STRATFORDCOAL
Part of the Yancoal Australia Group

Stratford Extension Project
Environmental Impact Statement

APPENDIX D

AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

STRATFORD EXTENSION PROJECT – AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

Stratford Coal Pty Ltd

Job No: 5699

22 October 2012

A PEL Company

PROJECT TITLE:	**STRATFORD EXTENSION PROJECT – AIR QUALITY AND GREENHOUSE GAS ASSESSMENT**
JOB NUMBER:	**5699**
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

The Stratford Coal Mine (SCM) is owned and operated by Stratford Coal Pty Ltd (SCPL) (a wholly owned subsidiary of Yancoal Australia Ltd [Yancoal]) and is located approximately 100 kilometres (km) north of Newcastle, New South Wales (NSW) in the Gloucester Basin (**Figure 1.1**).

SCPL is seeking consent for the continuation and extension of open cut coal mining and processing activities at the SCM and Bowens Road North Open Cut (BRNOC) (collectively referred to as the Stratford Mining Complex) (hereafter referred to as the Project).

PAEHolmes has been commissioned by SCPL to undertake an Air Quality and Greenhouse Gas Assessment for the Project.

1.1 Background

Construction of the SCM commenced in 1995 with development of the Stratford Main Pit, which was mined for eight years. The Stratford Main Pit is now used for water storage and as an emplacement area for rejects from the SCM Coal Handling and Preparation Plant (CHPP).

The BRNOC has been in operation since 2003, and all coal extracted from this mine is transported to the SCM run-of-mine (ROM) pad and then blended and processed at the SCM CHPP.

The Duralie Coal Mine (DCM) is also owned by Yancoal and is located approximately 20 km south of the Stratford Mining Complex. The DCM commenced coal production in 2003 and ROM coal mined at DCM is also processed at the SCM CHPP.

The SCM CHPP blends and processes ROM coal from the three operations (SCM, BRNOC and DCM) at a current rate of 4.6 million tonnes per annum (Mtpa). Product coal is then railed to Newcastle.

SCPL is seeking approval from the NSW Minister for Planning and Infrastructure for a new Development Consent to increase the extent of open cut operations under Division 4.1 of Part 4 of the NSW *Environmental Planning and Assessment Act, 1979* for the Project. The approval sought would consolidate and replace the existing Development Consents (DA 23-98/99 and DA 39-02-01) for the SCM and BRNOC, respectively.

1.2 Study Requirements

The Air Quality and Greenhouse Gas Assessment is guided by the Director-General's Requirements (DGRs), outlined in **Table 1.1**. Agency comments have also been outlined by the NSW Environment Protection Authority[a] (EPA) (letter from Mr Bill George of the EPA to Mr Carl Dumpleton of the NSW Department of Planning and Infrastructure (DP&I) dated 30 November 2011) and are provided in **Table 1.2**.

The Air Quality and Greenhouse Gas Assessment has been prepared in accordance with the DGRs, NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (Approved Methods) (**DEC, 2005**) and in consideration of the EPA's agency comments in regards to the Project.

[a] The EPA existed as a legal entity operated within the NSW Office of Environment and Heritage (OEH) which came into existence in 2011. The EPA became a separate statutory authority on 29 February 2012. The OEH was previously part of the NSW Department of Environment, Climate Change and Water (DECCW). The DECCW was also recently known as the NSW Department of Environment and Climate Change (DECC), and prior to that the NSW Department of Environment and Conservation (DEC).

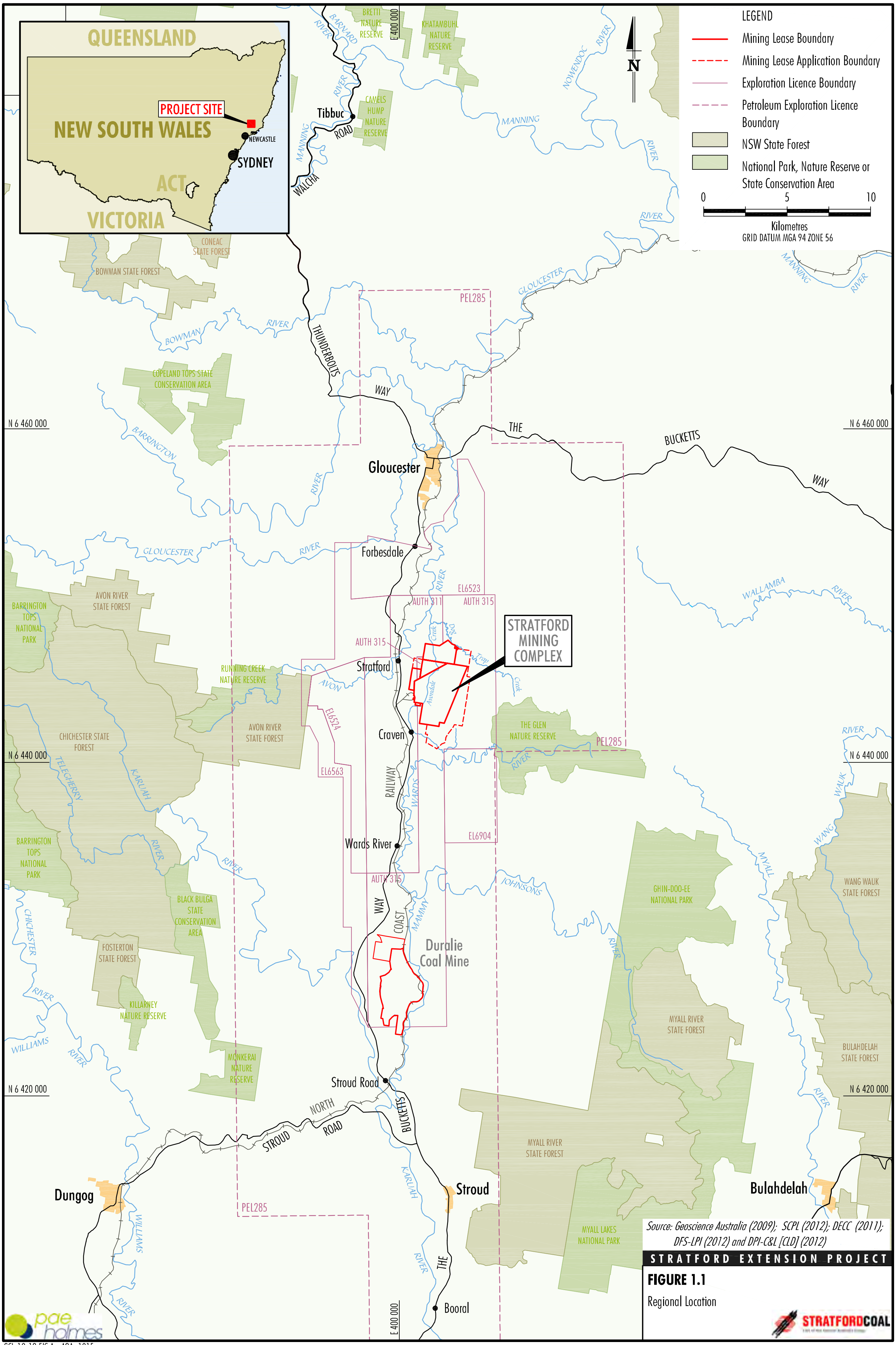

FIGURE 1.1
Regional Location

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Table 1.1: Director-General's Requirements

Discipline	Requirement
Air Quality	*including a quantitative assessment of potential:* - *construction and operational impacts, with a particular focus on dust emissions (including $PM_{2.5}$ and PM_{10} emissions, and dust generation from coal transport), as well as diesel, spontaneous combustion and blast fume emissions;* - *reasonable and feasible mitigation measures to minimise dust, diesel, spontaneous combustion and blast fume emissions, including evidence that there are no such measures available other than those proposed; and* - *monitoring and management measures, in particular real-time air quality monitoring and predictive meteorological forecasting.*
Greenhouse Gases	*including:* - *a quantitative assessment of the potential Scope 1, 2 and 3 greenhouse gas emissions from the project* - *a qualitative assessment of the potential impacts of these emissions on the environment* - *an assessment of the reasonable and feasible measures to minimise the greenhouse gas emissions and ensure energy efficiency*

Table 1.2: EPA Agency Comments

Comment	Report Section
Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk to human health and amenity *Justify the level of assessment undertaken on the basis of risk factors, including but not limited to:* *a. proposal location,* *b. characteristics of the receiving environment,* *c. type and quantity of pollutants emitted.*	**Entire report**
Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but need not be limited to: *a. Meteorology and climate,* *b. Topography,* *c. Surrounding land use, receptors and* *d. Ambient air quality.*	**Sections 3 and 5**
Include a description of the proposal. All processes that could results in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantify of all emissions must be provided.	**Sections 2 and 8**
Include a consideration of 'worse case' emission scenarios and impacts at proposed emission limits.	**Section 11**
Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.	**Sections 9 and 11**
Include air dispersion modelling where there is a risk of adverse air quality impacts or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the Approved Methods of the Modelling and Assessment of Air Pollutants in NSW (2005). *http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf.*	
Demonstrate the proposals ability to comply with the relevant regulatory framework specifically the Protection of the Environment Operations (POEO) Act (1997) and the POEO (Clean Air) Regulation (2002) [now *POEO (Clean Air) Regulation (2010)*].	**Section 4.4.2**
Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State plan 2010 and its implementation plan Action for Air.	**Section 4.4.1**
Detail emission control techniques/practices that will be employed by the proposal.	**Section 7 and Appendix D**

Comment	Report Section
The EIS should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO_2-e). Emissions should be reported broken down by: • *direct emissions (scope 1 as defined by the Greenhouse Gas Protocol),* • *indirect emissions from electricity (scope 2), and* • *upstream and downstream emissions (scope 3).*	**Section 11**
before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).	
The EIS should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.	
The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines.	
The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.	

EIS = Environmental Impact Statement.

tCO_2-e = tonnes of carbon dioxide equivalent.

2 PROJECT DESCRIPTION

2.1 Overview

The main activities associated with the development of the Project would include (refer to **Figure 2.1**):

- ROM coal production up to 2.6 Mtpa for an additional 11 years (commencing approximately 1 July 2013 or upon grant of all required approvals), including mining operations associated with:
  - completion of the BRNOC;
  - extension of the existing Roseville West Pit; and
  - development of the new Avon North and Stratford East Open Cuts;
- exploration activities;
- progressive backfilling of mine voids with waste rock behind the advancing open cut mining operations;
- continued and expanded placement of waste rock in the Stratford Waste Emplacement and Northern Waste Emplacement;
- progressive development of new haul roads and internal roads;
- coal processing at the existing CHPP including Project ROM coal, sized ROM coal received and unloaded from the DCM and material recovered periodically from the western co-disposal area;
- stockpiling and loading of product coal to trains for transport on the North Coast Railway to Newcastle;
- disposal of CHPP rejects via pipeline to the existing co-disposal area in the Stratford Main Pit and, later in the Project life, the Avon North Open Cut void;
- realignments of Wheatleys Lane, Bowens Road, and Wenham Cox/Bowens Road;
- realignment of a 132 kilovolt (kV) power line for the Stratford East Open Cut;
- continued use of existing contained water storages/dams and progressive development of additional sediment dams, pumps, pipelines, irrigation infrastructure and other water management equipment and structures;
- development of soil stockpiles, laydown areas and gravel/borrow areas;
- monitoring and rehabilitation;
- all activities approved under DA 23-98/99 and DA 39-02-01; and
- other associated minor infrastructure, plant, equipment and activities and minor modifications to existing structure, plant and equipment and activities.

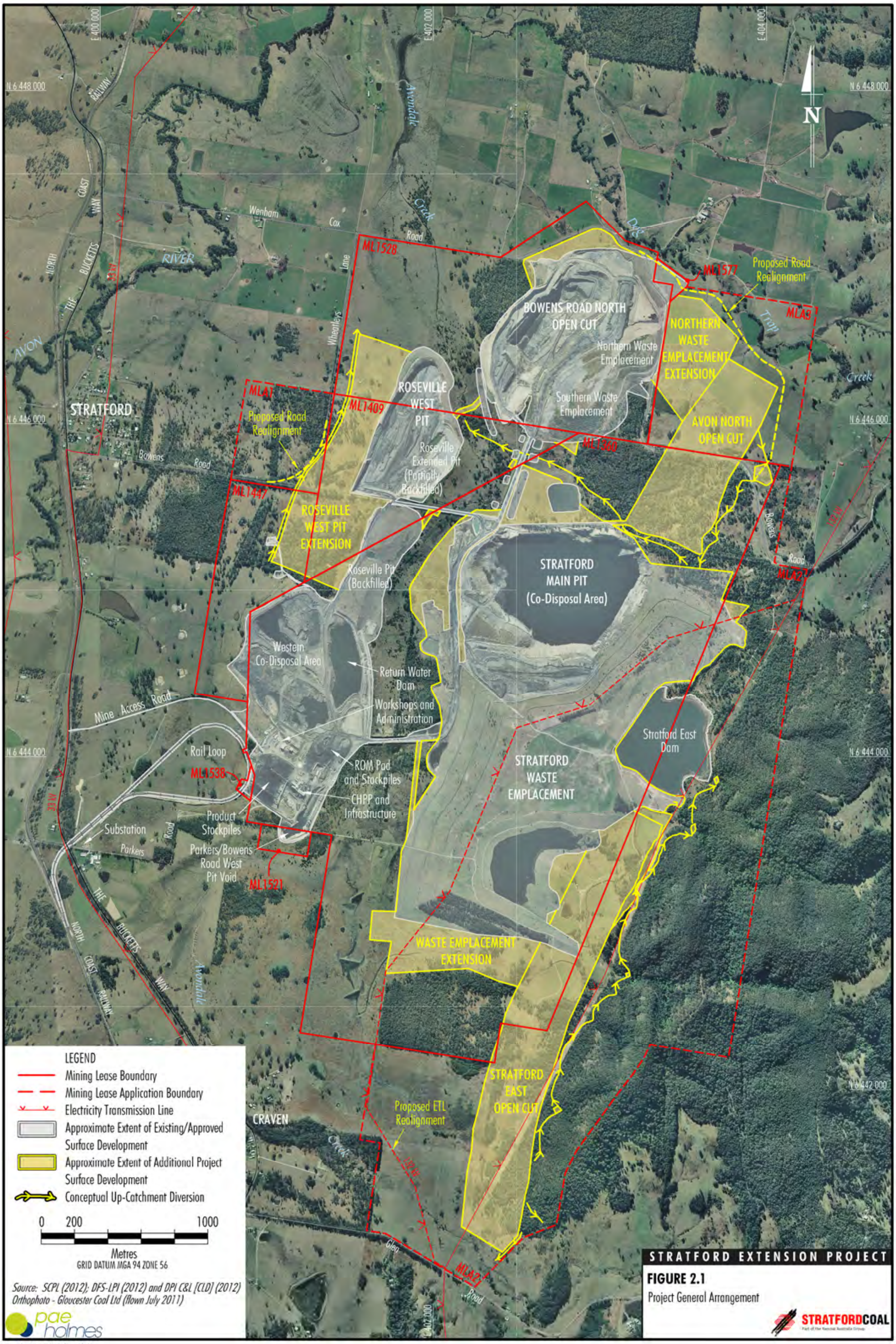

FIGURE 2.1
Project General Arrangement

2.2 Mining Operations

Project mining operations would be conducted during the periods specified below:

- BRNOC – mining operations would only occur between the hours of 7.00 am to 7.00 pm, seven days per week.
- Roseville West Pit Extension – mining operations would only occur between the hours of 7.00 am to 6.00 pm, seven days per week.
- Stratford East Open Cut (years 1 to 5) – mining operations would be conducted 24 hours per day, seven days per week, subject to compliance with noise limits. Fleet associated with the removal of overburden would generally only operate between the hours of 7.00 am to 6.00 pm, seven days per week.
- Stratford East Open Cut (years 6 to 11) – mining operations would be conducted 24-hours per day, seven days per week.
- Avon North Open Cut – mining operations would be conducted 24-hours per day, seven days per week.

Recovery of CHPP rejects by excavation from the western co-disposal area for re-processing would only occur between the hours of 7.00 am to 6.00 pm, seven days per week.

The Project includes four open cut mining areas, namely:

- BRNOC (completed in Year 1) within Mining Lease (ML) 1528 and ML 1409;
- Roseville West Pit Extension within ML 1409, ML 1360, ML 1447 and Mining Lease Application (MLA) 1;
- Avon North Open Cut within ML 1360 and MLA 3; and
- Stratford East Open Cut within ML 1360 and MLA 2.

An overview of the design features of each of the open cut mining areas and the western co-disposal area are provided below, with a focus on those features that are material from an air quality perspective.

2.2.1 Bowens Road North Open Cut

Coal mining operations in the BRNOC are scheduled to be completed during Year 1 of the Project, some 10 years after its commencement in 2003. No additional ROM coal would be mined from the BRNOC beyond the currently approved 5.4 million tonnes (Mt) coal reserve (total).

2.2.2 Roseville West Pit Extension

The Roseville West Pit Extension involves the continuation of open cut mining to the west and south of the existing Roseville West Pit at the Stratford Mining Complex. Extension of the open cut mining operation to the west would access the Marker [M7], Bindaboo, Deards, Cloverdale and Roseville Seams. As the open cut mining operation progresses to the south, the previously mined and backfilled Roseville Pit would be excavated/cut-back to allow mining through to the stratigraphically deeper Roseville Seam.

Approximately 7.3 Mt of ROM coal would be mined from the Roseville West Pit Extension. Access to the Roseville West Pit Extension would be via the existing waste rock and ROM coal haulage roads to the east and south, respectively.

At its nearest point, the Roseville West Pit Extension is approximately 1 km east of Stratford village (**Figure 2.1**).

2.2.3 Avon North Open Cut

The Avon North Open Cut is a new mining area to be developed north-east of the Stratford Main Pit. Approximately 4.3 Mt of ROM coal would be mined from the Avon North Open Cut, targeting the Avon Seam. Access to the Avon North Open Cut would be via an extension to the haul road north of the Stratford Main Pit to the toe of the Northern Waste Emplacement Extension.

Once mining operations in the Avon North Open Cut are completed the void would be used as a water storage and ultimately for co-disposal of CHPP rejects once the Stratford Main Pit co-disposal area void is filled.

2.2.4 Stratford East Open Cut

The Stratford East Open Cut is a second new mining area to be developed for the Project located east and south of the Stratford Waste Emplacement. Approximately 9.6 Mt of ROM coal would be mined from the Stratford East Open Cut, targeting the Cheer-up and Clareval Seams.

2.2.5 Western Co-Disposal Area

Opportunistic recovery of CHPP rejects from the western co-disposal area would occur as part of the Project. The extent of the western co-disposal area is contained by existing bunds to the west of the Return Water Dam.

Approximately 1.3 Mt of CHPP rejects would be recovered from the western co-disposal area during the life of the Project. At the end of the Project, the western co-disposal area would be re-profiled and rehabilitated.

2.2.6 Open Cut Mining Activities

Each of the open cut mining areas for the Project would be mined using conventional open pit methods. The open cut mining areas would involve supporting infrastructure such as haul roads, bunding, soil stockpiles, hardstands and water management structures and have been designed to integrate with the existing Stratford Mining Complex operations and minimise the amount of additional infrastructure required. A summary of the general open cut mining activities and sequence is provided below.

1. ***Vegetation Clearing -*** Vegetation would be progressively cleared over the life of the Project ahead of the active mining and waste rock emplacement areas.
2. ***Soil Stripping and Handling -*** Where stripped soils cannot be used directly for progressive rehabilitation, the soil would be stockpiled separately and seeded with grasses to maintain soil viability.
3. ***Weathered Overburden Removal -*** Some weathered or friable overburden would be removed by excavator and haul truck, with supporting dozers, and hauled for placement in mine waste rock emplacements (typically only at shallow stripping depths).
4. ***Overburden Drill and Blast -*** The method of material fragmentation at the Stratford Mining Complex is by drill and blasting techniques and dozer ripping.

5. ***Overburden/Interburden Removal and Handling -*** Overburden (and interburden) removal would continue to be undertaken by excavator and haul truck, with supporting dozers to expose the underlying coal seams. Overburden and interburden would be placed in out-of-pit mine waste rock emplacements, or as infill in the mine void, behind the advancing open cut mining operations.

6. ***Coal Mining and Handling -*** Mining of exposed coal seams at the Stratford Mining Complex typically involves excavators loading ROM coal to haul trucks for haulage to the ROM pad.

7. ***Landform Profiling and Rehabilitation -*** Landform profiling and rehabilitation of mine waste rock emplacements would be undertaken progressively over the life of the Project.

An indicative mine schedule for the Project is provided in **Table 2.1**.

Table 2.1: ROM Coal Extracted and Overburden Removed Over the Life of the Project

Project Year	ROM Extraction (Mtpa)	Overburden Removed (Mbcm)
Year 1*	1.8	12.8
Year 2	**1.7**	**14.5**
Year 3	1.7	13.3
Year 4	1.7	13.4
Year 5	2.0	13.9
Year 6	**1.8**	**16.4**
Year 7	2.1	16.5
Year 8	2.2	16.8
Year 9	2.4	16.8
Year 10	**2.6**	**16.9**
Year 11	1.5	6.6
Total	**21.5**	**157.9**

Notes * Assumed Project commencement date is 1 July 2013. Mbcm = million bank cubic metres

2.3 Construction/Development Activities

The Project would utilise existing infrastructure and supporting services at the Stratford Mining Complex. Additional infrastructure and construction/development activities which are required to support the Project would be progressively developed in parallel with ongoing mining operations, including:

- realignments of sections of Wheatleys Lane, Bowens Road, and Wenham Cox/Bowens Road;
- relocation of a 132 kV power line;
- installation of a new rotary breaker in the CHPP; and
- noise management infrastructure upgrades and haul road bunding.

3 LOCAL SETTING

The Stratford Mining Complex is an open cut mining operation located approximately 100 km north of Newcastle in the Gloucester Basin (see **Figure 1.1**).

The Project is located in a rural area characterised by cattle grazing on native and improved pastures, with intervening areas of remnant bushland (**SCPL, 2001**). Other land uses in the local area include rural residential, the existing Stratford Mining Complex, residential development in the villages of Stratford and Craven and areas of National Park/Nature Reserve.

The regional setting of the Project is shown in **Figure 1.1**. Significant geographic features in the area include the Barrington Tops National Park to the west, the Glen Nature Reserve directly to the south-east and other areas of native vegetation on the fringes of the Gloucester valley. The ridges on the fringes of the Gloucester valley rise up to 470 metres (m) Australian Height Datum (AHD), are moderately to steeply sloping and remain timbered, while the undulating lowlands generally range from 50 to 150 m AHD in elevation and are characterised by gentle slopes and cleared land (**SCPL, 2001**).

There are a number of receivers (e.g. dwellings) in the vicinity of the Project, as shown **Figure 3.1** and **Figure 3.2**.

Figure 3.3 provides a list of relevant land owners corresponding to **Figure 3.1** and **Figure 3.2**.

The topography of the area in and immediately around the Project is characterised by a north-south oriented ridge on the east transitioning to undulating lowlands and valley floor floodplains towards the west, which form part of the Gloucester Valley. **Figure 3.4** shows a pseudo three-dimensional (3D) representation of the local topography in the area of the Project and surrounds.

Topography plays an important role in steering winds, generating turbulence and large scale eddies, and in generating drainage flows at night and upslope flows in the day. Regional topography in the Gloucester valley has a strong influence on prevailing meteorology. The major topographical features that would be expected to influence air movements in the valley are displayed in **Figure 3.5**. It can be seen that the valley is orientated with a north-northeast to south-southwest orientation at Stratford, straightening to the north-south orientation at Gloucester. The margins of the valley also contain topographic features that may alter typical up and down valley flows at a local scale.

Open cut mining at the Stratford Mining Complex has historically modified the topography within the Project area. Modified landforms to date include the BRNOC, Roseville West and Stratford Main open pits and the Northern and Stratford Waste Emplacements (see **Figure 2.1**).

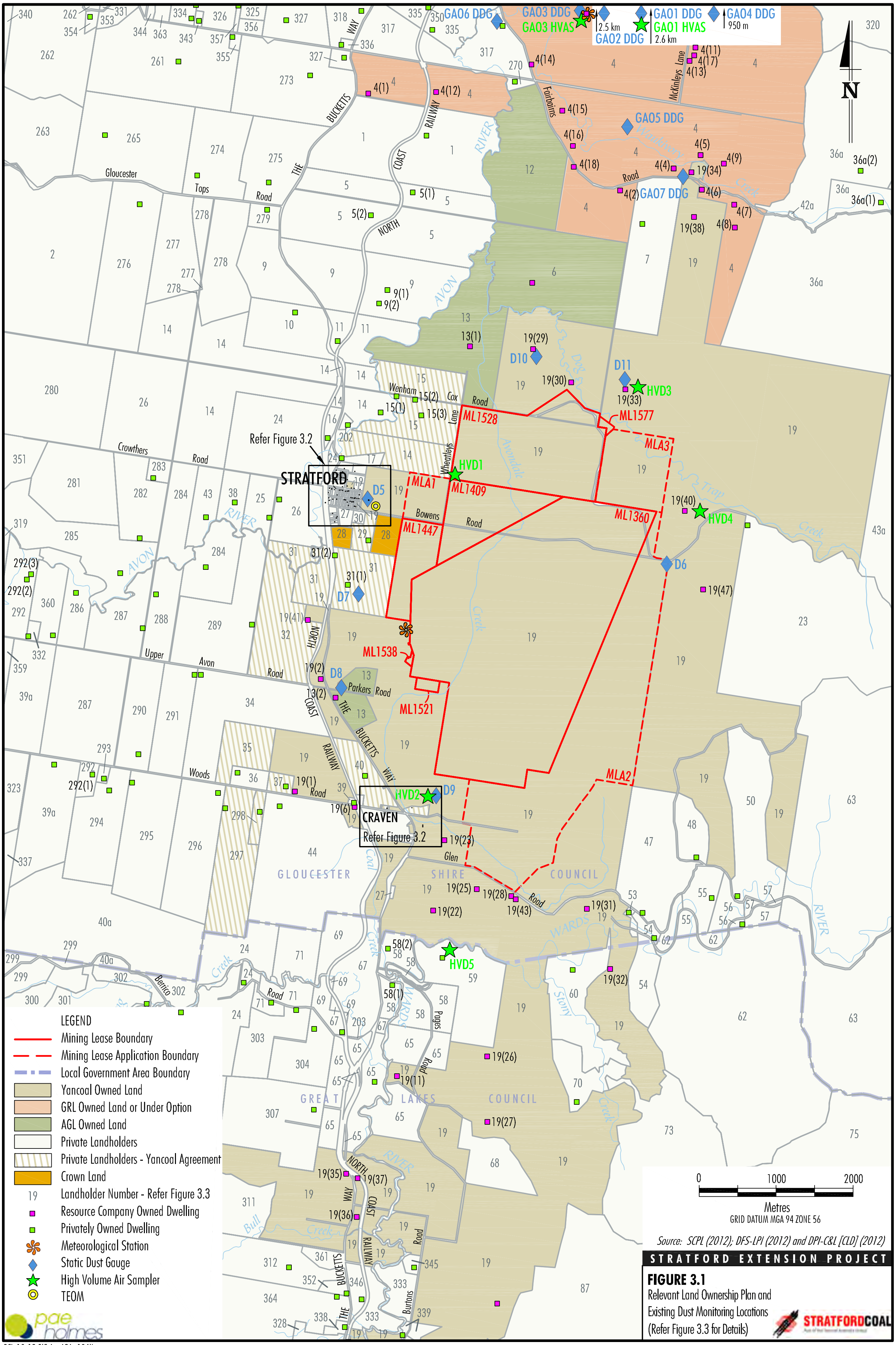

FIGURE 3.1
Relevant Land Ownership Plan and Existing Dust Monitoring Locations (Refer Figure 3.3 for Details)

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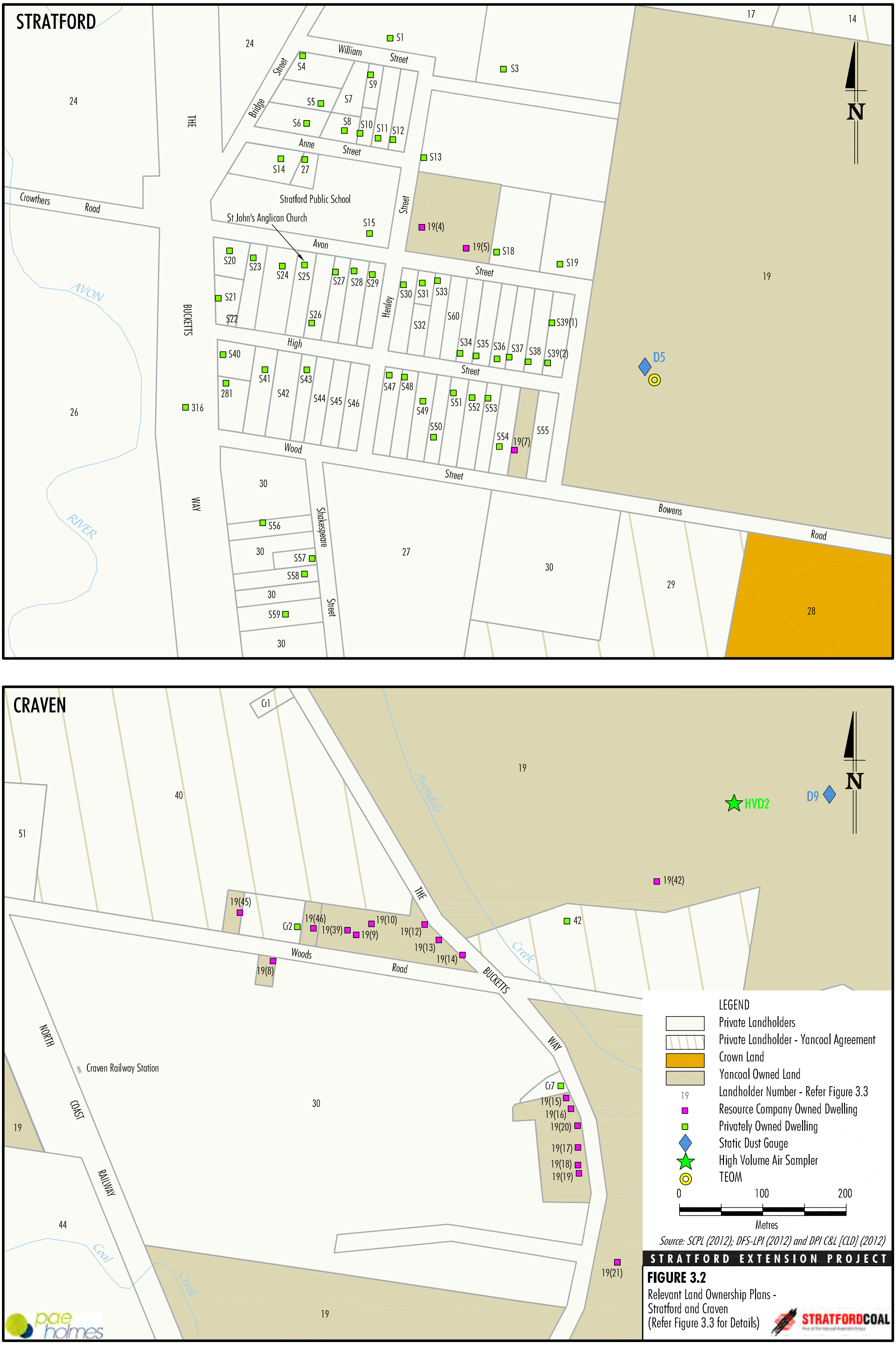

FIGURE 3.2

Relevant Land Ownership Plans - Stratford and Craven (Refer Figure 3.3 for Details)

GCL-10-12 EIS APPAQA_104K

1	Wendy Jane Fraser
2	Farley (Gloucester) Pty. Limited
4	Gloucester Resources Limited
5	Norman Edward Bignell
6	AGL Gloucester Le Pty Ltd in 70/100 Share & AGL Gloucester MG Pty Ltd in 30/100 Share as Tenants in Common
7	Mary Blanche Burrell
9	Norman John Williams
10	Kenneth James Whatmore & Anne Grace Whatmore
11	Brian Keith Walker, Lesley Jane Walker, Tyson Brian Walker & Lacey Maree Walker
12	AGL Upstream Investments Pty Limited
13	AGL Energy Limited
14	Allen James Wenham & Pamela Diane Wenham
15	GS & GL Falla Superannuation Pty Limited
16	Judith Helen Pickett
17	Darren James Fisher & Claire Louise Smith
19	Yancoal Australia Limited
23	Ross Lewis Bagnall
24	Geoffrey Lawrence Harris
25	Marisa Thompson
26	Kevin John Lowrey & Robyn Lowrey
27	The Council of the Shire of Gloucester
28	Crown Land
29	Edwin Dennis Ward & Rhonda Fay Ward
30	The State of New South Wales
31	Allan Stanley Isaac
32	Eliza Ann Ruth Mcintosh & Ronald Keith Mcintosh
34	Graham Wesley Hall & Kim Lorraine Hall
35	Leo John Dillon & Isobel Robyn Dillon
36	Graham Lindsay Wallace & Marion Frances Wallace
36a	Anthony Stanford Berecry
37	Timothy James Worth
38	Paul Michael Johnson & Judith Anne Johnson
39	Paula Anne Standen
39a	Woods Road Pty Ltd
40	Leslie Allenby Blanch
40a	Howard Kerr Williams & Margaret Russell Williams
42	Douglas John Blanch
42a	William Rainsford Ribbons
43	Vicki Colleen Moseley
43a	Lymarn Holdings Pty Limited
44	Peter Michael Cross & Kylie Jane
47	David Charles Digges, Carolyn Denise Digges, Timothy Charles Hart & Elizabeth Mary Hart
48	Marion Iris Rounsley
50	Neil James Porter
51	Gloucester Printing Services Pty Ltd
53	William Charles Barnes & Cheryl Freda Barnes
54	Kenneth John Hughes & Carrysong Pty Limited
55	Allan James Hancock & Lynda Margret Hancock
56	Gerald McCalden & Patricia Brawdley McCalden
57	Pamela Brawdley Harrison
58	Douglas William Blanch & Evelyn Fay Blanch
59	Guy William Cassar & Cecile Elizabeth Cassar
60	Graeme Healy & Philip Weston Greenwood
62	Dorothy May Beeston
63	National Parks and Wildlife Service
65	Noeline Elizabeth Weismantle
67	Ian Robert Bowen
68	Julie Dawn Lyford
69	Ralph Hooper & Bronwyn Ann Bartholmew
70	Robert George Knight
71	Anthony Douglas Burnet & Robyn Annette Burnet
73	Rodney John Pearce & Anne Jeanette Pearce
75	Geoffrey Ashton Wilson
87	Pacific Property Investments Ltd
202	Paul Phillip Wenham
203	Samuel Taylor
261	Frank Murray Hooke & Susan Elizabeth Hooke
262	Noel Albert Davis & Elizabeth Therese O'Sullivan
263	Patrick Michael Ryan
265	Hans Joran Stenstrom & Janete Stenhouse Stenstrom
270	Jason David Collins & Michelle Isobel Barrett
273	Baker Place Investments Pty Limited & Dr PW Brady Pty Limited as Tenants in Common in Equal Shares
274	Warren Neil Wilson & Colleen Therese Wilson
275	Pace Farm Pty Limited
276	Alan Luscombe & Carol Luscombe
277	John William Farley
278	Mark Anthony Campbell & Roseleen Linette Campbell
279	John Donald Cullum & Rachel Anne Cullum
280	Clifford John Bramley & Terri Louise Bramley
281	Colin William Lewis & Lesley Ann Lewis
282	Peter Stephen Ross
283	Janet Nolan
284	Alec Gregory Perrin & Noreen Nita Jean Perrin
285	Marshall Leon Carter & Theresa Kathleen Carter
286	Gerard Roland Burley
287	Dorothy Kay Sinderberry & Carole Martha Rinkin
288	Alec Gregory Perrin
289	Eliza Ann Ruth Mcintosh
290	Anne Frances Ryan & Darcy Tordoff
291	Trevor Allan Crawley & Coleen Dawn Crawley
292	James Reginald Fisher & Rhonda Patricia Fisher
293	Kerry Elizabeth Braunton
294	Gregory Vincent Morcom & Karen Morcom
295	William John Bush & Danielle Elizabeth Bush
296	Peter Geoffrey Watson & Heather Irene Watson
297	William Marten Bosma
298	Eric Allan Yates
299	Malcolm Ronald Lee
300	Bevan Douglas Hokin & Di Hokin
301	Folio Identifier Pty Limited
302	Edwin John Walton & Wendy Walton
303	JSTC Newcastle Pty Limited
304	Ernie Danzil Abeysekera & Sharee Ann Abeysekera
306	Gregory Hunt & Catherine Hunt
307	Graham John Wolfenden & Rosalind Mary Wolfenden
311	Paul Berthold & Carolyn Berthold
312	Allen James Harrison & Darlene Marie Harrison
316	Country Rail Infrastructure Authority
317	Adrian Kenneth Boorer/ Beverley Ruth Boorer
318	Albert Malcolm Timothy Sopher/ Gloria June Sopher
319	Allan John Maslen
320	Andrew Charles Vintner/ Kevin Thomas Vintner
323	Burmah Pastoral Co Pty Limited
325	Charles Robert Norman
326	Charnich Pty Limited
327	Dallas Reginald Andrews
328	Daphne May Chapman
331	Delese Ellen May Buckton
332	Erol William Hastings/ Lorraine Hastings
333	Gary Bruce Grant
334	Gary Douglas Randall/ Gai Lorraine Randall
335	Graeme Harold Harris
336	Gregory James Channon/ Tonia Alice Edwards
337	Gregory Thomas Price/ Dianne Elizabeth Price
338	Jason Bruce Steward/ Maria Eliana Steward
339	John Andersen
340	John Robert Higgins
343	Kerrie Banks
344	Kerry Anne Hartigan/ Antonino Virzi
345	Lliam Woolfrey
346	Lorraine Bruce
350	Raymond Keith Saunders/ Barbara Jayne Saunders
351	Roger Speaight/ Elisabeth Aili Maria Speaight
352	Ross Sidney Edwards
353	Ryan Garth Harris
354	Scott Ernest Hoy/ Leanne Margaret Barrett
355	Sue-Ellen Margaret Kingston/ Anthony Gerard Kingston
356	Thelma Elaine Mott
357	Victor Steven Pham/ Katherine Dawn Pham
359	William Kilpatrick Hunter/ Kay Edith Hunter
360	Ter Geoffrey Mason/ Sandra Joy Mason/ Valda Doreen
361	Helen Teresa Whelan
363	Linda Trudgeon
364	Heatscape Pty Limited
Cr.1	William Deane Wood
Cr.2	Rodger Malcolm Boorer
Cr.7	David Robert Pryce-Jones
S1	Gary Owen Rees
S3	Irene Myrtle Yeatman
S4	Belinda Maree Grady & Terry Raymond Grady
S5	Christopher James Britnell
S6	Gary Wayne Threadgate & Julie Frances Threadgate
S7	Raymond James Cawley & Lucinda Cawley
S8	Neville Charles Forbes
S9	Peter John Greenham & Beverley May Greenham
S10	Louise Frances Germon
S11	Adam John Glew
S12	Grant James Mitchell & Cecily Maree Mitchell
S13	Ian Mark Wells & Jody Ann Wells
S14	Kathleen Edith Bignell
S15	Minister for Education
S18	Keith Matthew John Whittall & Janelle Fiona Whittall
S19	Rodney Lawrence Carroll
S20	Sandra Ellen McGrath
S21	Marie Anne Adams
S22	Telstra Corporation Limited
S23	Marie Fay Bartlett
S24	David Carl John Mavay
S25	The Trustees of Church Property for the Diocese of Newcastle
S26	Margaret Elaine Young
S27	Terry Leonard Brown & Elizabeth Florence Brown
S28	David Charles Morris & Yvette Marie Morris
S29	Robert Charles Bagnall & Lyndell Joy Bagnall
S30	Kam Daryl Baker
S31	Tracey Louise Richards
S32	Peter Kelly
S33	Greta Alexandra Langtry, Jennifer Gilbert & Neville Bertram Gilbert
S34	Edward George Ashby
S35	Mark Rodgers & Korinna Yvette Bekker
S36	Kenneth George Platt & Ruth Lynne Platt
S37	Malcolm Neville Pryor & Helen Leone Pryor
S38	Stephen Russell Kirkman
S39	Lizabeth Joye Nicholls & Raymond John Husband
S40	Peter John Curtis
S41	Desmond Brice McClure & Coral Ann Aplin
S42	Stephen Ronald Murray & Wilma Joy Murray
S43	Deanne Donna Squire
S44	Ann Elizabeth Flack
S45	Daniel John Keywood, Dale Martin Keywood, Kelly Hazel Keywood & Amanda Margaret Hawkins
S46	Stephen Thomas Parker & Jean Maree Parker
S47	John Victor Potts
S48	James Bryson Farley & Glenda Laurel Farley
S49	Lindy Jayne Blanch
S50	Sheryl Fay Vanderdrift & Lindy Jane Blanch
S51	Gregory John Trenholme
S52	Ronald John Farley & Theresa Jane Barry
S53	Trevor Arthur
S54	Scott Anthony Adams
S55	Beryl Veronica Mostyn & Tony James Mostyn
S56	Graham John Collins & Elizabeth Collins
S57	Mavis Jean Gam
S58	Marilyn Dorothy Harrigan
S59	Terry Raymond Grady & Belinda Maree Grady
S60	Deanne Donna Squires

Source: SCPL (2012); DFS-LPI (2012) and DPI-C&L [CLD] (2012)

STRATFORD EXTENSION PROJECT

FIGURE 3.3

Relevant Land Ownership List

STRATFORDCOAL

pae holmes

GCL-10-02 EIS AppAQ_001D

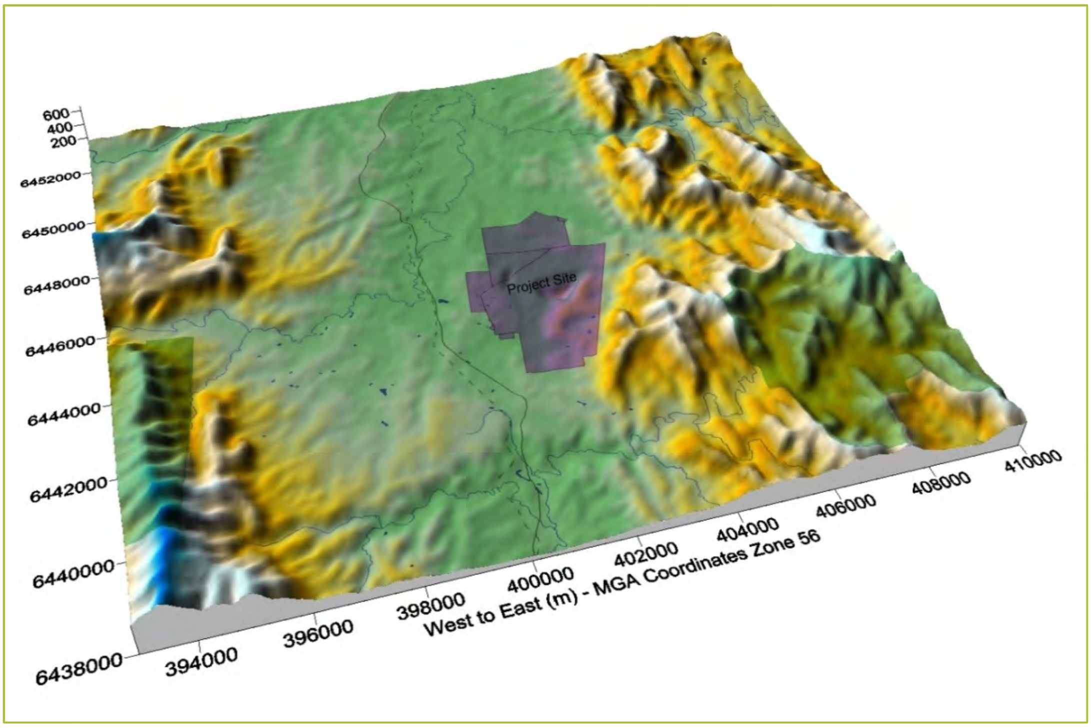

Figure 3.4: Pseudo 3-Dimensional Plot of the Local Topography

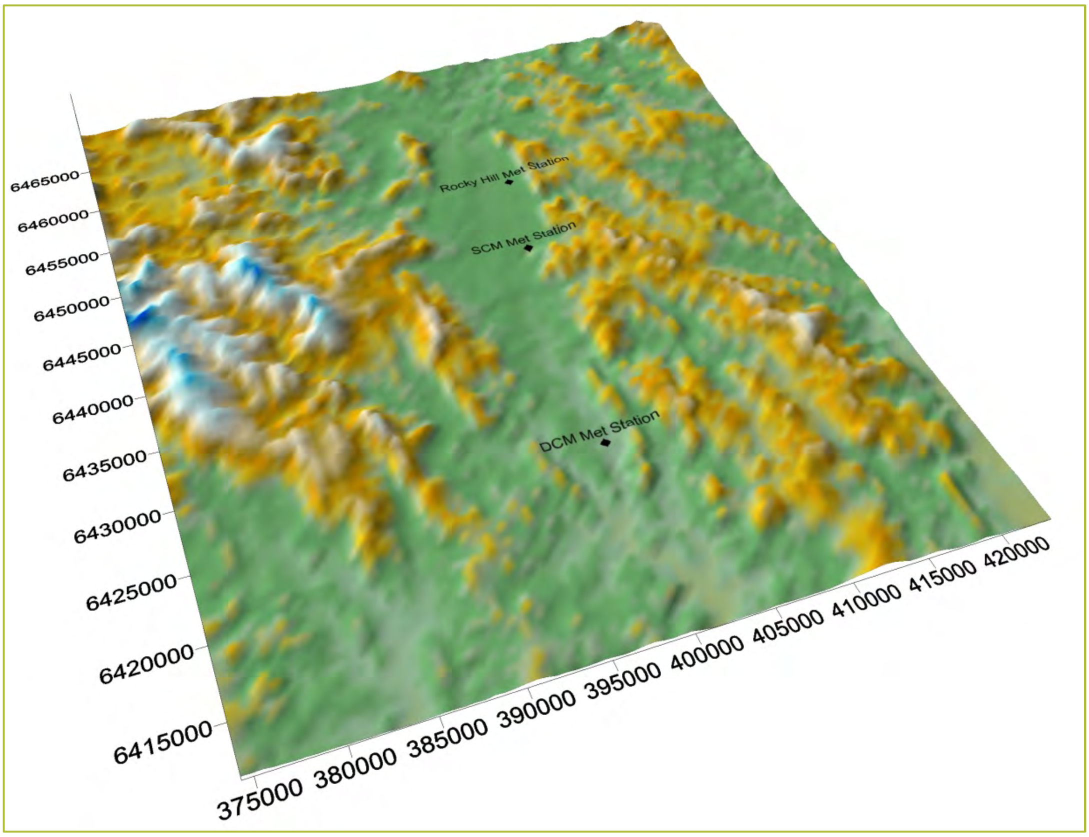

Figure 3.5: Pseudo 3-Dimensional Plot of the Regional Topography

4 LEGISLATIVE SETTING

4.1 Introduction

Project mining activities described in **Section 2** have the potential to generate fugitive dust emissions in the form of particulate matter described as total suspended particulate matter (TSP), particulate matter with an equivalent aerodynamic diameter of 10 micrometres (µm) or less (PM_{10}) and deposited dust emissions. In addition, combustion engines of generators and vehicles release emissions through engine exhausts including carbon monoxide (CO), minor quantities of sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). Diesel combustion also results in the emission of particulate matter which is accounted for in the estimates of fugitive emissions of particles, which include diesel particles as well as particles derived from the materials being handled.

