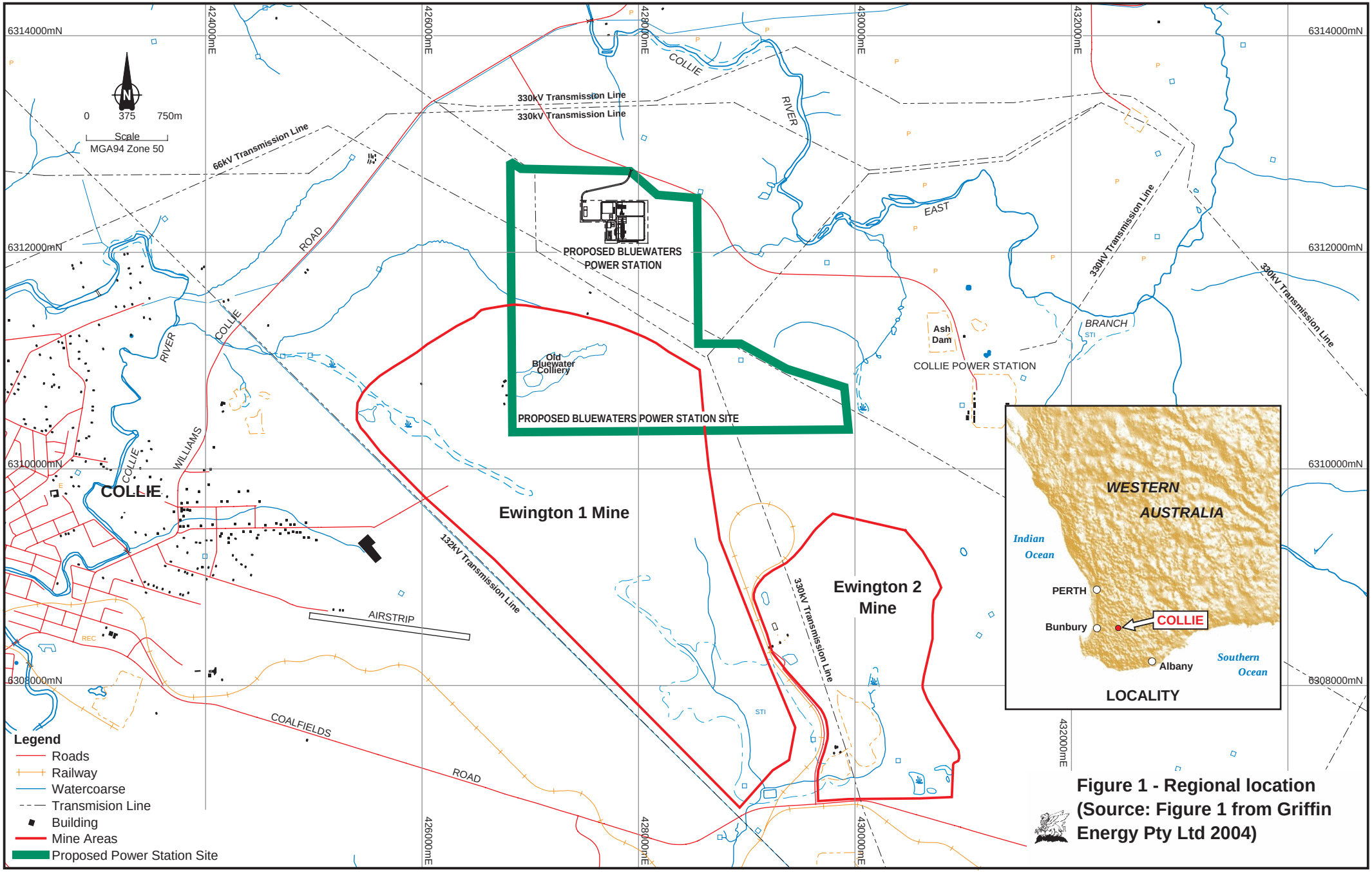

Figure 1 - Regional location (Source: Figure 1 from Griffin Energy Pty Ltd 2004)

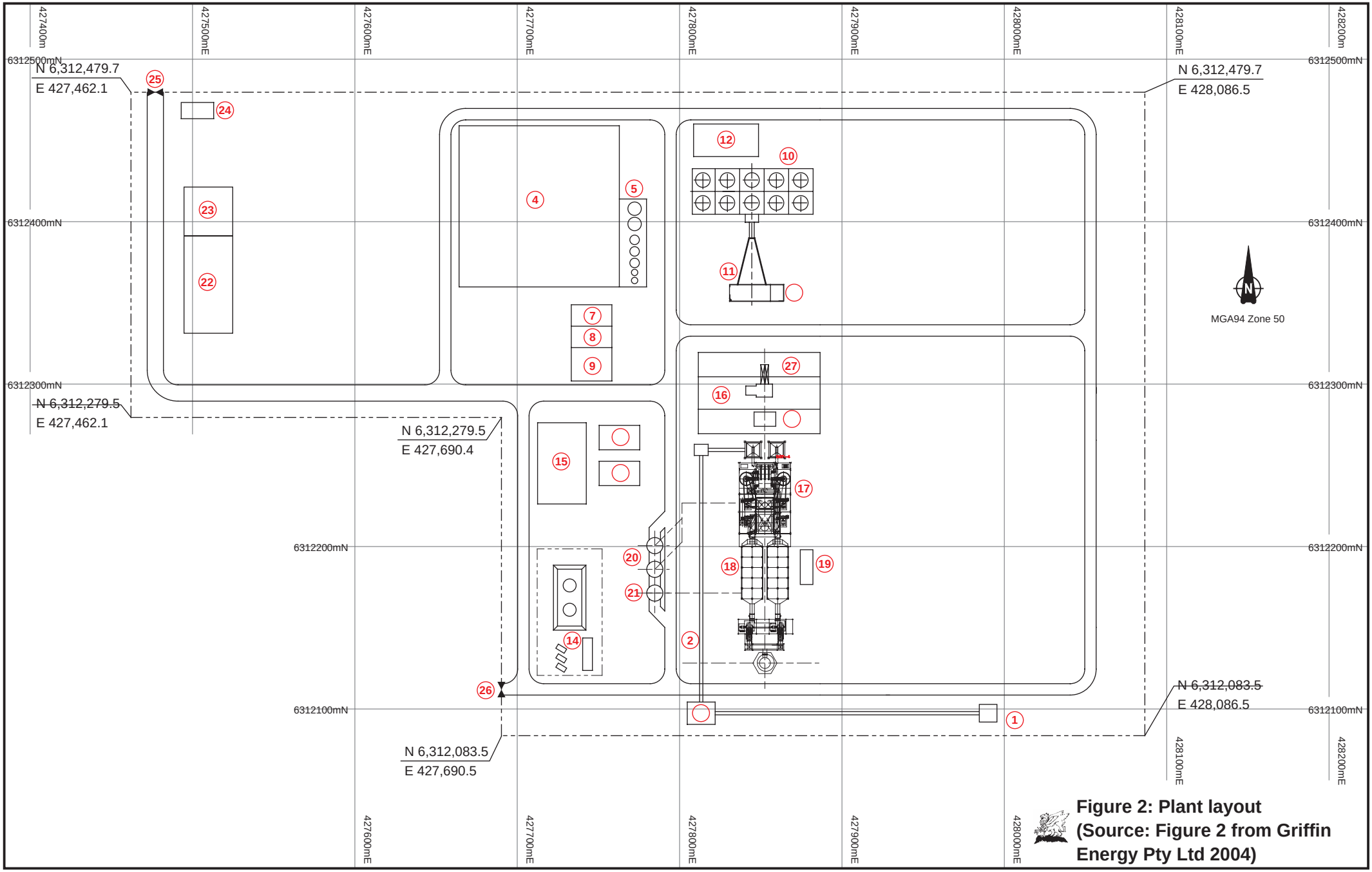

Figure 2: Plant layout (Source: Figure 2 from Griffin Energy Pty Ltd 2004)

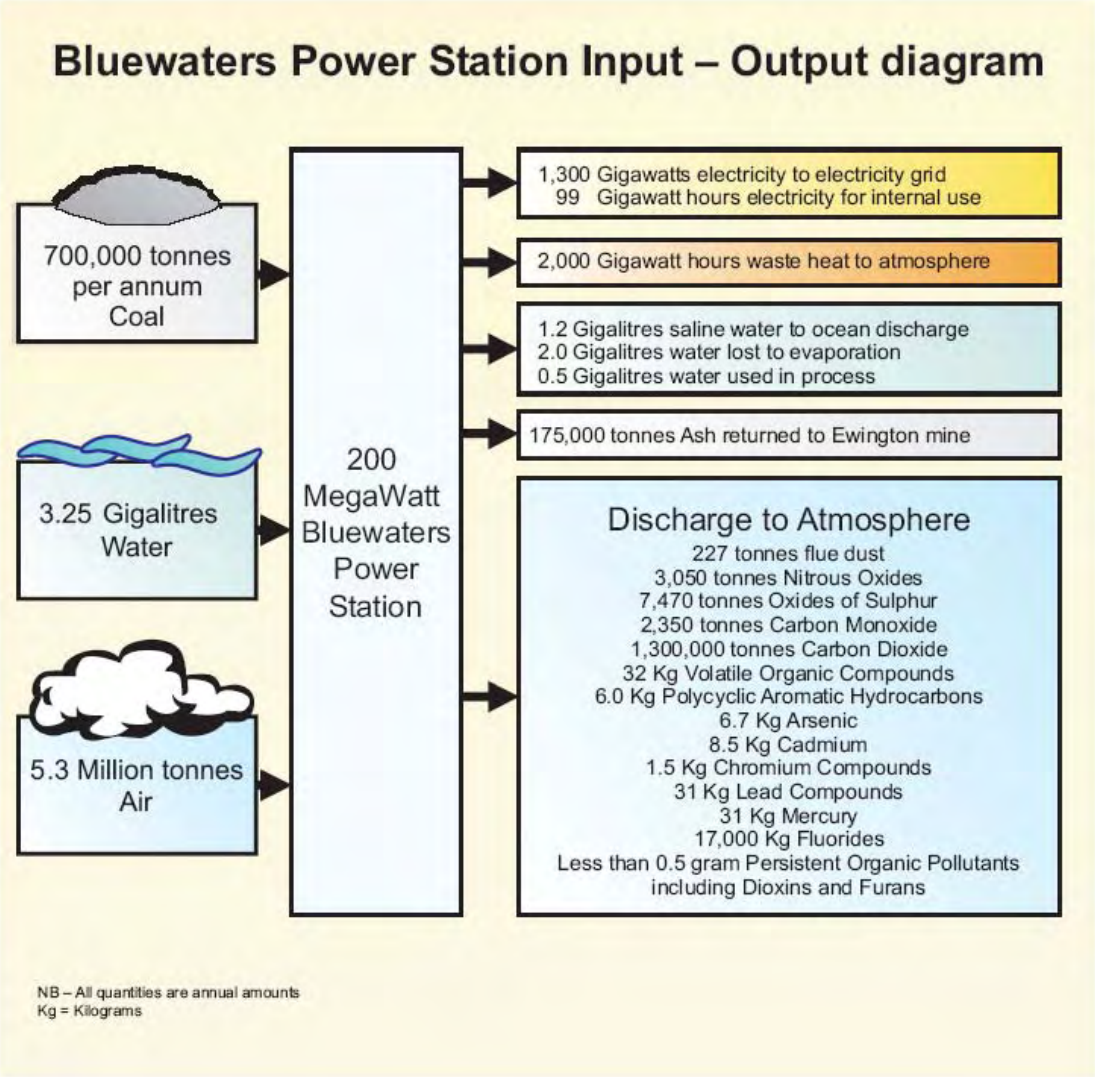

Figure 3: ***Input - output flow diagram (Source: Modified version of Figure 4 from Griffin Energy Pty Ltd 2004)***

Table 1: Summary of 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 200MW_e nominal, 202.3MW 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:	350m x 150m area
• Maximum Total Area:	15 hectares
Plant Facilities	
• Stacks:	1
• Height of Stack:	100m
• Diameter of Stack:	4.13m
• 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 – 200MW_e
• Wastewater collection:	Package treatment plant
Utilities	
• Water Supply:	3.25GL/yr sourced from mine dewatering at Ewington 1
• Coal Supply:	0.7Mtpa via conveyor owned and operated by Griffin Coal Mining Company
• Transmission Line Length:	100m up to 3km depending on interconnection point as required by Western Power
Emissions	
• Noise:	Less than 60dB(A) at 150m from the plant. Less than 29dB(A) at nearest residence in Collie
• Flue Dust:	47mg/Nm^3 at 7% O_2 dry basis; 9g/s; 227tpa
• Nitrogen Oxides:	606mg/Nm^3 at 7% O_2 dry basis; 121g/s; 3050tpa
• Sulphur Oxides:	1490mg/Nm^3 at 7% O_2 dry basis; 296g/s; 7470tpa
• Greenhouse Gases:	1,300,000tpa CO_2 e
• Carbon Monoxide:	500mg/Nm^3 at 7% O_2 dry basis; 93g/s; 2350tpa
• Volatile Organic Compounds:	32kg/yr
• PAHs:	6.0kg/yr
• Arsenic:	6.7kg/yr
• Cadmium:	8.5kg/yr
• Chromium compounds:	1.5kg/yr
• Lead compounds:	31kg/yr
• Mercury:	31kg/yr
• Fluorides:	17,000kg/yr (instantaneous rate estimated to be less than 590mg/s)
• POPs inc. Dioxins and Furans:	Less than 0.5 grams per year
Waste	
• Ash:	175,000tpa disposed to the adjacent mine (Ewington 1)
• Septage:	Packaged treatment plant
• Saline Water:	1.2GL/yr
Workforce	
• Construction:	Approximately 150 personnel at the peak of construction
• Operations:	Up to 30 full time operations and maintenance personnel

Abbreviations

CO_2 e	carbon dioxide equivalents	mg/s	milligrams per second
dB(A)	decibels A weighted	Mtpa	million tonnes per annum
g/s	grams per second	MW	megawatts
GL/yr	gigalitres per year	MW_e	megawatts sent out
HHV	higher heating value	O_2	oxygen
inc.	including	pa	per annum
kg	kilograms	PAHs	polycyclic aromatic hydrocarbons
kg/yr	kilograms per year	POPs	persistent organic pollutants
LHV	lower heating value	SWIS	South West Interconnected System
m	metres	tpa	tonnes per annum
mg/Nm^3	milligrams per standard cubic metre	%	percent

Source: Modified version of Table 2 from Griffin Energy Pty Ltd 2004

3. Relevant environmental factors

Section 44 of the *Environmental Protection Act, 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the relevant factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as terrestrial flora, terrestrial fauna, Aboriginal culture and heritage, and risk and hazards, are relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following environmental factors relevant to the proposal require detailed evaluation in this report:

(a) Greenhouse gas emissions;

(b) Atmospheric emissions;

(c) Liquid and solid waste disposal;

(d) Surface water and groundwater; and

(e) Noise.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors generated from the PER document and the submissions received, in conjunction with the proposal characteristics.

Details on the relevant environmental factors and their assessment are contained in Sections 3.1 - 3.5. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

3.1 Greenhouse gas emissions

Description

Operation of the proposed Bluewaters Power Station will generate a significant quantity of greenhouse gas emissions, predominantly in the form of 1,300,000 tonnes of carbon dioxide (CO_2) per annum.

Submissions

The overarching issues raised in the submissions in relation to greenhouse gas emissions included:

- information is required on the greenhouse gas intensity and thermal efficiency of the proposed plant, and the level of offsets that would be applied against the project;
- the application of a penalty or offset for coal to bring it into line with other energy sources with respect to carbon emissions is not supported;
- the proponent should provide evidence that a critical assessment of options such as Integrated Drying Gasification Combined Cycle (IDGCC), Mechanical Thermal Expression (MTE), dewatering, biomass, cogeneration [i.e. combined heat and power (CHP)], and plant optimisation has been conducted prior to the selection of the fuel and final plant configuration;
- the sub-critical technology proposed for the Bluewaters Power Station is "old technology" and is less efficient than super-critical technology;
- the proponent should provide a Greenhouse Gas Emission Management Plan as part of the approvals process;
- an assessment on the potential to use geosequestration was not provided; and
- it appears unlikely that the Bluewaters Power Station would significantly reduce the sent-out carbon intensity of electricity generation of the South West Interconnected System (SWIS).

Assessment

The EPA notes that operation of the proposed Bluewaters Power Station will generate approximately 1,300,000 tonnes of CO_2 per annum which represents 0.3% of Australia's 1990 baseline level for greenhouse gases. This amount is also well over the trigger level of 500,000 tonnes per annum (tpa) in EPA Guidance Statement No. 12 titled, "Guidance Statement for Minimising Greenhouse Gas Emissions" (EPA 2002a). The EPA understands that the proposal is for a coal fired power station at Collie, and that it is currently proposed to run as a merchant plant to supply large industrial power users. The EPA also understands from the proponents briefings that this plant may contribute to a future bid to supply Western Power with power for retail sale in Western Australia.

The EPA considers this proposal to be a significant contributor to Western Australia's greenhouse gas emissions. The EPA's objectives in regard to this environmental factor from both a global and Australian context, consistent with the State and National Greenhouse Strategies, are to:

- minimise greenhouse gas emissions in absolute terms and reduce emissions per unit of product to as low as reasonably practicable; and
- mitigate greenhouse gas emissions, mindful of relevant Commonwealth and State environmental policies, including EPA Guidance Statement No. 12.

The EPA is aware that the Australian Government has committed to limit Australia's increase in greenhouse emissions in 2008-2012 to no more than 8% above 1990 levels. Accordingly the EPA considers it necessary for greenhouse gas minimization to be kept firmly in mind when considering new development proposals which are likely to significantly add to emissions.

To achieve this, the EPA expects that potential greenhouse gas emissions from proposed projects are adequately addressed in the planning, design and operation of projects, and that:

- best practicable measures are applied to maximise energy efficiency and minimise emissions;
- comprehensive analysis is undertaken, where residual impacts occur, to identify and implement appropriate offsets; and
- proponents undertake an on-going programme to monitor and report emissions and periodically assess opportunities to further reduce greenhouse gas emissions over time.

In relation to best practice, maximising energy efficiency and minimising greenhouse gas emissions, the EPA considers that combined cycle gas turbine (CCGT) generation represents best practicable technology for base-load power generation, and hence represents the benchmark against which other technologies should be compared from an environmental point of view.

The EPA notes that the proposed plant would result in greenhouse gas emission of approximately 620,000 tpa greater than a CCGT plant of similar capacity. This would amount to approximately 18.6 million tonnes of extra greenhouse gases over a nominal 30 year life for the proposed plant.

The EPA has provided strategic environmental advice to the proponent (EPA 2003a) on its expectations for future power station proposals in relation to the mitigation of greenhouse gas emissions. The EPA indicated that if power stations are proposed which do not result in the least greenhouse gas intensity, the EPA expects that mitigation actions would be proposed, investigated during the Section 38 environmental impact assessment process, and adopted as appropriate.

The EPA also indicated that specific measures relevant to the reduction and mitigation of greenhouse gas emissions could include:

- renewable energy generation (wind and biomass);
- advanced, high efficiency coal fired generation technology;
- sequestration via forestry; and
- desalination as part of a regional water management strategy.

The EPA also stated that it considered that such a package of mitigating measures presents a responsible way of addressing the environmental impacts associated with higher greenhouse gas emissions from coal fired power stations. In view of the above, the EPA considers that if coal is used for base-load power generation it requires greenhouse gas offset measures to be considered to account for the additional greenhouse gas emissions produced by the proposed coal fired power station in comparison to a CCGT base-load power station of equivalent nominal generating capacity.

The EPA notes that the proponent has made a commitment (see Commitment No. 12 in Appendix 4 for full details) in regard to greenhouse gas emissions which includes the following action items:

1. 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 and suggestions on the implementation of measures such as afforestation mentioned in the Kyoto Protocol to further offset greenhouse gas emissions.
2. 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.
3. Use AGO Technical Efficiency guidelines in plant design and operational management.
4. Continue planting trees on former mined areas and rural land owned by Griffin affiliates to sequester a total of approximately 91,000 tonnes per annum of carbon dioxide for the nominal 30 year life of the project.
5. Participate in the construction of an 80 MW wind farm (with Griffin having a 40 MW net interest) near Cervantes, resulting in greenhouse gas savings of 220,000 tpa (110,000 tpa net interest).
6. Contribute to research and development of clean coal and other research projects which can contribute greenhouse gas offsets.

In addition to the above direct offsets, the proponent has also undertaken to provide support and access to Griffin owned land and facilities to enable the diversion by others of the East Collie River, to facilitate the diversion of first flush salt water away from Wellington Weir. The proponent anticipates that this project could lead to the return of 80 GL of water in Wellington Weir to potable standard within a three year time frame. The proponent calculated a benefit of up to 480,000 tpa of greenhouse gases avoided by not having to desalinate an equivalent volume of seawater.

The calculation above assumes Wellington Weir water can replace water that would otherwise be produced by desalination of seawater, using power from the state grid. The calculated benefit would be less if gas fired power were used, rather than power from the existing grid. This is in fact the likely scenario at Kwinana power station where coal firing is to be replaced with gas, which has less than 40% of the greenhouse intensity of current coal fired operations (EPA 2004). The calculated

benefit could thus be down to 151,000 tpa if gas was used to provide electricity for seawater desalination at Kwinana.

The EPA notes that the proponent has made the commitments listed above to partially offset the additional greenhouse gas emissions produced by the coal fired Bluewaters Power Station in comparison to the EPA's benchmark CCGT base-load power station of equivalent nominal generating capacity. The EPA also notes that the proponent has stated that it intends that the same package of offsets also apply to some other electricity generation proposals that the proponent plans to promote in the near future.

The EPA's position in relation to greenhouse gas emission offsets is consistent with the relevant Principles in Section 4 of the *Environmental Protection Act, 1986*. Principle 4 states in part that, "those who generate … waste should bear the cost of containment, avoidance or abatement", " environmental factors should be included in the valuation of assets and services", and "the users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes". Principle 5 states in part that "all reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment".

The EPA's position is also consistent with EPA Guidance Statement No.55 titled, "Implementing Best Practice in Proposals Submitted to the Environmental Impact Assessment Process" (EPA 2003b), which indicates that "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". In view of the above, the EPA expects proponents of development proposals that generate a larger quantity of waste (ie. CO_2) in comparison to other means of generating the same quantity of electrical power, to provide an appropriate package of offset measures.

The EPA notes that gas is becoming a premium fuel internationally because of its capacity to result in lower emissions, including greenhouse gases, per unit of energy produced. While some submitters stated that Collie coal was not preferred for electricity generation, others argued that one fuel (coal) should not be penalised with offsets that impose environmental management costs that another fuel (gas) does not incur. The EPA considers that projects should be subject to management that protects the environment to the same, consistent standards. In the EPA's view, there is inherent equity in internalising environmental costs. Coal, without greenhouse gas offsets, could be considered to have an unfair advantage if the additional environmental costs of greenhouse gas emissions were borne by the community and not internalised to the project.

The EPA notes that :

- While the proposal may be too small to use super-critical technology, it will be more efficient than older coal plant in Western Australia, although its contribution to improved efficiency across WA is likely to be about 1% or less;
- the proposal will generate about 620,000 tpa more greenhouse gases than an equivalent gas powered station;

- the proponent has offered to counter these extra emissions in part by direct offsets it can clearly control and account for, amounting to about 201,000 tpa from its interest in a wind farm and tree planting;
- these direct offsets amount to about one tonne in five of the additional emissions above the CCGT benchmark;
- the proponent has offered support for some other offsetting actions which are positive and potentially useful but are presently less tangible and less quantifiable;
- the proponent intends that the package of offsets offered should apply to the current Bluewaters Power Station proposal and some other future electricity generation proposals it plans to promote.

The EPA considers that:

- given the uncertainty of allocating a package of offsets across this proposal and future proposals, the EPA has considered the proponent's offer of direct offsets of about 201,000 tpa as if they applied wholly to this proposal;
- accordingly, the proponent has met the intent of the EPA's requirement to consider the issue of offsets and has offered direct offsets which form a worthwhile and useful package, noting however that there is still an excess of about 419,000 tpa of greenhouse gas emissions above the EPA's CCGT benchmark;
- the other offsets offered may be positive and useful in the future but the EPA is unable to ascertain the extent of the proponent's direct interest in them now. Accordingly, the EPA is prepared to consider their contribution to offsetting future proposals when the proponent's interest in them can be sufficiently clearly defined.

The EPA considers that the proponent's response to other matters raised in submissions in relation to this factor (Appendix 5) adequately addresses those matters.

Summary

Having particular regard to the:

(a) significant quantity of greenhouse gas emissions that will be produced by the proposed coal fired power station;

(b) the commitments made by the proponent; and

(c) EPA's view above about greenhouse gas emission offsets;

it is the EPA's opinion that CCGT is environmentally the best practicable technology for power generation and is the benchmark against which emissions should be measured. While the objective of considering offsets has been met by the proponent, and a worthwhile package offered, there is still a significant excess of emissions and hence best environmental practice for limiting greenhouse gas emissions has not been met. If Government approves the proposal, the package of offsets should be made legally binding so that they can be implemented and bound to this proposal.

3.2 Atmospheric emissions

Description

Construction and operation of the proposed Bluewaters Power Station will generate a variety of atmospheric emissions which have the potential to affect human health if not properly managed.

Submissions

The issues raised in the submissions in relation to atmospheric emissions were primarily related to:

- cumulative air quality impacts;
- health impacts and health risk assessment (HRA);
- characterisation and analysis of the atmospheric emissions;
- the air quality modelling that was undertaken; and
- the use of best practice/best available technology to minimise SO_2 emissions.

Assessment

The area considered for assessment of this factor is the Bluewaters Power Station site and surrounding areas, including residences in and around the town of Collie.

The EPA's environmental objective for this factor is to ensure that:

- atmospheric emissions do not adversely affect the environment or health, welfare and amenity of nearby land users by meeting statutory requirements (including Section 51 of the *Environmental Protection Act, 1986*) and acceptable standards;
- atmospheric emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem; and
- all reasonable and practicable measures are used to minimise the discharge of atmospheric emissions.

The EPA notes that the proposed Bluewaters Power Station will emit a range of atmospheric emissions as set out in Table 1, which have the potential to affect human health and the environment if not properly managed. The air quality modelling report prepared for the Bluewaters proposal being assessed here (Physik and Edwards 2004) indicates, however, that it will not substantially contribute to exceedances of relevant air quality standards.

Modelling results indicate that predicted ground-level concentrations of carbon monoxide, nitrogen dioxide and ozone are all well below NEPM ambient air quality standards. Predicted concentrations of mercury and PAH are well below WHO guidelines, and fluoride concentrations are well below the ANZEC goal.

Modelling indicates that dust particulate PM_{10} concentrations from point source emissions appear to be mainly from Muja power station and the contribution from the proposed Bluewaters power station does not appear to be significant, although the

contribution from mining operations in the region has not been addressed. The modelled PM_{10} impacts for the base-case scenario of existing sources (including Muja Power Station) indicate a maximum 24-hour average of approximately 20 μg m^{-3} at the Collie town-site, and a 99.9 percentile concentration of about 10 μg m^{-3}.

Emissions data detailed in the PER specify a sulphur dioxide emission rate of 232 grams per second, based on a coal sulphur content of 0.4% (dry, ash-free). Correspondence from the proponent has declared that this is the quality of coal contracted with their suppliers. The modelling report is conservatively based on a constant emission rate of 296 grams per second of sulphur dioxide, consistent with a coal sulphur content of 0.5%.

Predicted maximum one hour average sulphur dioxide concentrations (1104 μg m^{-3}) exceed the NEPM Ambient Air Quality Standard (570 μg m^{-3}) at some locations in the region, although not at population centres. The base-case scenario model results suggest that these incidents are due to emissions from existing sources, Muja Power Station in particular, with no significant contribution from the proposed 200 MW Bluewaters power station. Predicted maximum concentrations for sulphur dioxide (345 μg m^{-3}) do not exceed relevant air quality standards (570 μg m^{-3}) at populated areas such as the Collie township and outlying residences.

Health Impact Assessment

The Department of Health notes (DoH pers. comm.) that the WHO 10 minute guideline for SO_2 of 500 μg m^{-3} is considered a more appropriate limit for vulnerable groups than the National Health and Medical Research Council goal for a 10 minute period used in air modelling. While additional data on the total number of 10 minute SO_2 exceedances, the distribution of sensitive land uses (like sporting venues) outside Collie township and background levels of PM_{10} would have been desirable, the Department of Health concluded that modelling indicates adverse health effects are likely to be infrequent, particularly if other sources of air emissions decrease as planned. The Department of Health advice also emphasised that the air emission control technologies employed in existing and proposed power stations greatly influence the exposure potential of the community and that the planned phase out of the existing Muja A and B stations would be likely to lead to a significant decrease in SO_2 levels.

The EPA notes that the potential health impacts from atmospheric emissions generated by both existing and proposed industries in the Collie region will be further scrutinised in the Collie Basin Health Impact Assessment and the associated Collie Basin Cumulative Air Quality Assessment. These two assessments are being coordinated by Western Power Corporation and are related to the proposed Collie Power Station Expansion.

Best Practice Air Pollution Management

The EPA notes from the PER document that low NO_X burners will be installed and operated in the proposed power station to minimise NO_X emissions, and that the proponent considers that the design of these burners will reflect the objectives of EPA Guidance Statement on Best Practice (EPA 2003b). The EPA also notes from the PER document that dust (particulate) emissions from the proposed power station will

be controlled through the installation of either an electrostatic precipitator or a bag-house.

The EPA considers that the use of low NO_X burners and either an electrostatic precipitator or a bag-house in the proposed power station would adequately demonstrate the implementation of best practice technology by the proponent in relation to minimising NO_X and particulate emissions.

The EPA notes that the proponent has made a commitment (Commitment No. 11) in regard to managing atmospheric emissions from the proposed power station which includes the following action items:

1. Develop and implement a dust management plan as part of a construction phase EMP.
2. Develop and implement a dust management plan as part of an operational phase EMP.
3. Develop and implement an operational emissions monitoring and management plan.
4. Use EPA Guidance note Number 55 to assist power station design.

The EPA notes from the proponent's response to submissions that it does not intend to employ pollution control technology such as flue gas de-sulphurisation (FGD) to minimise the discharge of SO_2 from the proposed power station as it considers relevant standards will be met without FGD and FGD will result in a net cost to the environment. The EPA has previously used "European Directive 2000/76/EC on the Incineration of Waste" as guidance for recommending stack emission limits for the Global Olivine waste to energy plant (EPA, 2000) and the Blair Fox poultry litter fired power station (EPA, 2002b) proposals.

The equivalent Directive for large power stations is "European Directive 2001/80/EC on the Limitation of Emissions of Certain Pollutants into the Air from Large Combustion Plants". Table 2 below summarises the relevant limits and compares them with the Bluewaters proposal for the major emissions.

Table 2. Proposed emissions compared to European Commission limits.

Emission	**2000/76/EC**	**2001/80/EC**	**2001/80/EC "outer regions"**	**Bluewaters**
SO_2	50 mg m^{-3}	200 mg m^{-3}	525 mg m^{-3}*	1490 mg m^{-3}
NO_x	200 mg m^{-3}	200 mg m^{-3}	300 mg m^{-3}	606 mg m^{-3}
Particulates	10 mg m^{-3}	30 mg m^{-3}	30 mg m^{-3}	47 mg m^{-3}

Notes:

(i) * This limit could drop to 200 mg m^{-3} if an additional power station were built on the same site.

(ii) The EC values are limits (specified at 6% Oxygen) while the Bluewater values are continuous emissions (specified at 7% Oxygen). The Bluewaters values would increase if specified at 6% Oxygen.

(iii) The stack flow rates for the Global Olivine, Blair Fox and Bluewaters proposals are approximately 250 m^3/sec, 20 m^3/sec, and 220 m^3/sec respectively.

As noted earlier, air dispersion modelling predicts that the NEPM would be complied with in the Collie Region once Muja stage A and B were decommissioned.

The EPA notes that the analysis above shows that the Bluewaters proposal does not employ world's best practice for SO_2 management. Considering Principle 5 "waste minimisation" of the *Environmental Protection Act*, the EPA considers that additional pollution control equipment would minimise emissions and should be considered during the licensing process under Part V of the *Environmental Protection Act*.

While noting that air quality modelling indicates no significant contribution to exceedances of the NEPM from the proposed 200 MW Bluewaters power station, the EPA also notes that a scenario which includes all existing and currently mooted coal fired power generation plants in the Collie area would result in the 10-minute averaged concentrations of sulphur dioxide at the Collie township reaching 107% of the NHMRC Guideline and 153% of the WHO Guideline recommended for vulnerable groups (Physik and Edwards 2004). While this scenario would not occur with the current array of proposals if Muja A and B were shut down, it illustrates what could happen in future if more coal-fired facilities were built without reduced sulphur dioxide emissions. The EPA is also mindful of the advice of the Department of Health that technologies applied in the management of air emissions greatly influence the exposure potential of the community, and that new plant will typically remain in service for 30 to 40 years.

The EPA has been made aware of the proponent's view that imposition of the 2001/80/EC limits could add up to 4% of extra CO_2 emissions, reduce power plant efficiency by up to 2%, require 50 tonnes per day of limestone, increase the water requirements of the plant by 1.5 to 3.5 Ml per day, increase waste water disposal by 40 to 80 kl per day and create 80 tonnes per day of solid (mainly gypsum) waste (Griffin pers. comm.). The EPA is also aware that the proponent considers that taking such action would not lead to any health benefit and would result in a net cost to the environment.

Having been presented with all the above advice, the EPA considers that, on balance, action should be taken to ensure that new power stations meet world's best practice for air emissions management. Accordingly, the EPA recommends that the Department of Environment (DoE) ensures that any Part V License for the proposal requires best practicable technology, consistent with current industry standards and considers the adoption of the limits in 2001/80/EC for "outer most regions", at least. Noting also that the existing Muja A and B stations have been identified as the major contributors to air emissions at Collie, the EPA strongly supports the closure of these plants as soon as possible.

Summary

Having particular regard to the:

(a) level of air emissions from current and mooted future coal fired power plants around Collie;

(b) the results of air emissions modelling and the advice of the Department of Health on health effects; and

(c) commitments made by the proponent;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that best practice is applied to the control of SO_2 emissions, consistent with industry standards, by considering European Directive 2001/80/EC for outer regions as the standard during the DoE licensing process.

3.3 Liquid and solid waste disposal

Description

Construction and operation of the proposed Bluewaters Power Station will generate liquid and solid wastes that will require disposal.

Submissions

The issues raised in the submissions in relation to liquid and solid waste disposal were centred on:

- ash disposal;
- ocean discharge of saline wastewater; and
- the design of the on-site wastewater system for the treatment and disposal of sewage.

Assessment

The area considered for assessment of this factor is the Bluewaters Power Station site and surrounding areas, including the Ewington 1 Mine and the marine environment in the vicinity of the existing Collie Power Station saline wastewater pipeline ocean outfall.

The EPA's environmental objective for this factor is to ensure that:

- where possible, waste is minimised, reused or recycled to levels which are as low as reasonably practicable; and
- liquid and solid wastes do not affect surface water and groundwater quality, the marine environment, nor lead to soil contamination.

The EPA notes from the PER document that the proposed power station will generate about 1.2GL of saline wastewater per year and about 175,000 tonnes of ash per annum during operation. The EPA also notes that the saline wastewater is proposed to be disposed of via the existing Collie Power Station saline wastewater pipeline and ocean outfall system, and that the ash will be disposed of in the nearby Ewington 1 mine.

The EPA notes from the PER document that the proponent has obtained an "agreement in principle" from Western Power Corporation to access the Collie Power Station saline wastewater pipeline to enable the disposal of saline wastewater from the Bluewaters Power Station. The pipeline has been previously assessed by the EPA and is subject to Ministerial and DoE license conditions. The EPA understands from the proponent's briefings that the pipeline currently operates considerably below capacity. The EPA also notes that the operator of the Bluewaters Power Station will be responsible for obtaining a separate license to discharge into the pipeline.

The EPA understands from the PER document that discharge into the line will be covered by a commercial agreement between the licensed discharge line operator and the operator of the Bluewaters Power Station. The EPA notes that the agreement will cover access terms which will specify, as a minimum, that discharge from the Bluewaters Power Station will not be accepted into the pipeline unless the discharge has been tested to ensure that it meets the Bluewaters Power Station discharge license condition.

The disposal of saline wastewater has the potential to impact on the marine environment through cumulative effects if there is an increase beyond the current license limits in discharge volume, the mixing zone or the total load of contaminants released into the sea. The EPA understands that the saline wastewater is likely to contain biocides such as hypochlorite and hydrobromide, as well as corrosion and scale inhibitors.

The key marine issue is water quality and its potential impact on marine biota. It is desirable that the monitoring and management of marine water quality should be consistent with the Environmental Quality Criteria Reference Document for Cockburn Sound (EPA in press). This framework has been adopted since the existing outfall was assessed and licensed. Accordingly, any update of the pipeline license which may be required as a result of increased discharge from the line should take account of the framework.

While it is open to the existing pipeline licensee to enter into contractual arrangements with other users, the EPA expects that the licensee will retain responsibility for discharges from the pipeline. Management of discharges from the Bluewaters proposal to the pipeline can be managed by a DoE discharge license on the Bluewaters operation. Such a license should ensure that the currently licensed discharge from the ocean outfall is either not exceeded or is subject to further appropriate assessment. Any such assessment should ensure that end of pipe combined effluent toxicant concentrations meet 80% species protection guidelines for bio-accumulatory toxicants and 99% species protection guidelines at the edge of the zone of initial dilution (except cobalt, which should meet 95% species protection guidelines).

It would be advisable for the DoE license to require that whole of effluent toxicity testing be required annually for the combined effluent and that the combined effluent quality be consistent with the requirements of the Environmental Quality Criteria Reference Document for Cockburn Sound (EPA in press). To ensure that the density of the combined effluent will not increase, and does not potentially limit the dilutions

achieved at the edge of the zone of initial dilutions, license conditions should ensure that 100 fold dilutions will be maintained to the edge of that zone.

The EPA notes from the PER document that the co-disposal of ash and mine overburden into mine voids above the water table would enable trace elements within the ash to be fixed by reaction with clay. The EPA understands that the use and disposal of fly ash in mine voids is common in coal mining areas in the Unites States, although there are strict controls on the manner in which the material is used. The EPA also notes from the PER document that this method of disposal is currently being used at the Bayswater Power Station in New South Wales. The EPA is aware that the disposal of ash into mine voids has the potential to increase groundwater salinity, and may lead to the contamination of groundwater by some of the trace elements found in the ash.

The EPA notes that the proponent has made two commitments (Commitment Nos. 7 and 9) in regard to liquid and solid waste disposal. Commitment No. 7 includes the following action item:

1. Cooperate with the operator of Collie A disposal pipeline – to ensure effluent water meets discharge license conditions prior to introduction into the pipeline.

Commitment No. 9 includes the following action items:

1. Develop and implement a waste management plan as part of the construction phase EMP.
2. Develop and implement a waste management plan as part of the operational phase EMP.
3. Develop and implement a fly ash management plan as part of the operational phase EMP.

The EPA notes from the proponent's response to submissions that a fly ash management plan will produced, as referred to in Commitment No. 9. The EPA understands that the plan will include a groundwater monitoring program which will be agreed in consultation with the operator of the Ewington 1 Mine, the DoE, and other stakeholders. Nevertheless, the EPA recommends that the above-mentioned management plan should include details which indicate how surface water run-off and infiltration through the ash and overburden material will be managed to prevent groundwater contamination from occurring.

The EPA considers that the management measures described on pages 30 and 61 of the PER document to minimise potential impacts from liquid and solid waste disposal are environmentally acceptable. The EPA considers that the proponent's response to the above-mentioned submissions (Appendix 5) adequately addresses the concerns that were raised in relation to liquid and solid waste disposal.

Summary

Having particular regard to the:

(a) necessity of the proposal to fit within the licensed capacity of the marine discharge pipeline;

(b) commitments made by the proponent; and

(c) management measures that will be used to minimise potential impacts from liquid and solid waste disposal;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.4 Surface water and groundwater

Description

Construction and operation of the proposed Bluewaters Power Station has the potential to affect surface water and groundwater quality.

Submissions

The issues raised in the submissions in regard to surface water and groundwater included:

- it would be sensible for the plant design to allow for the use of saline water for cooling purposes; and
- in Section 4.6 of the PER a wet cooling tower is specified. To what extent have other technologies such as air cooled condensers been explored?

Assessment

The area considered for assessment of this factor is the Bluewaters Power Station site and surrounding areas and the route of the saline wastewater discharge pipeline.

The EPA's environmental objectives for this factor are to maintain the quality of surface water and the quality, quantity and distribution of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.

The EPA notes from the PER document that there are no major drainage channels located within the proposed power station site, and that potential impacts on surface hydrology are likely to be restricted to sheetflow movement. Construction and operation of the proposed power station has the potential to increase surface water and sediment run-off to nearby wetlands, and to affect the quality of regional surface water resources. The proponent advises that the power station will require 3.25GL of water per year which will be sourced from mine dewatering at the Ewington 1 Mine. The EPA understands that no additional groundwater or other water will be required to supplement the water obtained from dewatering.

The operation of the proposed power station has the potential to affect the quality of groundwater due to run-off from plant hard stand and storage areas, flyash disposal, saline wastewater leakage from storage ponds, and contamination from hydrocarbons and other chemicals used on site. The EPA considers that there is also the potential for surface and ground water quality to be affected by leaks and/or ruptures in the saline wastewater discharge pipeline.

The EPA notes that the proponent has made two commitments (Commitment Nos. 4 and 5) in regard to surface water and groundwater. Commitment No. 4 includes the following action items:

1. Develop and implement a surface water management plan as part of a construction phase EMP.
2. Develop and implement a surface water management plan as part of an operational phase EMP.
3. Document the existing surface water quality in the project area.

Commitment No. 5 includes the following action items:

1. Develop and implement a groundwater management plan as part of a construction phase EMP.
2. Develop and implement a groundwater management plan as part of an operational phase EMP.

The EPA considers that the management measures described on pages 52 and 55 of the PER document that will be used to minimise potential impacts on surface water and groundwater, are environmentally acceptable. The EPA considers that the proponent's response to the above-mentioned submissions (Appendix 5) adequately addresses the concerns that were raised in relation to surface water and groundwater.

Summary

Having particular regard to the:

(a) undertakings that no additional groundwater will be required to supplement the water obtained from dewatering at the Ewington 1 Mine;

(b) commitments made by the proponent; and

(c) management measures that will be used to minimise potential impacts on surface water and groundwater;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

3.5 Noise

Description

Construction and operation of the proposed Bluewaters Power Station has the potential to affect existing noise levels.

Submissions

The issues raised in the submissions in regard to noise included:

- the acoustic assessment provided in the PER has been undertaken for a power station of 150MW only, whereas Bluewaters is 200MW; and

- the noise modelling that was undertaken deals mainly with compliance at the nearest noise sensitive premises in Collie, and does not address other requirements of the *Environmental Protection (Noise) Regulations, 1997*. It is not clear from the PER document whether the proposed power station complies with the requirement to meet 60dB(A) at all undeveloped noise sensitive premises such as the nearest non-mining land, or whether cumulative noise impacts were taken into account in the modelling.

Assessment

The area considered for assessment of this factor is the Bluewaters Power Station site and surrounding areas, including residences in and around the town of Collie.

The EPA's environmental objective for this factor is to ensure that:

- noise levels from construction activities comply with the requirements of Australian Standard 2436-1981 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites*"; and
- noise levels from the proposed power station comply with the *Environmental Protection (Noise) Regulations, 1997*.

The EPA notes from the PER document and the proponent's response to submissions that the proposed power station will comply with the requirements of the *Environmental Protection (Noise) Regulations, 1997* and that appropriate noise abatement technology will be installed to ensure the proposed power station meets the relevant noise criteria.

The proponent has made a commitment (Commitment No. 10) in regard to managing noise emissions from the proposed power station which includes the following action items:

1. Develop and implement a noise management plan as part of the construction phase EMP.
2. Develop and implement a noise management plan as part of the operational phase EMP.

The EPA considers that the proponent's response to the above-mentioned submissions (Appendix 5) adequately addresses the concerns that were raised in relation to noise.

Summary

Having particular regard to the:

(a) results of noise modelling which indicate that the proposed plant will comply with the requirements of the *Environmental Protection (Noise) Regulations, 1997*;

(b) commitment to installation of appropriate noise abatement technology to ensure that the proposed power station meets the relevant noise criteria; and

(c) other commitments made by the proponent;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

4. Conditions and Commitments

Section 44 of the *Environmental Protection Act, 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

4.1 Proponent's commitments

The proponent's commitments as set out in the PER and subsequently modified, as shown in Appendix 4, should be made enforceable. These include commitments on:

1. Biodiversity;
2. Terrestrial Flora;
3. Terrestrial Fauna;
4. Surface Water Quality;
5. Groundwater Quality;
6. Water Supply;
7. Marine Water Quality;
8. Contamination (oil and chemical spills);
9. Solid and Liquid Wastes;
10. Noise and Vibration;
11. Air Emissions;
12. Greenhouse Gas Emissions;
13. Recreational Activity;
14. Visual Amenity;
15. Aboriginal Culture and Heritage; and

16. Public Risk.

4.2 Recommended conditions

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Griffin Energy Pty Ltd to construct and operate the Bluewaters Power Station, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;

(a) preparation and implementation of a greenhouse gas emissions management plan;

(b) preparation and implementation of a stack emissions management plan; and

(c) compliance audit and performance reviews and a decommissioning plan.

It should be noted that other regulatory mechanisms relevant to the proposal include:

- Department of Environment Works Approval and license.
- Department of Industry and Resources regulations.

5. Other Advice

5.1 Industrial buffer

The EPA considers that State government planning agencies and the Shire of Collie should coordinate the establishment of a suitable designated buffer zone around the proposed Bluewaters Power Station, as well as the development of appropriate measures to protect the buffer zone from the encroachment of incompatible land uses so that adequate separation distances are maintained.

5.2 Air quality management in the Collie region

Air modelling predicts that emissions of sulphur dioxide from existing sources, in particular the Muja A and B power stations, may exceed the one hour NEPM Ambient Air Quality Standard at some locations in the Collie region, although not at population centres. The EPA notes the advice from Western Power that the Western Power Board has committed, at its meeting on 9 September 2004, to the retirement of Muja A and B by April 2007 (Appendix 6). Given that the Bluewaters proposal would require a construction period of 30 months (Table 1) from the date of final approval, Western Power's commitment would mean that Muja A and B would be shut down before Bluewaters came into commercial operation. Consistent with its recommendation that new plant include best practice air emission management technology, the EPA

strongly supports the timely shut down of the old Muja A and B plants as a means of further improving air quality in the Collie region.

5.3 Greenhouse gas differential between fuel sources

During the assessment of this proposal, the EPA has become aware of a view that opposes the application of a penalty or offset for coal to bring its greenhouse gas emissions into line with other energy sources. While some may see this as an economic penalty which discriminates between fuel sources (particularly coal or oil and gas) this is clearly not the case from the environmental perspective. The EPA is required by Section 15 of the *Environmental Protection Act* to use its best endeavours to protect the environment. Section 4A4 of the *Environmental Protection Act* also requires regard to be paid to principles relating to improved valuation, pricing and incentive mechanisms to protect the environment.

Arguments have been put that any requirement to offset the greater greenhouse gas emissions of coal would distort the market between fuel sources. The EPA considers this argument ignores the full array of environmental costs (and their associated environmental effects) involved in power production and is not valid. Any suggestion that alternative means of producing the same product (electrical power) should not be subject to measures to ensure they are limited to the same level of emissions is clearly not based on the application of a level environmental playing field. Further, it assumes that some fuel sources (coal or oil) should be allowed to externalise their environmental costs, providing those sources with an unfair capacity to generate more emissions than other sources (gas or renewables) and shift the cost of those emissions to the community.

While an argument could be put that the benchmark for emissions should be set at the levels achievable by renewables, the EPA has previously accepted that issues of size, technical capability and strategic matters will need consideration (EPA 2002c). While the EPA encourages the use of renewables wherever possible (EPA 1990, 2002c) it accepts that they will need further encouragement, development and time to become practicable at the scale required to supply a major fraction of Western Australia's power needs. The EPA also accepts that there may be sound reasons for other decision makers to decide to diversify the fuel sources for electrical power generation in Western Australia. In fulfilling its environmental role, however, the EPA considers that a transparent approach requires that the full environmental consequences of alternatives be made clear.

Offsets are a flexible means for coal fired power stations to address the increased greenhouse gas emissions that they produce, now. If additional costs are incurred to provide these offsets, then an equitable approach is to ensure that those costs are internalised to ensure that coal does not generate higher environmental costs for the whole community. If users of coal fired electrical power paid the full cost of abating or offsetting the higher level of emissions, then coal would not be free riding by imposing its environmental costs on the wider community.

As an example of internalised costs, the EPA notes that retail users of power in remote parts of Western Australia are charged the same tariff as users on the South West Interconnected System, where economies of scale make power production costs lower. By spreading the cost to supply remote users across the whole community, disadvantageous costs are not imposed on one, remote sector of the community. The

EPA considers that it would be equitable, defensible and environmentally sound to require that environmental costs were fully internalised during power production. Such costs could be spread across all users, as is the case with power generation costs for remote communities. Any argument that environmental comparisons should not be made between fuels is considered spurious.

6. Conclusions

The EPA has considered the proposal by Griffin Energy Pty Ltd to construct and operate the 200MW Bluewaters Power Station as described in Section 2.

The EPA considers that combined cycle, gas fueled power plants represent best practice for large scale power generation. The proposed 200MW coal fired plant will produce an extra 620,000 tonnes of carbon dioxide per year compared to a combined cycle gas turbine plant of equivalent capacity. The EPA has previously advised that it expects proponents to mitigate all or part of the extra greenhouse gases produced.

The EPA is satisfied that the proponent has investigated mitigation actions and notes that the quantity of greenhouse gases to be offset is about 201,000 tpa which is a worthwhile and useful package. It is, however, about 419,000 tpa less than the additional greenhouse gases produced by this proposal compared to a combined cycle gas turbine plant of equivalent capacity.

If a decision is made so that the proposal may be implemented, the EPA considers that the offsets offered by the proponent should be made legally enforceable and tied to this proposal for the life of the proposal. The EPA recognises that the issue of greenhouse gas management is a matter for judgment and that decisions about this proposal will include consideration of broader economic, regional development and strategic issues which are outside the scope of the EPA. From an environmental perspective, the EPA advises that a coal fired power station without full offsets will not deliver the best environmental outcome.

The EPA also considers that the proposal does not represent best practice for sulphur dioxide emissions management and recommends that European Directive 2001/80/EC for outer regions be considered as the standard if the proposal proceeds to the Department of Environment licensing stage.

With the exception of greenhouse gas management, the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4, and summarised in Section 4.

The EPA also wishes to draw attention to the advice provided in Section 5 of this report in relation to air quality, offsets and the equitable internalisation of full environmental costs when considering proposals of this nature.

7. Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister notes that the proposal being assessed is for the construction and operation of the Bluewaters Power Station.
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3.
3. That the Minister notes that the EPA has concluded that, with the exception of greenhouse gas management, it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments.
4. If a decision is made allowing the proposal to be implemented, that the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Appendix 1

List of submitters

Organisations:

1. Bunbury Wellington Economic Alliance.
2. Department of Health.
3. Department of Indigenous Affairs.
4. Department of Conservation and Land Management.
5. Department of Planning and Infrastructure.
6. Environmental Protection Authority Service Unit.
7. Heritage Council of Western Australia.
8. Joint submission from Conservation Council of WA, Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia.
9. Pollution Action Network.
10. Shire of Collie.
11. South West Chambers of Commerce and Industry.
12. South West Development Commission.
13. Western Power Corporation.