The low sulphur content of Australian diesel, in combination with the fact that mining equipment (including generators) is widely dispersed over mine sites; is such that the ambient air quality goals for SO_2 would not be exceeded, even in mining operations that use large quantities of diesel. For this reason, no detailed study is required to demonstrate that emissions of SO_2 from the Project would not significantly affect ambient SO_2 concentrations. Similarly, NO_2 and CO emissions from the mining activities are limited and too widely dispersed to require a detailed modelling assessment. For this reason these emissions are not considered further in this report.

Other emissions to air from the Project include greenhouse gases (GHG) such as fugitive methane (CH_4) from exposed coal, carbon dioxide (CO_2) from the combustion of fuel in combustion engines, blasting and indirect GHG emissions from the combustion of coal produced on-site. GHG emissions are assessed in **Section 11**.

The following sections provide information on the air quality criteria used to assess the impact of dust and particulate emissions. To assist in interpreting the significance of predicted concentration and deposition levels some background discussion is also provided.

4.2 Particulate Matter and its Health Significance

Particulate matter has the capacity to affect health and to cause nuisance effects, and is categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The particulate size ranges are commonly described as:

- TSP – refers to all suspended particles in the air. In practice, the upper size range is typically 30 µm to 50 µm.
- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10 µm, that is, all particles that behave aerodynamically in the same way as spherical particles with diameters less than 10 µm and with a unit density. PM_{10} are a sub-component of TSP.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm diameter (a subset of PM_{10}). These are often referred to as the fine particles and are a sub-component of PM_{10}.
- $PM_{2.5-10}$ – defined as the difference between PM_{10} and $PM_{2.5}$ mass concentrations. These are often referred to as coarse particles.

Evidence suggests that health effects from exposure to airborne particulate matter are predominantly related to the respiratory and cardiovascular systems. The human respiratory system has in-built defensive systems that prevent larger particles from reaching the more sensitive parts of the respiratory system. Particles larger than 10 µm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason air quality goals make reference to measures of the total mass of all particles suspended in the air, this is referred to as TSP. In practice particles larger than 30 to 50 µm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 µm.

Both natural and anthropogenic processes contribute to the atmospheric load of particulate matter. Coarse particles ($PM_{2.5-10}$) are derived primarily from mechanical processes resulting in the suspension of dust, soil, or other crustal[b] materials from roads, farming, mining, dust storms, and so forth. Coarse particles also include sea salts, pollen, mould, spores, and other plant parts. Mining dust is likely to be composed of predominantly coarse particulate matter (and larger).

Fine particles or $PM_{2.5}$ are derived primarily from combustion processes, such as vehicle emissions, wood burning, coal burning for power generation, and natural processes such as bush fires. Fine particles also consist of transformation products, including sulphate and nitrate particles, and secondary organic aerosol from volatile organic compound emissions. $PM_{2.5}$ may penetrate beyond the larynx and into the thoracic respiratory tract and evidence suggests that particles in this size range are more harmful than the coarser component of PM_{10}.

The size of particles determine their behaviour in the respiratory system, including how far the particles are able to penetrate, where they deposit, and how effective the body's clearance mechanisms are in removing them. This is demonstrated in **Figure 4.1**, which shows the relative deposition by particle size within various regions of the respiratory tract. Additionally, particle size is an important parameter in determining the residence time and spatial distribution of particles in ambient air; key considerations in assessing exposure.

[b] Crustal dust refers to dust generated from materials derived from the earth's crust.

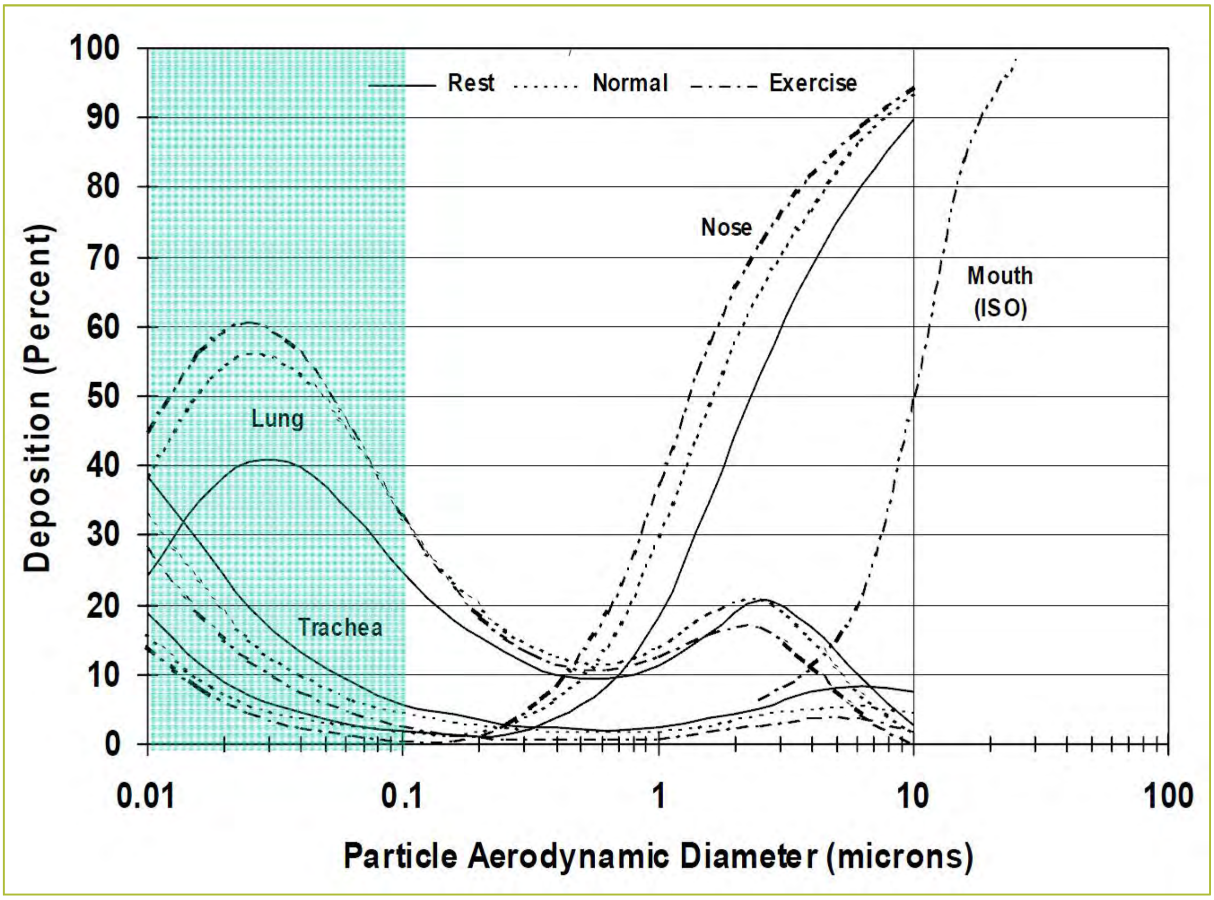

Figure 4.1: Particle Deposition within the Respiratory Track (Source: Chow, 1995)

The health-based assessment criteria used by the EPA have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion (**EPA**, **1998**; **National Environment Protection Council** [**NEPC**], **1998a**; **NEPC**, **1998b**). This means that, in contrast to dust of crustal origin, the particulate matter from urban areas would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

4.3 EPA Criteria

The Approved Methods specifies air quality assessment criteria relevant for assessing impacts from air pollution (**DEC, 2005**). The air quality goals relate to the total dust burden in the air and not just the dust from the Project. In other words, consideration of background dust levels needs to be made when using these goals to assess potential impacts. These criteria are health-based (i.e. they are set at levels to protect against health effects).

These criteria are consistent with the *National Environment Protection Measure for Ambient Air Quality* (referred to as the Ambient Air-NEPM) (**NEPC, 1998a**). However, the EPA's criteria include averaging periods, which are not included in the Ambient Air-NEPM, and also references other measures of air quality, namely dust deposition and TSP.

Table 4.1 summarises the air quality goals for concentrations of particulate matter that are relevant to this study.

Table 4.1: EPA Air Quality Standards/Goals for Particulate Matter Concentrations

Pollutant	Averaging Period	Standard/Goal	Agency
TSP	Annual mean	90 µg/m^3	National Health and Medical Research Council.
PM_{10}	24-hour maximum	50 µg/m^3	EPA impact assessment criteria; Ambient Air-NEPM reporting goal, allows five exceedances per year for bushfires and dust storms.[1]
	Annual mean	30 µg/m^3	EPA impact assessment criteria.
$PM_{2.5}$	Annual Mean	8 µg/m^3	Ambient Air-NEPM Advisory Reporting Standard.
	24-hour average	25 µg/m^3	

Notes: µg/m^3 – micrograms per cubic metre.

[1] The 50 µg/m^3 24-hour maximum PM_{10} criteria are cumulative (i.e. include background concentrations but exclude extraordinary events such as bushfires) in the existing SCM Development Consent (DA 23-98/99), however the 50 µg/m^3 property acquisition criteria applies specifically Project-only. A 150 µg/m^3 cumulative criterion applies cumulatively in DA 23-98/99.

In May 2003, the NEPC released a variation to the Ambient Air-NEPM (**NEPC, 2003**) to include advisory reporting standards for particulate matter with an equivalent aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$). The purpose of the variation was to gather sufficient data nationally to facilitate the review of the Ambient Air-NEPM, which is currently underway. The variation includes a protocol setting out monitoring and reporting requirements for $PM_{2.5}$ particles. It is noted that the Ambient Air-NEPM $PM_{2.5}$ advisory reporting standards are not impact assessment criteria.

Notwithstanding the above, in the absence of any other relevant standard/goal, the advisory reporting standards have been used in this report for comparison against dispersion modelling results (**Section 9**).

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fallout relatively close to source. Dust fallout can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance or amenity impacts.

Table 4.2 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (**DEC, 2005**).

Table 4.2: EPA Criteria for Dust (Insoluble Solids) Fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Notes: g/m^2/month – grams per square metre per month.

4.4 Legislative Considerations

4.4.1 Action for Air

The NSW State Plan identifies cleaner air and progress on GHG reductions as priorities. In 1998, the NSW Government implemented a 25 year air quality management plan, Action for Air, for Sydney, Wollongong and the Lower Hunter (**DECCW, 2009**). Action for Air is a key strategy for implementing the State Plan's cleaner air goals.

Action for Air seeks to provide long-term ongoing emission reductions. It does not target acute and extreme exceedances from events such as bushfires. The aim of Action for Air includes:

- meeting the national air quality standards for six pollutants as identified in the Ambient Air-NEPM; and
- reducing the population's exposure to air pollution, and the associated health costs.

The six pollutants in the Ambient Air-NEPM include CO, NO_2, SO_2, lead, ozone and PM_{10}. The main pollutant from the Project that is relevant to the Action for Air is PM_{10}. Action for Air aims to reduce air emissions to enable compliance with the Ambient Air-NEPM targets to achieve the aims described above, with a focus on motor vehicle emissions.

Whilst the Stratford Mining Complex is not located within the areas relevant to the Action for Air plan (i.e. Sydney, Wollongong and the Lower Hunter), the Project generally addresses the aims of the Action for Air Plan in the following ways:

- SCPL and PAEHolmes have reviewed potential mitigation measures, and a range of measures have been adopted for the Project (**Section 5**).
- Air quality emissions potentially associated with the Project have been quantified (**Section 8**).
- Dispersion modelling has been conducted by PAEHolmes to predict the impact of these emissions on nearby receivers, and assess the effect of the emissions on ambient concentrations which can then be compared with the Ambient Air-NEPM goals (**Section 9**).
- SCPL has committed to a real-time air quality monitoring system to facilitate real-time management of elevated dust levels that might arise due to Project activities (**Section 7**).

4.4.2 Protection of the Environment Operations Act, 1997

SCM currently holds Environment Protection Licence (EPL) No. 5161 (SCM) and No. 11745 (BRNOC) issued by the EPA under the POEO Act. Relevant to air quality, the EPL includes a requirement to minimise dust emissions and specifies dust deposition and PM_{10} sampling requirements. Both EPLs also contain Pollution Reduction Programs (PRP) in relation to air quality (**Section 7**).

It is understood that a variation of EPL 5161 would be sought to incorporate the Project.

In addition, the NSW *POEO (Clean Air) Regulation, 2010* prescribes requirements for domestic solid fuel heaters, control of burning, motor vehicle emissions and industrial emissions (such as Volatile Organic Carbons). Motor vehicle emissions would be addressed by regular maintenance of all vehicles associated with the Project.

In addition, any burning on-site (e.g. for agricultural purposes) would be conducted to minimise potential for smoke impacts on neighbouring receivers (e.g. by avoiding burning activities during winds prevailing towards receivers).

5 EXISTING ENVIRONMENT

The Stratford Mining Complex air quality monitoring network is shown in **Figure 3.1** and consists of:

- seven dust deposition gauges, measuring dust deposition rates over the period of one month;
- five high volume air samplers (HVASs), measuring PM_{10} concentrations for 24-hours periods on a one day in six run cycle; and
- a meteorological monitoring station.

Air quality sampling is undertaken in accordance with the provisions of the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (**DEC, 2006**) (**SCPL, 2011a**).

5.1 Meteorology

5.1.1 Local Wind Data

The SCM meteorological station has collected 15-minute averages of wind speed, wind direction, temperature, solar radiation, relative humidity, sigma-theta and rainfall from 2002 to the present. Due to instrument problems and other reasons, some years appear to have more representative data than others. Comparative statistics for each year of SCM meteorological data are shown in **Table 5.1** and windroses for each year are presented in **Appendix A**. A period from November 2010 to October 2011 is chosen for modelling based on this analysis. This period is the latest 12 month dataset available at the time of writing, is representative of wind patterns across all years and seasons and does not exhibit some of the seasonal inconsistencies noted in the datasets for other years.

Table 5.1: Comparative Statistics for Meteorological Data

Period	% Calms	Average Wind Speed (m/s)	% Data Recovery
July 2003 – June 2004	38	2.0	100
July 2004 – June 2005	44	1.6	81
July 2005 – June 2006	2	2.6	91
July 2006 – June 2007	2	2.4	96
July 2007 – June 2008	4	1.3	100
July 2008 – June 2009	6	2.5	100
July 2009 – June 2010	10	2.7	100
July 2010 – June 2011	14	2.1	100
Nov 2010 – Oct 2011	9	2.1	100

% = percent   m/s = metres per second

Reference is also made to meteorological data collected at the DCM (located approximately 20 km south of the Stratford Mining Complex) and a meteorological station operated for the proposed Rocky Hill Coal Project (located approximately 5 km north of the SCM). Comparative windroses for the SCM data, DCM data and Rocky Hill Coal Project data are presented in **Figure 5.1**.

On an annual basis, winds are from the north, north-northeast and south. This pattern is reflected in all seasons. The annual percentage of calms (winds less than 0.5 m/s) is 9% and the annual average wind speed is 2.1 m/s.

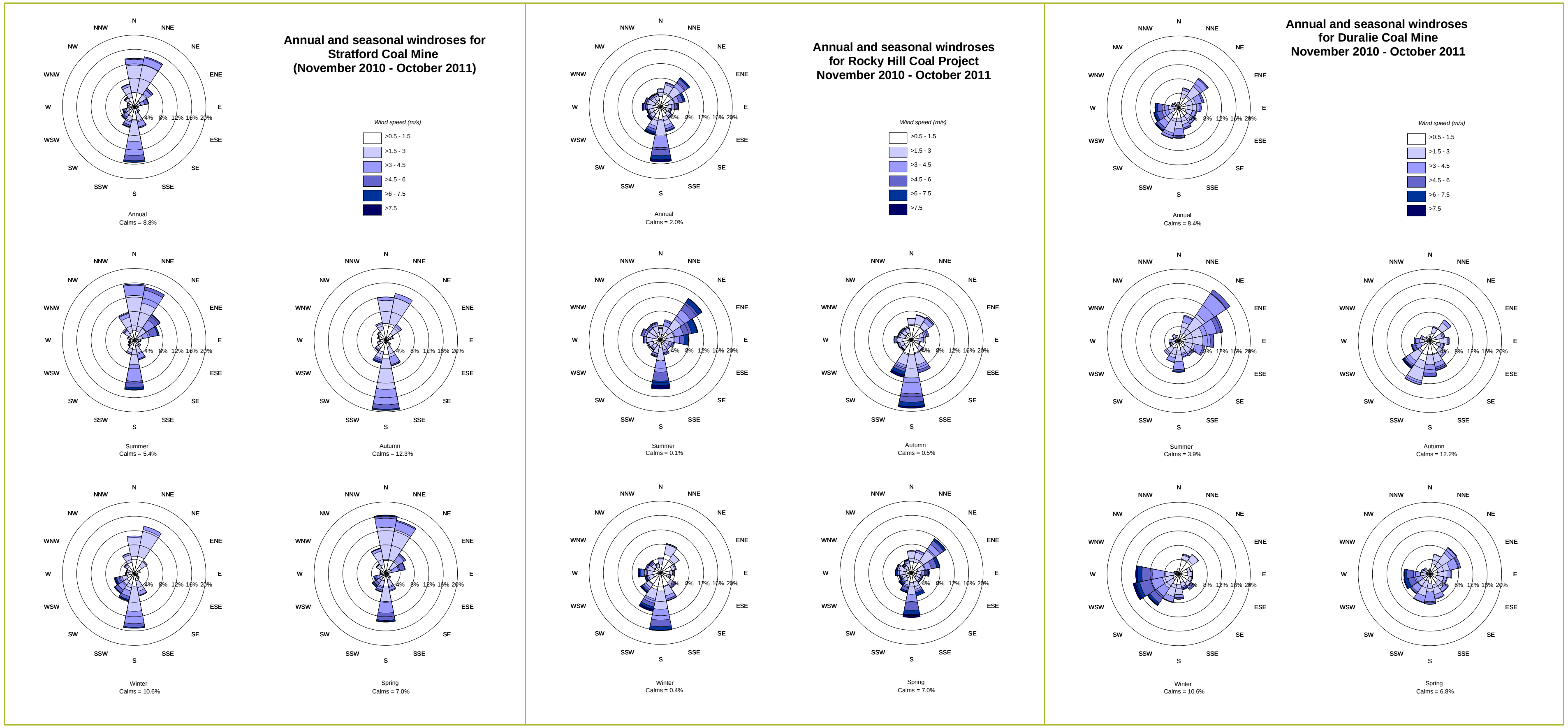

Figure 5.1: Annual and Seasonal Windroses for SCM, DCM and Rocky Hill Coal Project

Very similar patterns occur at the Rocky Hill Coal Project meteorological site on an annual basis, with a greater occurrence of southerly winds and a steering from north-northeast to north-east. Data recorded at the DCM reflects a broader spread of wind directions across the south-west and northeast quadrants.

Subtle differences in the wind patterns can be explained by the changing topographical features between the sites, both in terms of the site's position within the Gloucester valley and smaller scale features close to the margins at each of the monitoring sites (refer to **Section 3** for a description of local topography).

5.2 Local Climatic Conditions

Long-term meteorological data for the region is available from Commonwealth Bureau of Meteorology (BoM) meteorological stations (**Table 5.2**).

5.2.1 Temperature

The closest BoM meteorological stations to the Project recording temperature data are located at Chichester Dam and in Dungog (BoM, 2011). Long-term, monthly-average daily maximum and minimum temperatures from Chichester Dam and Dungog Post Office meteorological stations show that temperatures are warmest from November to February and coolest in the winter months of June, July and August (**Table 5.2**). Monthly-average daily maximum temperatures and daily minimum temperatures for the Dungog Post Office and Chichester Dam meteorological stations are provided in **Table 5.2**.

5.2.2 Rainfall

With records dating back to 1888, the long-term average annual rainfall recorded at the Gloucester Post Office (60015), located approximately 14 km north of the Project, is 983 millimetres (mm) (**Table 5.2**). Closer to the Project, rainfall records at Craven (Longview [60042]) since 1961 and Gloucester (Hiawatha [60112]) since 1976 indicate the average annual rainfall since these stations were commissioned is 1,057 mm and 1,021 mm, respectively (**Table 5.2**). The months with the highest monthly-average rainfalls at the Gloucester Post Office, Craven (Longview) and Gloucester (Hiawatha) meteorological stations are February and March (121.7 mm and 127.9 mm, 136.8 mm and 133.9 mm, and 131.7 and 124.1 mm, respectively) (**Table 5.2**). For the period 1996 to 2011, the average annual rainfall recorded by the Stratford Mining Complex meteorological station was 924 mm, with maximum monthly rainfall typically occurring during the warmer months from November to March (**Table 5.2**). The average annual rainfall as predicted by the BoM Data Drill Application[c] at the Stratford Mining Complex is 1,067 mm (**Table 5.2**).

5.2.3 Evaporation

Evaporation records are available from the Chichester Dam (61151), Taree Airport AWS (60141) and Paterson (Tocal) (61250) meteorological stations, which have recorded average annual evaporation of approximately 1,059 mm, 1,607 mm and 1,571 mm, respectively (**Table 5.2**). The highest monthly-average evaporation is in December (151.9 mm, 201.5 mm and 210.8 mm, respectively) and the lowest monthly-average evaporation is in June (33 mm, 66 mm and 63 mm, respectively) (**Table 5.2**). Based on the available datasets, measured monthly-average evaporation exceeds the measured monthly-average rainfall for most of the year (**Table 5.2**). The average annual evaporation as predicted by the BoM Data Drill Application at the Stratford Mining Complex is 1,374 mm (**Table 5.2**).

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[c] The Data Drill Application is a system which provides continuous, synthetic daily data sets for a specified point by interpolation between surrounding point records held by the BoM.

Table 5.2: Meteorological Summary - Average Temperature, Rainfall and Evaporation

Period of Record	Average Daily Temperature (°C)[1] [Minimum-Maximum]		Average Monthly Rainfall (mm)[2]					Average Monthly Evaporation (mm)[3]			
	Chichester Dam (61151)	Dungog Post Office (61017)	Data Drill Sequence[4]	Gloucester Post Office (60015)[1]	Craven (Longview) (60042)[1]	Gloucester (Hiawatha) (60112)[1]	Stratford Mining Complex AWS[2,5]	Data Drill Sequence[4]	Chichester Dam (61151)[1]	Taree Airport AWS (60141)[1]	Paterson [Tocal] AWS (61250)[1]
	1938 to 1956	1966 to 1975	1889 to 2011	1888 to 2011	1961 to 2011	1976 to 2011	1996 to 2011	1970 to 2011	1942 to 2011	1999 to 2011	1967 to 2011
January	13.7-30.1	15.7-34.0	121.6	114.8	125.3	113.3	99.6	171.5	139.5	201.5	192.2
February	13.8-29.8	15.5-31.1	129.3	121.7	136.8	131.7	111.1	135.2	110.2	155.4	149.7
March	13.1-26.2	13.1-29.3	134.6	127.9	133.9	124.1	107.9	120.7	93.0	148.8	130.2
April	2.8-23.3	7.6-27.4	88.3	77.3	85.2	83.8	71.1	88.3	69.0	105.0	99.0
May	0.8-21.0	6.1-23.6	78.1	68.6	88.3	81.4	72.1	64.5	46.5	83.7	74.4
June	4.4-17.4	2.6-19.8	79.9	68.4	79.2	60.4	79.2	54.0	33.0	66.0	63.0
July	4.4-15.9	0.3-20.2	58.9	51.4	40.3	39.9	51.0	62.0	40.3	74.4	74.4
August	4.9-20.5	3.7-20.8	53.1	46.6	44.3	36.1	36.6	87.4	58.9	99.2	105.4
September	6.8-21.8	5.9-25.2	55.9	51.2	47.4	44.5	42.8	115.4	87.0	138.0	132.0
October	7.8-23.9	7.5-28.0	73.9	69.2	79.3	68.5	70.6	142.0	108.5	158.1	161.2
November	12.3-28.7	10.8-31.4	85.6	83.9	91.8	102.4	106.1	152.0	123.0	162.0	174.0
December	14.4-30.7	11.2-31.3	108.1	104.4	98.5	101.7	78.7	180.0	151.9	201.5	210.8
Annual Average	11.0-21.9	10.3-24.8	1,067 [1067.3]	983 [985.4]	1,057 [1,050.3]	1,021 [987.8]	924 [926.8]	1,374 [1,373.0]	1,059 [1,060.8]	1,607 [1,593.6]	1,571 [1,566.3]

1 Source: BoM (2011).
2 Source: After Gilbert & Associates (2012).
3 As measured by Class A Evaporation Pan.
4 Data Drill located at 32.15°S, 151.95°E – located to the south-west of ML 1360 at the Stratford Mining Complex. The Data Drill sequence is a continuous, synthetic record based on interpolation of data from nearby sites.
5 Records missing for periods: 12 March 2001 to 31 December 2001; 10 February 2005 to 25 March 2005; 7 November 2005 to 30 November 2005; and 17 January 2008 to 13 February 2008.
[ ] Sum of average monthly records.
°C degrees Celsius

5.3 Existing Air Quality

Air quality standards and goals refer to pollutant levels that include the contribution from specific projects and existing sources. To fully assess impacts against the relevant air quality standards and goals it is necessary to have data on existing dust concentration and deposition levels in the area in which the Project is likely to contribute to these levels. It is important to note that the existing air quality conditions (that is, background conditions) will be influenced by existing operations at the Stratford Mining Complex.

The Stratford Mining Complex air quality monitoring network currently consists of five HVASs and seven dust deposition gauges (**Figure 3.1**).

Current ambient air monitoring at the Stratford Mining Complex shows that existing operations have a minimal impact on local air quality. An independent environmental audit of the Stratford Mining Complex concluded that monitoring undertaken around the site demonstrates compliance with the air quality management criteria imposed in the Project Approval and EPLs (**Applied Environmental Management Consultants, 2011**).

5.3.1 Dust Deposition

A dust deposition monitoring network was established for the SCM in 1995. Initially six sites were established with a seventh site added in 2004. **Table 5.3** provides a summary of the annual average dust deposition data collected for the previous 10 years. Data are presented as fiscal year averages in accordance with annual environmental monitoring reporting requirements. Annual average dust deposition data collected for previous 10 years are also shown in **Figure 5.2**.

Monitoring data show that generally dust deposition levels are below the EPA impact assessment of 4 g/m^2/month. The average across all sites for the last 10 years is 1 g/m^2/month. Based on the data collected more recently current dust deposition levels are well below the impact assessment criteria in the vicinity of the Stratford Mining Complex.

Monitor D10 shows exceedances of the criterion of 4 g/m^2/month in 2002, 2003 and 2004. Each of the three years showed at least one month with unusually high readings; 27.1 g/m^2/month in 2002, 21.4 g/m^2/month in 2003 and 32.2 g/m^2/month and 23.7 g/m^2/month in 2004.

In 2002, there was a particularly large proportion of ash residue (23.1 g/m^2/month) reported, suggesting that the dust was mineral (non-combustible) in origin. The high results at D10 in 2003 and 2004 did not show a large percentage of ash residue, suggesting the dust was organic in origin. This could indicate contamination by insects or vegetation or could indicate a high component of coal dust.

Whilst it is unclear from the records if these high dust levels were a result of local contamination, contamination of some form is considered likely in this period at D10. Location D11 which is also located north of mining operations did not record similar high results. If these anomalous results are removed from the annual average calculations, D10 would remain below the criterion for all years.

Table 5.3: Dust Deposition Yearly Average (Insoluble Solids)

Fiscal Year ending	D5	D6	D7	D8	D9	D10	D11
Jun-02	0.5	0.8	0.6	3.3	1.5	4.7	N/A
Jun-03	1.6	1.0	1.2	1.5	2.1	5.2	0.9
Jun-04	0.6	0.7	0.7	1.1	1.4	7.4	1.2
Jun-05	0.6	0.7	0.6	0.7	0.7	1.7	1.0
Jun-06	0.6	0.5	1.4	0.6	0.6	0.4	1.2
Jun-07	0.5	0.5	1.5	0.9	0.6	0.5	1.1
Jun-08	0.5	0.5	0.5	0.4	0.6	0.5	0.6
Jun-09	0.5	0.5	0.9	0.6	0.4	0.6	0.7
Jun-10	0.9	0.6	1.5	0.6	0.5	0.5	0.7
Jun-11	0.7	0.7	0.9	0.7	1.0	0.8	0.8
Sep-11	0.3	0.8	0.8	0.6	0.6	0.3	0.6
Average	**0.7**	**0.7**	**1.0**	**1.0**	**0.9**	**2.0**	**0.9**
Average across all sites							**1.0**

Notes: 2011 data to September only. Contaminated results from D10 excluded from averages.

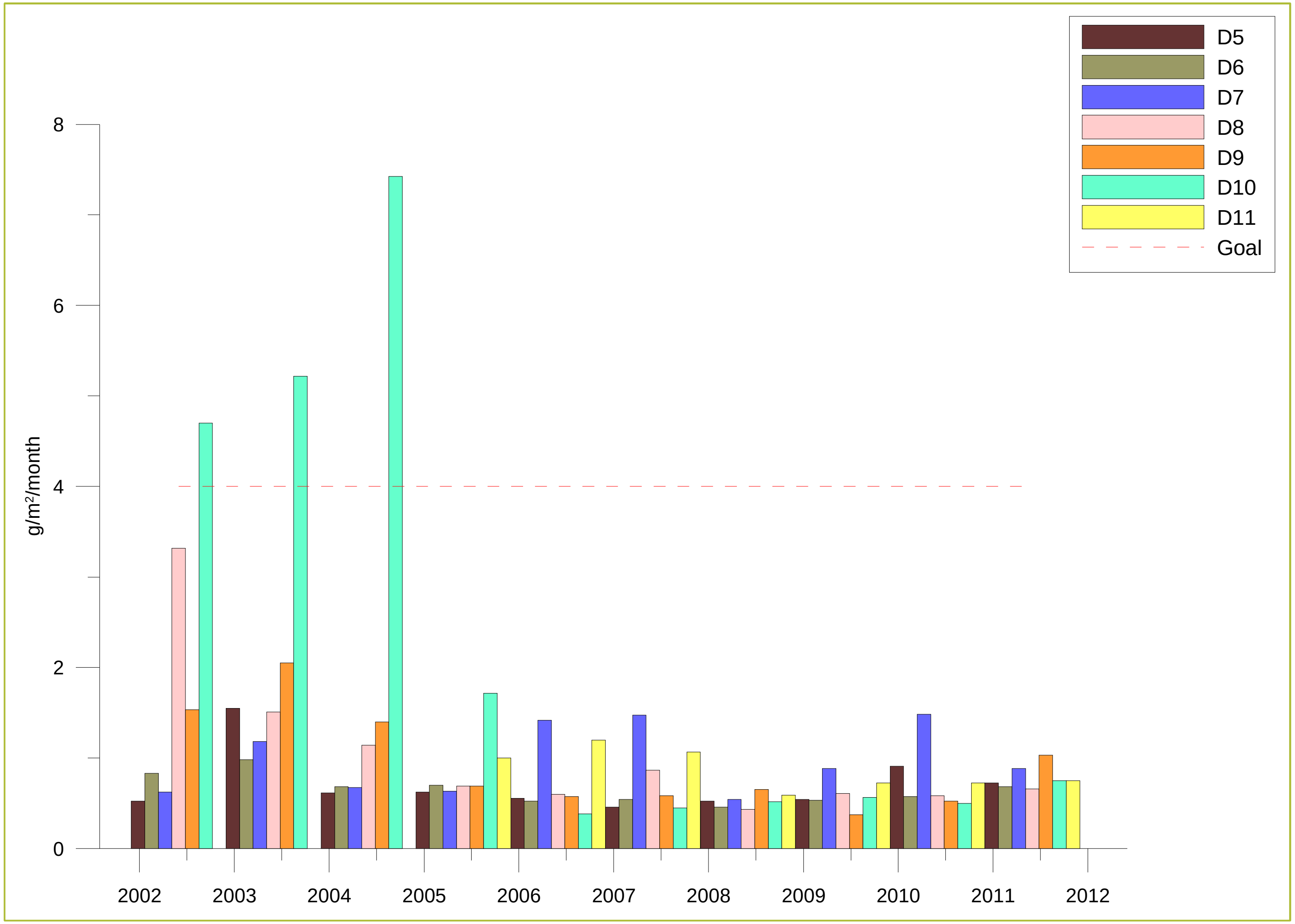


Figure 5.2: Annual Average Dust Deposition (Insoluble Solids – g/m²/month)

5.3.2 PM_{10} Concentrations

A HVAS network was established for the Stratford Mining Complex in May 2001. Initially two sites were established (HVD1 and HVD2), with HVD3 and HVD4 added in March 2003 and HVD5 added in September 2008.

Table 5.4 provides a summary of the annual average PM_{10} concentration data collected to date. Data are presented as fiscal year averages in accordance with annual environmental monitoring reporting requirements. Monitoring results show that since monitoring began in 2001, there have been no exceedances of the EPA annual average criterion of 30 µg/m^3. The average across all sites for the monitoring period is 11 µg/m^3.

The day to day variability in ambient levels of 24-hour PM_{10} concentrations for the same period is shown in **Figure 5.3**. Monitoring data collected at the Stratford Mining Complex HVAS indicates that there have been fifteen elevated recordings above the EPA 24-hour average criterion of 50 µg/m^3. A more detailed review shows that the worst-case 24-hour PM_{10} concentrations are strongly influenced by regional-scale phenomena, such as bushfires and dust storms (**PAEHolmes, 2010**). The data shown in **Figure 5.3** indicates that excursions above the impact assessment criteria have been less frequent in recent years.

Table 5.4: Annual Average PM_{10} Concentration

Year	HVD1 (µg/m^3)	HVD2 (µg/m^3)	HVD3 (µg/m^3)	HVD4 (µg/m^3)	HVD5 (µg/m^3)
July 2001 - June 2002	8	11	ND	ND	ND
July 2002 - June 2003	14	16	11	9	ND
July 2003 - June 2004	11	11	15	12	ND
July 2004 - June 2005	11	11	13	10	ND
July 2005 - June 2006	10	9	14	7	ND
July 2006 - June 2007	10	10	14	8	ND
July 2007 - June 2008	8	8	11	7	ND
July 2008 - June 2009	14	15	15	10	15
July 2009 - June 2010	13	13	16	12	12
July 2010 - June 2011	8	9	9	8	8
July 2011 - Sept 2011	7	10	10	7	7
Average	**10**	**11**	**13**	**9**	**11**
Average across all sites					**11**

Note: 2011 data to September only

5.3.3 TSP Concentrations

No TSP concentration data are available in the vicinity of the Project. However, annual average TSP concentrations can be estimated from the PM_{10} measurements by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM10 monitors operated for long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**). Use of this relationship indicates that when taking the PM_{10} average over all sites (from the Stratford Mining Complex data), the existing annual average TSP concentration is approximately 28 µg/m^3.

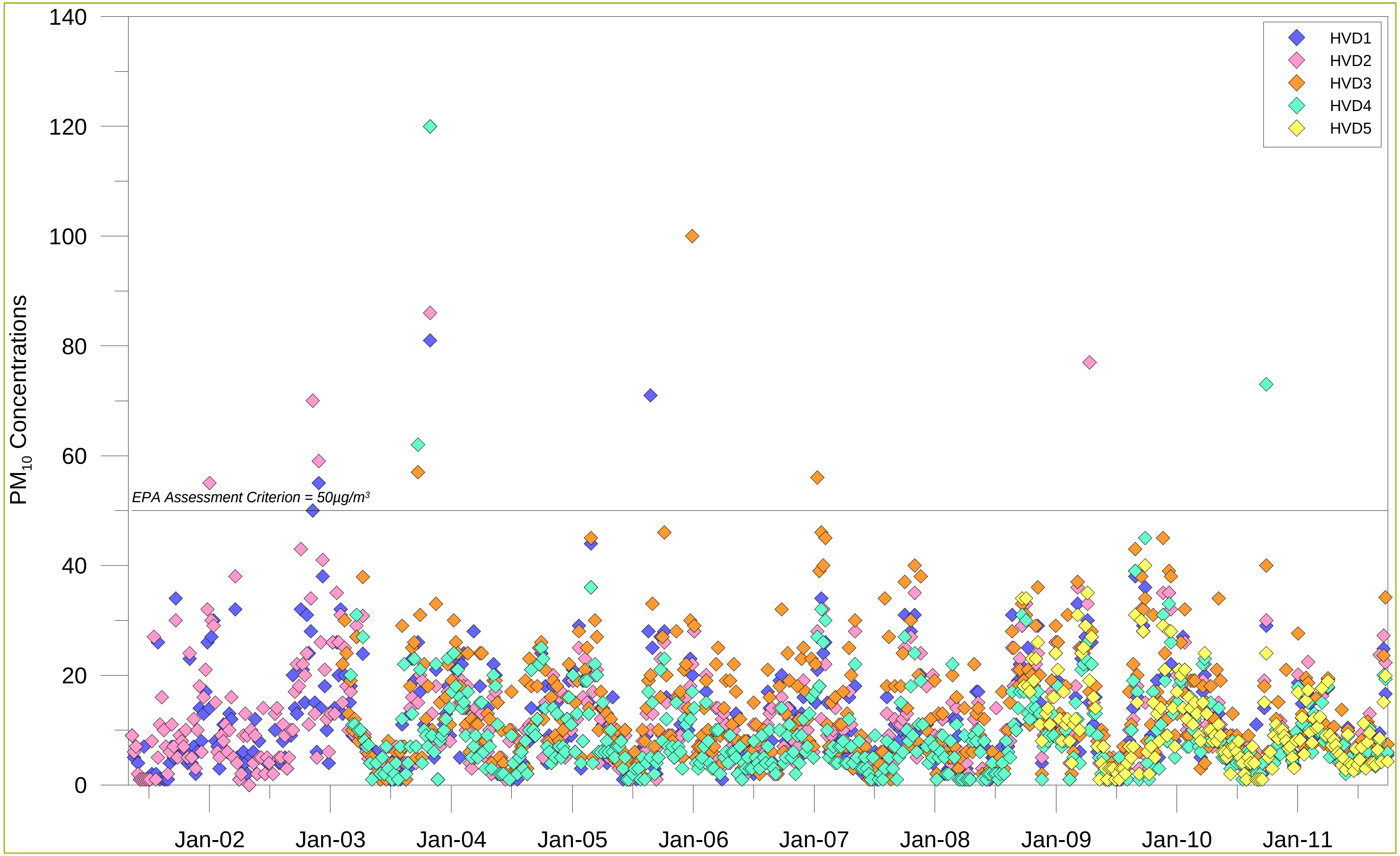


Figure 5.3: 24-Hour PM_{10} Concentrations (µg/m^3)

5.3.4 $PM_{2.5}$ Concentrations

No $PM_{2.5}$ concentration data are available in the vicinity of the Project. Co-located monitors for PM_{10} and $PM_{2.5}$ are operated by the EPA at a number of locations in the Hunter Valley. The average ratio of $PM_{2.5}/PM_{10}$ across all three sites is 0.4.

It is noted that a different monitoring method is used for the two size fractions, Tapered Element Oscillating Microbalance (TEOM) for PM_{10} and Beta Attenuation Mass for $PM_{2.5}$. This results in a number of ratios greater than 1, which is not realistic given that $PM_{2.5}$ is a subset of PM_{10}. The higher ratios tend to occur during winter months. Thus a possible explanation for $PM_{2.5}:PM_{10}$ ratios that are greater than 1.0 is that a greater proportion of the particulate matter comes from wood burning in domestic fires. These particles are known to be associated with volatile components which are not measured effectively by certain TEOM models.

When winter months are excluded, that ratio of $PM_{2.5}/PM_{10}$ across all three sites drops to 0.35. Notwithstanding, the 0.4 overall average ratio was used for determining background $PM_{2.5}$ concentrations for the Project. Using this ratio and applying it to the PM_{10} data for Stratford Mining Complex, the annual average $PM_{2.5}$ concentration would be approximately 4 µg/m^3.

5.3.5 Rocky Hill Coal Project

Data collected at the proposed Rocky Hill Coal Project has also been made available for this study. An air quality monitoring programme was established in July 2010 to monitor dust deposition and dust concentration (as PM_{10}) in the vicinity of the proposed Project, including:

- two HVAS monitoring PM_{10}; and
- seven dust deposition gauges.

Table 5.5 provides a summary of the annual average PM_{10} concentration data collected at the Rocky Hill Coal Project. **Figure 3.1** shows the location of these sites. The average over both sites for these data is 8.5 µg/m^3. **Table 5.6** provides a summary of the annual average dust deposition data collected at the Rocky Hill Coal Project. The average across all sites for the monitoring period is 0.9 g/m^2/month.

Table 5.5: Annual Average PM_{10} Concentration for the Rocky Hill Coal Project (µg/m^3)

Date	HVAS - GA1	HVAS - GA3
July 2010 - June 2011	9	8.5
July 2010 - Nov 2011	8	8
Average	**9**	**8**
Average across both sites		**8.5**

Table 5.6: Dust Deposition Data (Insoluble Solids) for the Rocky Hill Coal Project (g/m^2/month)

Date	DDG - GA1	DDG - GA2	DDG - GA3	DDG - GA4	DDG - GA5	DDG - GA6	DDG - GA7
July 2010 - June 2011	0.4	0.4	0.5	1.4	1.1	1.5	0.8
July 2010 - Nov 2011	0.3	0.4	0.5	1.8	0.5	1.0	0.7
Average	**0.3**	**0.4**	**0.5**	**1.6**	**0.8**	**1.2**	**0.7**
Average across all sites							**0.8**

5.4 Contribution of Existing Operations to Ambient Dust Levels

It is important to note that the background air quality, as measured around the Stratford Mining Complex, would be influenced by existing operations at the Stratford Mining Complex. To estimate the extent of the contribution from existing mining, operations at the Stratford Mining Complex for a current year have been modelled. Further information on the modelling set up and approach is provided in **Section** 6.

Emission estimates have been made for all dust sources at the Stratford Mining Complex for July 2010 to June 2011, based on mine plan information and the amount of material handled (coal and overburden) for that year. Meteorological data from July 2010 to June 2011 were used in the dispersion modelling to predict the off-site ground level concentration of dust for that period.

Modelling predictions of PM_{10} were made at the exact locations of the Stratford Mining Complex HVAS and compared to the actual levels recorded for that same period. By subtracting the modelling prediction for the Stratford Mining Complex from the actual level recorded at the HVAS (observed), an estimation of background without the existing contribution from Stratford Mining Complex can be made.

The modelling predictions for existing operations at Stratford Mining Complex are presented in **Table 5.7**. The modelling indicates that the contribution from Stratford Mining Complex mining in 2010 – 2011 was 1 to 3 µg/m^3 as an annual average. When subtracted from the actual measured values at the HVAS, the background contribution from all other sources is estimated to be between 6 - 8 µg/m^3 as an annual average and suggests that the contribution from the Stratford Mining Complex to existing levels is small. This conclusion is supported by the data collected at the Rocky Hill Coal Project, which is remote from the Stratford Mining Complex. Rocky Hill Coal Project data suggests that annual average PM_{10} concentrations remote from mining would be approximately 8.5 µg/m^3, generally similar to data collected around the Stratford Mining Complex.

Table 5.7: Comparison of Measured and Modelled Annual Average PM_{10} Data (µg/m^3)

Site	Annual Average PM_{10} – Measured	Annual Average PM_{10} – Stratford Mining Complex Contribution (as modelled)	Difference (Observed Minus Predicted)
HVD2	9	2	7
HVD3	9	3	6
HVD4	8	1	7
HVD5	8	0.3	7.7

Note: Predictions were not made for HVD1 due to the proximity of this monitoring (250m) to existing mining operations

The modelled emissions inventory for 2010/2011 is provided in **Appendix B**. Further details on the existing operations modelling scenario are presented in **Appendix C**.

5.5 Existing Air Quality for Assessment Purposes

The monitoring data collected at the Stratford Mining Complex air quality monitoring network would include contributions from the existing mining operations, as well as all other sources for the area. However, because data collected close to the Stratford Mining Complex is generally similar to data collected for the proposed Rocky Hill Coal Project, away from existing mining sources, the indication is that the contribution from existing mining operations are minor.

The average PM_{10} concentration across all sites for the Stratford Mining Complex (11 µg/m^3) is the similar to the average of the two Rocky Hill Coal Project monitoring sites (8.5 µg/m^3). The annual average dust deposition across all sites is also comparable.

For the purposes of assessing cumulative impacts, a modelling scenario for existing operations was completed to determine current mining contributions to existing levels of dust (**Section 5.4**). The difference between modelled and measured annual average PM_{10} concentrations was between 6 and 7.7 µg/m^3 across all HVAS locations. This derived background annual average is similar to the annual average PM_{10} concentrations measured for the Rocky Hill Coal Project, and provides a good indication of background PM_{10} concentrations.

The highest annual average PM_{10} concentration when the current operations of the Stratford Mining Complex are excluded from the measured data is rounded-up to 8 µg/m^3. This is the adopted background concentration for annual average PM_{10}. Background for TSP and $PM_{2.5}$ has been derived based on this PM_{10} value and scaled according to the ratios estimated in **Section 5.3.4**.

An annual average dust deposition level of 1 g/m^2/month has been adopted which is consistent with the average across all Stratford Mining Complex sites and is similar to the Rocky Hill Coal Project data average.

In summary, the following background air quality levels are conservatively assumed for all sources other than the existing mining activity.

- annual average PM_{10} concentration of 8 µg/m^3;
- annual average $PM_{2.5}$ concentration of 3 µg/m^3;
- annual average TSP concentration of 20 µg/m^3; and
- annual average dust deposition of 1 g/m^2/month.

5.6 Existing Air Quality Mitigation and Management Measures

Air quality management at the Stratford Mining Complex is described in the Stratford Mining Complex Air Quality and Greenhouse Gas Management Plan (AQGHGMP) (**SCPL, 2011a**). Current air quality mitigation and management measures employed at the Stratford Mining Complex are summarised in **Table 5.8**.

Table 5.8: Management Measures and Controls from Stratford Mining Complex AQGHGMP

Source	Activity	Management Measure
Wind Blown Dust Sources	Areas disturbed by mining	• Only the minimum area necessary for mining will be disturbed. • Exposed areas will be reshaped, topsoiled and revegetated as soon as practicable.
	Waste rock emplacement areas	• Exposed waste emplacement surfaces that are hauled on will be watered to suppress dust. • Progressive rehabilitation (i.e. reshaping, topsoil placement and revegetation) of waste emplacement areas will continue throughout the life of the Stratford Mining Complex.
	Coal handling areas	• Coal-handling areas will be kept in a moist state using water carts to minimise windblown and traffic generated dust.
	Coal stockpiles	• Automatic sprinklers are installed in the existing Stratford Mining Complex product coal stockpile area and are activated when wind speeds exceed 5 m/s, except during rain events.
Mining Generated Dust Sources	Haul road dust	• All roads and trafficked areas will be watered using water carts to minimise the generation of dust. • Obsolete roads will be ripped and revegetated.
	Minor roads	• Development of minor roads will be limited and the locations of these will be clearly defined. • Regularly used minor roads will be watered. • Obsolete roads will be ripped and revegetated.
	Topsoil stripping	• Access tracks used for topsoil stripping during the loading and unloading cycle will be watered.
	Topsoil stockpiling	• Long-term topsoil stockpiles will be revegetated with a cover crop.
	Drilling	• Dust aprons will be lowered during drilling. • Water injection or dust suppression sprays will be used when high levels of dust are being generated.
	Blasting	• Fine material collected during drilling will not be used for blast stemming. • Adequate stemming will be used at all times. • Blasting will only occur following an assessment of weather conditions by the Environmental Officer to ensure that wind speed and direction will not result in excess dust emissions from the site towards adjacent residences (refer to the Blasting and Vibration Management Plan for further information). No blasting will occur in the Stratford Mining Complex when wind speeds exceed 5 m/s in a direction that would be likely to carry dust to a nearby receptor.

Source: SCPL, 2011a

5.7 Air Quality Complaints Overview

The complaints register for the SCM indicates that only 13 dust or air quality related complaints have been received since 2003 (**Table 5.9**). During 2011, six complaints were received. SCPL investigates all complaints received and provides responses to complainants.

Table 5.9: Complaints History Relating to Air Quality

Period	Number of Complaints
2003	2
2004	0
2005	0
2006	2
2007	1
2008	0
2009	1
2010	1
2011	6

Source: SCPL (2010a); SCPL (2010b), SCPL (2011a)

6 MODELLING APPROACH

The assessment follows a conventional approach commonly used for air quality assessment in Australia and outlined in the Approved Methods (**DEC, 2005**).

6.1 Modelling System

The CALMET/CALPUFF modelling system was chosen for this study. CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the 3-dimensional (3D) meteorological fields that are utilised in the CALPUFF dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region. CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (**Scire *et al.*, 2000**). The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff, and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

In March 2011 generic guidance and optional settings for the CALPUFF modelling system were published for inclusion in the Approved Methods (**TRC, 2011**). The model set up for this study has been conducted in consideration of these guidelines.

6.2 Model Set Up

CALMET was initially run for a coarse outer grid domain of 40 km x 40 km with a 1 km resolution. Observed hourly surface data were incorporated into the outer domain modelling, including the SCM site data, data from the DCM and data collected as part of the Rocky Hill Coal Project data (refer **Section 5.1.1**). Cloud amount and cloud heights were sourced from the closest available hourly observations (BoM Automatic Weather Station at Murrurundi Gap).

Upper air information was incorporated through the use of prognostic 3D data extracted from The Air Pollution Model (TAPM)[d].

The CALMET generated meteorological parameters from the outer grid were then used as input into a finer resolution inner grid domain of 14 km x 20 km with a 200 m resolution, centred on the SCM site. Observed surface data from the SCM site were again incorporated into the inner domain modelling. Detailed mine plan terrain data were incorporated into the modelling and a separate CALMET wind field generated for each mine plan scenario. Further details on model set up are provided in **Appendix D**.

6.3 Dispersion Meteorology

The CALMET generated winds are compared with the measured data from the SCM site and presented in **Figure 6.1**.

[d] The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in (Hurley 2008; Hurley, Edwards et al., 2009).

The CALMET windrose is extracted for a single point at the approximate location of the SCM site. The CALMET windrose displays very similar characteristics to the measured data with dominant winds from north, south and north-northeast. The average wind speed from CALMET is the same (2.1 m/s) and the percentage occurrence of calm conditions (defined as wind speeds <0.5m/s) are similar, 9% recorded at SCM compared with 5% predicted by CALMET.

6.4 Justification of Approach

Three years have been chosen for quantitative dispersion modelling. These years along with their rationale for selection are provided below:

- Year 2 – Representative of initial mining at the Roseville West Pit Extension, Avon North Open Cut, and Stratford East Open Cut. Coincides with maximum DCM ROM coal handling, processing and transportation on-site and maximum over product coal production. Representative of northern-most operations during the Project.
- Year 6 – Includes placement of waste rock on higher levels of Stratford Waste Emplacement, is the first full year of 24-hour waste rock production from the Stratford East Open Cut, and is the final year that includes receipt of DCM coal.
- Year 10 – Maximum Project ROM coal and waste rock production rates. Representative of southern-most operations during the Project.

Dispersion modelling results for the above years are considered to represent the worst case for the Project at any particular residential receiver.

Air quality impacts are estimated in this study via the use of dispersion modelling (i.e. CALPUFF). This is considered to be appropriate to quantify potential impacts on privately-owned receivers which are located in the vicinity of the Project. The results of dispersion modelling are compared with the relevant EPA air quality criteria, which are generally health-based (with the exception of dust deposition, which is an amenity-based criterion) (**Section 4.2**).

The CALPUFF dispersion model has been selected for this Air Quality and Greenhouse Gas Assessment as it is considered by the EPA to be appropriate for locations of complex terrain. The local topography is characterised by the Gloucester Valley, therefore the use of CALPUFF is considered to be appropriate.

An Environmental Risk Assessment (**SP Solutions, 2012**) (Appendix R of the EIS) was undertaken for the Project. The following issues were identified as key potential environmental impacts relating to air quality.

- Increased emissions of PM_{10}/$PM_{2.5}$/TSP/dust deposition from the Project, resulting in an increased predicted impact (health and amenity) at residential receivers.
- Increase in cumulative impact associated with the Project, Rocky Hill Coal Project and the AGL Gloucester Pty Ltd (AGL) Gloucester Gas Project.
- Heightened community concern regarding health related air quality issues, including cumulative impacts.
- Dust and aerial contaminants on Stratford Village homes and into their tank water supplies.
- Differences between the air quality effects between modelled and actual levels (due to conservative assumptions in modelling).

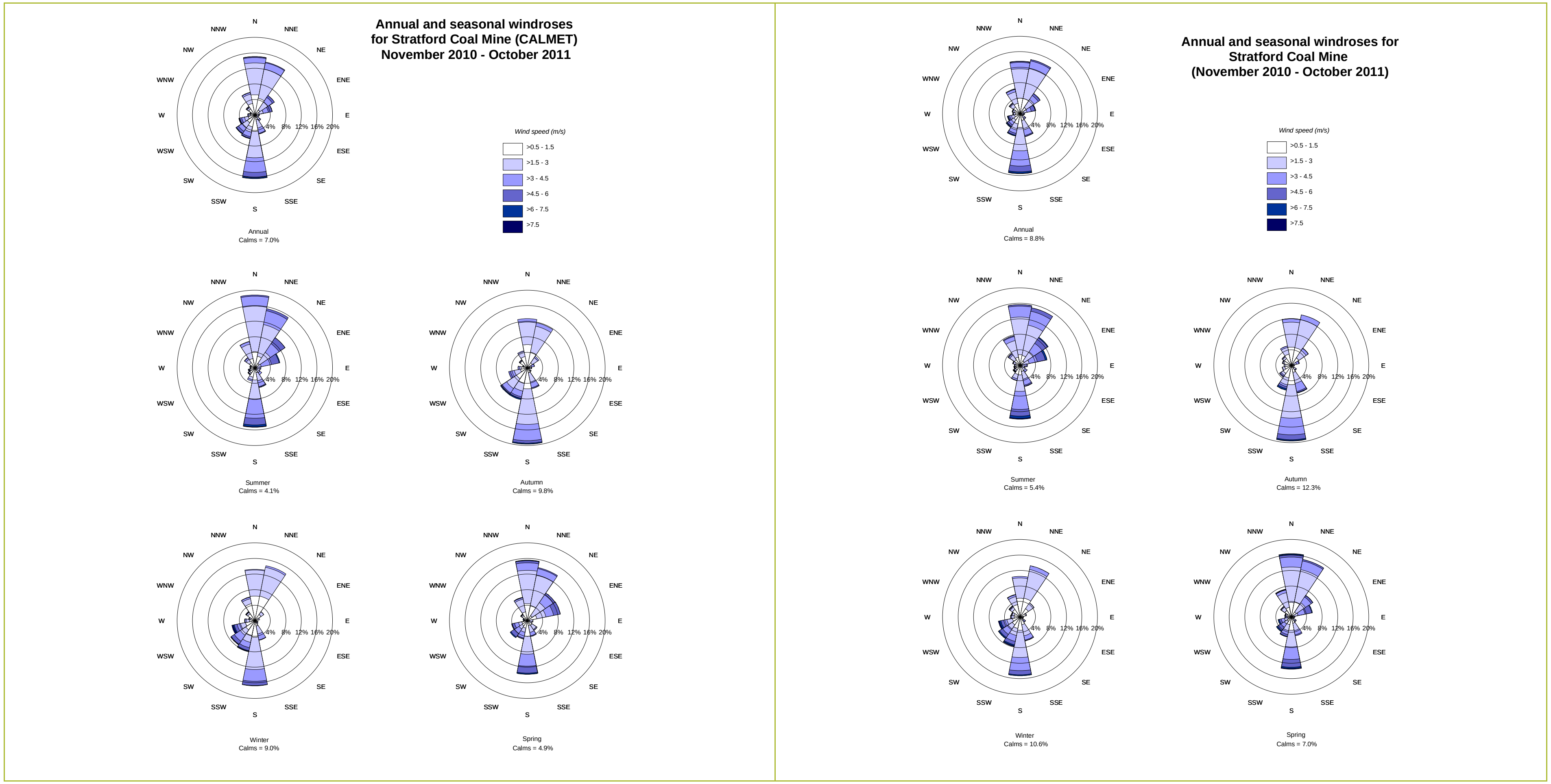


Figure 6.1: Annual and Seasonal Windroses for SCM and CALMET

In accordance with the outcomes of the Environmental Risk Assessment, this Air Quality and Greenhouse Gas assessment assesses potential air quality emissions in the context of health-based air quality criteria (**Section 9**), assesses cumulative impacts (**Sections 8.4, 9.3, 9.5, 9.9, 9.11 and 9.13**), assesses the potential for effects on domestic tank water supply (**Section 9.18**) and discusses the conservative nature of modelling (**Section 5.4**).

As noted in **Section 2.2**, whilst operations in Stratford East Open Cut would generally be operated during the hours 7.00 am to 6.00 pm, operations outside of these hours may be conducted subject to compliance with noise limits. The results of air quality modelling of Year 2 presented in **Section 9** assumed Stratford East Open Cut waste rock operations are undertaken 7.00 am to 6.00 pm. In terms of air quality emissions, operations outside of those hours have the potential to result in some additional emissions due to the additional hours in which dozers would operate. Additional analysis (including CALPUFF modelling) was undertaken for Year 2 to investigate the effect of additional emissions that could arise from Stratford East Open Cut dozer operations in the period 6.00 pm to 7.00 am. The additional analysis takes account of two factors:

- Emissions could increase because of the additional hours in which the dozers might operate.
- Additional emissions could occur under less favourable dispersion conditions that are often associated with the evening and night-time period.

The results of this additional analysis indicated:

- The emissions inventory increases by approximately 0.9%.
- The dispersion modelling indicates that modelling results are largely the same, with differences in 24-hour PM_{10} emissions being 0 at the majority of receivers and up to a maximum of 1 $\mu g/m^3$.

Given that dispersion modelling results are largely the same when comparing general Year 2 operations with Year 2 operations including Stratford East Open Cut dozer operations in the period 6.00 pm to 7.00 am, no further discussion of the additional modelling is provided in this report.

7 OVERVIEW OF BEST PRACTICE DUST CONTROL

Air quality management measures currently employed at the Stratford Mining Complex are described in the Stratford Mining Complex AQGHGMP (**SCPL, 2011a**). These controls are compared to recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (**Donnelly *et al.*, 2011**) (the Best Practice Report), a study that was commissioned by the NSW EPA.

As an outcome of the Best Practice Report, the EPA developed a PRP that requires each mining company to prepare a report on the practicability of implementing best practice measures to reduce particle emissions. The PRP requirements were included in the Stratford Mining Complex EPLs (EPLs 5161 and 11745). Subsequent to this, SCPL responded to the Coal Mine Particulate Matter Control Best Practice PRP in February 2012 (**PAEHolmes, 2012**).

In accordance with the PRP requirements, the report included:

- Identification, quantification and justification of existing measures that are being used to minimise particle emissions.
- Identification, quantification and justification of additional measures that could be used to minimise particle emissions.
- Evaluation of the practicality of implementation of additional best practice measures.
- Proposal of a timeframe for implementing all practicable best practice measures.
- The Project, along with the existing Stratford Mining Complex, was considered as part of SCPL's evaluations of each potential mitigation measure identified by **PAEHolmes (2012)**.

As a result of the evaluation, the following additional best practice measures were proposed for implementation (**PAEHolmes, 2012**) (proposed timeframe for implementation and indication of whether the measure was included in Project modelling in parentheses):

- Vehicle Speed Restriction to 60 kilometres per hour (km/hr) (end of FY2013).
- Use of larger vehicles – end of FY2014 (contingent on approval of Project) (included in Project emissions inventory).
- Increase intensity of Haul Road Sprays (end of FY2014 - contingent on approval of Project) (90% control applied in Project emissions inventory – refer to **Section 8.3**).
- Watering of wind erosion areas (end of FY2014 - contingent on approval of Project) (50% control applied in Project emissions inventory).
- Vegetative groundcover on wind erosion areas (end of FY2013).

The above best practice measures were incorporated into Project emissions estimates (**Section 8.2**), with the exception of vehicle speed restriction to 60 km/hr and vegetative groundcover of wind erosion areas. The effect on overall emissions associated with vehicle speed reduction to 60 km/hr was not considered to be quantifiable by **PAEHolmes (2012)**.

The effect of vegetative groundcover would be up to a 70% reduction of emissions associated with wind erosion areas, however this was conservatively not incorporated into this assessment. This control would be additional to the proposed watering of wind erosion areas and assumptions regarding planning rehabilitation and partial rehabilitation areas, which are included in this assessment. Therefore, the emissions estimates presented in **Section 8.2** are conservatively higher in this regard.

Given that the evaluation of mitigation measures in **PAEHolmes (2012)** included consideration of the Project, no other mitigation measures are considered to be feasible and reasonable.

7.1 Monitoring and Management Measures

7.1.1 Real-Time Dust Monitoring

An additional aspect of the best practice management at the site is the proposed proactive dust management system. An outline of the proposed proactive dust management system (using real-time dust monitoring) is provided in the Stratford Mining Complex AQGHGMP (**SCPL, 2011a**).

In summary, a TEOM will be installed to monitor PM_{10} concentrations continuously, at a location in close proximity to Stratford; representative of receivers who may experience short-term elevated dust concentrations. A short-term average performance indicator will be set at a level that allows proactive dust management if dust levels are expected to approach the 24-hour PM_{10} impact assessment criteria in the upcoming 24 hours.

To augment the Stratford monitor, a TEOM is also recommended for installation in Craven (as discussed in **Section 9.3.2**).

A procedural response (the Standard Protocol) would facilitate the day-to-day management of dust emissions triggered if the performance indicator is exceeded (**SCPL, 2011a**). The Standard Protocol will involve four steps as follows:

1. Source Identification – identify the activities generating excessive dust;

2. Management Strategy – determine the controls used minimise dust;

3. Implementation – implement those controls identified; and

4. Review – the effectiveness of these controls.

7.1.2 Predictive Meteorological Forecasting System

The AQGHGMP would be updated to include a meteorological forecasting system as part of the Project. This system would predict meteorological conditions for the coming day to determine, one day in advance, where the risk of dust emissions may occur (e.g. based on wind speed, direction, rainfall and atmospheric stability).

The predictive meteorological forecasting system would work in conjunction with the real-time monitoring system, providing an alert for the appropriate personnel to review the real-time data and manage the intensity of activities for that day, increase controls or limit activity to various areas of the site.

8 EMISSIONS TO AIR

The operation of the Project has been analysed and estimates of dust emissions for the key dust generating activities have been made. Emission factors developed both locally, and by the United States Environmental Protection Agency (US EPA), have been applied to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most reliable, contemporary methods for determining dust generation rates.

The mining plans for the Project have been analysed and detailed emissions inventories have been prepared for three key operating scenarios, being Project Years 2, 6 and 10. These modelled years are considered to be representative of worst-case operations; for example where coal and waste production are highest, where extraction or wind erosion areas are largest or where operations are located closest to receivers.

Detailed calculations are provided in **Appendix B** which provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content, etc.), information on the way in which equipment would be used to undertake different mining operations and the quantities of materials that would be handled in each operation.

An emissions inventory was also developed for existing operations (FY2011) and an existing operations scenario was modelled to determine the contribution of the SCM to measured ambient air quality, and derive a background for assessment. The results of the FY2011 modelling are provided in **Appendix C**. Further discussion and interpretation of the results is provided in **Section 5.4**.

8.1 Particle Size Categories

The modelling has been based on the use of three particle-size categories (0 to 2.5 µm - referred to as fine particles [FP] or $PM_{2.5}$, 2.5 to 10 µm - referred to as coarse matter [CM] and 10 to 30 µm - referred to as the Rest). The distribution of particles in each particle size range is as follows (**State Pollution Control Commission [1986]**):

- $PM_{2.5}$ (FP) is 0.0468 of the TSP.
- $PM_{2.5-10}$ (CM) is 0.3440 of TSP.
- PM_{10-30} (Rest) is 0.6090 of TSP.

Emission rates of TSP have been calculated using emission factors developed both within NSW and by the US EPA (see **Appendix B**). Modelling was undertaken for each of the size fractions which are assumed to emit according to the distribution above and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass mean of the particle size range.

The resultant predicted concentrations are then combined as follows to determine the concentrations of each size fraction:

- $PM_{2.5}$ = FP.
- PM_{10} = FP + CM.
- TSP = FP +CM+ Rest.

8.2 Emission Estimates

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities for the modelled scenarios.

To model the effect of pit retention for emissions within the open cut pits and the effects of other mine landforms; detailed mine terrain has been incorporated into the modelling for each modelled mine year.

The information used for developing the inventories has been based on the operational descriptions and mine plan drawings and used to determine haul road distances and routes, stockpile and pit areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

Table 8.1 to **Table 8.3** summarise the quantities of TSP estimated to be released by each activity of the Project.

As described in **Section 1.1**, the Project would include the transporting of DCM ROM coal to the SCM for handling, processing and transportation via trains. Estimated emissions from all activities associated with the DCM coal are included in the emissions inventories.

8.3 Additional Haul Road Controls

Preliminary emissions estimations indicated that of the potential dust sources on-site, emissions from the hauling of overburden and ROM coal contributes more than any other source group to short-term PM_{10} impacts at the closest residential receivers. Typically, modelling assessments for mine sites apply a haul road control level of 75% (representing control via > Level 2 watering). In accordance with the modelling scenarios presented in this report, an additional level of control on hauling (90% control) has been applied to emissions estimations.

This 90% control level is supported by **Sinclair Knight Merz (2005)** who derived an equation that shows control benefits for increased watering up to 95%. This finding is confirmed by **Buonicore and Davis (1992)** who state that a level of control of 90% is expected to be achieved by increasing the application rate of water and/or through the use of dust suppressants. The study states that 90% control can only be maintained provided the moisture content of the surface material is approximately 8% (refer to **Figure 8.1**).

The above observations are further reinforced within **US EPA, 2006**. **Figure 8.2** (after **US EPA, 2006**) presents the relationship between the instantaneous control efficiency due to watering and the resulting increase in surface moisture. The moisture ratio "M" (shown on the x-axis) is calculated by dividing the surface moisture content of the watered road by the surface moisture content of the uncontrolled road.

Table 8.1: Estimated TSP emissions Year 2 of the Project

ACTIVITY	TSP emission for Year 2 (kg/y)
Topsoil Removal - Dozers/Excavators stripping topsoil (Avon North Open Cut)	15,071
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West Pit Extension)	11,052
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East Open Cut)	11,052
Topsoil removal - Sh/Ex/FELs loading topsoil (Avon North Open Cut)	7
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West Pit Extension)	6
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East Open Cut)	18
Topsoil removal - Hauling topsoil from Avon North Open Cut to north soil stockpile	175
Topsoil removal - Hauling topsoil from Roseville West Pit Extension to north soil stockpile	227
Topsoil removal - Hauling topsoil from Stratford East Open Cut to north soil stockpile	1,171
Topsoil removal - Emplacing topsoil from all pits at soil stockpile	13
OB - Drilling Roseville West Pit Extension	788
OB - Drilling Avon North Open Cut	1,352
OB - Drilling Stratford East Open Cut	1,042
OB - Blasting Roseville West Pit Extension	1,388
OB - Blasting Avon North Open Cut	2,382
OB - Blasting Stratford East Open Cut	1,836
OB - Sh/Ex/FELs loading from Roseville West Pit Extension OB to trucks	2,937
OB - Sh/Ex/FELs loading OB from Avon North Open Cut to trucks	5,039
OB - Sh/Ex/FELs loading OB from Stratford East Open Cut to trucks	3,884
OB - Hauling OB from Roseville West Pit Extension to Stratford Waste Emplacement	112,105
OB - Hauling OB from Avon North Open Cut to Northern Waste Emplacement (daytime, not evening)	32,096
OB - Hauling OB from Avon North Open Cut to Main Pit (evening/night-time)	82,976
OB - Hauling OB from Stratford East Open Cut to Stratford Waste Emplacement	124,822
OB - Emplacing OB from Roseville West Pit Extension at Stratford Waste Emplacement	2,937
OB - Emplacing OB from Avon North Open Cut at Northern Waste Emplacement (daytime)	2,310
OB - Emplacing OB from Avon North Open Cut at Main Pit (evening/night-time)	2,730
OB - Emplacing OB from Stratford East Open Cut to Stratford Waste Emplacement	3,884
OB - Dozers on OB - Roseville West Pit Extension	55,259
OB - Dozers on OB - Northern Waste Emplacement (daytime, not evening)	11,052
OB - Dozers on OB - Main Pit (evening/night-time)	13,061
OB - Dozers on OB - Stratford East Open Cut (daytime only)	11,052
IB - Dozers ripping/pushing/clean-up (Avon North Open Cut)	43,404
IB - Dozers ripping/pushing/clean-up (Stratford East Open Cut)	43,404
IB - Dozers ripping/pushing/clean-up (Roseville West Pit Extension)	22,104
CL - Dozers ripping/pushing/clean-up (Avon North Open Cut)	26,260
CL - Dozers ripping/pushing/clean-up (Stratford East Open Cut)	26,260
CL - Dozers ripping/pushing/clean-up (Roseville West Pit Extension)	13,373
CL - Loading ROM coal from Roseville West Pit Extension to trucks	33,687
CL - Loading ROM coal from Avon North Open Cut to trucks	50,530
CL - Loading ROM coal from Stratford East Open Cut to trucks	11,229
CL - Loading coal for Co-Disposal area to trucks	5,614
CL - Hauling ROM coal from Roseville West Pit Extension to ROM stockpile	10,961
CL - Hauling ROM coal from Avon North Open Cut to ROM stockpile	15,516
CL - Hauling ROM coal from Stratford East Open Cut to ROM stockpile	3,301
CL - Hauling coal from Co-Disposal area to ROM stockpile area	330
CL - Unloading ROM coal to ROM Stockpile	50,530
CL - Unloading ROM coal directly to hopper	25,265
CL - Loading ROM coal (incl. DCM coal) from ROM stockpile to hopper	109,483
CL - Unloading DCM coal to conveyor	289
CL - Unloading DCM coal to ROM stockpile	174
CL - ROM hopper unloading coal to conveyor	463
CL – Crushing	6,480
CL - Conveyer from hopper to CHPP	278
CL - Conveyor unloading ROM coal to CHPP	463
CL - Dozer on product stockpiles	131,302
CL - Handling coal at CHPP	278
CL - Unloading coal to product stockpile	347
CL - Conveyor unloading to trains	347
WE - Stratford East Open Cut Waste Emplacement	12,539
WE - Stratford East Open Cut	20,492
WE - Stratford East Open Cut Partial Rehabilitation Area	187
WE - Main Pit	12,198
WE - Roseville West Pit Extension Waste Emplacement	29,958
WE - Roseville West Pit Extension	35,617
WE - Roseville West Pit Extension Partial Rehabilitation	117
WE - Bowens Rd North exposed area down to pit water	13,954
WE - Avon North Open Cut Waste Rock Emplacement	32,739
WE - Avon North Open Cut	21,175

ACTIVITY	TSP emission for Year 2 (kg/y)
WE - Avon North Open Cut Partial Rehabilitation	342
WE - Co-disposal Area	32,202
WE - North Soil Stockpile	2,147
WE - ROM Coal Stockpile	2,586
WE - Product Coal Stockpile	1,415
Grading roads (Roseville West Pit Extension) (daytime)	43,671
Grading roads (Northern Waste Emplacement) (daytime)	21,835
Grading roads Main Pit (Night-time)	13,101
Grading roads (Stratford East) (24 hours)	34,937
Total TSP emissions for FY2015 (kg/year)	**1,476,612**

Notes: OB = overburden; CL = coal; WE = wind erosion; kg/year = kilograms per year

Table 8.2: Estimated TSP emissions Year 6 of the Project

ACTIVITY	TSP emission for Year 6 (kg/y)
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West Pit Extension)	11,052
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East)	11,052
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West Pit Extension)	6
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East)	13
Topsoil removal - Hauling topsoil from Roseville West Pit Extension to south soil stockpile	186
Topsoil removal - Hauling topsoil from Stratford East Open Cut to south soil stockpile	1,196
Topsoil removal - Emplacing topsoil at south soil stockpile	6
OB - Drilling Roseville West Pit Extension	1,045
OB - Drilling Stratford East Open Cut	3,041
OB - Blasting Roseville West Pit Extension	1,841
OB - Blasting Stratford East Open Cut	5,359
OB - Sh/Ex/FELs loading from Roseville West Pit Extension OB to trucks	3,894
OB - Sh/Ex/FELs loading OB from Stratford East Open Cut to trucks	11,337
OB - Hauling OB from Roseville West Pit Extension to Main Pit	81,750
OB - Hauling OB (backfill) from Roseville West Pit Extension to top of pit	59,455
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement (daytime)	162,474
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement (evening/night-time)	165,346
OB - Emplacing OB from Roseville West Pit Extension at Main Pit	1,947
OB - Emplacing OB (backfill) from Roseville West Pit Extension to top of pit	1,947
OB - Emplacing OB from Stratford East Pit to Stratford Waste Emplacement (daytime)	5,196
OB - Emplacing OB from Stratford East Pit to Stratford Waste Emplacement (night-time)	6,141
OB - Dozers on OB - Main Pit Waste Emplacement (waste from Roseville West Pit Extension) (daytime)	22,104
OB - Dozers on OB - Roseville West Pit Extension (backfill) (daytime)	11,052
OB - Dozers on OB - Stratford Waste Emplacement (24 hours)	48,226
IB - Dozers ripping/pushing/clean-up (Roseville West Pit Extension)	59,680
IB - Dozers ripping/pushing/clean-up (Stratford East Open Pit) (24 hours)	43,404
CL - Dozers ripping/pushing/clean-up (Roseville West Pit Extension) (daytime)	36,108
CL - Dozers ripping/pushing/clean-up (Stratford East Open Pit) (24 hours)	26,260
CL - Loading ROM coal from Roseville West Pit Extension to trucks	42,109
CL - Loading ROM coal from Stratford East Pit to trucks	58,952
CL - Loading coal for Co-Disposal area to trucks	11,229
CL - Hauling ROM coal from Roseville West Pit Extension to ROM stockpile	9,671
CL - Hauling ROM coal from Stratford East Pit to ROM stockpile	19,257
CL - Hauling coal from Co-Disposal area to ROM stockpile area	660
CL - Unloading ROM coal to ROM Stockpile	56,145
CL - Unloading ROM coal directly to hopper	28,072
CL - Loading ROM coal (incl. DCM coal) from ROM stockpile to hopper	70,181
CL - Unloading DCM coal to conveyor	145
CL - Unloading DCM coal to ROM stockpile	87
CL - ROM hopper unloading coal to conveyor	338
CL – Crushing	4,725
CL - Conveyer from hopper to CHPP	203
CL - Conveyor unloading ROM coal to CHPP	338
CL - Dozer on product stockpiles	131,302
CL - Handling coal at CHPP	203
CL - Unloading coal to product stockpile	280
CL - Conveyor unloading to trains	280
WE - Stratford East Open Cut	46,839
WE - Stratford East Open Cut Waste Emplacement	38,252
WE - Stratford East Open Cut Waste Emplacement (partial rehabilitation)	1,952
WE - Main Pit (waste emplacement)	23,029
WE - Roseville West Pit Extension	58,842
WE - Roseville West Pit Extension Active Emplacement	42,448
WE - Roseville West Pit Extension Active Emplacement (partial rehabilitation)	55
WE - Roseville West Pit Extension Active Emplacement (backfill)	2,440
WE - Bowens Rd North exposed area down to pit water	10,734
WE - Avon North Open Cut	15,613
WE - Co-disposal Area	32,202
WE - North Soil Stockpile	2,147
WE - ROM Coal Stockpile	2,586
WE - Product Coal Stockpile	1,415
Grading roads (Roseville West Pit Extension) (daytime)	43,671
Grading roads Main Pit (Night-time)	13,101
Grading roads (Stratford East) (24 hours)	34,937
Total TSP emissions for FY2015 (kg/year)	**1,585,557**

Notes: OB = overburden; IB = interburden; CL = coal; WE = wind erosion.

Table 8.3: Estimated TSP emissions Year 10 of the Project

ACTIVITY	TSP emission for Year 10 (kg/y)
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West Pit Extension)	15,071
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East)	15,071
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West Pit Extension)	2
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East)	2
Topsoil removal - Hauling topsoil from Roseville West Pit Extension to north soil stockpile	114
Topsoil removal - Hauling topsoil from Stratford East Open Cut to north soil stockpile	356
Topsoil removal - Emplacing topsoil from Roseville West Pit Extension at north soil stockpile	2
Topsoil removal - Emplacing topsoil from Stratford East Open Cut at north soil stockpile	2
OB - Drilling Roseville West Pit Extension	1,030
OB - Drilling Stratford East Open Cut	3,184
OB - Blasting Roseville West Pit Extension	1,815
OB - Blasting Stratford East Open Cut	5,611
OB - Sh/Ex/FELs loading from Roseville West Pit Extension to trucks	3,840
OB - Sh/Ex/FELs loading OB from Stratford East Open Cut to trucks	11,869
OB - Hauling OB from Roseville West Pit Extension to Roseville West Emplacement	127,037
OB - Hauling OB from Stratford East Open Cut to Stratford Open Cut Waste Emplacement	268,028
OB - Emplacing OB from Roseville West Pit Extension at Roseville West Pit Extension Waste Emplacement	3,840
OB - Emplacing OB from Stratford East Pit at Stratford East Open Cut Waste Emplacement	11,869
OB - Dozers on OB - Roseville West Pit Extension (daytime)	22,104
OB - Dozers on OB - Stratford East Open Cut (24 hours)	48,226
IB - Dozers ripping/pushing/clean-up (Roseville West Pit Extension) (daytime)	79,573
IB - Dozers ripping/pushing/clean-up (Stratford East Open Cut) (24 hours)	43,404
CL - Dozers ripping/pushing/clean-up (Roseville West Pit Extension) (daytime)	48,144
CL - Dozers ripping/pushing/clean-up (Stratford East Open Cut) (24 hours)	26,260
CL - Loading ROM coal from Roseville West Pit Extension to trucks	42,109
CL - Loading ROM coal from Stratford East Open Cut to trucks	103,868
CL - Hauling ROM coal from Roseville West Pit Extension to ROM stockpile	9,671
CL - Hauling ROM coal from Stratford East Open Cut to ROM stockpile	36,983
CL - Unloading ROM coal to ROM Stockpile	72,988
CL - Unloading ROM coal directly to hopper	36,494
CL - Loading ROM coal from ROM stockpile to hopper	36,494
CL - ROM hopper unloading coal to conveyor	251
CL – Crushing	3,510
CL - Conveyer from hopper to CHPP	150
CL - Conveyor unloading ROM coal to CHPP	150
CL - Dozer on product stockpiles	131,302
CL - Handling coal at CHPP	150
CL - Unloading coal to product stockpile	138
CL - Conveyor unloading to trains	138
WE - Stratford East Open Cut	55,426
WE - Stratford East Open Cut Waste Emplacement (partial rehabilitation)	98
WE - Stratford East Open Cut Waste Emplacement (active)	10,246
WE - Roseville West Pit Extension	57,085
WE - Roseville West Pit Extension Active Emplacement (backfill)	7,514
WE - Roseville West Pit Extension Waste Emplacement (partial rehabilitation)	65
WE - Avon North Open Cut (partial rehabilitation)	208
WE - Co-disposal Area	32,202
WE - ROM Coal Stockpile	2,586
WE - Product Coal Stockpile	1,415
Grading roads (Roseville West Pit Extension) (daytime)	32,025
Grading roads (Stratford East) (24 hours)	34,937
Total TSP emissions for FY2015 (kg/year)	**1,444,662**

Notes: OB = overburden; IB = interburden; CL = coal; WE = wind erosion.

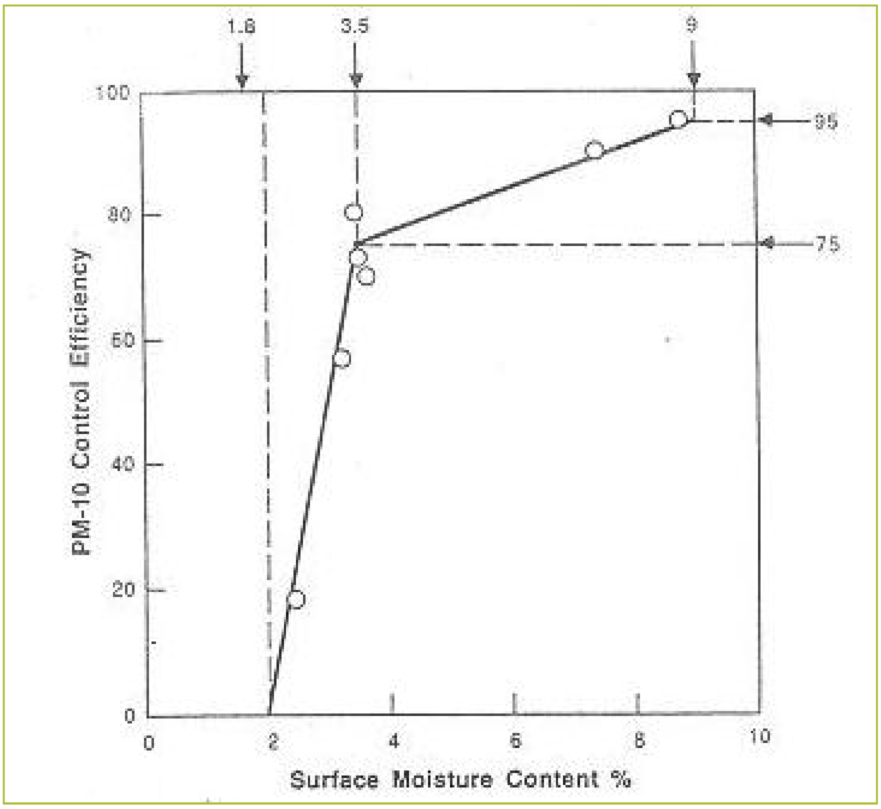


Figure 8.1: Watering Control Effectiveness for Unpaved Roads (Buonicore and Davis, 1992)

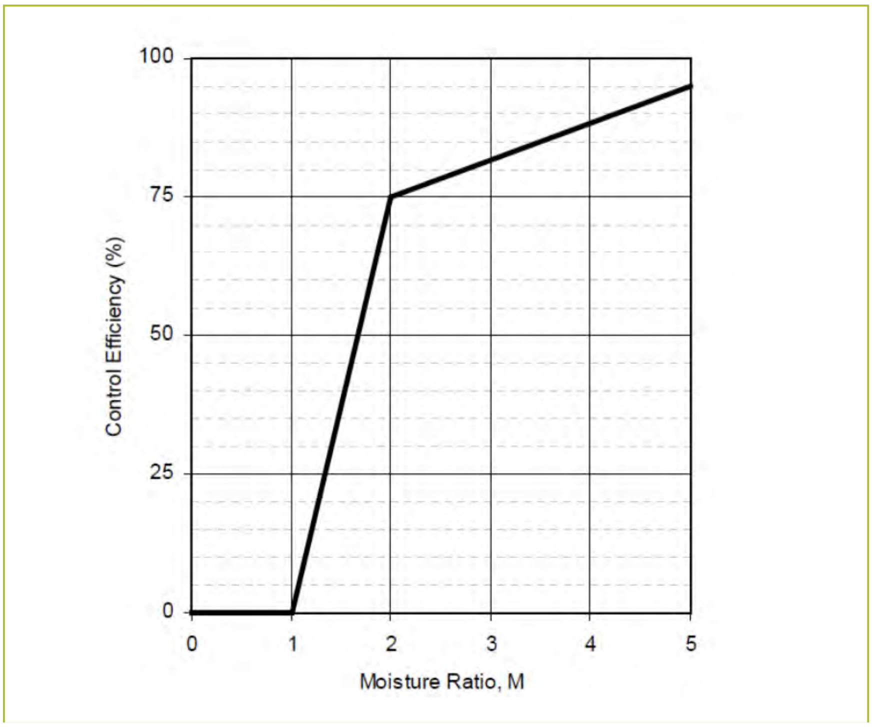


Figure 8.2: Watering Control Effectiveness for Unpaved Travel Surfaces (US EPA, 2006)

US EPA, 2006 states that as the watered surface dries, both the ratio M, and the predicted instantaneous control efficiency (shown on the y-axis), decrease. The figure shows that between the uncontrolled surface moisture content and a value twice as large, a small increase in moisture content results in a large increase in control efficiency. Beyond that, control efficiency grows slowly with increased moisture content. For example, if the uncontrolled surface moisture content was 2%, and the addition of water increased this to 4%, a 75% reduction in emissions could be expected. However, increasing the surface moisture content further to 6% would only result in an additional 5% control.