Individuals:

1. Ian Miffling.
2. Trevor Prowse.
3. A private citizen.
4. 239 proforma submissions from members of the public.

Appendix 2

References

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Appendix 3

Summary of identification of relevant environmental factors

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
BIOPHYSICAL			
Terrestrial flora	The site has already been largely cleared for grazing. It is likely that there will be minimal impact on terrestrial flora.	**Department of Conservation and Land Management** The likely downstream impacts of the proposal regarding the clearing of forest for mining and power transmission to support the project should be clearly identified.	The EPA considers that the concern raised has been adequately addressed by the response provided by the proponent. In view of the above, and given that the power station site has already been largely cleared, the EPA considers that this environmental factor does not require further evaluation.
Terrestrial fauna	The site has already been largely cleared for grazing. It is likely that there will be minimal impact on terrestrial fauna.	**Conservation Council of WA, Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia** The statement in the Executive Summary of the PER that "Construction of the plant does not require… disturbance to ecosystems" contradicts the results of the flora and fauna survey, which refers to the potential impact on Baudin's Cockatoo and Red-tailed Black Cockatoo. **Department of Planning and Infrastructure** Information on the indirect impact on fauna movements between vegetation remnants from the development of new infrastructure associated with the proposed power station needs to be provided, and could be addressed via an Operational Environmental Management Plan.	The EPA considers that the concerns raised have been adequately addressed by the responses provided by the proponent. In view of the above, and given that the power station site has already been largely cleared, the EPA considers that this environmental factor does not require further evaluation.
POLLUTION			
Greenhouse gas emissions	The Bluewaters Power Station will generate up to 1.2 million tonnes of CO_2 per year.	**Conservation Council of WA, Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia** An assessment of geosequestration potential was not included despite the Collie Basin being identified as a potential storage site by the Cooperative Research Centre for Greenhouse Technologies. The proponent should provide the Bluewaters Power Station's GHG emissions per MWh. The proposed Bluewaters Power Station will be operated at part load (<80%), which has a lower efficiency than full load. Information on the part load efficiency of the proposed power station should be provided. The proponent does not state that they will apply the Australian Greenhouse Office (AGO) Generator Technical Efficiency Standards to the construction of the plant. The proponent does not state that they will enter into a Deed of Agreement with the AGO for the proposed project. Further information about the proposed initiative to supply trees to landcare groups in the south west is required to determine whether this can be considered a carbon offset. The proponent has not provided information on the level of offsets that will be applied against the project. The sub-critical technology proposed for the Bluewaters Power Station is "old technology" and is less efficient than super-critical technology. As Griffin Energy has stated that a 200MW station is too small to use super-critical technology and the Bluewaters Power Station is the first of three 200MW power stations, then it should investigate the option of constructing a larger generator that can utilise more efficient technology.	In view of the significant quantity of greenhouse gas emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that greenhouse gas emissions is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Greenhouse gas emissions (Continued)	The Bluewaters Power Station will generate up to 1.3 million tonnes of CO_2 per year.	**Conservation Council of WA, Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia (Continued)** The proponent should provide evidence that a critical assessment of options and plant optimisation has been conducted prior to the selection of the fuel and final plant configuration. Other "low emission" technologies such as Integrated Drying Gasification Combined Cycle (IDGCC) and Mechanical Thermal Expression (MTE) were not considered in the PER. There has been no discussion on the use of biomass and Combined Heat and Power (CHP). The potential to use "low emission" coal technologies, such IDGCC and MTE or dewatering technologies should be assessed. The potential to use "low emission" coal technologies as a pilot or research plant in order to contribute to research being undertaken to lower emissions from coal use should be examined. The potential to use of biomass instead of coal and the potential application of biomass co-firing should be addressed. All fuel options and technologies, such as cogeneration opportunities should be examined. Information about Collie coal should be presented to establish whether the thermal efficiency of Bluewaters is world's best practice. The proposed development would breach the objectives of the United Nations Framework Convention on Climate Change (UNFCCC). **Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, Climate Action Network Australia, and Pollution Action Network** The proponent should provide a Greenhouse Gas Emission Management Plan as part of the approvals process. The PER does not fulfil the requirements of the Environmental Protection Authority (EPA) Guidance Statement for Minimising Greenhouse Gas Emissions (No. 12). **Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, Climate Action Network Australia, and Western Power Corporation** There are inconsistencies in relation to the amount of greenhouse emissions the project will produce.	In view of the significant quantity of greenhouse gas emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that greenhouse gas emissions is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Greenhouse gas emissions (Continued)	The Bluewaters Power Station will generate up to 1.3 million tonnes of CO_2 per year.	**Pollution Action Network** More acceptable options for power generation in the south-west are available. And sustainable energy systems based on cogeneration, renewables and energy conservation should be considered. **Western Power Corporation** The claim in Sections 2.5 and 3.2 of the PER document that the proposed power station would reduce the carbon intensity of electricity generated within the South West Interconnected System (SWIS) appears to be erroneous because: - it apparently considers only WPC's electricity generation and does not take into account electricity production into the SWIS from other non-WPC sources; - it apparently considers WPC's total electricity generation and fuel use instead of only that relating specifically to the SWIS itself; - it apparently combines generated carbon intensities with sent-out carbon intensities, the latter which takes into account the electricity consumed within the generating facilities themselves which is not available to the SWIS; and - new generating facilities such as the proposed power station generating electricity into the SWIS would not exclusively displace the electricity generated by the older plant at Muja Power Station. The average sent-out carbon intensity of electricity generation into the SWIS in 2003/2004 was 870kg of CO_2 per MWh. Using information provided in the PER document, and assuming that 5.5% of the electricity generated by the proposed power station will be used internally, the Bluewaters Power Station would have a sent-out carbon intensity of about 925kg of CO_2 per MWh, thus making it appear unlikely that it would significantly reduce the sent-out carbon intensity of electricity generation of the SWIS. **Department of Planning and Infrastructure** Additional investment in carbon sequestration such as tree farming should be strongly encouraged. **Members of the public** I am concerned that coal has not received fair treatment compared with other forms of energy in selection as a fuel for electricity generation. Each fuel should be addressed on its merits and efficiencies should be sought for each fuel based on its own properties. I do not support and "penalty" or "offset" for coal to bring it into line with other energy sources with respect to carbon emissions. To do so would impact the viability of the coal industry and the town of Collie and its surrounds and consequently have a negative impact on environmental values in the south west. This is exactly the position defined in the WA Government "diversity in fuel" policy.	In view of the significant quantity of greenhouse gas emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that greenhouse gas emissions is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Greenhouse gas emissions (Continued)	The Bluewaters Power Station will generate up to 1.3 million tonnes of CO_2 per year.	**Members of the public (Continued)** Given that the proponent is proposing to burn coal to produce electricity instead of cleaner and more efficient natural gas, I thought that they would consider making a commitment to implement some form of greenhouse gas reduction strategy such as tree planting. There should be no demand for offsets placed on this project by the EPA. Offsets are contrary to the Federal Government position as defined by the AGO Technical Efficiency Guidelines and contrary to the State Government diversity in fuel policy. The EPA approach to condition setting and commitment seeking should be in line with State Government policy.	In view of the significant quantity of greenhouse gas emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that greenhouse gas emissions is a relevant environmental factor.
Atmospheric emissions	The Bluewaters Power Station will emit the following estimated quantities of atmospheric emissions: • Nitrogen oxides (NO_X) - 3,050tpa; • Sulphur oxides (SO_X) - 7,470tpa; • Flue dust - 227tpa; • Carbon monoxide (CO) - 2,350tpa; • Fluorides - 17tpa; • Volatile organic compounds (VOCs) - 32kg/yr; • Polycyclic aromatic hydrocarbons (PAHs) - 6.0kg/yr; • Persistent organic pollutants (POPs), including dioxins and furans - less than 0.5g/yr; • Mercury - 31kg/yr; • Arsenic - 6.7kg/yr; • Cadmium - 8.5kg/yr; • Chromium compounds - 1.5kg/yr; and • Lead compounds - 31kg/yr.	**Western Power Corporation** The total VOC emission for Bluewaters appears to be underestimated. Why was the Griffin Energy 800MW South West Power Project (SWPP) excluded from air emission studies? Air modelling should include the proposed Worsley expansion. **Department of Health** There needs to be an overall development plan for Collie. Modelling for the estimation of short term average ground level concentration needs to be undertaken for contaminants that can have health effects following short term duration exposures. No information has been provided on the characterisation of emissions from the present power stations or whether the substances included for consideration are representative of coal fired emissions. The data that was used to model the relevant pollutants were derived from the National Pollutant Inventory data. The use of this data would only enable a broad estimate of emissions to be determined which may not be accurate. Justification should be provided for not characterising the emissions. The identification and characterisation of the potentially exposed population (i.e. sensitive receptors) has not been undertaken, and the modelling averaging periods of 1 hour are considered to be too long to enable the possible health effects on exposed individuals to be determined. Transparent mechanisms should be used by the proponent when responding to issues raised by stakeholders in order to ensure that they are adequately addressed according to their significance. The health risks to the community should be addressed on a cumulative and incremental basis.	In view of the significant quantity of atmospheric emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that atmospheric emissions is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Atmospheric emissions (Continued)	The Bluewaters Power Station will emit the following estimated quantities of atmospheric emissions: • Nitrogen oxides (NO_X) - 3,050tpa; • Sulphur oxides (SO_X) - 7,470tpa; • Flue dust - 227tpa; • Carbon monoxide (CO) - 2,350tpa; • Fluorides - 17tpa; • Volatile organic compounds (VOCs) - 32kg/yr; • Polycyclic aromatic hydrocarbons (PAHs) - 6.0kg/yr; • Persistent organic pollutants (POPs), including dioxins and furans - less than 0.5g/yr; • Mercury - 31kg/yr; • Arsenic - 6.7kg/yr; • Cadmium - 8.5kg/yr; • Chromium compounds - 1.5kg/yr; and • Lead compounds - 31kg/yr.	**Department of Health (Continued)** There is no analysis of well being versus absence of disease in the PER. The Australian Framework for Health Risk Assessment should have been used to determine community health risk from the proposal. A health risk assessment is an integral part of a health impact assessment, and a health risk assessment was not presented in the PER document. A health risk assessment should be an essential requirement for this type of assessment, and the proponent should be required to undertake one for this proposal. Modelling of relevant pollutants should be undertaken using averaging periods which are consistent with the expected health effects from those substances. The modelling presented in the PER document suggests that emissions from existing sources have the potential to be impacting on the health of exposed individuals, and this implies that the issue surrounding power production in the area needs to be considered in a holistic fashion that may require a change from existing to newer less polluting technology. The outcomes derived from the consultation process were not attributed to the identified substances except in broad terms, and the consultation process that was undertaken appears to have added little value to the overall assessment other than to provide an opportunity for stakeholders to comment. The demographic information provided about the community identified a significant aboriginal population in the region. However, there was no obvious representation of this group on the stakeholders consultation group. The report indicated that the model is comparable with actual data recorded by the Collie Air Quality Monitoring Network. Evidence is required to demonstrate that the comparisons are appropriate for all contaminants that have been modelled. Justification is required on the reasons for modelling some pollutants and not others, as well as the use of the National Pollutant Inventory data over measured levels. Details are required to explain why the consultants chose to model only SO_2, CO, mercury, PAHs, fluoride, NO_2, ozone, and PM_{10}, and what the risks of these pollutants are in relation health guideline levels. Relevant calculations should be included in the report to show that the addition of the proposed power station is of negligible risk to the population of Collie and surrounding areas.	In view of the significant quantity of atmospheric emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that atmospheric emissions is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Atmospheric emissions (Continued)	The Bluewaters Power Station will emit the following estimated quantities of atmospheric emissions: • Nitrogen oxides (NO_X) - 3,050tpa; • Sulphur oxides (SO_X) - 7,470tpa; • Flue dust - 227tpa; • Carbon monoxide (CO) - 2,350tpa; • Fluorides - 17tpa; • Volatile organic compounds (VOCs) - 32kg/yr; • Polycyclic aromatic hydrocarbons (PAHs) - 6.0kg/yr; • Persistent organic pollutants (POPs), including dioxins and furans - less than 0.5g/yr; • Mercury - 31kg/yr; • Arsenic - 6.7kg/yr; • Cadmium - 8.5kg/yr; • Chromium compounds - 1.5kg/yr; and • Lead compounds - 31kg/yr.	**Pollution Action Network** The proponent has not adequately addressed the environmental health impacts of the proposed power station, particularly in relation to air pollutants such as acidic gases, heavy metals, volatile organic compounds, polycyclic aromatic compounds, and particulates, all of which are capable of causing serious human health and ecological impacts. The modelling that has been undertaken indicates that the cumulative impact of the proposed power station and the existing Collie Power Station will lead to exceedances of the National Environmental Protection Measure limits for SO_2 and dust, which is unacceptable. The proponent has not made a convincing case in regard to emissions of volatile organic compounds, reactive organic compounds, and heavy metals which international research indicates are serious problems with power stations burning low grade coal. Additional monitoring and analysis of existing power stations using Collie coal is required. **Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia** Insufficient research has been undertaken in Collie to determine the effect of this particular proposal, and the effect of coal mining and power generation industry in general. The community made it clear that they would like more work to be undertaken in this area and that they are uncertain about the potential impacts of this proposal. Although individual projects may not on their own contribute significantly to health risks, the cumulative impacts of the coal mining and power generation industry must be taken into account in assessing individual projects. **Member of the public** I am concerned about the levels of SO_2, NO_X and particulates that will be emitted from the proposed power station. The proposed emission level of 1,250mg/Nm^3 for SO_2 is six times the limit of 200mg/Nm^3 set by Directive 2001/80/EC of the European Parliament and the Council of the European Union for SO_2 emissions for new large combustion plants burning solid fuel, and thus does not represent best practice. The proponent apparently considers that they are operating in some underdeveloped third world country where the importation and use of superseded substandard equipment is acceptable.	In view of the significant quantity of atmospheric emissions that will be emitted by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that atmospheric emissions is a relevant environmental factor.
Liquid and solid waste disposal	The Bluewaters Power Station will generate 1.2GL/yr of saline wastewater and 175,000tpa of ash during operation. The saline wastewater will be disposed of via the existing Collie Power Station saline wastewater pipeline and ocean outfall system. Ash will be disposed of in the nearby Ewington 1 mine.	**Department of Conservation and Land Management** If the chosen method for flyash disposal is to be supported, additional technical justification is required. The PER does not demonstrate the merits of the chosen method for flyash disposal by comparing the relative risks and benefits with alternative techniques. It is not apparent whether flyash will be disposed of into backfilled pits or out of pit overburden dumps.	In view of the significant quantity of liquid and solid wastes that will be generated by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that liquid and solid waste disposal is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Liquid and solid waste disposal (Continued)	The Bluewaters Power Station will generate 1.2GL/yr of saline wastewater and 175,000tpa of ash during operation. The saline wastewater will be disposed of via the existing Collie Power Station saline wastewater pipeline and ocean outfall system. Ash will be disposed of in the nearby Ewington 1 mine.	**Department of Conservation and Land Management (Continued)** The regulatory framework that would allow the disposal of flyash within the mine lease located within a State forest needs to be determined. CALM should be included as an advisory agency with respect to Commitment 10 in the PER. **Department of Health** The on-site wastewater system for the treatment and disposal of sewage will require the Department's approval, and a concept plan of the system will need to be submitted to the Department for consideration. The volume of wastewater generated by construction workers during the peak construction period needs to be taken into consideration in the design of the proposed system. The ability of the soil and the adequacy of the area for effluent disposal should be demonstrated if disposal by soil absorption is proposed. **Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia** There is no indication of what investigations have been undertaken or planned with respect to developing markets for alternative uses for flyash. **Pollution Action Network** The discharge of contaminated cooling and washing water into the ocean off Australind will raise water pollution issues given that this water will contain elevated levels of residual pollutants such as heavy metals. **Western Power Corporation** Use of the existing saline pipeline does not take into account that future local power generation supply water quality is likely to be significantly different, with attendant impact on pipeline capacity availability. Some type of groundwater/leachate monitoring would be required in order to gauge the effect of disposing of flyash by mixing it with overburden and returning it to the Ewington mine. Since the use of the Collie Power Station wastewater pipeline has not been confirmed, the proponent should consider alternative methods of disposal more fully. Further detailed discussion is required in relation to the on-site evaporation pond referred to in the PER document given that it could have a significant impact on the environment.	In view of the significant quantity of liquid and solid wastes that will be generated by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that liquid and solid waste disposal is a relevant environmental factor.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
POLLUTION			
Liquid and solid waste disposal (Continued)	The Bluewaters Power Station will generate 1.2GL/yr of saline wastewater and 175,000tpa of ash during operation. The saline wastewater will be disposed of via the existing Collie Power Station saline wastewater pipeline and ocean outfall system. Ash will be disposed of in the nearby Ewington 1 mine.	**Western Power Corporation (Continued)** It is stated that the existing Collie Power Station saline water pipeline will be used for saline water disposal. In the absence of confirmation of this means of disposal, alternatives for saline water disposal should be addressed in more detail. **EPA Service Unit** Additional detailed information is required in regard to marine environmental impact especially with respect to dilution factors, background water quality, cumulative discharge concentrations, flowrate, dilution zones, toxicant concentrations, and comparisons with Guidelines.	In view of the significant quantity of liquid and solid wastes that will be generated by the proposed power station and the nature of the concerns raised in the comments that were received, the EPA considers that liquid and solid waste disposal is a relevant environmental factor.
Surface water and groundwater	The Bluewaters Power Station will require about 3.25GL/yr of water which will be sourced from mine dewatering activities at Ewington 1 mine.	**Department of Planning and Infrastructure** It would be sensible for the plant design to allow for the use of saline water for cooling purposes. **Western Power Corporation** In Section 4.6 of the PER a wet cooling tower is specified. To what extent have other technologies such as air cooled condensers been explored?	In view of the significant quantity of groundwater that will be required by the proposed power station, and the potential for stored fuel and hazardous materials and plant construction and maintenance activities to impact upon surface water and groundwater quality, the EPA considers that surface water and groundwater is a relevant environmental factor.
Noise	Construction and operation of the Bluewaters Power Station has the potential to affect existing noise levels.	**Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia** The acoustic assessment provided in the PER has been undertaken for a power station of 150MW only, whereas Bluewaters is 200MW. **Western Power Corporation** The noise modelling that was undertaken deals mainly with compliance at the nearest noise sensitive premises in Collie, and does not address other requirements of the *Environmental Protection (Noise) Regulations, 1997*. It is not clear from the PER document whether the proposed power station complies with the requirement to meet 60dB(A) at all undeveloped noise sensitive premises such as the nearest non-mining land, or whether cumulative noise impacts were taken into account in the modelling.	The proponent has made a commitment to install appropriate noise abatement technology to ensure that the proposed power station meets relevant noise criteria. However, given the nature of the concerns raised in the comments that were received, the EPA considers that noise is a relevant environmental factor.
SOCIAL SURROUNDINGS			
Risk and hazards	Operation of the Bluewaters Power Station will not lead to any significant increase in risk levels. Hazardous materials will be stored and handled according to Department of Industry and Resources (DoIR) regulations.	No specific concerns were raised in the submissions that were received.	In view of the very low increase in risk levels due to the operation of the proposed power station, and that hazardous materials will be stored and handled according to DoIR regulations, the EPA considers that this environmental factor does not require further evaluation.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
SOCIAL SURROUNDINGS			
Aboriginal culture and heritage	Construction activities within the project area have the potential to disturb Aboriginal heritage sites. Aboriginal heritage surveys have been undertaken and the results indicate that it is unlikely that any Aboriginal sites are located within the project area.	**Department of Indigenous Affairs and Shire of Collie** The proponent should fully explore indigenous and archaeological issues associated with the development, and will be required to seek approval from the Minister for Indigenous Affairs should any aboriginal sites be discovered during construction.	The EPA considers that the concerns raised have been adequately addressed by the response provided by the proponent. The proponent has made a commitment to submit an application to the Minister for Indigenous Affairs to clear under Section 18 of the *Aboriginal Heritage Act*, 1972 before disturbance, if sites of aboriginal significance are found during construction. This environmental factor does not require further evaluation by the EPA.
European heritage	There are no known European heritage sites located within the project area.	No specific concerns were raised in the submissions that were received.	This environmental factor does not require further evaluation by the EPA.
Visual amenity	The most significant visual impact from the Bluewaters Power Station will be its 100m tall stack. The surrounding land is used for coal mining operations. Collie is located about 4km to the south-west.	No specific concerns were raised in the submissions that were received.	The proponent has made a commitment to minimise potential impacts on visual amenity through planning design and screening strategies (eg. natural barriers), and by developing appropriate vegetation management and landscape strategies. This environmental factor does not require further evaluation by the EPA.
Recreational activities	The Bluewaters Power Station is unlikely to have an impact on recreational activities in the general area.	No specific concerns were raised in the submissions that were received.	The proponent has made a commitment to minimise impacts on recreational activities through planning design and screening strategies (eg. noise bunds and natural barriers), and by ensuring that access to adjoining bush will not be affected. This environmental factor does not require further evaluation by the EPA.

Appendix 4

Recommended Environmental Conditions and Proponent's Consolidated Commitments

Statement No.

RECOMMENDED CONDITIONS AND PROCEDURES

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT, 1986)

BLUEWATERS POWER STATION
SHIRE OF COLLIE

Proposal: The construction and operation of the Bluewaters Power Station, a sub-critical coal fired base load power generating facility with a nominal generating capacity of 200 megawatts on a site located approximately four kilometers north-east of Collie, as documented in schedule 1 of this statement.

Proponent: Griffin Energy Pty Ltd

Proponent Address: 15th Floor, 28 The Esplanade, PERTH WA 6000

Assessment Number: 1487

Report of the Environmental Protection Authority: Bulletin 1160

The proposal referred to above may be implemented by the proponent subject to the following conditions and procedures:

1 Implementation

1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions of this statement.

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement, to the

requirements of the Minister for the Environment on the advice of the Environmental Protection Authority.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act, 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-year period referred to in condition 4-1.

The application shall demonstrate that:

1. the environmental factors of the proposal have not changed significantly;

2. new, significant, environmental issues have not arisen; and

3. all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

1. the status of implementation of the proposal as defined in schedule 1 of this statement;

2. evidence of compliance with the conditions and commitments; and

3. the performance of the environmental management plans and programs.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act, 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

5-2 The proponent shall submit a performance review report every five years after the start of operations, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, which addresses:

1. the major environmental issues associated with the project; the targets for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those targets;

2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;

3. significant improvements gained in environmental management, including the use of external peer reviews;

4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and

5. the proposed environmental targets over the next five years, including improvements in technology and management processes.

5-3 The proponent may submit a report prepared by an auditor approved by the Department of Environment under the "Compliance Auditor Accreditation Scheme" to the Chief Executive Office of the Department of Environment on each condition/commitment of this statement which requires the preparation of a management plan, programme, strategy or system, stating whether the requirements of each condition/commitment have been fulfilled within the timeframe stated within each condition/commitment.

6 Greenhouse Gas Emissions

6-1 Prior to commencement of construction of the power station, the proponent shall prepare a Greenhouse Gas Emissions Management Plan to:

- ensure that through the use of best practice, the total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product from the project are minimised; and

- manage "greenhouse gas" emissions in accordance with the *Framework Convention on Climate Change 1992*, and consistent with the National Greenhouse Strategy;

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1 calculation of the "greenhouse gas" emissions associated with the proposal, as advised by the Environmental Protection Authority;

Note: The current requirements of the Environmental Protection Authority are set out in: *Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors, No. 12* published by the Environmental Protection Authority (October 2002). This document may be updated or replaced from time to time.

2 specific measures to minimise the total net "greenhouse gas" emissions and/or the "greenhouse gas" emissions per unit of product associated with the proposal using a combination of "no regrets" and "beyond no regrets" measures;

3 estimation of the "greenhouse gas" efficiency of the project (per unit of product and/or other agreed performance indicators) and comparison with the efficiencies of other comparable projects producing a similar product, both within Australia and overseas;

4 actions for the monitoring and annual reporting of "greenhouse gas" emissions and emission reduction strategies;

5 a target set by the proponent for the reduction of total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product and as a percentage of total emissions over time, and annual reporting of progress made in achieving this target. Consideration should be given to the use of renewable energy sources such as solar, wind or hydro power;

6 consideration by the proponent of entry (whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate) into the Commonwealth Government's "Greenhouse Challenge" voluntary cooperative agreement program. Components of the agreement program include:

i. an inventory of emissions;
ii. opportunities for abating "greenhouse gas" emissions in the organisation;
iii. a "greenhouse gas" mitigation action plan;
iv. regular monitoring and reporting of performance; and
v. independent performance verification.

Note: In (2) above, the following definitions apply:

1. "no regrets" measures are those which can be implemented by a proponent and which are effectively cost-neutral.
2. "beyond no regrets" measures are those which can be implemented by a proponent and which involve additional costs that are not expected to be recovered.

6-2 The proponent shall implement the Greenhouse Gas Emissions Management Plan required by condition 6-1, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

6-3 Prior to construction, the proponent shall make the Greenhouse Gas Emissions Management Plan required by condition 6-1 publicly available, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

7 Stack Emissions

7-1 Prior to construction of the power station, the proponent shall prepare a Stack Emissions Management Plan, to:

- Ensure that best available practicable and efficient technologies are used to minimise total air emissions from the power station;

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall address:

1 specific measures to minimise total air emissions from the power station to meet emission limits consistent with best practicable technology and current industry standards;

2 monitoring of air emissions; and

3 public reporting of air emissions and any complaints about air emissions.

7-2 The proponent shall implement the Stack Emissions Management Plan required by condition 7-1, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

7-3 The proponent shall make the Stack Emissions Management Plan, required by condition 7-1 publicly available, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

8 Decommissioning Plans

8-1 Prior to commencement of construction, the proponent shall prepare a Preliminary Decommissioning Plan, which provides the framework to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Preliminary Decommissioning Plan shall address:

1 the rationale for the siting and design of plant and infrastructure as relevant to environmental protection, and conceptual plans for the removal or, if appropriate, retention of plant and infrastructure;

2 the long-term management of ground and surface water systems affected by the power station, coal stockpiles, waste disposal areas and associated infrastructure;

3 a conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders;

4 a conceptual plan for a care and maintenance phase; and

5 management of potentially polluting materials to avoid the creation of contaminated areas.

8-2 At least 12 months prior to the anticipated date of decommissioning, or at a time agreed with the Environmental Protection Authority, the proponent shall prepare a Final Decommissioning Plan designed to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Final Decommissioning Plan shall address:

1 the removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;

2 the long-term management of ground and surface water systems affected by the power station, coal stockpiles, waste disposal areas and associated infrastructure;

3 rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and

4 identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

8-3 The proponent shall implement the Final Decommissioning Plan required by condition 8-2 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent’s decommissioning responsibilities have been fulfilled.

8-4 The proponent shall make the Final Decommissioning Plan required by condition 8-2 publicly available, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

Procedures

1 Where a condition states “to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority”, the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.

2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3 Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment.

Notes

1 The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

2 The proponent is required to apply for a Works Approval and Licence and Registration for this project under the provisions of Part V of the *Environmental Protection Act, 1986.*

3 Within this statement, to “have in place” means to “prepare, implement and maintain for the duration of the proposal”.

Schedule 1

Bluewaters Power Station (Assessment No. 1487)

Griffin Energy Pty Ltd, proposes to construct and operate the Bluewaters Power Station on a site located approximately 4km north-east of Collie (Figure 1). It will be a subcritical coal fired base-load generation facility with a nominal generating capacity of up to 200MW. The Bluewaters Power Station will supply electricity to customers in the proposed Coolangatta Industrial Estate, or via the South West Interconnected System (SWIS).

The proposed Bluewaters Power Station will comprise the following components:

- boiler and turbine power block;
- mechanical draft cooling tower;
- flue gas cleaning equipment;
- a 100m stack;
- ash and dust disposal plant;
- water treatment plant;
- generator transformer switchyard;
- 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; and
- saline wastewater discharge via the existing Collie Power Station ocean outfall.

The plant layout of the Bluewaters Power station is shown in Figure 2 below. A diagram which illustrates the input and output flows for the Bluewaters Power Station is shown in Figure 3 below. The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in section 4 of the PER document (Griffin Energy Pty Ltd 2004).

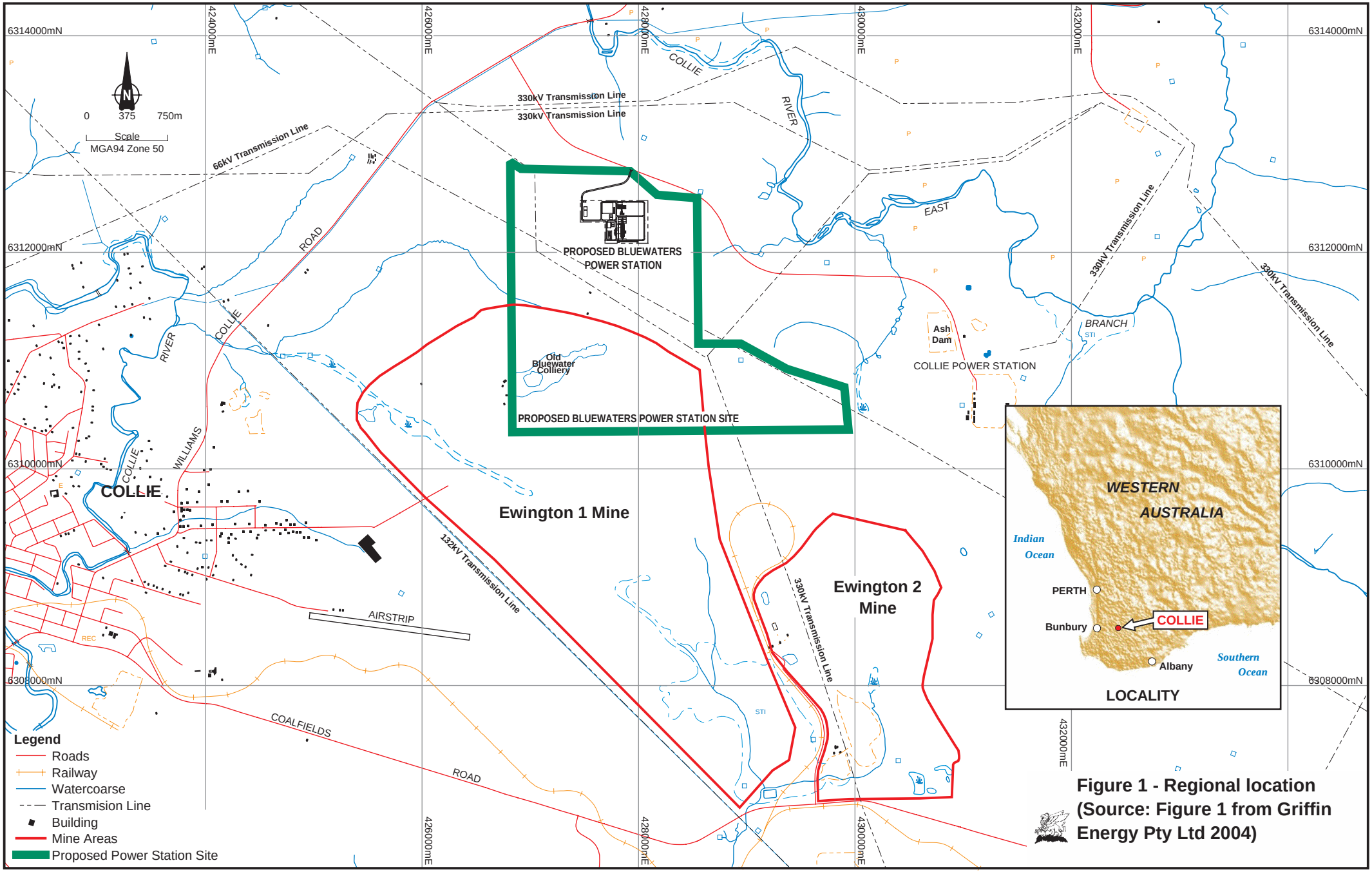

Figure 1 - Regional location (Source: Figure 1 from Griffin Energy Pty Ltd 2004)

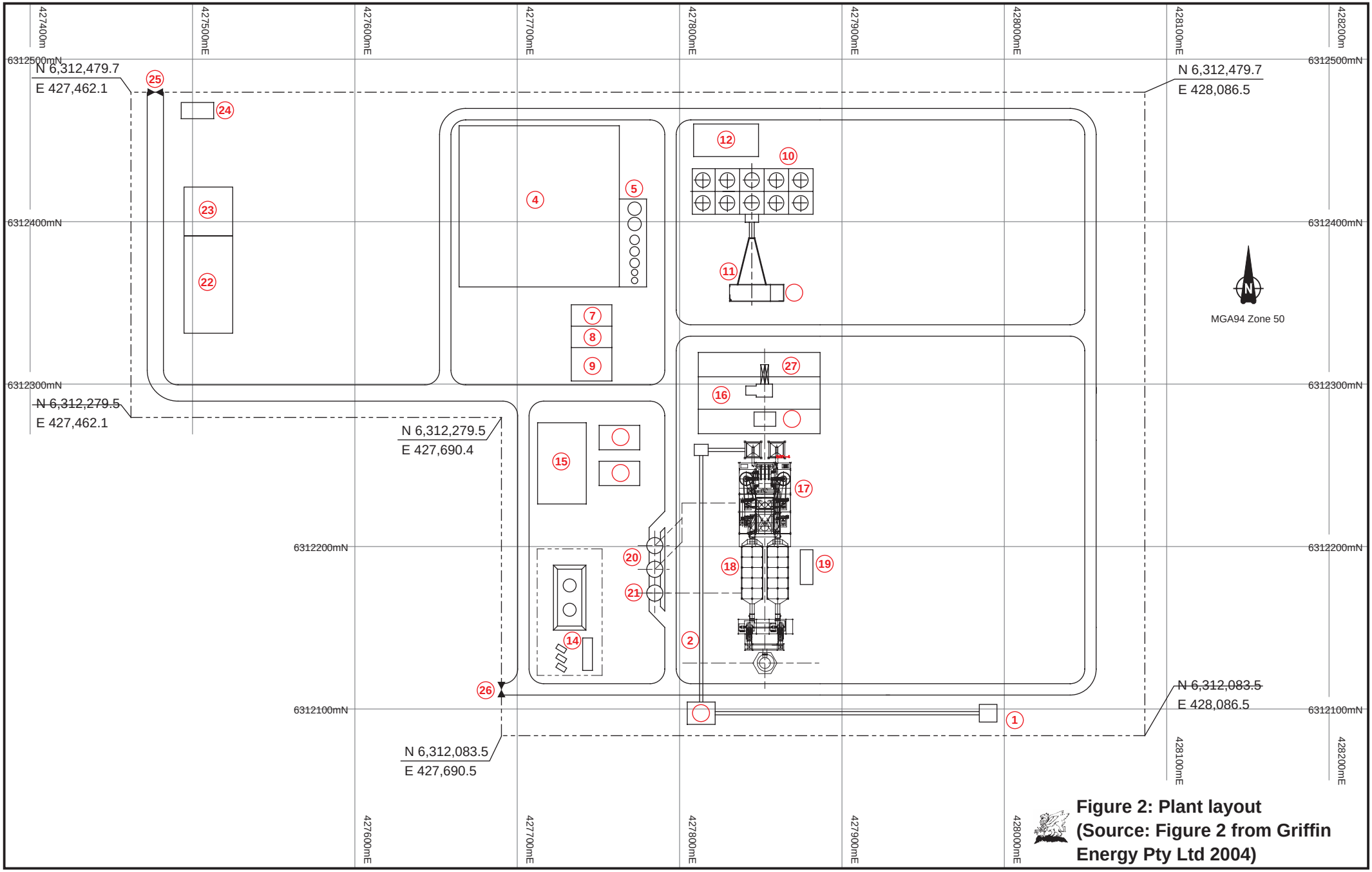

Figure 2: Plant layout (Source: Figure 2 from Griffin Energy Pty Ltd 2004)

Table 1: Summary of 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 200MW_e nominal, 202.3MW 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:	350m x 150m area
• Maximum Total Area:	15 hectares
Plant Facilities	
• Stacks:	1
• Height of Stack:	100m
• Diameter of Stack:	4.13m
• 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 – 200MW_e
• Wastewater collection:	Package treatment plant
Utilities	
• Water Supply:	3.25GL/yr sourced from mine dewatering at Ewington 1
• Coal Supply:	0.7Mtpa via conveyor owned and operated by Griffin Coal Mining Company
• Transmission Line Length:	100m up to 3km depending on interconnection point as required by Western Power
Emissions	
• Noise:	Less than 60dB(A) at 150m from the plant. Less than 29dB(A) at nearest residence in Collie
• Flue Dust:	47mg/Nm^3 at 7% O_2 dry basis; 9g/s; 227tpa
• Nitrogen Oxides:	606mg/Nm^3 at 7% O_2 dry basis; 121g/s; 3050tpa
• Sulphur Oxides:	1490mg/Nm^3 at 7% O_2 dry basis; 296g/s; 7470tpa
• Greenhouse Gases:	1,300,000tpa CO_2 e
• Carbon Monoxide:	500mg/Nm^3 at 7% O_2 dry basis; 93g/s; 2350tpa
• Volatile Organic Compounds:	32kg/yr
• PAHs:	6.0kg/yr
• Arsenic:	6.7kg/yr
• Cadmium:	8.5kg/yr
• Chromium compounds:	1.5kg/yr
• Lead compounds:	31kg/yr
• Mercury:	31kg/yr
• Fluorides:	17,000kg/yr (instantaneous rate estimated to be less than 590mg/s)
• POPs inc. Dioxins and Furans:	Less than 0.5 grams per year
Waste	
• Ash:	175,000tpa disposed to the adjacent mine (Ewington 1)
• Septage:	Packaged treatment plant
• Saline Water:	1.2GL/yr
Workforce	
• Construction:	Approximately 150 personnel at the peak of construction
• Operations:	Up to 30 full time operations and maintenance personnel

Abbreviations

CO_2 e	carbon dioxide equivalents	mg/s	milligrams per second
dB(A)	decibels A weighted	Mtpa	million tonnes per annum
g/s	grams per second	MW	megawatts
GL/yr	gigalitres per year	MW_e	megawatts sent out
HHV	higher heating value	O_2	oxygen
inc.	including	pa	per annum
kg	kilograms	PAHs	polycyclic aromatic hydrocarbons
kg/yr	kilograms per year	POPs	persistent organic pollutants
LHV	lower heating value	SWIS	South West Interconnected System
m	metres	tpa	tonnes per annum
mg/Nm^3	milligrams per standard cubic metre	%	percent

Source: Modified version of Table 2 from Griffin Energy Pty Ltd 2004

Schedule 2

Proponent's Environmental Management Commitments

November 2004

BLUEWATERS POWER STATION

(Assessment No. 1487)

Griffin Energy Pty Ltd

Proponent's Environmental Management Commitments - December 2004

BLUEWATERS POWER STATION (Assessment No. 1487)

Note: The term "commitment" as used in this schedule includes the entire row of the table and its six separate parts as follows:

- a commitment number;
- a commitment topic;
- the objective of the commitment;
- the 'action' to be undertaken by the proponent;
- the timing requirements of the commitment; and
- the body/agency to provide technical advice to the Department of Environmental Protection.

Bluewaters Power Station - 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: 1.1 Develop and implement a construction phase EMP. 1.2 Develop and implement an operational phase EMP.	Prior to construction and ongoing. Prior to construction. Prior to commissioning and ongoing.	Various stakeholders as indicated below. Various stakeholders as indicated below. Various stakeholders as indicated below.

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
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. 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.	2.1 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. 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. Prior to construction.	CALM. 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.
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. 4.2 The plant will be designed to ensure that contaminants are not released to the environment. 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. 4.4 Develop and implement construction phase surface water management plan as part of construction phase EMP. 4.5 Develop and implement operational phase surface water management plan as part of operational phase EMP. 4.6 Document the existing surface water quality in the project area.	Prior to construction. Prior to commissioning and ongoing. Prior to construction. Prior to construction. Prior to commissioning Prior to construction.	DoE – Water & Rivers Commission. DoE – Water & Rivers Commission. DoE – Water & Rivers Commission. DoE – Water & Rivers Commission. DoE – Water & Rivers Commission. DoE – Water & Rivers Commission.

Commitment Number	Environmental Factor	Management Objective	Action	Timing	Advice From
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 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.
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 license conditions prior to introduction into line.	Prior to commissioning and ongoing.	DoE South West Region Office and operator of Collie A discharge 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.	Prior to commissioning	DoE South West Region Office and operator of Collie A discharge line.
			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	DoE South West Region Office and operator of Collie A discharge line.

Commitment Number	Environmental Factor	Management Objective	Action		Timing	Advice From
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.	Prior to construction.	DoE – Land and Water Quality Branch.
			8.2	The plant will be designed to ensure spillages of chemicals or hydrocarbons are contained and collected.	Prior to commissioning and ongoing.	DoE – Land and Water Quality Branch.
			8.3	During operation of the plant, all potentially contaminating or hazardous materials will be stored in accordance with relevant legislation and regulations	Ongoing	DoE, DoIR
			8.4	Develop and implement construction phase contamination management (spills) plan as part of construction phase EMP.	Prior to construction.	DoE
			8.5	Develop and implement operational phase contamination management (spills) plan as part of operational phase EMP.	Prior to commissioning	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	Develop and implement a flyash management plan as part of the operational phase EMP.	Prior to commissioning and ongoing	DoE, CALM
			9.6	Cooling water discharge will be directed to Western Power's saline Water Pipeline Develop construction phase waste management plan as part of the construction phase EMP.	Prior to construction and ongoing	DoE
			9.7	Develop and implement construction phase waste management plan	Prior to construction	DoE
			9.8	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 trees 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	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

Bluewaters Power Station - 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.

Appendix 5

Summary of Submissions and
Proponent's Response to Submissions

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

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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.

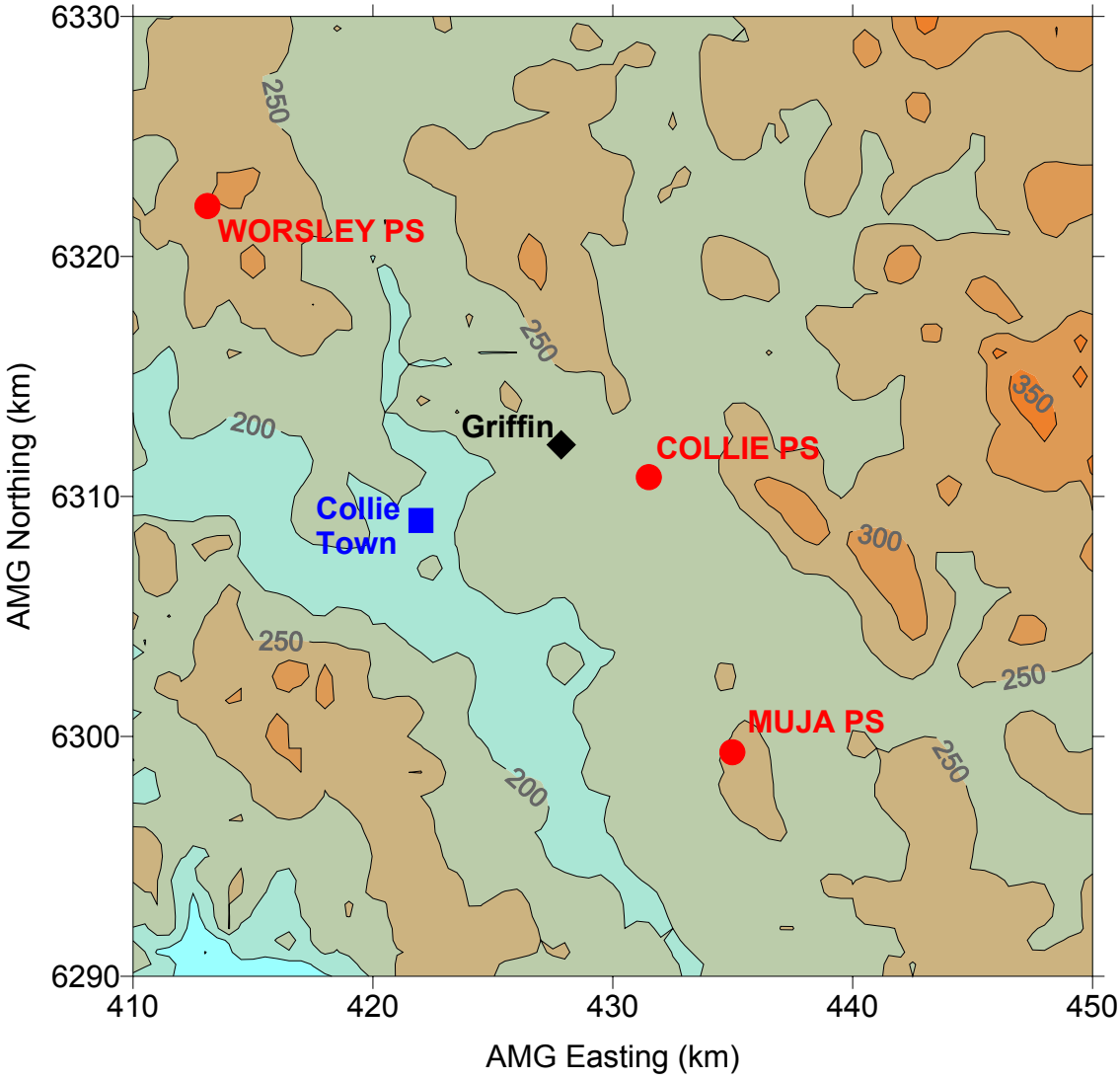

Figure 2.1 Topographic map of the study region showing the location of the Collie, Muja and Worsley power station sources (●), the Collie township (■) and the proposed Griffin Energy site at Bluewaters (♦). Contours indicate terrain height above sea level (m).

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 ($33^{o}23'$ S, $116^{o}15.5'$ 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.

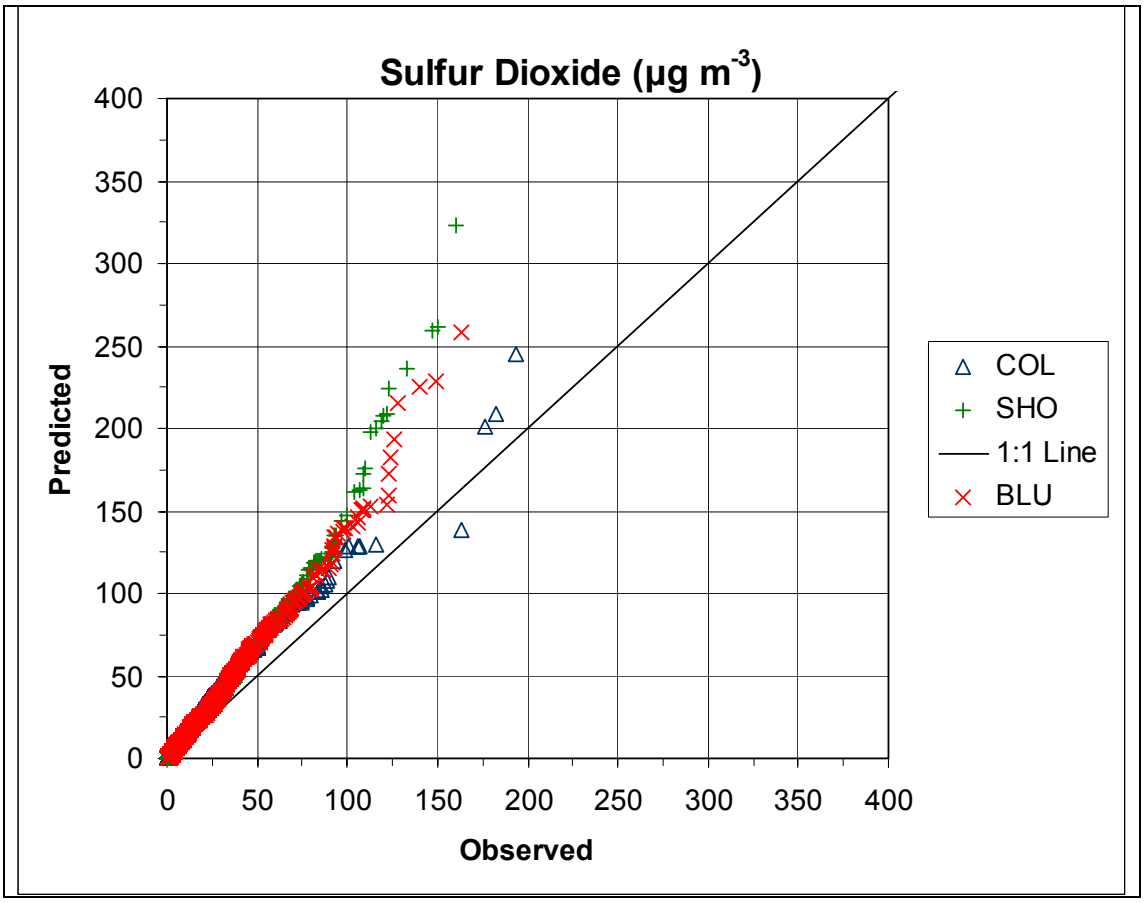

Figure 2.2 Plot of ranked model predictions (TAPM V2.6) against ranked observations of hourly-averaged SO_2 concentrations for 2001 at three monitoring sites, Collie (Δ), Shotts (+) and Bluewaters (×).

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
9th-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
9th-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 9th-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 ($\mu g/m^3$)	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 ($\mu g\ m^{-3}$) 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 $\mu g\ m^{-3}$ 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 $\mu g\ m^{-3}$ for each scenario.

The highest regional concentration of 106 $\mu g\ m^{-3}$ easily exceeds the NEPM standard for a 24-hour average of 50 $\mu g\ m^{-3}$ 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} ($\mu g\ m^{-3}$) 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} ($\mu g\ m^{-3}$) 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.

Acknowledgments

CSIRO and Griffin Energy acknowledge permission from Western Power to use hourly-emission files for 2001 for the Muja and Collie power stations. The authors also acknowledge the contribution of Mark Hibberd through his calculation of the short-term concentrations of sulfur dioxide.

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Appendix A Contour plots for TAPM SO_2 concentrations

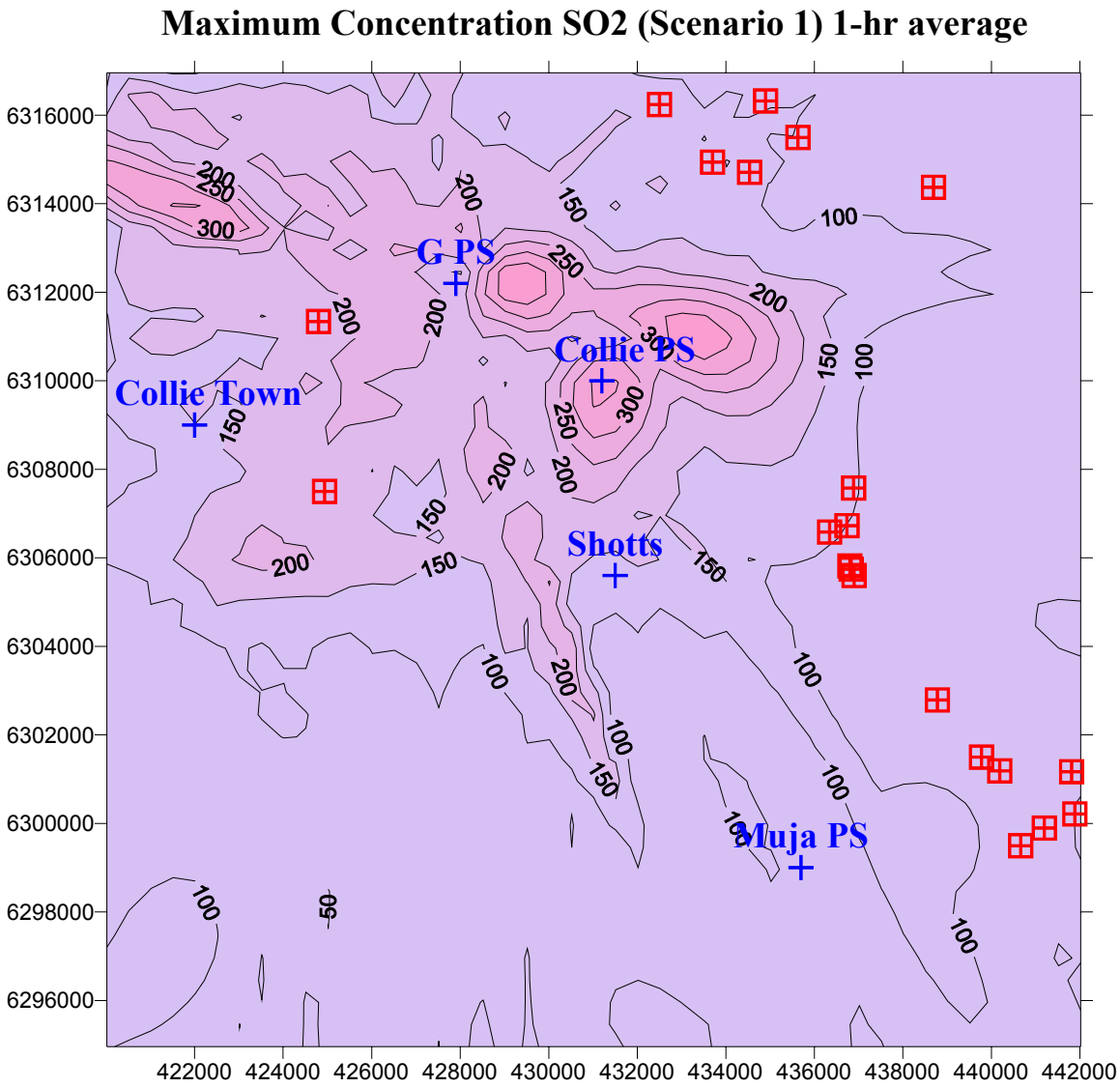

Figure A.1 For Scenario 1 (Bluewaters I), contours of *highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

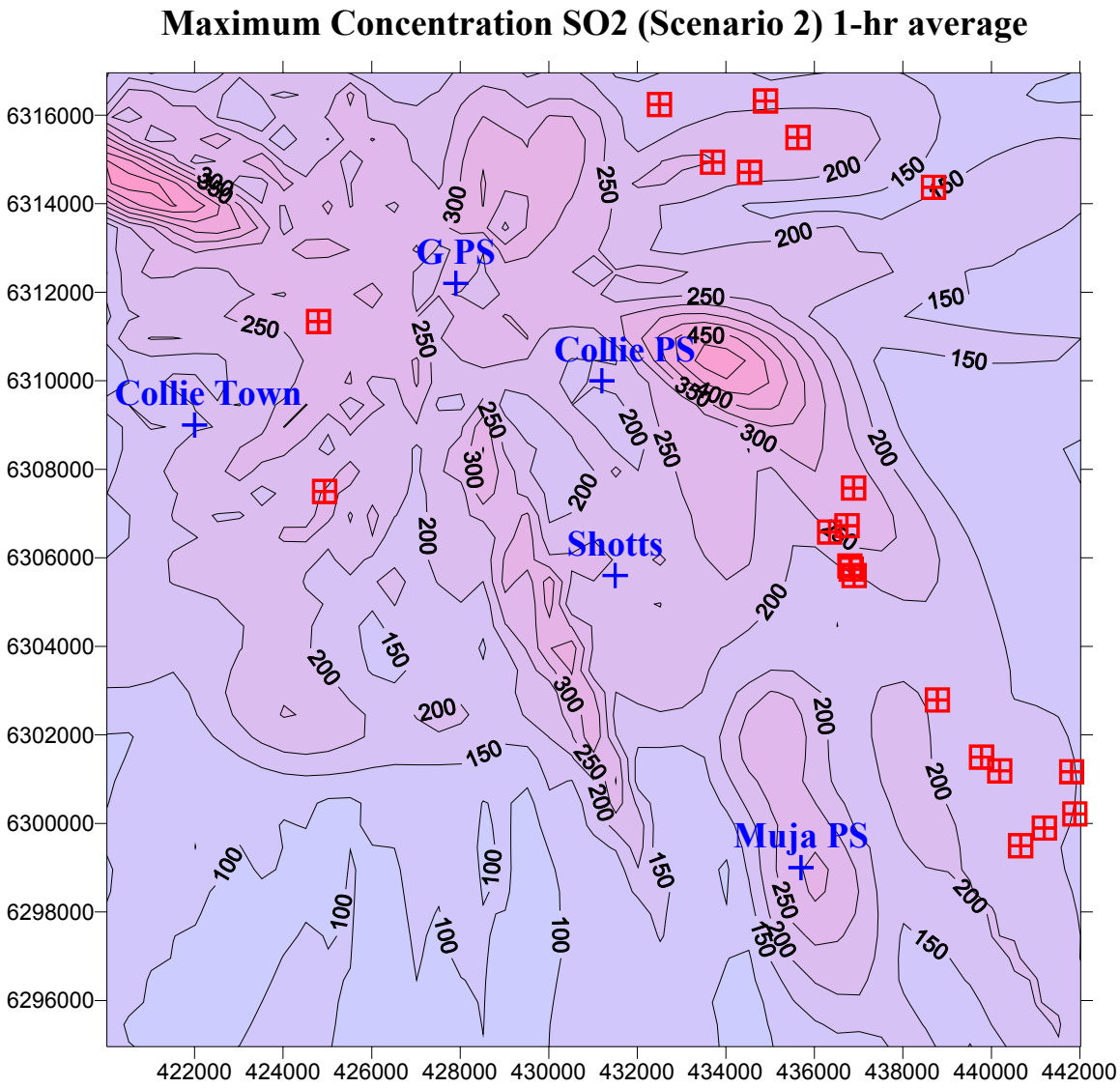

Figure A.2 For Scenario 2 (Bluewaters I + II), contours of *highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