Notwithstanding the above, it is clear from **Figure 8.2**, that, while returns diminish beyond 75% control, theoretical control efficiencies from the application of water alone may reach up to 95%.

The Air & Waste Management Association Air Pollution Engineering Manual (**Buonicore & Davis, 1992**) provides the following empirical equation to calculate average control efficiencies from watering:

$$C = 100 - \frac{0.8pdt}{i}$$

Where:

C = average control efficiency (%);

p = potential average hourly daytime evaporation rate, millimetres per hour (mm/hr);

d = average hourly daytime traffic (h-1);

i = application intensity (litres per square metre); and

t = time between applications.

Applying this equation demonstrates that 90% control can be achieved through watering by, for example, increasing water above 2 litres per square metre per hour (L/m²/hr). This can be achieved by an increased number of applications in an hour (at the same rate) or increasing the application rate above 2 L/m²/hr.

Assuming conservative high evaporative conditions of 2 mm/hr (summer) and a traffic rate of 30 trucks per hour, Stratford Mining Complex could theoretically achieve over 90% control by having 3 applications per hour at 2 L/m² or 2 applications per hour at 3 L/m².

In instances where a mine is operating under a water surplus (as with the Project [**Gilbert & Associates, 2012]**), the use of water suppression on haul roads may be considered to be both competitive with the use of chemical dust suppressants, and in itself the optimal best practice option for this activity.

SCPL has indicated that the proposed haul road spray system (**Section 7**) would target saturation of the haul surface which should achieve a moisture content of 8% or Moisture Ratio between 4 and 5 (4-5 times as wet as an uncontrolled road) (**PAEHolmes, 2012**). This haul road spray system would be augmented by the use of standard water trucks. It is understood that NSW EPA is rolling out new Pollution Reduction Programs (PRPs) requiring mines to implement best practice and demonstrate site specific haul road control efficiency. SCPL will therefore be required to demonstrate that they can achieve 90% control through watering through this process.

8.4 Consideration of Cumulative Emissions

The DCM is located approximately 20 km south of the Stratford Mining Complex. Air quality impacts from cumulative operations separated by this distance would be negligible. Therefore, the discussion below focuses on the Rocky Hill Coal Project and the AGL Gloucester Gas Project.

8.4.1 Rocky Hill Coal Project

An application for DGRs for the Rocky Hill Coal Project has been submitted to the DP&I. Documentation supporting the application (Gloucester Resources Limited **[GRL], 2012**), is available on their website (http://majorprojects.planning.nsw.gov.au/index.pl? action=view_job&job_id=5156).

The proposed Rocky Hill Coal Project would be located approximately 5 km north of the Stratford Mining Complex and although cumulative air quality impacts are not expected to be significant at this separation distance, emissions from the Rocky Hill Coal Project have been included in the cumulative modelling assessment.

Based on information provided in **GRL (2012),** GRL's proposed timing for development of the Rocky Hill Coal Project is generally consistent with the Projects indicative timing. Therefore, the estimated Rocky Hill Coal Project emissions have been quantitatively included in the cumulative assessment. Detailed information on the operations is not yet available, however estimates of dust emissions have been made based on information presented in **GRL (2012)**.

GRL has developed a conceptual layout of the mine area comprising open cut mining areas with associated CHPP, overland conveyor and rail load-out facility. GRL proposes to mine up to 2.5 Mt of ROM coal per year.

The annual TSP emissions from the Rocky Hill Coal Project have been estimated by multiplying the TSP/ROM ratio for the Project (0.6 kg TSP/tonne ROM) by the maximum ROM mining rate (2.5 Mtpa) to get the annual TSP emission in kg/year.

To simulate mining operations for the Rocky Hill Coal Project, dust emission source locations have been nominated according to the conceptual mine layout, including areas covered by open pit activities, CHPP and rail load-out.

Sources have been considered in three classes covering all dust emission sources for which there are emission factor equations for open cut mines. These classes are as follows:

1. Wind erosion sources where emissions vary with the hourly average wind speed according to the cube of the wind speed.
2. Loading and dumping operations where emissions vary with wind speed raised to the power of 1.3.
3. All other sources where emissions are assumed to be independent of wind speed.

The proportions of emissions in each of these categories have been assumed based on the same ratios estimated for the Project, as follows:

- 0.85 for emissions independent of wind speed;
- 0.02 for emissions that depend on wind speed (such as loading and dumping); and
- 0.1 for wind erosion sources.

8.4.2 AGL Gloucester Gas Project

The AGL Gloucester Gas Project was approved in February 2011 (Project Approval 08_0154) and includes:

- gas-producing wells and associated infrastructure;
- a gas compression and treatment facility (two alternate locations near Stratford), known as the Central Processing Facility (CPF);
- a high-pressure gas pipeline from Stratford to Hexham; and
- a delivery station at Hexham.

Potential dust emissions would occur during site construction, which is anticipated to take approximately 18 months. Impacts during construction would be small in scale and temporary in nature, and would be controlled using commonly applied dust management measures. During operations, emissions to air would include emissions from small scale power generation and flaring.

Modelling predictions presented in the Air Quality Assessment (**AECOM, 2009**) indicate that the maximum 24-hour PM_{10} impacts from the CPF would be less than 1 µg/m^3 at all receiver locations. Particle emissions from the operation of the flare, which would occur temporarily for up to four weeks following commissioning of a well, are also presented in the AECOM Air Quality Assessment. The assessment states that 24 hour PM_{10} ground level concentrations from flaring operations would be approximately 10 µg/m^3 at the source, with these concentrations decreasing rapidly with distance from the source. However, the results presented would overestimate the impacts from the flaring as set out below.

The flare was modelled by AECOM as a volume source, which is likely to significantly underestimate thermal plume rise (typically modelled as a point source at 1,000^{o}C) and therefore overestimate ground level concentrations. Also, AECOM estimated emissions rates using an emission estimation technique for combustion engines. This is likely to significantly over estimate emission rates and associated impacts. If operated efficiently, the creation of smoke or soot particles from the flare should be minor. Furthermore, the flare would only operate well during start up and emergencies. Only a small pilot flare would operate during normal operations.

Notwithstanding, when conservatively considering the modelling predictions for the flare (**AECOM, 2009**), concentrations decrease rapidly with distance from flare and at 200 m (distance to closest receiver) the concentrations would be within air quality limits (when considered cumulatively).

On this basis, the cumulative impacts associated with the operation of the AGL Gloucester Gas Project are not considered further.

9 IMPACT ASSESSMENT

Dispersion model predictions have been made for Years 2, 6 and 10 of Project mining operations. Contour plots of particulate concentrations and deposition levels show the areas that are predicted to be affected by dust at different levels. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths it is necessary to make interpolations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

The actual predicted particulate concentrations/levels at nearby receivers are presented in tabular form, with those that are predicted to experience levels above the EPA's impact assessment criteria highlighted in bold.

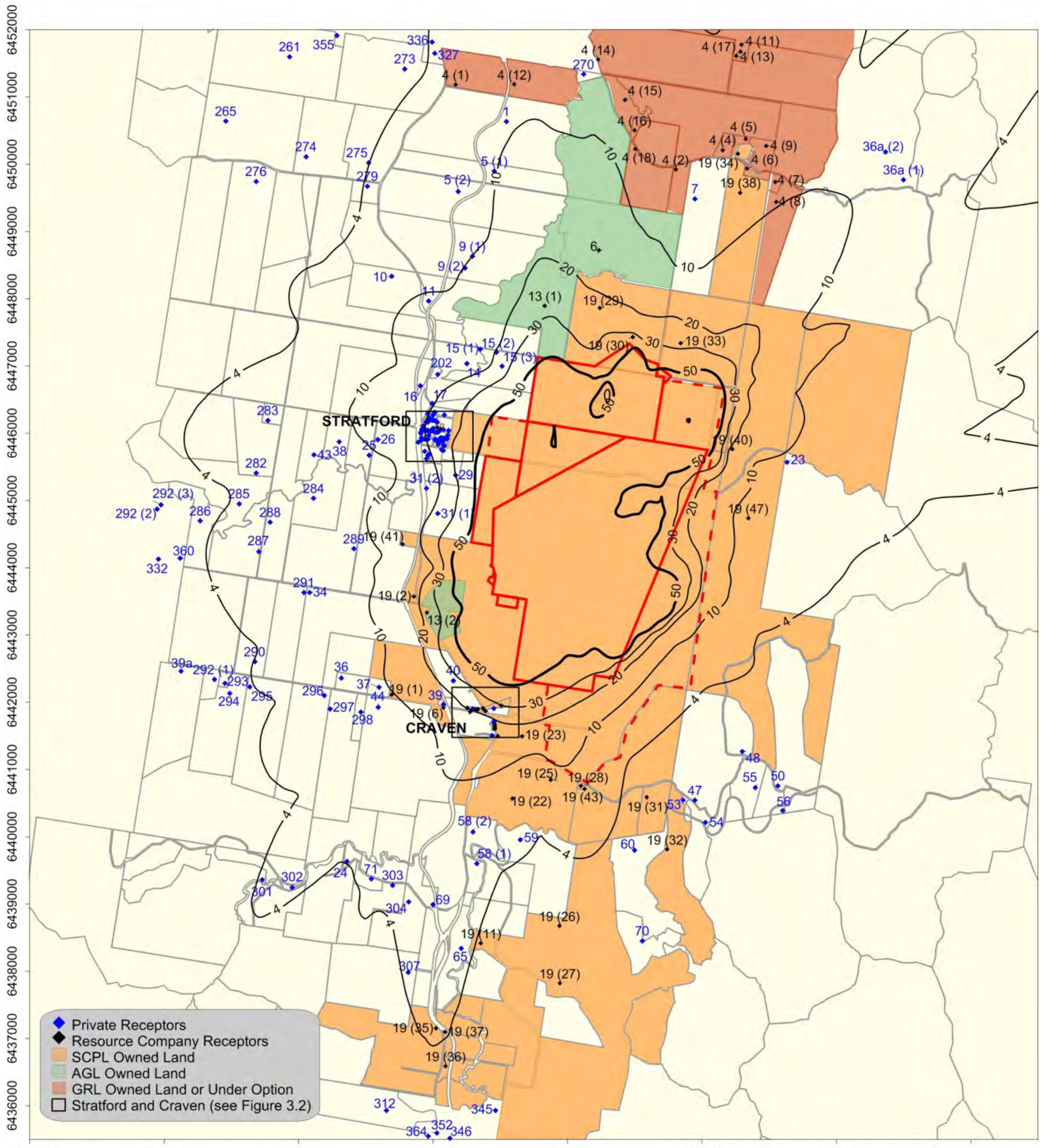
9.1 Project-only 24-hour Average PM_{10}

Figure 9.1 to **Figure 9.3** present contour plots for the predicted maximum 24-hour PM_{10} concentrations for the Project-only for each modelled scenario. The isopleth for the 24-hour average criterion of 50 µg/m^3 is bolded.

The 24-hour PM_{10} contours presented in **Figure 9.1** to **Figure 9.3** do not represent a single worst case day, but rather represent the potential worst case 24-hour PM_{10} concentration that could be reached at any particular location across the entire modelling year.

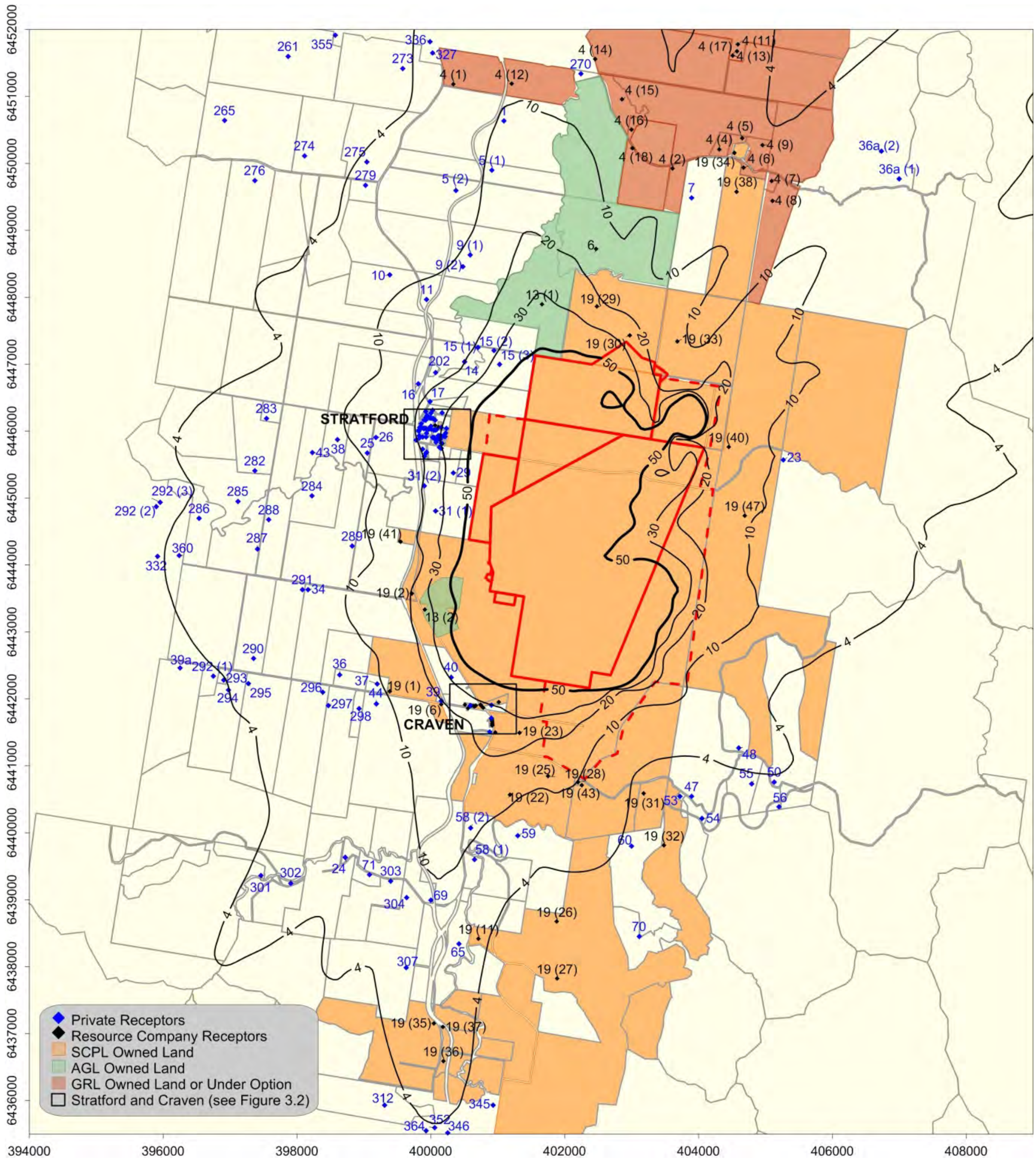
9.2 Summary of 24-hour average PM_{10} Results at Individual Receivers

A summary of the predicted particulate concentrations at each of the individual receivers is provided in **Table 9.1**. There are no privately owned receivers that are predicted to experience 24-hour average PM_{10} concentrations above the assessment criteria, due to emissions from the Project-only.



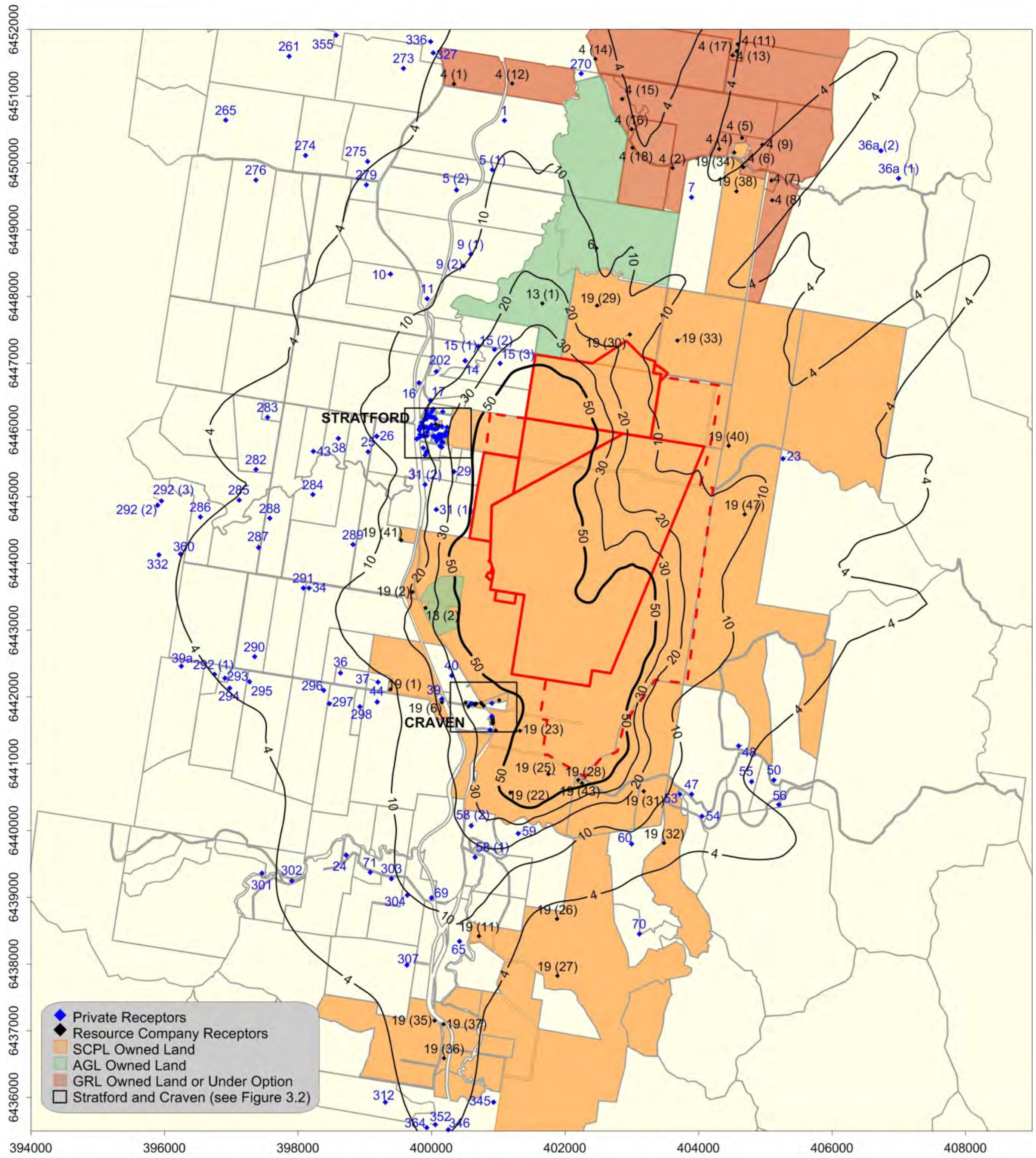
Species: PM_{10}	**Location:** Stratford	**Scenario:** Year 2	**Percentile:** Maximum	**Averaging Time:** 24-Hour
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Guideline:** 50 µg/m³	**Met Data:** CALMET	**Plot:** R. Kellaghan

Figure 9.1: Predicted Maximum 24-hour PM_{10} Concentration Project-Only –Year 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Stratford	Year 6	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m³	50 µg/m³	CALMET	R. Kellaghan

Figure 9.2: Predicted Maximum 24-hour PM_{10} Concentration Project-Only –Year 6



Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Stratford	Year 10	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	50 µg/m^3	CALMET	R. Kellaghan

Figure 9.3: Predicted Maximum 24-hour PM_{10} Concentration Project-Only –Year 10

Table 9.1: Maximum Predicted Project-only 24-hour Average PM_{10} Concentrations (µg/m³)

Receiver ID (refer Figures 9.1 to 9.3)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average PM_{10} (µg/m³)		
	Assessment criteria = 50 µg/m³		
Privately-owned Receivers			
1	9	11	8
5 (1)	10	11	10
5 (2)	7	7	6
7	6	7	4
9 (1)	10	11	10
9 (2)	10	11	10
10	7	8	6
11	11	13	9
14	16	20	18
15 (1)	17	21	20
15 (2)	20	28	27
15 (3)	24	36	35
16	16	16	14
17	20	22	20
23	10	10	9
24	4	5	6
25	9	11	9
26	11	13	11
27	21	23	21
29	31	36	32
31 (1)	22	26	24
31 (2)	16	21	18
34	7	8	8
36	6	6	7
36a (1)	8	7	2
36a (2)	9	7	2
37	9	9	9
38	8	9	8
39	15	20	22
39a	3	4	4
40	26	31	29
42	26	29	40
43	7	7	6
44	8	8	8
47	2	3	8
48	2	5	5
50	1	4	3
53	2	3	9
54	2	3	7
55	1	3	4
56	1	3	4
58 (1)	6	9	17
58 (2)	7	11	23
59	5	7	25
60	3	4	8
65	5	7	9
69	6	9	11
70	2	2	3
71	4	6	7
202	16	16	15
261	2	2	2
265	2	2	2
270	8	7	6
273	4	4	3
274	3	3	3
275	4	4	4
276	3	3	3
279	4	4	4
281	18	21	18
282	5	5	4
283	6	6	5
284	6	7	5
285	4	5	4
286	4	4	4
287	5	6	5
288	5	6	5
289	7	8	8
290	4	5	5

Receiver ID (refer Figures 9.1 to 9.3)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average PM_{10} ($\mu g/m^3$)		
	Assessment criteria = 50 $\mu g/m^3$		
291	6	8	8
292 (1)	3	4	4
292 (2)	3	4	3
292 (3)	3	4	3
293	3	4	4
294	4	4	4
295	4	5	5
296	6	6	6
297	6	6	5
298	7	7	6
301	4	4	4
302	4	5	4
303	5	7	9
304	5	8	10
307	4	6	6
316	17	20	17
327	4	5	4
332	3	4	4
336	4	5	4
355	3	3	2
360	4	4	4
Cr.2	20	25	33
Cr.7	19	23	39
S1	22	24	22
S3	25	28	25
S4	20	22	20
S5	21	23	21
S6	20	23	21
S8	21	24	22
S9	22	24	22
S10	22	24	22
S11	22	25	22
S12	23	26	23
S13	24	27	24
S14	20	22	20
S15	22	25	23
S18	26	30	27
S19	28	32	29
S20	19	21	19
S21	18	21	18
S23	19	22	19
S24	20	23	20
S25	21	23	21
S26	21	23	21
S27	21	24	22
S28	22	25	22
S29	23	25	23
S30	24	27	24
S31	24	27	24
S33	25	28	25
S34	26	29	26
S35	26	30	27
S36	27	30	27
S37	27	31	28
S38	28	32	28
S39 (1)	29	32	29
S39 (2)	29	32	29
S40	18	21	18
S41	19	22	19
S43	20	23	21
S47	23	26	23
S48	24	27	24
S49	24	27	24
S50	24	28	25
S51	25	29	26
S52	26	30	26
S53	27	30	27
S54	27	30	27
S56	18	21	18
S57	19	22	19

Receiver ID (refer Figures 9.1 to 9.3)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average PM_{10} ($\mu g/m^3$)		
	Assessment criteria = 50 $\mu g/m^3$		
S58	19	22	19
S59	17	20	18
Resource Company-owned Receivers[1]			
4 (1)	5	6	5
4 (2)	6	8	7
4 (3)	5	7	5
4 (4)	5	6	4
4 (5)	6	5	3
4 (6)	7	5	4
4 (7)	7	7	6
4 (8)	9	8	6
4 (9)	7	4	4
4 (11)	4	6	4
4 (12)	8	9	7
4 (13)	4	6	4
4 (14)	7	6	5
4 (15)	8	6	4
4 (16)	8	5	4
4 (17)	4	6	4
4 (18)	8	5	4
6	16	15	10
13 (1)	28	33	24
13 (2)	23	19	25
19 (1)	10	33	9
19 (2)	18	10	21
19 (4)	24	26	24
19 (5)	25	27	26
19 (6)	14	29	22
19 (7)	27	19	28
19 (8)	19	31	32
19 (9)	20	24	35
19 (10)	20	26	35
19 (11)	4	26	7
19 (12)	22	5	37
19 (13)	22	28	37
19 (14)	22	27	37
19 (15)	19	27	39
19 (16)	18	23	39
19 (17)	17	23	38
19 (18)	16	23	37
19 (19)	16	23	37
19 (20)	18	23	38
19 (21)	14	23	39
19 (22)	7	23	59
19 (23)	15	12	54
19 (25)	8	183	119
19 (26)	2	12	3
19 (27)	1	2	2
19 (28)	8	2	68
19 (29)	23	10	14
19 (30)	31	23	17
19 (31)	3	24	15
19 (32)	2	3	6
19 (33)	28	3	7
19 (34)	6	5	4
19 (35)	4	6	7
19 (36)	4	5	6
19 (37)	4	6	7
19 (38)	7	5	6
19 (39)	20	26	35
19 (40)	18	15	7
19 (41)	15	15	13
19 (42)	30	33	43
19 (43)	7	9	55
19 (45)	20	25	31
19 (46)	20	25	34
19 (47)	8	11	12

1 Denotes those receivers owned by SCPL, GRL or AGL.

9.3 Cumulative 24-hour average PM_{10} Impacts

9.3.1 Introduction

The EPA describes two methods for assessing cumulative air quality effects (see Section 11.2 of [**DEC, 2005**]).

- A Level 1 assessment (suitable for a screening assessment) requires the highest predicted concentration from the proposal be added to the highest observed concentration in a data set which provides measurements of PM_{10} concentrations representative of conditions at the site being assessed. If this results in exceedances of the PM_{10} impact assessment criteria, a Level 2 assessment is required.
- A Level 2 assessment provides a more rigorous approach when background levels are elevated and requires (1) that the highest ten observed 24-hour PM_{10} concentrations (below criteria) are added to the predicted concentrations for the same days; and (2) the ten highest predicted 24-hour PM_{10} concentrations are added to the observed concentrations for the same days.

Both the Level 1 and Level 2 assessments require continuous background ambient monitoring data. The Level 2 assessment works well when there are ambient monitoring data available for each day that coincide with the period of time of predicted impacts, and the data are representative of the site being assessed.

At the time of writing, there are no available continuous 24-hour PM_{10} data for the area. HVAS data are available every sixth day, however, this is insufficient to provide a representative background for each day of the model simulation. The closest available continuous 24-hour PM_{10} data are measured approximately 100 km to the southwest (Beresfield). The monitor at Beresfield is less than 20 km from the Newcastle central business district. It is therefore in a very different air quality environment from that which applies near the Stratford Mining Complex and therefore the data are not useful in estimating background air quality in the Project area.

Therefore, an alternative statistical approach (using a Monte Carlo Simulation) is presented, to achieve the objectives of a Level 2 Assessment. The cumulative assessment focuses on representative receivers in key areas in the vicinity of the mine. Three locations are selected to provide an indication of worst case cumulative 24-hour PM_{10} concentrations, as follows:

- location representative of Stratford village – receiver S38 (**Figure 3.2**);
- location representative of Craven village – receiver 19 (42) (**Figure 3.2**); and
- location of highest 24-hour PM_{10} prediction – receiver 15 (**Figure 3.1**).

9.3.2 Level 2 Assessment Based on Monte Carlo Simulation

The Monte Carlo Simulation is a modelling approach that uses the statistical properties of a variable (in this case background 24-hour PM_{10} concentrations) and generates individual values that are taken randomly from the statistical distribution of the real data.

There were 616 daily values of PM_{10} concentration available from the HVD1 (Stratford) monitor, 629 daily values of PM_{10} concentration available from the HVD2 (Craven) monitor, and 183 daily values of PM_{10} concentration available from the HVD5 (Cassar) monitor. There were three data points removed from each dataset which corresponded to days where there was a dust storm or significant smoke in the valley.

All available 24-hour average PM_{10} monitoring data collected for each site were used to generate a random daily background 24-hour PM_{10}. A different background 24-hour PM_{10} value is randomly selected from the background dataset each time the simulation is run.

The process assumes that a randomly selected background value from the real dataset would have a chance equal to that of any other background value from the dataset of occurring on the given 'model day'. Over sufficient time this would yield a good statistical estimate of the combined and independent effects of varying background and Project contributions to total PM_{10}.

It is noted that the monitoring data provide a conservatively high indication of background for the receivers, given that the data include contributions from current mining operations (these contributors are estimated in **Section 5.4**).

The randomly chosen background 24-hour average PM_{10} data for each site have been paired with the modelling predictions made at the corresponding site, as follows:

- Modelling prediction for Stratford village (receiver S38) paired with HVD1 – Stratford;
- Modelling prediction for Craven village (receiver 41) paired with HVD2 – Craven;
- Modelling prediction for highest prediction (receiver 15) paired with HVD5 – Cassar;

Modelled PM_{10} concentrations due to Project at the selected receivers were analysed for one year (the 'model year'). The modelling predictions chosen were the Project year with the worst case predicted impact (Year 6 for Stratford and Cassar; Year 10 for Craven) and included modelled contributions from the proposed Rocky Hill Coal Project. Analysis of model predictions for receivers located between the Project and the Rocky Hill Coal Project shows that the maximum 24-hour PM_{10} predictions for these two sources do not occur on the same day. For example, on the day when receiver 7 (**Figure 3.1**) is predicted to receive a maximum Project PM_{10} concentration of 7 $\mu g/m^3$, the Rocky Hill Coal Project contribution is zero; whilst the on the day when receiver 7 is predicted to receive a maximum Rocky Hill Coal Project PM_{10} concentration of 22 $\mu g/m^3$, the Project contribution is zero. This is because the Project maximum contribution is under prevailing southerly wind conditions, whilst the Rocky Hill Coal Project maximum contribution is under generally northerly wind conditions. As it is unlikely that northerlies and southerlies would occur at the same time, the potential for significant 24 hour PM_{10} contributions from both projects at receivers located between the Project and the Rocky Hill Coal Project is considered to be low.

In addition, the Project would not be a significant contributor to 24-hour PM_{10} emissions at receivers to the north of the Rocky Hill Coal Project because of the distance between the source and the receivers. Similarly, the Rocky Hill Coal Project is unlikely to be a significant contributor of emissions to the south of the Project.

To generate greater confidence in the statistical robustness of the results, the Monte Carlo Simulation was repeated ten times. In other words, the same 1-year set of predicted (modelled) 24-hour PM_{10} concentrations due to Project were added to 10 variations of the randomly selected background concentrations at each representative receiver (i.e. a different random background concentration is selected each time).

The results of this analysis are presented graphically in **Figure 9.4** to **Figure 9.6**. The plots show the statistical probability of 24-hour PM_{10} concentrations being above a particular value for a given year and compare 'B*ackground Only'* probability with the *'Mine plus Background'* probability.

At all sites, the statistics indicate some probability of days per year with PM_{10} concentrations above 50 µg/m³. This is the case for both '*Background Only*' (because the background data already has values above this level) and the '*Mine plus Background*'.

At all sites there is a slightly increased probability of exceeding 50 µg/m³ when the project is added, noting that the probability of exceedance remains very low (less than or close to 1% at the locations analysed). It is noted that the actual number of exceedances per year cannot be predicted precisely and would depend on actual Project activities, weather conditions, implementation of real-time controls and predictive meteorological forecasting, and background levels in the future.

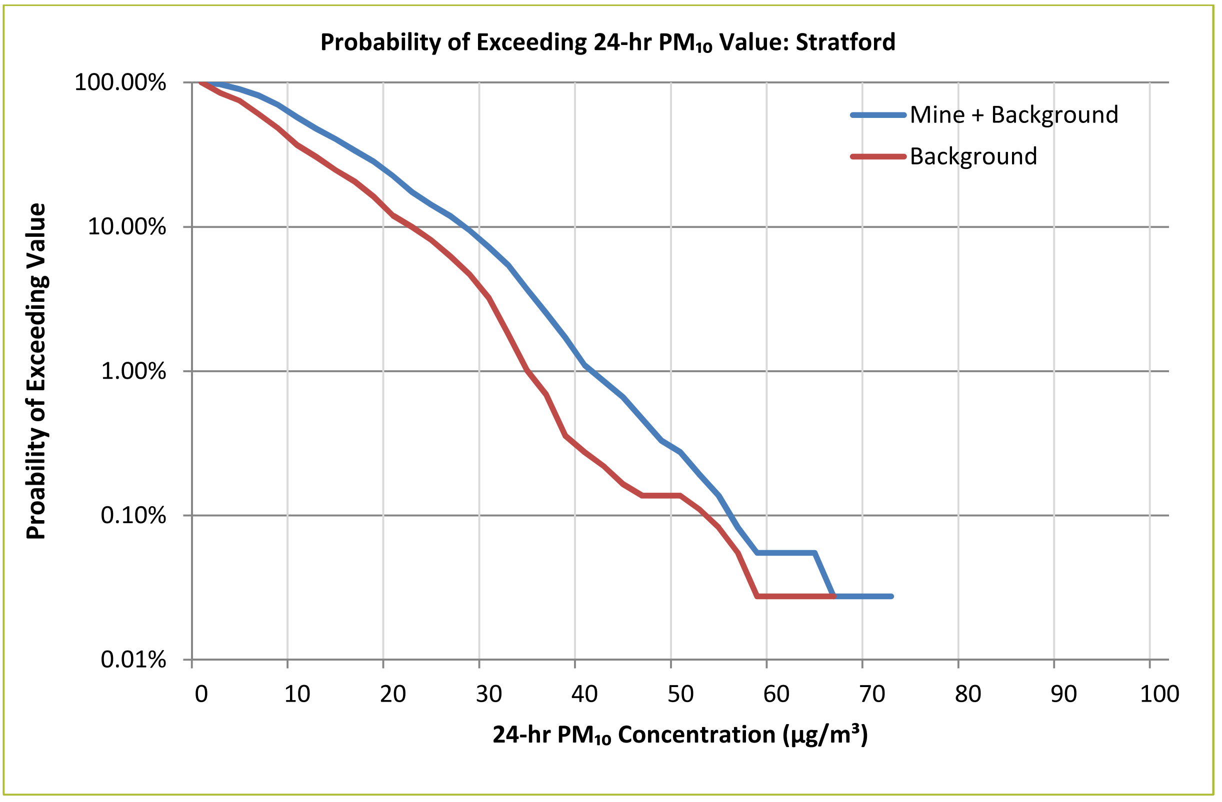


Figure 9.4: Year 6 – Receiver S38 – Probability Distribution of 24-hr PM_{10} concentration (µg/m³)

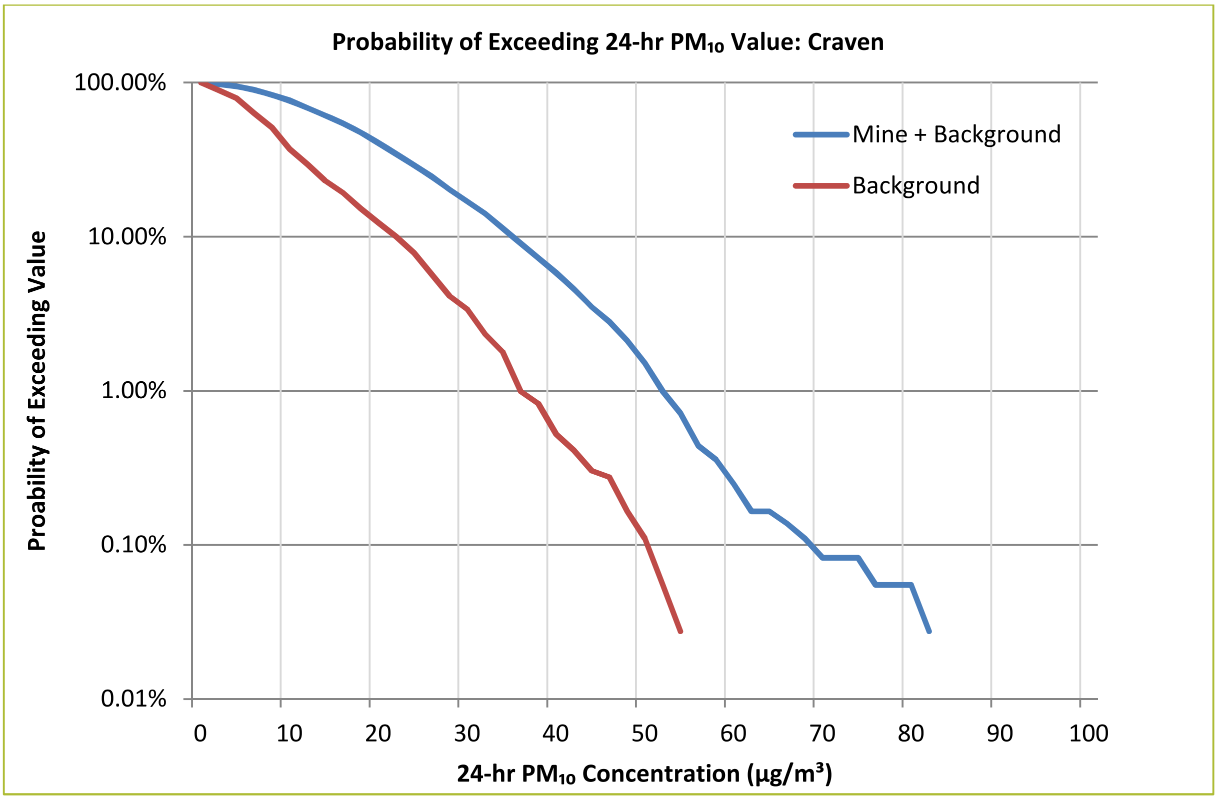


Figure 9.5: Year 10 – Receiver 19 (42) – Probability Distribution of 24-hr PM_{10} concentration (μg/m^3)

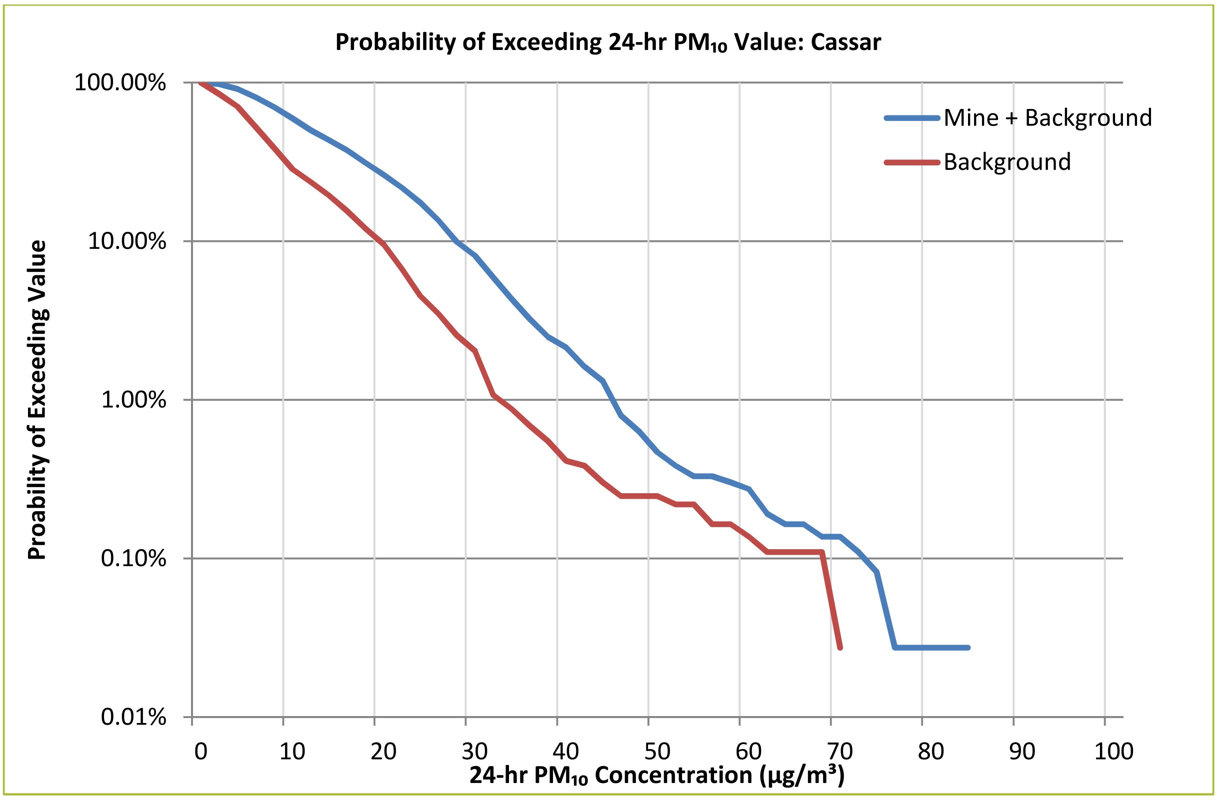


Figure 9.6: Year 6 – Receiver 15 – Probability Distribution of 24-hr PM_{10} concentration (μg/m^3)

Table 9.2 presents the probability statistics in tabular form, for current (background) and future (Project plus background). The table also shows the number of days expected to exceed the criterion.

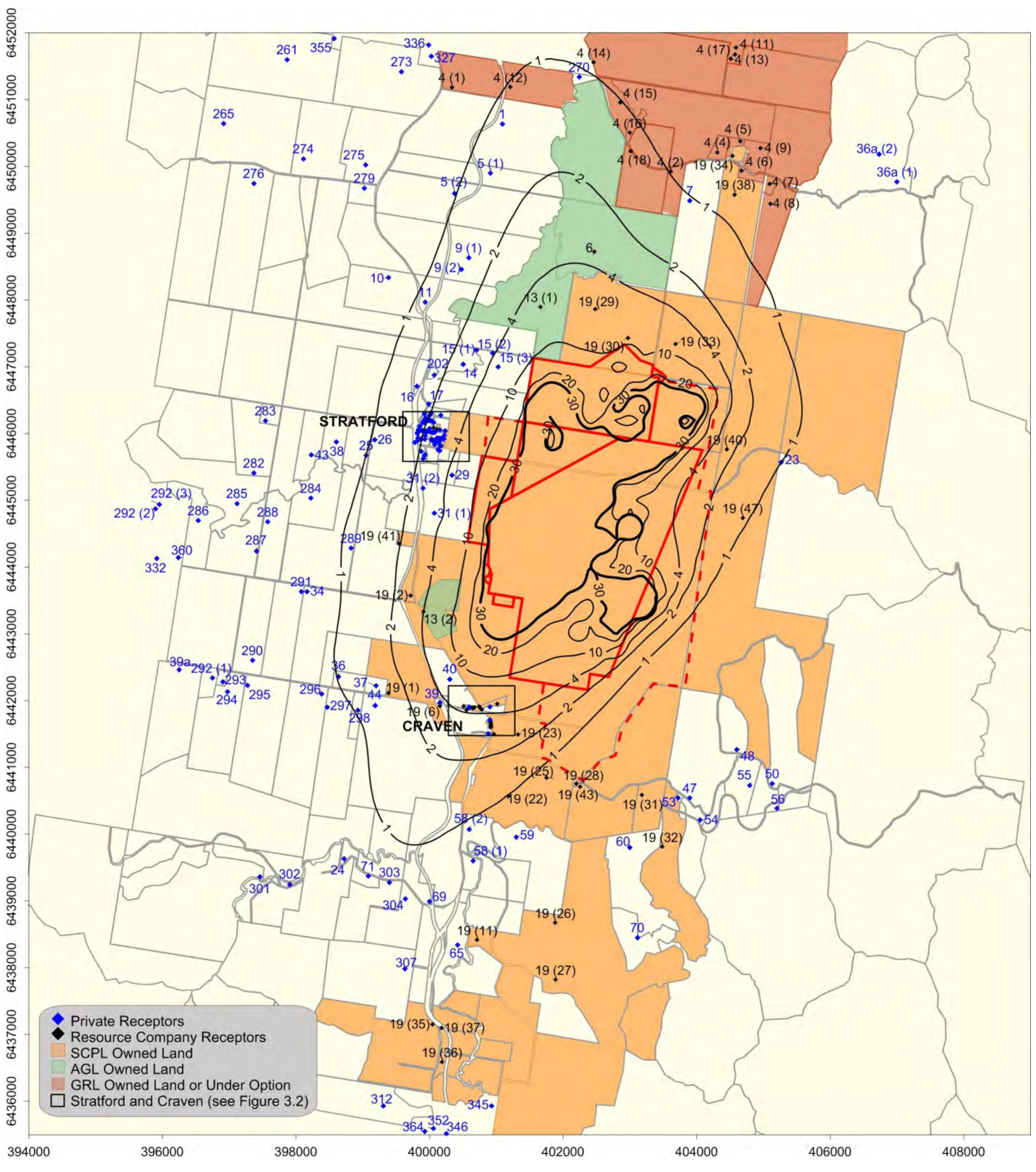
Table 9.2: Probability of exceeding the 24-hour average PM_{10} criterion

Location	Current probability of exceeding the 24-hour average PM_{10} criterion (%) and number of days/year	Future probability of exceeding the 24-hour average PM_{10} criterion (%) and number of days/year
Stratford	0.17% (0.6 days/year)	0.27% (0.9 days/year)
Craven	0.14% (0.5 days/year)	1.5% (5.4 days/year)
Cassar	0.23% (0.8 days/year)	0.8% (2.9 days/year)

In consideration of the potential increase in exceedances, it is relevant to note that the background contributions in the current probabilities include the existing Stratford Mining Complex operations, therefore the future probabilities include an element of double counting. In consideration of the potential increase in probability of exceeding the average 24 hour criterion in Craven, it is recommended that a real-time air quality monitor be installed in Craven as discussed in **Section 7.1**.

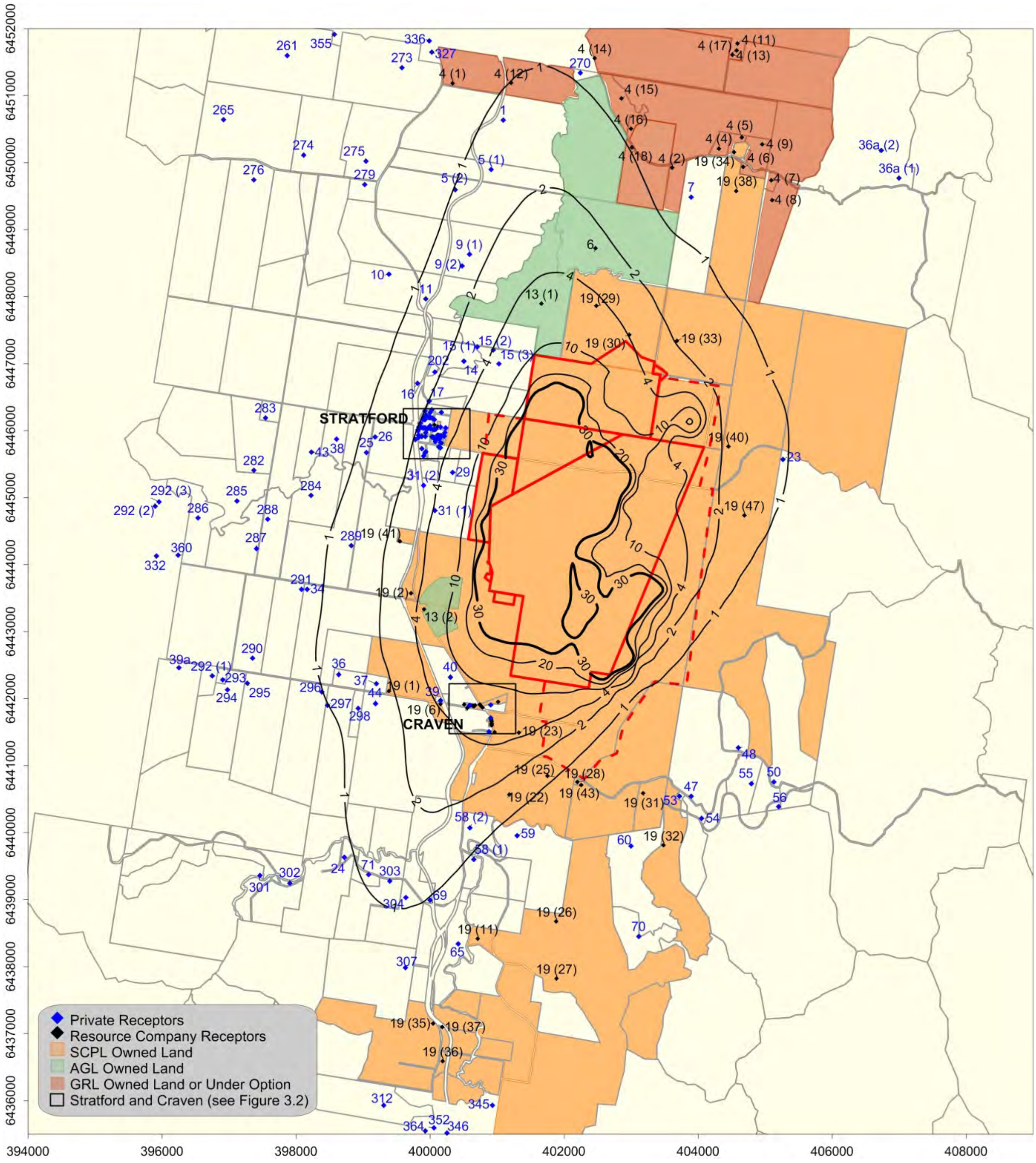
9.4 Project Only Annual Average PM_{10}

The Project-only contributions to annual average PM_{10} concentrations are presented in **Figure 9.7** to **Figure 9.9** for each modelled year.



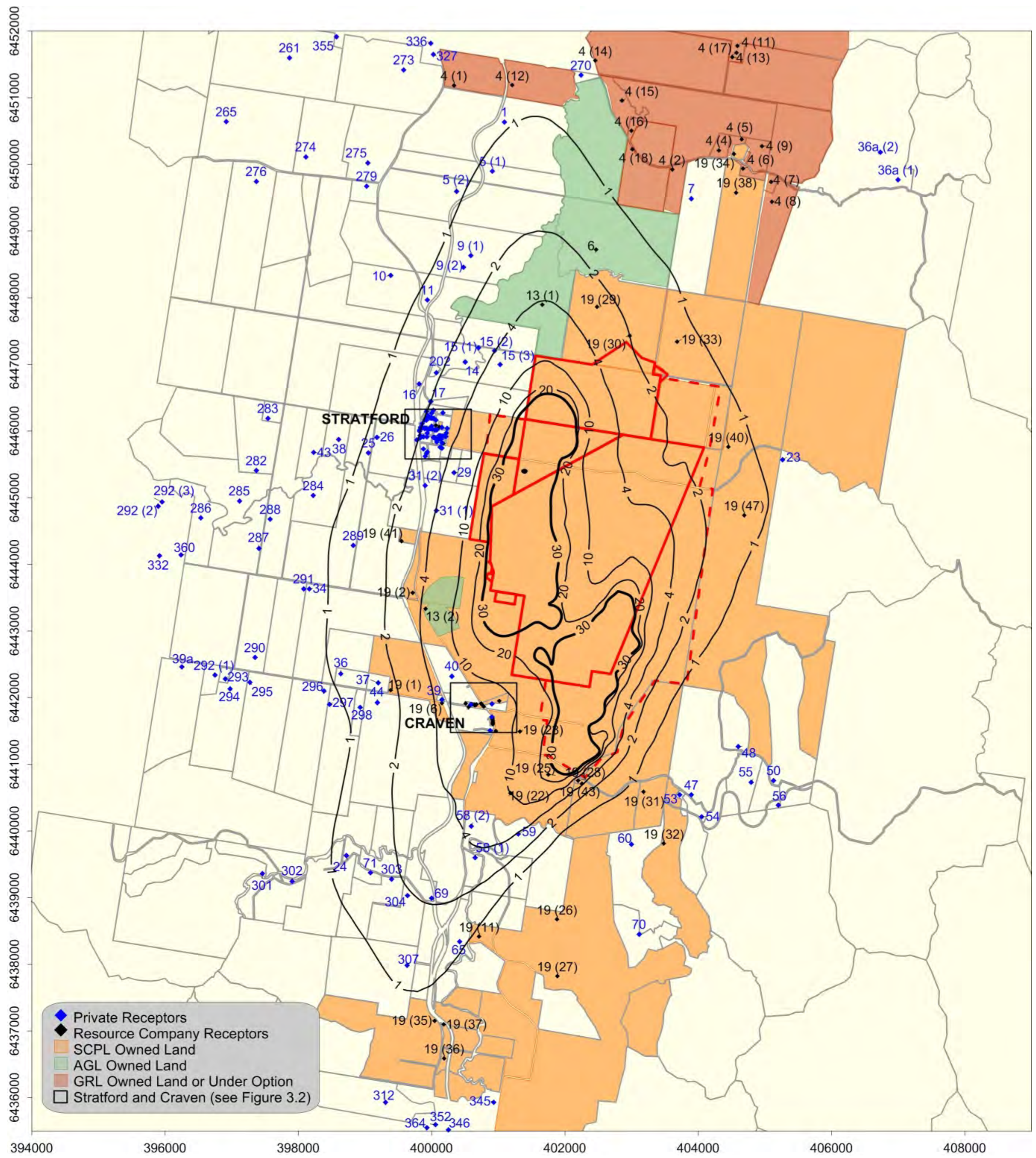
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Stratford	Year 2	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	30 µg/m^3	CALMET	R. Kellaghan

Figure 9.7: Predicted Annual Average PM_{10} Concentration Project-Only –Year 2



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Stratford	Year 6	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	30 µg/m^3	CALMET	R. Kellaghan

Figure 9.8: Predicted Annual Average PM_{10} Concentration Project-Only –Year 6



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Stratford	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	30 µg/m^3	CALMET	R. Kellaghan

Figure 9.9: Predicted Annual Average PM_{10} Concentration Project-Only –Year 10

9.5 Summary of Project-only and Cumulative Annual Average PM_{10} Results at Individual Receivers

A summary of the predicted PM_{10} concentrations at each of the individual receivers is provided in **Table 9.3**.

There are no privately owned receivers that are predicted to experience annual average PM_{10} concentrations above the assessment criteria, due to emissions from the Project-only. Similarly, there are no privately owned receivers that are predicted to exceed the assessment criteria when including background concentrations (**Section 5.5**) or cumulative sources.

Note: Cumulative values in **Table 9.3** include background concentrations and model predictions from the Rocky Hill Coal Project.

Table 9.3: Annual Average PM_{10} Concentrations (µg/m³)

Receiver ID (refer Figures 9.7 to 9.9)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average PM_{10} (µg/m³)					
	Assessment criteria = 30 µg/m³					
Privately-owned Receivers						
1	1	1	1	12	12	12
5 (1)	1	1	1	12	12	12
5 (2)	1	1	1	10	10	10
7	1	1	1	11	10	10
9 (1)	1	2	1	11	11	10
9 (2)	1	2	1	10	10	10
10	1	1	1	9	10	9
11	1	1	1	10	10	10
14	2	3	3	11	11	11
15 (1)	3	3	3	11	11	11
15 (2)	4	4	4	12	12	12
15 (3)	5	5	5	13	14	14
16	1	2	2	10	10	10
17	2	2	2	10	10	10
23	1	1	1	9	9	9
24	1	1	1	9	9	9
25	1	1	1	9	9	9
26	1	1	1	9	10	9
27	2	2	2	10	10	10
29	6	5	5	13	14	13
31 (1)	3	4	4	12	12	12
31 (2)	3	3	3	11	11	11
34	1	1	1	9	9	9
36	1	1	1	9	9	9
36a (1)	0	0	0	9	9	9
36a (2)	0	0	0	9	9	9
37	1	2	2	9	10	10
38	1	1	1	9	9	9
39	4	4	5	12	13	13
39a	0	0	0	9	9	9
40	6	7	7	14	15	15
42	5	6	8	13	15	16
43	1	1	1	9	9	9
44	1	1	1	9	10	10
47	0	0	0	8	8	8
48	0	0	0	8	8	8
50	0	0	0	8	8	8
53	0	0	0	8	8	8
54	0	0	0	8	8	8
55	0	0	0	8	8	8
56	0	0	0	8	8	8
58 (1)	1	1	3	9	9	12
58 (2)	1	1	4	9	9	13
59	1	1	4	9	9	12
60	0	0	0	8	8	8
65	0	1	1	8	9	9

Receiver ID (refer Figures 9.7 to 9.9)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average PM_{10} ($\mu g/m^3$)					
	Assessment criteria = 30 $\mu g/m^3$					
69	1	1	2	9	9	10
70	0	0	0	8	8	8
71	1	1	1	9	9	10
202	2	2	2	10	10	10
261	0	0	0	9	9	9
265	0	0	0	8	8	8
270	1	1	1	28	28	28
273	0	0	0	9	9	9
274	0	0	0	9	9	9
275	0	0	0	9	9	9
276	0	0	0	9	9	9
279	0	0	0	9	9	9
281	2	2	2	10	10	10
282	0	0	0	9	9	9
283	0	0	0	9	9	9
284	1	1	1	9	9	9
285	0	0	0	9	9	9
286	0	0	0	9	9	9
287	0	1	1	9	9	9
288	0	1	1	9	9	9
289	1	1	1	9	10	10
290	1	1	1	9	9	9
291	1	1	1	9	9	9
292 (1)	0	1	1	9	9	9
292 (2)	0	0	0	9	9	9
292 (3)	0	0	0	9	9	9
293	0	1	1	9	9	9
294	1	1	1	9	9	9
295	1	1	1	9	9	9
296	1	1	1	9	9	9
297	1	1	1	9	9	9
298	1	1	1	9	9	9
301	0	1	1	9	9	9
302	0	1	1	9	9	9
303	1	1	2	9	9	10
304	1	1	2	9	9	10
307	0	1	1	9	9	9
316	2	2	2	10	10	10
327	1	1	0	9	9	9
332	0	0	0	9	9	9
336	1	1	0	9	9	9
355	0	0	0	9	9	9
360	0	0	0	9	9	9
Cr.2	4	6	7	13	14	15
Cr.7	4	5	8	12	13	16
S1	2	2	2	10	11	11
S3	2	3	3	11	11	11
S4	2	2	2	10	10	10
S5	2	2	2	10	10	10
S6	2	2	2	10	10	10
S8	2	2	2	10	11	11
S9	2	2	2	10	11	11
S10	2	2	2	10	11	11
S11	2	2	2	10	11	11
S12	2	2	2	10	11	11
S13	2	2	2	11	11	11
S14	2	2	2	10	10	10
S15	2	2	2	10	11	11
S18	3	3	3	11	11	11
S19	3	3	3	11	12	11
S20	2	2	2	10	10	10
S21	2	2	2	10	10	10
S23	2	2	2	10	10	10
S24	2	2	2	10	11	10
S25	2	2	2	10	11	11
S26	2	2	2	10	11	11
S27	2	2	2	10	11	11
S28	2	2	2	10	11	11

Receiver ID (refer Figures 9.7 to 9.9)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average PM_{10} ($\mu g/m^3$)					
	Assessment criteria = 30 $\mu g/m^3$					
S29	2	2	2	11	11	11
S30	2	3	3	11	11	11
S31	2	3	3	11	11	11
S33	2	3	3	11	11	11
S34	3	3	3	11	11	11
S35	3	3	3	11	11	11
S36	3	3	3	11	11	11
S37	3	3	3	11	11	11
S38	3	3	3	11	12	11
S39 (1)	3	3	3	11	12	12
S39 (2)	3	3	3	11	12	12
S40	2	2	2	10	10	10
S41	2	2	2	10	11	10
S43	2	2	2	10	11	11
S47	2	3	3	11	11	11
S48	2	3	3	11	11	11
S49	3	3	3	11	11	11
S50	3	3	3	11	11	11
S51	3	3	3	11	11	11
S52	3	3	3	11	11	11
S53	3	3	3	11	11	11
S54	3	3	3	11	12	11
S56	2	2	2	10	11	11
S57	2	3	3	11	11	11
S58	2	3	3	11	11	11
S59	2	3	2	10	11	11
Resource Company-owned Receivers[1]						
4 (1)	1	1	1	10	10	10
4 (2)	1	1	1	14	14	14
4 (3)	1	1	1	17	17	17
4 (4)	1	1	0	15	14	14
4 (5)	1	1	0	14	14	14
4 (6)	1	1	0	11	11	11
4 (7)	1	1	0	10	10	9
4 (8)	1	1	0	9	9	9
4 (9)	1	1	0	11	11	11
4 (11)	0	0	0	38	38	38
4 (12)	1	1	1	13	13	13
4 (13)	0	0	0	43	43	43
4 (14)	1	1	1	35	35	35
4 (15)	1	1	1	46	46	45
4 (16)	1	1	1	34	34	34
4 (17)	0	0	0	38	38	38
4 (18)	1	1	1	22	22	21
6	3	3	2	12	11	10
13 (1)	5	5	4	14	14	13
13 (2)	4	5	4	12	13	13
19 (1)	2	2	2	10	10	10
19 (2)	3	3	3	11	11	11
19 (4)	2	3	3	11	11	11
19 (5)	3	3	3	11	11	11
19 (6)	3	4	5	11	12	13
19 (7)	3	3	3	11	12	12
19 (8)	4	5	6	12	14	15
19 (9)	4	6	7	13	14	15
19 (10)	5	6	7	13	14	15
19 (11)	0	0	1	8	9	9
19 (12)	5	6	7	13	14	15
19 (13)	4	6	7	13	14	15
19 (14)	4	6	7	12	14	15
19 (15)	3	5	8	12	13	16
19 (16)	3	5	8	11	13	16
19 (17)	3	5	8	11	13	16
19 (18)	3	5	8	11	13	16
19 (19)	3	5	8	11	13	16
19 (20)	3	5	8	11	13	16
19 (21)	3	5	8	11	13	16
19 (22)	1	1	10	9	9	18

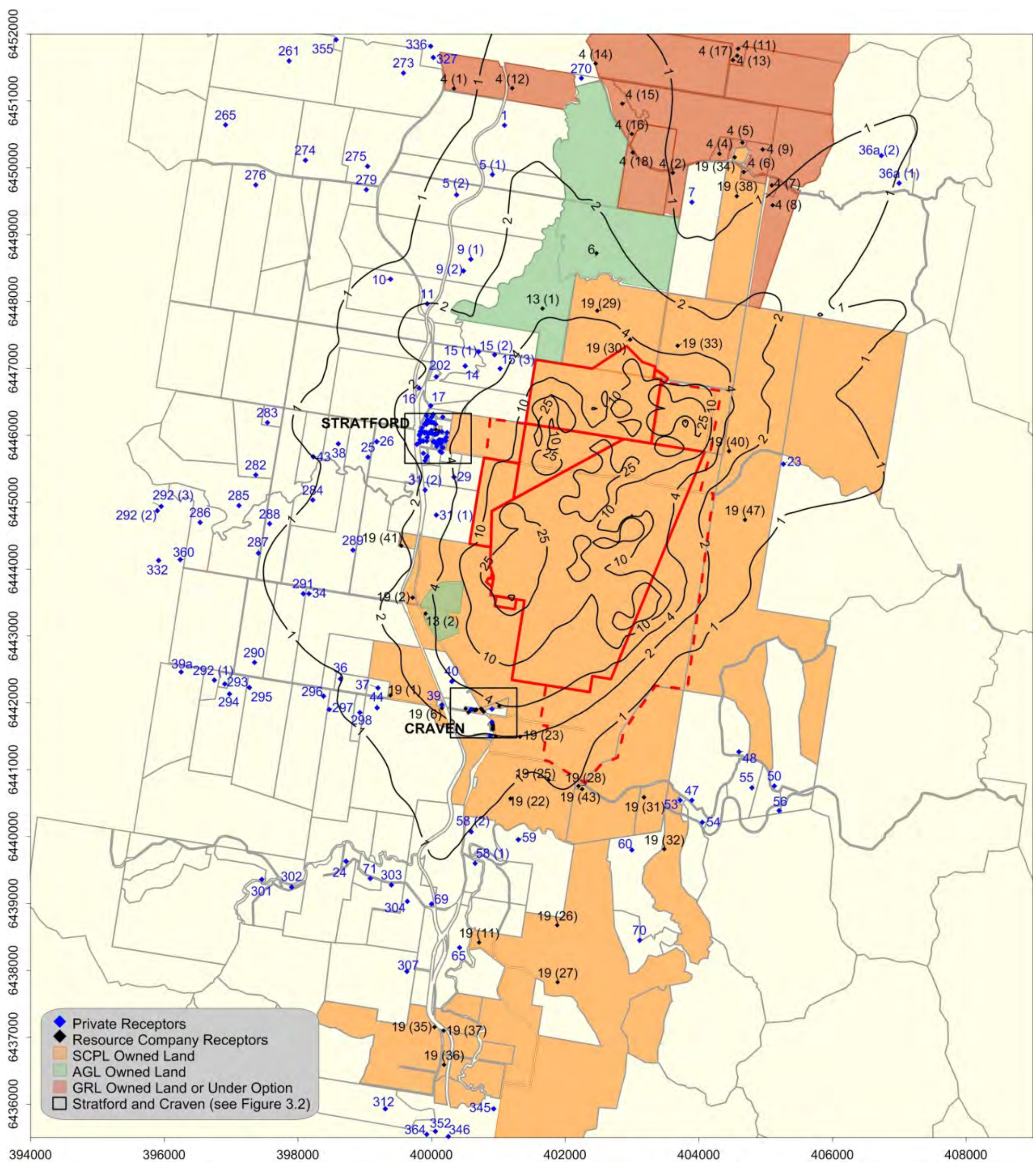
Receiver ID (refer Figures 9.7 to 9.9)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average PM_{10} (µg/m³)					
	Assessment criteria = 30 µg/m³					
19 (23)	2	4	11	11	13	19
19 (25)	1	1	25	9	9	33
19 (26)	0	0	0	8	8	8
19 (27)	0	0	0	8	8	8
19 (28)	1	1	6	9	9	14
19 (29)	6	5	3	14	13	11
19 (30)	9	4	2	17	12	10
19 (31)	0	0	1	8	8	9
19 (32)	0	0	0	8	8	8
19 (33)	8	2	1	16	10	9
19 (34)	1	1	0	13	12	12
19 (35)	0	0	1	8	9	9
19 (36)	0	0	1	8	8	9
19 (37)	0	0	1	8	8	9
19 (38)	1	1	1	10	10	10
19 (39)	4	6	7	13	14	15
19 (40)	2	2	1	10	10	9
19 (41)	2	2	2	10	11	11
19 (42)	5	7	8	13	15	17
19 (43)	0	1	4	9	9	12
19 (45)	4	6	6	13	14	15
19 (46)	4	6	7	13	14	15
19 (47)	1	1	1	9	9	9

[1] Denotes those receivers owned by SCPL, GRL or AGL.

9.6 Project-only 24-hour Average $PM_{2.5}$

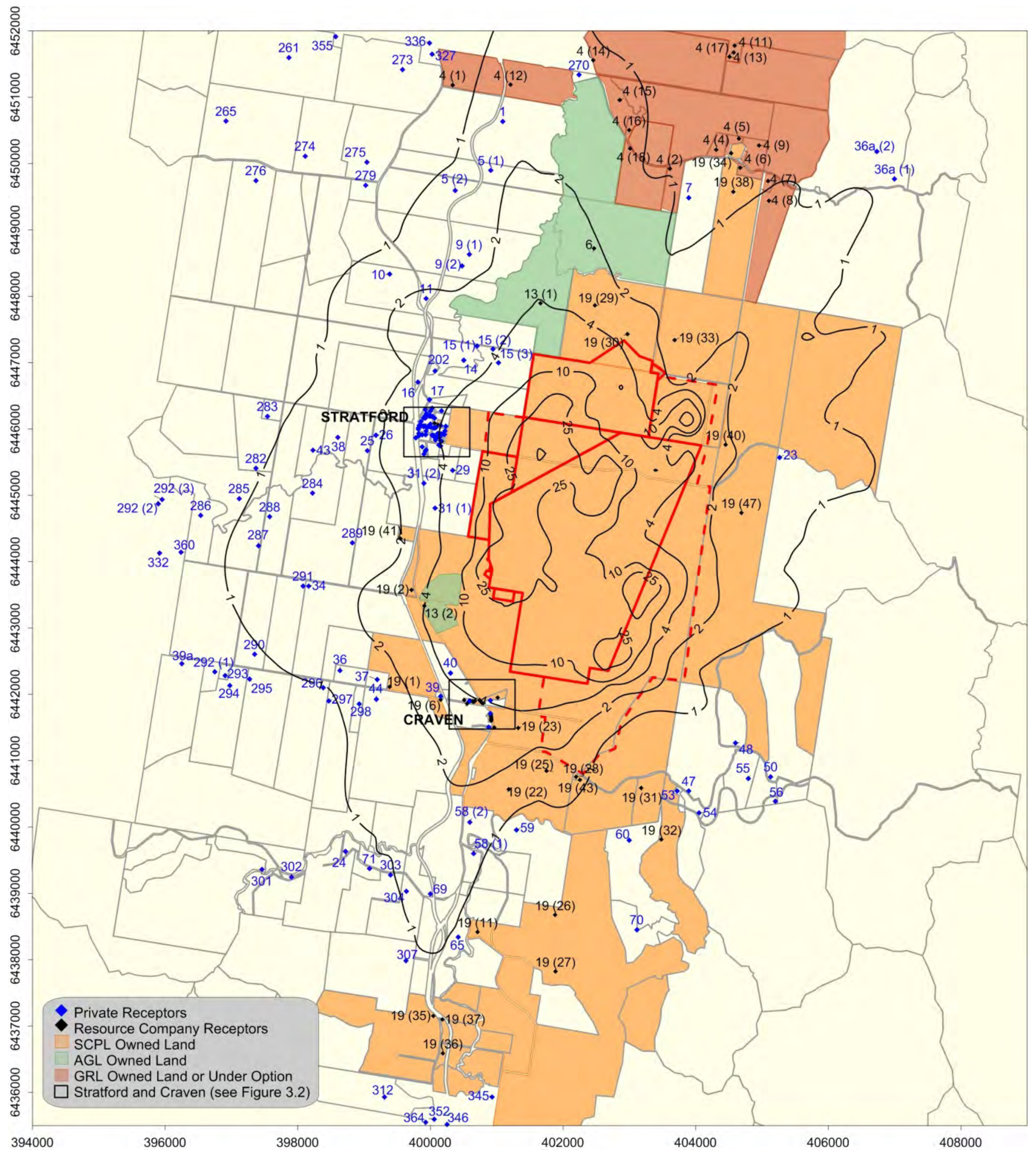
Figure 9.10 to **Figure 9.12** present contour plots for the predicted maximum 24-hour $PM_{2.5}$ concentrations for the Project-only for each modelled scenario.

The 24-hour $PM_{2.5}$ contours do not represent a single worst case day, but rather represent the potential worst case 24-hour $PM_{2.5}$ concentration that could be reached at any particular location across the entire modelling year.



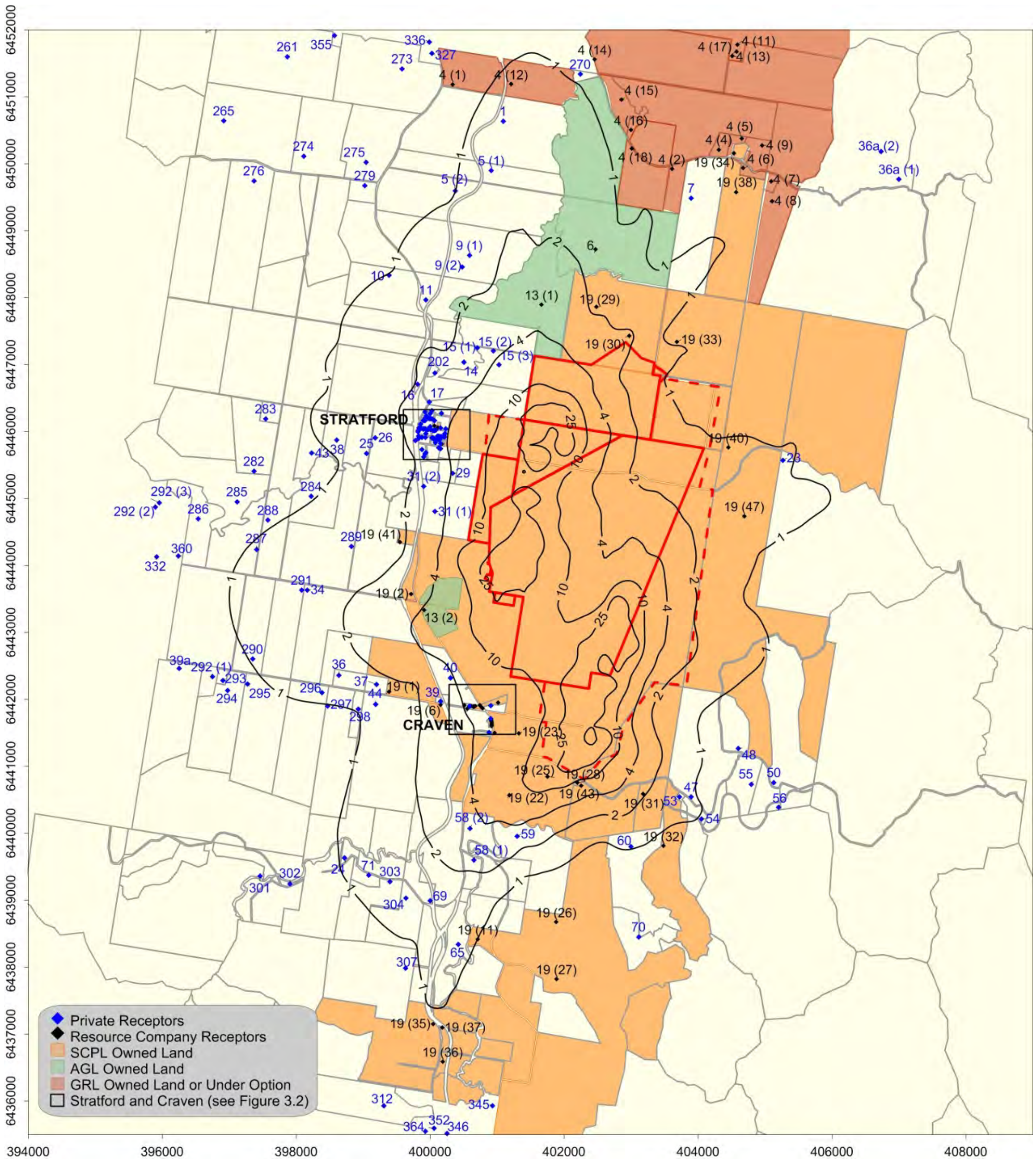
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
$PM_{2.5}$	Stratford	Year 2	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m³	25 µg/m³	CALMET	R. Kellaghan

Figure 9.10: Predicted Maximum 24-hour $PM_{2.5}$ Concentration Project-Only –Year 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Stratford	Year 6	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m³	25 µg/m³	CALMET	R. Kellaghan

Figure 9.11: Predicted Maximum 24-hour $PM_{2.5}$ Concentration Project-Only –Year 6



Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Stratford	Year 10	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	25 µg/m^3	CALMET	R. Kellaghan

Figure 9.12: Predicted Maximum 24-hour $PM_{2.5}$ Concentration Project-Only –Year 10

9.7 Summary of 24-hour Average $PM_{2.5}$ Results at Individual Receivers

A summary of the predicted particulate concentrations at each of the individual receivers is provided in **Table 9.4**.

There are no privately owned receivers that are predicted to experience 24-hour average $PM_{2.5}$ concentrations above the advisory reporting standard, due to emissions from the Project-only.

Table 9.4: Maximum Predicted Project-only 24-hour Average $PM_{2.5}$ Concentrations (µg/m^3)

Receiver ID (Figures 9.10 to 9.12)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average $PM_{2.5}$ (µg/m^3)		
	Assessment criteria = 25 µg/m^3		
Privately-owned Receivers			
1	2	2	1
5 (1)	2	2	1
5 (2)	1	1	1
7	1	1	1
9 (1)	2	2	1
9 (2)	2	2	2
10	1	1	1
11	2	2	1
14	2	3	2
15 (1)	2	3	3
15 (2)	3	4	3
15 (3)	3	5	5
16	2	2	2
17	3	3	3
23	2	2	1
24	1	1	1
25	1	2	1
26	2	2	2
27	3	3	3
29	4	5	4
31 (1)	3	4	3
31 (2)	2	3	3
34	1	1	2
36	1	1	1
36a (1)	1	1	0
36a (2)	1	1	0
37	1	1	2
38	1	1	1
39	2	3	3
39a	1	1	1
40	4	4	4
42	3	4	5
43	1	1	1
44	1	1	1
47	0	0	1
48	0	1	1
50	0	1	0
53	0	0	1
54	0	0	1
55	0	0	1
56	0	0	1
58 (1)	1	1	2
58 (2)	1	2	3
59	1	1	3
60	0	0	1
65	1	1	1
69	1	1	1
70	0	0	0
71	1	1	1
202	2	2	2
261	0	0	0
265	0	0	0
270	1	1	1
273	1	1	1
274	1	1	0

Receiver ID (Figures 9.10 to 9.12)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average $PM_{2.5}$ ($\mu g/m^3$)		
	Assessment criteria = 25 $\mu g/m^3$		
275	1	1	1
276	0	1	0
279	1	1	1
281	3	3	2
282	1	1	1
283	1	1	1
284	1	1	1
285	1	1	1
286	1	1	1
287	1	1	1
288	1	1	1
289	1	2	1
290	1	1	1
291	1	1	1
292 (1)	1	1	1
292 (2)	1	1	1
292 (3)	1	1	1
293	1	1	1
294	1	1	1
295	1	1	1
296	1	1	1
297	1	1	1
298	1	1	1
301	1	1	1
302	1	1	1
303	1	1	1
304	1	1	1
307	1	1	1
316	2	3	2
327	1	1	1
332	1	1	1
336	1	1	1
355	0	0	0
360	1	1	1
Cr.2	3	4	4
Cr.7	2	3	5
S1	3	3	3
S3	3	4	3
S4	3	3	3
S5	3	3	3
S6	3	3	3
S8	3	3	3
S9	3	3	3
S10	3	3	3
S11	3	3	3
S12	3	3	3
S13	3	4	3
S14	3	3	3
S15	3	3	3
S18	4	4	4
S19	4	4	4
S20	3	3	3
S21	3	3	2
S23	3	3	3
S24	3	3	3
S25	3	3	3
S26	3	3	3
S27	3	3	3
S28	3	3	3
S29	3	3	3
S30	3	4	3
S31	3	4	3
S33	3	4	3
S34	3	4	3
S35	4	4	4
S36	4	4	4
S37	4	4	4
S38	4	4	4
S39 (1)	4	4	4
S39 (2)	4	4	4

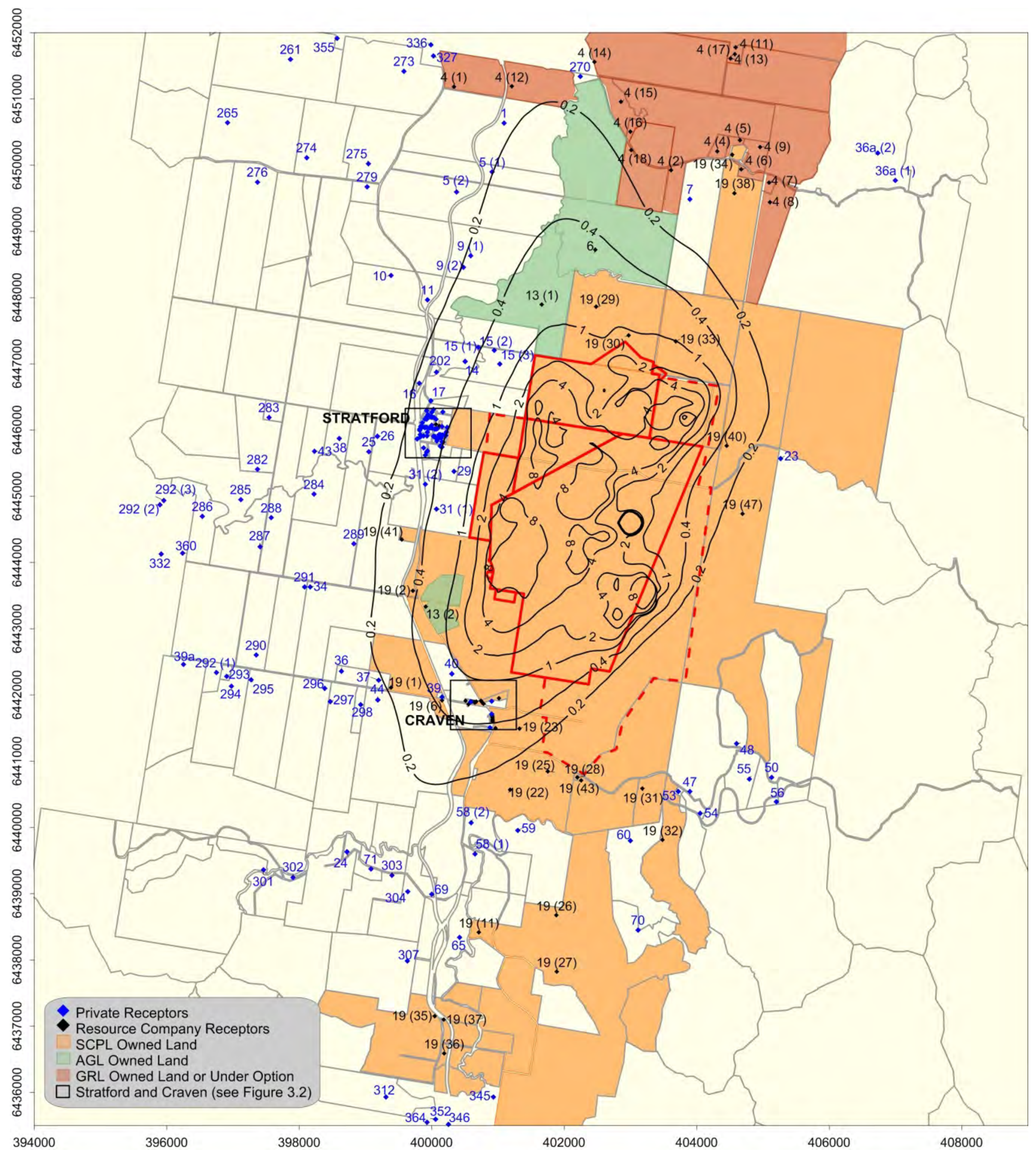
Receiver ID (Figures 9.10 to 9.12)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average $PM_{2.5}$ (µg/m³)		
	Assessment criteria = 25 µg/m³		
S40	3	3	2
S41	3	3	3
S43	3	3	3
S47	3	4	3
S48	3	4	3
S49	3	4	3
S50	3	4	3
S51	3	4	3
S52	4	4	4
S53	4	4	4
S54	4	4	4
S56	2	3	2
S57	3	3	3
S58	3	3	3
S59	2	3	2
Resource Company-owned Receivers[1]			
4 (1)	1	1	1
4 (2)	1	1	1
4 (3)	1	1	1
4 (4)	1	1	1
4 (5)	1	1	0
4 (6)	1	1	1
4 (7)	1	1	1
4 (8)	1	1	1
4 (9)	1	1	1
4 (11)	1	1	1
4 (12)	1	1	1
4 (13)	1	1	1
4 (14)	1	1	1
4 (15)	1	1	1
4 (16)	1	1	1
4 (17)	1	1	1
4 (18)	1	1	1
6	2	2	2
13 (1)	4	4	3
13 (2)	3	4	4
19 (1)	2	2	2
19 (2)	3	3	3
19 (4)	3	4	3
19 (5)	3	4	3
19 (6)	2	3	3
19 (7)	4	4	4
19 (8)	3	3	4
19 (9)	3	4	5
19 (10)	3	4	5
19 (11)	1	1	1
19 (12)	3	4	5
19 (13)	3	4	5
19 (14)	3	4	5
19 (15)	2	3	5
19 (16)	2	3	5
19 (17)	2	3	5
19 (18)	2	3	5
19 (19)	2	3	5
19 (20)	2	3	5
19 (21)	2	3	5
19 (22)	1	1	8
19 (23)	2	3	7
19 (25)	1	2	15
19 (26)	0	0	0
19 (27)	0	0	0
19 (28)	1	1	8
19 (29)	4	3	2
19 (30)	4	3	2
19 (31)	0	0	2
19 (32)	0	0	1
19 (33)	3	2	1
19 (34)	1	1	0
19 (35)	1	1	1
19 (36)	1	1	1

Receiver ID (Figures 9.10 to 9.12)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone
	24-hour Average $PM_{2.5}$ ($\mu g/m^3$)		
	Assessment criteria = 25 $\mu g/m^3$		
19 (37)	1	1	1
19 (38)	1	1	1
19 (39)	3	4	4
19 (40)	2	2	1
19 (41)	2	2	2
19 (42)	4	5	5
19 (43)	1	1	7
19 (45)	3	4	4
19 (46)	3	4	4
19 (47)	1	1	1

[1] Denotes those receivers owned by SCPL, GRL or AGL.

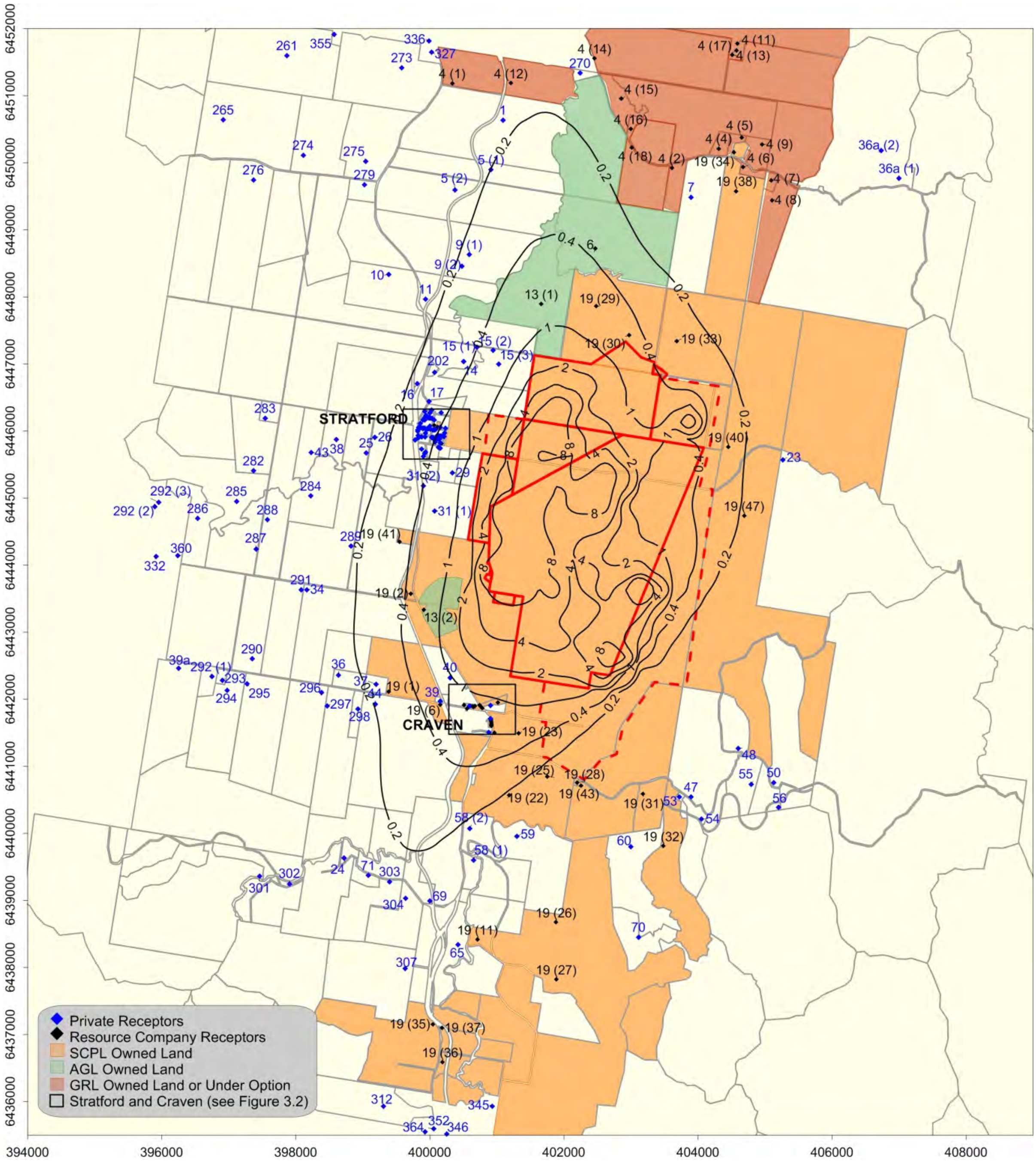
9.8 Project Only Annual Average $PM_{2.5}$

The Project-only contributions to annual average $PM_{2.5}$ concentrations are presented in **Figure 9.13** to **Figure 9.15** for each modelled year.