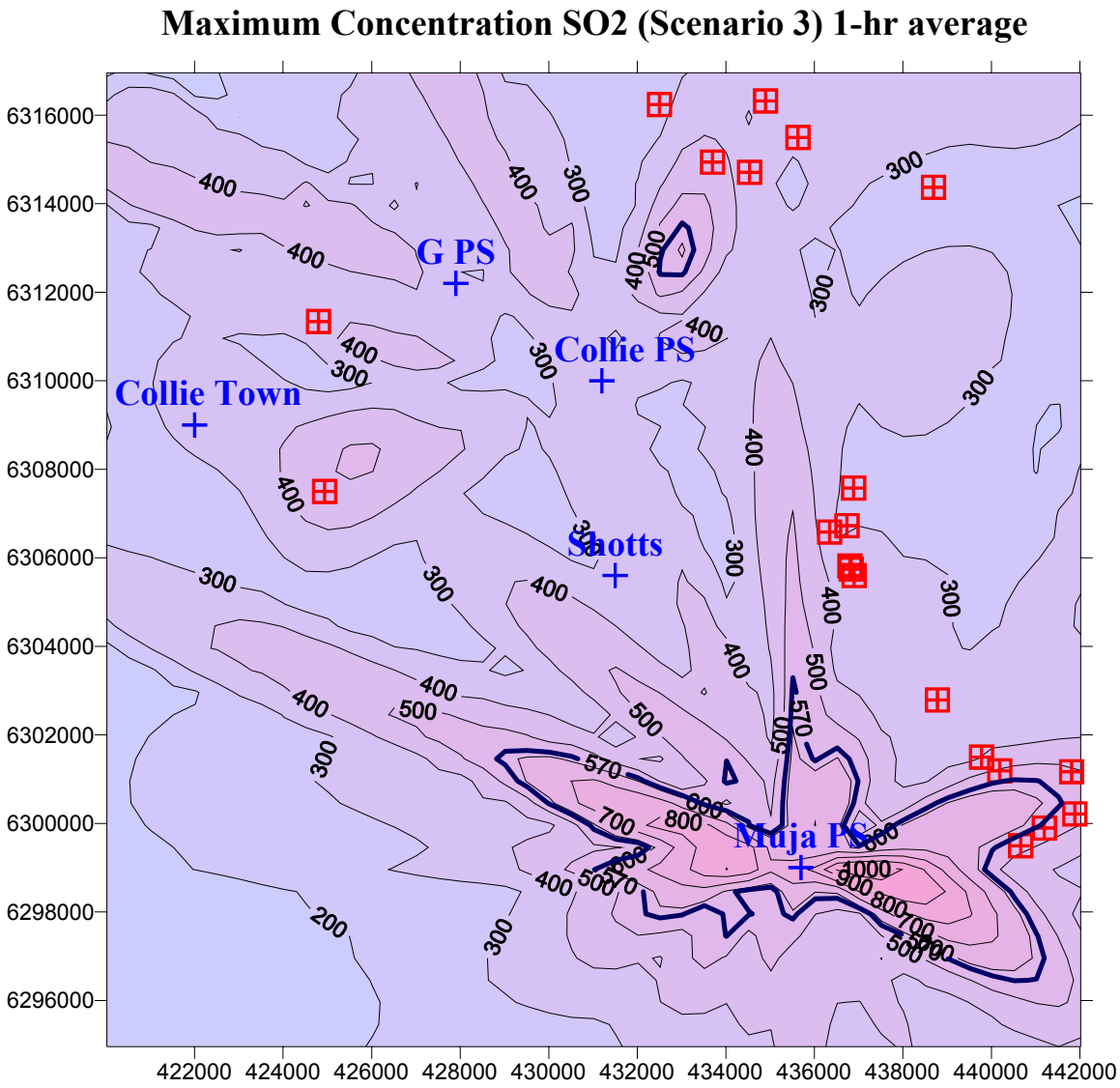

Figure A.3 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

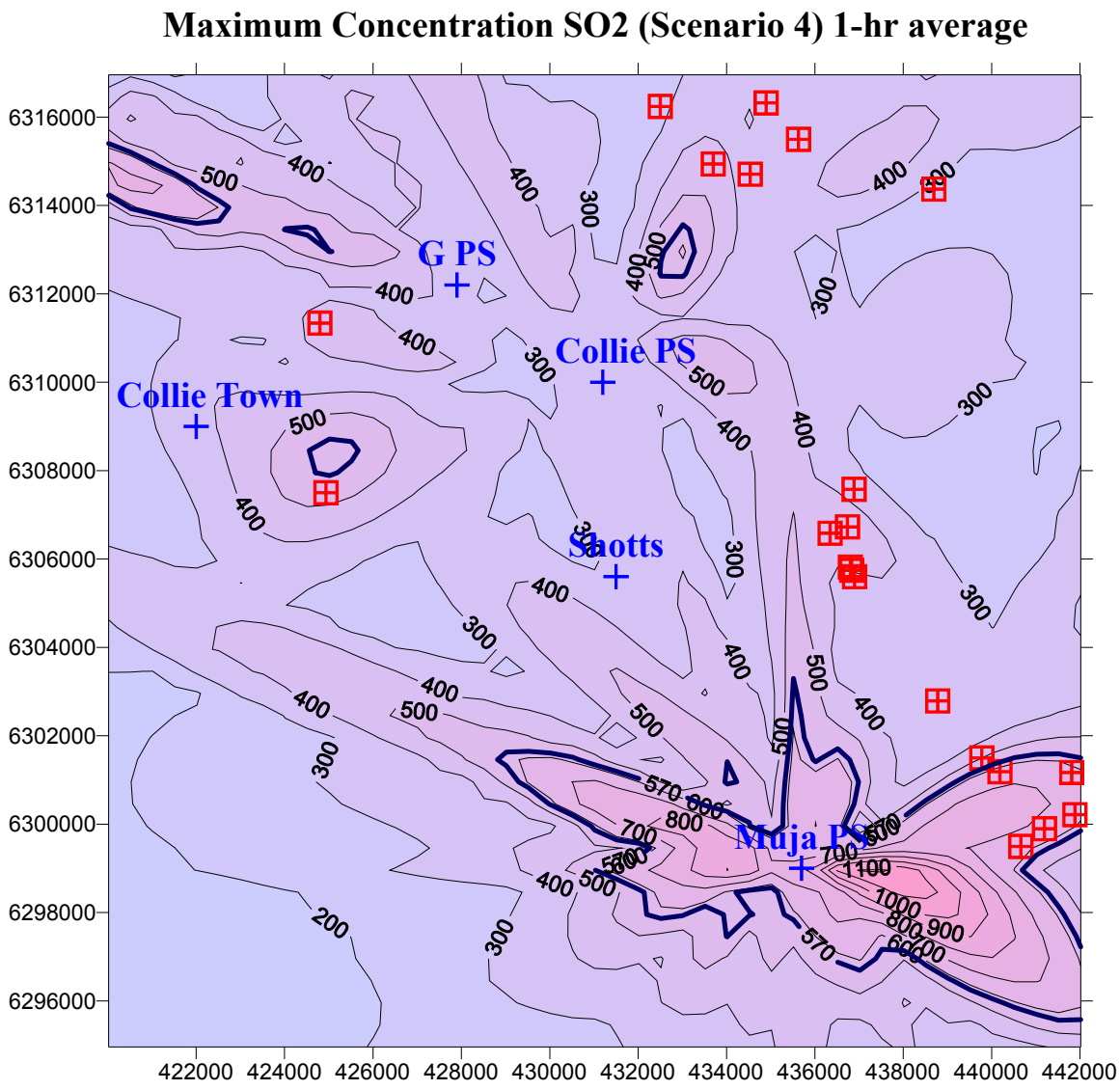

Figure A.4 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

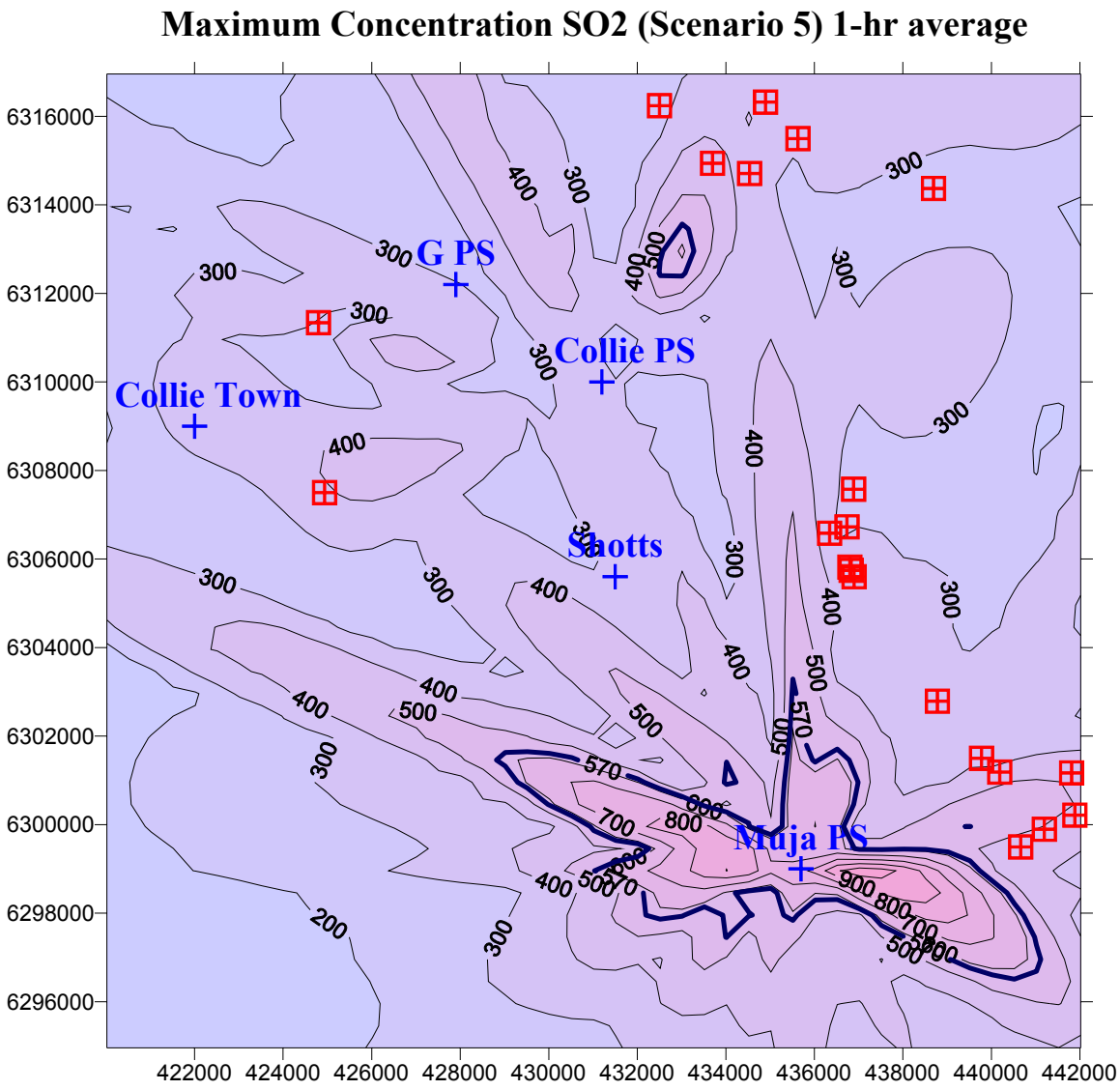

Figure A.5 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

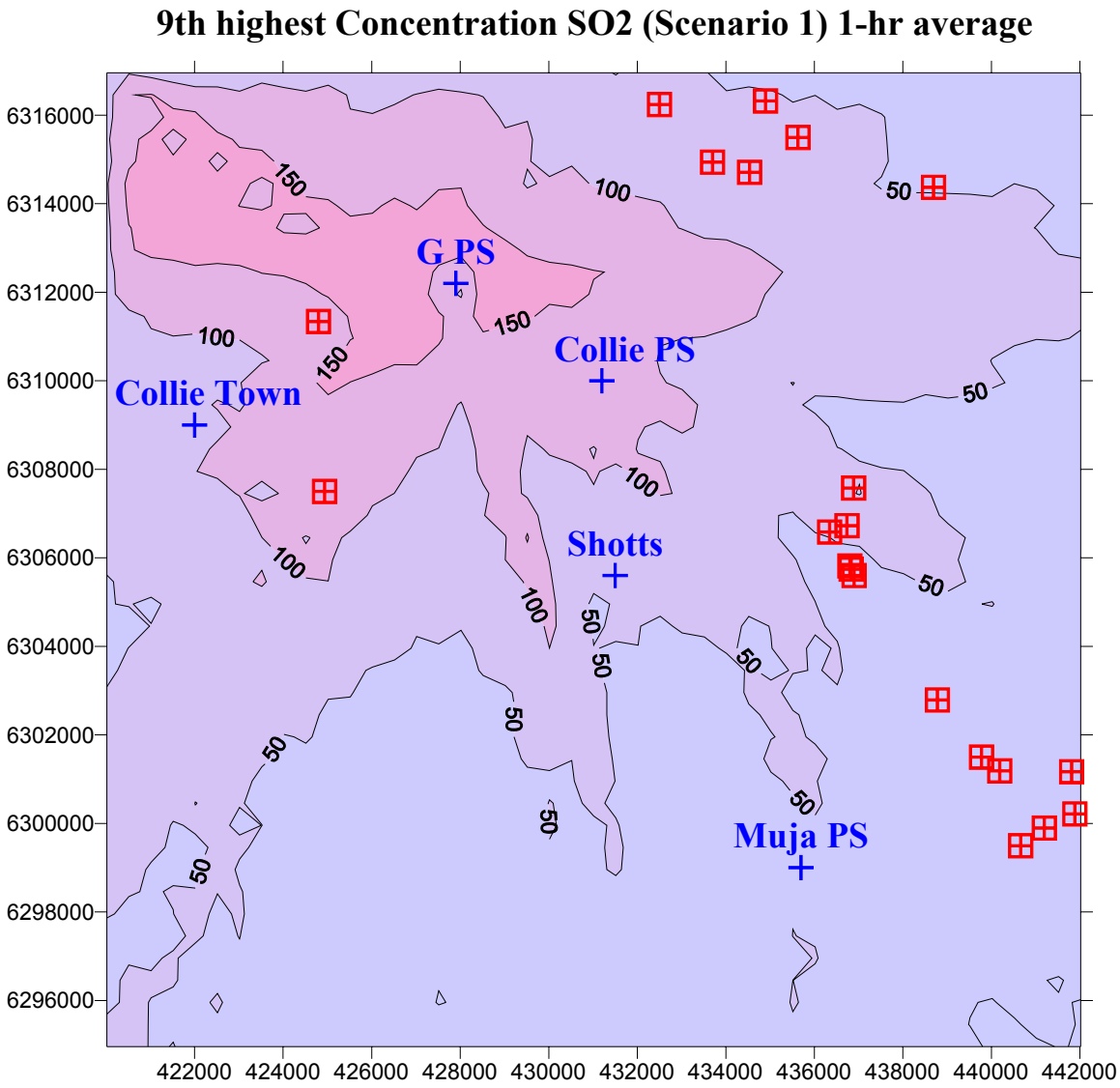

Figure A.6 For Scenario 1 (Bluewaters I), contours of *9th-highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

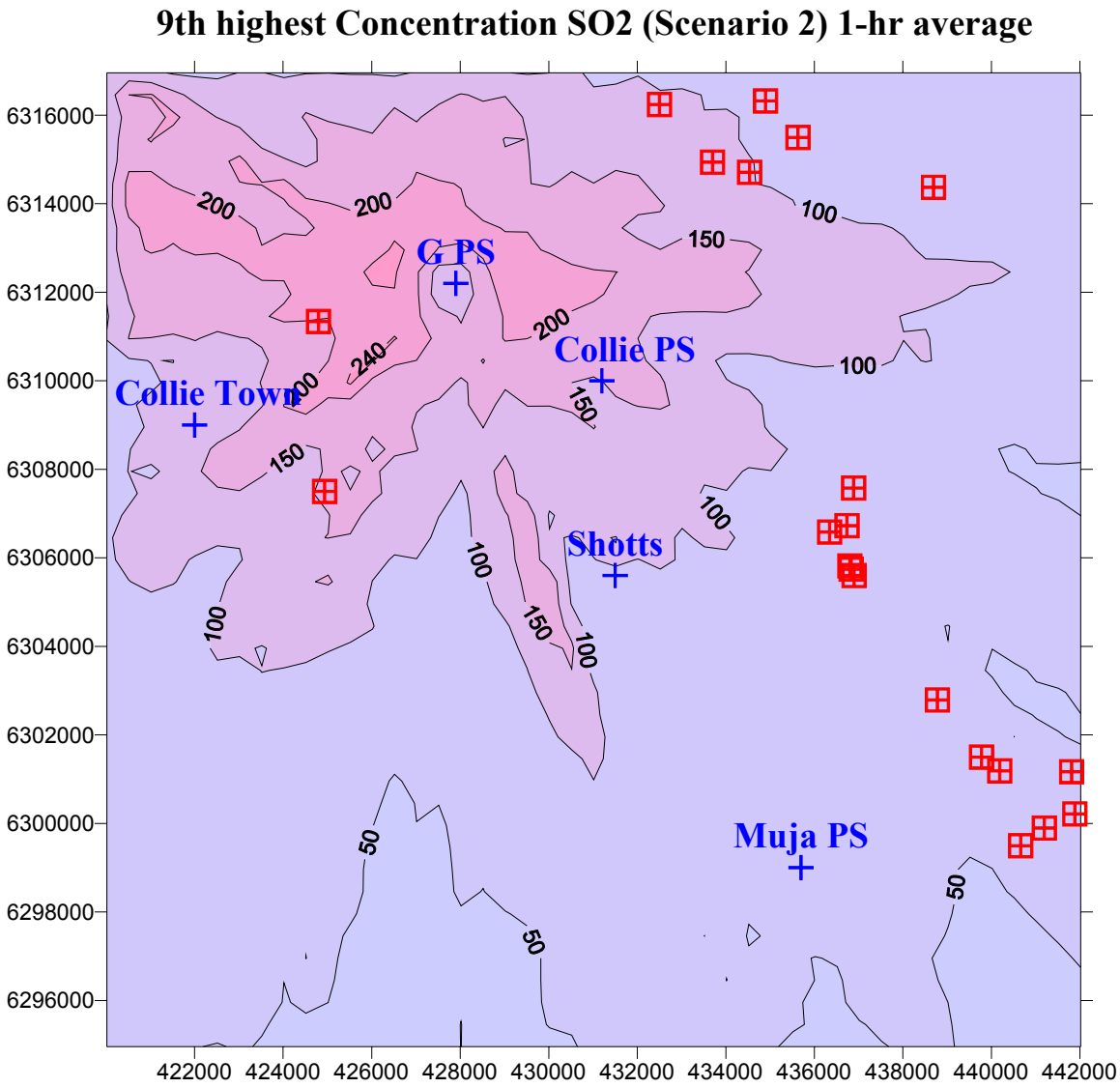

Figure A.7 For Scenario 2 (Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

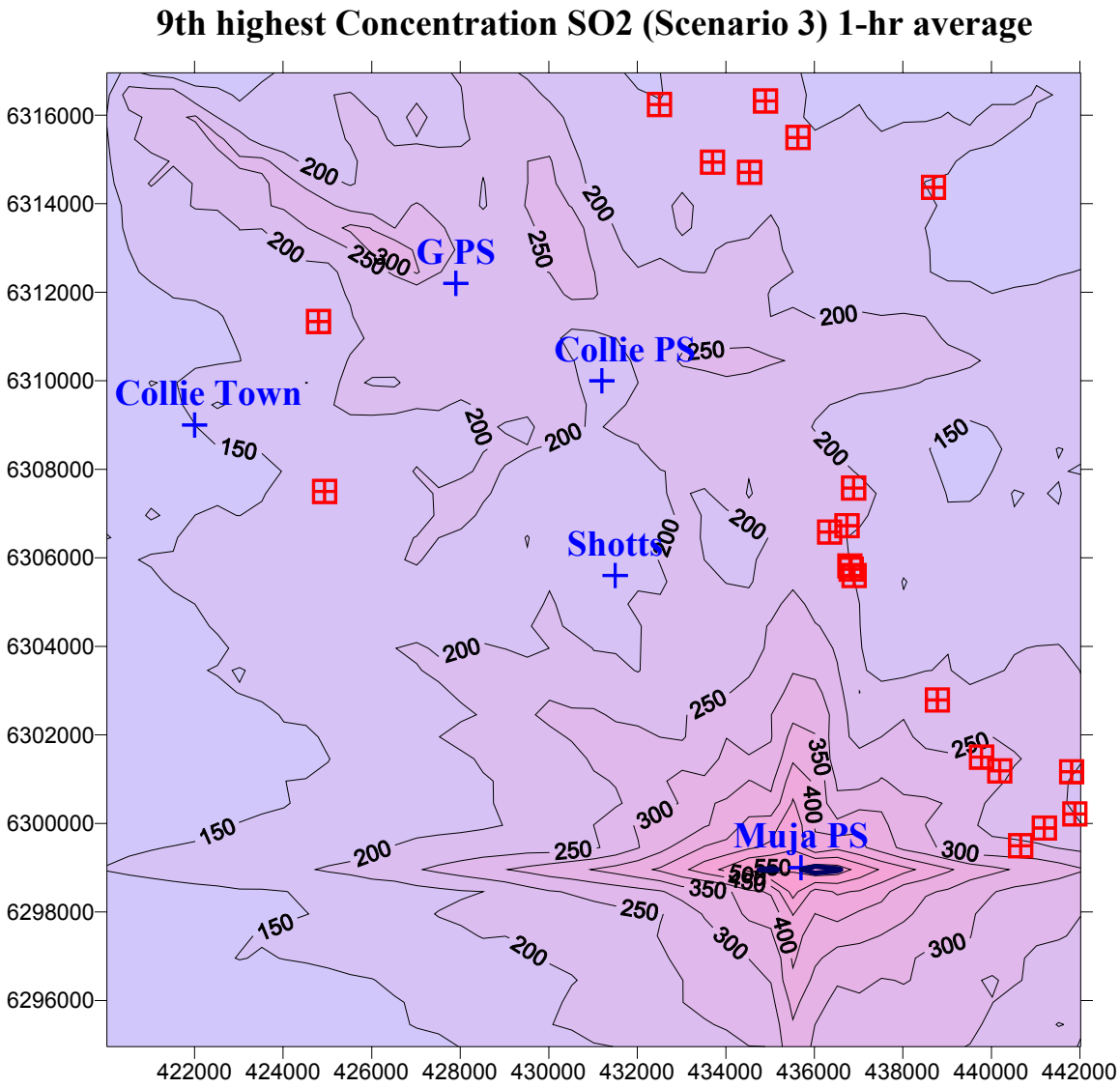

Figure A.8 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th-highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

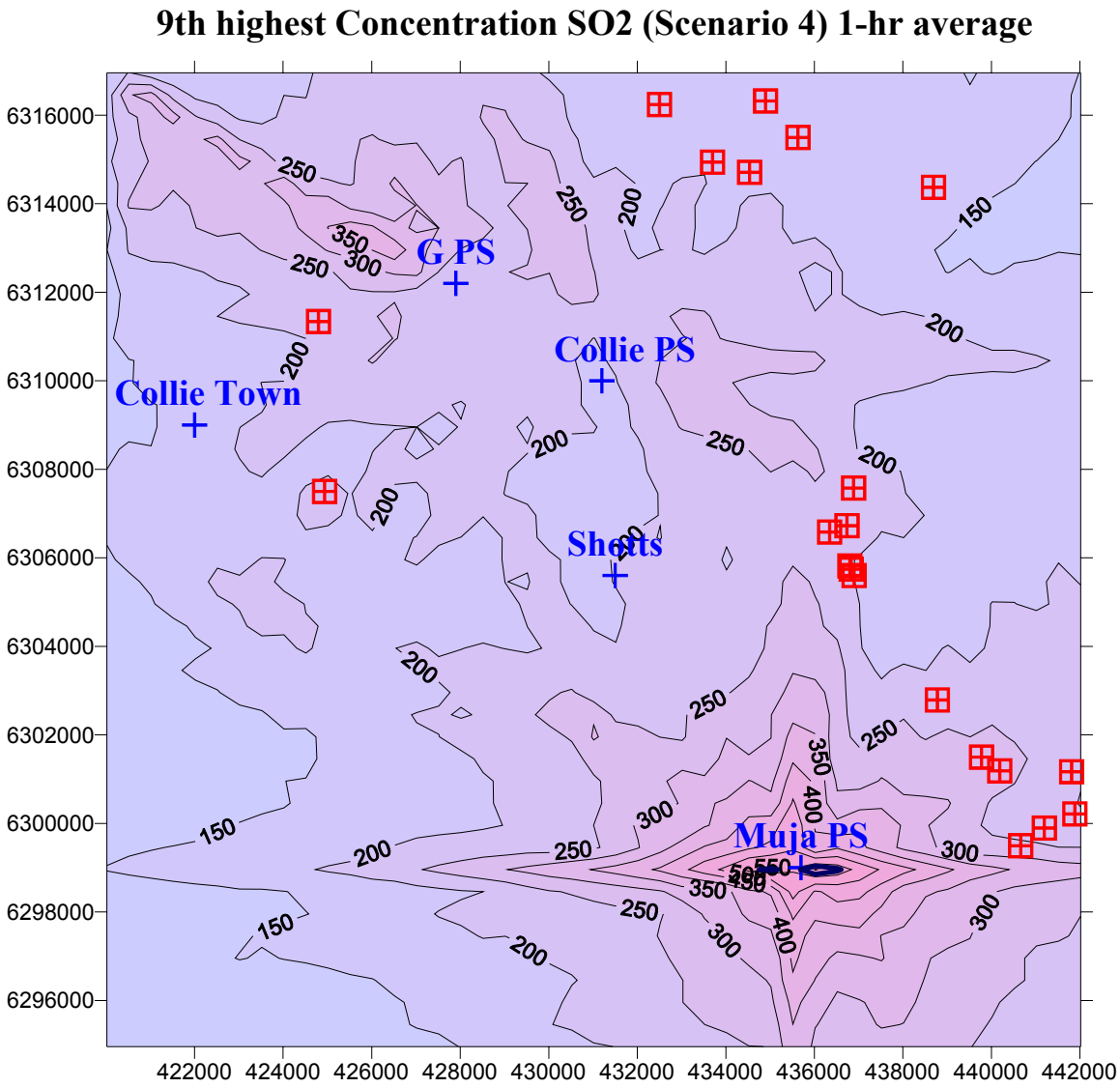

Figure A.9 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

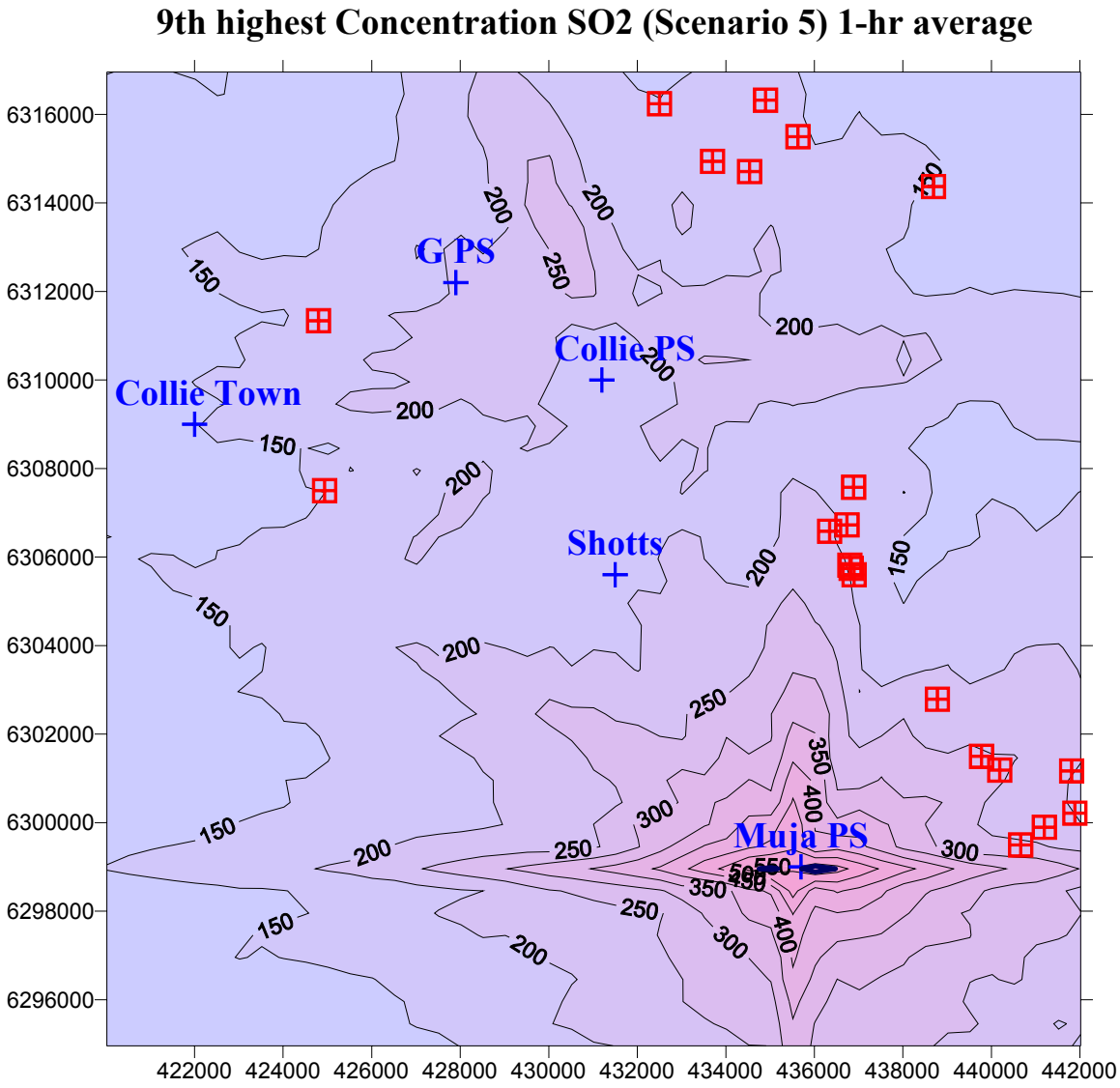

Figure A.10 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *9th-highest* hourly-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (570 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

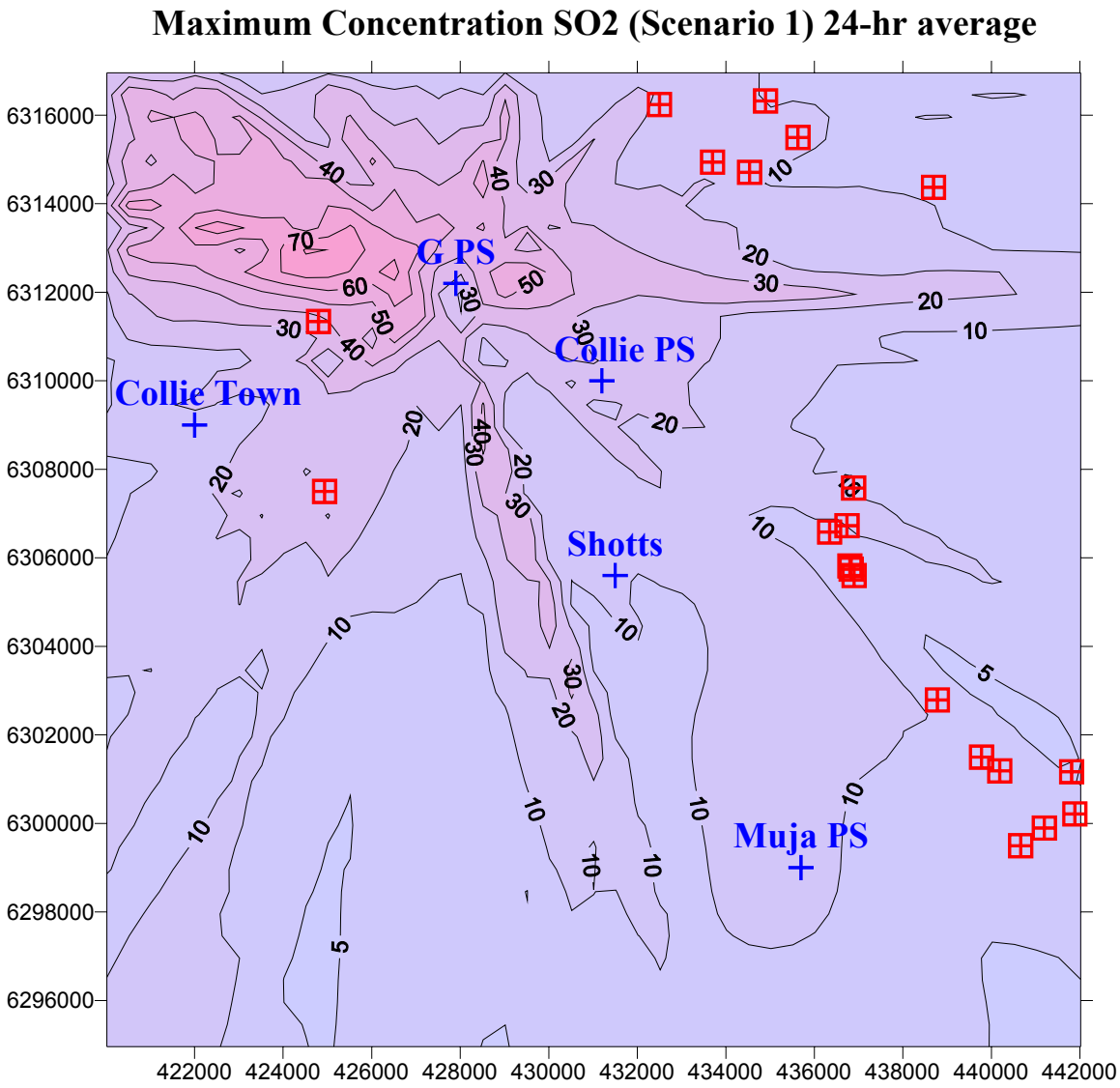

Figure A.11 For Scenario 1 (Bluewaters I), contours of *highest* 24-hour-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

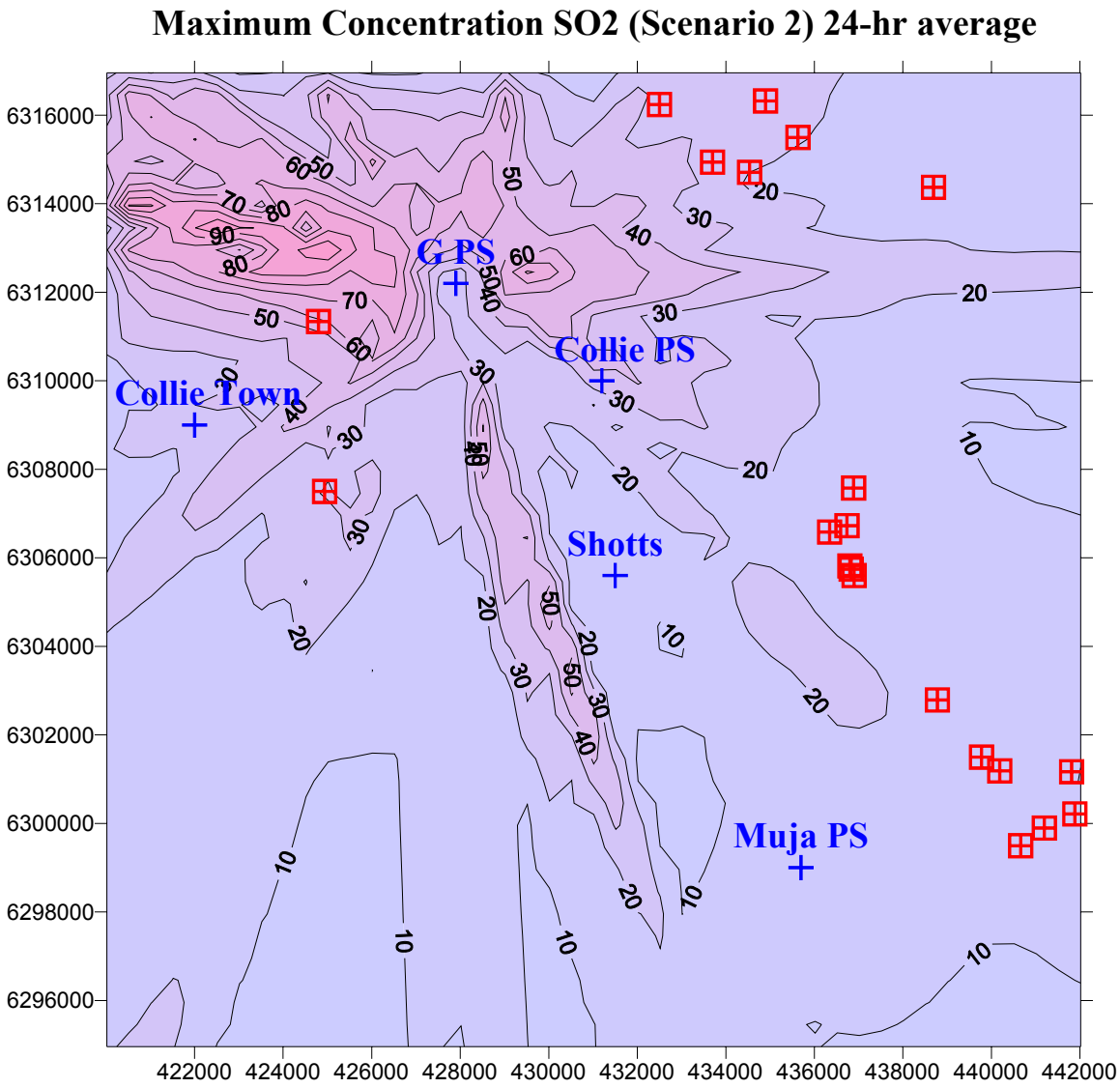

Figure A.12 For Scenario 2 (Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

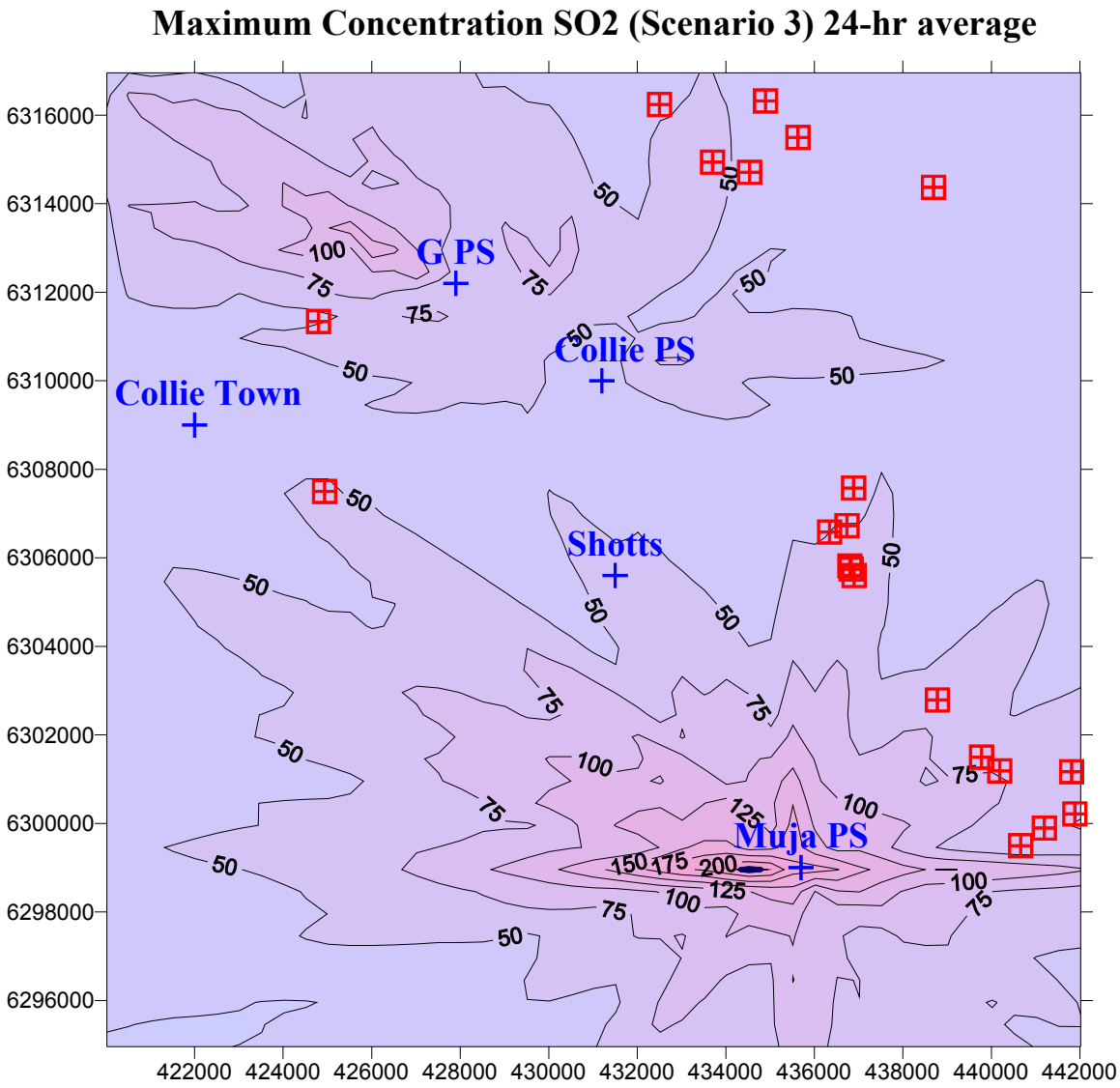

Figure A.13 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

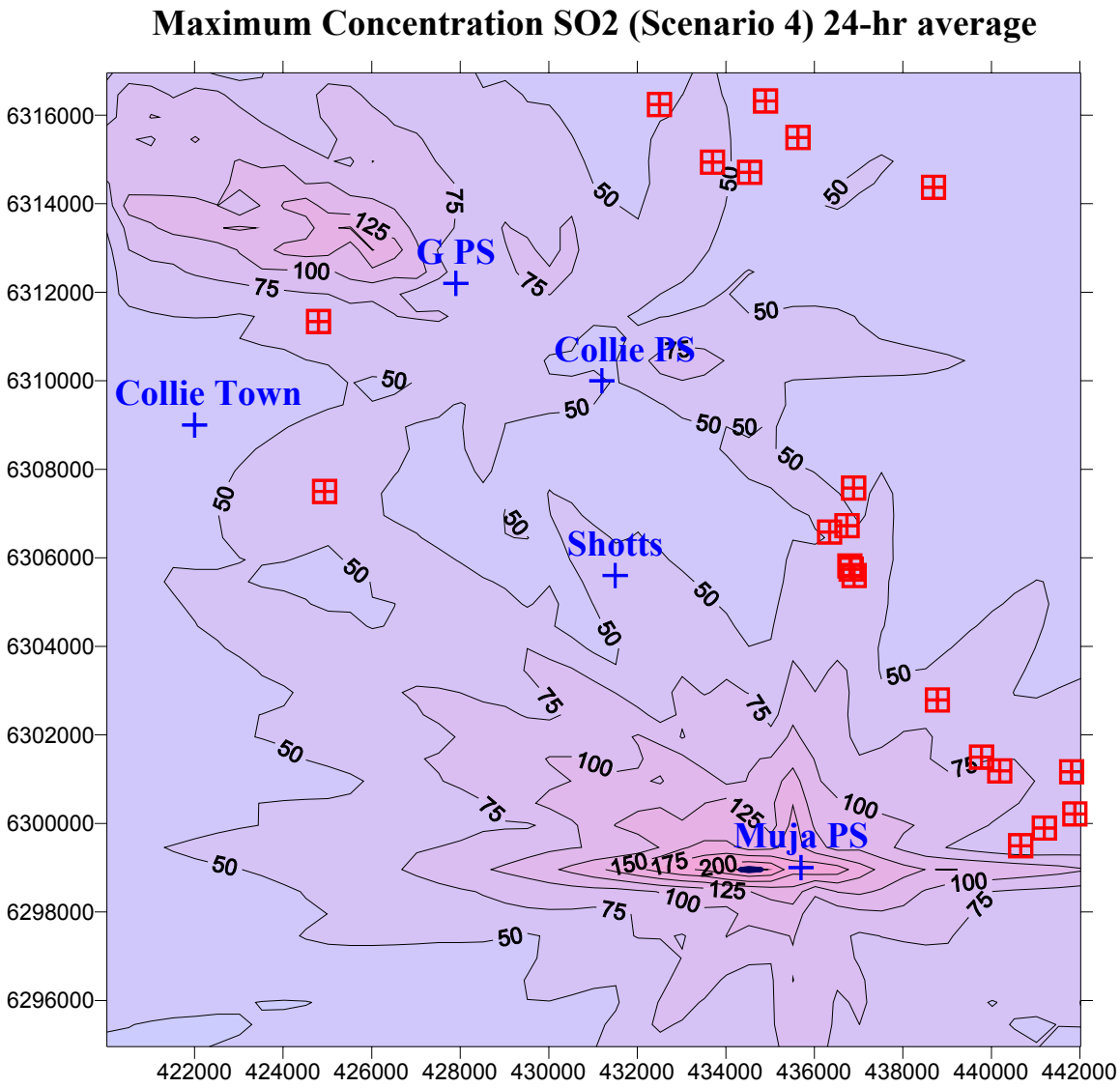

Figure A.14 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of SO_2 ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 $\mu g\ m^{-3}$), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

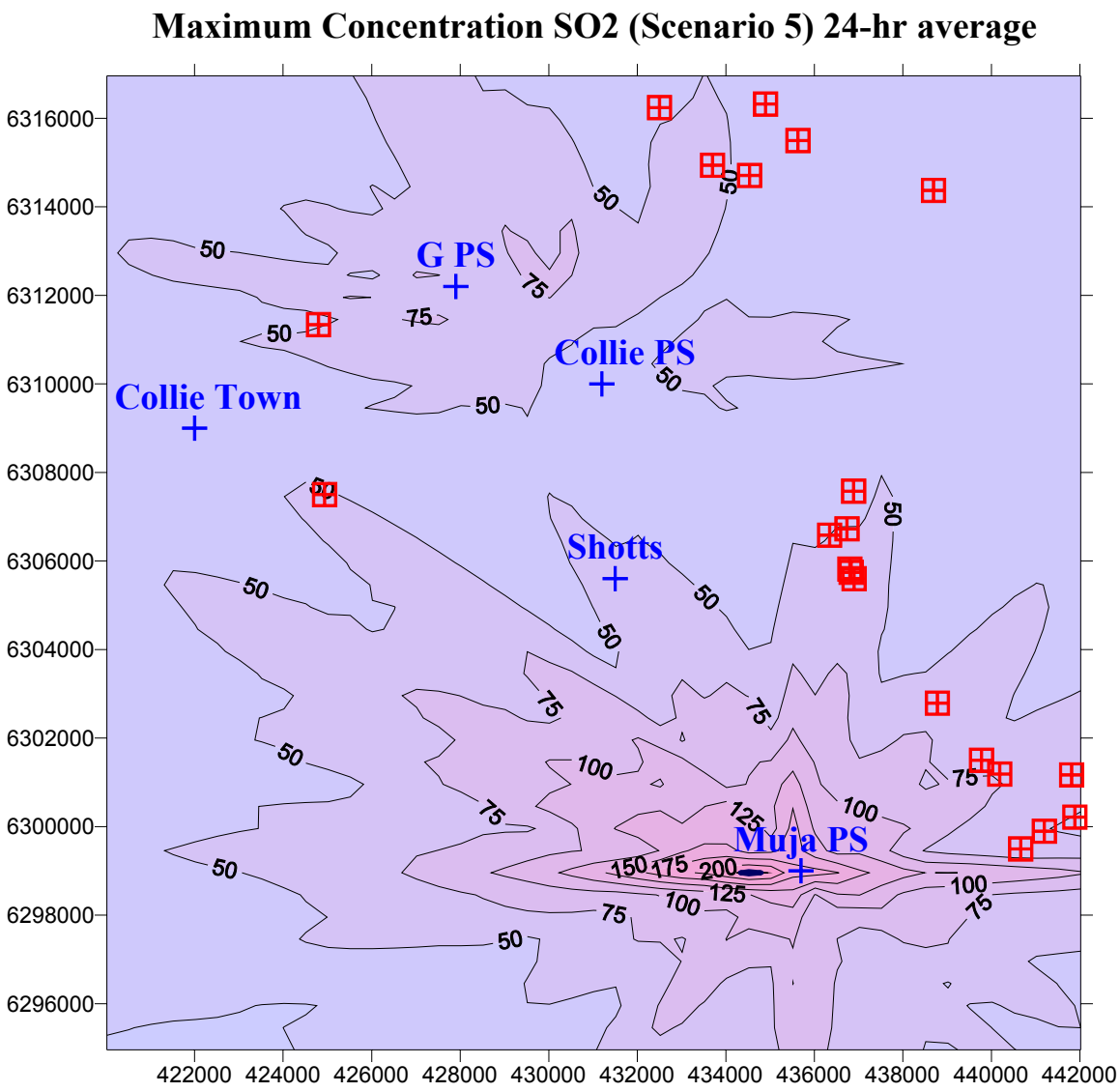

Figure A.15 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of SO_2 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (228 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

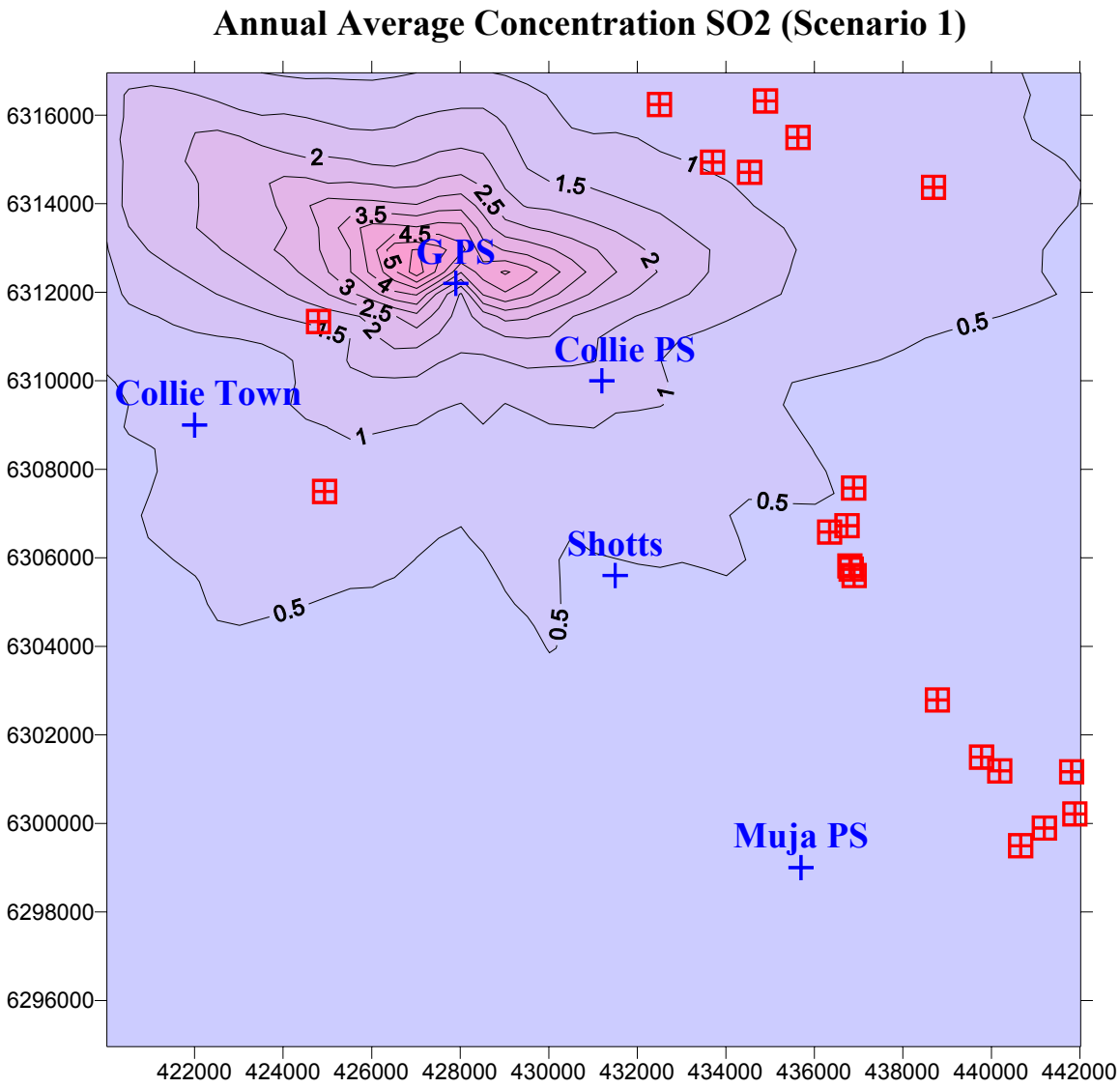

Figure A.16 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

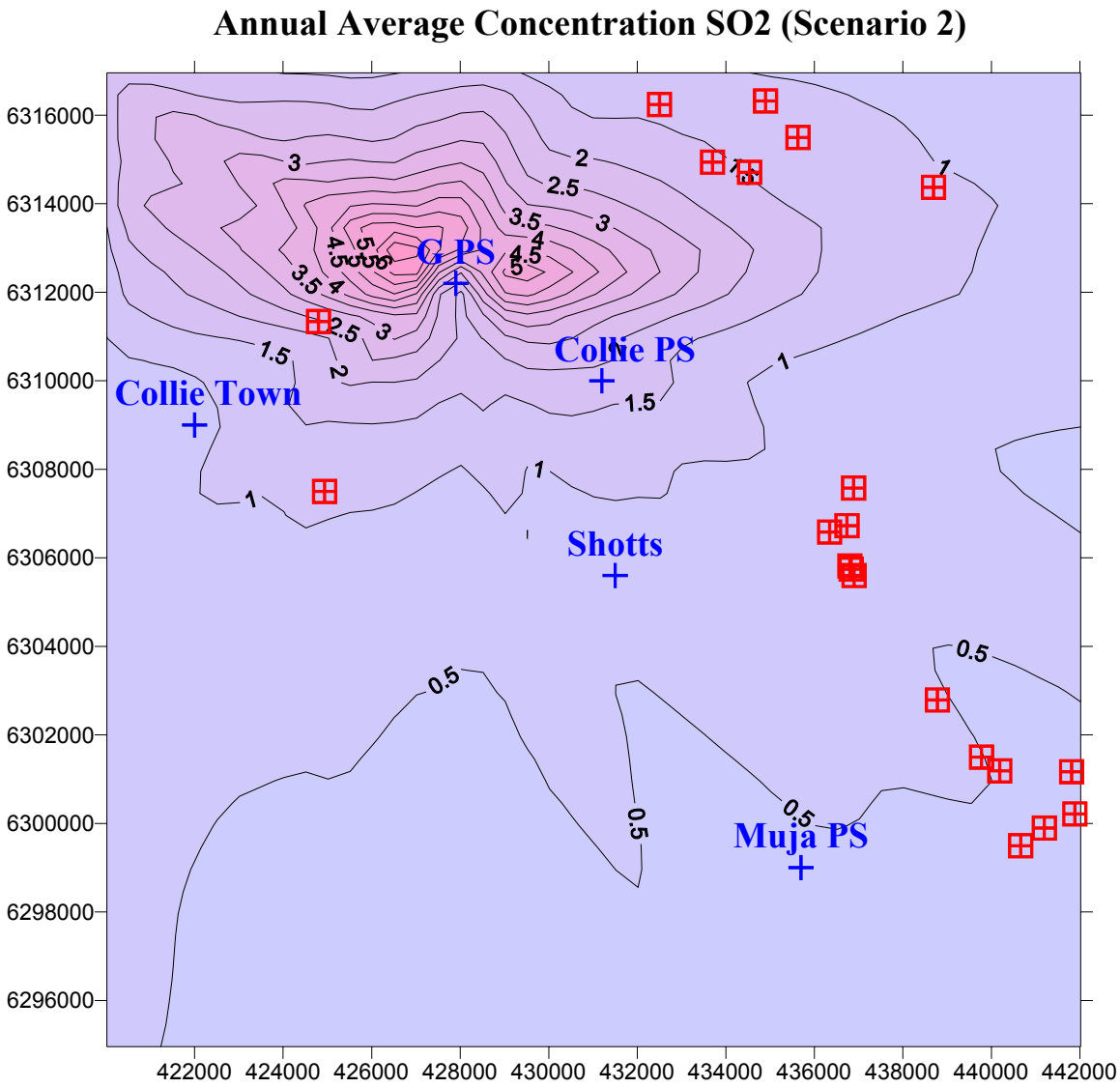

Figure A.17 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

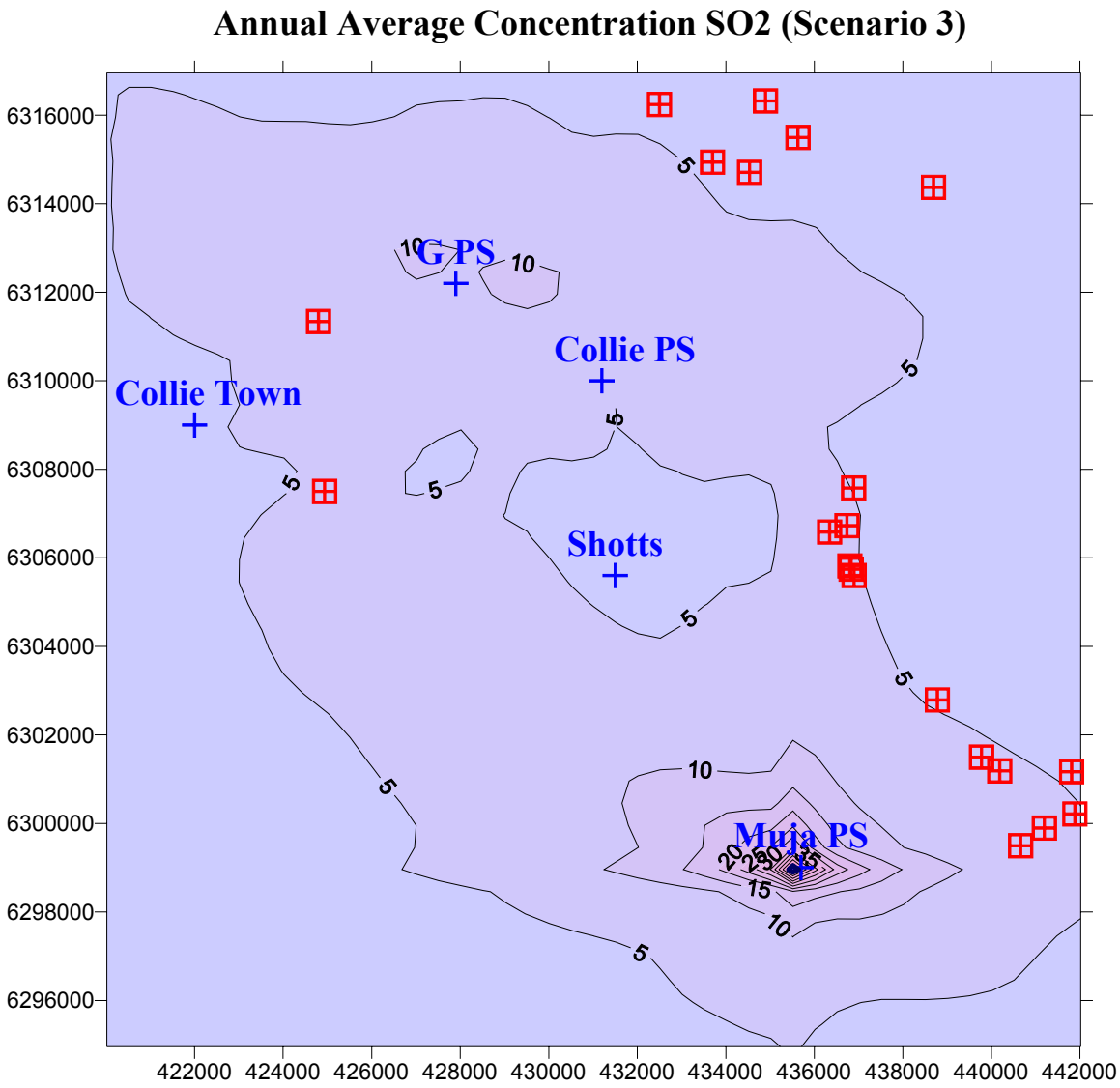

Figure A.18 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

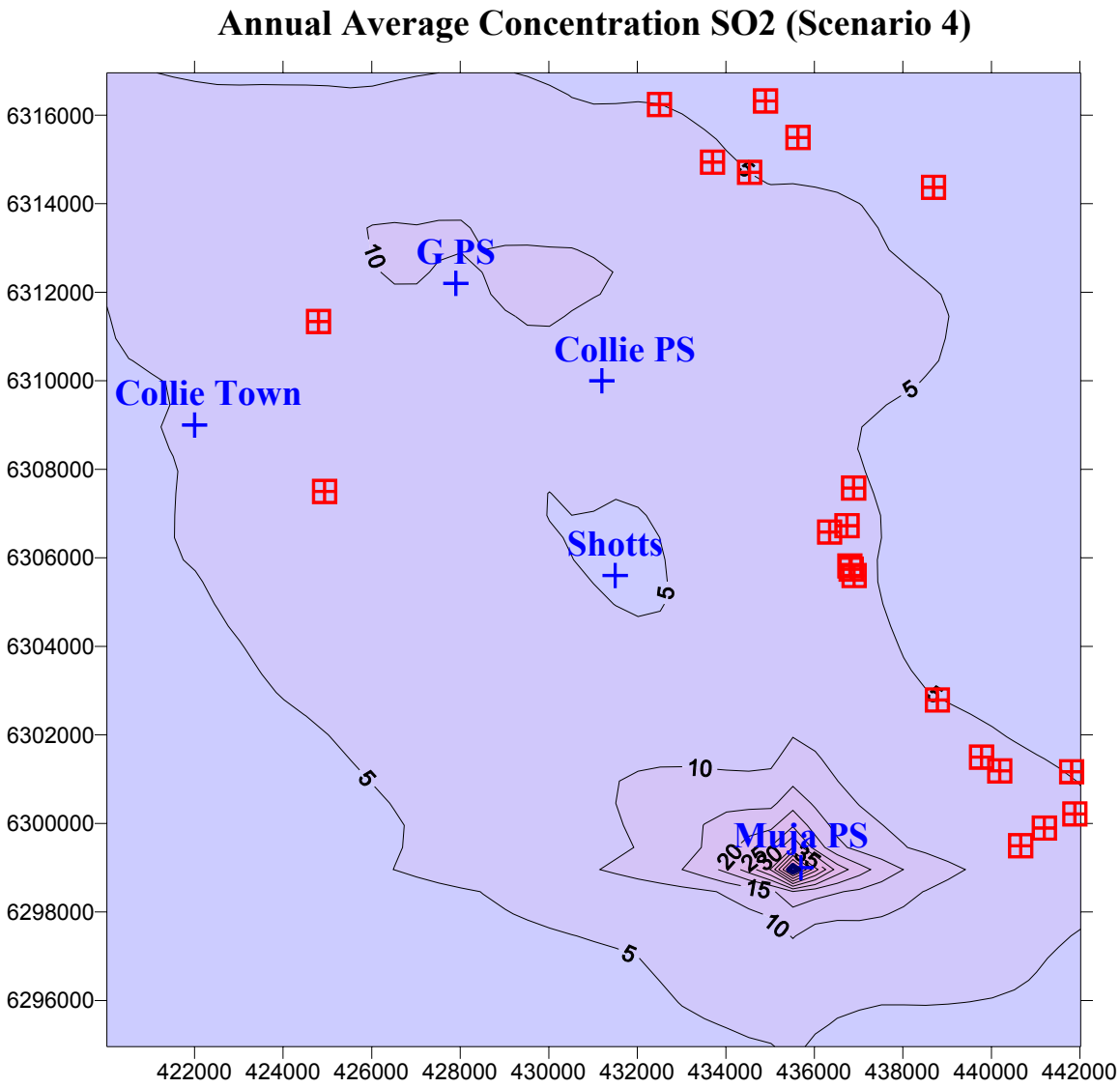

Figure A.19 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

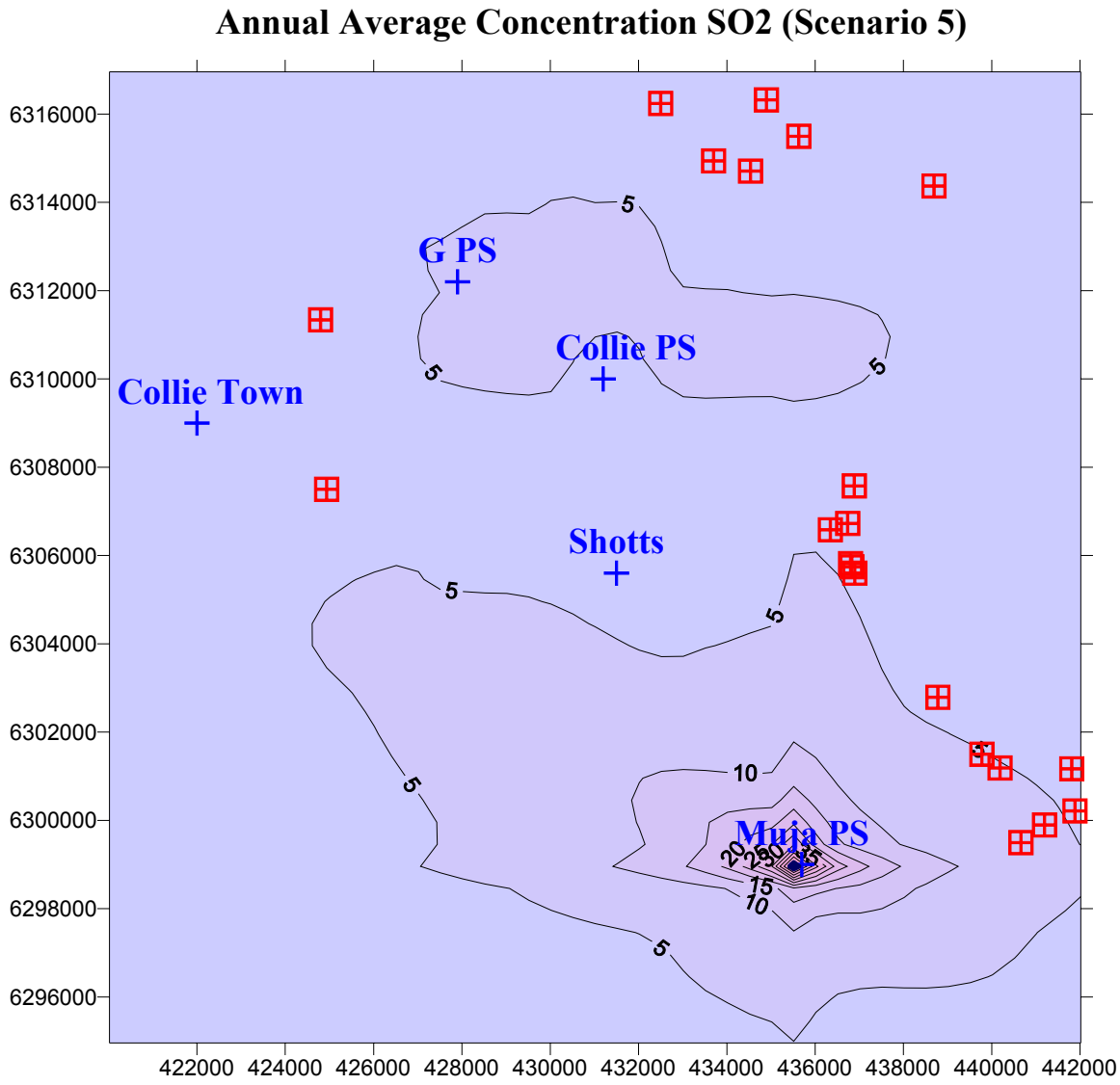

Figure A.20 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of SO_2 (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix B Contour plots for TAPM CO concentrations