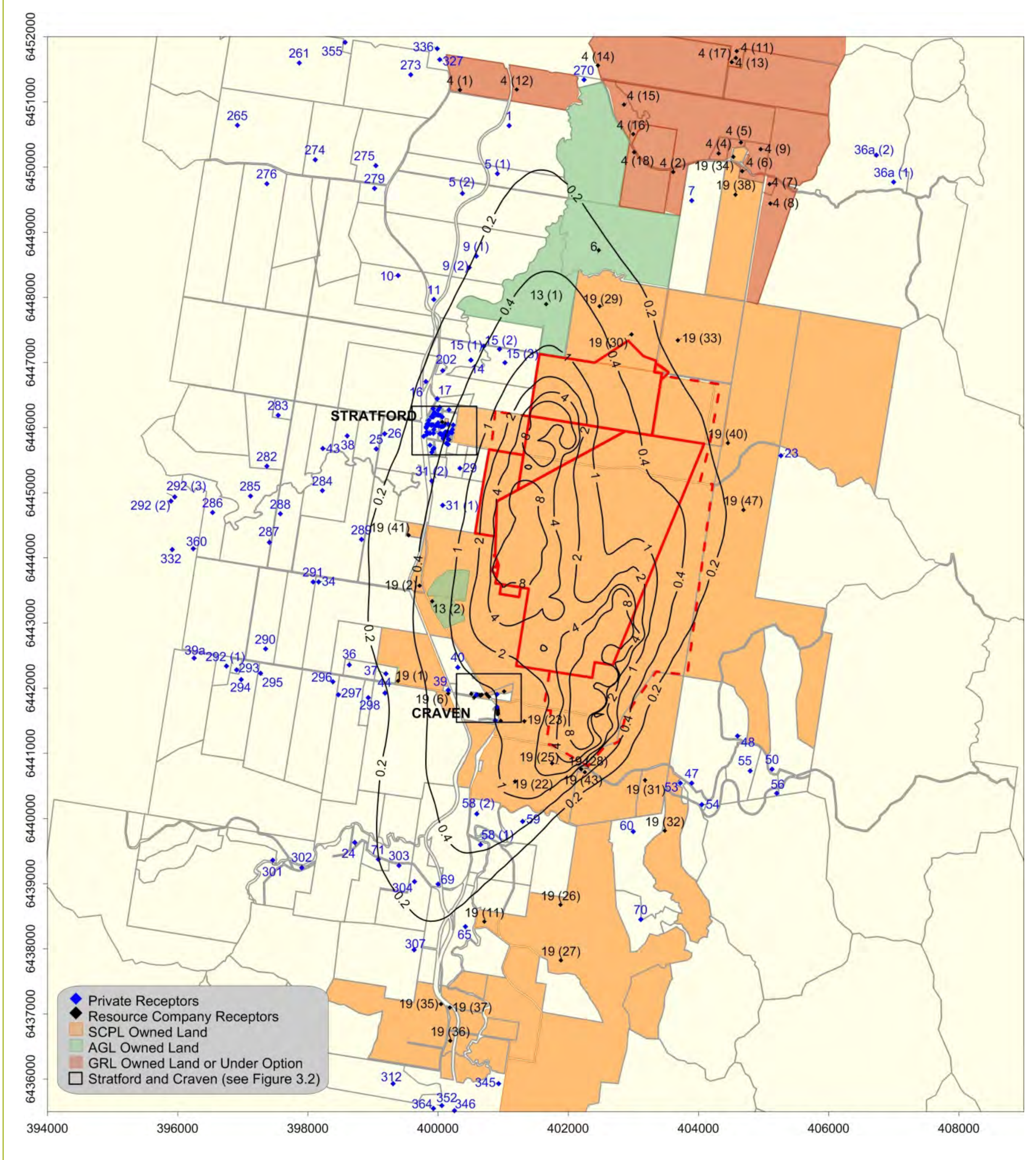
Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
$PM_{2.5}$	Stratford	Year 2	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	8 µg/m^3	CALMET	R. Kellaghan

Figure 9.13: Predicted Annual $PM_{2.5}$ Concentration Project-Only –Year 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Stratford	Year 6	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m³	8 µg/m³	CALMET	R Kellaghan

Figure 9.14: Predicted Annual $PM_{2.5}$ Concentration Project-Only –Year 6



Species:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	Stratford	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	8 µg/m^3	CALMET	R Kellaghan

Figure 9.15: Predicted Annual $PM_{2.5}$ Concentration Project-Only –Year 10

9.9 Summary of Project-only and Cumulative Annual Average $PM_{2.5}$ Results at Individual Receivers

A summary of the predicted particulate concentrations at each of the individual receivers is provided in **Table 9.5**.

There are no privately owned receivers that are predicted to experience annual average $PM_{2.5}$ concentrations above the assessment criteria, due to emissions from the Project-only. Similarly, there are no privately owned receivers that are predicted to exceed the assessment criteria when including background concentrations (**Section 5.5**) or cumulative sources.

Note: Cumulative values in **Table 9.5** include background concentrations and model predictions from the Rocky Hill Coal Project.

Table 9.5: Annual Average $PM_{2.5}$ Concentrations (µg/m³)

Receiver ID (refer Figures 9.13 to 9.15)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual average $PM_{2.5}$ (µg/m³)					
	NEPM Guideline = 8 µg/m³					
Privately-owned Receivers						
1	0	0	0	4	4	4
5 (1)	0	0	0	4	4	3
5 (2)	0	0	0	3	3	3
7	0	0	0	3	3	3
9 (1)	0	0	0	3	3	3
9 (2)	0	0	0	3	3	3
10	0	0	0	3	3	3
11	0	0	0	3	3	3
14	0	0	0	3	3	3
15 (1)	0	0	0	3	3	3
15 (2)	1	1	1	4	4	4
15 (3)	1	1	1	4	4	4
16	0	0	0	3	3	3
17	0	0	0	3	3	3
23	0	0	0	3	3	3
24	0	0	0	3	3	3
25	0	0	0	3	3	3
26	0	0	0	3	3	3
27	0	0	0	3	3	3
29	1	1	1	4	4	4
31 (1)	0	1	1	3	4	4
31 (2)	0	0	0	3	3	3
34	0	0	0	3	3	3
36	0	0	0	3	3	3
36a (1)	0	0	0	3	3	3
36a (2)	0	0	0	3	3	3
37	0	0	0	3	3	3
38	0	0	0	3	3	3
39	0	1	1	3	4	4
39a	0	0	0	3	3	3
40	1	1	1	4	4	4
42	1	1	1	4	4	4
43	0	0	0	3	3	3
44	0	0	0	3	3	3
47	0	0	0	3	3	3
48	0	0	0	3	3	3
50	0	0	0	3	3	3
53	0	0	0	3	3	3
54	0	0	0	3	3	3
55	0	0	0	3	3	3
56	0	0	0	3	3	3
58 (1)	0	0	0	3	3	3
58 (2)	0	0	1	3	3	4
59	0	0	0	3	3	4
60	0	0	0	3	3	3
65	0	0	0	3	3	3
69	0	0	0	3	3	3

Receiver ID (refer Figures 9.13 to 9.15)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual average $PM_{2.5}$ ($\mu g/m^3$)					
	NEPM Guideline = 8 $\mu g/m^3$					
70	0	0	0	3	3	3
71	0	0	0	3	3	3
202	0	0	0	3	3	3
261	0	0	0	3	3	3
265	0	0	0	3	3	3
270	0	0	0	6	6	6
273	0	0	0	3	3	3
274	0	0	0	3	3	3
275	0	0	0	3	3	3
276	0	0	0	3	3	3
279	0	0	0	3	3	3
281	0	0	0	3	3	3
282	0	0	0	3	3	3
283	0	0	0	3	3	3
284	0	0	0	3	3	3
285	0	0	0	3	3	3
286	0	0	0	3	3	3
287	0	0	0	3	3	3
288	0	0	0	3	3	3
289	0	0	0	3	3	3
290	0	0	0	3	3	3
291	0	0	0	3	3	3
292 (1)	0	0	0	3	3	3
292 (2)	0	0	0	3	3	3
292 (3)	0	0	0	3	3	3
293	0	0	0	3	3	3
294	0	0	0	3	3	3
295	0	0	0	3	3	3
296	0	0	0	3	3	3
297	0	0	0	3	3	3
298	0	0	0	3	3	3
301	0	0	0	3	3	3
302	0	0	0	3	3	3
303	0	0	0	3	3	3
304	0	0	0	3	3	3
307	0	0	0	3	3	3
316	0	0	0	3	3	3
327	0	0	0	3	3	3
332	0	0	0	3	3	3
336	0	0	0	3	3	3
355	0	0	0	3	3	3
360	0	0	0	3	3	3
Cr.2	1	1	1	4	4	4
Cr.7	0	1	1	3	4	4
S1	0	0	0	3	3	3
S3	0	0	0	3	3	3
S4	0	0	0	3	3	3
S5	0	0	0	3	3	3
S6	0	0	0	3	3	3
S8	0	0	0	3	3	3
S9	0	0	0	3	3	3
S10	0	0	0	3	3	3
S11	0	0	0	3	3	3
S12	0	0	0	3	3	3
S13	0	0	0	3	3	3
S14	0	0	0	3	3	3
S15	0	0	0	3	3	3
S18	0	0	0	3	3	3
S19	0	0	0	3	3	3
S20	0	0	0	3	3	3
S21	0	0	0	3	3	3
S23	0	0	0	3	3	3
S24	0	0	0	3	3	3
S25	0	0	0	3	3	3
S26	0	0	0	3	3	3
S27	0	0	0	3	3	3
S28	0	0	0	3	3	3
S29	0	0	0	3	3	3

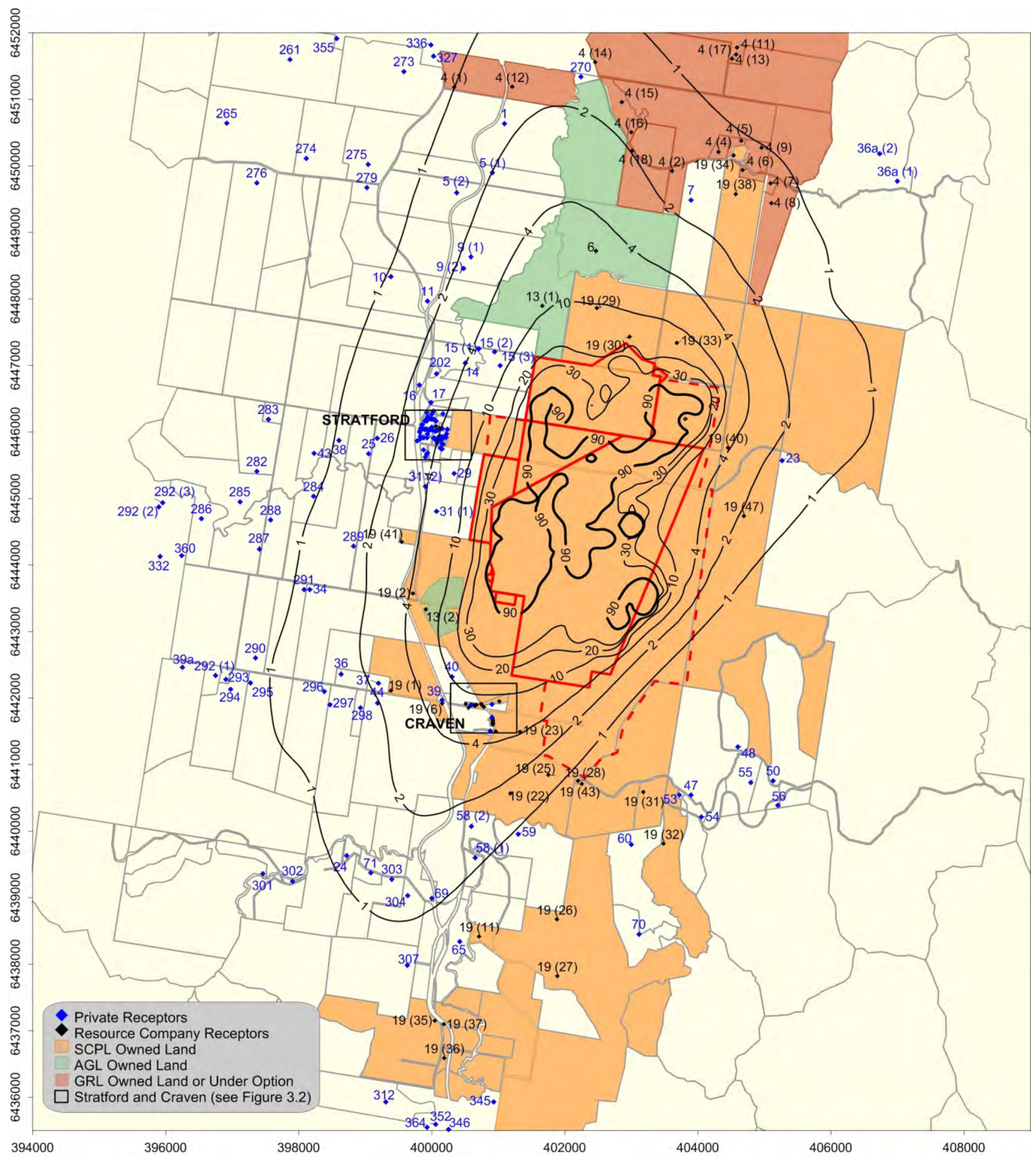
Receiver ID (refer Figures 9.13 to 9.15)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual average $PM_{2.5}$ ($\mu g/m^3$)					
	NEPM Guideline = 8 $\mu g/m^3$					
S30	0	0	0	3	3	3
S31	0	0	0	3	3	3
S33	0	0	0	3	3	3
S34	0	0	0	3	3	3
S35	0	0	0	3	3	3
S36	0	0	0	3	3	3
S37	0	0	0	3	3	3
S38	0	0	0	3	3	3
S39 (1)	0	0	0	3	3	3
S39 (2)	0	0	0	3	4	3
S40	0	0	0	3	3	3
S41	0	0	0	3	3	3
S43	0	0	0	3	3	3
S47	0	0	0	3	3	3
S48	0	0	0	3	3	3
S49	0	0	0	3	3	3
S50	0	0	0	3	3	3
S51	0	0	0	3	3	3
S52	0	0	0	3	3	3
S53	0	0	0	3	3	3
S54	0	0	0	3	3	3
S56	0	0	0	3	3	3
S57	0	0	0	3	3	3
S58	0	0	0	3	3	3
S59	0	0	0	3	3	3
Resource Company-owned Receivers[1]						
4 (1)	0	0	0	3	3	3
4 (2)	0	0	0	4	4	4
4 (3)	0	0	0	4	4	4
4 (4)	0	0	0	4	4	4
4 (5)	0	0	0	4	4	4
4 (6)	0	0	0	3	3	3
4 (7)	0	0	0	3	3	3
4 (8)	0	0	0	3	3	3
4 (9)	0	0	0	3	3	3
4 (11)	0	0	0	7	7	7
4 (12)	0	0	0	4	4	4
4 (13)	0	0	0	7	7	7
4 (14)	0	0	0	7	7	6
4 (15)	0	0	0	8	8	8
4 (16)	0	0	0	6	6	6
4 (17)	0	0	0	7	7	7
4 (18)	0	0	0	5	5	5
6	0	0	0	4	3	3
13 (1)	1	1	1	4	4	4
13 (2)	1	1	1	4	4	4
19 (1)	0	0	0	3	3	3
19 (2)	0	0	0	3	3	3
19 (4)	0	0	0	3	3	3
19 (5)	0	0	0	3	3	3
19 (6)	0	1	1	3	4	4
19 (7)	0	0	0	3	4	3
19 (8)	1	1	1	4	4	4
19 (9)	1	1	1	4	4	4
19 (10)	1	1	1	4	4	4
19 (11)	0	0	0	3	3	3
19 (12)	1	1	1	4	4	4
19 (13)	1	1	1	4	4	4
19 (14)	1	1	1	4	4	4
19 (15)	0	1	1	3	4	4
19 (16)	0	1	1	3	4	4
19 (17)	0	1	1	3	4	4
19 (18)	0	1	1	3	4	4
19 (19)	0	1	1	3	4	4
19 (20)	0	1	1	3	4	4
19 (21)	0	1	1	3	4	4
19 (22)	0	0	1	3	3	4
19 (23)	0	1	1	3	4	4

Receiver ID (refer Figures 9.13 to 9.15)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual average $PM_{2.5}$ (µg/m^3)					
	NEPM Guideline = 8 µg/m^3					
19 (25)	0	0	3	3	3	6
19 (26)	0	0	0	3	3	3
19 (27)	0	0	0	3	3	3
19 (28)	0	0	1	3	3	4
19 (29)	1	1	0	4	4	3
19 (30)	1	1	0	4	4	3
19 (31)	0	0	0	3	3	3
19 (32)	0	0	0	3	3	3
19 (33)	1	0	0	4	3	3
19 (34)	0	0	0	4	4	4
19 (35)	0	0	0	3	3	3
19 (36)	0	0	0	3	3	3
19 (37)	0	0	0	3	3	3
19 (38)	0	0	0	3	3	3
19 (39)	1	1	1	4	4	4
19 (40)	0	0	0	3	3	3
19 (41)	0	0	0	3	3	3
19 (42)	1	1	1	4	4	4
19 (43)	0	0	0	3	3	4
19 (45)	1	1	1	4	4	4
19 (46)	1	1	1	4	4	4
19 (47)	0	0	0	3	3	3

[1] Denotes those receivers owned by SCPL, GRL or AGL.

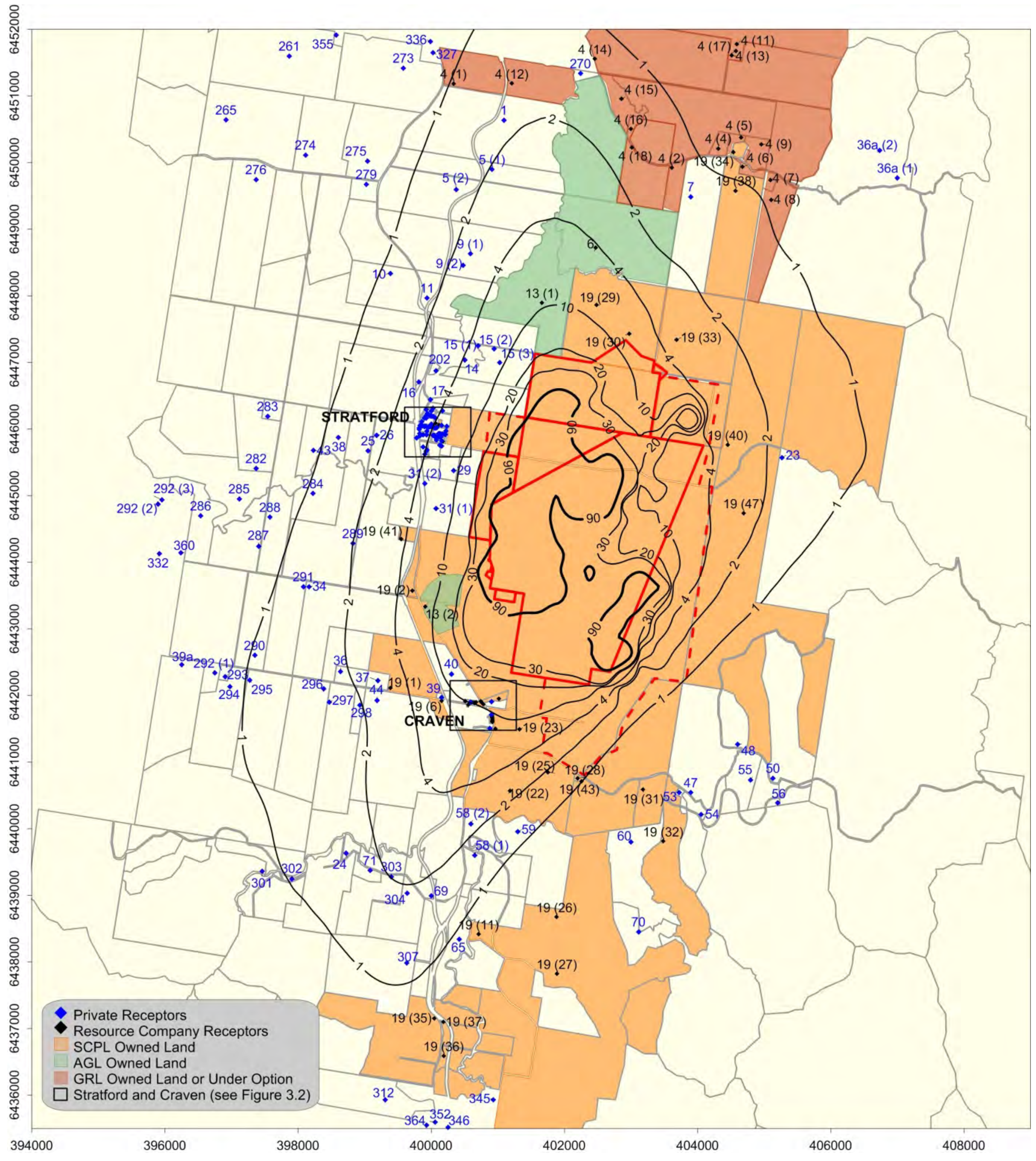
9.10 Project-Only Annual Average TSP

The predicted TSP concentrations for the contribution of the Project-only for annual average TSP concentrations are presented in **Figure 9.16** to **Figure 9.18** for each modelled year.



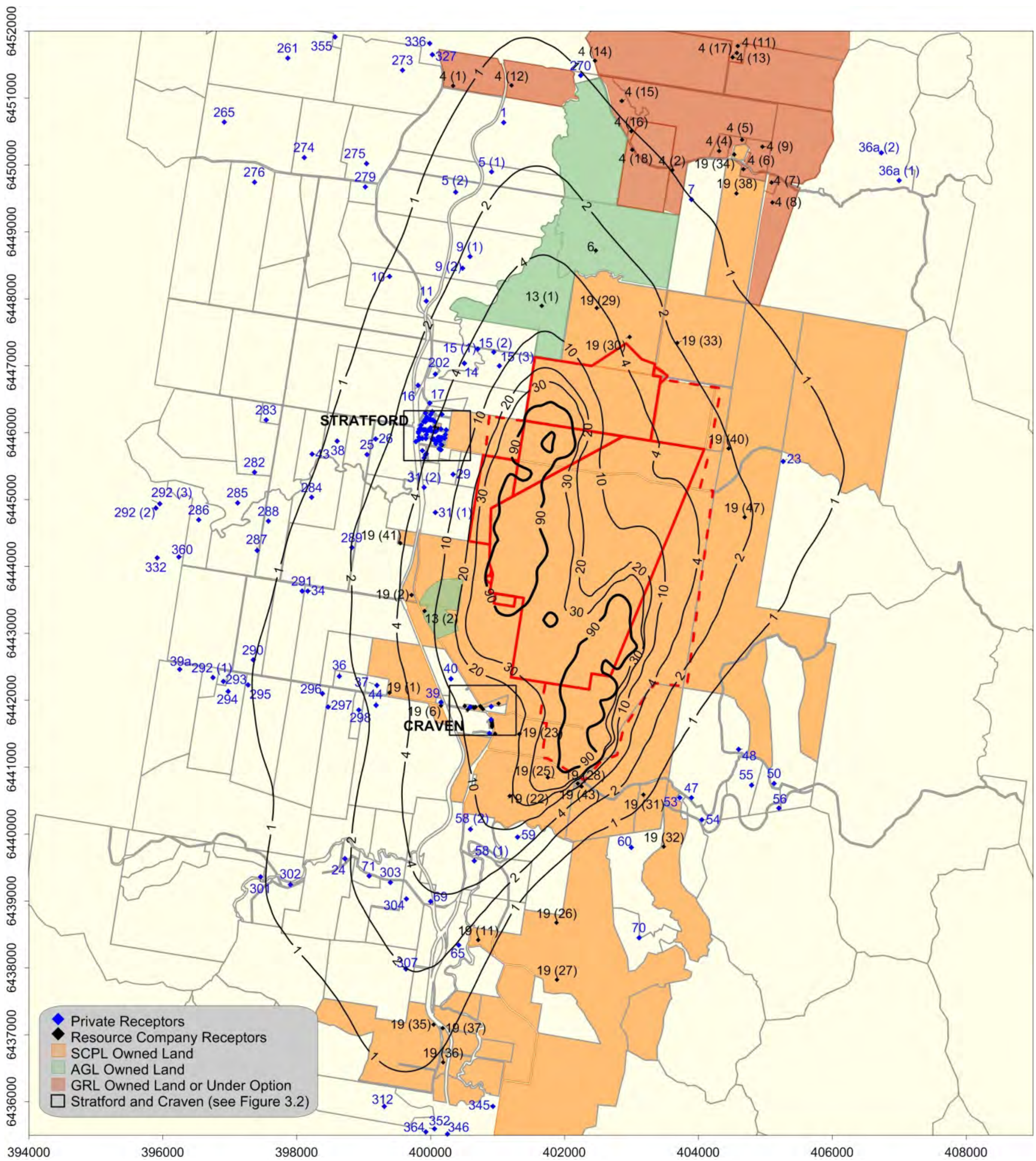
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Stratford	Year 2	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	90 µg/m^3	CALMET	R Kellaghan

Figure 9.16: Predicted Annual TSP Concentration Project-Only –Year 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Stratford	Year 6	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m^3	90 µg/m^3	CALMET	R Kellaghan

Figure 9.17: Predicted Annual TSP Concentration Project-Only –Year 6



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
TSP	Stratford	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	µg/m³	90 µg/m³	CALMET	R Kellaghan

Figure 9.18: Predicted Annual TSP Concentration Project-Only –Year 10

9.11 Summary of Project-only and Cumulative Annual Average TSP Results at Individual Receivers

A summary of the predicted particulate concentrations at each of the individual receivers is provided in **Table 9.6**.

There are no privately owned receivers that are predicted to experience annual average TSP concentrations above the assessment criteria, due to emissions from the Project-only. Similarly, there are no privately owned receivers that are predicted to exceed the assessment criteria when including background concentrations (**Section 5.5**) or cumulative sources.

Note: Cumulative values in **Table 9.6** include background concentrations and model predictions from the Rocky Hill Coal Project.

Table 9.6: Annual Average TSP Concentrations (μg/m^3)

Receiver ID (refer Figures 9.16 to 9.18)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average TSP (μg/m^3)					
	Assessment criteria = 90 μg/m^3					
Privately-owned Receivers						
1	2	2	1	27	27	27
5 (1)	2	2	2	26	26	26
5 (2)	1	2	1	24	24	24
7	2	1	1	24	24	24
9 (1)	2	2	2	24	24	24
9 (2)	2	2	2	24	24	24
10	1	1	1	22	22	22
11	2	2	2	23	23	23
14	4	4	4	25	25	25
15 (1)	4	5	5	25	25	25
15 (2)	6	7	6	27	27	27
15 (3)	8	9	9	29	29	29
16	2	2	2	23	23	23
17	3	3	3	24	24	24
23	2	2	1	22	22	22
24	1	2	2	21	22	22
25	2	2	2	22	22	22
26	2	2	2	22	22	22
27	3	3	3	24	24	24
29	7	9	8	28	29	29
31 (1)	5	6	6	25	27	27
31 (2)	4	5	5	24	25	25
34	1	1	1	21	22	22
36	2	2	2	22	22	22
36a (1)	1	1	0	21	21	21
36a (2)	1	1	0	21	21	21
37	2	3	2	22	23	23
38	1	1	1	22	22	22
39	6	7	8	26	28	28
39a	1	1	1	21	21	21
40	10	12	11	30	32	32
42	8	11	13	28	31	34
43	1	1	1	21	21	21
44	2	2	2	22	23	22
47	0	0	1	20	20	21
48	0	0	0	20	20	21
50	0	0	0	20	20	20
53	0	0	1	20	20	21
54	0	0	0	20	20	20
55	0	0	0	20	20	20
56	0	0	0	20	20	20
58 (1)	1	2	6	21	22	26
58 (2)	2	2	8	22	22	28
59	1	1	7	21	21	27
60	0	0	1	20	20	21
65	1	1	2	21	21	22
69	1	2	4	21	22	24

Receiver ID (refer Figures 9.16 to 9.18)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average TSP (µg/m³)					
	Assessment criteria = 90 µg/m³					
70	0	0	0	20	20	20
71	1	2	2	21	22	23
202	3	3	3	23	24	24
261	0	0	0	21	21	21
265	0	0	0	21	21	21
270	2	1	1	54	54	53
273	1	1	1	22	22	22
274	0	0	0	21	21	21
275	1	1	1	22	22	22
276	0	0	0	21	21	21
279	1	1	1	22	22	22
281	3	3	3	23	24	24
282	1	1	1	21	21	21
283	1	1	1	21	21	21
284	1	1	1	21	22	22
285	1	1	1	21	21	21
286	0	0	0	21	21	21
287	1	1	1	21	21	21
288	1	1	1	21	21	21
289	2	2	2	22	22	22
290	1	1	1	21	21	21
291	1	1	1	21	22	22
292 (1)	1	1	1	21	21	21
292 (2)	0	0	0	21	21	21
292 (3)	0	0	0	21	21	21
293	1	1	1	21	21	21
294	1	1	1	21	21	21
295	1	1	1	21	21	21
296	1	2	1	22	22	22
297	1	2	1	22	22	22
298	2	2	2	22	22	22
301	1	1	1	21	21	21
302	1	1	1	21	21	21
303	1	2	3	21	22	23
304	1	2	3	21	22	23
307	1	1	2	21	21	22
316	3	3	3	23	24	24
327	1	1	1	22	22	22
332	0	0	0	21	21	21
336	1	1	1	22	22	22
355	0	0	0	21	21	21
360	0	0	0	21	21	21
Cr.2	8	10	11	28	30	31
Cr.7	6	10	14	26	30	34
S1	3	3	3	24	24	24
S3	4	4	4	24	25	25
S4	3	3	3	23	24	24
S5	3	3	3	24	24	24
S6	3	3	3	23	24	24
S8	3	3	3	24	24	24
S9	3	3	3	24	24	24
S10	3	3	3	24	24	24
S11	3	4	4	24	24	24
S12	3	4	4	24	24	24
S13	3	4	4	24	24	24
S14	3	3	3	23	24	24
S15	3	4	4	24	24	24
S18	4	5	4	25	25	25
S19	4	5	5	25	26	25
S20	3	3	3	23	24	24
S21	3	3	3	23	24	24
S23	3	3	3	23	24	24
S24	3	3	3	24	24	24
S25	3	3	3	24	24	24
S26	3	4	4	24	24	24
S27	3	4	4	24	24	24
S28	3	4	4	24	24	24
S29	3	4	4	24	24	24

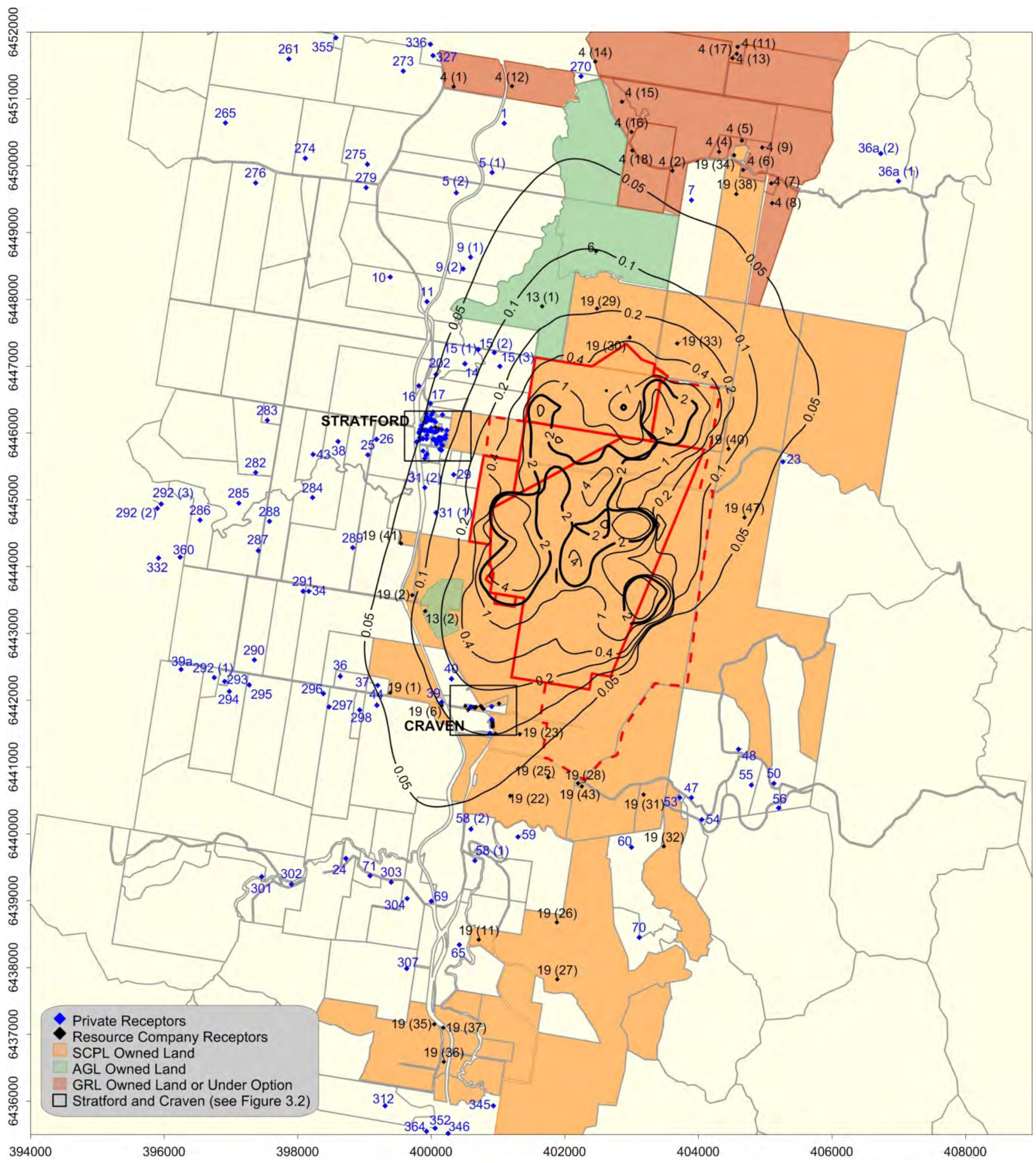
Receiver ID (refer Figures 9.16 to 9.18)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average TSP (µg/m³)					
	Assessment criteria = 90 µg/m³					
S30	4	4	4	24	25	24
S31	4	4	4	24	25	25
S33	4	4	4	24	25	25
S34	4	5	5	25	25	25
S35	4	5	5	25	25	25
S36	4	5	5	25	25	25
S37	4	5	5	25	25	25
S38	5	5	5	25	26	26
S39 (1)	5	5	5	25	26	26
S39 (2)	5	5	5	25	26	26
S40	3	3	3	23	24	24
S41	3	3	3	24	24	24
S43	3	4	4	24	24	24
S47	4	4	4	24	25	25
S48	4	4	4	24	25	25
S49	4	4	4	24	25	25
S50	4	5	5	24	25	25
S51	4	5	5	25	25	25
S52	4	5	5	25	25	25
S53	4	5	5	25	25	25
S54	4	5	5	25	26	26
S56	3	4	4	24	24	24
S57	3	4	4	24	25	24
S58	3	4	4	24	24	24
S59	3	4	4	24	24	24
Resource Company-owned Receivers[1]						
4 (1)	1	1	1	23	23	23
4 (2)	2	1	1	31	30	30
4 (3)	1	1	1	35	35	34
4 (4)	1	1	1	31	30	30
4 (5)	1	1	1	30	29	29
4 (6)	1	1	1	25	24	24
4 (7)	1	1	1	23	23	22
4 (8)	1	1	1	22	22	22
4 (9)	1	1	1	25	25	25
4 (11)	1	1	1	73	73	73
4 (12)	2	2	1	28	28	27
4 (13)	1	1	1	81	81	81
4 (14)	1	1	1	67	67	67
4 (15)	2	1	1	86	86	86
4 (16)	2	1	1	67	66	66
4 (17)	1	1	1	72	72	72
4 (18)	2	2	1	44	43	43
6	6	4	3	27	25	24
13 (1)	9	9	7	30	30	28
13 (2)	6	8	7	27	28	27
19 (1)	2	3	3	23	23	23
19 (2)	4	5	5	25	25	25
19 (4)	4	4	4	24	25	24
19 (5)	4	4	4	24	25	25
19 (6)	6	7	8	26	27	28
19 (7)	5	5	5	25	26	26
19 (8)	7	10	11	27	30	31
19 (9)	8	10	12	28	30	32
19 (10)	8	10	12	28	31	32
19 (11)	1	1	1	21	21	22
19 (12)	8	11	12	28	31	32
19 (13)	8	11	12	28	31	32
19 (14)	7	10	12	28	30	33
19 (15)	6	9	14	26	30	34
19 (16)	6	9	14	26	30	34
19 (17)	5	9	14	26	29	34
19 (18)	5	9	14	25	29	34
19 (19)	5	9	14	25	29	34
19 (20)	6	9	14	26	29	34
19 (21)	5	9	14	25	29	35
19 (22)	2	2	19	22	22	39
19 (23)	4	8	20	24	28	40

Receiver ID (refer Figures 9.16 to 9.18)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 10 – Cumulative
	Annual Average TSP (µg/m³)					
	Assessment criteria = 90 µg/m³					
19 (25)	1	2	49	21	22	69
19 (26)	0	0	0	20	20	21
19 (27)	0	0	0	20	20	20
19 (28)	1	1	11	21	21	31
19 (29)	10	8	4	31	29	25
19 (30)	16	7	3	36	27	24
19 (31)	0	0	1	20	21	21
19 (32)	0	0	0	20	20	21
19 (33)	14	3	2	34	24	22
19 (34)	1	1	1	27	27	27
19 (35)	1	1	1	21	21	21
19 (36)	0	1	1	21	21	21
19 (37)	1	1	1	21	21	21
19 (38)	1	1	1	23	23	23
19 (39)	8	10	12	28	30	32
19 (40)	4	3	2	24	23	22
19 (41)	3	4	4	23	24	24
19 (42)	8	12	15	28	33	35
19 (43)	1	1	7	21	21	27
19 (45)	8	10	11	28	30	31
19 (46)	8	10	11	28	30	32
19 (47)	2	2	2	22	23	22

[1] Denotes those receivers owned by SCPL, GRL or AGL.

9.12 Project-Only Annual Average Dust Deposition

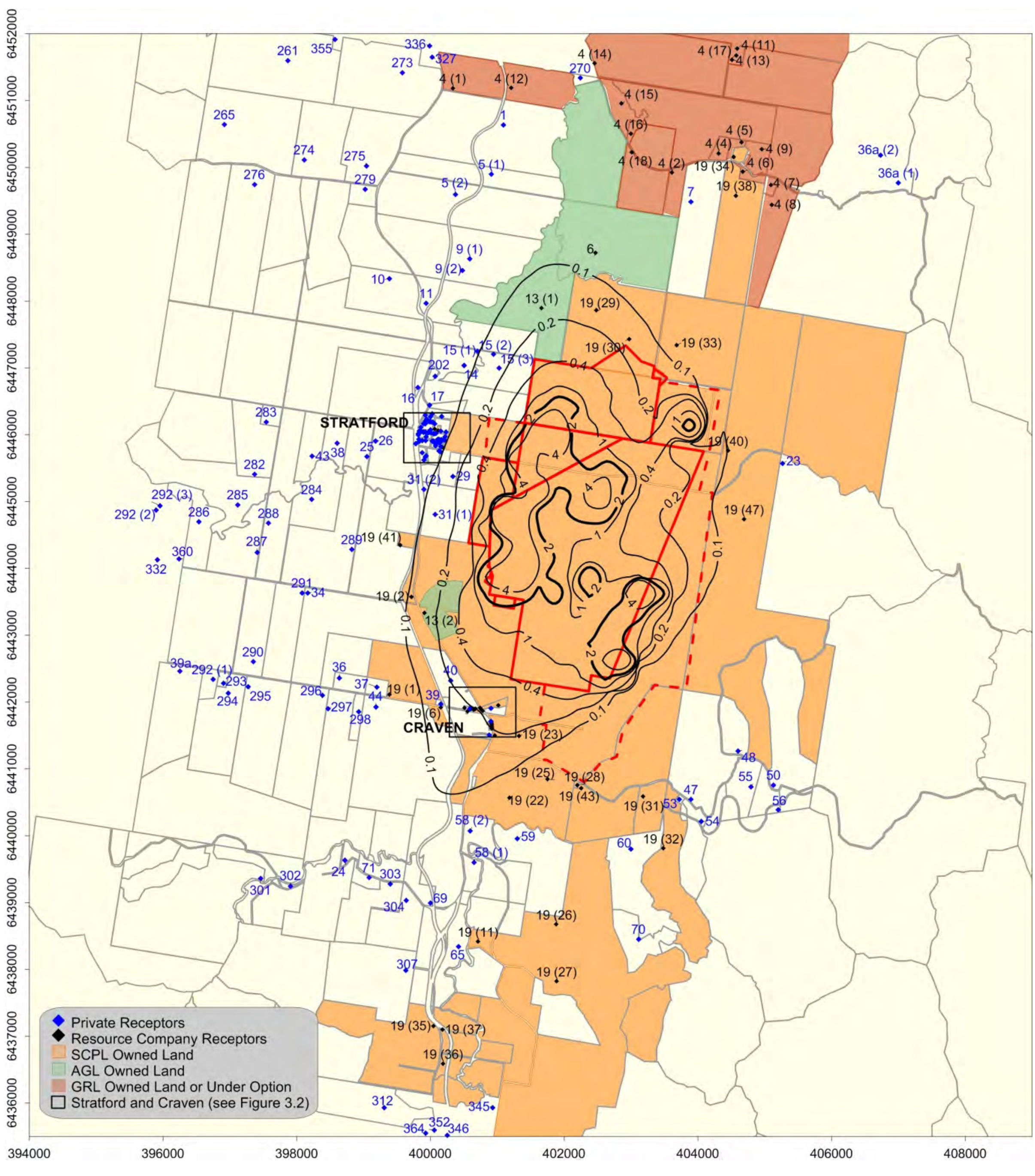
The predicted contribution of the Project-only to annual average dust deposition levels are presented in **Figure 9.19** to **Figure 9.21** for each modelled year. The Project-only assessment criterion for dust deposition is 2 g/m^2/month.



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
Dust Deposition	Stratford	Year 2	N/A	Annual

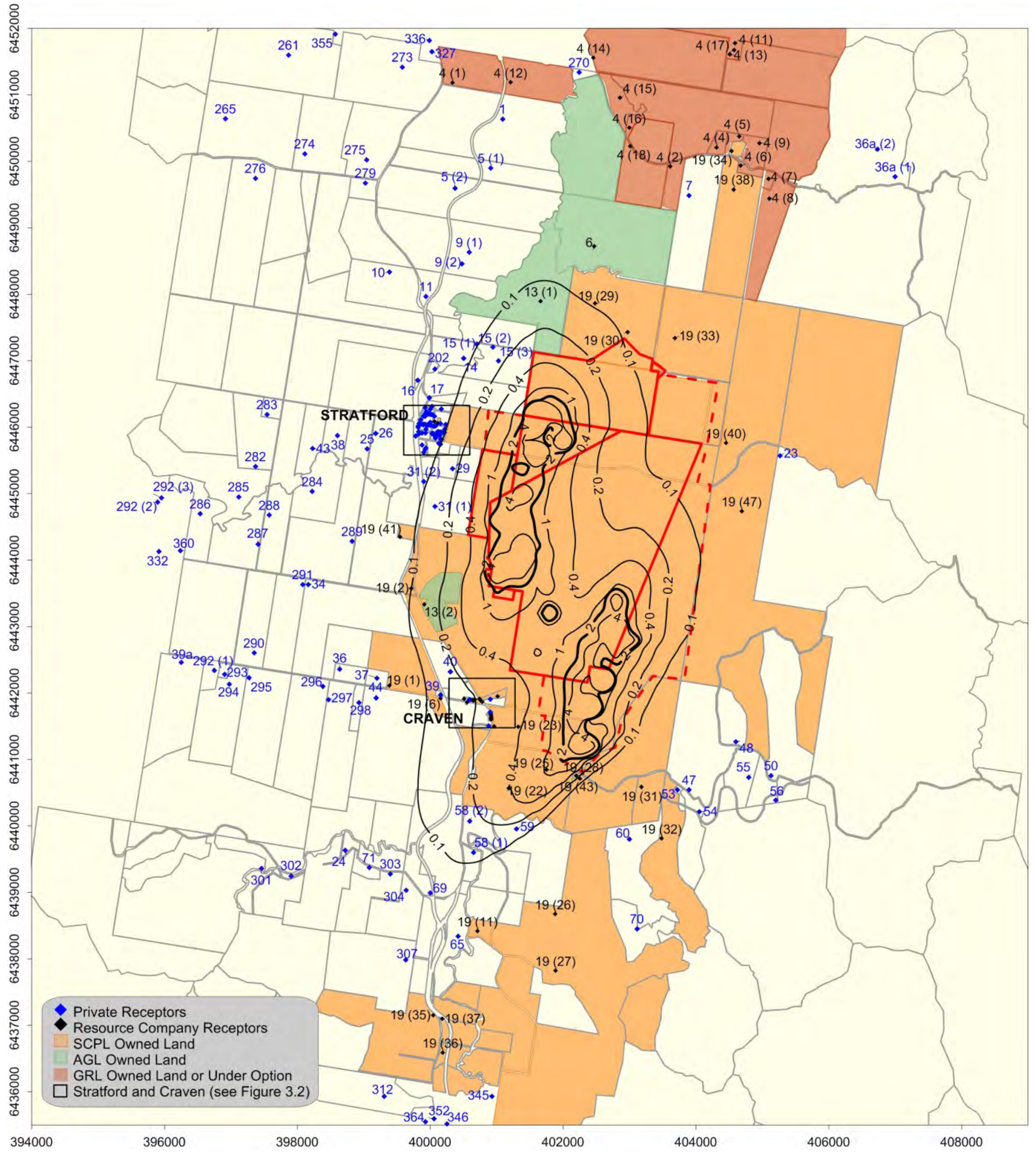
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	g/m^2/month	2 g/m^2/month	CALMET	R Kellaghan

Figure 9.19: Predicted Annual Dust Deposition Project-Only –Year 2



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust Deposition	Stratford	Year 6	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	$g/m^2/month$	2 $g/m^2/month$	CALMET	R Kellaghan

Figure 9.20: Predicted Annual Dust Deposition Project-Only –Year 6



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
Dust Deposition	Stratford	Year 10	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.42	$g/m^2/month$	2 $g/m^2/month$	CALMET	R Kellaghan

Figure 9.21: Predicted Annual Dust Deposition Project-Only –Year 10

9.13 Summary of Project-only and Cumulative Annual Average Dust Deposition Results at Individual Receivers

A summary of the predicted particulate concentrations at each of the individual receivers is provided in **Table 9.7**.

There are no privately owned receivers that are predicted to experience annual average dust deposition levels above the assessment criteria, due to emissions from the Project-only. Similarly, there are no privately owned receivers that are predicted to exceed the assessment criteria when including background concentrations (**Section 5.5**) or cumulative sources.

Note: Cumulative values in **Table 9.7** include background concentrations and model predictions from the Rocky Hill Coal Project.

Table 9.7: Annual Average Dust Deposition Levels (µg/m³)

Receiver ID (refer Figures 9.19 to 9.21)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 9 – Cumulative
	Annual Average Dust Deposition (g/m²/month)					
	Assessment criteria = 2 g/m²/month (Project) 4 g/m²/month (cumulative)					
Privately-owned Receivers						
1	0	0	0	1.1	1.1	1.1
5 (1)	0	0	0	1.1	1.1	1.1
5 (2)	0	0	0	1.1	1.1	1.1
7	0	0	0	1.1	1.1	1.1
9 (1)	0	0	0	1.1	1.1	1.1
9 (2)	0	0	0	1.1	1.1	1.1
10	0	0	0	1.1	1.1	1.1
11	0	0	0	1.1	1.1	1.1
14	0.1	0.1	0.1	1.1	1.1	1.1
15 (1)	0.1	0.1	0.1	1.1	1.1	1.1
15 (2)	0.1	0.1	0.1	1.1	1.1	1.2
15 (3)	0.1	0.2	0.2	1.2	1.2	1.2
16	0	0	0	1.1	1.1	1.1
17	0.1	0.1	0.1	1.1	1.1	1.1
23	0	0.1	0	1	1.1	1
24	0	0	0	1	1	1
25	0	0	0	1	1	1
26	0	0	0	1	1	1
27	0.1	0.1	0.1	1.1	1.1	1.1
29	0.1	0.2	0.2	1.1	1.2	1.2
31 (1)	0.1	0.1	0.1	1.1	1.1	1.1
31 (2)	0.1	0.1	0.1	1.1	1.1	1.1
34	0	0	0	1	1	1
36	0	0	0	1	1.1	1
36a (1)	0	0	0	1	1	1
36a (2)	0	0	0	1	1	1
37	0.1	0.1	0.1	1.1	1.1	1.1
38	0	0	0	1	1	1
39	0.1	0.1	0.1	1.1	1.1	1.1
39a	0	0	0	1	1	1
40	0.2	0.2	0.2	1.2	1.2	1.2
42	0.1	0.2	0.2	1.1	1.2	1.2
43	0	0	0	1	1	1
44	0	0.1	0	1.1	1.1	1.1
47	0	0	0	1	1	1
48	0	0	0	1	1	1
50	0	0	0	1	1	1
53	0	0	0	1	1	1
54	0	0	0	1	1	1
55	0	0	0	1	1	1
56	0	0	0	1	1	1
58 (1)	0	0	0.1	1	1	1.1
58 (2)	0	0.1	0.2	1	1.1	1.2
59	0	0	0.2	1	1	1.2
60	0	0	0	1	1	1
65	0	0	0	1	1	1
69	0	0	0.1	1	1	1.1

Receiver ID (refer Figures 9.19 to 9.21)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 9 – Cumulative
	Annual Average Dust Deposition (g/m^2/month)					
	Assessment criteria = 2 g/m^2/month (Project) 4 g/m^2/month (cumulative)					
70	0	0	0	1	1	1
71	0	0	0	1	1	1.1
202	0	0.1	0.1	1.1	1.1	1.1
261	0	0	0	1	1	1
265	0	0	0	1	1	1
270	0	0	0	1.6	1.6	1.6
273	0	0	0	1	1	1
274	0	0	0	1	1	1
275	0	0	0	1	1	1
276	0	0	0	1	1	1
279	0	0	0	1	1	1
281	0.1	0.1	0.1	1.1	1.1	1.1
282	0	0	0	1	1	1
283	0	0	0	1	1	1
284	0	0	0	1	1	1
285	0	0	0	1	1	1
286	0	0	0	1	1	1
287	0	0	0	1	1	1
288	0	0	0	1	1	1
289	0	0	0	1	1	1
290	0	0	0	1	1	1
291	0	0	0	1	1	1
292 (1)	0	0	0	1	1	1
292 (2)	0	0	0	1	1	1
292 (3)	0	0	0	1	1	1
293	0	0	0	1	1	1
294	0	0	0	1	1	1
295	0	0	0	1	1	1
296	0	0	0	1	1	1
297	0	0	0	1	1.1	1
298	0	0	0	1	1.1	1
301	0	0	0	1	1	1
302	0	0	0	1	1	1
303	0	0	0.1	1	1	1.1
304	0	0	0.1	1	1	1.1
307	0	0	0	1	1	1
316	0	0.1	0.1	1.1	1.1	1.1
327	0	0	0	1	1	1
332	0	0	0	1	1	1
336	0	0	0	1	1	1
355	0	0	0	1	1	1
360	0	0	0	1	1	1
Cr.2	0.1	0.2	0.2	1.1	1.2	1.2
Cr.7	0.1	0.2	0.2	1.1	1.2	1.2
S1	0.1	0.1	0.1	1.1	1.1	1.1
S3	0.1	0.1	0.1	1.1	1.1	1.1
S4	0.1	0.1	0.1	1.1	1.1	1.1
S5	0.1	0.1	0.1	1.1	1.1	1.1
S6	0.1	0.1	0.1	1.1	1.1	1.1
S8	0.1	0.1	0.1	1.1	1.1	1.1
S9	0.1	0.1	0.1	1.1	1.1	1.1
S10	0.1	0.1	0.1	1.1	1.1	1.1
S11	0.1	0.1	0.1	1.1	1.1	1.1
S12	0.1	0.1	0.1	1.1	1.1	1.1
S13	0.1	0.1	0.1	1.1	1.1	1.1
S14	0.1	0.1	0.1	1.1	1.1	1.1
S15	0.1	0.1	0.1	1.1	1.1	1.1
S18	0.1	0.1	0.1	1.1	1.1	1.1
S19	0.1	0.1	0.1	1.1	1.1	1.1
S20	0	0.1	0.1	1.1	1.1	1.1
S21	0	0.1	0.1	1.1	1.1	1.1
S23	0.1	0.1	0.1	1.1	1.1	1.1
S24	0.1	0.1	0.1	1.1	1.1	1.1
S25	0.1	0.1	0.1	1.1	1.1	1.1
S26	0.1	0.1	0.1	1.1	1.1	1.1
S27	0.1	0.1	0.1	1.1	1.1	1.1
S28	0.1	0.1	0.1	1.1	1.1	1.1
S29	0.1	0.1	0.1	1.1	1.1	1.1

Receiver ID (refer Figures 9.19 to 9.21)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 9 – Cumulative
	Annual Average Dust Deposition ($g/m^2/month$)					
	Assessment criteria = 2 $g/m^2/month$ (Project) 4 $g/m^2/month$ (cumulative)					
S30	0.1	0.1	0.1	1.1	1.1	1.1
S31	0.1	0.1	0.1	1.1	1.1	1.1
S33	0.1	0.1	0.1	1.1	1.1	1.1
S34	0.1	0.1	0.1	1.1	1.1	1.1
S35	0.1	0.1	0.1	1.1	1.1	1.1
S36	0.1	0.1	0.1	1.1	1.1	1.1
S37	0.1	0.1	0.1	1.1	1.1	1.1
S38	0.1	0.1	0.1	1.1	1.1	1.1
S39 (1)	0.1	0.1	0.1	1.1	1.1	1.1
S39 (2)	0.1	0.1	0.1	1.1	1.1	1.1
S40	0	0.1	0.1	1.1	1.1	1.1
S41	0.1	0.1	0.1	1.1	1.1	1.1
S43	0.1	0.1	0.1	1.1	1.1	1.1
S47	0.1	0.1	0.1	1.1	1.1	1.1
S48	0.1	0.1	0.1	1.1	1.1	1.1
S49	0.1	0.1	0.1	1.1	1.1	1.1
S50	0.1	0.1	0.1	1.1	1.1	1.1
S51	0.1	0.1	0.1	1.1	1.1	1.1
S52	0.1	0.1	0.1	1.1	1.1	1.1
S53	0.1	0.1	0.1	1.1	1.1	1.1
S54	0.1	0.1	0.1	1.1	1.1	1.1
S56	0.1	0.1	0.1	1.1	1.1	1.1
S57	0.1	0.1	0.1	1.1	1.1	1.1
S58	0.1	0.1	0.1	1.1	1.1	1.1
S59	0.1	0.1	0.1	1.1	1.1	1.1
Resource Company-owned Receivers[1]						
4 (1)	0	0	0	1.1	1.1	1.1
4 (2)	0	0	0	1.2	1.2	1.2
4 (3)	0	0	0	1.2	1.2	1.2
4 (4)	0	0	0	1.2	1.2	1.2
4 (5)	0	0	0	1.2	1.2	1.2
4 (6)	0	0	0	1.1	1.1	1.1
4 (7)	0	0	0	1.1	1.1	1.1
4 (8)	0	0	0	1.1	1.1	1
4 (9)	0	0	0	1.1	1.1	1.1
4 (11)	0	0	0	2.2	2.2	2.2
4 (12)	0	0	0	1.1	1.1	1.1
4 (13)	0	0	0	2.3	2.3	2.3
4 (14)	0	0	0	1.8	1.8	1.8
4 (15)	0	0	0	2	2	2
4 (16)	0	0	0	1.8	1.7	1.7
4 (17)	0	0	0	2.1	2.1	2.1
4 (18)	0	0	0	1.4	1.4	1.4
6	0.1	0.1	0.1	1.1	1.1	1.1
13 (1)	0.1	0.2	0.1	1.2	1.2	1.2
13 (2)	0.1	0.1	0.1	1.1	1.2	1.1
19 (1)	0.1	0.1	0.1	1.1	1.1	1.1
19 (2)	0.1	0.1	0.1	1.1	1.1	1.1
19 (4)	0.1	0.1	0.1	1.1	1.1	1.1
19 (5)	0.1	0.1	0.1	1.1	1.1	1.1
19 (6)	0.1	0.1	0.1	1.1	1.1	1.1
19 (7)	0.1	0.1	0.1	1.1	1.1	1.1
19 (8)	0.1	0.2	0.2	1.1	1.2	1.2
19 (9)	0.1	0.2	0.2	1.1	1.2	1.2
19 (10)	0.1	0.2	0.2	1.1	1.2	1.2
19 (11)	0	0	0	1	1	1
19 (12)	0.1	0.2	0.2	1.1	1.2	1.2
19 (13)	0.1	0.2	0.2	1.1	1.2	1.2
19 (14)	0.1	0.2	0.2	1.1	1.2	1.2
19 (15)	0.1	0.2	0.2	1.1	1.2	1.2
19 (16)	0.1	0.2	0.2	1.1	1.2	1.2
19 (17)	0.1	0.2	0.2	1.1	1.2	1.3
19 (18)	0.1	0.2	0.3	1.1	1.2	1.3
19 (19)	0.1	0.2	0.3	1.1	1.2	1.3
19 (20)	0.1	0.2	0.2	1.1	1.2	1.3
19 (21)	0.1	0.2	0.3	1.1	1.2	1.3
19 (22)	0	0.1	0.4	1	1.1	1.4
19 (23)	0.1	0.2	0.4	1.1	1.2	1.4

Receiver ID (refer Figures 9.19 to 9.21)	Year 2 – Project alone	Year 6 – Project alone	Year 10 – Project alone	Year 2 – Cumulative	Year 6 – Cumulative	Year 9 – Cumulative
	Annual Average Dust Deposition ($g/m^2/month$)					
	Assessment criteria = 2 $g/m^2/month$ (Project) 4 $g/m^2/month$ (cumulative)					
19 (25)	0	0	1.1	1	1.1	2.1
19 (26)	0	0	0	1	1	1
19 (27)	0	0	0	1	1	1
19 (28)	0	0	0.2	1	1	1.2
19 (29)	0.2	0.2	0.1	1.2	1.2	1.1
19 (30)	0.3	0.2	0.1	1.3	1.2	1.1
19 (31)	0	0	0	1	1	1
19 (32)	0	0	0	1	1	1
19 (33)	0.3	0.1	0.1	1.3	1.1	1.1
19 (34)	0	0	0	1.1	1.1	1.1
19 (35)	0	0	0	1	1	1
19 (36)	0	0	0	1	1	1
19 (37)	0	0	0	1	1	1
19 (38)	0	0	0	1.1	1.1	1.1
19 (39)	0.1	0.2	0.2	1.1	1.2	1.2
19 (40)	0.1	0.1	0.1	1.1	1.1	1.1
19 (41)	0.1	0.1	0.1	1.1	1.1	1.1
19 (42)	0.2	0.2	0.2	1.2	1.2	1.3
19 (43)	0	0	0.1	1	1	1.1
19 (45)	0.1	0.2	0.2	1.1	1.2	1.2
19 (46)	0.1	0.2	0.2	1.1	1.2	1.2
19 (47)	0.1	0.1	0.1	1.1	1.1	1.1

[1] Denotes those receivers owned by SCPL, GRL or AGL.

9.14 Consideration of Vacant Land

Recent conditions of consent in relation to air quality have included a reference to vacant land in air quality criteria. Specifically, vacant land is considered to be affected if greater than 25% of a property is predicted to exceed the impact assessment criteria.

PAEHolmes has reviewed the relevant air quality contours and land tenure information for the Project. From this review, no potential vacant land impacts have been identified for the Project.

9.15 Construction Phase

As discussed in **Section 2.3**, additional infrastructure and construction/development activities which are required to support the Project would be progressively developed in parallel with ongoing mining operations, including:

- realignments of sections of Wheatleys Lane, Bowens Road, and Wenham Cox/Bowens Road;
- relocation of a 132 kV power line;
- installation of a new rotary breaker in the CHPP; and
- noise management infrastructure upgrades and haul road bunding.

From an air quality perspective it is important to consider the potential emissions that would occur during construction. While dust emissions from construction activities can have impacts on local air quality, impacts are typically of a short duration and relatively easy to manage through commonly applied dust control measures. Procedures for controlling dust impacts during construction would include, but not necessarily be limited to the following:

Clearing/Excavation

Emissions from vegetation stripping topsoil clearing and excavation may occur, particularly during dry and windy conditions. Emissions would be effectively controlled by increasing the moisture content of the soil/surface (i.e. through the use of water carts/trucks). Other controls that would be undertaken include:

- modifying working practices by limiting excavation during periods of high winds; and
- limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.

Road Realignments/Bulk Earthworks for Noise Mitigation

The use of earth moving equipment can be a significant source of dust, and emissions would be controlled through the use of water sprays.

Haulage, Heavy Plant and Equipment

Vehicles travelling over paved or unpaved surfaces tend to produce wheel generated dust. The following measures would be implemented during construction to minimise dust emissions from these activities:

- all vehicles on-site would be confined to designated routes with speed limits enforced;
- trips and trip distances would be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips; and
- when conditions are excessively dusty and windy, a water cart/truck (for water spraying of travel routes) would be used.

Wind Erosion

Wind erosion from exposed surfaces during construction would be controlled as part of the best practice environmental management of the site. Wind erosion from exposed ground would be limited by avoiding unnecessary vegetation clearing and by progressively rehabilitating exposed areas as quickly as possible (e.g. through the use of a cover crop). Wind erosion from temporary stockpiles would be limited by minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles.

9.16 Blast Fume Emissions

Blasting activities have the potential to result in fugitive fume and particulate matter emissions. Particulate matter emissions from blasting are included in dispersion modelling results and are controlled by adequate stemming of the blast.

Imperfect blasts (e.g. when the explosive product is incorrectly formulated) may result in nitrogen oxide (NO_x) fumes (**Australian Explosives Industry and Safety Group Inc., 2011**). Measures to minimise or avoid imperfect blasts would be implemented in accordance with *Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting* (**Australian Explosives Industry and Safety Group Inc., 2011**), and these measures would be incorporated into the Project Blast Management Plan.

Fumes from blasting would be managed in accordance with *Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting* (**Australian Explosives Industry and Safety Group Inc., 2011**). Measures that would be implemented include:

- formulation of explosive products to an appropriate oxygen balance to reduce the likelihood of fumes;
- reviewing geological conditions in the formulation of blast designs;
- reviewing ground conditions (e.g. presence of clay or loose/broken ground);
- minimising the time between drilling and loading, and loading and shooting of the blast; and
- consideration of meteorological conditions in blast scheduling.

9.17 Spontaneous Combustion

Spontaneous combustion events have the potential to give rise to odour emissions.

Review of the last two Annual Environmental Management Reports (**SCPL, 2010b, 2011b,**) indicated no incidences of spontaneous combustion. However, two separate incidences of spontaneous combustion have occurred historically in the Stratford Main Pit associated with the Glenview Seam being exposed in the final highwall/endwall by geological faulting. These incidences were due to structural failures in the northern highwall of the pit exposing a coal seam that has not previously been mined at the SCM (**SCPL, 2009**).

Mitigative works employed by SCPL (placement of inert material over self heating areas and highwall stability works) combined with rising water levels in the Stratford Main Pit resulted in the extinguishment of these self-heating areas (**SCPL, 2010b**).

A Spontaneous Combustion Management Plan is currently in place at the SCM (**SCPL, 2004**). This plan outlines management and mitigation measures to reduce the potential for spontaneous combustion events, including:

- identification of potential self-heating coal seams as part of coal quality assessment; and
- placement of inert material over areas where known self-heating seams would otherwise be permanently exposed.

For the Project, it is understood that the Glenview Seam may be a feature of the proposed Avon North Open Cut. Therefore, the potential for spontaneous combustion events in the Avon North Open Cut would be closely managed. In particular, the final highwall/end wall would be designed to limit the potential for long-term exposure in the Glenview Seam. It is noted that any exposure of this seam would likely be temporary as the Avon North Open Cut final void would be used as a contained water storage for the Project and would ultimately be partially backfilled with waste rock CHPP rejects.

The Spontaneous Combustion Management Plan would continue to be employed for the Project and would be reviewed/augmented as necessary.

9.18 Potential Effects of Dust on Domestic Tank Water Supply

Studies relating to the potential for build-up of harmful constituents in water tanks of residents close to mining operations have previously been undertaken both in the Stratford village and elsewhere in the NSW mining industry.

A study conducted by Gloucester Shire Council (**Parkinson and Stimson, 2010**) included laboratory testwork of rainwater tanks in Stratford village as well as from tanks in a number of other villages remote from coal mining areas. The study concluded (**Parkinson and Stimson, 2010**):

A 'snapshot' sample of water from rainwater tanks at Stratford, Barrington and Copeland Villages was undertaken. Results of laboratory testing were compared to the Australian Drinking Water Guidelines (ADWG's) and the majority of values were within these guidelines. There were however several isolated results for zinc, aluminium and iron that exceeded the guidelines, however these parameters are aesthetic only, and do not indicate health concerns. There were two lead levels that exceeded the guideline value; however it is believed that this is attributed to the poor condition of the dwellings and tanks concerned.

Statistical comparison of values between each village failed to indicate any significant difference in values between Stratford Village and the other villages tested.

It is noted from review of **Section 9.12** that deposited dust levels are well below the relevant criteria. For example, the highest predicted incremental (Project-only) dust deposition rate at privately-owned receivers was 0.2 g/m^2/month, which is well below the criteria of 2 g/m^2/month (Project-only).

Appendix L of the EIS presents an assessment of the geochemistry of waste rock (**Environmental Geochemistry International [EGi], 2012**). In relation to the potential for element enrichment of waste rock, Appendix L of the EIS concludes (**EGi, 2012**):

Multi-element analysis suggests that waste rock represented by the samples tested would have no significant elemental enrichment apart from S [Sulphur] *(mainly for Stratford East Open Cut).*

9.19 Potential Effects of Dust on Agricultural Production

The potential effects of coal dust on agricultural production has been the subject of previous study (**Andrews and Skriskandarajah, 1992** in **Connell Hatch, 2008**).

This study found that:

- Cattle did not find feed unpalatable if coal mine dust was present at a level equivalent to a dust deposition level of 4,000 milligrams per square metre per day ($mg/m^2/day$) (equivalent to a dust deposition level of approximately 120 $g/m^2/month$);
- The presence of coal mine dust in feed did not affect the amount of feed that the cattle ate or the amount of milk that the cattle produced at a level equivalent to a dust deposition level of 4,000 $mg/m^2/day$; and
- Cattle did not preferentially eat feed that did not contain coal mine dust. The cattle were able to choose between feed that was free of coal mine dust, feed that contained 4,000 $mg/m^2/day$ of coal mine dust and feed that contained 8,000 $mg/m^2/day$ of coal mine dust.

Given that predicted Project dust deposition levels are far lower at nearby properties that those studies in (**Andrews and Skriskandarajah, 1992** in **Connell Hatch, 2008**), effects of Project-related dust on agricultural production are expected to be minimal.

9.20 Potential Effects of Dust on TransGrid Electricity Transmission Line

The extent of the Stratford East Open Cut would require the relocation of a section of the existing 132 kV power line owned by TransGrid (**Figure 2.1**). It is noted that TransGrid has raised concern regarding the effect of excess dust levels on the 132 kV power line (email from Mr David Turvey [TransGrid] to Mr Carl Dumpleton [DP&I]).

Comparison of the proposed realignment location on **Figure 2.1** and the Project only dust deposition contours on **Figure 9.21** indicates that, with the implementation of the mitigation measures described in **Section 7**, Project-related dust levels on the power line are not expected to be excessive.

10 COAL TRANSPORTATION

SCPL commissioned an investigation of dust emissions from the transportation of coal between the SCM and the Port of Newcastle (**Introspec Consulting, 2012**). The study objective was to determine the Dust Extinction Moisture (DEM) level for the SCM product coal and to simulate the dust lift off levels from the transport of coal between the sites and to the Port of Newcastle.

The report concludes that the DEM level for Stratford Mining Complex washed thermal coal of 5% is significantly lower than product coal moisture levels advised by SCPL (7-8%). SCPL also has confirmed that the moisture content of export coal (thermal and coking) received at the Port of Newcastle during the months of January and February 2012 was consistently greater than or equal to 5%.

This suggests that dust lift off during transportation by rail is likely to be minimal.

The potential for health effects from coal dust emissions from rail transport has recently been studied extensively in Queensland. Queensland Rail (QR) commissioned an environmental evaluation of coal dust emissions from rolling stock in the Central Queensland Coal Industry (**Connell Hatch, 2008**). The purpose of this study was to determine the extent of the issue and identify any potential environmental harm caused by fugitive dust from coal wagons, in the context of nuisance and health impacts and to identify the potential reasonable and feasible measures that could reduce any environmental harm.

In terms of impacts on human health, the QR study concluded that there appears to be minimal risk of adverse impacts due to fugitive coal emissions from trains throughout the network, based on results of monitoring and modelling predictions (**Connell Hatch, 2008**). In terms of impacts on amenity, the results of monitoring and modelling indicate that fugitive coal dust at the edge of the rail corridor are below levels that are known to cause adverse impacts on amenity (**Connell Hatch, 2008**).

11 GREENHOUSE GAS ASSESSMENT

11.1 Introduction

GHG emissions have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol *The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition* (**WRI/WBCSD, 2004**);
- *National Greenhouse and Energy Reporting (Measurement) Determination 2008*; and
- The Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) *National Greenhouse Accounts* (NGA) *Factors 2011* (**DCCEE, 2011**).

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes, as described below. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment. The 'scope' of an emission is relative to the reporting entity. Indirect scope 2 and scope 3 emissions will be reportable as direct scope 1 emissions from another facility.

1) Scope 1: Direct Greenhouse Gas Emissions

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG emissions are those emissions that are principally the result of the following types of activities undertaken by an entity:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources.
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials (e.g. the manufacture of cement, aluminium, etc.).
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources (e.g. trucks, trains, ships, aeroplanes, buses and cars).
- Fugitive emissions. These emissions result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, packing, and gaskets; CH_4 emissions from coal mines and venting); hydroflurocarbon emissions during the use of refrigeration and air conditioning equipment; and CH_4 leakages from gas transport.

2) Scope 2: Energy Product Use Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for GHG emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 in relation to coal mines typically covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

3) Scope 3: Other Indirect Greenhouse Gas Emissions

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

In the case of the Project, scope 3 emissions will include emissions associated with the extraction, processing and transport of diesel, and the transportation and combustion of product coal. The GHG Protocol provides that reporting scope 3 emissions is optional. If an organisation believes that scope 3 emissions are a significant component of the total emissions inventory, these can be reported along with scope 1 and scope 2. However, the GHG Protocol notes that reporting scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or products difficult because reporting is voluntary. Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The GHG Protocol also recognises that compliance regimes are more likely to focus on the "point of release" of emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity.

11.2 Greenhouse Gas Emission Estimates

Emissions of CO_2 and CH_4 would be the most significant GHGs for the Project. These gases are formed and released during the combustion of fuels used on-site and from fugitive emissions occurring during the mining process, due to the liberation of CH_4 from coal seams.

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of CO_2 equivalent (CO_2-e) emissions by applying the relevant global warming potential. The GHG assessment has been conducted using the NGA Factors, published by the **DCCEE (2011)**.

Project-related GHG sources included in the assessment are as follows:

- fuel consumption (diesel) during mining operations – scope 1;
- release of fugitive CH_4 during mining – scope 1;
- emissions associated with the loss of carbon through vegetation clearing – scope 1;
- indirect emissions associated with on-site electricity use – scope 2;
- indirect emissions associated with the production and transport of fuels – scope 3;
- emissions from coal transportation – scope 3; and
- emissions from the use of the product coal – scope 3.

A summary of the annual GHG emissions is provided in **Table 11.1**. Detailed emission calculations are provided in **Appendix E**.

Emissions from the shipping of product coal are not included in this assessment due to the uncertainties in emission estimates, including uncertainty in future export destinations and limited data on emission factors and/or fuel consumption for ocean going vessels.

Table 11.1: Summary of Estimated CO_2-e (tonnes) – All Scopes

	Scope 1 Emissions (t CO_2-e)				Scope 2 Emissions (t CO_2-e)	Scope 3 Emissions (t CO_2-e)				
Year	**Diesel**	**Fugitive Methane**	**Vegetation**	***Total***	**Electricity**	**Diesel**	**Electricity**	**Energy Production**	**Rail**	***Total***
1	50,856	82,184	3,934	*136,973*	31,590	3,878	6,389	3,370,152	3,998	*3,384,417*
2	57,854	76,500	3,934	*138,288*	38,126	4,412	7,711	3,110,909	3,690	*3,126,722*
3	53,521	74,250	3,934	*131,705*	29,412	4,081	5,948	3,370,152	3,998	*3,384,179*
4	54,337	76,500	3,934	*134,771*	30,501	4,144	6,169	3,370,152	3,998	*3,384,462*
5	56,674	88,144	3,934	*148,752*	33,769	4,322	6,830	3,629,394	4,305	*3,644,851*
6	66,568	81,000	3,934	*151,502*	25,054	5,076	5,067	3,370,152	3,998	*3,384,293*
7	67,120	94,500	3,934	*165,554*	16,340	5,119	3,305	3,888,637	4,613	*3,901,672*
8	69,087	101,250	3,934	*174,270*	16,340	5,268	3,305	3,888,637	4,613	*3,901,822*
9	69,174	105,750	3,934	*178,857*	16,340	5,275	3,305	3,888,637	4,613	*3,901,829*
10	70,035	117,000	3,934	*190,969*	17,429	5,341	3,525	4,147,879	4,920	*4,161,665*
11	28,017	66,326	3,934	*98,277*	10,893	2,137	2,203	2,592,424	3,075	*2,599,839*
Total	**643,244**	**963,405**	**43,270**	**1,649,919**	**265,794**	**49,053**	**53,756**	**38,627,124**	**45,818**	**38,775,751**

Note: Totals may differ to the sum of the columns due to rounding and significant figures.

A site specific emission factor for fugitive CH_4 for the Stratford East Open Cut has been calculated to be approximately 0.0008 tonnes (t) CO_2-e/t ROM (**Geogas, 2009**). This is less than 2% of the default factor for open cut coal mines sourced from **DCCEE (2011)**. Therefore, as an indication of the sensitivity of fugitive emissions to this factor, maximum annual emissions would reduce from 117,000 tonnes (t) CO_2-e per annum) to approximately 2,000 t CO_2-e per annum if this factor was adopted for the Project. Therefore, fugitive emissions presented in **Table 11.1** are likely to be a significant overestimate of fugitive CH_4 emissions.

It is also noted that diesel would be consumed post-mining during rehabilitation and decommissioning of the Project. However, SCPL estimates that this would involve less diesel consumption due to the reduced demand for diesel-generated power and reduced quantities of material movements relative to the operational phase (where progressive rehabilitation also occurs). These emissions have therefore not been specifically quantified.

11.3 Impact on the Environment

According to the Intergovernmental Panel of Climate Change's (IPCC) Fourth Assessment Report, global surface temperature has increased 0.74 ± 0.18°C during the 100 years ending 2005 (**IPCC, 2007a**). The IPCC has determined *"most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".* "Very likely" is defined by the IPCC as greater than 90% probability of occurrence (**IPCC, 2007b**).

Climate change projections specific to Australia have been determined by the CSIRO, based on the following global emissions scenarios predicted by the IPCC (**CSIRO, 2007**):

- A1F1 (high emissions scenario) – assumes very rapid economic growth, a global population that peaks in mid-century and technological change that is fossil fuel intensive.
- A1B (mid emissions scenario) – assumes the same economic and population growth as A1F1, with a balance between fossil and non-fossil fuel intensive technological changes.
- B1 (low emissions scenario) – assumes the same economic and population growth as A1F1, with a rapid change towards clean and resource efficient technologies.

For the global emissions scenarios described above, the projected changes in annual temperature relative to 1990 levels for Australian cities for 2030 and 2070 are presented in **Table 11.2** as determined by the **CSIRO (2007)**. The towns/cities presented in **Table 11.2** are those closest to the Stratford Mining Complex for which results are available.

Table 11.2: Projected Changes in Annual Temperature (relative to 1990)

Location	2030 - A1B (mid-range emissions scenario)	2070 - B1 (low emissions scenario)	2070 - A1F1 (high emissions scenario)
		Temperature (°C)	
Brisbane	0.7 - 1.4	1.1 - 2.3	2.1 - 4.4
Dubbo	0.7 - 1.5	1.2 - 2.5	2.2 - 4.8
St George (Queensland)	0.7 - 1.6	1.2 - 2.7	2.4 - 5.2
Sydney	0.6 - 1.3	1.1 - 2.2	2.1 - 4.3

Notes: Range of values represents the 10^{th} and 90^{th} percentile results.
For 2030, only A1B results are shown as there is little variation in projected results for the global emission scenarios A1B, B1 and A1F1 (**CSIRO, 2007**).
Source: **CSIRO (2007)** *Climate Change in Australia – Technical Report 2007*, Commonwealth Scientific and Industrial Research Organisation.

The CSIRO also details projected changes to other meteorological parameters (for example rainfall, potential evaporation, wind speed, relative humidity and solar radiation) and the predicted changes to the prevalence of extreme weather events (for example droughts, bush fires and cyclones).

The potential social and economic impacts of climate change to Australia are detailed in the Garnaut Climate Change Review (**Garnaut, 2008**), which draws on IPCC assessment work and the CSIRO climate projections. The Garnaut review details the negative and positive impacts associated with predicted climate change with respect to:

- agricultural productivity;
- water supply infrastructure;
- urban water supplies;
- buildings in coastal settlements;
- temperature related deaths;
- ecosystems and biodiversity; and
- geopolitical stability and the Asia-Pacific region.

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual scope 1 emissions from the Project (0.1 million tonnes [Mt] CO_2-e) would represent approximately 0.03% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions, given that Australia contributed approximately 1.5% of global GHG emissions in 2005 (**Commonwealth of Australia, 2011**).

A comparison of predicted annual GHG emissions from the Project with global, Australian and NSW emissions inventories are presented in **Table 11.3**.

Table 11.3: Comparison of Greenhouse Gas Emissions

Geographic Coverage	Source Coverage	Timescale	Emission Mt CO_2-e	Reference
Project	Scope 1 only	Average annual	0.1	This report.
Global	Consumption of fossil fuels	Total since industrialisation 1750 - 1994	865,000	IPCC (2007a). Figure 7.3 converted from Carbon unit basis to CO_2 basis. Error is stated greater than ±20%.
Global	CO_2-e emissions	2005	35,000	Based on Australia representing 1.5% of global emissions (Commonwealth of Australia, 2011). Australian National Greenhouse Gas Inventory (2005) taken from http://www.ageis.greenhouse.gov.au/
Global	CO_2-e emission increase 2004 to 2005	2005	733	IPCC (2007a). From tabulated data presented in Table 7.1 on the basis of an additional 733 Mt/a. Data converted from Carbon unit basis to CO_2 basis.
Australia	1990 Base	1990	547.7	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/
Australia	Kyoto target	Average annual 2008 - 2012	591.5	Based on 1990 net emissions multiplied by 108% Australia's Kyoto emissions target.
Australia	Total (inclusive of existing Stratford Mining Complex)	2009	564.5	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/

Geographic Coverage	Source Coverage	Timescale	Emission Mt CO_2-e	Reference
NSW	Total	2009	160.5	Taken from the National Greenhouse Gas Inventory (2009) http://www.ageis.greenhouse.gov.au/

The commitment from the Australian Government to reduce GHG emissions is proposed to be achieved through the introduction of the Australian Government's proposed carbon pricing mechanisms. From 1 July 2012, this will involve a fixed price on GHG emissions, with no cap on Australia's GHG emissions, or emissions from individual facilities (**Commonwealth of Australia, 2011**).

From 1 July 2015 an emissions trading scheme is proposed to be implemented. As such, Australia's GHG emissions, inclusive of emissions associated with the Project, would be capped at a level specified by the Australian Government. Under the emissions trading scheme, there will specifically be no limit on the level of GHG emissions from individual facilities, with the incentive for facilities to reduce their GHG emissions driven by the carbon pricing mechanism (**Commonwealth of Australia, 2011**).

It is expected that the Project would exceed the facility threshold of 25,000 t CO_2-e per annum for participation in the carbon pricing mechanisms, and as such scope 1 GHG emissions from the Project would be subject to the carbon pricing mechanism. As such, SCPL would directly contribute to the revenue generated by the carbon pricing mechanism, which is to be used to fund the following initiatives designed to reduce Australia's GHG emissions (**Commonwealth of Australia, 2011**):

- $1.2 billion Clean Technology Program to improve energy efficiency in manufacturing industries and support research and development in low-pollution technologies.
- $10 billion Clean Energy Finance Corporation to invest in renewable energy, low-pollution and energy efficiency technologies.
- $946 million Biodiversity Fund (over the first six years) to protect biodiverse carbon stores and secure environmental outcomes from carbon farming.

In addition to contributing to these initiatives, SCPL would implement Project-specific GHG mitigation measures, as described in **Section 11.5**.

11.4 Greenhouse Gas Emissions Intensity

The estimated GHG emissions intensity of the Project is approximately 0.11 t CO_2-e/t saleable coal (this includes all scope 1 emissions) (**Figure 11.1**).

The largest source of scope 1 GHG emissions is fugitive CH_4 emissions (approximately 60%) (refer **Table 11.1**). These emissions have likely been over-estimated by using the NGA Factors default emission factor in the absence of site specific data. For example, preliminary gas content testing for the site indicates that the site specific emission factor could be as low as 2% of this default value (**Section 11.2**). Using the site specific fugitive CH_4 emissions factor, the average emissions intensity reduces to 0.05 t CO_2-e/t saleable coal, which would place the Project emissions in line with the average emissions for Australian open cut mines as reported in **Deslandes, 1999**.

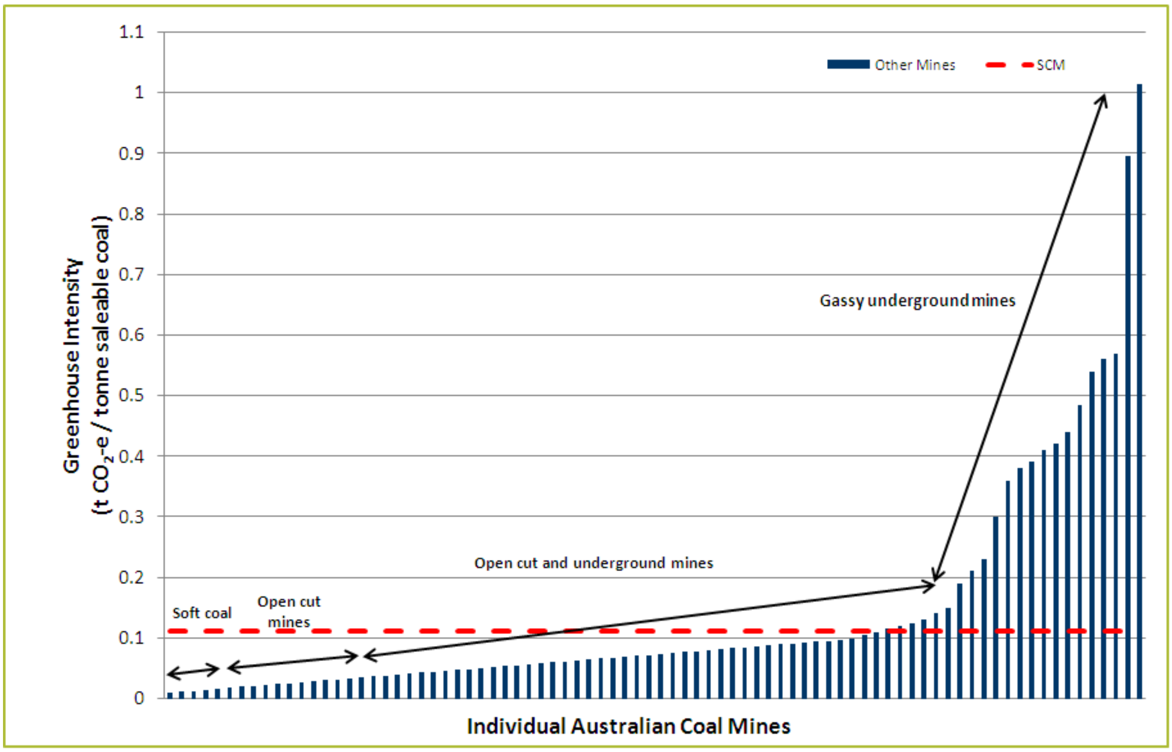


Figure 11.1: Greenhouse Gas Intensity Comparison

11.5 Greenhouse Gas Management

GHG management measures current employed at the Stratford Mining Complex are described in the Stratford Mining Complex AQGHGMP (**SCPL, 2011a**). SCPL has implemented a number of reasonable and feasible measures to minimise GHG emissions from the Stratford Mining Complex. These measures are described below:

- Maximising energy efficiency as a key consideration in the development of the mine plan. For example, significant savings of GHG emissions (through increased energy efficiency) are achieved by mine planning decisions which minimise haul distances for ROM coal and waste rock transport, and therefore fuel use.
- SCPL has prepared and implemented an Energy Savings Action Plan in accordance with the NSW *Energy Administration Amendment (Water and Energy Savings) Act, 2005* and the *Guidelines For Energy Savings Action Plans* (**Department of Energy, Utilities and Sustainability, 2005**). SCPL has conducted a comprehensive analysis of energy usage and management strategies at the Stratford Mining Complex, and has identified cost-effective energy saving opportunities, including:
  - installation of power factor correction equipment to reduce the maximum electricity demand at the Stratford Mining Complex by an estimated 10%;
  - replacement of existing pumps in the CHPP with more efficient models;
  - potential replacement of an existing compressor in the CHPP with a more efficient model;
  - potential replacement of the CHPP rejects pipeline to increase pumping efficiency; and
  - potential adjustment of the number and location of lights in mining and infrastructure areas.

In addition, the following measures will be implemented:

- regular maintenance of plant and equipment to minimise fuel consumption; and
- consideration of energy efficiency in the plant and equipment selection phase.

The effectiveness of these measures to reduce GHG emissions (and energy consumption) will be monitored, as SCPL will annually estimate GHG emissions and energy consumption in accordance with National Greenhouse and Energy Reporting and Energy Efficiency Operations requirements.

For the Project, SPCL would also directly measure the gas content representative of the coal seams being mined in order to provide a site-specific factor of the scope 1 emissions.