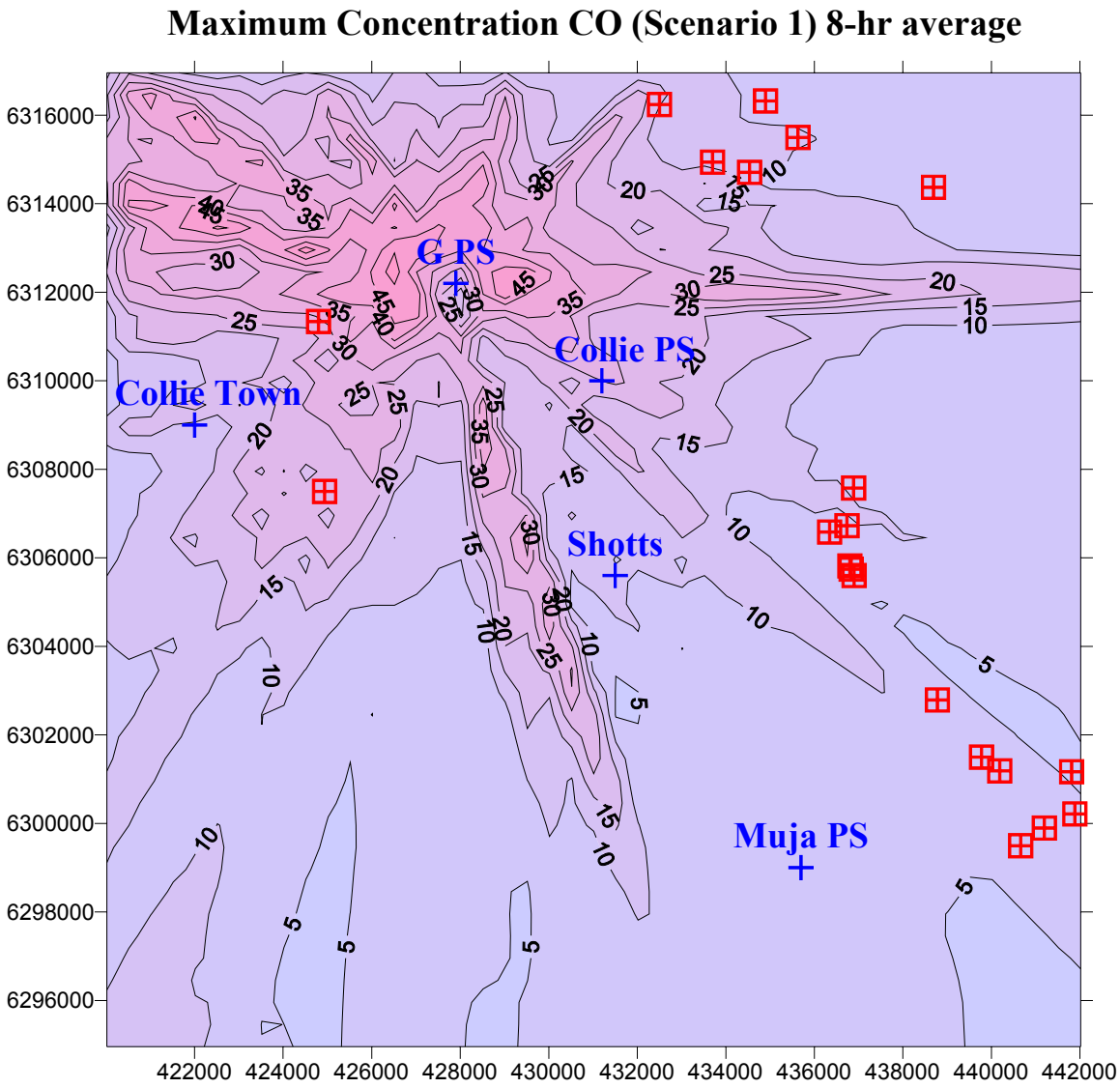

Figure B.1 For Scenario 1 (Bluewaters I), contours of *highest* 8-hour-averaged concentration of CO (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

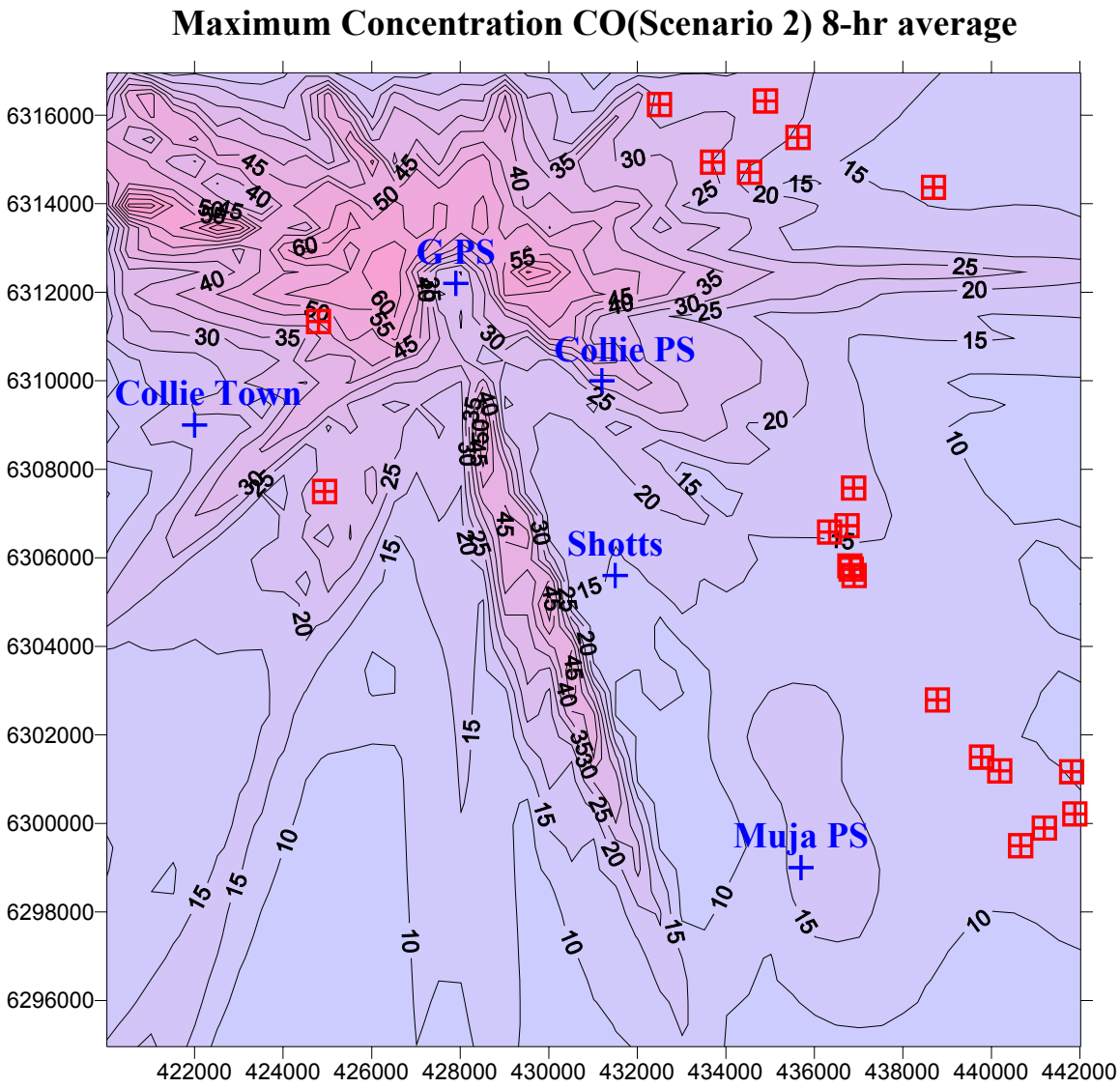

Figure B.2 For Scenario 2 (Bluewaters I + II), contours of *highest* 8-hour-averaged concentration of CO (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

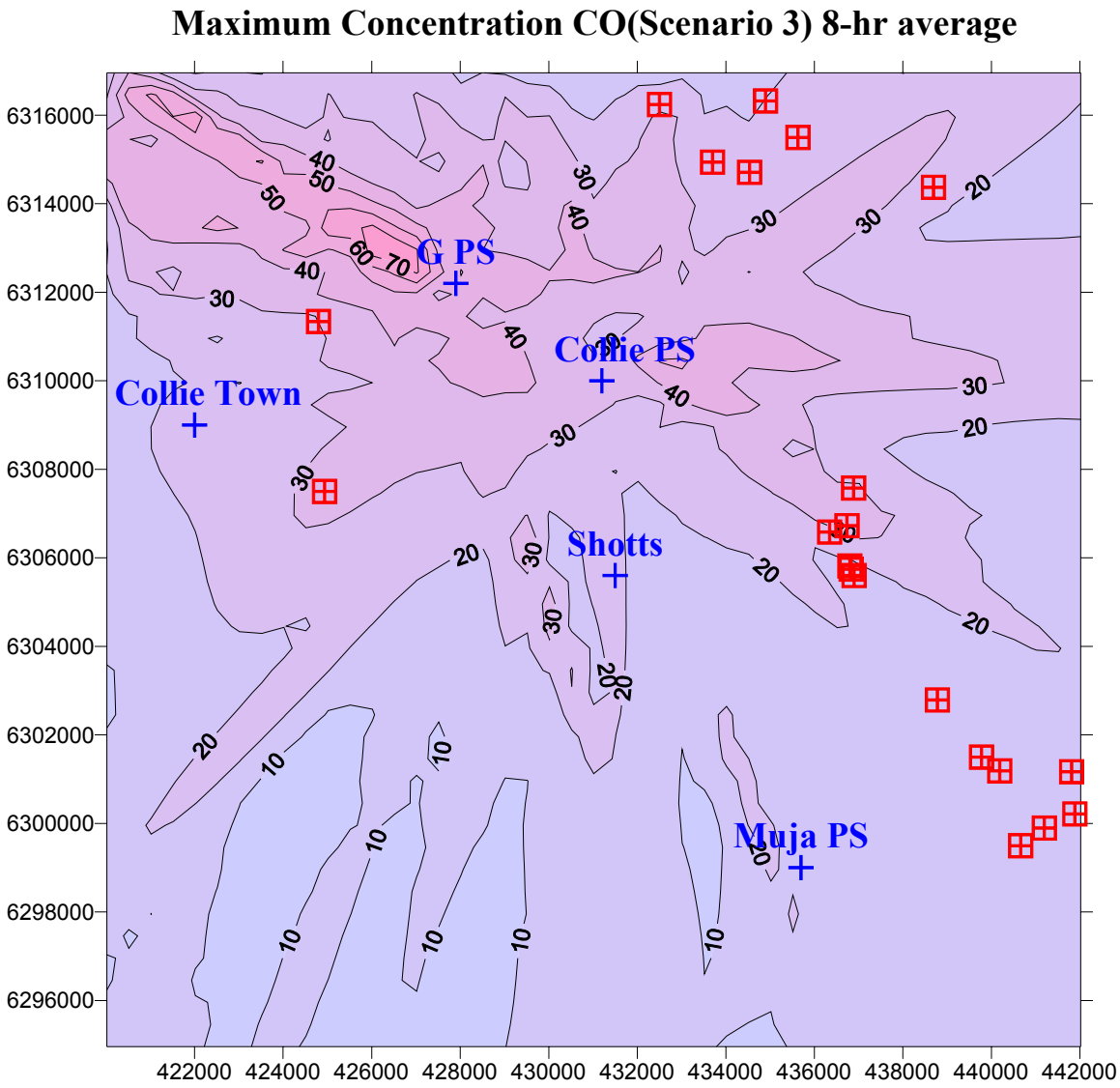

Figure B.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 8-hour-averaged concentration of CO (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

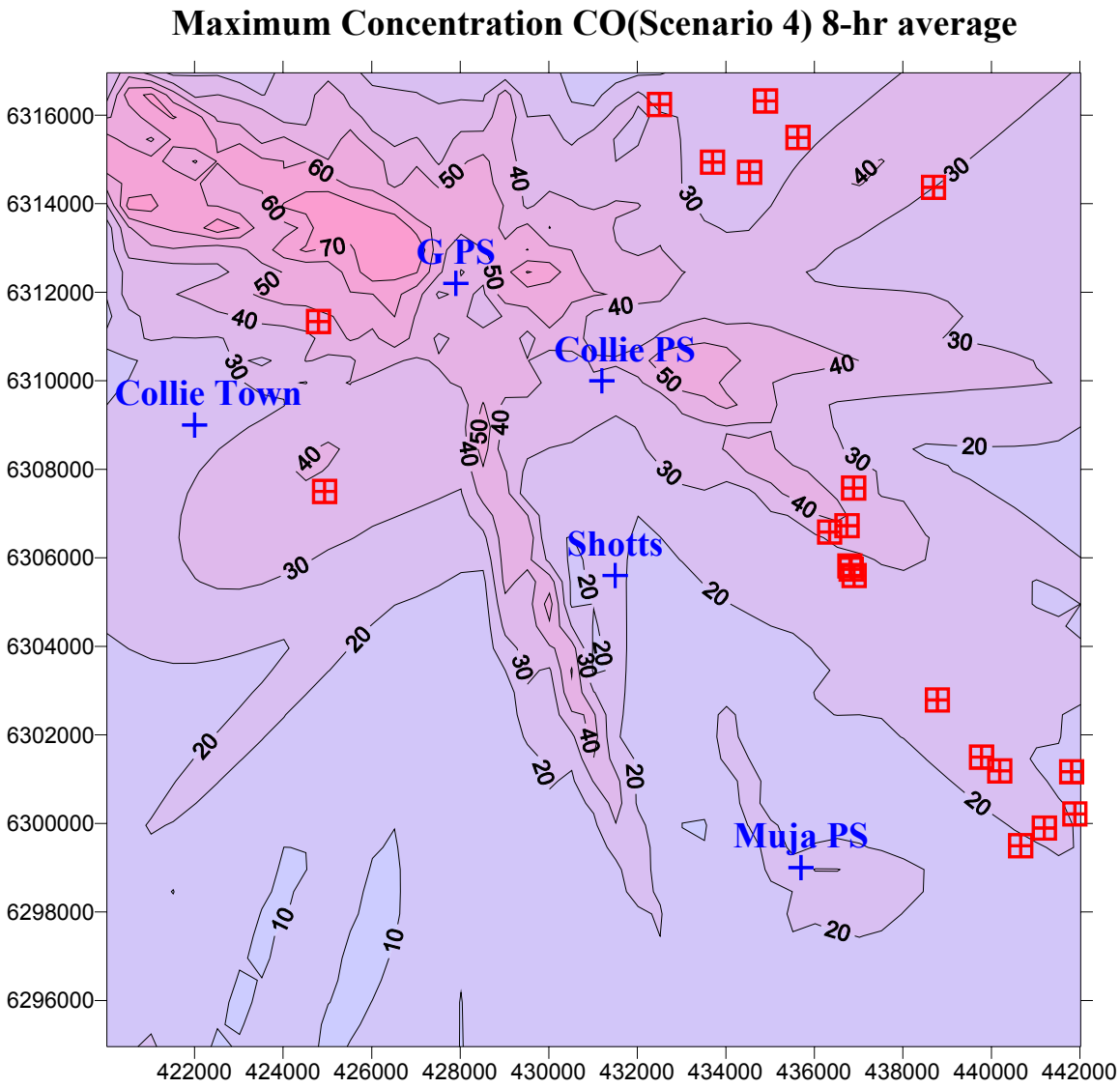

Figure B.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 8-hour-averaged concentration of CO ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

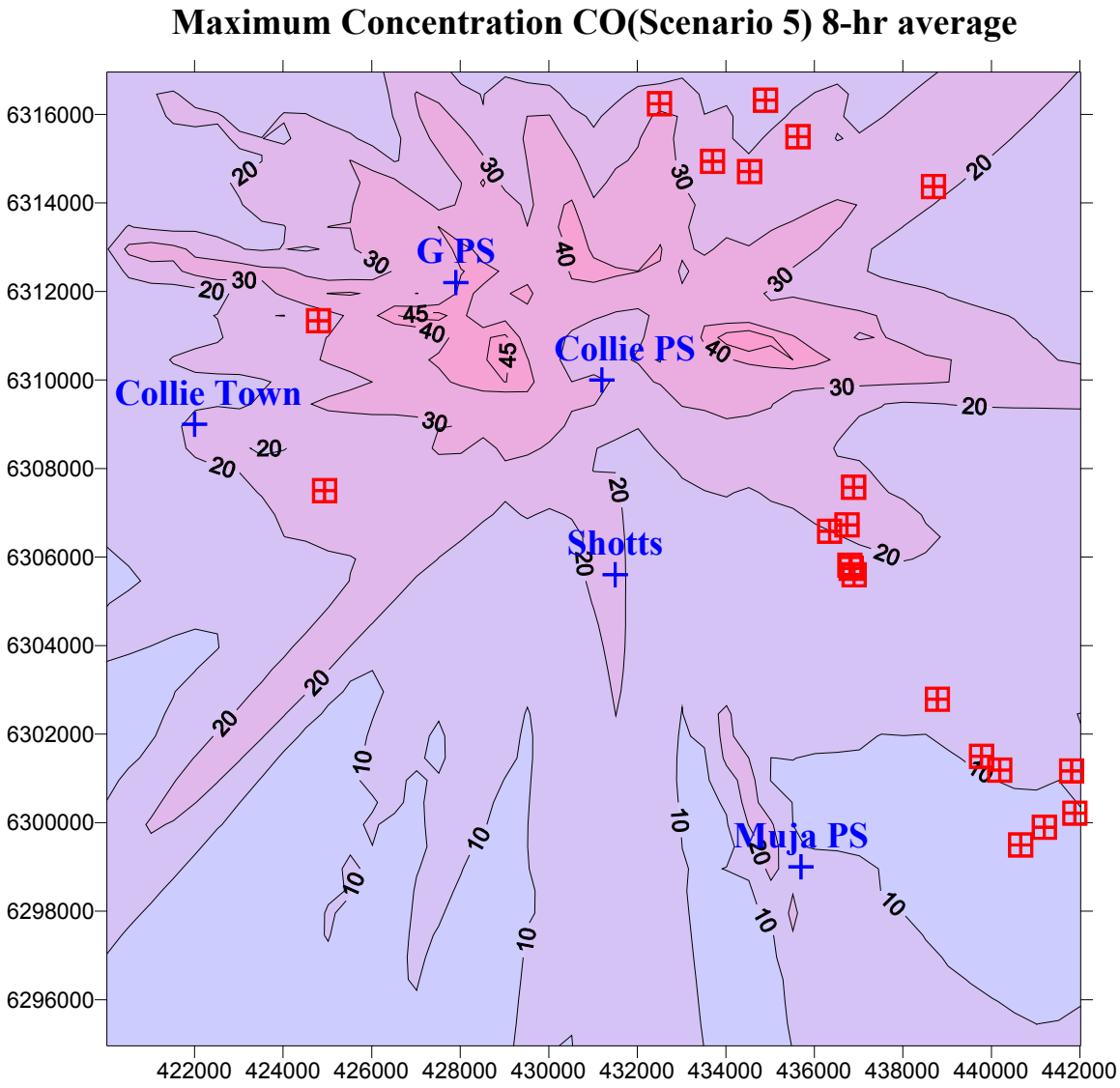

Figure B.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 8-hour-averaged concentration of CO (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix C Contour plots for TAPM Hg concentrations

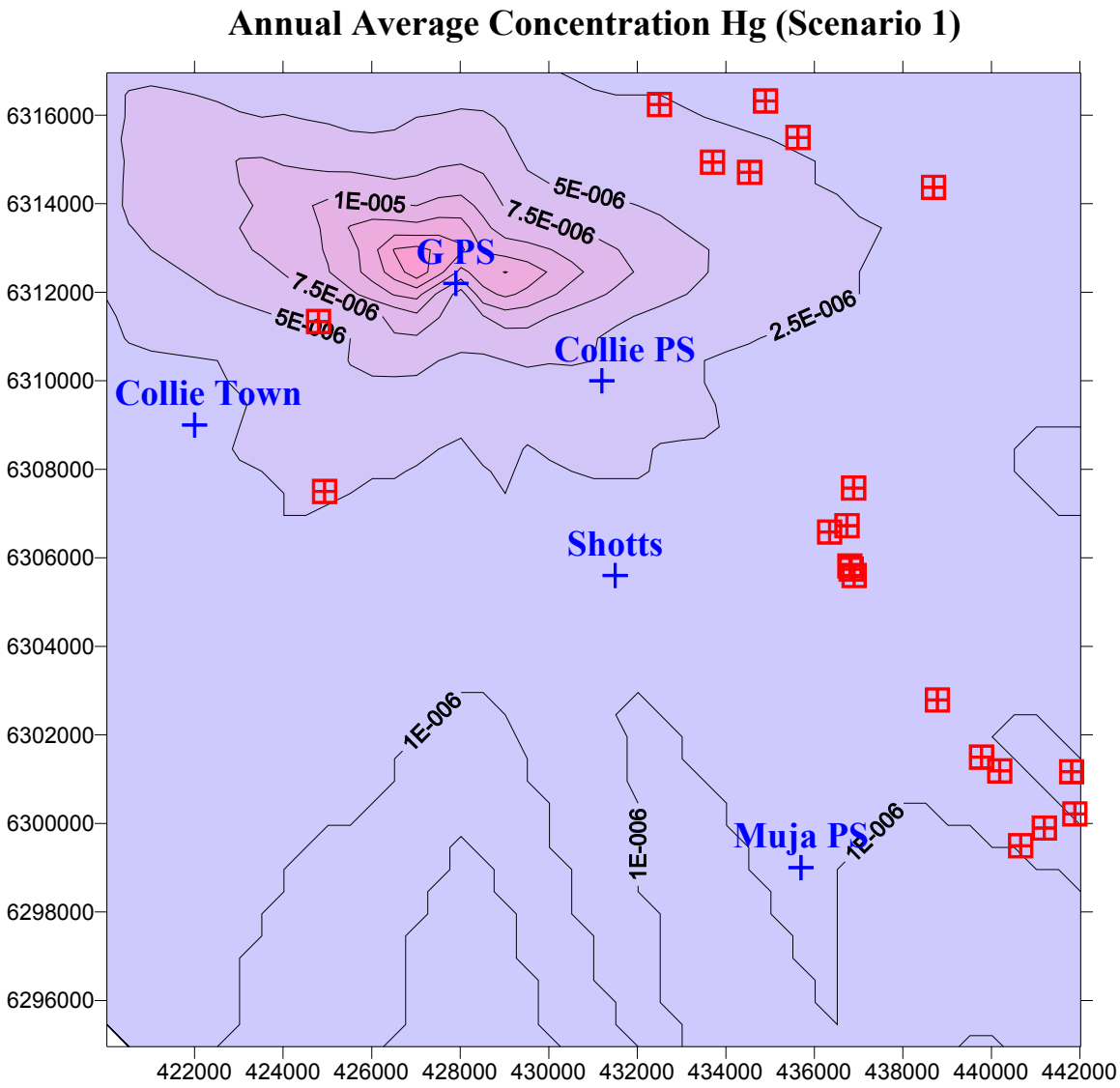

Figure C.1 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

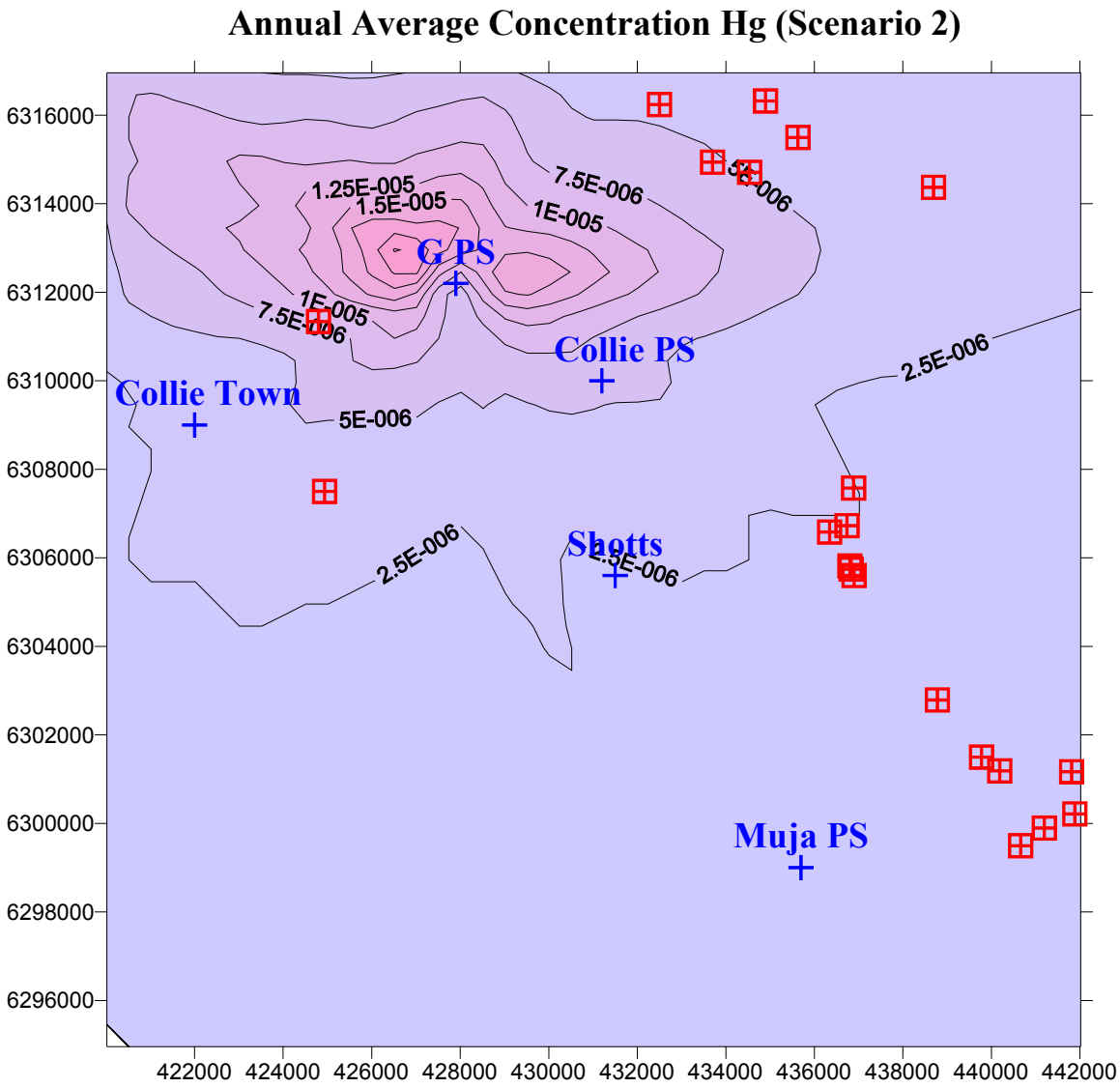

Figure C.2 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

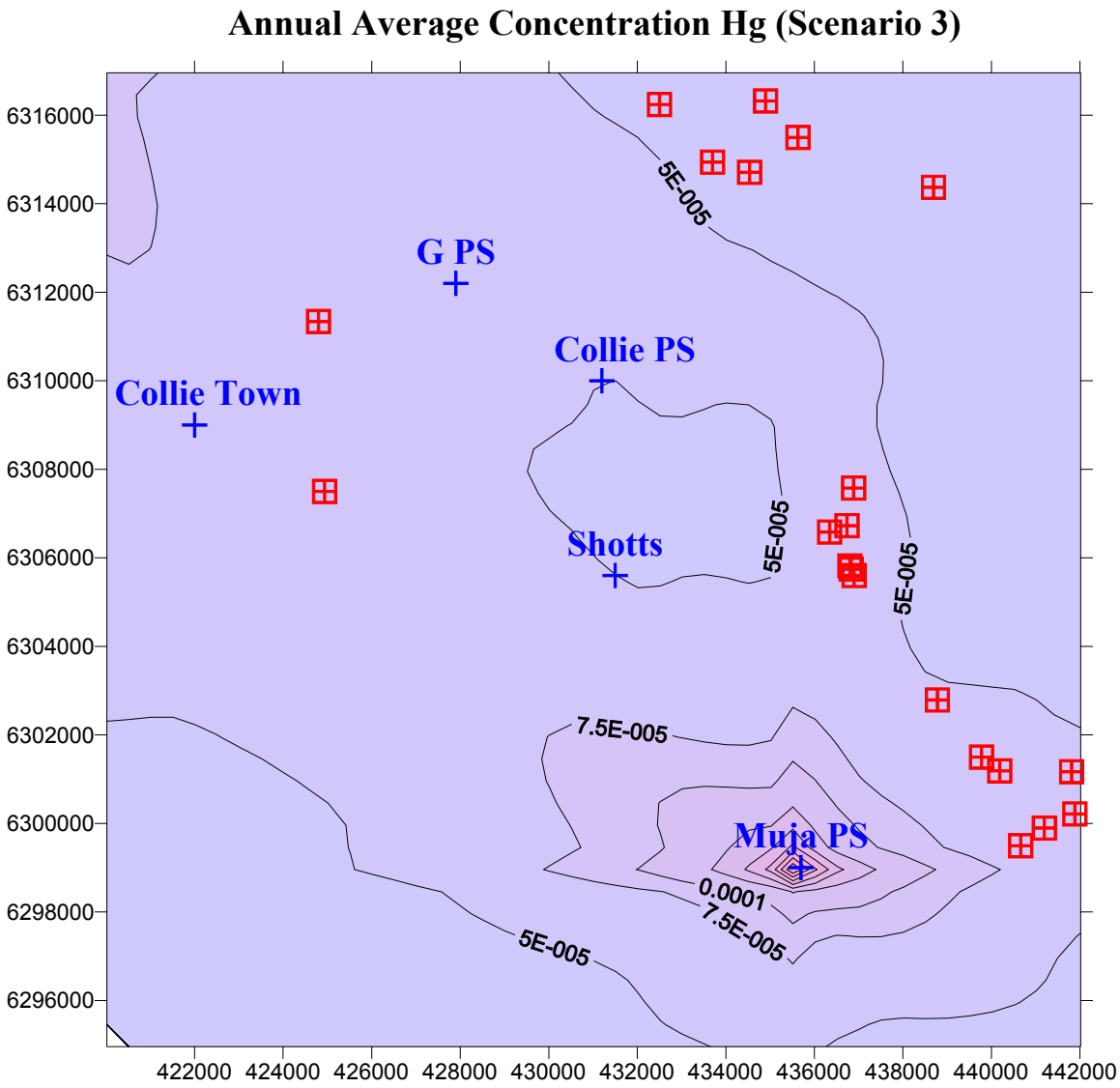

Figure C.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

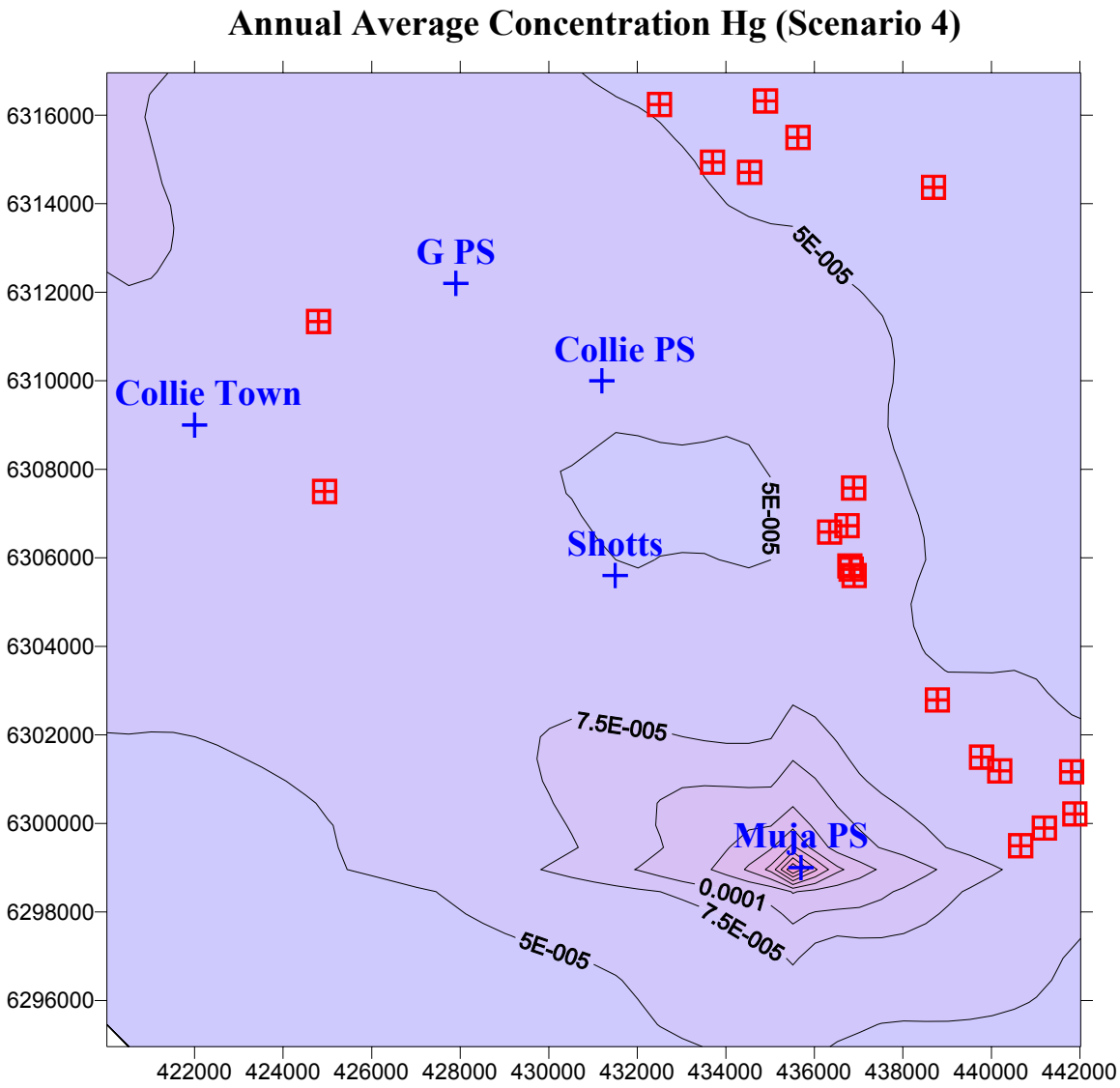

Figure C.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

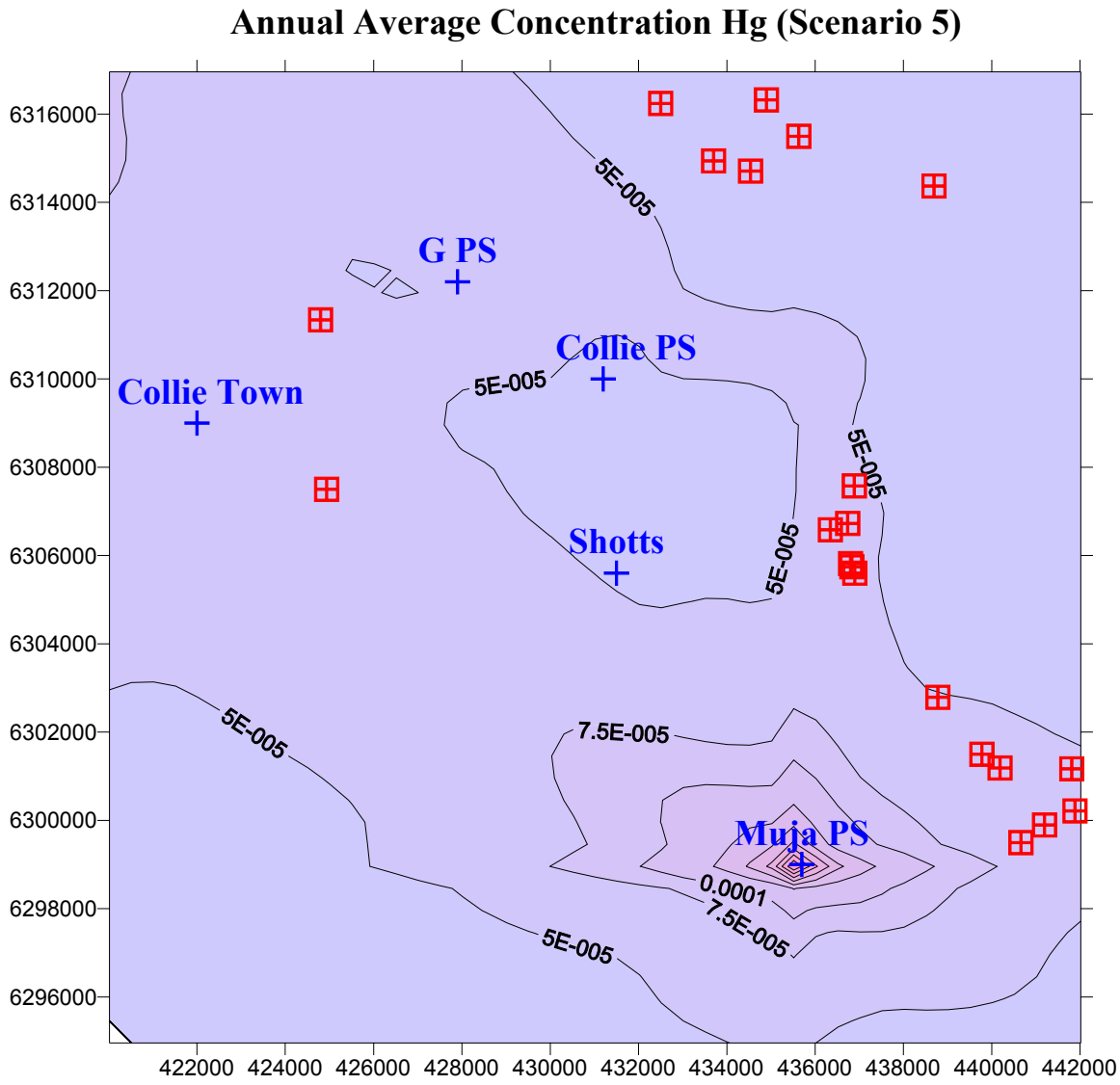

Figure C.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of Hg (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix D Contour plots for TAPM PAH concentrations

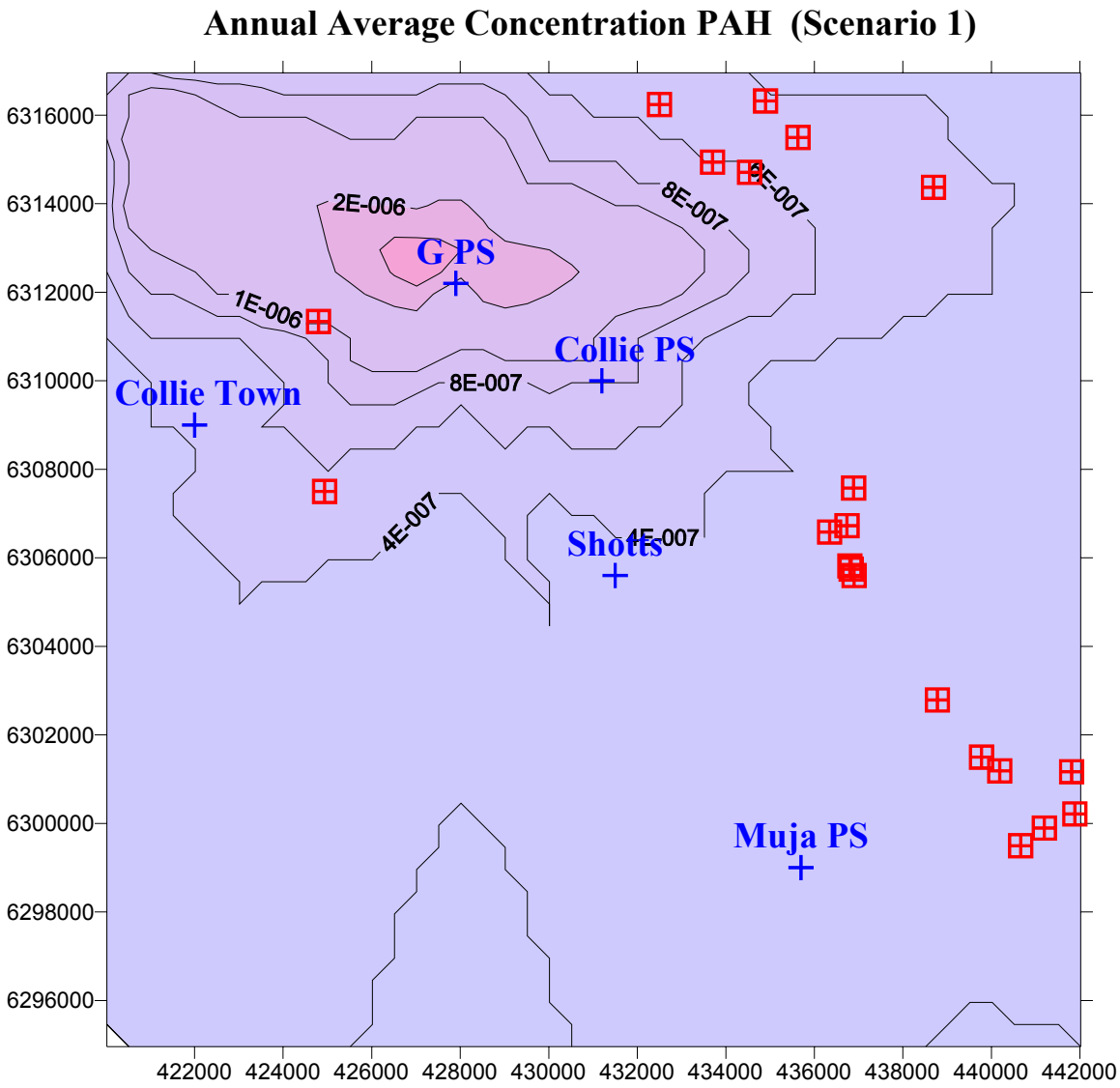

Figure D.1 For Scenario 1 (Bluewaters I), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

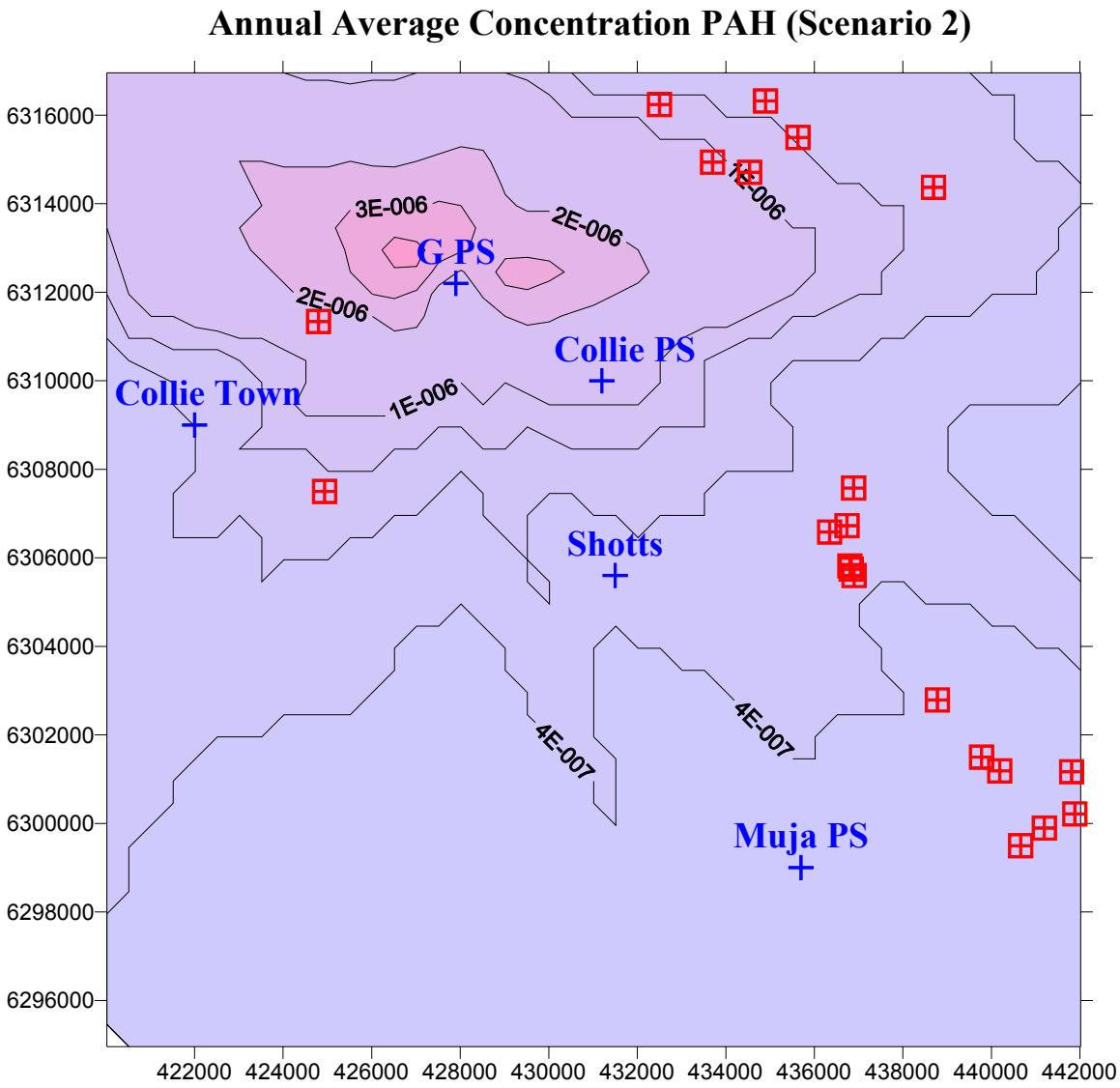

Figure D.2 For Scenario 2 (Bluewaters I + II), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

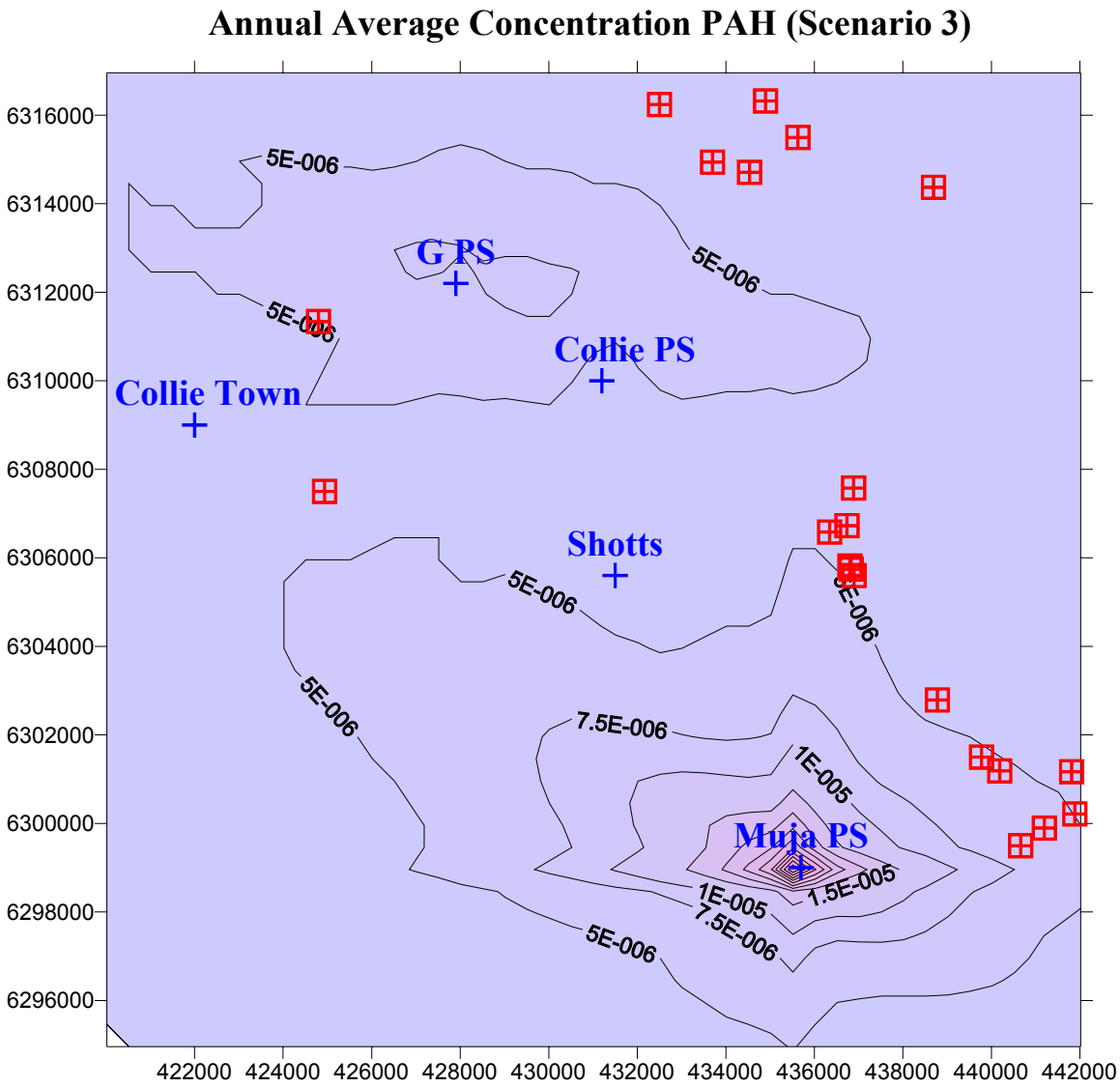

Figure D.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of PAH (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

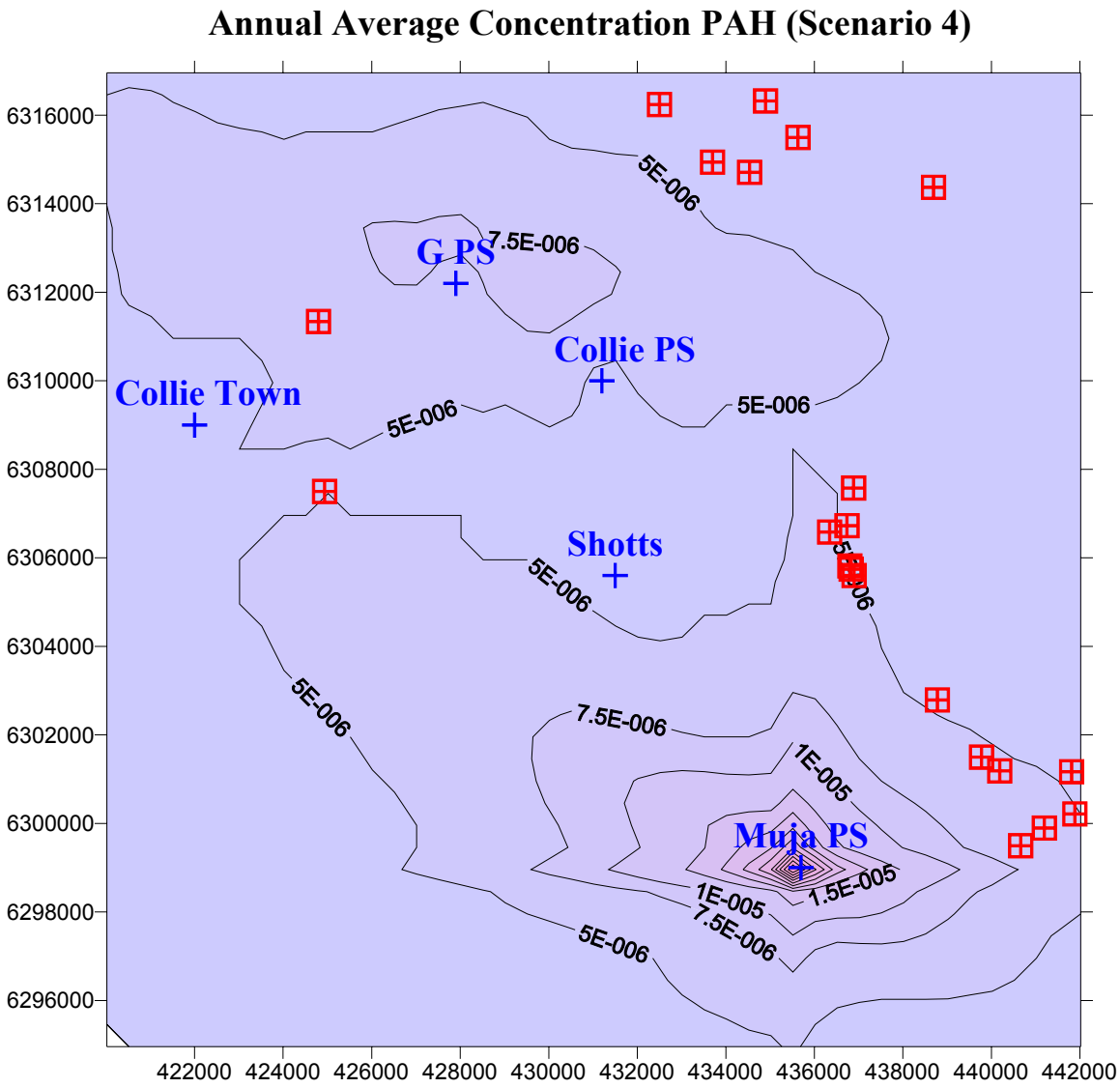

Figure D.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

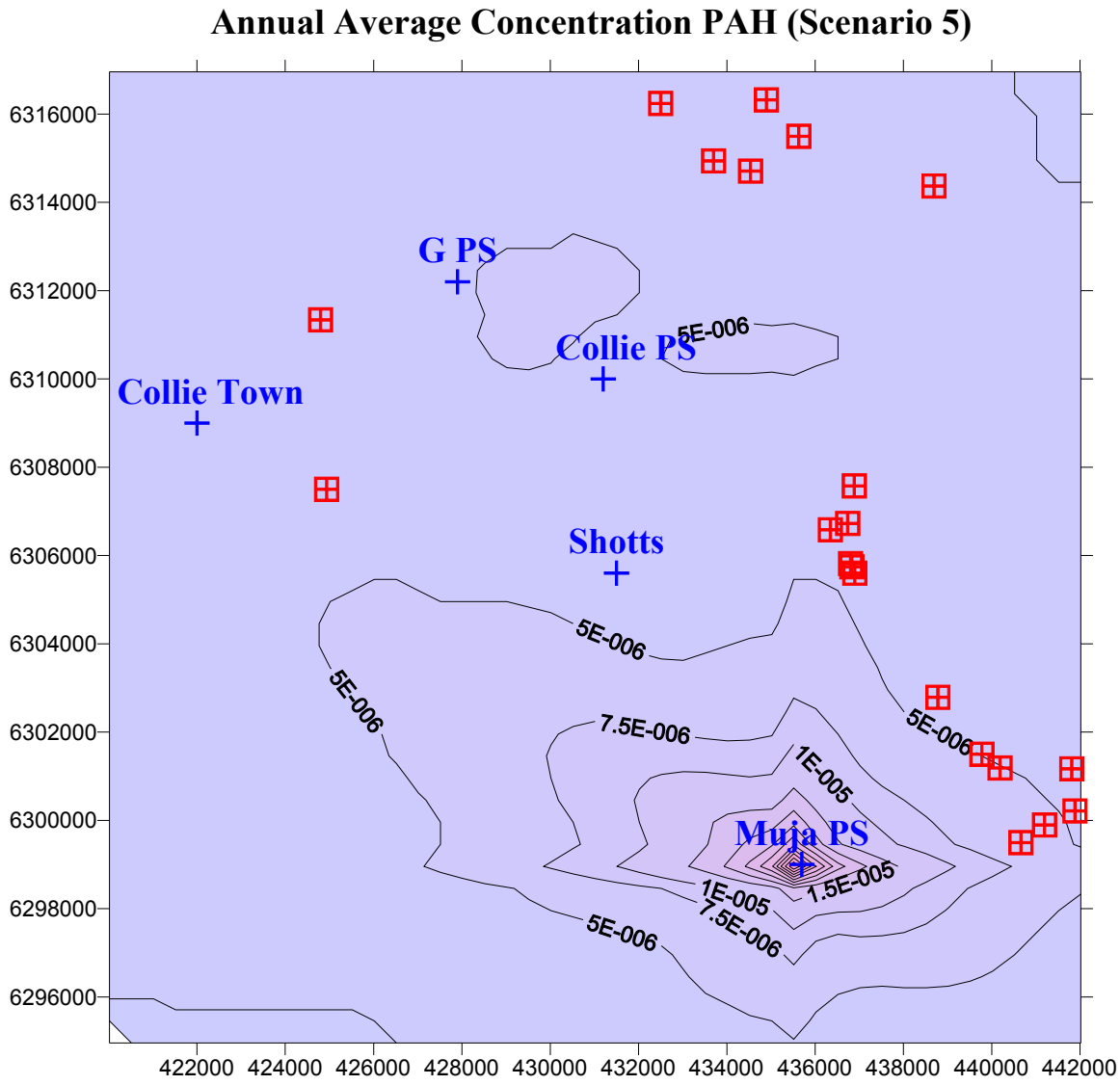

Figure D.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of PAH (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix E Contour plots for TAPM FI concentrations

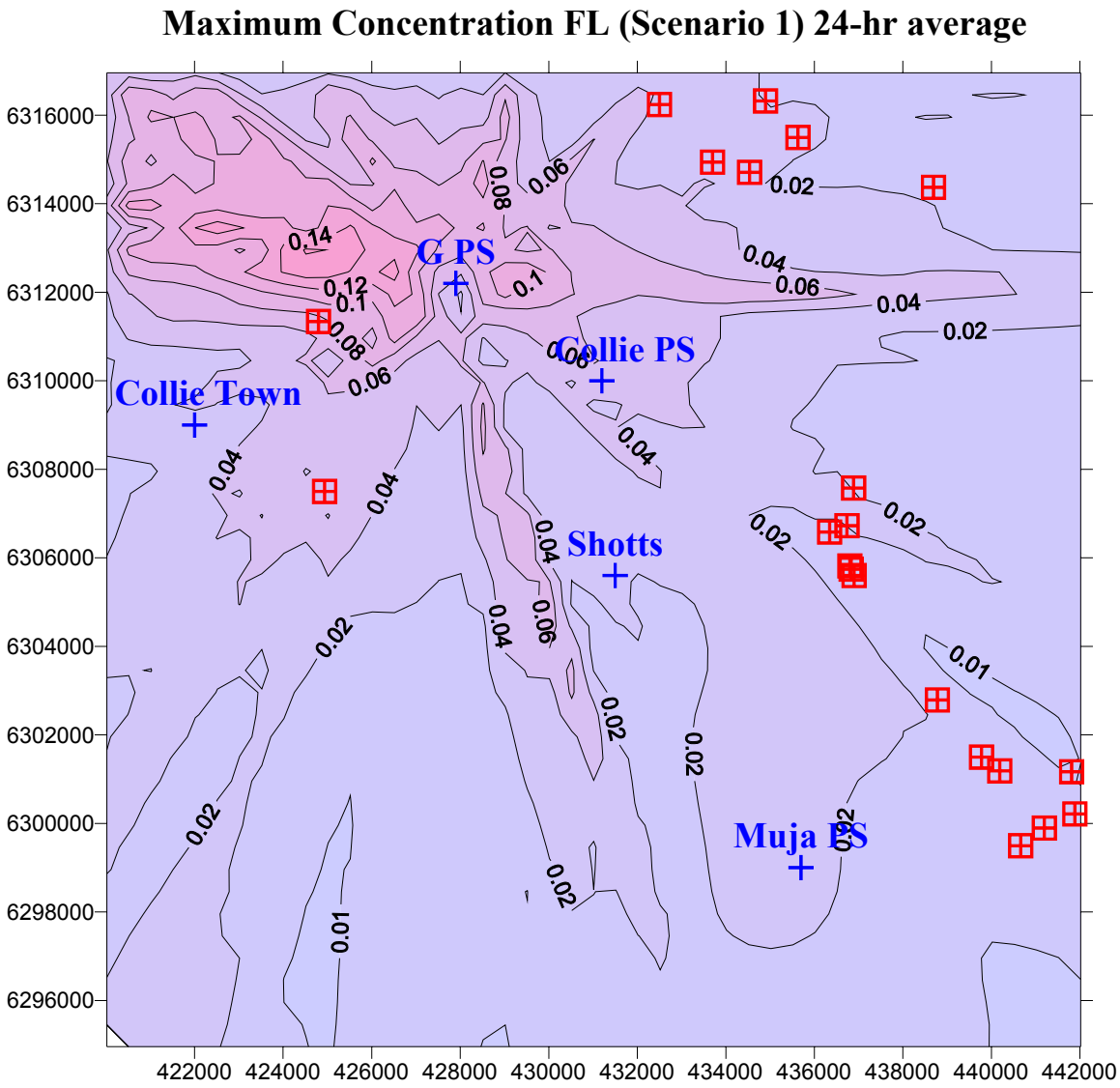

Figure E.1 For Scenario 1 (Bluewaters I), contours of *highest* 24-hour-averaged concentration of fluoride (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

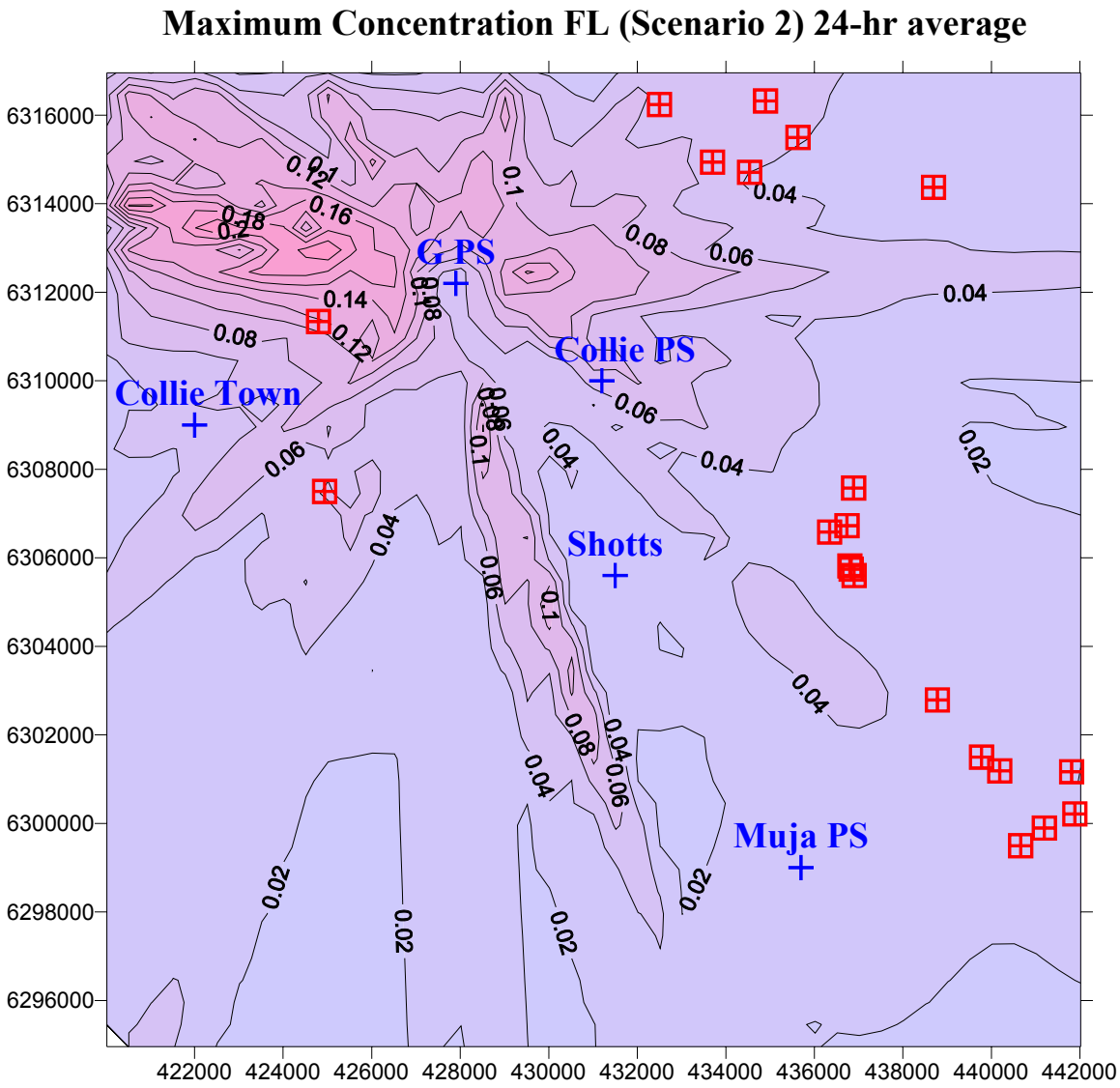

Figure E.2 For Scenario 2 (Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of fluoride (μg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

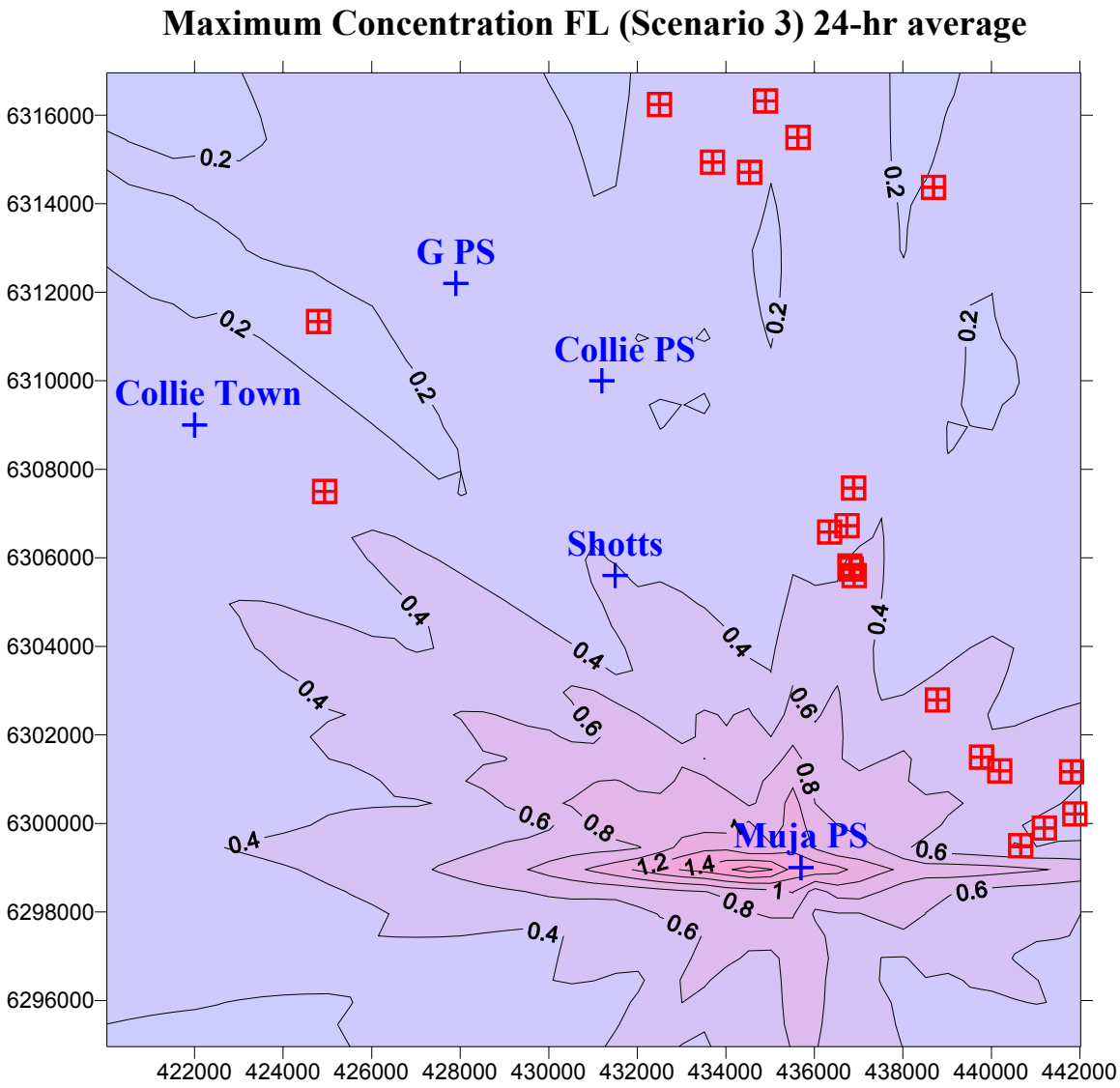

Figure E.3 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of fluoride ($\mu g\ m^{-3}$) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

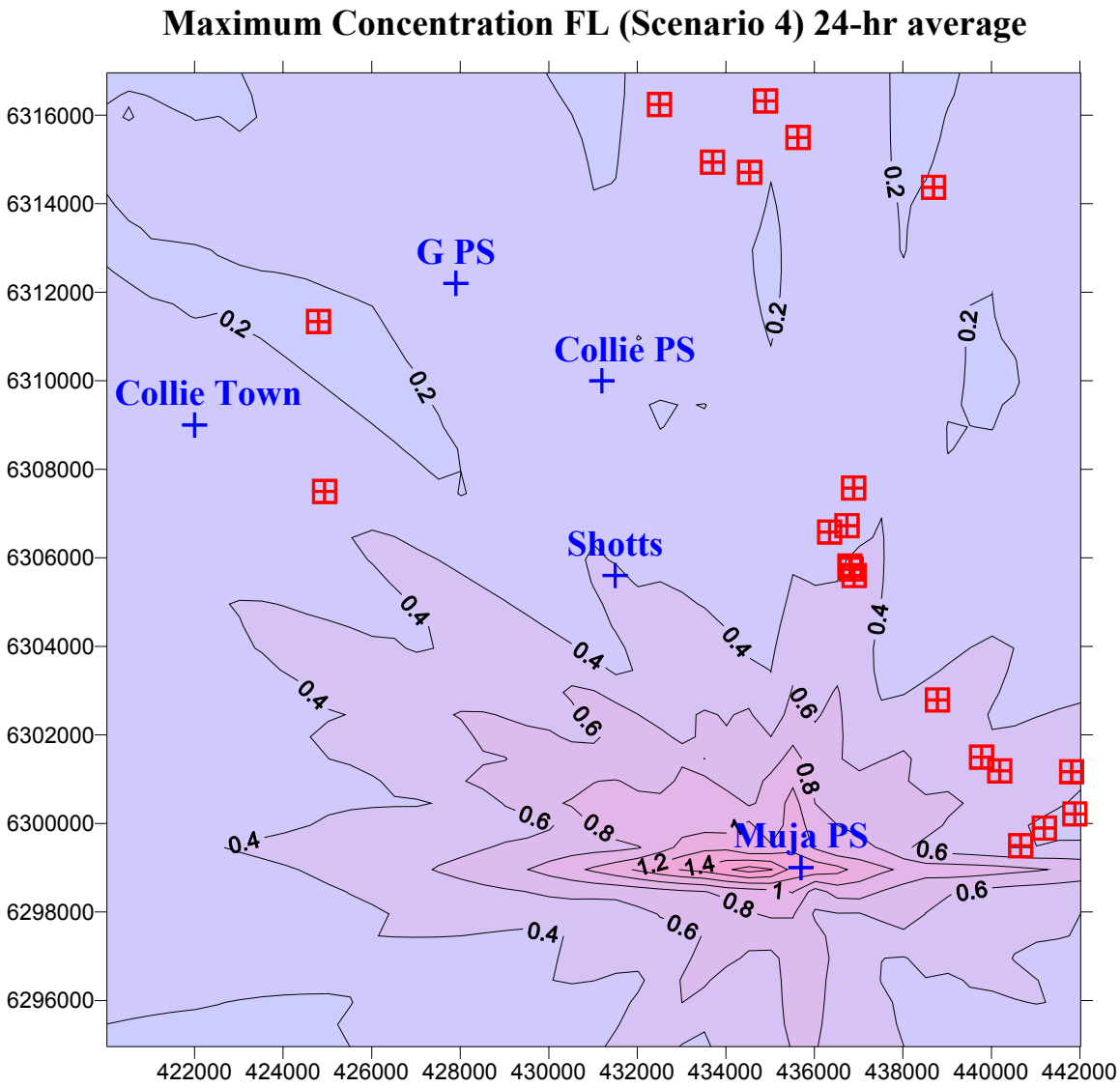

Figure E.4 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of fluoride (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

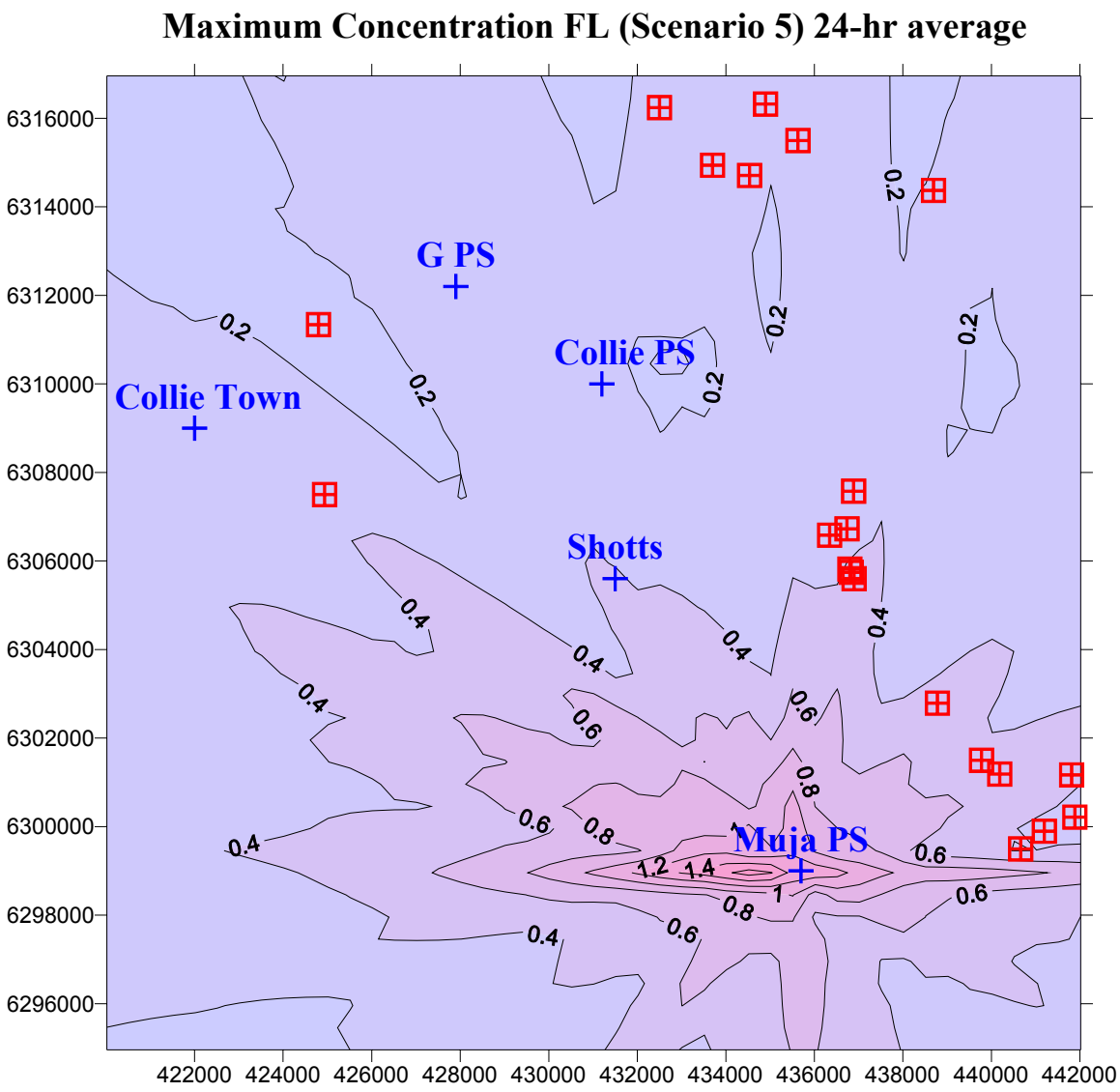

Figure E.5 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of fluoride (µg m^{-3}) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix F Contour plots for TAPM NO_2 concentrations

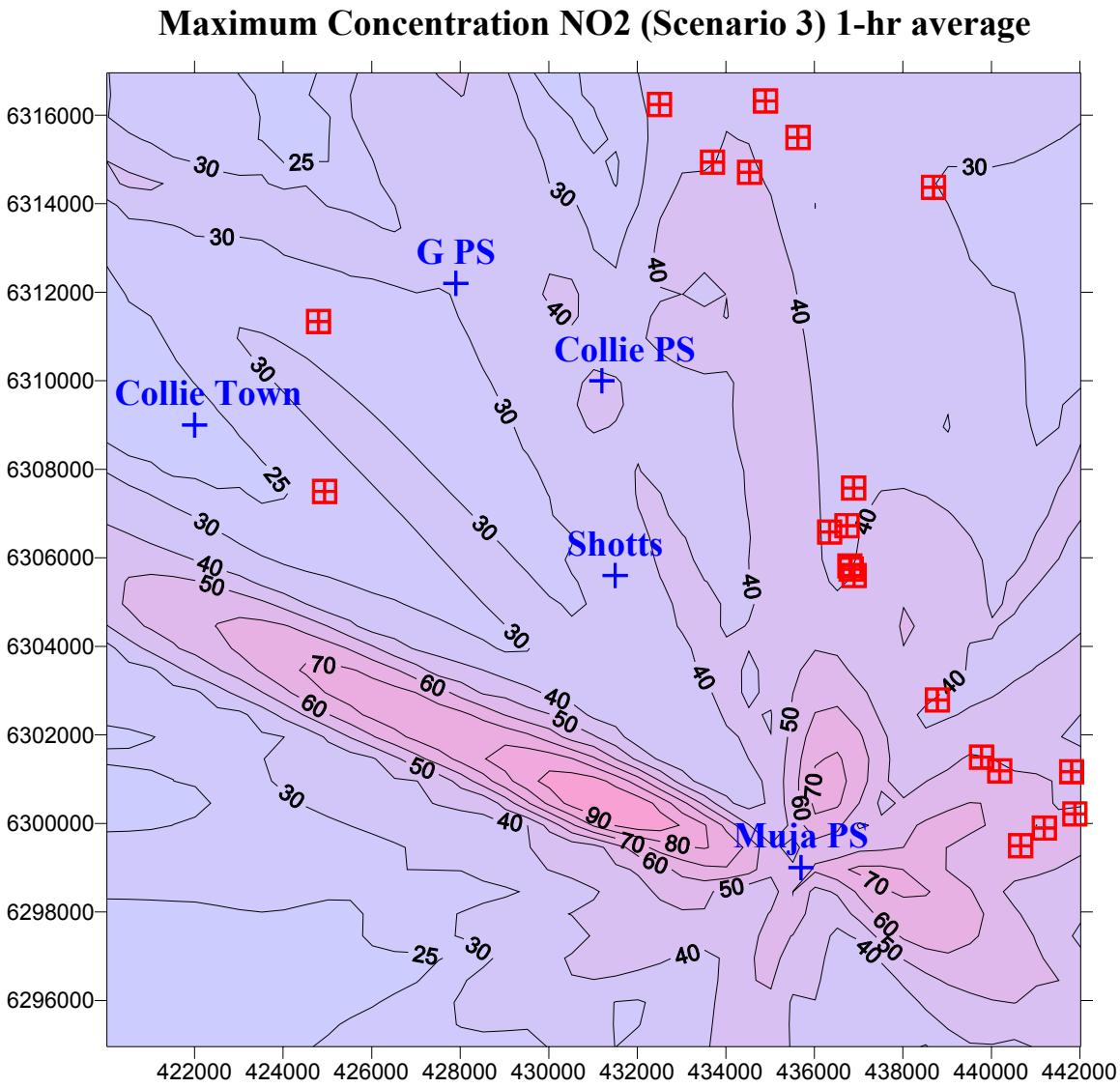

Figure F.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

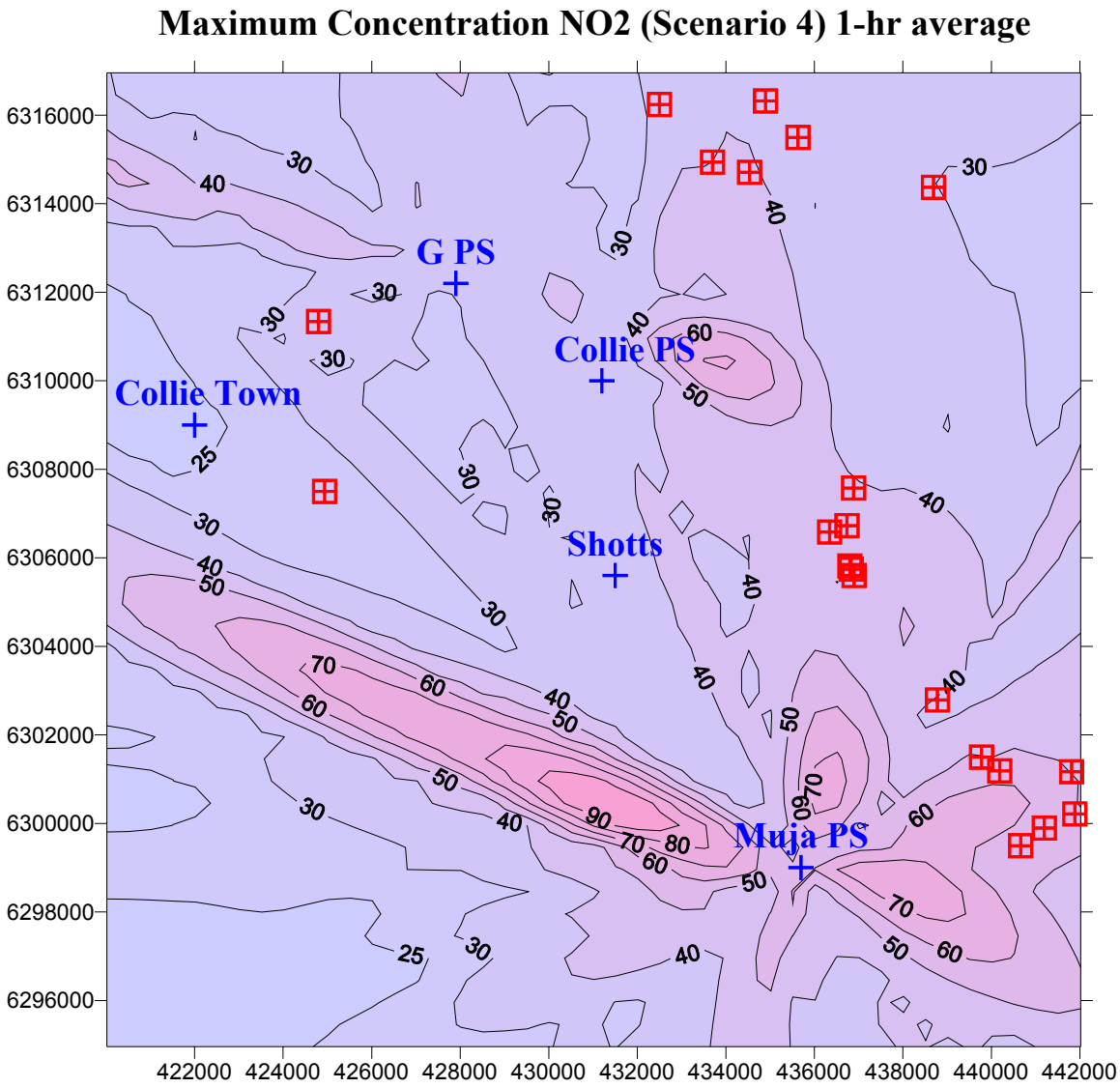

Figure F.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

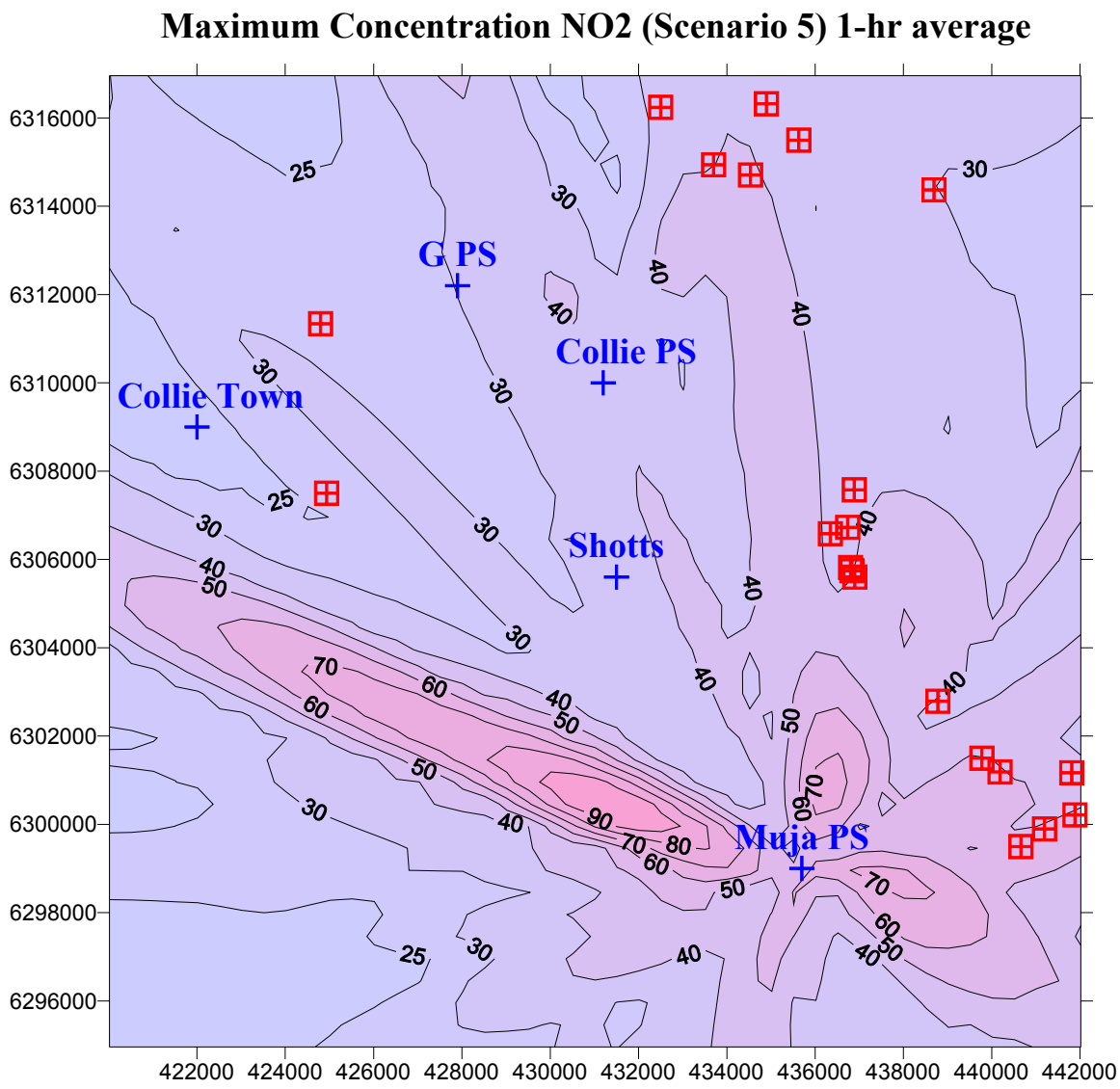

Figure F.3 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

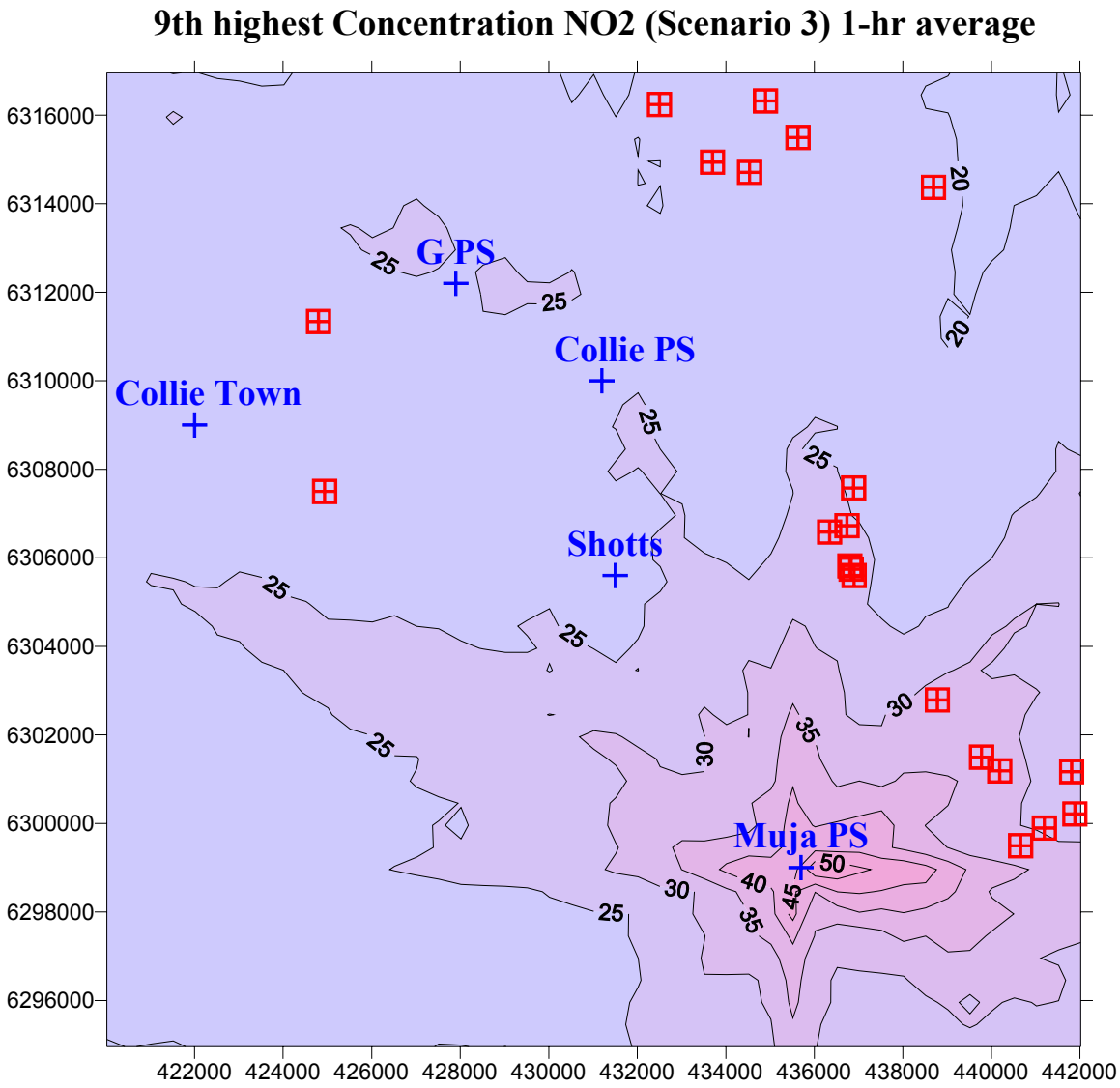

Figure F.4 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

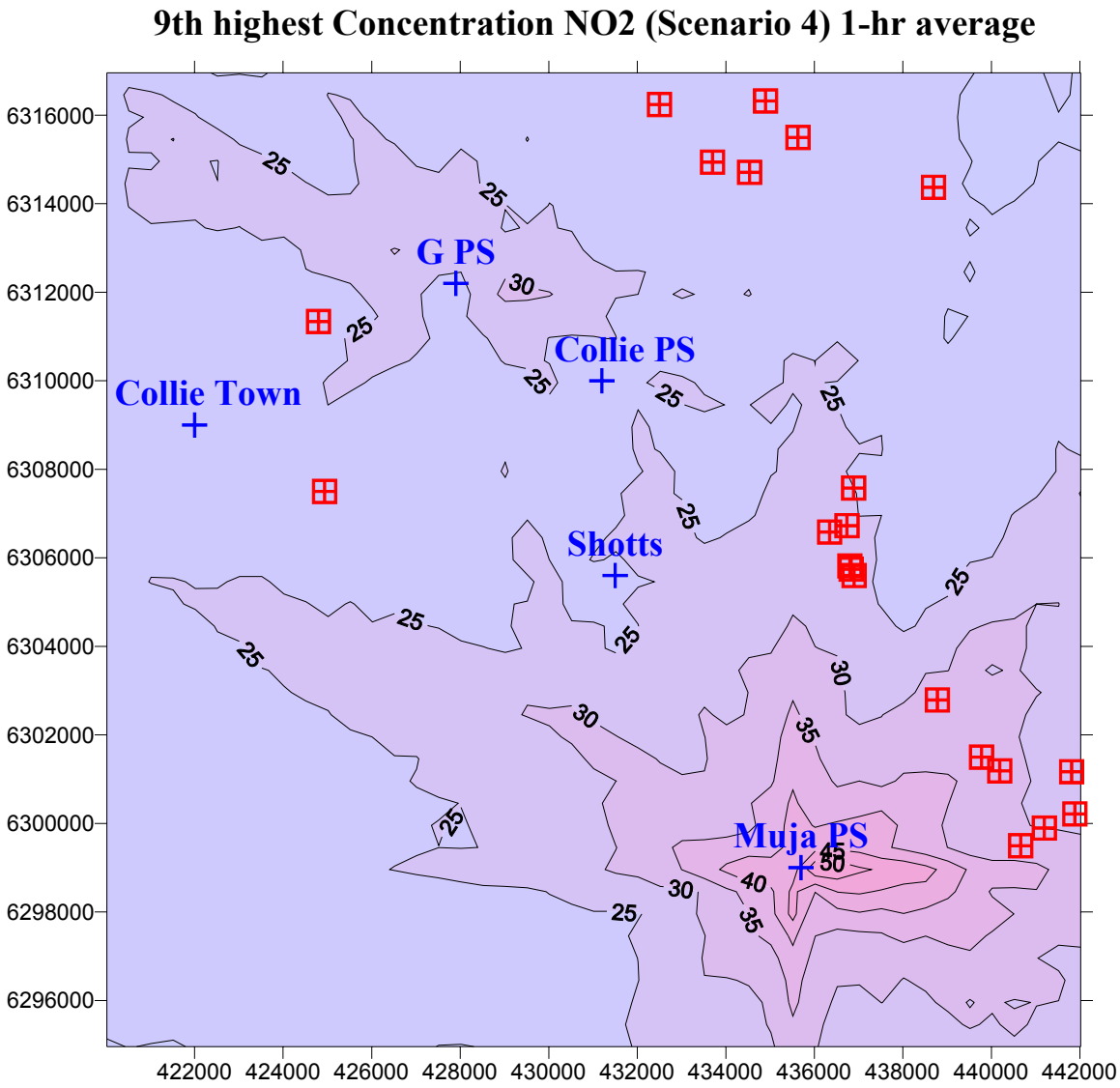

Figure F.5 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

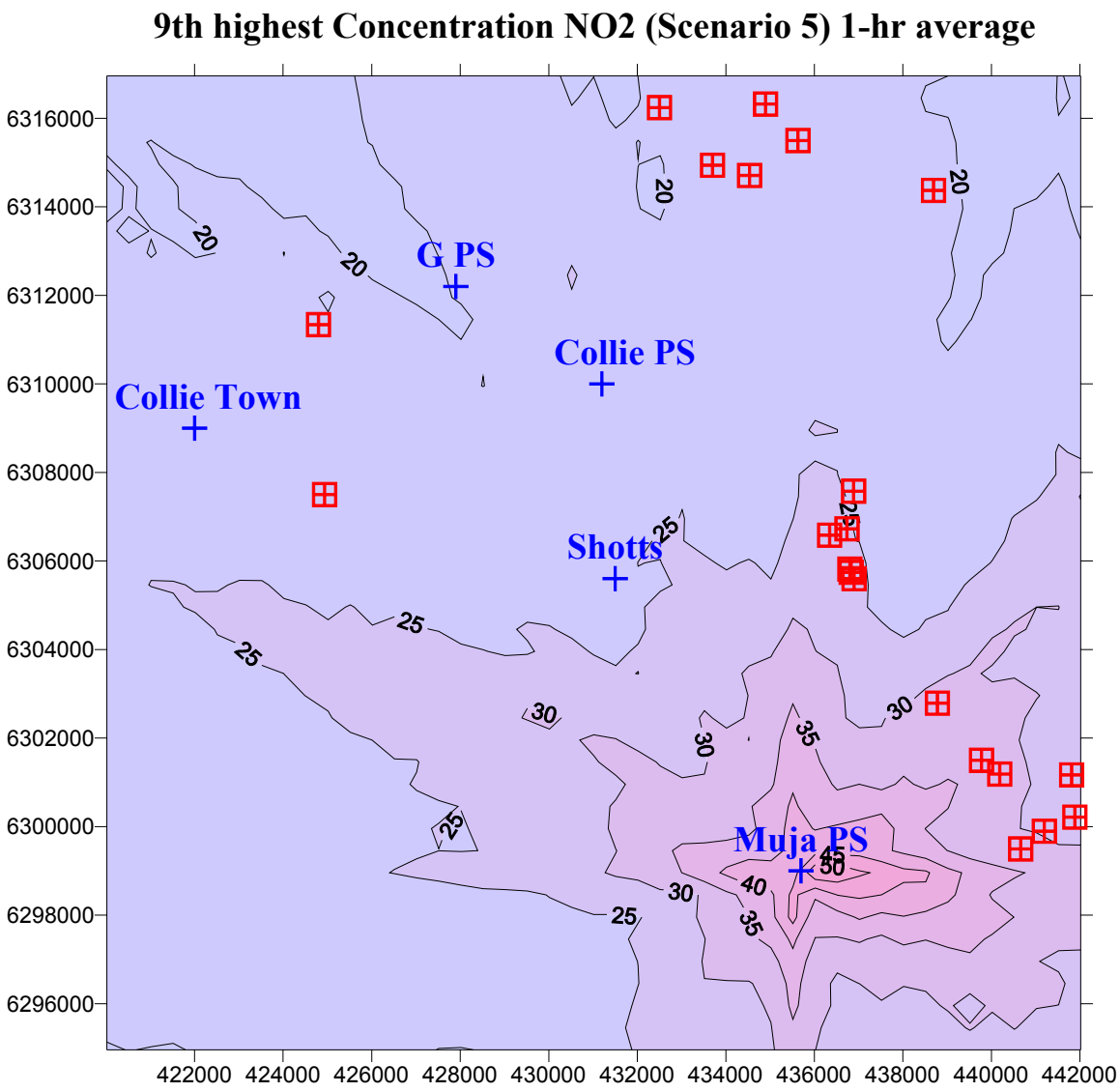

Figure F.6 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9th-highest* hourly-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

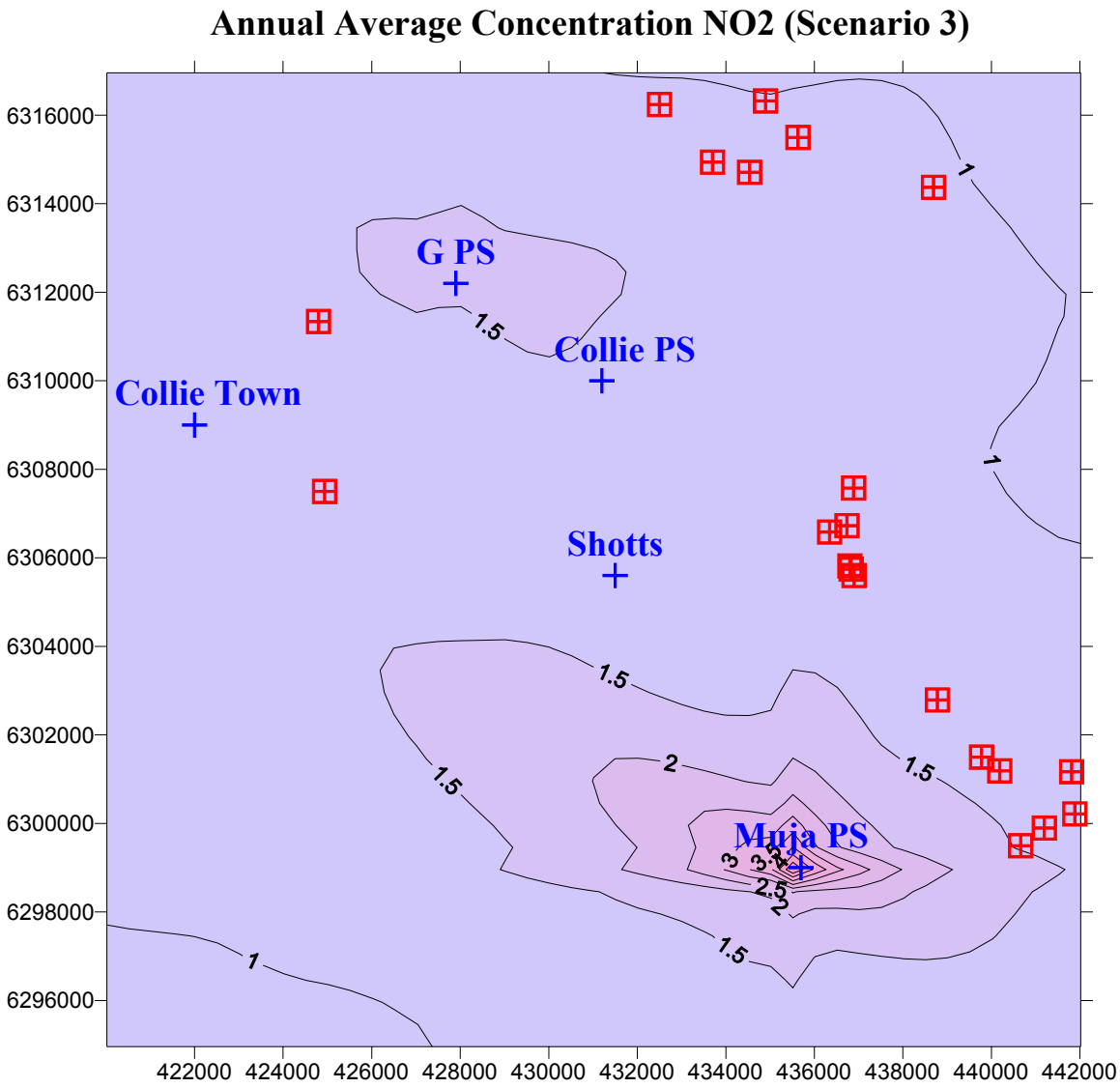

Figure F.7 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

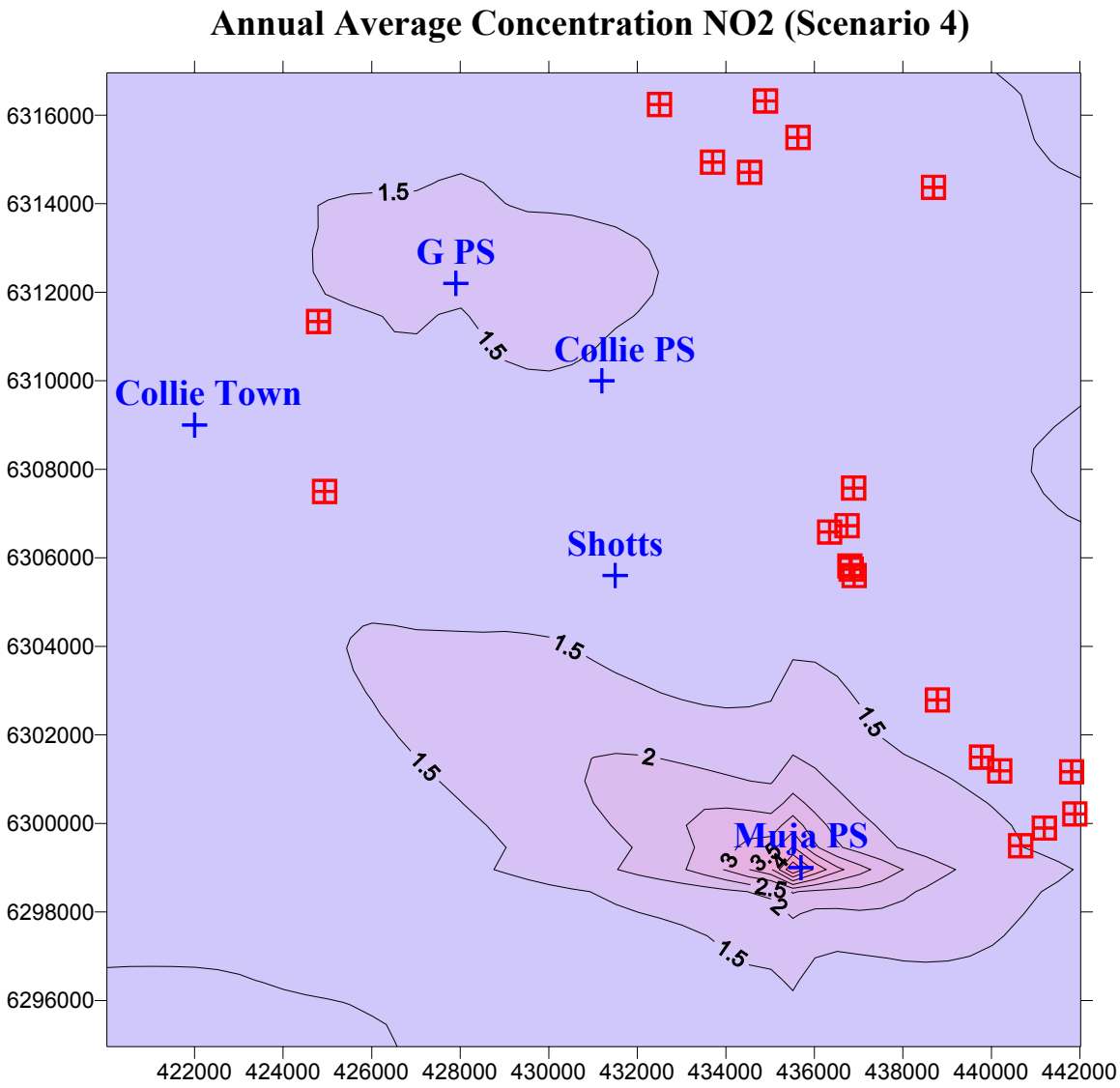

Figure F.8 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

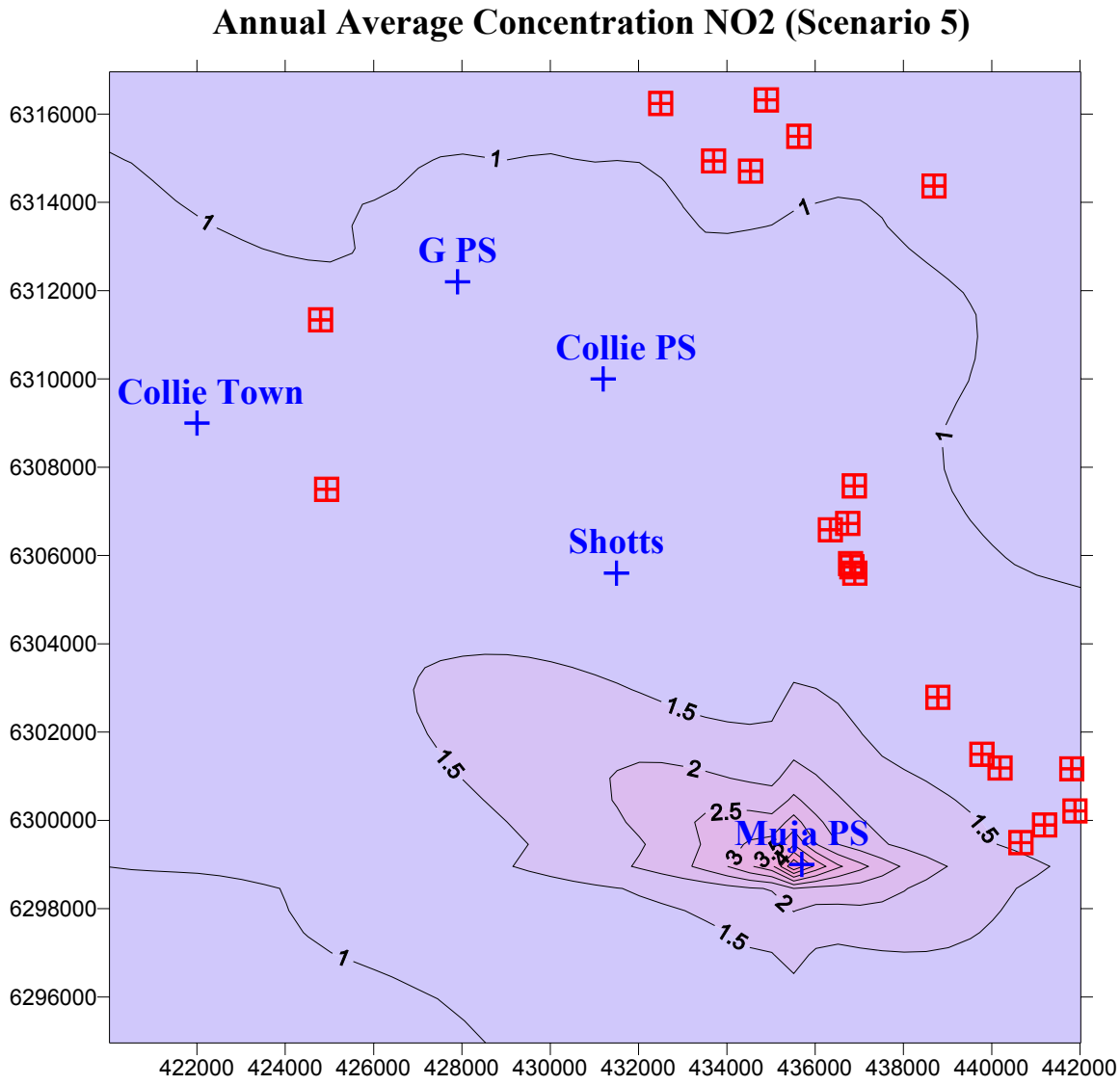

Figure F.9 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of annual-averaged concentration of NO_2 (ppb) modelled by TAPM for 2001. Red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

Appendix G Contour plots for TAPM O_3 concentrations

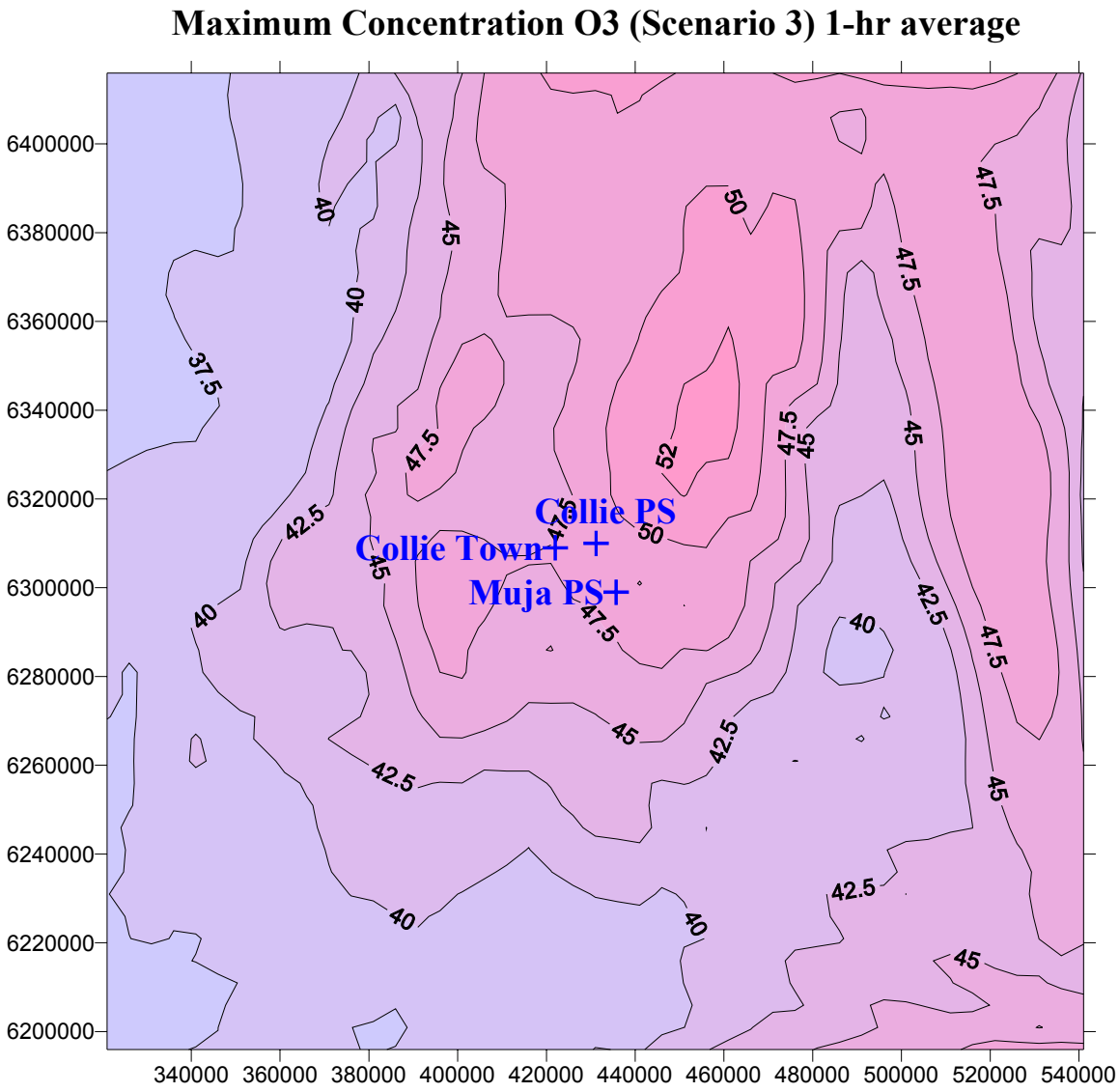

Figure G.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

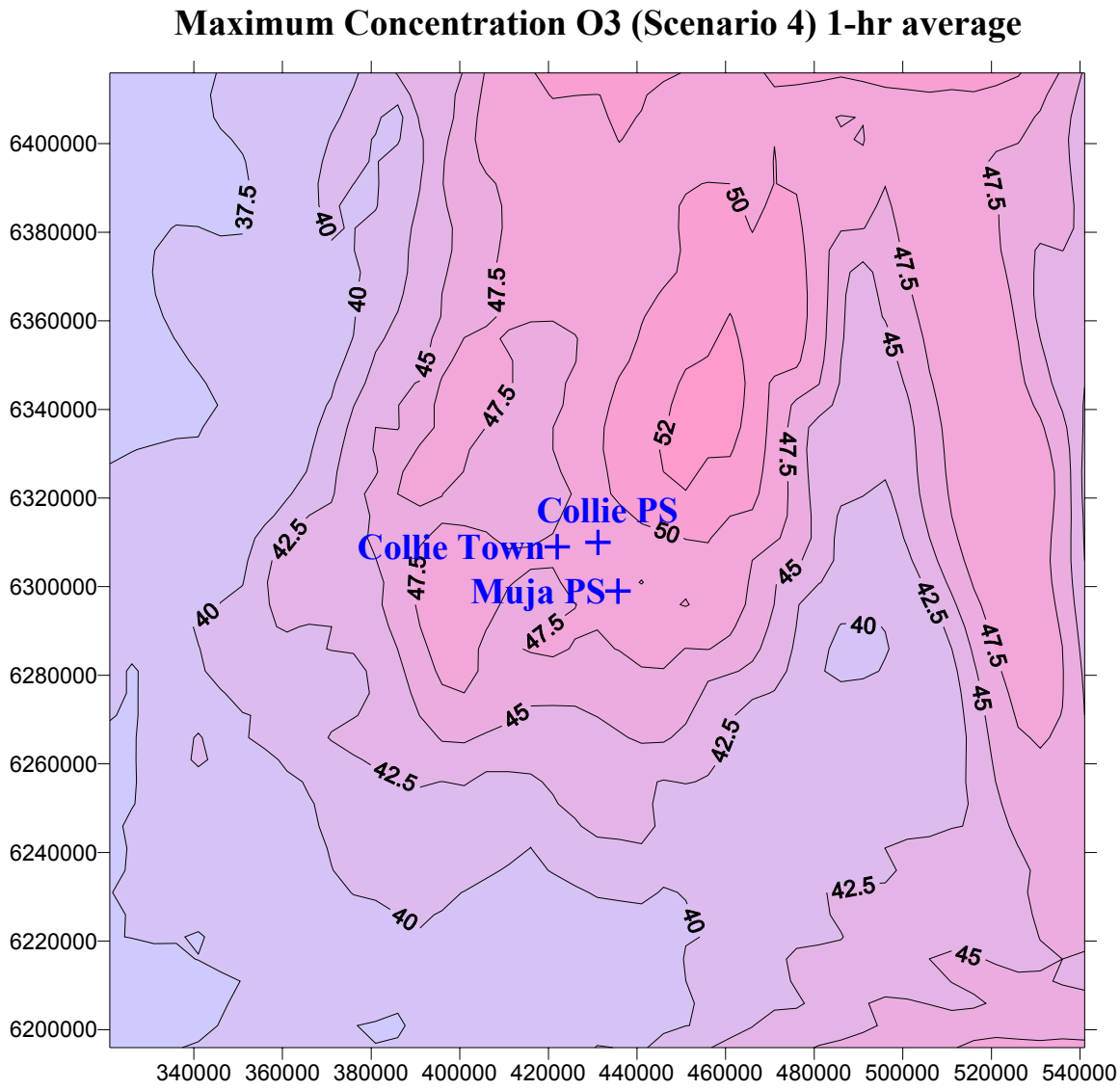

Figure G.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

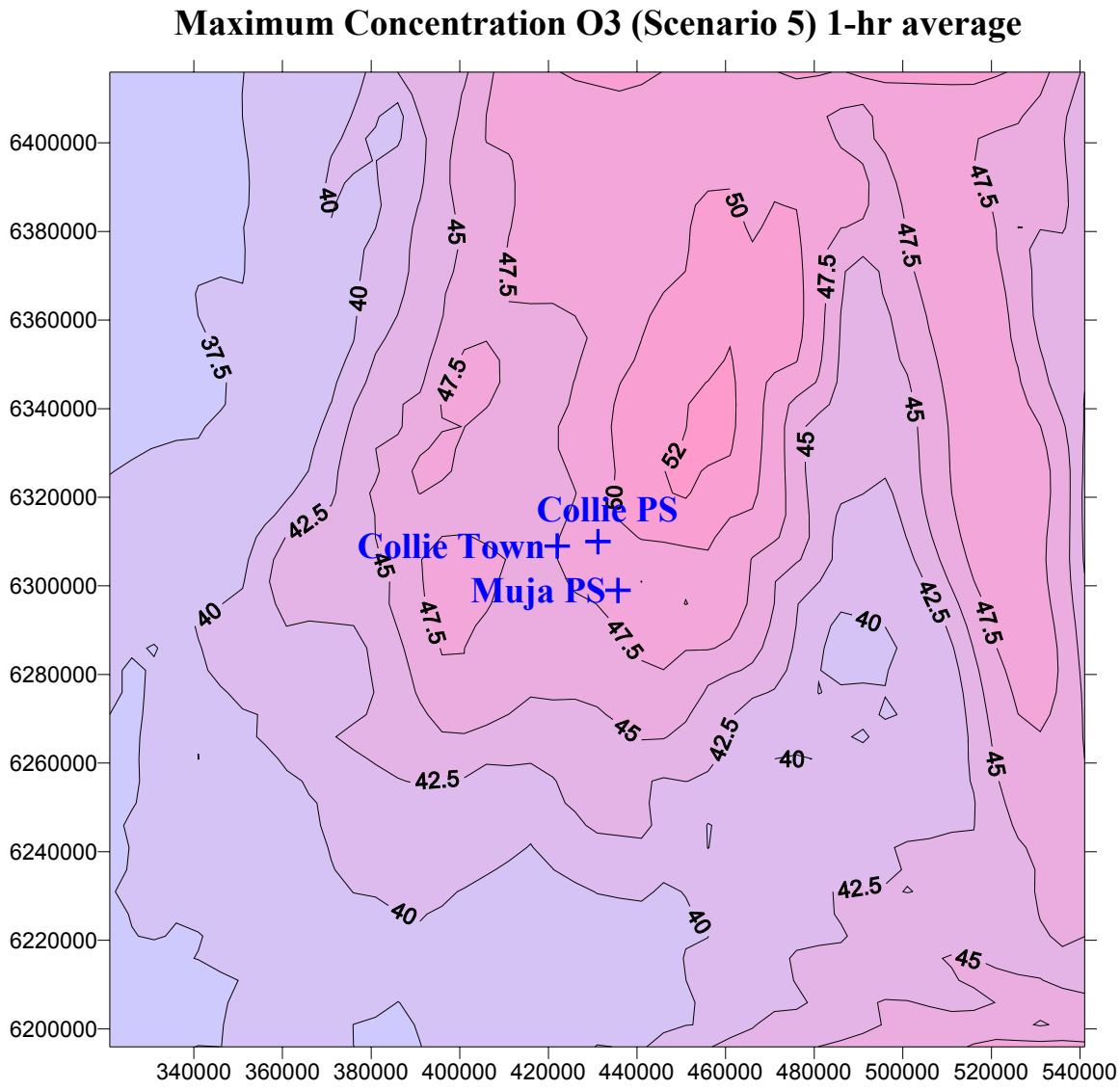

Figure G.3 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

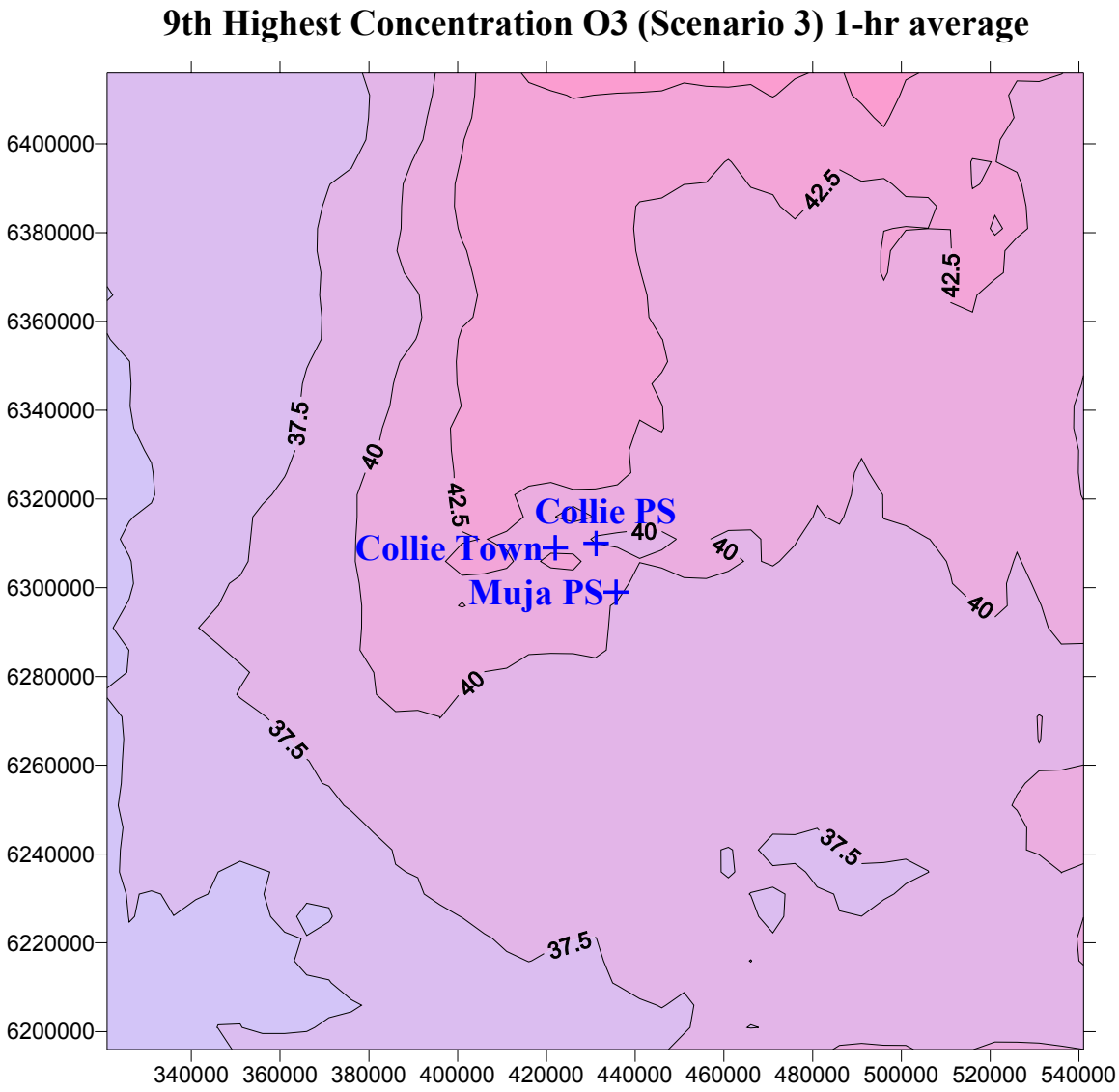

Figure G.4 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th-highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

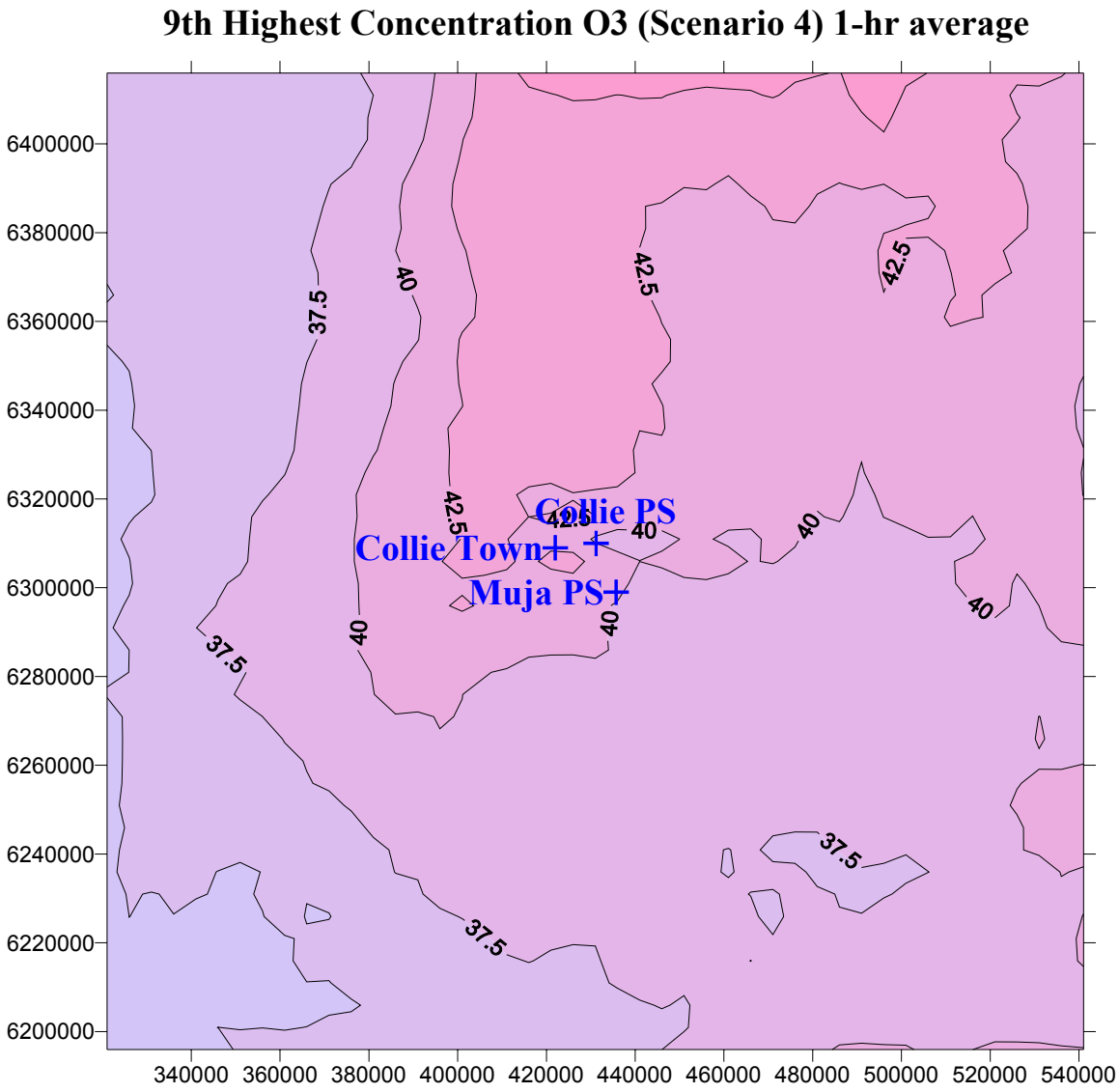

Figure G.5 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *9th-highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

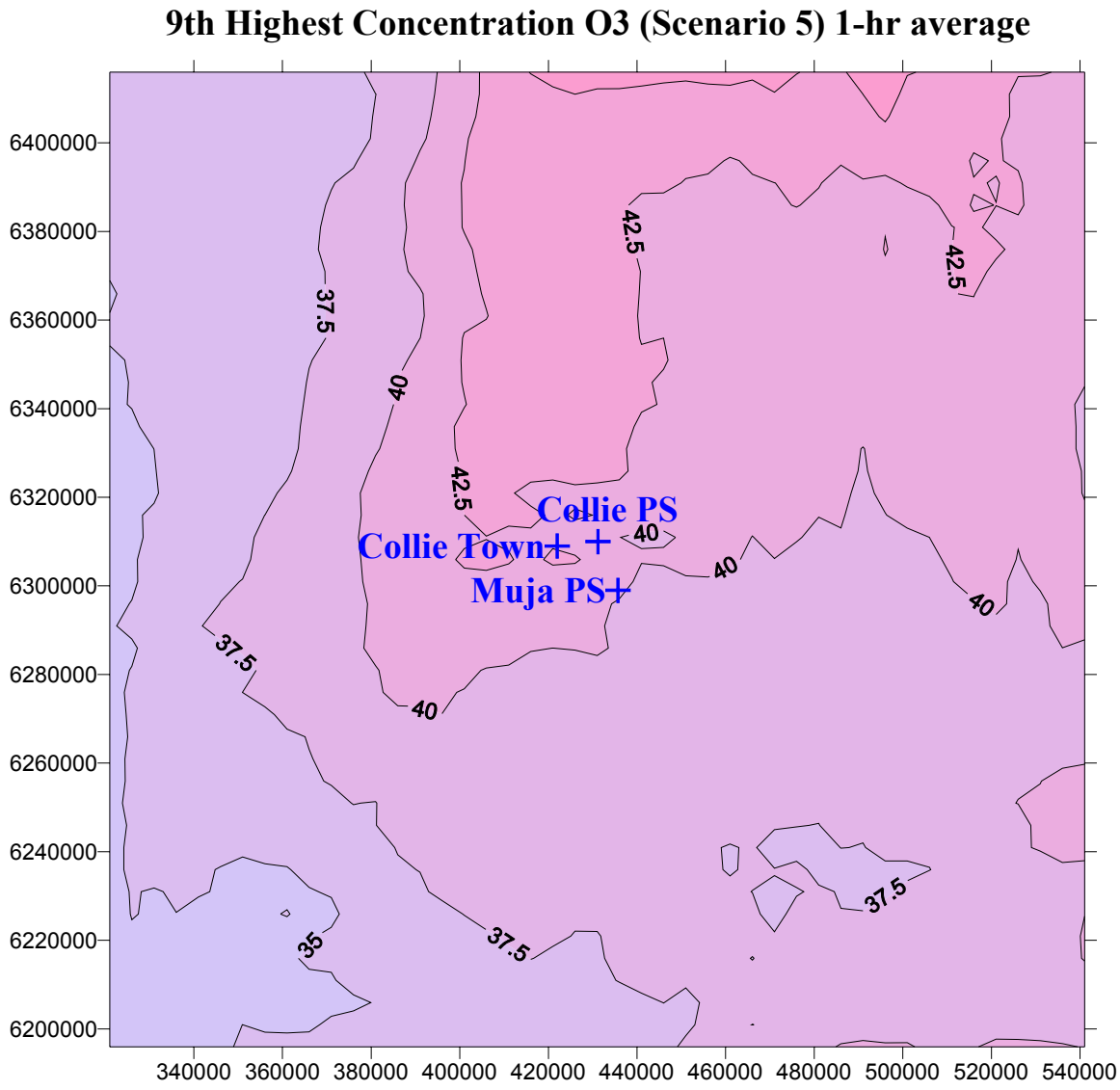

Figure G.6 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9th-highest* hourly-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

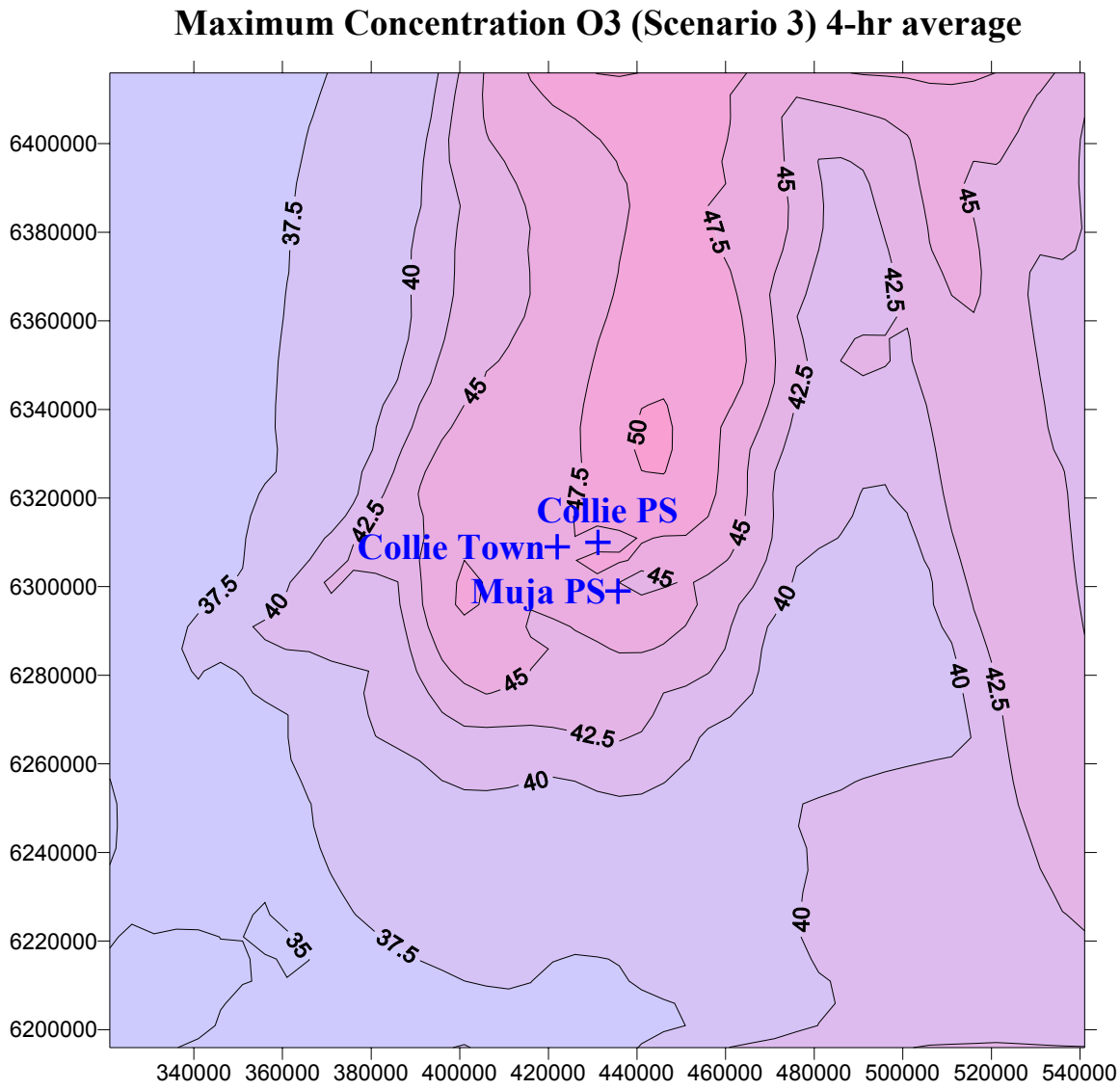

Figure G.7 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

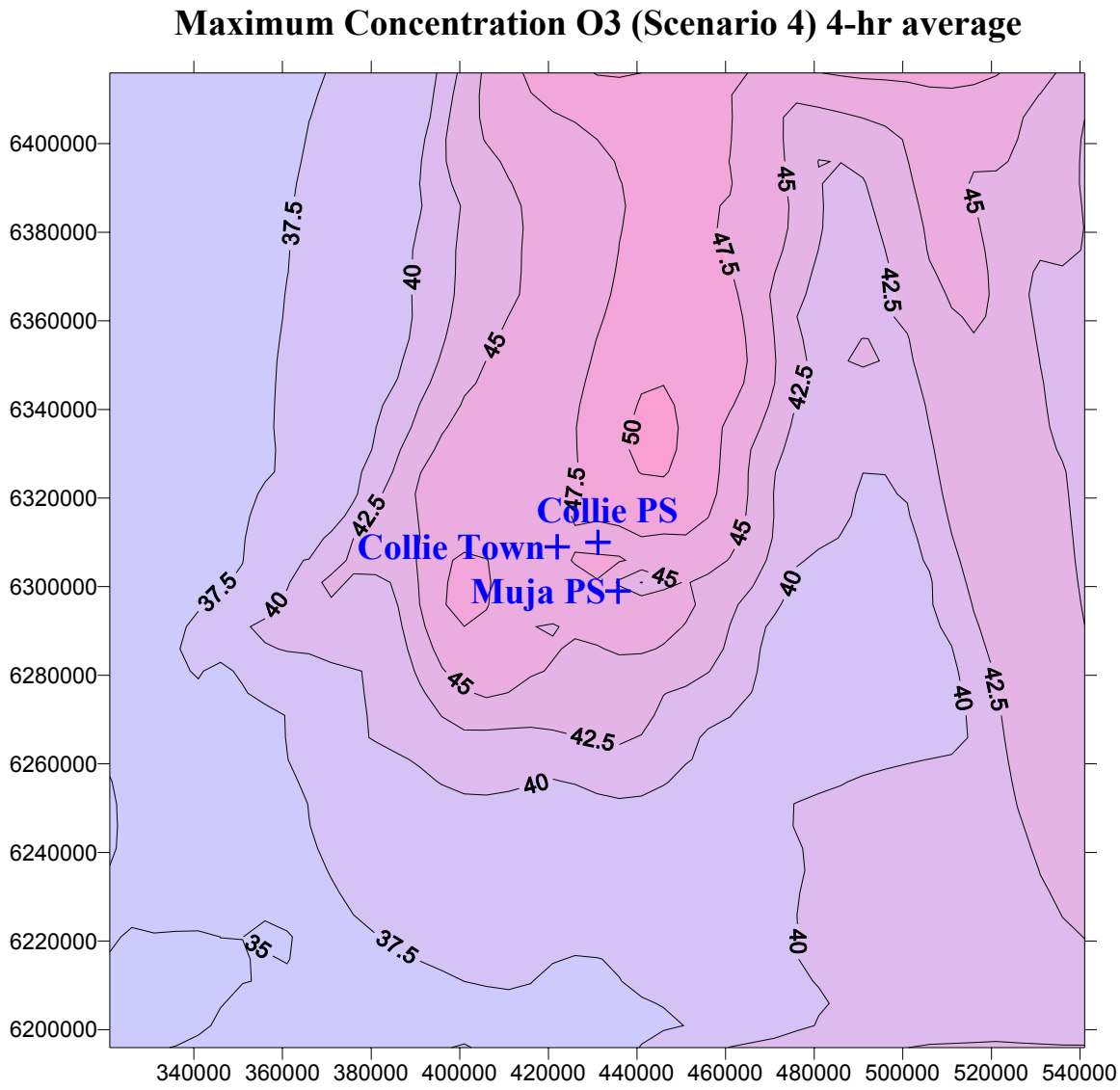

Figure G.8 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

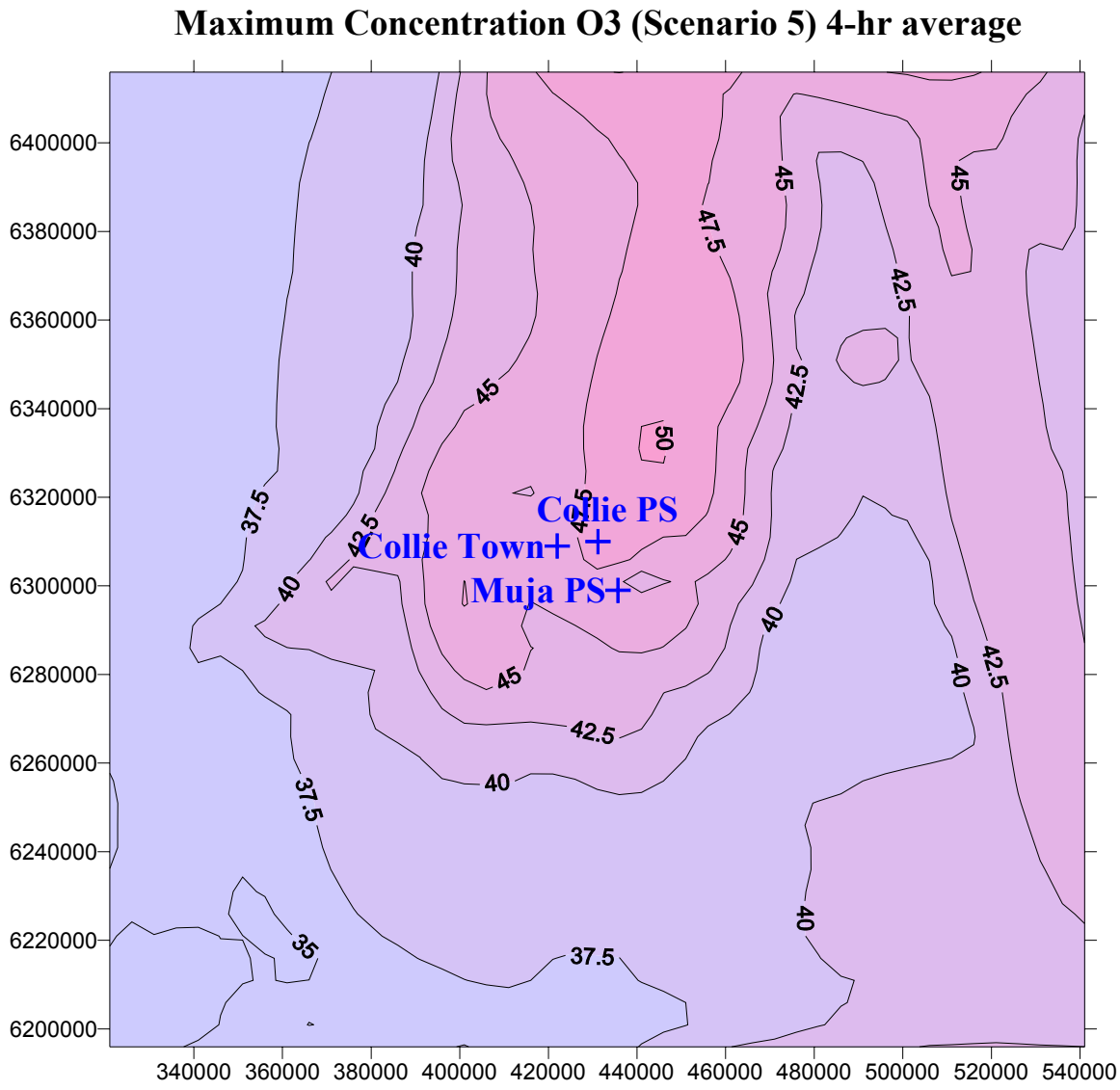

Figure G.9 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

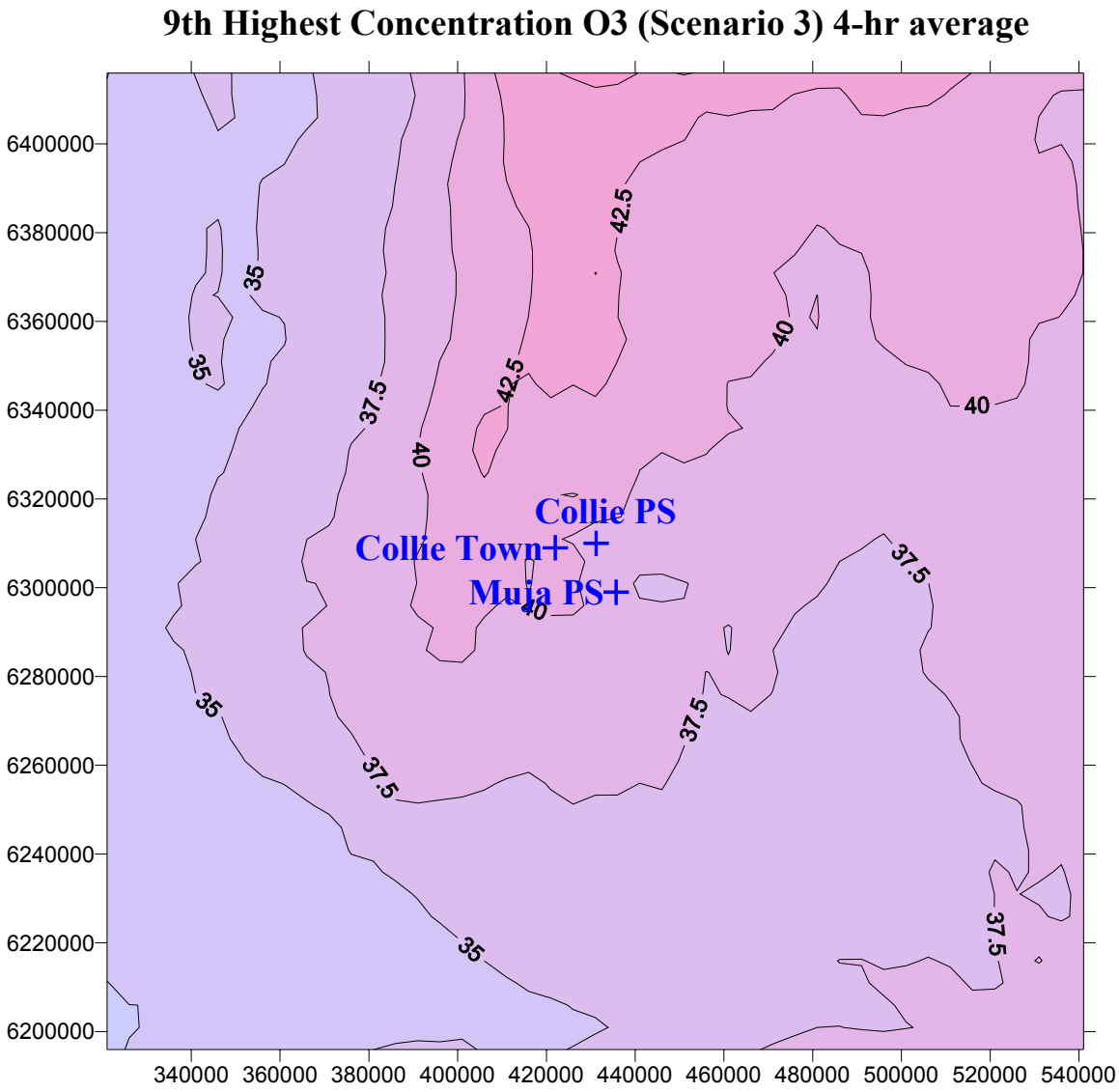

Figure G.10 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of 9^{th} *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

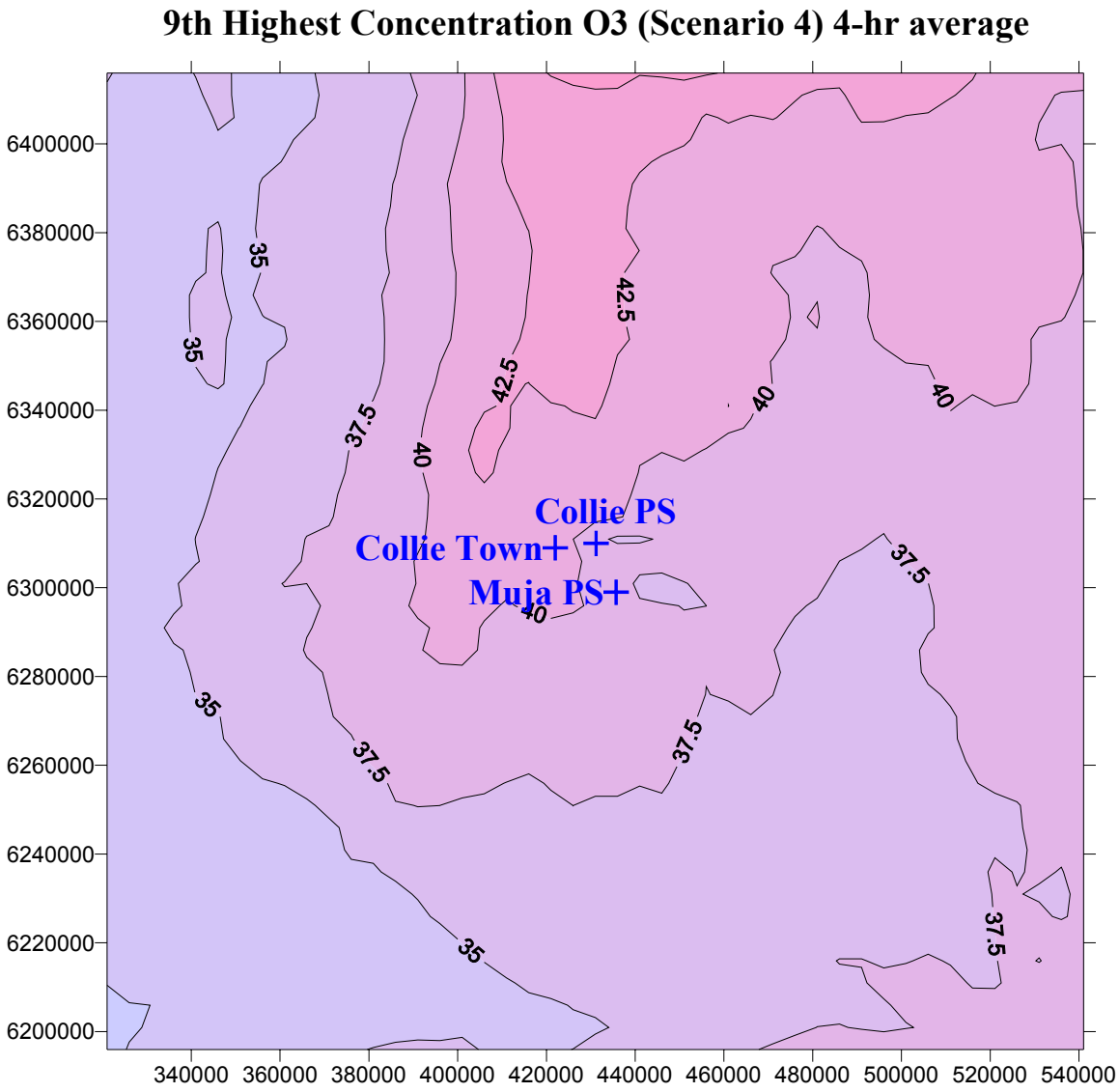

Figure G.11 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of 9^{th} *highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

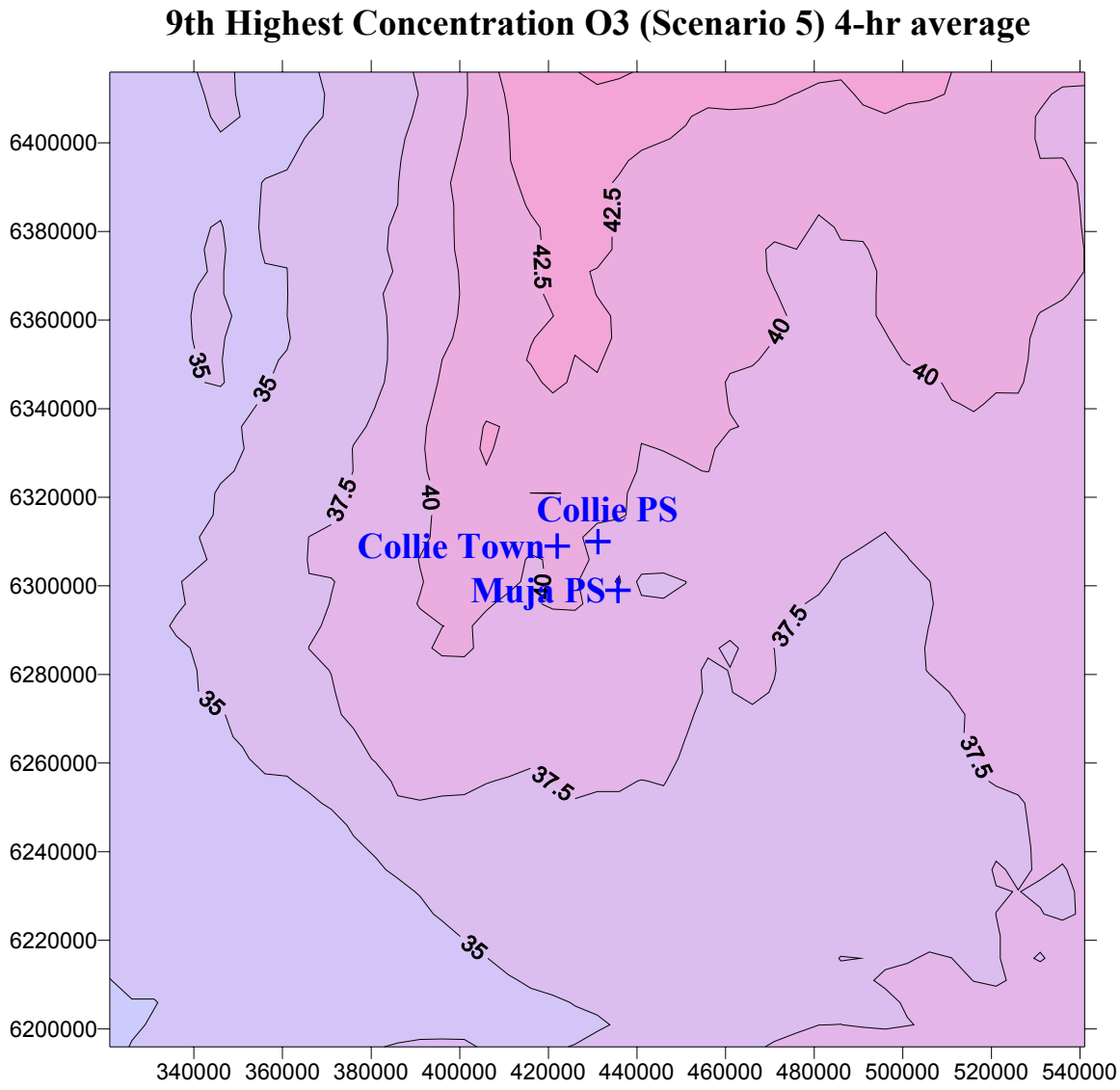

Figure G.12 For Scenario 5 (Muja A, B, Muja C, D, Collie A, B, and Worsley), contours of *9th highest* 4-hour-averaged concentration of O_3 (ppb) modelled by TAPM for 2001.

Appendix H Contour plots for TAPM PM_{10} concentrations

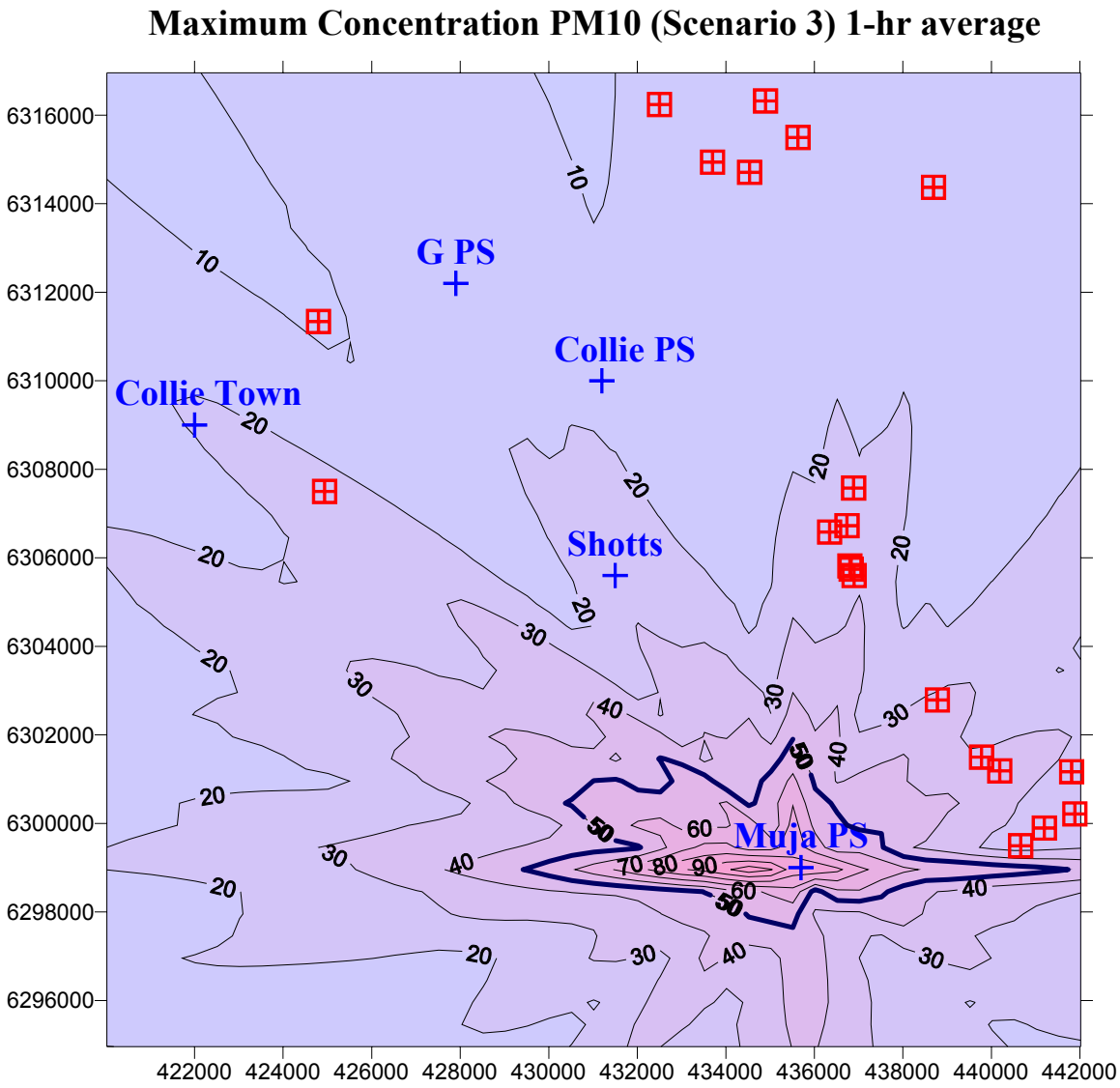

Figure H.1 For Scenario 3 (Muja A, B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

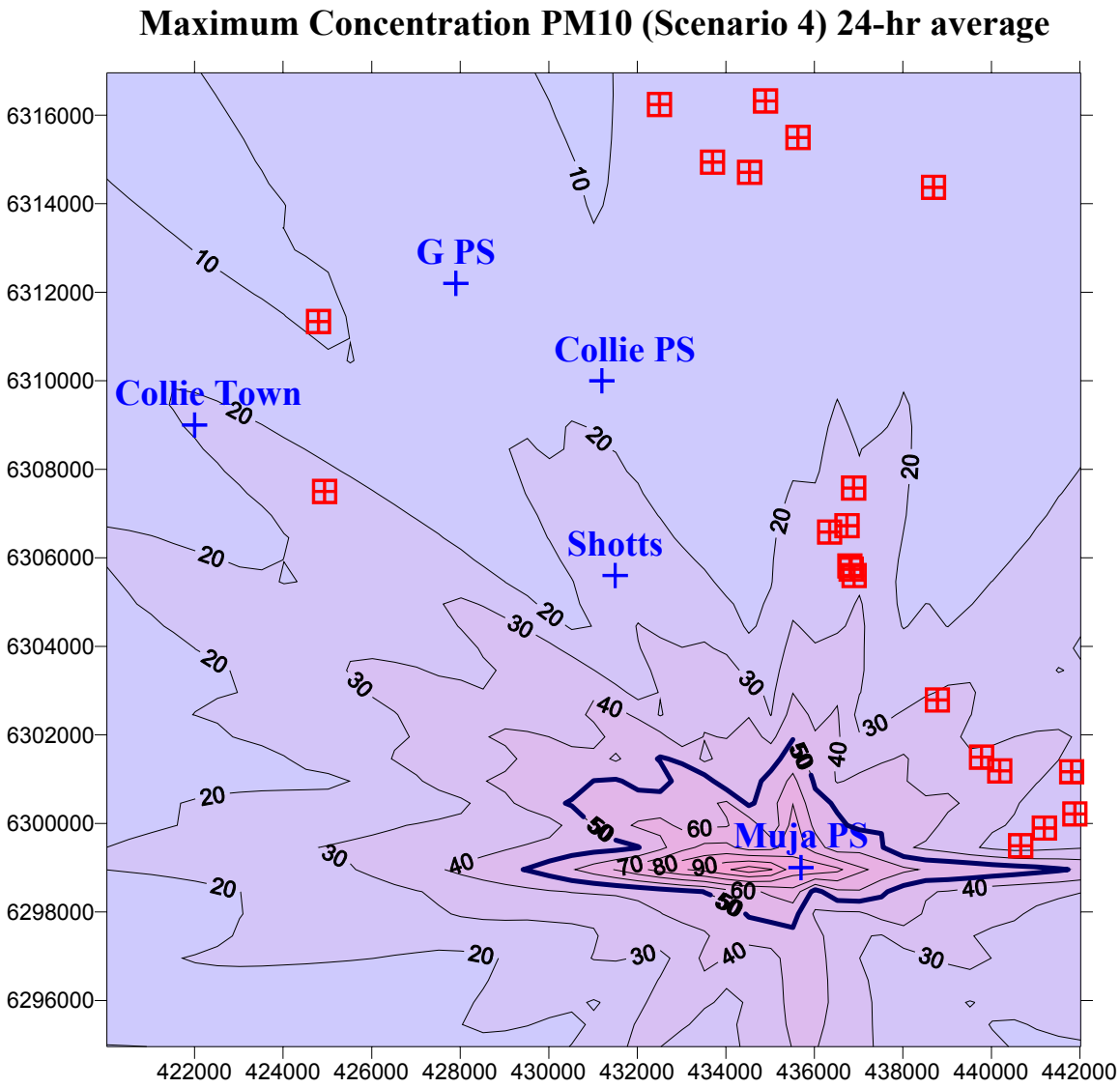

Figure H.2 For Scenario 4 (Muja A, B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of *highest* 24-hour-averaged concentration of PM10 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

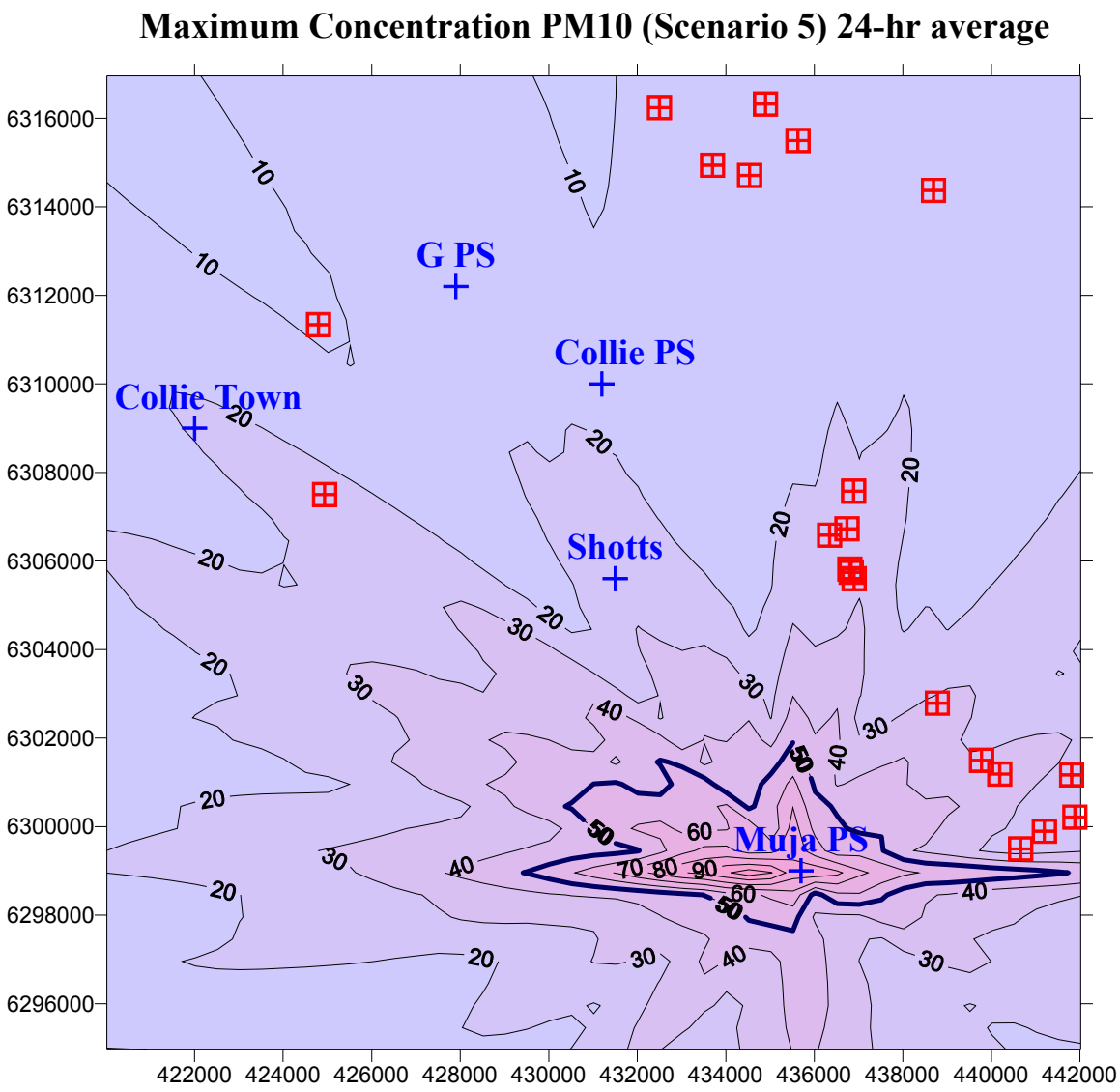

Figure H.3 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of *highest* 24-hour-averaged concentration of PM10 (µg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 µg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

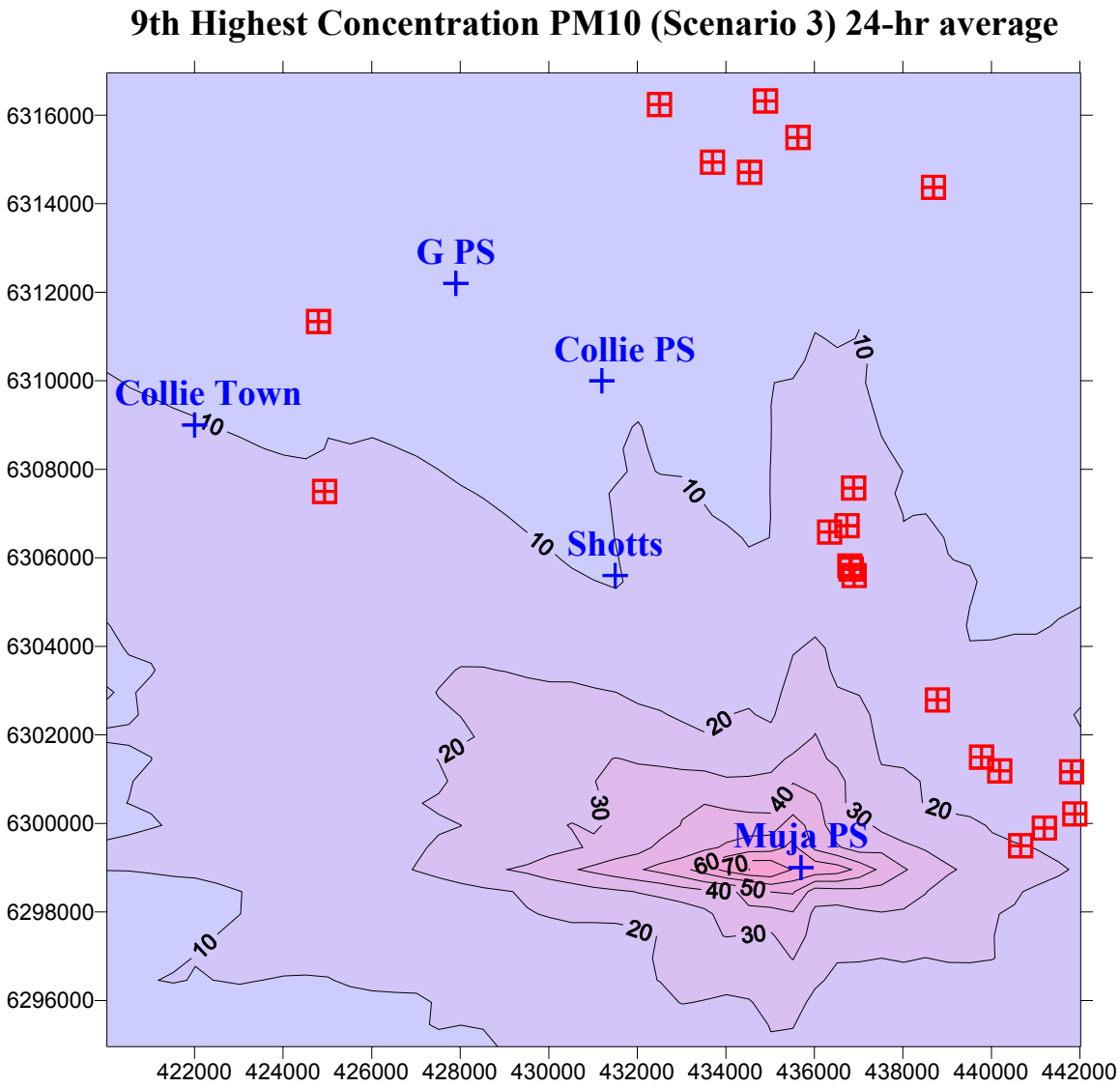

Figure H.4 For Scenario 3 (Muja A B, Muja C, D, Collie A, B, Worsley and Bluewaters I), contours of *9th highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

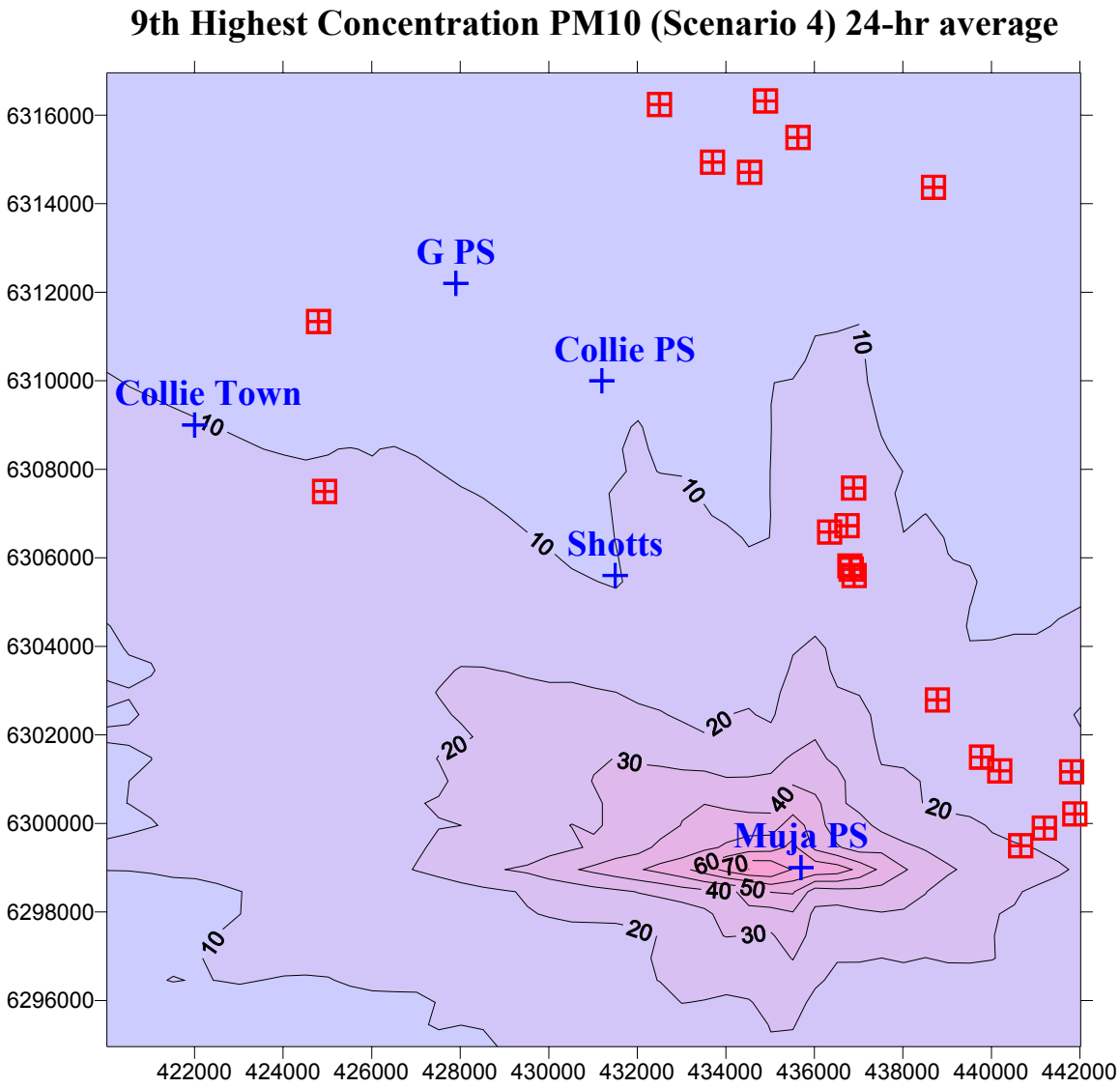

Figure H.5 For Scenario 4 (Muja A B, Muja C, D, Collie A, B, Worsley, and Bluewaters I + II), contours of 9^{th} *highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

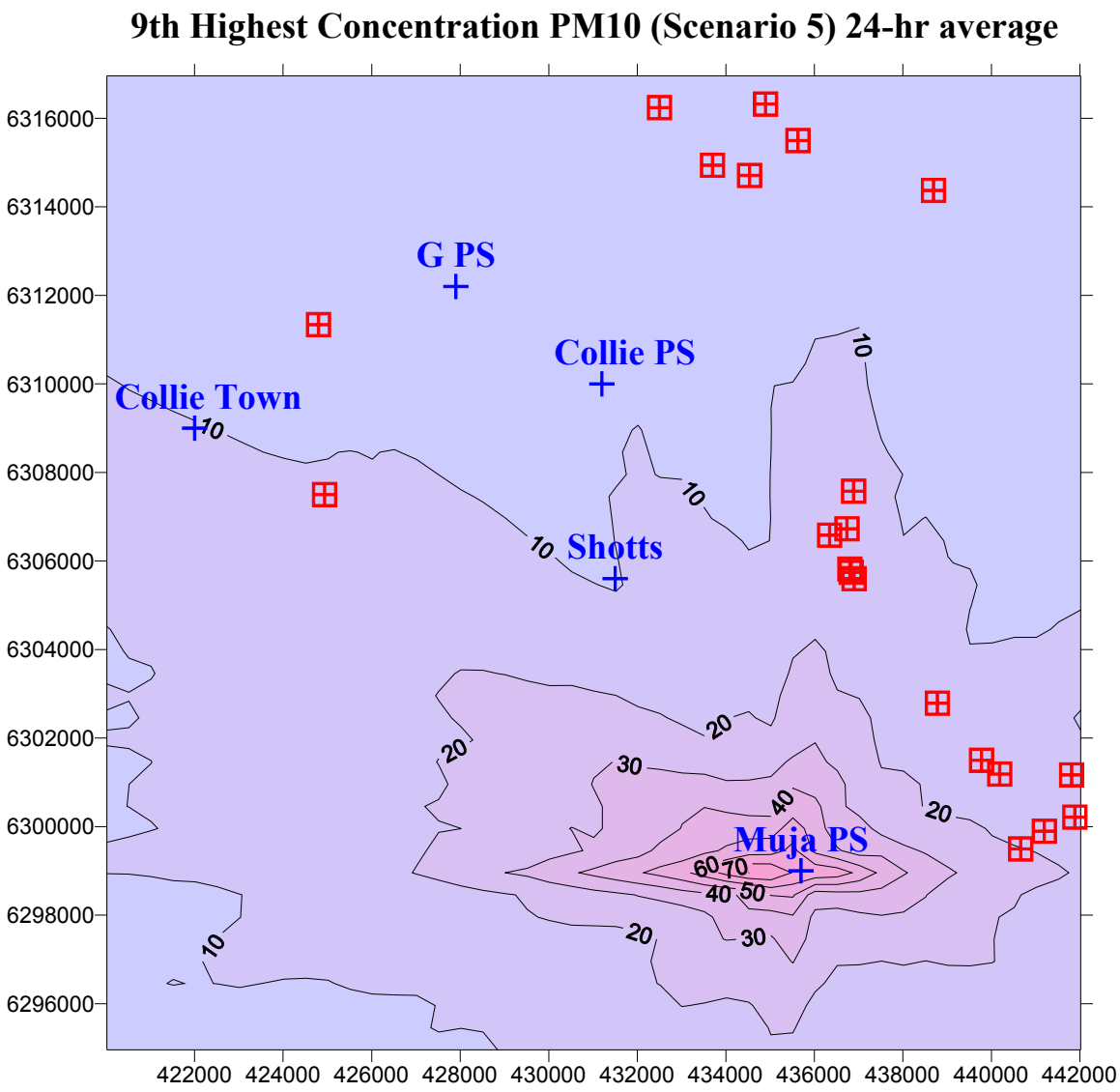

Figure H.6 For Scenario 5 (Muja A B, Muja C, D, Collie A, B, and Worsley), contours of 9^{th} *highest* 24-hour-averaged concentration of PM10 (μg m^{-3}) modelled by TAPM for 2001. Thick contour denotes NEPM standard (50 μg m^{-3}), red window symbol denotes buildings. G PS denotes the location of the proposed Griffin station at Bluewaters.

GRIFFIN ENERGY PTY LTD

Bluewaters Power Station

(Bluewaters)

Proponent's Response to Submissions

October 2004

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Summary of Submissions Received

A total of 255 submissions were received by the Environmental Protection Authority (EPA).

The submissions comprised:

- 147 pro-forma email submissions via the Bluewaters website
- 92 written pro-forma submissions
- 2 direct email submissions to the EPA.

Written submissions were received from the following:

- One private citizen
- Department of Health (DoH)
- Department of Conservation and Land Management (CALM)
- Department of Planning and Infrastructure (DPI)
- EPA Service Unit (EPASU)
- Pollution Action Network (PAN)
- Heritage Council of Western Australia (HCWA)
- Shire of Collie
- South West Development Commission (SWDC)
- Bunbury Wellington Economic Alliance (BWEA)
- Western Power Corporation (WPC)
- South West Chamber of Commerce and Industry (SWCCI)
- Department of Indigenous Affairs (DIA)
- Joint submission from the Conservation Council of WA, the Australian Conservation Foundation, WWF Australia, and Climate Action Network Australia (CCWA, ACF, WWF, CANA).

Of the submissions received there were 5 submissions totally opposed to the project (three members of the public, PAN, and CCWA, ACF, WWF, CANA), 7 submissions commented without indicating support either against or for the project (DOH, CALM, DPI, EPASU, HCWA, DIA, WPC), and 243 submissions supported the project.

Of the 239 pro-forma submissions, 72 included extra comments in the pro-forma in the space provided. Of these extra comments, only two took a position against the project, all of the remaining extra comments were in support of the proposal.

Overall the submissions received by the EPA were 95% in support of the project. In the supporting submissions the general theme was one of support as a result of the positive social and economic impacts on the town and region. The supporting submissions were also complimentary on the environmental approach adopted by Griffin Energy in proposing the project.

1 Noise

Issue 1.1 Raised by CCWA, ACF, WWF, CANA.
The Acoustic assessment provided in the Public Environmental Review (PER) has been undertaken for a power station of 150MW only, whereas Bluewaters is 200 MW.

Response The modelling for Bluewaters used noise data for a nominal 400MW unit and is therefore conservative. Refer to paragraph four on page one of the Herring Storer Environmental Acoustic Assessment.

Issue 1.2 Raised by WPC.
The noise modelling that was undertaken deals mainly with compliance at the nearest noise sensitive premises in Collie, and does not address other requirements of the *Environmental Protection (Noise) Regulations, 1997*. It is not clear from the PER document whether the proposed power station complies with the requirement to meet 60dB(A) at all undeveloped noise sensitive premises such as the nearest non-mining land, or whether cumulative noise impacts were taken into account in the modelling.

Response Part 1 – Meeting 60 dB(A) at all undeveloped premises.

The modelling carried out by Herring Storer Acoustics shows that this requirement will be met. Refer to Figures 01 and 02 of the Noise Assessment report in the PER.

Part 2 – Cumulative Noise Impact.

As Bluewaters stages I and II are effectively on the same premises, then 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 Stage I was based on noise levels from a 400MW power station. Therefore, we believe that the modelling of Bluewaters is conservative. The addition of Bluewaters Stage 2 has been subsequently modelled, 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.

2 Water Usage and Disposal

Issue 2.1 Raised by DPI.
It would be sensible for the plant design to allow the use of saline water for cooling purposes.

Response Griffin Energy will keep this option under consideration, however it should be noted that 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 the plant efficiency. If the make-up water has a high mineral content, it can undergo fewer cycles of recirculation before being discharged. Therefore, there would be a significant increase in the amount of water demand and waste water requiring disposal.

Issue 2.2 Raised by WPC.
Cooling. In section 4.6 of the PER a wet cooling tower is specified. To what extent have other technologies such as air cooled condensers, been explored?

Response 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 1 gives an indicative comparison between dry and evaporative cooling systems under Collie conditions.

Table 1
Comparison between Dry and Evaporative Cooling Systems

	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

3 Flora and Fauna

Issue 3.1 Raised by CCWA, ACF, WWF, CANA.
The statement in the Executive Summary of the PER that " Construction of the plant does not require… disturbance to any ecosystems" contradicts the results of the flora and fauna survey, which refers to the potential impact on Baudin's Cockatoo and Red-Tailed Black Cockatoo. These species are listed Threatened Species under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*.

Response The flora and fauna report covered a larger area than that which will be impacted by Bluewaters. The purpose of the flora and fauna report was twofold, namely to provide information on a regional context and on site specific information. As Bluewaters is to be built on cleared agricultural land there will be no disturbance to any ecosystems.
Bluewaters 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 2003/1289).

Issue 3.2 Raised by DPI.
Information on the indirect impact on fauna movements between vegetation remnants from the development of new infrastructure associated with the proposed power station needs to be provided, and could be addressed via an Operational Environmental Management Plan.

Response No major new infrastructure is required to support the proposal (see response to Issue Number 7.3). The project area is cleared grazing land on the proposed Coolangatta Industrial Estate. Griffin notes and agrees with DPI's comment that indirect impacts on fauna during operations will be dealt with in the Operations Environmental Management Plan. 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.

Issue 3.3 Raised by CALM.
The likely downstream impacts of the proposal regarding the clearing of forest for mining and power transmission to support the project should be clearly identified.

Response It is noted that the connection points for this project are characterised by cleared land. The coal supply for the power station will be sourced from the Ewington I coal mine. The coal mine is in the final stages of obtaining approval for its Environmental Management Plan. The mine will supply other customers besides Bluewaters. The projected life for Bluewaters and the Ewington I mine is expected to be of the order of twenty five years. The impacts of the mine development have been fully documented in the approval process for the mine. Therefore, the

downstream impacts of the proposal with respect to mining have been fully documented.

Bluewaters will access the existing 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 Atmospheric Emissions

Issue 4.1 Raised by WPC.
The total Volatile Organic Compounds (VOC) emission for Bluewaters appears to be underestimated.

Response The method for estimating VOC emissions was to pro-rata data on the NPI website for the existing Collie Power Station for the reporting year 2001-2002. Griffin Energy notes the information published on the National Pollutant Inventory (NPI) database that the amount of VOC emitted from coal fired power stations in the Collie region is insignificant when compared to biogenic sources.

Issue 4.2 Raised by WPC.
Why was the Griffin Energy 800MW South West Power Project (SWPP) excluded from air emission studies?

Response The Bluewaters proposal replaces SWPP, therefore to include SWPP would mean modelling for emissions that will never occur.

Issue 4.3 Raised by WPC.
Air modelling should include the proposed Worsley expansion.

Response It did. At the time the air modelling was undertaken the proposed expansion at Worsley had not been formally announced. Subsequent to the advice of the expansion Worsley advised that the expansion would not significantly alter the air emission profile from their facility. Griffin commissioned further air modelling which includes a conservative increase in the air emission profile for Worsley.

Issue 4.4 Raised by DoH.
There needs to be an overall development plan for Collie.

Response A development plan for Collie needs to be addressed from a broader perspective than an individual development proposal such as Bluewaters. Maintaining or improving air quality in the Collie area is of prime concern to Griffin Energy. Air emission modelling undertaken in support of the Bluewaters proposal clearly demonstrates that there is no

deterioration of air quality in the Collie area attributable to Bluewaters. The modelling clearly shows the limits to be well within all accepted guidelines.

Overall planning for the Shire is the responsibility of the Shire of Collie and responsible State government authorities. Griffin Energy is committed to ongoing consultation with these and all other stakeholders to facilitate an overall development plan, and to ensure that all due processes are followed in the development of any proposal put forward by the company, including Bluewaters.

Issue 4.5 Raised by DoH.
Modelling for the estimation of short term average ground level concentration needs to be undertaken for contaminants that can have health effects following short term-duration exposures.

Response Modelling for SO_2, NO_x, PM_{10}, CO, Hg, PAH and Fluoride was undertaken. The quantities of other components of the emissions are very low and if they were modelled would produce results that are statistically meaningless. The only substance to approach any of the accepted standards is Sulphur Dioxide. In this case the modelling clearly demonstrates that Bluewaters is not a significant contributor to the Collie air shed. This is shown in Table 3 on page 25 of the PER. See also the response to Issue 4.8.

Issue 4.6 Raised by DoH.
No information has been provided on the characterisation of emissions from the present power stations or whether the substances included for consideration are representative of coal-fired emissions.

Response Table 2 on page 16 of the PER (Key Proposal Characteristics) gives an emission profile for Bluewaters. This profile is an estimation based on an operating profile similar to that expected in the proposed plant. It was prepared by engineers responsible for designing the proposed plant. It was verified by comparison with the profile of the Collie A Power Station obtained from the NPI. The emission profiles of all power stations in the Collie area are similar and vary only to the extent of the age of the plants and the technology used within the plants. Collie A Power Station was used as an analogue for Bluewaters because it is most similar in technology and pollution control equipment to that expected to be installed at Bluewaters. The emission data obtained from the NPI is data collected from the power stations themselves, using consistent methodology appropriate to the collection of such data. The data is regularly verified through stack monitoring as required under the power stations operating licences.

Issue 4.7 Raised by DoH.
The data that was used to model the relevant pollutants were derived from the National Pollutant Inventory (NPI) data. The use of this data would only enable a broad estimate of emissions to be determined which may not be accurate. Justification should be provided for not characterising the emissions.

Response Actual emission rates for each hour of the year in 2001 for SO_2 are used in the modelling for Muja and Collie power stations, obtained from Western Power. For the remaining pollutants considered (NOx, PM_{10}, CO, Hg, PAH and fluorides), hourly emission rates have also been derived by scaling the SO_2 rate each hour by the ratio of the annual NPI total emission of the pollutant under consideration and the annual SO_2 emission. In this way, important hourly variation is introduced for all pollutants. Even if measured emissions each hour of the year had been available for other parameters, the answer to the Study question (what is the impact of the proposed Bluewaters power station) would not have been any different, i.e. that Bluewaters does not significantly contribute to raising levels of NOx, PM_{10}, CO, Hg, PAH and fluorides to anywhere near guideline levels.

Issue 4.8 Raised by DoH.
The identification and characterisation of the potentially exposed population (i.e. sensitive receptors) has not been undertaken, and the modelling averaging periods of 1 hour are considered to be too long to enable the possible health effects on exposed individuals to be determined.

Response Modelling has shown that SO_2 levels are below the accepted NHMRC 10 minute average standard.
The scenarios examined and presented in Table 2 below are:

Scenario 1	Bluewaters in isolation
Scenario 2	Bluewaters stage I and II operating in tandem
Scenario 3	Muja A,B,C and D, Collie A plus proposed Collie B and Worsley (including proposed upgrade) and Bluewaters I
Scenario 4	Combined scenario 1 and 3
Scenario 5	Existing emission profile in Collie

Time averages from TAPM modelling for the proposed 200 MW power station at Bluewaters (Physick and Edwards, May 2004).

Table 2
SO_2 concentrations at Collie township in µg m^{-3}

Scenario	1	2	3	4	5
Hourly averages					
Highest	163	284	287	287	233
9th-highest	108	159	168	206	117
NEPM standard	570	570	570	570	570
Short-Term averages (10 min)					
Highest	334	582	588	588	477
9th-highest	221	326	344	422	240
NHMRC (250 ppb)	715	715	715	715	715
WHO 10 min average	500	500	500	500	500
UK DEFRA 15 min avg 100 ppb (max 35 exceedences)	266	266	266	266	266

Estimates of 10-minute have been made using a power law dependence of the concentration on averaging time of the form:

$$\frac{c_a}{c_m} = \left(\frac{t_a}{t_m} \right)^p , \qquad (1)$$

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 Environmental Protection Authority 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 in the above table.

Consistent with enHealth hierarchical source of information or guidelines, the most appropriate guideline for concentrations shorter than 1 hour is the NHMRC guideline of 715 µg m^{-3} (250 ppb) for 10-minute average concentrations.

The predicted, short-term SO_2 concentrations from the proposed facility are within the more conservative 10-min guideline by WHO. Whilst, the United Kingdom (UK) Department of the Environment Food and Rural Affairs (DEFRA)

(http://www.defra.gov.uk/environment/airquality/aqs/so2/7.htm) guideline is exceeded by the predicted concentrations in some scenarios, it should be noted that their 24-h average (125 µg/m^3) is the same as the 24-h average by WHO, whilst their 1-h average is 350 µg/m^3, that is, higher than the 15-min average.

The maximum 1-hour average concentration of SO_2 in the Collie townsite reported by Western Power from their ambient air monitoring in the Collie area was less than 0.08 ppm. The monitoring was undertaken during the period March 1995 to April 2002.

DEFRA provides guidance that whenever the1-hour mean concentration of SO_2 exceeded 50 ppb, then it is likely that the DEFRA 15-minute guideline of 100 ppb is exceeded.

The data provided by Western Power in the Collie Power Station Expansion SER was examined using the DEFRA guidelines. The results indicate that the 15-minute average guideline could have been exceeded 12 times over the seven-year monitoring period.

Interpretation of TAPM modelling (W.L.Physick pers comm.) predicts 4 such excursions in the modelling year (2001) for existing emitters. The predicted 4 exceedences for the year 2001 are more than would be expected from examination of the actual data collected over seven years. If 2001 was considered an 'average' year then the measured data, to be consistent with the model, would have shown 28 exceedences over the seven years. This further demonstrates the conservative nature of the TAPM model.

The model output was mapped against actual measurements from the Collie Monitoring program undertaken by Western Power. The following diagram (Figure 1) shows the predicted versus actual levels for three sample locations, being Shotts townsite east of Collie, Bluewaters Farm and Collie Town. The mapping of actual versus predicted levels shows that the model has sufficient accuracy for it to be used with confidence.

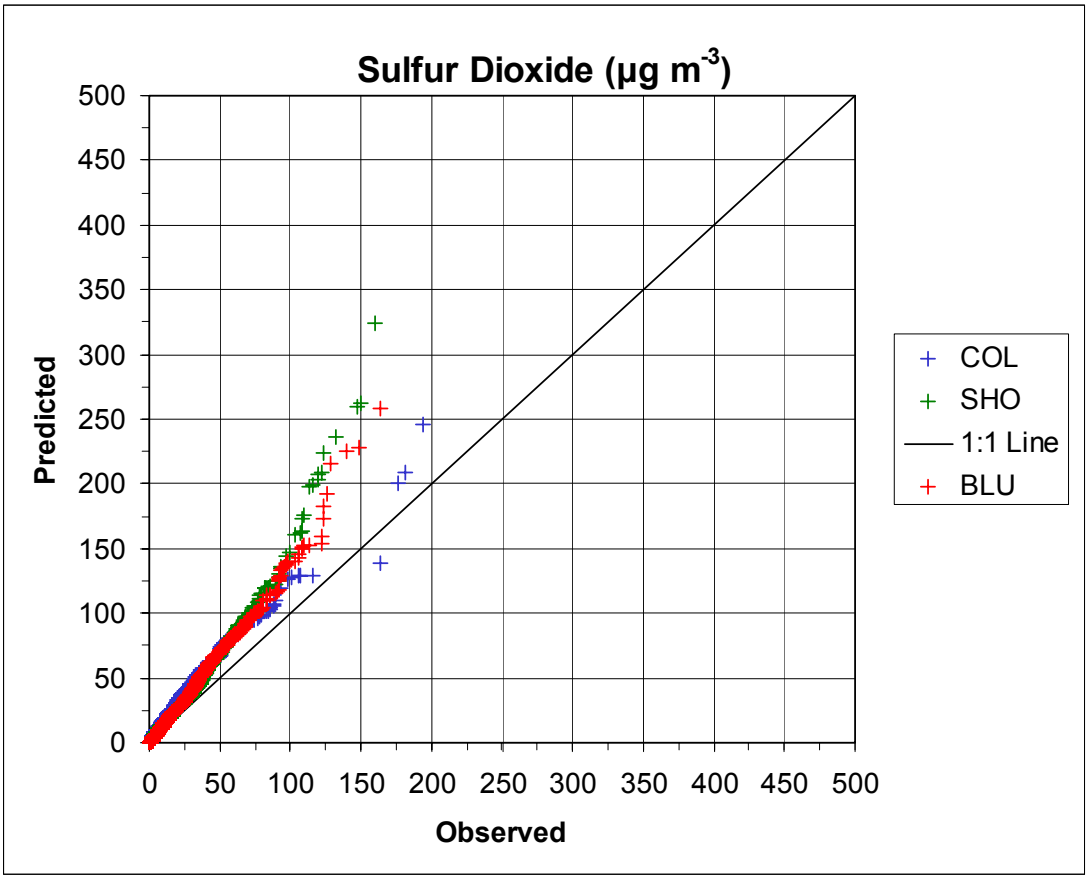


Figure 1 – Correlation of predicted vs actual SO_2 concentrations
Note: COL = Collie; SHO = Shotts; BLU= Bluewaters Farm

The results given by the model are conservative and within accepted NEPM and NHMRC standards, as shown in Table 3.

Table 3
Summary of actual and predicted levels against standards

Scenario	Bluewaters I	Existing Emitters (from TAPM model 2001 data)	Model prediction (existing plus proposed emitters)	Western Power Measured data (1995 – 2002)
Highest level (µg m^{-3})	163	233	287	230
NEPM 1 hour standard (570 µg m^{-3})	Not exceeded	Not exceeded	Not exceeded	Not exceeded
NHMRC 10 minute exposure standard (715 µg m^{-3})	Not exceeded	Not exceeded	Not exceeded	Extrapolation from data shows no exceedence
DEFRA 15 min std (286 µg m^{-3}) max 35 exceedences	Not exceeded	Exceeded 4 times/year	Exceeded 9 times/year	Exceeded 12 times in 7 years

According to the information provided with existing national standards, compliance with the one hour NEPM provides "adequate" protection for the general population. Sensitive sub-groups, such as asthmatics and sufferers from chronic heart and lung disease, have been considered in the derivation of ambient air quality guidelines. Hence compliance with the guidelines, affords protection to these groups.

Sensitive Receptors

Sensitive receptors would include hospitals, senior citizens homes and schools. Collie contains six such locations where sensitive individuals could be found. All are well within the town boundary, which has been demonstrated to have no exceedences of the NHMRC 10 minute limit. In addition there are two farm houses within 2.5 kilometres of Bluewaters. Modelling has shown that exposure levels at these locations are comparable to the levels in the town and are well within accepted limits.

As can be seen from the above analysis, the addition of Bluewaters has no impact on the predicted results for the town of Collie, thus confirming that there is no incremental health risk within the town of Collie attributable to Bluewaters emissions.

Griffin Energy is committed to continuing dialogue with the residents of Collie and will maintain an ongoing brief with the community on health and other issues relating to the power station.

Issue 4.9 Raised by DoH.

Transparent mechanisms should be used by the proponent when responding to issues raised by stakeholders in order to ensure that they are adequately addressed according to their significance.

Response 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.

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

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

- Press advertisements regarding the PER process state-wide
- The provision of 22,000 brochures, distributed as a newspaper insert, 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 including:
  - Collie Bowling Club
  - Collie Rotary Club
  - Apex Club of Collie
  - Collie Chamber of Commerce
  - Retired Mineworkers
  - Collie RSL
  - Collie High School teachers
  - Collie Tourist Information Centre
- Hosted two independently facilitated community workshops on 16 and 17 June at Collie and Bunbury respectively. Griffin management representatives were present at both these sessions. The two sessions were attended by over 36 interested parties and representatives including: Government departments, Collie Chamber of Commerce and Industry, Collie Shire Council, Western Australian Chamber of Minerals and Energy and Corporate stakeholders.
- Placed press advertisements in the Collie Mail and South West Times during the week leading up to the community workshops.

Feedback forms distributed at the community workshops included space for participants to indicate their responses to the Bluewaters proposal. In addition to the verbal questions and answers provided during the

feedback sessions, these feedback forms were returned to Griffin for analysis with the following results:

- 23 registered responses were received from Collie, though numbers attending the workshop were slightly higher
- 13 registered responses were received from Bunbury
- Numbers attending the community consultation workshops indicate that less than 1% of the 22,000 residents who received the community consultation invitation brochure were interested in attending these workshops.

Supportive comments, made by those that attended, included:

- "I am glad to see this project go ahead"
- "I strongly support the Bluewaters project"
- "I am fully supportive of what Griffin Energy is proposing to do – good for Collie and the State".

Common themes for questions raised at the workshops were:

- Provision of water to supply the power station and its impact on local wetlands and the Collie River
- Griffin's strategy for dealing with greenhouse gas emissions.

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 posed at these community consultation workshops were recorded and a questions and answer document was developed.

Summary of Community Consultation Process

The community consultation workshops have provided positive feedback to the establishment of the Bluewaters Power Station. Despite some concerns about water management in the Collie Basin in the future, there was no verbal opposition to the proposed project elicited at either of the community workshops. Health concerns did not rate a mention in the community workshops; however the impact on employment opportunities was an issue that was raised in a positive sense by attendees.

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

Issue 4.10 Raised by DoH.
The health risks to the community should be assessed on a cumulative and incremental basis.

Response The air emission modelling did address impacts on a cumulative and incremental basis. This is addressed in the response to Issue 4.8.

Issue 4.11 Raised by DoH.
Indirect health benefits need to be detailed so that a demonstration of employment and other benefits is shown.

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

The Griffin Coal Mining Company Pty Ltd (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.

Issue 4.12 Raised by DoH.
There is no analysis of well being vs. absence of disease in the PER.

Response Tools for this form of analysis are not fully developed and are difficult to address quantitatively. However, the response from the community provides a basis for qualitative assessment. The outcomes of the stakeholder program (see response to Issue 4.9) would indicate that the Collie community supports the project and considers that Bluewaters would provide considerable benefits to the Collie community. This suggest that the anxiety and stress in communities in controversial locations, that often lead to a heightened awareness of common health complaints and a tendency for individuals or communities to assign cause to the unwanted activities in their communities, is unlikely to be a concern in Collie. The project is welcomed because it is seen as making a positive financial and social, hence wellbeing, contribution to the Collie community.

As outlined in Sections 7.9 and 7.10 of the PER, Griffin Energy has committed to comply with all regulatory requirements regarding noise and dust, both during the construction of the facility and during the operation of the power plant. Moreover, Griffin Energy has committed to comply with emission standards and licence conditions imposed by the Department of Environment. Part of the responsible and environmentally sound management of the facility is a commitment to monitoring emissions and ambient levels to validate the predicted levels from the ambient air modelling and ensuring compliance with regulatory requirements.

Issue 4.13 Raised by DoH.
The Australian Framework for Health Risk Assessment should have been used to determine Community Health Risk from the proposal.

Response It is not entirely clear what this means. The Health Impact Assessment Guidelines published by enHealth in September 2001 and the Environmental Health Risk Assessment Guidelines (2002) were used to guide preparation of statements on Health Risk and Impact Assessment. Modelling was used to derive ground level concentration of predicted emissions; hence the exposure was assessed. The outcomes have been compared with established national air quality guidelines, the results of which show that the emissions are unlikely to pose a health risk to the community (risk characterisation). Sensitive individuals have been taken into account in the development of air quality guidelines as well as using short term averages as reference, hence the sensitive receptors identified. This is consistent with the enHealth risk assessment methodology.

Given the support for the project from the community and little or no concerns from the community, this approach is entirely consistent with national guidelines.

The Community Health Risk Workshop in Collie on December 12th 2003 was designed using the guideline as a reference. The baseline data used to provide a community health profile for the workshop was obtained from the report by Leiper, Stone and Clearwater "Epidemiology Profile for South West", produced by the South West Population Health Unit of the DoH in August 2003. The report showed that the health profile of the town of Collie is consistent with other South West towns and that the biggest impact on overall health in the South West could be gained through better diet and fitness regimes as well as controls on intake of drugs such as alcohol and smokes.

The enHealth Guidelines themselves state that they are not considered "tight" in their focus (Section 1.3 page 4). The proponents took the view that the guidelines required assessment as to the level of health risk assessment was first required. The air modelling and community consultation program was designed to meet this objective. Following the guidelines and referring to Figure 1 on page 12 of the guidelines leads to the conclusion that the health impacts from the project are negligible. The proponent believes that the intent of the guidelines was met. However Griffin Energy is committed to ongoing community stakeholder consultation and will maintain an ongoing monitoring brief with the community on health and other issues relating to the power station.

Given the analysis provided in previous responses and the level of support for the project from the town of Collie it is apparent that the real and perceived risks are acceptable to the Collie Community.

Issue 4.14 Raised by DoH.
There should be a commitment to the local communities.

Response The Griffin Group through Griffin Coal is in its 77th 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 the initiatives of Griffin Coal in its support of the Collie and South West communities.

Issue 4.15 Raised by a private citizen.
I am concerned about the levels of SO_2, NO_x and particulates that will be emitted from the proposed power station. The proposed emission level of 1,250mg/Nm^3 for SO_2 is six times the limit of 200mg/Nm^3 set by Directive 2001/80/EC of the European Parliament and the Council of the European Union for SO_2 emissions for new large combustion plants burning solid fuel, and thus does not represent best practice. The proponent apparently considers that they are operating in some underdeveloped third world country where the importation and use of superseded substandard equipment is acceptable.

Response The proponent has sought to adopt Best Practicable Measures to minimise atmospheric emissions from Bluewaters 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.

Regional air emission modelling undertaken in support of Bluewaters has demonstrated that cumulative Sulphur Dioxide levels in the surrounding community are well within accepted NEPM standards and are not predicted to have adverse impacts on local or regional air quality. (See also detailed response to Issue 4.8).

Directive 2001/80/EC was evaluated for relevance by the proponents for Bluewaters, however given the particular circumstances of the Collie region, 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 a low sulphur content by global standards, and a significant part of the industrial energy in the southwest 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 release in the process, and increased electrical power is used in the process. This would result in an extra 60,000 tpa of CO_2-e to be emitted from the Bluewaters power station.

In addition, quarrying and transport of 120,000 tonne/year of limestone would be required for the desulphurisation process. The process would also involve the consumption of a significant amount of additional water.

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 this process were used. The fuel cost would then 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;
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 desulfurisation;

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

The overall net environmental benefit from the application of Directive 2001/80/EC at Bluewaters 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 Guidance Statement 55. Bluewaters 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.

Issue 4.16 Raised by DoH.

A health risk assessment is an integral part of a health impact assessment, and a health risk assessment was not presented in the PER document. A health risk assessment should be an essential requirement

for this type of development, and the proponent should be required to undertake one for this proposal.

Response Griffin Energy has consulted further with DOH and has provided further information and clarification on the Health risk assessment for the project (see responses to previous issues in this section). DOH has agreed that sufficient work has been undertaken to be able to determine that the risk to the community in Collie is acceptable. See also the response to Issue 4.13.

Issue 4.17 Raised by DoH.
Modelling of relevant pollutants should be undertaken using averaging periods which are consistent with the expected health effects from those substances.

Response This issue is covered in the response to Issue 4.8.

Issue 4.18 Raised by DoH.
The modelling presented in the PER document suggests that emissions from existing sources have the potential to be impacting on the health of exposed individuals, and this implies that the issue surrounding power production in the area need to be considered in a holistic fashion that may require a change from existing to newer less polluting technology

Response This is a whole of Government issue and one that is not capable of being managed by a single proponent. Griffin Energy will support any proposal for a whole-of-area assessment of health impacts in the Collie region. However, it is fair to state that the Bluewaters proposal has been demonstrated, through the cumulative modelling carried out and reported in the PER and in these responses, not to have any significant impact on the health profile of Collie. Griffin Energy accepts that the closure of the older less efficient Muja plant will have a beneficial effect, however, the ultimate decision on the closure of Muja is a matter for Western Power.

Issue 4.19 Raised by DoH.
The outcomes derived from the consultation process were not attributed to the identified substances except in broad terms, and the consultation process that was undertaken appears to have added little value to the overall assessment other than to provide an opportunity for stakeholders to comment.

Response This issue is comprehensively covered in the response to Issue 4.9. Griffin Energy undertook a comprehensive consultation programme specific to the Bluewaters project. The concern raised here refers only to one particular workshop, whereas Griffin Energy as part of the Griffin Group has adopted a policy of continuos consultation with all members of the community on all aspects of existing and proposed operations. Members of the community are encouraged to raise any issues of concern at any opportunity in any forum that they feel comfortable with, so that the issue can be addressed in a positive and consultative manner.

Griffin has been part of the community for a considerable length of time and prides itself on keeping the local community informed and engaged in all aspects of operation and planned developments.

Issue 4.20 Raised by DoH.
The demographic information provided about the community identified a significant aboriginal population in the region. However, there was no obvious representation of this group on the stakeholder's consultation group.

Response Griffin Energy has a policy of ongoing consultation with all stakeholders and members of the community. To this end a presentation was made to the South West Land and Sea Council on Tuesday August 24th 2004. The main issues raised at this meeting were employment opportunities and economic impact of the proposal.

Griffin will continue to meet with representatives of all stakeholder groups to receive input and provide feedback on all existing and planned developments by the group.

Issue 4.21 Raised by DoH.
The report indicated that the model is comparable with actual data recorded by the Collie Air Quality Monitoring Network. Evidence is required to demonstrate the comparisons are appropriate for all contaminants that have been modelled.

Response The monitoring performed in Collie measured PM_{10} and SO_2. Figure 1 presented in the response to Issue 4.8 shows that the modelling is very close to measured data.

Issue 4.22 Raised by DoH.
Justification is required on the reasons for modelling some pollutants and not others, as well as the use of the NPI data over measured levels.

Details are required to explain why the consultants chose to model only SO_2, CO, Hg, PAHs, fluoride, NO_2, ozone and PM_{10}, and what the risks of these pollutants are in relation to health guideline levels

Response Actual emission rates for each hour of the year in 2001 for SO_2, used in the modelling for Muja and Collie power stations were obtained from Western Power. For the remaining pollutants considered (NOx, PM_{10}, CO, Hg, PAH and fluorides), hourly emission rates have also been derived by scaling the SO_2 rate each hour by the ratio of the annual NPI total emission of the pollutant under consideration and the annual SO_2 emission. In this way, important hourly variation is introduced for all pollutants. Even if measured emissions each hour of the year had been available, the answer to the Study question (what is the impact of the Bluewaters proposal) would not have been any different, i.e. that Bluewaters does not significantly contribute to raising levels of NOx, PM_{10}, CO, Hg, PAH and fluorides to anywhere near guideline levels.

Griffin Energy consulted with the EPASU on which substances should be modelled. Following the consultation the list of substances to be modelled was determined by Griffin Energy.

The modelling clearly demonstrated that the levels of all of the substances in the Collie town and at nearby farm residences to be well within accepted health guidelines. Refer also to the response to Issue 4.7.

Issue 4.23 Raised by DoH.
Relevant calculations should be included in the report to show that the addition of the proposed power station is of negligible risk to the population in Collie and surrounding areas.

Response This issue is covered in the response to Issue 4.8.

Issue 4.24 Raised by PAN.
The proponent has not adequately assessed the environmental health impacts of the proposed power station, particularly in relation to air pollutants such as acidic gases, heavy metals, volatile organic compounds, polycyclic aromatic compounds, and particulates, all of which are capable of causing serious human health and ecological impacts.

Response This issue is covered in the response to all of the preceding issues relating to atmospheric emissions.

Issue 4.25 Raised by PAN.
The modelling that has been undertaken indicates that the cumulative impact of the proposed power station and the existing Collie Power Station will lead to exceedences of the National Environmental Protection Measures limits for SO_2 and dust, which is unacceptable

Response This issue is covered in the response to Issue 4.8. Table 3 shows that there are no exceedences in the town of Collie. The modelling also shows NEPM standards are not exceeded at any sensitive receptor locations. Bluewaters is not predicted to result in any significant increase in emission levels received at any location. Dust monitoring undertaken by Griffin Coal has also indicated that dust levels within the town of Collie are within NEPM limits. Therefore the cumulative effect of Bluewaters on the existing situation is for no increase in exceedences of NEPM limits at any location. Any exceedences shown in the modelling are as a consequence of the existing scenario, with the exceedences occurring close to the existing emitters and remote from any existing sensitive receptors.

Issue 4.26 Raised by PAN.
The proponent has not made a convincing case in regard to emissions of volatile organic compounds, reactive organic compounds, and heavy metals which international research indicates are serious problems with

power stations burning low grade coal. Additional monitoring and analysis of existing power stations using Collie coal is required.

Response Coal is generally classified by Rank, Grade or Type**.** Grade classification of coal is a measurement of ash content. Collie coal is very low ash (approximately 6%), therefore Collie coal is considered a high grade coal. Collie coal is neither an inferior Type nor a low Ranking coal. Modelling undertaken by the CSIRO has shown that air quality at Collie will not be compromised by the Bluewaters proposal. VOC output by Bluewaters is very small when compared to the biogenic output of VOCs in the area as reported on the NPI website. Mercury was modelled in the air emission study as it is the most significant heavy metal found in Collie coal. The modelling undertaken by CSIRO indicated that annual-averaged emission levels for Mercury are three orders of magnitude smaller than the WHO Guideline value. Peterson et al (2004) found the contribution of Mercury from all Australian coal fired power stations to regional airsheds is over reported, therefore, the levels estimated in the air modelling carried out for Bluewaters by CSIRO are a conservative estimate of actual levels in the air. The levels of other heavy metals in the exhaust from Bluewaters were assessed to be so low, that any modelling results would not be meaningful or useful.

Issue 4.27 Raised by CCWA, ACF, WWF, CANA.
Insufficient research has been undertaken in Collie to determine the effect of this particular proposal, and the effect of coal mining and power generation industry in general. The community made it clear that they would like more work to be undertaken in this area and that they are uncertain about the potential impacts of this proposal.

Response This point of view is at variance to the overwhelming level of support shown by the community of Collie towards the proposal. Notwithstanding that Griffin is willing to cooperate with any overarching survey of impacts of power generation. With respect to the issue of research into health and other impacts of the proposal these have been covered in all preceding responses to Air Emission issues.

Issue 4.28 Raised by CCWA, ACF, WWF, CANA.
Although individual projects may not on their own contribute significantly to health risks, the cumulative impacts of the coal mining and power generation industry must be taken into account in assessing individual projects.

Response Cumulative impacts were taken into account in the air modelling and health impact assessment. All emission levels that are compared to standards assume the addition of Bluewaters and Collie B. Refer also to the response to Issue 4.8.

5 Greenhouse Issues

Issue 5.1 Raised by CCWA, ACF, WWF, CANA.
An assessment of geosequestration potential was not included despite the Collie Basin being identified as a potential storage site by the Cooperative Research Centre for Greenhouse Technologies (CO2CRC).

Response The Collie Basin was not identified as a potential storage site in the quoted study. In fact it is the Perth Basin that was included in the study (*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. The Collie basin exists within the Yilgarn Craton. In the study the Perth Basin was risked at 0.2 for potential storage sites, which means there is only a 20% chance that a suitable site exists within the basin for geosequestration. In addition the significant offshore component of the basin means the likelihood exists that a suitable site for geosequestration 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. When this cost is added to the cost of placing the gas in 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.

Issue 5.2 Raised by 138 private citizens.
I am concerned that coal has not received fair treatment compared with other forms of energy in selection as a fuel for electricity generation. Each fuel should be assessed on its merits and efficiencies should be sought for each fuel based on its own properties. I do not support any "penalty" or "offset" for coal to bring it into line with other energy sources with respect to Carbon emissions. To do so would impact the viability of the coal industry and the town of Collie and its surrounds and consequently have a negative impact on environmental values in the South West. This is exactly the position defined in the WA government "diversity in fuel" policy.

Response These submissions expressed a view consistent with Griffin Energy's position and State and Federal government policy. See also responses to Issue 5.11 and 5.26.

Issue 5.3 Raised by CCWA, ACF, WWF, CANA and PAN.
The Proponent should provide a Greenhouse Gas Emission Management Plan as part of the approvals process.

Response Griffin Energy has committed to preparing a Greenhouse Gas Emission Management Plan (PER commitment number 13.2). The plan will be made public (PER Section 7.8.3).

The Greenhouse Gas Emission Management 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 project, 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, and
- Continued investigation of 'no regrets' and 'beyond no regrets' options for greenhouse minimisation during the life of the project.

Preparation of the plan prior to construction is consistent with the timing of similar plans for other large proposals.

Issue 5.4 Raised by Western Power Corporation.
The claim in Sections 2.5 and 3.2 of the PER document that the proposed power station would reduce the carbon intensity of electricity generated within the South West Interconnected System (SWIS) appears to be erroneous because:

- It apparently considers only WPC's electricity generation and does not take into account electricity production into the SWIS from other non-WPC sources.
- It apparently considers WPC's total electricity generation and fuel use instead of only relating specifically to the SWIS itself.
- It apparently combines generated carbon intensities with sent out-out carbon intensities, the latter which takes into account the electricity consumed within the generating facilities themselves which is not available to the SWIS.
- New generating facilities such as the proposed power station generating electricity into the SWIS would not exclusively displace the electricity generated by the older plant at Muja Power Station.

Response The implications of new power generation in 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 by 2010 (see Figure 3-6 in WPC 2002).

The results presented in the Bluewaters PER were determined using data in Western Power's Annual Report. It would appear that the above

concern was generated using data not available to Griffin Energy when preparing the PER.

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

Whilst the Western Power statement about displacement of electricity generated by older plant at Muja is true it is not entirely relevant. The load supplied by Bluewaters 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 plant. Western Power will always, whether Bluewaters exists or not, to the greatest extent possible reduce the capacity factor of its lowest merit plant. Other generators will do the same. The increased average efficiency of the coal-fired fleet will result in lower CO_2 emissions from coal-fired generation. 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. Such an issue depends upon commercial considerations and cannot be quantified at this stage.

The net reduction or otherwise of greenhouse intensity is always most accurately calculated in retrospect. It is noted that there is intrinsic uncertainty in projecting power generation contributions, and hence greenhouse intensity, of the SWIS. See also response to Issue 5.22.

Issue 5.5 Raised by CCWA, ACF, WWF, CANA and Western Power Corporation. There are inconsistencies in relation to the amount of Greenhouse emissions the project will produce.

Response The inconsistencies relate to the amount of coal expected to be used in the plant. The actual amount of coal used on an annual basis at a capacity factor of 80% is 700,000 tonnes per annum. The use of this amount of coal in Bluewaters will result in 1,300,000 tonnes per annum of greenhouse gas emissions based on 36% efficiency. In reality, Bluewaters is expected to achieve 36.5 – 37%.

The amount of coal used as stated in the PER is incorrect. The station is not physically capable of consuming 1,000,000 tonnes of coal per annum.

Issue 5.6 Raised by CCWA, ACF, WWF, CANA.
The Proponent should provide the Bluewaters Power Station GHG emissions per MWh.

Response Bluewaters Greenhouse intensity is predicted to be 933Kg CO_2 per MWh.

Issue 5.7 Raised by CCWA, ACF, WWF, CANA.
The proposed Bluewaters Power Station will be operated at part load (<80%), which has a lower efficiency than full load. Information on the part load efficiency of the proposed power station should be provided.

Response This submission may be confusing the terms 'capacity factor' (CF) and 'efficiency'. Bluewaters will be designed to operate at its 100% maximum continuous rating (MCR) with best plant thermal efficiency (36%). When Bluewaters is required to be operated at reduced load, because of customer demand, the plant efficiency will be only a little lower. Based on Griffin Energy's estimate of the customer demand profile Bluewaters is expected to operate at 80% capacity factor. Capacity factor refers to the ratio of the plant's actual total sent out energy (in GWh) to its design maximum sent-out capacity (in GWh) in a period of time (e.g. a calendar year). A 200MW power plant operating at 80% CF will send out about 1,402 GWh in a period of 8760 hours (a year).

Issue 5.8 Raised by CCWA, ACF, WWF, CANA.
In Section 7.8.4, the Proponent does not state that they will apply the Australian Greenhouse Office (AGO) Generator Technical Efficiency Standards to the construction of the plant. The Proponent does not state that they will enter into a Deed of Agreement with the AGO for the proposed Project.

Response The second sentence in the third paragraph on page 65 of the PER states "*Griffin Energy is committed to implementing these (AGO Technical Efficiency Standards) at Bluewaters…"*. This is also repeated in Commitment 13.3. This commitment clearly carries with it the obligation to apply the standards to both the design and the construction of Bluewaters. The commitment to sign on to the Greenhouse Challenge is in fact a commitment to enter into a Deed of Arrangement with the AGO.

Issue 5.9 Raised by CCWA, ACF, WWF, CANA and PAN.
The PER did not fulfil the requirements of the Environmental Protection Authority (EPA) Guidance Statement for Minimising Greenhouse Gas Emissions (No. 12).

Response Griffin Energy has committed to preparing a Greenhouse Gas Emission Management Plan (PER commitment number 13.2). The plan will be made public (PER Section 7.8.3). It will be consistent with the EPA Guidance Statement for Minimising Greenhouse Gas Emissions (No. 12). Preparation of the plan prior to construction is appropriate and consistent with the timing of similar plans for other large proposals. See also response to Issue 5.3.

Issue 5.10 Raised by CCWA, ACF, WWF, CANA.

Further information about the proposed initiative to supply trees to landcare groups in the southwest is required to determine whether this can be considered a carbon offset.

Response The initiative is linked to the research project that is directed towards reducing salinity levels in the Collie River. See also response to Issue number 5.11.

Issue 5.11 Raised by CCWA, ACF, WWF, CANA.
The proponent has not provided information on the level of offsets that will be applied against the project.

Response Griffin Energy is committed to participating in the Greenhouse Challenge (**www.greenhouse.gov.au/challenge**) as detailed in the PER and in the response to Issue 5.3. Griffin Energy has adopted a sustainable approach to Bluewaters 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 does not propose any formal mitigation of greenhouse gas for the project down to any arbitrary target level, as to do so will affect the economic viability of Bluewaters, 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 will have the effect of disadvantaging the project 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.

Griffin's Commitments

Technologies that can reduce coal emissions are potentially of great benefit to Australia's economy and environment (Commonwealth of Australia, 2004). Griffin Energy is committed to a range of measures to mitigate emissions of greenhouse gases (GHG), including:

- Adoption of state-of-the-art plant technology appropriate to the scale of the project, with proven greenhouse efficiency benefits, using the AGO Technical Efficiency guidelines in design and operational management;
- A strong corporate commitment to the *Greenhouse Challenge* Programme to further characterise GHG emissions, benchmark GHG intensity against other comparable generation plants, and continually identify practicable opportunities for emissions management;

- Preparation and implementation of a publicly available Greenhouse Management Strategy, to the satisfaction of the Environmental Protection Authority (EPA).

The following offsets will be considered in the development of a Greenhouse Management Strategy for Bluewaters:

1 Sequestration Research on Minilya Station
2 Tree planting on Joanna Downs agricultural property
3 80MW Wind Power at Emu Downs
4 Collie Catchment recovery program
5 Retirement and Replacement of Muja A/B
6 Research into fly ash use
7 Diversion of East Collie River
8 Purchase of carbon credits
9 Tree plantation
10 Mine Rehabilitation at Griffin Coal sites.

Specifically each of the offsets is described as follows:

1 Sequestration Research on Minilya Station

Minilya Station is a property owned by W.R. Carpenter Agriculture Pty Ltd (WRCA), a member of the Griffin Group. Changed management practices on Minilya Station North of Carnarvon have resulted in an increased vegetative cover on the pastoral property. This project involves the CSIRO measuring and validating a methodology for quantifying Carbon sequestration on Minilya.

There is significant potential for sequestration in rangelands. This project is a two-year research project with an ongoing monitoring component, once the initial research project has quantified the extent of carbon sequestration and validated the ongoing measurement approach.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets", this option would initially be designated as a secondary offset, however subject to the research proposal results could be redesignated a primary offset.

2 Tree planting on Joanna Downs agricultural property

Joanna Downs is also an agriculture property owned by WRCA in the Mid West region of WA. This project calls for the planting of 2,000Ha of trees on the property to fulfil the following objectives.

- Salinity control
- Erosion control
- Shelter belts
- Direct sequestration of greenhouse gases for Bluewaters

- Potential economic gain from oil mallee plantation.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a primary offset.

3 80MW Wind Power at Emu Downs

Emu Downs is another property owned by WRCA in the Shire of Dandaragan. The wind profile on the property makes it very attractive for wind generated electricity. The development of a wind farm on the property has been investigated for some time. The project is nearing formal commencement.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a primary offset.

4 Collie River Catchment recovery program

Griffin Energy has been investigating the potential for catchment recovery in the Collie River for some time. The project involves tree planting in the upper catchment of the Collie River and investigation of the potential for drawing down the saline near surface aquifers, in certain parts of the catchment, through pumping.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets", this option would initially be designated as a secondary offset, however, subject to the project results, could be redesignated a primary offset for vegetation cover and secondary for the added environmental benefit of improving environmental values in the Collie River.

5 Retirement and Replacement of Muja A/B

Muja A and B are scheduled for closure. Using Bluewaters as a direct replacement for Muja A and B results in an immediate net saving of up to 214,000 tonnes per annum of Carbon Dioxide.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option is a primary offset.

6 Research into fly ash use

Fly-ash has potential for re-use. The most common form of re-use is in cement manufacture. Unfortunately in WA the full potential has not been realised due to the cost of transporting the fly-ash to a suitable market

In addition to use in cement manufacture, flyash has potential in a number of other areas, for example in the production of

Cenosperes and Zeolites. Research is required to fully understand the properties of Collie fly-ash and to commercialise these opportunities.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would initially be designated as a secondary offset, however, subject to the research results and successful commercialisation, could be redesignated a primary offset.

7 Diversion of East Collie River

Diversion of the East Collie river into a disused mine void has been proposed as a means of returning Wellington Dam to potable condition. Currently Wellington Dam is too saline for it to be used as a source of drinking water and its use is restricted to pasture irrigation and in a limited sense to "shandying" with other water sources to increase the total water supply to the state's water system.

The sustainable yield of Wellington Dam is approximately 85Gl per annum. The scheme to divert the East Collie River into a disused mining void involves diverting the first flush of water coming down the River each winter until the water quality has reached a level whereby it can be allowed to flow into Wellington Dam. It is estimated that by the diverting early flushes of high salinity river flows over two years Wellington Dam would approach potable condition.

Griffin Energy initiated and paid for the initial studies that have proved the scheme up to a point where it has been adopted by the Collie Catchment Recovery Team as its preferred option with the DoE considering a trial in 2005. Griffin Coal is providing the disused mine voids and additional support for the project.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a secondary offset.

8 Purchase of carbon credits

Direct purchase of credits involves an established Carbon trading market and direct purchase of credits. Whilst there is no established market in Australia at the current time, this may change. Currently Carbon trades are being made in the range of \$1.00 per tonne CO_2 equivalent up to \$15 per tonne.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a primary offset.

9 Tree Plantation

Planting trees in a plantation involves committing to planting sufficient trees to sequester an equivalent amount of carbon output that is required to be offset.

In a report to Western Power, Greenhouse Gas Primary Offsets for Coal Generation – Bidders Discussion Paper, prepared by SKM Consultants in August 2004, the cost of tree planting as a sequestration option is detailed. Using the data provided in the report the area required for full offset sequestration for Bluewaters would be 240,000 hectares for a commercial plantation and 90,000 hectares for a non harvested plantation. The lifetime cost of a commercial plantation to the project would be $960 million and for a non harvested plantation $316 million. Clearly these costs make carbon offsets using this option impractical as they render the project uneconomic.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a primary offset.

10 Mine Rehabilitation (tree plantation on Griffin owned land)
Griffin Coal has rehabilitated several areas using Tasmanian Blue Gums. The Carbon sequestered through these trees can be applied as a bankable credit against Griffin Energy's power proposals. There are currently 250Ha of rehabilitated mine areas giving a credit of 112,500 tonnes in the ground with an annual credit of 11,250 tonnes per annum.

Using the definitions provided in the Environmental Protection Authority Preliminary Position statement No.9 "Environmental Offsets" this option would be designated as a primary offset.

Issue 5.12 Raised by CCWA, ACF, WWF, CANA.
The sub-critical technology proposed for the Bluewaters Power Station is "old technology" and is less efficient than super-critical technology. As Griffin Energy has stated that a 200 MW station is too small to use super-critical technology and the Bluewaters Power Station is the first of three 200 MW power stations, then it should investigate the option of constructing a larger generator that can utilise more efficient technology. Griffin is a contributor to CRC for coal in Sustainable Development and consequently supports R&D in a broad range of clean coal technologies.

Response The 200 MW unit size proposed by Griffin Energy 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.

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 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 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.

The steam cycle to subcritical conditions (typically a maximum of 180 bar, 540°C / 560°C reheat), boiler design and operation is simplified, but overall efficiency is limited to about 36 - 37% (net generation, and 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.

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 400 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.

This is also born out in the Australian experience with Supercritical power station developments on the east coast, summarised in Table 4 below.

Table 4
Australian Supercritical experience

	Callide C	**Millmerran**	**Tarong North**	**Kogan Creek**
Main Steam Pressure	25 MPa	24.2 MPa	25 MPa	25 MPa
Main Steam	566°C	565.5°C	566°C	540°C

Temperature				
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 5
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
HuanengNanjingPower 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 250 – 350 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 higher.

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 of auxiliary plant.

This issue was addressed in section 3.3.3 of the Public Environmental Review.

Issue 5.13 Raised by CCWA, ACF, WWF, CANA.
The Proponent should provide evidence that a critical assessment of options and plant optimisation has been conducted prior to the selection of the fuel and final plant configuration.

Response The plant configuration has been developed by one of the most highly successful and respected power plant developers and manufacturers, with a capability and knowledge of virtually all plant technologies currently available. See also response to Issue 5.12.

Issue 5.14 Raised by CCWA, ACF, WWF, CANA
There should be discussion on the use of biomass and Combined Heat and Power (CHP).

Response CHP and Biomass co-firing technologies do have lower greenhouse gas intensity than the conventional coal fire technology, due to the high overall energy efficiency of CHP and the renewable nature of the biomass.

Given Bluewaters will be constructed on an industrial estate, the potential for CHP exists when heat intensive industry relocates to the industrial estate. See also response to Issue 5.13.

With respect to biomass co-firing, the biomass contribution is typically less than 5% of the overall fuel input (dependent upon the specific nature of biomass). Again, in general co-firing does not require a significant redesign of the plant, and should suitable and economic biomass sources become available, the potential for biomass co-firing is retained for Bluewaters in the future.

Issue 5.15 Raised by CCWA, ACF, WWF, CANA.
The potential to use "low-emission" coal technologies, such as Integrated Drying Gasification Combined Cycle (IDGCC), Mechanical Thermal Expression (MTE) or dewatering technologies should be assessed.

Response IDGCC is a development of the gasification process intended specifically for the 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 Integrated Gasification Combined Cycle (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.

Issue 5.16 Raised by CCWA, ACF, WWF, CANA.
The potential to apply "low-emission" coal technologies as a pilot or research plant in order to contribute to research being undertaken to lower emissions from coal use should be examined.

Response The Griffin Group through Griffin Coal is a contributor to the CRC for Coal in Sustainable Development and therefore supports a range of 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 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 initially for Bluewaters 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, as CCWA, ACF, WWF, CANA have pointed out, 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.

While not explicitly, CCWA, ACF, WWF, CANA in effect raise an issue here that is a perpetual challenge to industry and governments; that is, the challenge of bringing first-of a-kind or non-conventional technology to maturity. This is an issue that requires more than CCWA, ACF, WWF, CANA lobbying, more than the political will of the Western

Australian Government, and more than the resources of the power industry. 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:

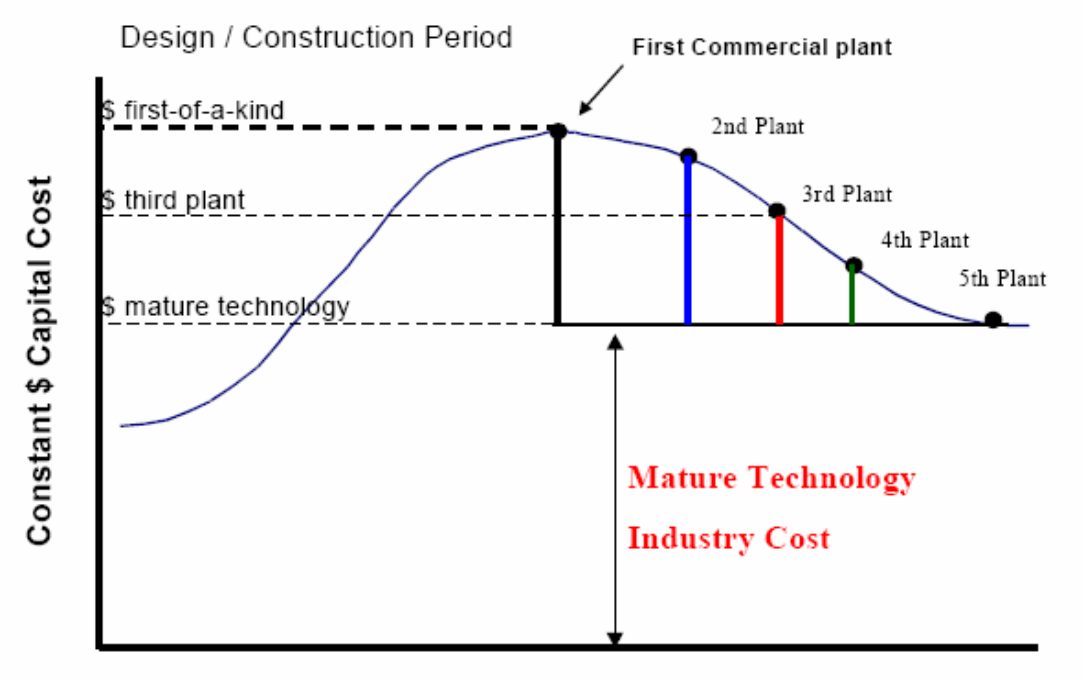
"*It is well known in many industries involving large capital-intensive plant that the first-of-a-kind have a relatively high capital cost and initially, at least, suffer from low availability. It is only after several installations and a number of years of operational experience that sufficient developments 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 diagram.



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, the CCWA, ACF, WWF, CANA's of this world, and the financial institutions. This issue is therefore much bigger than the Bluewaters 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 agreed that both CHP (cogeneration) and biomass co-firing have lower greenhouse gas intensities than the Bluewaters proposal and are reasonably mature technologies.

However, CHP requires a host or consumer for the heat. While Bluewaters 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.

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 6

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 are provided in Table 7.

Table 7
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. Financial institutions do not consider that the capital costs 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*".

Issue 5.17 Raised by CCWA, ACF, WWF, CANA.
The potential use of biomass instead of coal and the potential application of biomass co-firing should be addressed.

Response 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) 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. See also response to Issue 5.14.

Issue 5.18 Raised by CCWA, ACF, WWF, CANA.
All fuel options and technologies, such as cogeneration opportunities should be examined.

Response Refer to response to Issue 5.16 and 5.17.

Issue 5.19 Raised by CCWA, ACF, WWF, CANA
Information about Collie coal should be presented to establish whether the thermal efficiency of Bluewaters is World's Best Practice.

Response Thermal efficiency is related more to the plant selected than the coal properties. The Bluewaters project has selected the most appropriate technology for a coal fired plant of the scale proposed.

Issue 5.20 Raised by CCWA, ACF, WWF, CANA.
The proposed development would breach the objectives of the United Nations Framework Convention on Climate Change (UNFCCC).

Response Meeting the objectives of the UNFCCC is a matter for the Commonwealth Government and is not an issue for the proponents of Bluewaters. Notwithstanding this, Griffin Energy has committed to the development of a Greenhouse Gas Management Plan as detailed in the response to Issue 5.3.

Issue 5.21 Raised by Western Power Corporation.
The average sent-out carbon intensity of electricity generation into the SWIS in 2003/2004 was 870kg of CO_2 per MWh. Using information provided in the PER document, and assuming that 5.5% of the electricity generated by the proposed power station will be used internally, the Bluewaters Power Station would have a sent out carbon intensity of about 925kg of CO_2 per MWh, thus making it appear unlikely that it would significantly reduce the sent-out carbon intensity of electricity generation of the SWIS.

Response The issue, as detailed, highlights the difficulty in accounting for greenhouse contributions from various sources into a network such as the

SWIS, especially when some producers may be claiming credits from non-electricity generating initiatives.
Notwithstanding the above, it is clear that the introduction of Bluewaters into the system will reduce the Greenhouse intensity of coal fired electricity produced in the Collie region due to the better efficiencies used by Bluewaters 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 and all of the other coal fired plants being available at the time of calculation.

The calculated sent out intensity of Bluewaters is 933kg of CO_2 per MWh.

This concern is also addressed in the response to Issue 5.4.

Issue 5.22 Raised by DPI.
Additional Investment in carbon sequestration such as tree farming should be strongly encouraged.

Response Griffin Energy is considering many options for carbon management. The options are detailed in the response to Issue 5.11.

Issue 5.23 Raised by a private citizen.
Given that the proponent is proposing to burn coal to produce electricity instead of cleaner and more efficient natural gas, I thought that they would consider making a commitment to implement some form of greenhouse gas reduction strategy such as tree planting.

Response Griffin Energy is considering many options for carbon management. The options are detailed in the response to Issue 5.11.

Issue 5.24 Raised by PAN.
More acceptable options for power generation in the south-west are available. And sustainable energy systems based on cogeneration, renewables and energy conservation should be considered.

Response This issue is addressed in the responses to Issues 5.14, 5.15, 5.16 and 5.18.

Issue 5.25 Raised by a private citizen.
There should be no demand for offsets placed on this project by the EPA. Offsets are contrary to the Federal government position as defined by the AGO Technical Efficiency Guidelines and contrary to the State Government diversity in fuel policy. The EPA approach to condition setting and commitment seeking should be in line with state government policy.

Response Griffin agrees that policy should be consistent across all arms of government.

6 Liquid and Solid Waste Disposal

Issue 6.1 Raised by CALM.
If the chosen method for flyash disposal is to be supported, additional technical justification is required.

The PER does not demonstrate the merits of the chosen method for flyash disposal by comparing the relative risks and benefits with alternative techniques.

It is not apparent whether flyash will be disposed of into backfilled pits or out of pit overburden dumps.

Response The issue of flyash disposal raises the following questions:

- *What is the composition, acidity, and heavy metal composition of the flyash*
- *What will be the impact on the composition of the flyash if the mine voids become acidic*
- *If the mine voids that are filled with flyash do become acidic, what happens to the acidic water run-off*
- *Can the flyash be fixed in place in "a clay stabilised form" as indicated on page 54 of the PER document*
- *Proposals for flyash disposal should be verified as the most appropriate disposal technique and benchmarked*
- *What are the risks relating to the selected disposal method and can the risks be quantified*

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). 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.

In the absence of fly ash sales, the utilisation of flyash for mine backfill purposes alleviates the need to excavate a separate site for ash disposal.

Coal and Ash Composition

Combustion of blended Ewington coal, deemed typical of customer supply quality, in a Boiler Simulation Furnace at ACIRL produced fly ash with the chemical composition detailed in Table 8.

Table 8
Ewington Coal and Flyash Composition

	Coal % as received	Laboratory Ash
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
Mercury		0.02
Selenium		0.01
Cadmium		<0.02
Lead		18
Boron		<5
Zinc		15
Antimony		0.2
Beryllium		1.4
Fluorine		50
Chlorine		0.03

Acidity of flyash itself is not generally measured, however, when the flyash from Collie coal is mixed with water an acidic aqueous phase is typically produced.

Acidic leachate has the potential to mobilise metallic species from the ash and surrounding materials. Fly ash leaching tests indicate the presence of manganese, cadmium and chromium in quantities above the drinking water standard. Trace metals in the Ewington coal blend are regarded as low in comparison to other Australian and U.S. coals.

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 before saturation and leaching. Rainfall ingress would be minimised by rolling and grading the working face of the laid down ash and progressive capping with stored topsoil and revegetation. Since the fly ash bed will be kept above the groundwater table, the potential for leachate will be minimised.

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.

Acidic Mine Water Interaction with Fly 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.

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 flyash to assist in back filling the mined areas will reduce the volume of any remaining void thereby reducing the amount of acidic mine water. The flyash 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 flyash directly. If acidic mine void water were to contact the flyash bed the potential for leaching of metallic species does exist.

Fixation of Flyash

The interaction of flyash with the over / inter burden claystones has not been established at this stage. 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 flyash interactions with other materials. There have been previous studies on interactions of fly ash with mineral sand waste, red mud from bauxite mining and soil for soil improvement purposes.

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 methods are 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 operations.

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.

Issue 6.2 Raised by CALM.
The regulatory framework that would allow the disposal of flyash within the mine lease located within a State Forest needs to be determined.

Response The Ewington I mine will be subject to closure criteria. The criteria will be established in consultation with stakeholders including CALM. The mine will be returned to the custody of CALM when the closure criteria have been met after rehabilitation. The flyash incorporation will be a component of the closure plan. A closure plan for the mine is currently in preparation by Griffin Coal as part of the Environmental Management plan for the mine. Flyash disposal back into the mine is current accepted practice in many coal mines in Australia and around the world.

The Collie Coal (Griffin) Agreement Act 1979 provides for activities associated with the mining of coal to be carried on within the mining leases subject to the Act. The return of flyash is an initiative associated with the expansion of activities and increased production as specified in the Agreement Act.

Issue 6.3 Raised by CCWA, ACF, WWF, CANA.
There is no indication of what investigations have been undertaken or planned with respect to developing markets for alternative uses for flyash.

Response ***Current market for flyash 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% passing the 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 growth in this market

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.

Potential for value-adding flyash

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.

Cenosphere is 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 geo-polymers making 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.

Issue 6.4 Raised by CALM.
CALM should be included as an advising agency with respect to Commitment 10 in the PER.

Response Griffin Energy agrees and will work towards this being done.

Issue 6.5 Raised by DoH.
The on-site wastewater system for the treatment and disposal of sewage will require the Department's approval, and a concept plan of the system

will need to be submitted to the Department for consideration. The volume of wastewater generated by construction workers during the peak construction period needs to be taken into consideration in the design of the proposed system.

Response The Wastewater treatment plant approval will be a component of the building approval received from the Shire of Collie. Griffin Energy will be making all appropriate applications for the project as required. Where the Health Department or any other government authority or agency is required to be involved in the approval process this will be done.

No particular effluent disposal system has as yet been selected by the proponents at this early stage of project development, but all relevant information will be included within the Local Government Report to the DoH at the time of submission of the appropriate application. It is probable that an existing and approved off the shelf system (e.g. Biomax) as has been used at other Griffin sites is likely to be adopted.

Issue 6.6 Raised by DoH.
The ability of the soil and the adequacy of the area for effluent disposal should be demonstrated if disposal by soil absorption is proposed.

Response This will be done in consultation with the Shire of Collie and other stakeholders. The subject site has various soil types from deep sands to various clays, gravels and rock within its confines, many of which will be well suited to the absorption of effluent wastes if that method is the preferred and approved choice.

Issue 6.7 Raised by PAN.
The discharge of contaminated cooling and washing water into the ocean off Australind will raise water pollution issues given that this water will contain elevated levels of residual pollutants such as heavy metals.

Response The discharge water will not contain elevated levels of pollutants. As discussed in the PER the proposal is to utilise the existing Collie Power Station ocean discharge line. This issue is fully covered in the response to Issue No. 9.2.

Issue 6.8 Raised by WPC.
Use of the existing saline pipeline does not take into account that future local power generation supply water quality is likely to be significantly different, with attendant impact on pipeline capacity availability.

Response WPC provided in-principle approval for the use of the saline pipeline in its letter to Griffin Energy dated 6 February 2004. The proponent will continue to work with WPC regarding saline water disposal and other water issues. Griffin Energy is confident of having the facility available for Bluewaters' operation.

Issue 6.9 Raised by WPC.

Some type of groundwater/leachate monitoring would be required in order to gauge the effect of disposing of flyash by mixing it with overburden and returning it to the Ewington mine.

Response This is indeed proposed. The final monitoring program for Ewington mine is overseen by the Collie Coal Mines Environment Committee (CCMEC) thus ensuring that relevant stakeholders such as CALM are included in the design of the monitoring program and assessment of results. See also response to Issue No. 6.4.

Issue 6.10 Raised by WPC.
Since the use of the Collie Power Station wastewater pipeline has not been confirmed, the proponent should consider alternative methods of disposal more fully.

Response WPC provided approval in principle for the use of the saline pipeline in its letter to Griffin Energy dated 6 February 2004 The proponent will continue to work with WPC regarding saline water disposal and other water issues. Griffin Energy is confident of having the disposal facility available for Bluewaters' operation. See also response to Issue 6.8.

Issue 6.11 Raised by WPC.
Further detailed discussion is required in relation to the on-site evaporation pond referred to in the PER document given that it could have a significant impact on the local environment.

Response No on-site evaporation pond is proposed for Bluewaters. Refer to response to Issue 6.10.

Issue 6.12 Raised by WPC.
It is stated that the existing Collie Power station Saline water pipeline will be used for saline water disposal. In the absence of confirmation of this means of disposal, alternatives for saline water disposal should be addressed in more detail.

Response Griffin Energy has agreement in Principle from Western Power for the use of the pipeline. The arrangements for the use of the line are the subject of commercial negotiations. Refer also to Responses to Issues 6.10 and 6.11. Griffin Energy is confident that the ocean disposal facility will be available for the power stations operation.

Issue 6.13 Raised by EPASU.
Additional detailed information is required in respect to marine environmental impact especially with respect to the following points:

- Dilution factors
- Background water quality
- Cumulative discharge concentrations
- Flowrate
- Dilution zones
- Toxicant concentrations

- Comparisons with Guidelines

Response **Wastewater Dilution**

The wastewater dilution figures presented in Table 8 of the PER are a simple dilution calculation that does not take into consideration the natural, or background, concentration of the listed substances in the receiving environment.

Table 9 (below) presents concentration values for background water quality, based on the values quoted in Department of Environmental Protection (DEP) licence 6637/4, McAlpine et al (in press) and discharge site reference values, and for the predicted water quality of the cumulative wastewater discharge.

Table 9
Existing background water quality and proposed cumulative discharge concentrations

Parameter	Background (Western Australian coastal waters)[1]	Background (Perth coastal waters)[2]	Background Water Quality in vicinity of Discharge Location[3]	Predicted cumulative discharge: Collie A plus Bluewaters[4]
PH	8.2		8.4 – 8.5	7.3
mg/L				
Dissolved oxygen	7		6 – 7	8.1
TDS	34,500		32,600 – 33,100	1,500
TSS	10			23
µg/L				
Phosphate-P	10			2
Nitrate-N	20			550
Cadmium	0.1	0.0045	<0.2 – 0.3	<10
Calcium	400,000			231,000
Chloride	19,000,000			1,732,000
Chromium (III)	0.05	0.2	<10 – 11	20
Copper	3	0.085	<0.005 – 6	30
Iron	10			300
Lead	0.03	<0.019	<5 – 15	10
Magnesium	1,400,000			91,000
Mercury (total)	0.05	0.0004	<0.1 – <0.2	<3
Nickel	2			75
Potassium	280,000			29,000
Silica	6,000			78,000
Sodium	10,500,000			815,000
Sulphate	2,450,000			244,000
Zinc	10	0.502	<2 – 10	67
L/s				
Flowrate	92.5*			92.5

* design capacity
1 taken from licence number 6637/4
2 McAlpine et al (in press)
3 Western Pacific reference site values
4 Bluewaters PER

Background values used in this assessment have been adopted in the following order of priority: McAlpine et al (in press), discharge site reference data (URS 2003), DEP Licence 3367/4. The data presented in Table 9, and actual in-pipeline wastewater toxicant concentrations measured to fulfil the environmental licensing conditions (Table 10), are then compared to ANZECC/ARMCANZ (2000) water quality guidelines and DoE Environmental Quality Objectives at the point of discharge and at the edge of the zone of initial dilution (ZID) (Tables 10 and 11 and subsequent discussion), based on 1 in 100 dilution at the edge of the ZID in seawater at background concentrations.

Flowrate of Combined Effluent

The flow rate of the combined effluent has been nominally set at 92.5L/sec, which is the original design flow rate for a 600 MW power station. The pumping rate for the Collie A 300 MW Power Station is 43 L/sec (155 m^3/hr) but flow is intermittent and the average flow is approximately 21 L/sec (based on data for a three month in 2001 – 2002 [URS 2003]).

This allows for approximately a four-fold increase in volume within present design and licence parameters.

Initial dilution zone

The zone of initial dilution (to achieve a minimum dilution of 1 in 100 throughout the water column) has been modelled under assumed worst case conditions (winter). The flow rate modelled was 92.5 L/sec, which is the nominal discharge rate for the combined effluent (the actual rate may be less). 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 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 modelling indicates 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 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.

Background seawater, physical parameters and toxicant concentrations

A revised calculation for dilution of toxicants, based on receiving water background concentrations, is presented in Table 10.

Values for the combined effluent are based on weekly operational data for two three-month periods of operation of the Collie A Power Station in 2000 and 2001-2002. The data 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.

Table 10
Comparison of Mixing Zone Concentrations to ANZECC Toxicant Guidelines

Parameter (concentrations expressed in µg/L)	Background water quality[1]	Combined Effluent (95th percentile of 26 samples)[2]	100-fold dilution	ANZECC 99% species protection	ANZECC 80% species protection
Cadmium	0.0045	<1	0.014	0.7	36
Chromium	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[2]	<3	0.049	2.2	12
Mercury (total)	0.0004	<0.1	0.0014	0.1 (Inorg.)	1.4 (Inorg.)
Nickel	2[3]	<30	2.28	7	560
Zinc	0.502	90	1.397	7	43

1 McAlpine et al (in press)
2 assumed to be the maximum value for the purpose of calculation
3 taken from licence number 6637/4
ID insufficient information available to derive a reliable guideline

Calculation for physical characteristics at the edge of the ZID, based on the discharge conditions and receiving water background concentrations set out in Table 9, is presented in Table 11.

Table 11
Physical conditions at the edge of the ZID

Parameter (concentrations expressed in mg/L)	Background water quality	Predicted quality of combined effluent	Concentration following 100-fold dilution	ANZECC Guideline (Southern Western Australian Coastal Waters)
pH	8.2	7.3	-	8.0 – 8.4
Dissolved Oxygen (mg/L)	7	8.1	-	>90% sat.
TDS	34,500	<2,500	34,180	N/G
TSS	10	<50	10.4	N/G
Nitrate-N (µg/L)	20	<5	19.85	5
Phosphate-P (µg/L)	10	<5	9.95	5
Sulphate (mg/L)	2450	<250	2428	10,000

N/G No guideline

COMPARISON WITH ANZECC/ARMCANZ (2000) GUIDELINES TO ASSESS IN-PIPELINE AND DIFFUSED DISCHARGE

WATER QUALITY IN RELATION TO THE VALUE OF ECOSYSTEM HEALTH

Comparison of in-pipeline combined effluent concentrations with ANZECC/ARMCANZ (2000) 80% species protection guidelines:

Based on Collie A Power Station monitoring data (Table 10), with one exception the 95th percentile in-pipeline concentrations of all metal toxicants, including cadmium and mercury, in the combined effluent meet the ANZECC 80% species protection guideline.

The exception to the above being zinc, which on six of the 26 sampling dates exceeded the guideline concentration of 43 μg/L. Evaluation over a longer time frame would be required to assess whether such occurrences occur on an ongoing basis, as four of the exceedances occurred over a single four week period.

Comparison of in-pipeline combined effluent concentrations with ANZECC/ARMCANZ (2000) 95-99% species protection guidelines:

All metal concentrations in the combined effluent, other than cobalt, meet the relevant ANZECC/ARMCANZ 99% species protection guideline at the edge of the ZID (Table 10).

From the available data, it would be possible that the concentration of cobalt exceeds the 99% species protection guideline. However, the concentration indicated may simply be a reflection of the high detection level used in the analysis of this metal (no concentration has ever exceeded the 20 and 50 μg/L detection levels used at various times in this monitoring program).

At all times the cobalt concentration has met the 95% species protection guideline concentration of 1 μg/L.

COMPARISON WITH GUIDELINES FOR OTHER "SOCIAL USE OBJECTIVES"

EQO 1: Maintenance of Ecosystem Integrity

As noted above, the physical and chemical parameters of the combined effluent will meet the requirements for maintenance of ecosystem integrity at the boundary of the ZID.

The concentration of cobalt meets the 95% species protection guideline but could exceed the 99% species protection guideline level, the uncertainty being due to the high level of detection used in analysing for this metal. Analysis at a lower level of detection would be required to further assess the possible influence of this metal.

EQO 2: Maintenance of Aquatic Life for Human Consumption

The concentrations of the identified metallic toxicants will not adversely impact on the maintenance of aquatic life for human consumption.

Analysis of mussels from the discharge site (URS 2003) have shown no evidence of exceedance of the nominated guidelines or standards for metals in seafood (molluscs).

Total arsenic concentration in both reference (Cockburn Sound commercially produced mussels) and impact site mussels have exceeded the inorganic arsenic concentration Environmental Quality Standard, however, no speciation into organic and inorganic arsenic in mussels has been undertaken.

EQO 3: Maintenance of Aquaculture

The requirements for physical stressors (pH and dissolved oxygen) will be met.

For the protection of wild fish stocks (refer to ANZECC/ARMCANZ [2000] guidelines section 4.4.1) the concentration guidelines for the identified toxicants present in the effluent (nitrate-nitrogen, cadmium, chromium, copper, lead, mercury and zinc) will be met within the ZID at four metres horizontal and vertical from the diffuser, based on existing modelling.

EQO 4: Maintenance of Primary Contact Recreation Values

The biological indicators for primary contact recreation will continue to be met.

The guideline pH range of 5 - 9 encompasses the in-pipeline pH of 7.3 for the combined effluent.

Water clarity will not be impacted, TSS will increase only marginally.

The concentrations of known potential toxins in the combined effluent (refer to PER) will not exceed the environmental quality guidelines for primary contact recreation.

EQO 5: Maintenance of Secondary Contact Recreation Values

The biological indicators for secondary contact recreation will continue to be met.

The guideline pH range of 5 - 9 encompasses the in-pipeline pH of 7.3 for the combined effluent. The actual pH is expected to be close to background at the edge of the ZID.

EQO 6: Maintenance of Aesthetic Values

All visual indicators of aesthetic quality will continue to be met.

The guideline concentration of copper and zinc (as fish tainting substances) of 1,000 µg/L and 5,000 µg/L, respectively, is higher than the in-pipeline concentration of copper and zinc (<20 µg/L and 90 µg/L, respectively) in the combined effluent.

EQO 7: Maintenance of Industrial Water Supply Values

Water supply at the boundary of the ZID would be suitable for industrial water supply, however the discharge site is offshore and is highly unlikely to ever be considered for industrial water supply.

7 Social and Heritage Issues

Issue 7.1 Raised by DoH.
The discussion of social issues appears to be general and commentary rather than supported by assessment when considering issues such as the requirement for a construction and operations workforce, and the potential impacts on the Shire and Region.

Response The Shire of Collie in its submission to the EPA made the following comments with respect to Social and Community Issues:

"*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."

In addition Griffin Energy commissioned a report on Economic and Social Impacts of Bluewaters 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".*

Issue 7.2 Raised by DPI.
The proximity of Special Residential areas should be given more detailed consideration, particularly in relation to the impact of the proposed development and buffer zone requirements.

Response For the purposes of the noise and emission modelling carried out in support of the project no distinction was made between the Special Residential areas and other residential areas of the towns. The closest noise receptor is at the town's eastern limits, a Special Residential zone. Modelling and assessments were made on this basis. Bluewaters meets the separation distances proposed in the EPA draft guideline No. 3 on Separation distances (see response to Issue 7.6).

Issue 7.3 Raised by DPI.
Additional information is required on infrastructure requirements including potential electricity lines, conveyor belts and haul roads, the upgrading of roads for construction and operational workforce, as well as the impact on transportation infrastructure in general.

Response As stated in the PER, Bluewaters will maximise the use of existing infrastructure and requires no new infrastructure to support it (Section 3.3.1). No new electrical distribution lines are required except for the interconnection to the SWIS grid. The actual interconnection is yet to be specified by WPC, however, will not require clearing of any native or remnant vegetation.

The existing road transport network was sufficient for the construction of Collie A and will be sufficient for Bluewaters which is smaller than Collie A. Coal supply will be the responsibility of Griffin Coal and will be covered in the Environmental Management Plan for the Ewington I Mine. The ACIL Tasman report, Economic and social impacts of Bluewaters, details the positive impacts in more detail.

Issue 7.4 Raised by DPI.
There is no actual commitment by Griffin Energy to try to obtain its work force as much as possible from the local area as well as to ensure that these positions are on a long term basis.

Response The Griffin Coal workforce at Collie is drawn from the following areas;

- 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.

Issue 7.5 Raised by Shire of Collie, SWCCI and BWEA.
The project will benefit the region economically by maintaining employment opportunities and provide for long term jobs. Population drift to the larger centres will be reduced and, in accordance with the State Governments priority, sustainability of an important small town and community can be better assured.

Response This supports Griffin Energy's position. A more detailed analysis of the impact of the proposal is contained in the report prepared by ACIL Tasman on the Economic and social impacts of Bluewaters.

Issue 7.6 Raised by DPI.
Mechanisms to establish and maintain buffers to the plant are not adequately addressed.

The PER document does not specify the land area requirements, associated buffer zone requirements, and buffer zone management measures to minimise off-site impacts.

Response Bluewaters needs to be considered in its full and proper context. That is, as a primary land use within the proposed Coolangatta Industrial Estate (Coolangatta).

Coolangatta comprises 490ha and is contained wholly within Lot 8 Wellington Location 796 Boys Home Road and is owned in fee simple by W.R. Carpenter Agriculture Pty Ltd, a member of the Griffin Group of companies of this Bluewaters will comprise less than 3%.

The positioning of Bluewaters in the north-east corner of Coolangatta means that it is located 3.5km from the nearest sensitive land use. This conforms to the EPA's Draft Guidance for the Assessment of Environmental Factors – Separation Distances between Industrial and Sensitive Land Uses guidelines which states *"4.4.2 General guidance is*

required on separation distances in the absence of site specific technical studies, OR An estimation of the area that could be subject to land use conflicts."

"Where a separation under consideration is less than in the table, it is recommended that a new project does not proceed in the absence of site-specific investigations and a report demonstrating that the separation distance will meet acceptability criteria and that enforceable management techniques will be applied to ensure an appropriates environmental outcome."

The PER prepared for Bluewaters included site-specific investigations that demonstrated that the lesser distance to the nearest sensitive landuse, being a rural residence 3.5km to the west of the proposed power station, would not be adversely impacted. The environmental assessment carried out for Coolangatta also considered the issues. The conclusion from both studies was that there will be no impact on the nearest sensitive landuse and therefore, there are sufficient buffers in place.

In effect Coolangatta contains, within it, sufficient buffer to meet the concerns raised in the above issue. In addition, the requirement for any further industrial proposals on Coolangatta to undergo formal environmental assessment under Part IV of the Environmental Protection Act, will ensure that buffers for all industries within Coolangatta are considered and maintained at the time each specific proposal is proposed.

Issue 7.7 Raised by DPI.
The PER document does not specify the land area requirements, associated buffer zone requirements, and buffer zone management measures to minimise off-site impacts.

Response Table 2 on page 16 of the PER (Key Proposal Characteristics) specified the land requirement. The Maximum total area required is 15 hectares. The maximum facility footprint is 350 metres by 150 metres. The nearest sensitive location is a farmhouse 3.5 km to the west. Noise and air modelling demonstrate that this residence will not be impacted by the proposal. Bluewaters meets the separation distance suggested in EPA draft Guidance Statement No.3 – Separation Distances between Industry and Sensitive Locations. See also response to Issue 7.6.

Issue 7.8 Raised by 153 individuals, Shire of Collie, BWEA and SWCCI.
Bluewaters will make significant contribution towards a sustainable future for Collie and the South West.

Response Griffin Energy agrees that Bluewaters will be a positive contribution to Collie and the South West. This is further detailed in the ACIL Tasman report.

Issue 7.9 Raised by 134 individual submissions, Shire of Collie, BWEA and SWCCI.

Bluewaters is a positive investment both socially and economically and is also environmentally responsible.

Response This supports Griffin Energy's position. A more detailed analysis of the impact of the proposal is contained in the report prepared by ACIL Tasman on the Economic and social impacts of Bluewaters.

Issue 7.10 Raised by DIA and Shire of Collie.
The proponent should fully explore Indigenous and Archaeological issues associated with the development and will be required to seek approval from the Minister for Indigenous Affairs should any Aboriginal sites be discovered during construction.

Response Griffin Energy has fully explored Indigenous and Archaeological issues associated with the development. Copies of applicable Ethnographic and Archaeological reports were supplied to the DIA covering the site chosen for the power station. 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.
Commitment number 16 in the PER covers this issue.

8 Other Issues

Issue 8.1 Raised by WPC.
It is not correct to imply that Bluewaters will provide capacity for the aging Muja Power Units. Western Power has in place an Asset Replacement Program to manage its portfolio of generation plant and under this program Cockburn 2 gained approval on the basis that Muja A/B would be decommissioned.

Response The Minister for Energy on 5th August announced that the Cockburn 2 proposal by Western Power would not proceed. Given that at some stage Muja A & B will be required to be decommissioned, Bluewaters remains an option to replace the Muja A/B capacity.

Issue 8.2 Raised by WPC.
Is the South West Power Project (SWPP) still being considered along with Bluewaters?

Response No – The Bluewaters program replaces the SWPP.

Issue 8.3 Raised by WPC.
The role of Bluewaters in the Western Power, Power Procurement Process (PPP) should be clarified.

Response Bluewaters is a merchant plant. In combination with the proposed Bluewaters II it has been offered as an option to Western Power for the PPP. Notwithstanding the outcome of the PPP, Bluewaters is planned to proceed.

Issue 8.4 Raised by DPI.
Will the coal resource be available from the approved capacity of the mine?

Response Bluewaters will require approximately 700,000 tonnes of coal per annum (not 1 million tonnes per annum as stated in the PER) for the life of the station (25 years) to operate at an 80% capacity factor. Ewington I mine has an 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. Refer also to the response to Issue 5.5.

Issue 8.5 Raised by CCWA, ACF, WWF, CANA.

The plant is not justified. Energy demand is not growing at a rate that will require both the PPP 300MW and Bluewaters 200MW within the same timeframe.

Response The following graph of power demand using information provided by Western Power clearly demonstrates a demand for power. The PPP program is not sufficient to cover off the increased demand.

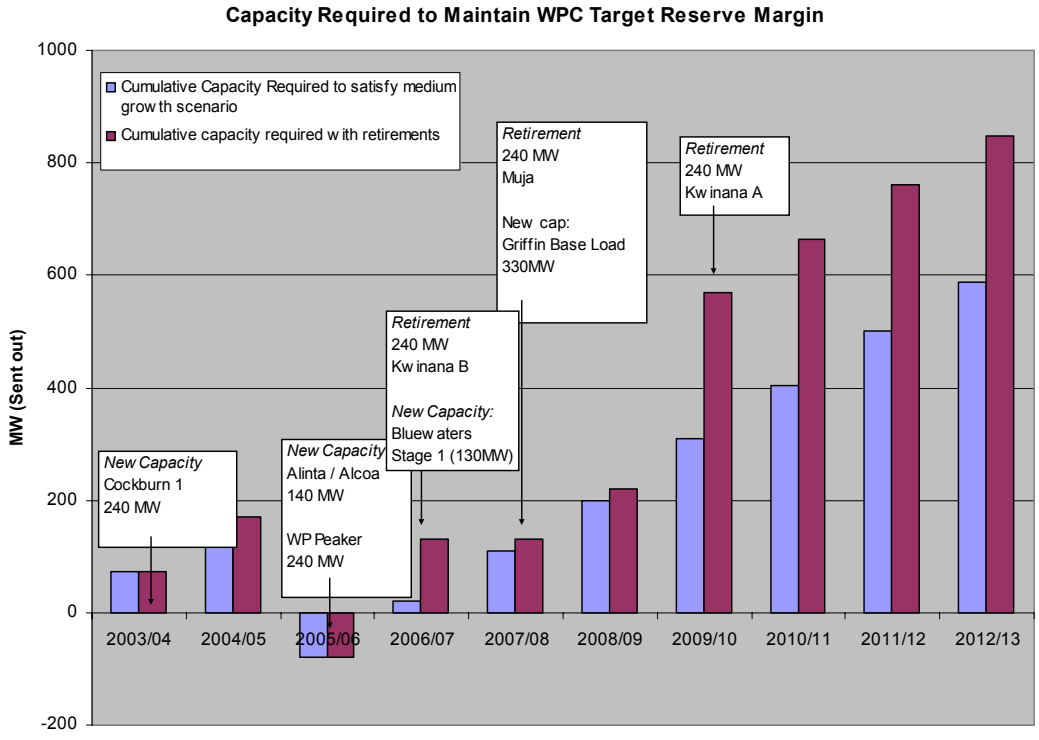


Figure 2 – Capacity Required to Maintain WPC Target Reserve Margin

Issue 8.6 Raised by CCWA, ACF, WWF, CANA.
The Proponent should release a supplementary PER addressing the deficiencies of the original PER, which should be made available for public comment.

Response Griffin Energy has followed due process in preparing and presenting the PER for public review. The preceding scoping document and the PER were reviewed by the EPA prior to release to the public for review. There is a considerable amount of support for the project in the Collie area and the greater South West. Griffin Energy is responding to all issues raised in submissions. The responses are available for public scrutiny. There is no justification for a supplementary PER.

Issue 8.7 Raised by CCWA, ACF, WWF, CANA.
The proponent should justify the use of Griffin Coal as the fuel for Bluewaters.

Response Bluewaters, 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. This response provides detail on the rationale for the selection of coal as a viable energy source for the Bluewaters Project.

This information is supplementary to that already provided in the PER released for public comment in May 2004.

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 the Bluewaters Project 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 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 which cut electricity consumption.

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 technology will improve environmental performance and reduce electricity generation costs on the SWIS (Office of Energy, 2003). Bluewaters 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 site of the proposed Bluewaters Project is represented by existing cleared grazing land, and 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 project design incorporates state-of-the-art technology for plants of this 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 windpower 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 windpower is 33% compared to 95% offered by coal-fired power generation. The area required for windpower generation is 12 ha/MW compared with 0.3 ha/MW for coal-fired power plants. Most importantly, however, is that typically windpower 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 windpower", for example, wind generators operate intermittently and "are not able to reliably produce their rated output when required to meet demand" (Western Power 2002).

Issue 8.8 Raised by CCWA, ACF, WWF, CANA.
Data regarding the moisture and energy content and price of coal should be presented to verify the statement that "Collie coal is an efficient, available and comparatively inexpensive local source of energy".

Response The price of the coal is commercial in confidence and not relevant to the Environmental Review process. However, the availability of Collie coal is a matter of record by virtue of the stated reserves.

Collie coal is a comparatively inexpensive source of energy for electricity production purposes. By comparison wind and solar sources, while considered cost free, require much higher capital cost equipment to convert the energy source to electricity. Furthermore, wind and solar electricity generators must be fully backed up by other, (usually thermal) generators, for periods when the wind and solar insolation is not available in order to meet the reliability and availability requirements of electricity customers. The requirement to back up those supplies automatically renders them more expensive than Collie coal because of the capital and other fixed costs of both the renewable and thermal generators. Other renewable energy sources are not available locally in the scale required for the Bluewaters Project.

Issue 8.9 Raised by CCWA, ACF, WWF, CANA.
The proponent should clarify whether or not it has a policy to full replace Muja A and B power stations when they are retired.

Response The ultimate decision regarding the replacement of Muja A and B is a matter for Western Power.

Issue 9.10 Raised by DPI.
Section 2.6, Table 1 in the PER does not refer to planning documents or legislation.

Response Table 12 is an amended Table of applicable legislation.

Table 12
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.

Issue 8.11 Raised by DPI.
An explanation of the statutory processes and the role of the PER in seeking approval of the development of Bluewaters is required, especially with respect to the Coolangatta Industrial Estate.

Response The role and purpose of the PER is detailed in Sections 2.1 and 2.4 of the PER. With respect to Coolangatta, the rezoning process is the responsibility of the landowner (WRCA). Once they have been successful in rezoning the land, Griffin Energy will negotiate a lease with the owners, and then submit a Development Application to the Shire of Collie.

Issue 8.12 Raised by CCWA, ACF, WWF, CANA and PAN.
The PER does not meet the requirements of the EPA's Guidelines for Preparing a Public Environmental review, as it does not provide a description of legal framework, including existing zoning and environmental approvals and decision making authorities.

Response Griffin Energy followed due process in preparing the PER. The scoping document was accepted by the EPA and the PER was approved for public circulation. If the PER did not meet the requirements it is unlikely that the PER would have been approved for circulation by the EPA. Legal framework, legislation and decision-making authorities are covered in Section 2 of the PER.

Issue 8.13 Raised by CCWA, ACF, WWF, CANA.
The potential for building a bigger plant to take advantage of CHP or super-critical technologies should be examined

Response The CHP process is widely used in densely-populated cities in cold climates. It features the distribution from the power plant of hot water at less than 100° C for domestic heating and hot water. The process substitutes energy from a low-temperature heat source for this purpose in place of high-grade energy (electricity, or natural gas). Conditions for the application of CHP do not exist at Collie.

The sale of steam to industrial customers is a different consideration; the steam is bled from the turbine at appropriate conditions causing a reduction in the electric power output. Cycle efficiency is increased, but steam must be priced appropriately in recognition of its energy content and the foregone electrical energy. Currently there are no industrial demands for steam in the vicinity of the project but these may arise when the adjacent industrial estate is developed.

See also the response on size and super-critical technology (Issue 5.12).

Issue 8.14 Raised by 111 private citizens.
I support Bluewaters Power Station because the project represents a commitment by Griffin Energy to the town of Collie and the South West and I believe it will contribute to a sustainable future for the town and region.

Response Griffin Energy agrees with the point of view expressed. In fact this view was consistent with the feedback received by Griffin Energy during the public consultation period.

Issue 8.15 Raised by 134 private citizens.
WA needs this new coal-fired power station to protect us from power shortages such as those that occurred on 18 February 2004. We cannot rely on gas for power generation as it is supplied through a single pipeline. We need a balanced fuel supply and coal has to be part of the mix. Power shortages as a result of the very risky approach of too much reliance on a single source of fuel should not be tolerated.

Response Griffin Energy agrees with the point of view expressed. In fact this view was consistent with the feedback received by Griffin Energy during the public consultation period, and supported by research carried out by the Australian Research Group on behalf of Griffin Energy.

Issue 8.16 Raised by 133 private citizens.
Bluewaters will ensure that industry will have access to low cost power which in turn will foster economic growth and prosperity in the South West.

Response Fostering economic growth in Collie and the surrounding regions is one of Griffin Energy's motivations for proposing the power station.

Issue 8.17 Raised by 121 private citizens.
I believe Bluewaters will accelerate the necessary and ultimate closure of older power plants, resulting in a net positive environmental benefit to Western Australia. A new Bluewaters power station will reduce the greenhouse intensity across the South West Interconnected System .

Response Griffin Energy agrees with the point of view.

Issue 8.18 Raised by a private citizen.
There is little question that the proposal is soundly balanced and geared towards enhancing Collie, The South West and WA through improved efficiencies that will increase rural employment, not only maintain but improve local environmental conditions, It is considered win/win by ensuring that WA wins with better guarantees to security of supply, the environment wins with a proposal to desalinate waterways and the proposal is ultimately profitable which will ensure that supply is continuous and plant is upgraded – insurance that what is environmentally positive today remains that way.

Response Griffin Energy agrees with the point of view.

Issue 8.19 Raised by a private citizen.
Natural gas is a premium transportation fuel, and its use for base load power generation here and overseas is a deplorable short term policy which is likely to see the resource plundered to exhaustion within the lifetime of those currently permitting it. We should be conserving

natural gas for what it is needed for, and using coal for what it is good for.

Response Griffin Energy agrees with the point of view.

Issue 8.20 Raised by a private citizen.
Griffin Energy have provided extensive consultation to the Collie community and have demonstrated the environmental benefits of modern coal fired power stations. Collie people look forward to Griffin Coal building this Power station, allowing them to continue their excellent relationship with the local community and South-West. With 100 years of Coal reserves this is clearly a sustainable choice in power generation without being dependent on a troublesome pipeline. We look forward to industries that would be attracted by such infrastructure.

Response Safeguarding the future of Collie is a strong motivation for Griffin Energy.

Issue 8.21 Raised by 49 private citizens.
The following points of view were forwarded to the EPA during the public review period of the PER. Griffin Energy acknowledges the support and agrees with all the sentiments expressed by these private citizens.

- With New technology that your company has available this should be an automatic choice for a PowerStation in Collie, good luck.
- I also believe the greater ability to sell gas overseas compared to WA coal is of huge importance to our state. Why use a product that can produce an income for the state if it is not necessary to use it locally. As shown recently with the gas emission near Dongara there is a lot of pollution that occurs with gas at points other than point of burn.
- My main concern is the reliance on one pipeline supplying gas from the north west.
- The state needs to think strategically to minimise the possibility of loss of the gas pipeline due to whatever reason. Coal can be stored and disruption to supply minimised.
- WA needs this power station to avoid debacles such as happened on February 18 this year.
- Would be good to see a group that has operated in the local area for such a long time take a new step into an industry in need. I feel that the company will carry on with its brilliant efforts and considerations and make a new path for power generation. Also continuing its support to the local community with jobs, sponsorships, education etc which it seems to pride itself.

- Griffin Coal is showing more leadership than the current government in that it is addressing the power demand and shortfall as well as ensuring the long term development of industries and the benefit the proposed power station will have on our state.

- My dad has worked there for 22 years and I hope it will employ more local people.

- About time someone is forward thinking and realises that gas is not the ideal solution to our electricity woes. I believe the gas pipeline is a sitting target for terrorist activity, given WA's strategic position and involvement with US military.

- I am pleased to see that someone is paying attention to our power requirements in WA.

- I strongly believe this is a step in the right direction, as gas produced in Western Australia is more valuable as an export commodity.

- The continuing negativity towards coal as a power source. People are not getting the full facts on the comparisons between coal and gas and the effects on the environment.

- A new coal fired power station in Collie will be an important contribution to sustaining the future for the town of Collie.

- I believe this project should proceed as it will ensure the viability of the region and provide low cost power for the region. Ultimately, it will lead to the closure of less efficient, higher greenhouse gas emitting plants.

- Greenhouse emissions from the million or so megawatt hours that will be produced each year by this privately funded power station, dwarf into insignificance compared with the several orders of magnitude higher emissions from east coast coal fired power stations. There can be no compelling reason to deprive the Collie region of its livelihood on the grounds of national greenhouse issues while Queensland and other states continue to build mega power stations to enhance their energy export industries.

- I was extremely annoyed at the power fiasco in February and my family and I have little faith in the existing power set-up (both political and electrical) in Western Australia. We definitely need to have a more-than-adequate power-supply system if we are to be able to cope with an ever-increasing demand for power and if we are to be able to fend off disaster should either a terrorist attack or an act of God render existing power-generating facilities inoperable. And both of the latter are entirely possible.

- As a small business owner in the Collie area, I can only see good in any proposal that will help guarantee the economic future of the area.

- The Collie Visitor Centre Management Committee does have some concerns regarding dust levels; however we believe that with the appropriate environmental practices in place and diligent monitoring of weather conditions, this can be overcome. The Visitor Centre also recognises that industrial tourism is becoming increasingly popular and would expect to see Bluewaters supporting the Visitor Centre and Shire of Collie's drive to promote tourism by making tours available of both the mine and the power station. We see this as an excellent opportunity to both entertain, but more importantly educate the public in the award winning environmental practices that coal mining in Collie achieves. We feel that tours of both the mine and the proposed Blue Waters Power Station, with its advanced technology will achieve that end.

- In the past there have been many sacrifices for Collie Mine Workers and the community to make coal more competitive in price and availability, resulting in loss of jobs and income for our Town, not to forget the social impact on workers and their families of the 24 hours, 7 days a week operation. That's why in my opinion the Collie Community deserves to get another Coal-fired Power Station and Industrial Park. We need a future (jobs) for us and our children, we need to grow.

- Attracting other industries and down streaming in the Coolangatta Industrial Park will also be an important economic spin-off, which will be jumpstarted by the Bluewaters Power Station project.

- It is imperative there be a balance in the fuel sources used to generate electricity in WA & this can only be achieved with any degree of security in the short to medium term by assuring the Bluewaters Project goes ahead.

- Why should our state import fuel to fire power plants when we have an abundance of coal in the SW, which is readily available? Using coal as an option 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.

- I do not want to be forced into year after year power shortage panics as happened last summer when electricity, etc had to be cut or people threatened with fines if caught using their power.

- My business (both patrons and employees) whom are members of the Collie community, wholeheartedly support Griffin Coal in their endeavour to build the Blue Waters Power Station. The town needs the economic benefits that will be a flow on from the attraction of new businesses to the region. Due to the cleaner New Collie Coal, we believe that Coal is well placed to be both competitive and an environmentally sustainable product that the State needs. The Collie community welcomes new industry and has the infrastructure within the town to cope with an increase in population. We believe the State cannot continue with it's reliance on the gas industry due to its

unreliability to continue supply. It is the right of all residents and business operators in W.A. to receive a reliable and cheap power source.

- Successful industrial proposals such as the Bluewater proposal have the potential to create wealth in the region and thus the ability to help manage environmental issues in the Collie region such as salinity and vegetation clearing.

- I believe gas is too valuable resource to be used in fixed plant. High carbon fuels such as coal should be used as energy sources for the likes of larger power stations where scales of economy can be implemented to recover pollutants and green house gasses.

- Western Australia has vast resources of coal which can be utilised to provide a reliable, sustainable, and economic source of fuel for the generation of electricity in the State.

- I have worked in the Energy & Resource sector for nearly 30 years and had experience with all 4(four) types of fuels used for power generation. Nuclear has to be ruled out because of Western Australia's non-nuclear policy so that leaves coal, gas & oil. Oil must be ruled as its price and supply is regulated by a cartel that can upset the world's balance with a turn of a valve. So that leaves Gas & Coal. I agree on the surface gas is a "cleaner" fuel by producing less carbon dioxide per TJ of energy released but "invisible" leaks from its systems damage the ozone layer in 26 times greater than produced by coal as the latter does not do damage in its "raw" form. Equally gas reserves are no where near in the amount of coal and even if they were, wouldn't it be more prudent to use it for EXPORT & HOME DOMESTIC HEATING, (i.e. to replace wood-burning appliances, by legislation if necessary). Low-rank coal, as produced locally in the Collie coalfields, is ideal for power generation as it does not form clinker on the fire-grate when burnt thereby making "ash" disposal easier and in most cases able to be used as by-product(s). With advent of "CLEAN COAL" power stations and state-of-the-art technology in removing SOx & NOx as well as complete combustion control and electrostatic dust precipitators, constituents that could cause acid rain and fugitive dust, respectively, are nullified. All in all there is only one fuel source for the proposed "Blue Waters" & Collie "B" power stations and that is COAL.

- There needs to be a balance between gas and coal based power. To make this work properly the Management of Western Power would appear to need some sorting out, and the coal unions will need to be more responsible than they have been in the past.

- The use of Collie Coal by the Griffin Group is a sensible use of an energy source that can only be utilised in Western Australia.

  - Too many of the judgements and comments made about Collie Coal are based on historical image of coal as a dirty industry leading to and black smoke producing industries. Modern technology ensures that the industry is now operating in a very clean and efficient manner.

  - In addition the Griffin Group of companies have looked at this proposal in a holistic fashion that incorporates renewable energy (wind power) and a desire to increase tree planting and reduce salt levels within the East Collie River.

  - The proposal should be strongly supported by West Australians.

- Griffin Coal has a long history of stable supply to many industries in Western Australia.

- Coal needs to be given a fair chance.

- Coal is a sensible fuel for power generation. Gas should be reserved for high value industries (petrochemical etc).

- Let us use the fuel 'coal' that we have in our back yard not gas from the north.

- This is a more viable option than gas fired plant.

- Collie Need diverse industries.

- Coal is the most reliable fuel for a Base Load station. Gas relies on only one supply source.

- There is plenty of coal, gas supply is uncertain and easier to sabotage. Coal emission is getting cleaner.

- I would like to see a stable future for the coal industry for our sake and my kids and their kid's sake. I support the new Collie Coal 100%.

- It is silly to use gas for power generation when gas has so many other valuable uses. Coal is suited mainly for power generation and should be use of first choice.

- I believe natural gas should not be used for new power generation because this has export potential, whereas coal doesn't.

- Using Collie coal will be better because of no methane.

- We need to use more coal to keep people in jobs.

- Coal the only way to go.

- I think it's the best that could happen for the future of coal and Collie.

- Security for my family and the town of Collie.

- The use of coal as a power supply has my full support.
- I totally support the use of Collie coal in power supply.
- I believe that a new base load coal power station is necessary to make up shortfall in supply at present and for future growth with other sources to top up on peak demand.

9 Glossary

ACF	The Australian Conservation Council
AGO	Australian Greenhouse Office
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BPM	Best Practicable Measure
BWEA	Bunbury Wellington Economic Alliance
CANA	Climate Action Network
CALM	Department of Conservation and Land Management
CCMEC	Collie Coal Mines Environment Committee
CCSD	Cooperative Research Centre for Coal in Sustainable Development
CCWA	Conservation Council of WA
CHP	Combined Heat and Power
CO	Carbon Monoxide
COAG	Council of Australian Governments
CO2CRC	Cooperative Research Centre for Greenhouse Technologies
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dB	Decibel
dB(A)	Decibel A weighted
DEFRA	Department of Environment Food and Rural Affairs
DEP	Department of Environmental Protection
DIA	Department of Indigenous Affairs
DoH	Department of Health
DPI	Department of Planning and Infrastructure
EC	European Commission
EPA	Environmental Protection Authority
EPASU	EPA Service Unit
EPBC	Environment Protection and Biodiversity Conservation
EQO	Environmental Quality Objective
g	Grams
GHG	Greenhouse Gases

GJ	Gigajoule
ha	Hectare
HCWA	Heritage Council of Western Australia
Hg	Mercury
HP	High Pressure
IDGCC	Integrated Drying Gasification Combined Cycle
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IPP	Independent Power Producer
kg	kilogram
L/sec	Litres per second
m^2	Square metres
m^3	Cubic metre
Mg/Nm^3	Milligrams per normal cubic metre
MPa	Mega Pascal
MTE	Mechanical Thermal Expression
MW	Megawatt
MWh	Mega Watt hour
NEPM	National Environment Protection measure
NHMRC	National Health and Medical research Council
NO_2	Nitrogen Dioxide
NO_x	Nitrous Oxides
NPI	National Pollutant Inventory
NSW	New South Wales
OECD	Organisation of Economic Cooperation and Development
PAN	Pollution Action Network
PAH	Polycyclic Aromatic Hydrocarbon
PER	Public Environmental Review
PM_{10}	Particulate matter less than 10 microns
PPP	Power Procurement Process
R&D	Research and Development
SKM	Sinclair Knight Merz
SO_2	Sulphur Dioxide
SOx	Oxides of Sulphur
SWCCI	South West Chamber of Commerce and Industry

SWDC	South West Development Commission
SWIS	South West Interconnected System
SWPP	South West Power Project
TAPM	The Air Pollution Model
tpd	Short (US) tons per day
t/h	Tonnes per hour
UNFCCC	United Nations Framework Convention on Climate Change
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
WWF	WWF Australia
ZID	Zone of Initial Dilution
$	Australian Dollar
µg m^{-3}	Micro grams per cubic metre
^{o}C	Degrees centrigrade
µg/L	micrograms per Litre

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Appendix 6

Letter from Western Power

Western Power

Our Ref: SM/77/7(80)V4
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Facsimile: (08) 9326 6989

28 October 2004

Environmental Protection Authority
Westralia Square
141 St. Georges Terrace
PERTH WA 6000
Attention: Ray Claudius

Dear Ray

SWIS POWER PROCUREMENT PROCESS – COLLIE POWER STATION EXPANSION ENVIRONMENTAL SCOPING DOCUMENT

Further to the matter of the future operation of Stage A & B generators at Muja Power Station (Muja A/B), which has arisen in relation to the air quality modelling requirements for the above scoping document.

Western Power has committed to the retirement of Muja A/B by April 2007. This retirement date was endorsed by the Western Power Board at its meeting on 9 September 2004.

No uncertainty now remains regarding the closure of these units, and Western Power therefore submits that they do not need to be included in the air quality modelling for the above expansion (or other projects commencing operation later than April 2007).

Yours faithfully

TREVOR HARVEY
MANAGER
POWER PROCUREMENT
DMS #2075089 V1
cc: Sinclair Knight Merz, Wesfarmers/J-Power, Griffin Energy