12 CONCLUSION

PAEHolmes has completed an Air Quality and Greenhouse Gas Assessment for the continuation and extension of open cut coal mining and processing activities at the Project. The assessment was prepared in accordance with the DGRs.

Current ambient air monitoring at the Stratford Mining Complex shows that existing operations have a minimal impact on local air quality.

Notwithstanding, SCPL has committed to a number of key mitigation measures, which have the potential to materially reduce the dust emissions of the Project:

- Vehicle speed restriction to 60 km/hr.
- Use of larger vehicles.
- Increase intensity of haul road water sprays.
- Watering of wind erosion areas.
- Vegetative groundcover on wind erosion areas.

The mining plans for the Project have been analysed and detailed emissions inventories have been prepared for three key scenarios representative of worst-case operations. Dispersion modelling was conducted for each scenario to predict the ground level concentrations for all relevant particulate matter and deposited dust emissions.

Cumulative impacts were also considered, taking into account the approved AGL Gloucester Gas Project and the proposed Rocky Hill Coal Project, as well as other non-mining sources.

The modelling indicates that there are no privately owned receivers or vacant land that are predicted to experience 24-hour average PM_{10} concentrations above the assessment criterion, due to emissions from the Project-only. There are no privately owned receivers or vacant land that are predicted to experience annual average PM_{10} concentrations above the assessment criteria, due to emissions from the Project-only.

There are no privately owned receivers or vacant land that are predicted to experience annual average TSP or dust deposition above the impact assessment criteria, either from the Project alone or cumulatively. There are no receivers or vacant land that are predicted to experience annual average $PM_{2.5}$ concentrations above the advisory reporting standard, either from the Project alone or cumulatively.

When the contour plots for an existing operations scenario (FY2011) are compared with the contours for the worst case year for the Project, the results indicate that emissions from existing operations are similar to the worst case year for the Project. Monitoring data for existing operations demonstrates compliance with air quality goals and the inference from the modelling results is that the Project should therefore not result in unacceptable air quality effects in the local area.

A GHG assessment for the Project indicates that average annual direct emissions from the Project (0.1 Mt CO_2-e) would represent approximately 0.03% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions.

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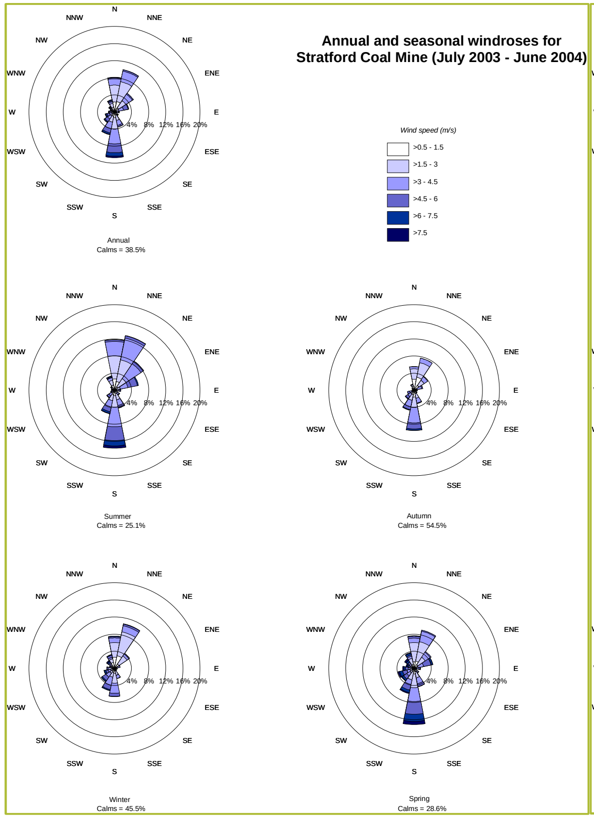
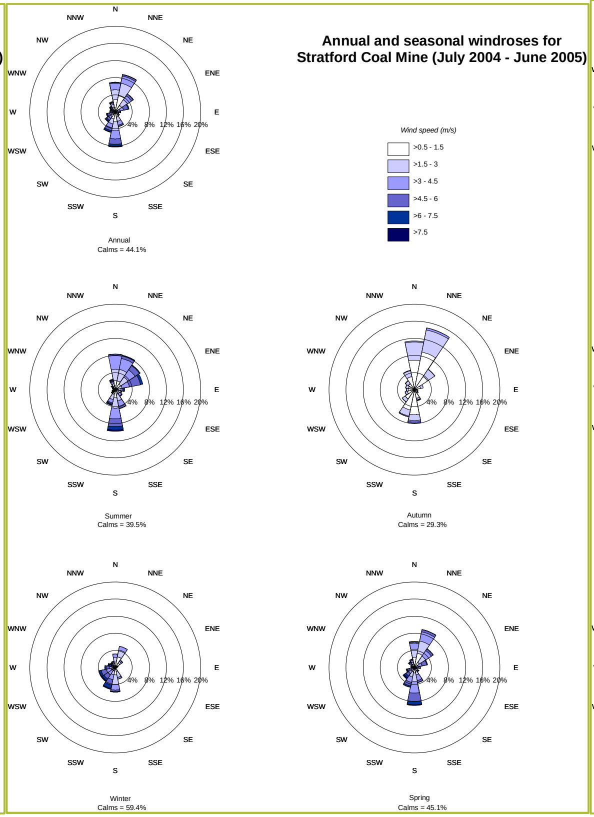
APPENDIX A - WIND ANALYSIS


Annual and seasonal windroses for
Stratford Coal Mine (July 2003 - June 2004)
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 38.5%
Summer
Calms = 25.1%
Autumn
Calms = 54.5%
Winter
Calms = 45.5%
Spring
Calms = 28.6%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Wind speed (m/s)
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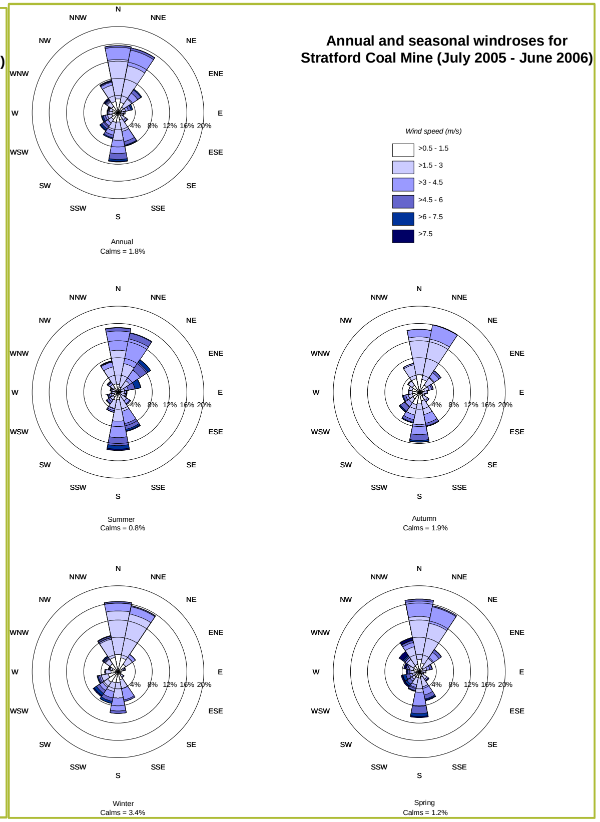
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 44.1%
Summer
Calms = 39.5%
Autumn
Calms = 29.3%
Winter
Calms = 59.4%
Spring
Calms = 45.1%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Wind speed (m/s)
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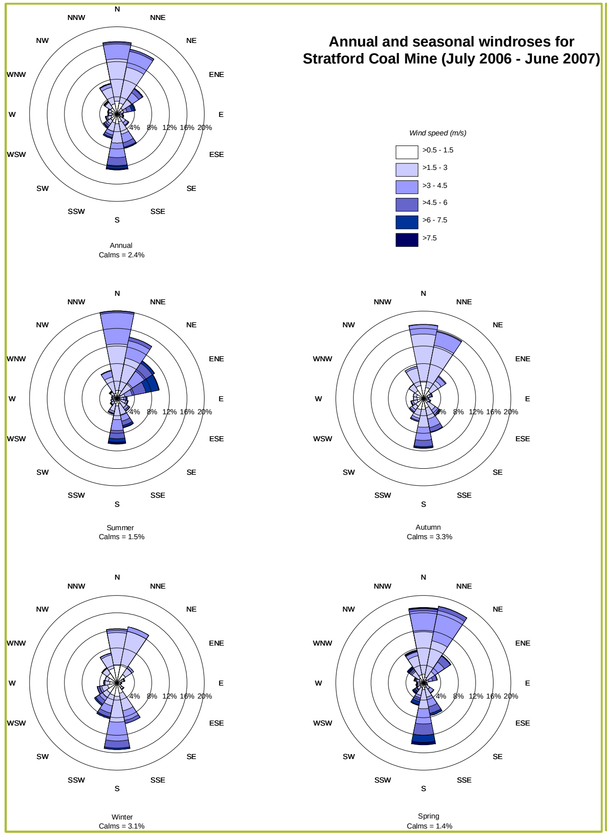
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 1.8%
Summer
Calms = 0.8%
Autumn
Calms = 1.9%
Winter
Calms = 3.4%
Spring
Calms = 1.2%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Wind speed (m/s)
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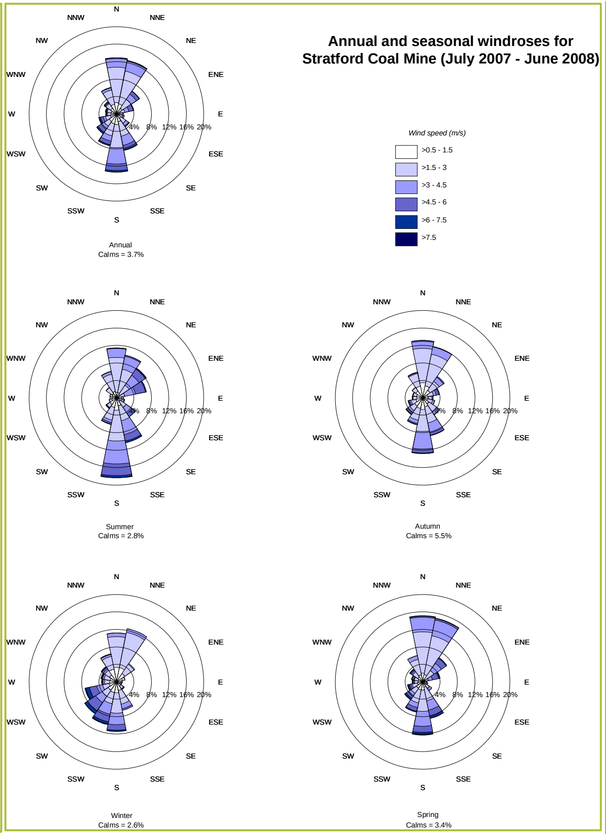
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 2.4%
Summer
Calms = 1.5%
Autumn
Calms = 3.3%
Winter
Calms = 3.1%
Spring
Calms = 1.4%


Annual and seasonal windroses for
Stratford Coal Mine (July 2007 - June 2008)
Wind speed (m/s)
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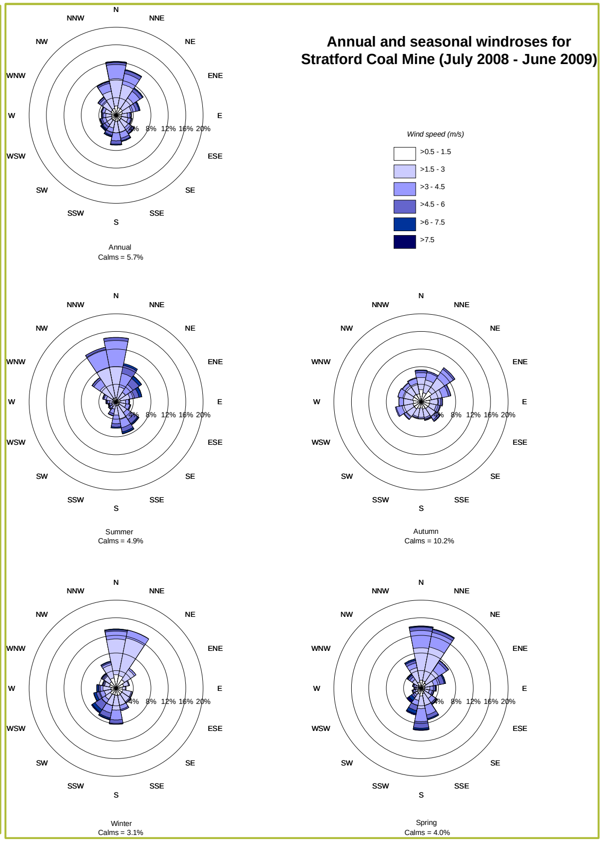
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 3.7%
Summer
Calms = 2.8%
Autumn
Calms = 5.5%
Winter
Calms = 2.6%
Spring
Calms = 3.4%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Wind speed (m/s)
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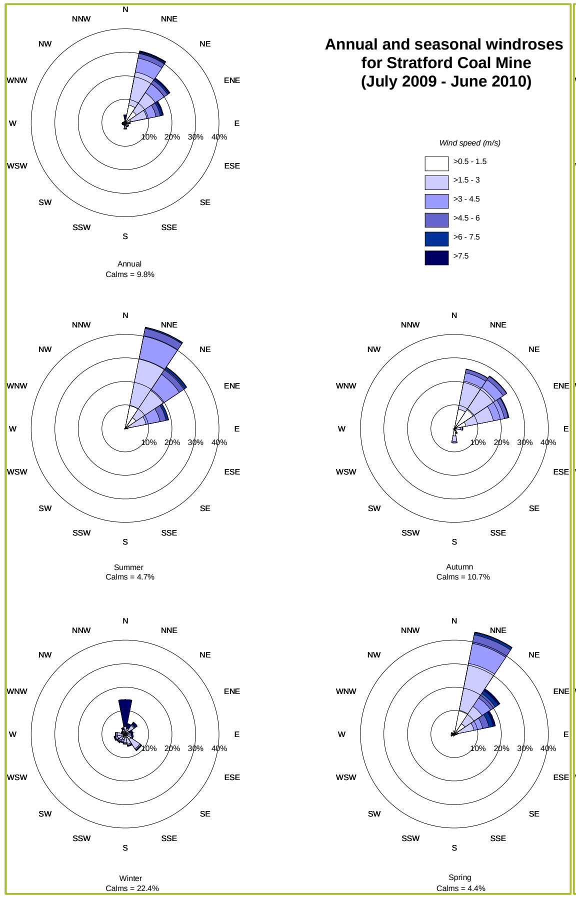
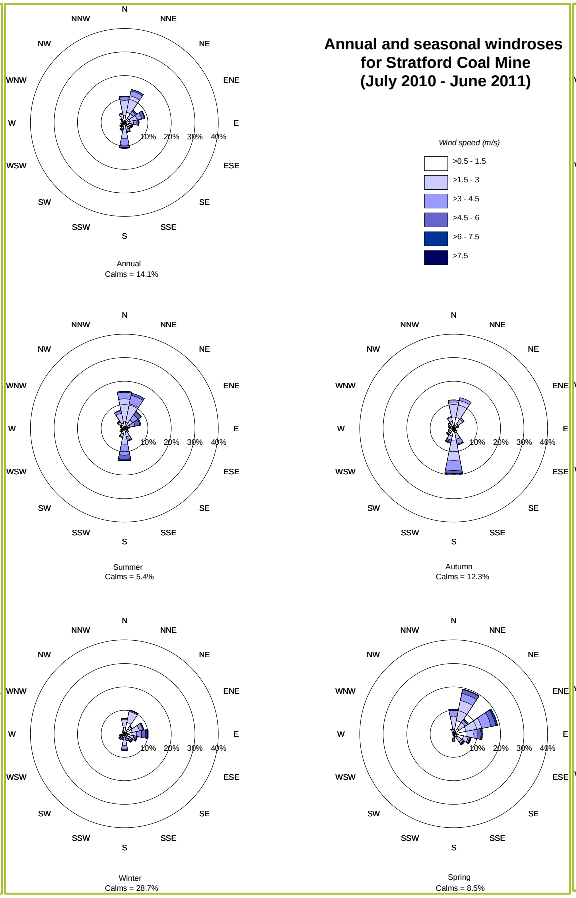
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 5.7%
Summer
Calms = 4.9%
Autumn
Calms = 10.2%
Winter
Calms = 3.1%
Spring
Calms = 4.0%


Annual and seasonal windroses
for Stratford Coal Mine
(July 2009 - June 2010)
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 9.8%
Summer
Calms = 4.7%
Autumn
Calms = 10.7%
Winter
Calms = 22.4%
Spring
Calms = 4.4%


Annual and seasonal windroses
for Stratford Coal Mine
(July 2010 - June 2011)
Wind speed (m/s)
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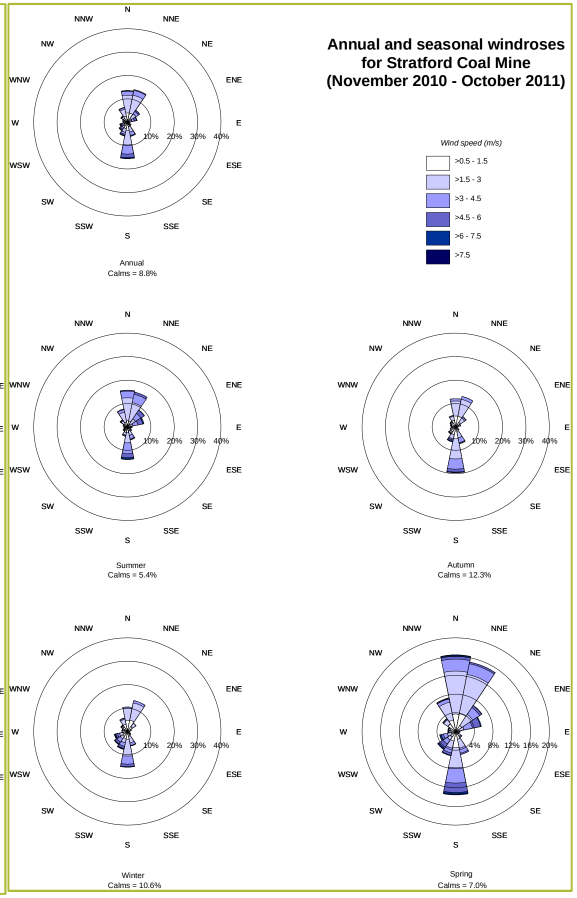
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 14.1%
Summer
Calms = 5.4%
Autumn
Calms = 12.3%
Winter
Calms = 28.7%
Spring
Calms = 8.5%


Annual and seasonal windroses
for Stratford Coal Mine
(November 2010 - October 2011)
Wind speed (m/s)
>0.5 - 1.5
>1.5 - 3
>3 - 4.5
>4.5 - 6
>6 - 7.5
>7.5
Annual
Calms = 8.8%
Summer
Calms = 5.4%
Autumn
Calms = 12.3%
Winter
Calms = 10.6%
Spring
Calms = 7.0%

APPENDIX B - ESTIMATION OF DUST EMISSIONS

Stratford Extension Project

The dust emission inventories have been prepared using the operational description of the proposed mining activities provided by Stratford Coal Mine (SCM).

Estimated emissions are presented for all significant dust generating activities associated with the operations. The relevant emission factors used for the study are described below. Activities have generally been modelled for 24-hours per day, with the exceptions noted below.

- **Bowens Road North Open Cut** – mining operations would only occur between the hours of 7.00 am to 7.00 pm, seven days per week.
- **Roseville West Pit Extension** – mining operations would only occur between the hours of 7.00 am to 6.00 pm, seven days per week.
- **Stratford East Open Cut (years 1 to 5)** – Fleet associated with the removal of overburden would only operate between the hours of 7.00 am to 6.00 pm, seven days per week. The remaining fleet would operate 24-hours per day, seven days per week.
- **Stratford East Open Cut (years 6 to 11)** – mining operations would be conducted 24-hours per day, seven days per week.
- **Avon North Open Cut** – mining operations would be conducted 24-hours per day, seven days per week.

Recovery of coal handling and preparation plant rejects by excavation from the western co-disposal area for re-processing would only occur between the hours of 7.00 am to 6.00 pm, seven days per week.

Dust from wind erosion is assumed to occur over 24-hours per day, however, wind erosion is also assumed to be proportional to the third power of wind speed. This will mean that most wind erosion occurs during the day when wind speeds are highest.

For each stage of the mine shown in **Figures B1** to **B3,** a corresponding emissions inventory has been developed. The modelled scenarios are considered to be representative of worst-case operations; for example where coal and waste rock production is highest, where extraction or wind erosion areas are largest or where operations are located closest to receivers.

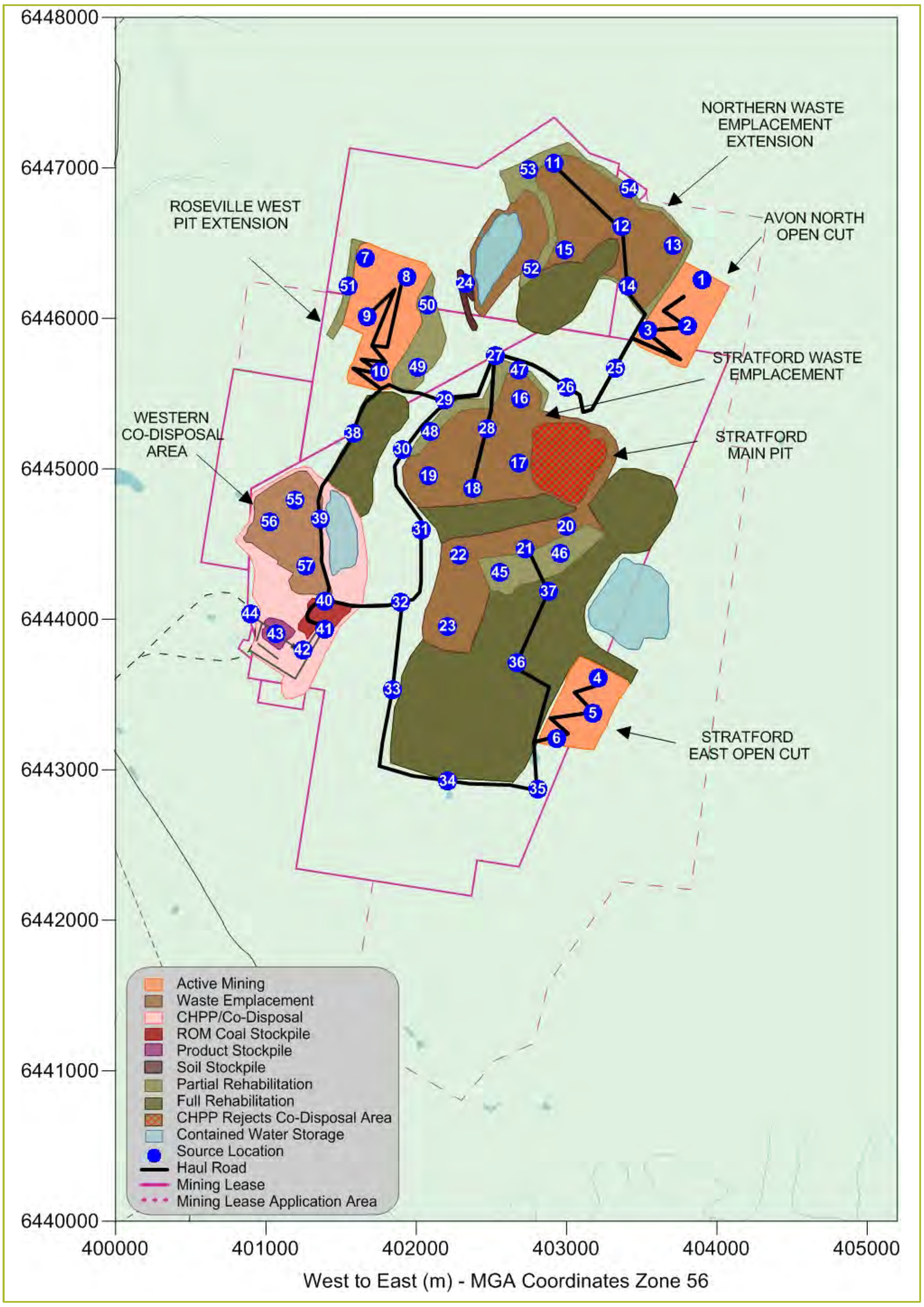


Figure B1: Location of Sources for Year 2

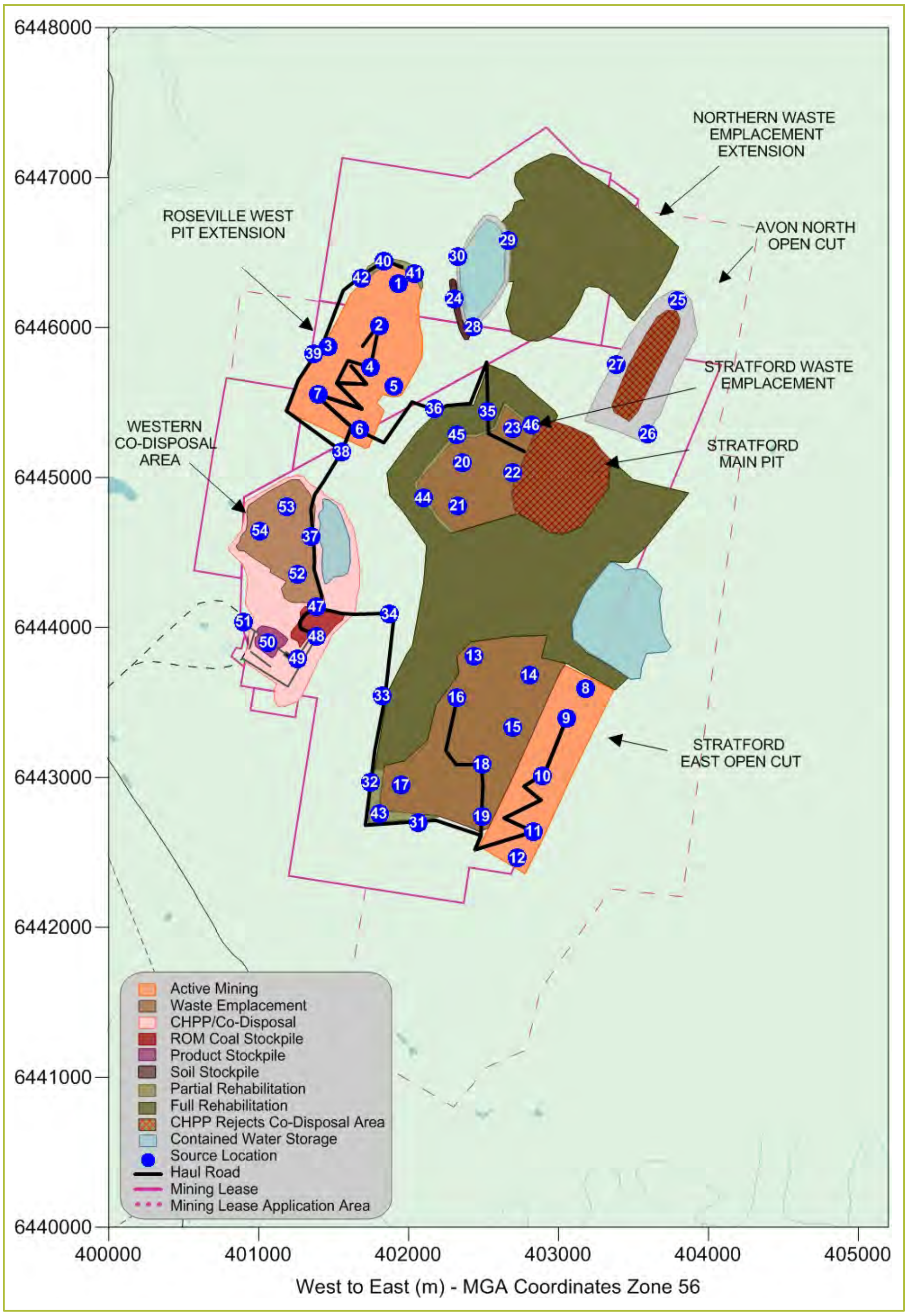


Figure B2: Location of Sources for Year 6

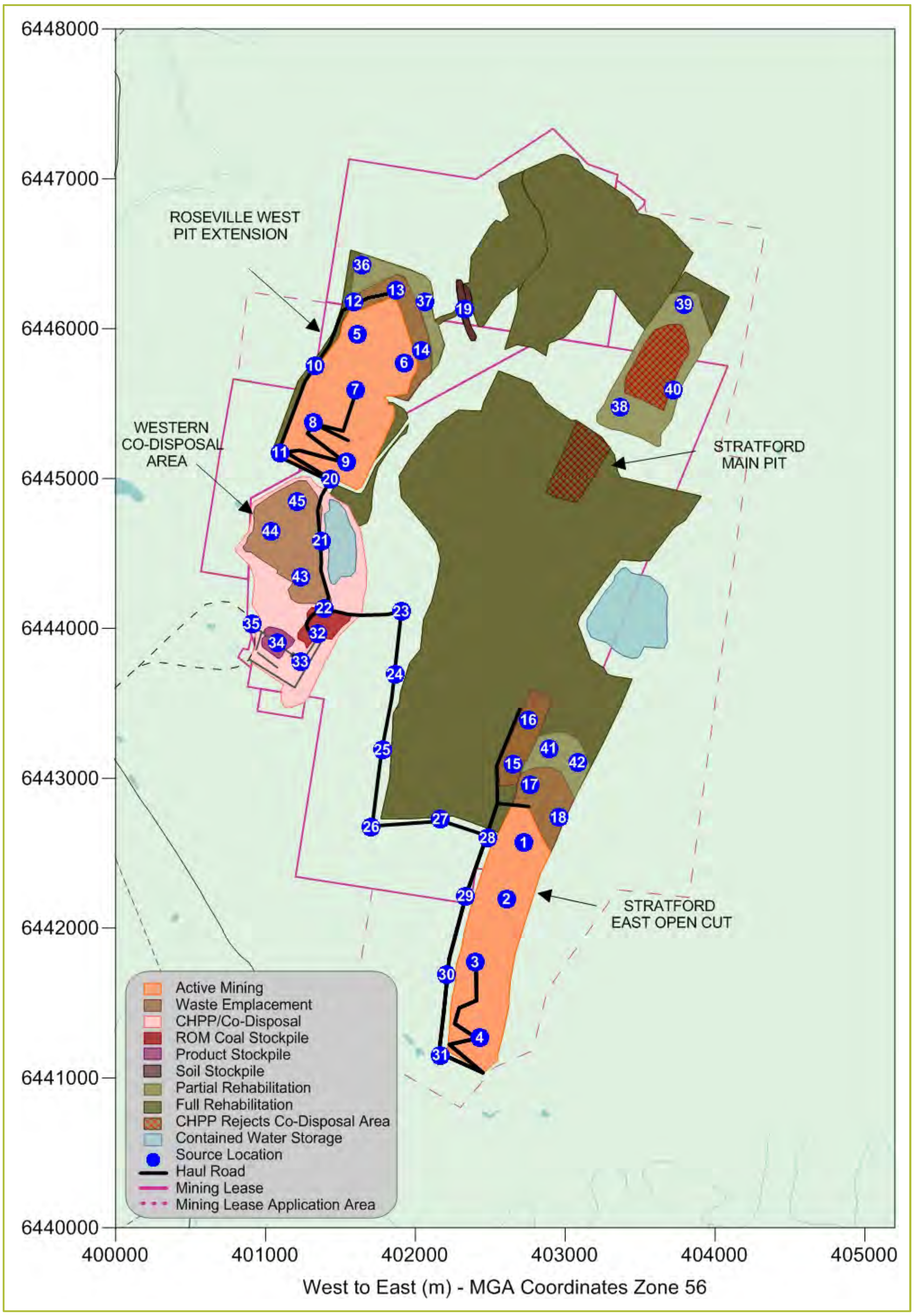


Figure B3: Location of Sources for Year 10

Stripping topsoil

Emissions from dozers on overburden have been calculated using the United States Environment Protection Agency (US EPA) emission factor equation (**US EPA, 1985 and updates**), per **Equation 1**.

Equation 1

$$E_{TSP} = 2.6 \times \frac{s^{1.2}}{M^{1.3}} \quad (kg|hour)$$

Where,

E_{TSP} = TSP emissions
s = silt content (%), and
M = moisture (%)

The silt content in the topsoil was assumed to be 10%, and the moisture content 4%. This results in an emission factor of 6.8 kg/h.

Drilling overburden and coal

The emission factor used for drilling has been taken to be 0.59 kg/hole (**US EPA, 1985 and updates**).

Blasting overburden and coal

TSP emissions from blasting were estimated using the **US EPA (1985 and updates)** emission factor equation given in **Equation 2**.

Equation 2

$$E_{TSP} = 0.00022 \times A^{1.5} \ (kg|blast)$$

where,
E_{TSP} = TSP emissions
A = area to be blasted in m^2

The area blasted for each scenario is 2,800 m^2.

Loading material /transfer material dumping overburden

Each tonne of material loaded will generate a quantity of TSP that will depend on the wind speed and the moisture content. **Equation 3** shows the relationship between these variables.

Equation 3

$$E_{TSP} = k \times 0.0016 \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right) (kg|t)$$

Where,

E_{TSP} = TSP emissions
k = 0.74,
U = wind speed (m/s)
M = moisture content (%) (for 0.25 <= M <=4.8)

The mean wind speed has been taken to be 0.94 m/s and a moisture content of 4%.

Hauling material/product on unsealed surfaces

The emission estimate of wheel generated dust presented in the EIS is based the US EPA AP42 emission factor for unpaved surfaces at industrial sites shown below:

$$E_{TSP} = 0.2819 \times \left[4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{\frac{W}{1.1023}}{3}\right)^{0.45} \right] (kg|VKT)$$

Where,
E_{TSP} = TSP emissions
s = silt content of road surface
W = mean vehicle weight

The adopted silt content (s) for the EA was 2%. This is higher (i.e. more conservative) than the silt content measured for the Duralie Coal Mine (1.6%) (**Heggies, 2009**) and is consistent with testing done at multiple mines sites in the Hunter Valley which measured average haul road silt contents of 2-3%, for a current ACARP project. The mean vehicle weight used in the emissions estimates is an average of the loaded and unloaded gross vehicle mass, to account for one empty trip and one loaded trip.

	Capacity	Full (GVM)	Empty	For Inventory
OB trucks (t) - CAT775	63.5	109.770	46	78
OB trucks (t) - CAT785	136	249.476	113	181
OB trucks (t) - CAT789	177	317.515	141	229

Dozers working on overburden

Emissions from dozers on overburden have been calculated using the US EPA emission factor **Equation 1** (**US EPA, 1985 and updates**).

The silt content of the overburden was assumed to be 10%, and the moisture content 4%. This results in an emission factor of 6.8 kg/h.

Dozers working on coal

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 5**.

Equation 5

$$E_{TSP} = 35.6 \times \frac{s^{1.2}}{M^{1.4}} \quad (kg|hour)$$

Where,
E_{TSP} = TSP emissions
s = silt content (%), and
M = moisture (%)

The silt content of the coal was assumed to be 10%, and the moisture content 7%. This results in an emission factor of 37.01 kg/h.

Loading/unloading coal

The **US EPA (1985 and updates)** emission factor equation has been used. It is given below in **Equation 6**.

Equation 6

$$E_{TSP}\ \left(\frac{kg}{t}\right) = \frac{0.580}{M^{1.2}}(kg|t)$$

Where,

E_{TSP} = TSP emissions

M = moisture (%)

The moisture content of the coal was assumed to be 7%.

Wind erosion

The US EPA (1985 and updates) emission factor equation has been used for wind erosion. It is given below in Equation 7.

Equation 7

$$E_{TSP}\ = 1.9\left(\frac{s}{1.5}\right)365\left(\frac{365-9}{235}\right)\left(\frac{f}{15}\right)\ (kg|ha)$$

Where,

E_{TSP} = TSP emissions

s = silt content (%)

p = number of days when rainfall is greater than (.0.25mm)

f = percentage of time that wind speed is greater than 5.4 m/s

The silt content in the stockpiles was assumed to be 10% for the wind erosion areas at the Stratford Coal Mine. The number of days when rainfall is greater than 0.25 millimetres was estimated to be 117 and the percentage of time that wind speed is greater than 5.4 metres per second was 3%.

50% control was assumed for some exposed areas at the SCM. For rehabilitated areas, 99% control was applied.

Grading roads

Estimates of TSP emissions from grading roads have been made using the **US EPA (1985 and updates)** emission factor equation (Equation 8).

Equation 8

$$E_{TSP}\ =\ 0.0034\ \times S^{2.5}$$

where,

S = speed of the grader in km/h (taken to be 8 km/h)

The following tables present the calculated emissions for Year 2, Year 6 and Year 9 which correspond to the sources allocations as represented in **Section 8**.

The abbreviations used in the tables are as follows:

- OB - overburden related activities
- CL - coal related activities
- WE - wind erosion emissions

Year 2 Inventory

ACTIVITY	TSP emission for Year 2 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Topsoil Removal - Dozers/Excavators stripping topsoil (Avon North)	15,071	4,435	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West)	11,052	3,252	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East)	11,052	3,252	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil removal - Sh/Ex/FELs loading topsoil (Avon North)	7	15,875	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West)	6	15,107	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East)	18	42,324	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
Topsoil removal - Hauling topsoil from Avon North to north soil stockpile	175	15,875	t/y	0.1101	kg/t	63.5	t/load	78	Vehicle gross mass (t)	4.1	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
Topsoil removal - Hauling topsoil from Roseville West to north soil stockpile	227	15,107	t/y	0.1504	kg/t	63.5	t/load	78	Vehicle gross mass (t)	5.6	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
Topsoil removal - Hauling topsoil from Stratford East to north soil stockpile	1,171	42,324	t/y	0.2767	kg/t	63.5	t/load	78	Vehicle gross mass (t)	10.3	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
Topsoil removal - Emplacing topsoil from all pits at soil stockpile	13	30,983	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
OB - Drilling Roseville West Pit	788	4,452	holes/y	0.59	kg/hole					70	% control						
OB - Drilling Avon North Pit	1,352	7,638	holes/y	0.59	kg/hole					70	% control						
OB - Drilling Stratford East Pit	1,042	5,887	holes/y	0.59	kg/hole					70	% control						
OB - Blasting Roseville West Pit	1,388	43	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Blasting Avon North Pit	2,382	73	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Blasting Stratford East Pit	1,836	56	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Sh/Ex/FELs loading from Roseville West Pit OB to trucks	2,937	6,954,818	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Sh/Ex/FELs loading OB from Avon North Pit to trucks	5,039	11,932,305	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Sh/Ex/FELs loading OB from Stratford East Pit to trucks	3,884	9,197,322	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Hauling OB from Roseville West Pit to Stratford Waste Emplacement	112,105	6,954,818	t/y	0.1612	kg/t	63.5	t/load	78	Vehicle gross mass (t)	6	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Avon North Pit to Northern Waste Emplacement (daytime, not ev	32,096	5,468,973	t/y	0.0587	kg/t	136	t/load	181	Vehicle gross mass (t)	3.2	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Avon North Pit to Main Pit (evening/nighttime)	82,976	6,463,332	t/y	0.1284	kg/t	136	t/load	181	Vehicle gross mass (t)	7	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement	124,822	9,197,322	t/y	0.1357	kg/t	136	t/load	181	Vehicle gross mass (t)	7.4	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Emplacing OB from Roseville West Pit at Stratford Waste Emplacement	2,937	6,954,818	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB from Avon North Pit at Northern Waste Emplacement (daytime)	2,310	5,468,973	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB from Avon North Pit at Main Pit (evening/nighttime)	2,730	6,463,332	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB from Stratford East Pit to Stratford Waste Emplacement	3,884	9,197,322	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Dozers on OB - Roseville West	55,259	16,261	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Northern Waste Emplacement (daytime, not evening)	11,052	3,252	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Main Pit (evening/nighttime)	13,061	3,843	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Stratford East (daytime only)	11,052	3,252	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
IB - Dozers ripping/pushing/clean-up (Avon North)	43,404	6,386	h/y	6.80	kg/h	10	silt content in %	4	moisture content of coal in %								
IB - Dozers ripping/pushing/clean-up (Stratford East)	43,404	6,386	h/y	6.80	kg/h	10	silt content in %	4	moisture content of coal in %								
IB - Dozers ripping/pushing/clean-up (Roseville West)	22,104	3,252	h/y	6.80	kg/h	10	silt content in %	4	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Avon North)	26,260	710	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Stratford East)	26,260	710	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Roseville West)	13,373	361	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Loading ROM coal from Roseville West Pit to trucks	33,687	600,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading ROM coal from Avon North Pit to trucks	50,530	900,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading ROM coal from Stratford East Pit to trucks	11,229	200,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading coal for Co-Disposal area to trucks	5,614	100,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM coal from Roseville West Pit to ROM stkpile	10,961	600,000	t/y	0.183	kg/t	63.5	t/load	78	Vehicle gross mass (t)	6.8	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
CL - Hauling ROM coal from Avon North Pit to ROM stkpile	15,516	900,000	t/y	0.172	kg/t	136	t/load	181	Vehicle gross mass (t)	9.4	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
CL - Hauling ROM coal from Stratford East Pit to ROM stkpile	3,301	200,000	t/y	0.165	kg/t	136	t/load	181	Vehicle gross mass (t)	9.0	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
CL - Hauling coal from Co-Disposal area to ROM stockpile area	330	100,000	t/y	0.033	kg/t	136	t/load	181	Vehicle gross mass (t)	1.8	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
CL - Unloading ROM coal to ROM Stockpile	50,530	900,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Unloading ROM coal directly to hopper	25,265	900,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - Loading ROM coal (incl. DCM coal) from ROM stockpile to hopper	109,483	3,900,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - Unloading DCM coal to conveyor	289	3,000,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	50	% Control						
CL - Unloading DCM coal to ROM stockpile	174	3,000,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %		% Control						
CL - ROM hopper unloading coal to conveyor	463	4,800,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	50	% Control						
CL - Crushing	6,480	4,800,000	t/y	0.003	kg/t					50	% Control						
CL - Conveyer from hopper to CHPP	278	4,800,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	70	% Control						
CL - Conveyor unloading ROM coal to CHPP	463	4,800,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	50	% Control						
CL - Dozer on product stockpiles	131,302	7,096	h/y	37.009	kg/h	10	silt content in %	7	moisture content of coal in %	50	% Control						
CL - Handling coal at CHPP	278	4,800,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	70	% Control						
CL - Unloading coal to product stockpile	347	3,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	50	% Control						
CL - Conveyor unloading to trains	347	3,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	50	% Control						
WE - Stratford East Waste Emplacement	12,539	25.7	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Stratford East Pit	20,492	21	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - Stratford East Partial Rehabilitated Area	187	19.2	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Main Pit	12,198	25	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Roseville West Pit Waste Emplacement	29,958	61.4	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Roseville West Pit	35,617	36.5	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - Roseville West Partial rehabilitation	117	12	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Bowens Rd North exposed area down to pit water	13,954	14.3	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - Avon North Waste Rock Emplacement	32,739	67.1	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Avon North Pit	21,175	21.7	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - Avon North Partial rehabilitation	342	35	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Co-disposal Area	32,202	33	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - North Soil Stockpile	2,147	2	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)		% control				
WE - ROM Coal Stockpile	2,586	5.3	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Product Coal Stockpile	1,415	2.9	ha	976	kg/ha/ye	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
Grading roads (Roseville West) (daytime)	43,671	70,956	km	0.6155	kg/km	8	speed of graders in km/h	8,870	grader hours								
Grading roads (Northern Waste Emplacement) (daytime)	21,835	35,478	km	0.6155	kg/km	8	speed of graders in km/h	4,435	grader hours								
Grading roads Main Pit (Nighttime)	13,101	21,287	km	0.6155	kg/km	8	speed of graders in km/h	2,661	grader hours								
Grading roads (Stratford East) (24 hours)	34,937	56,765	km	0.6155	kg/km	8	speed of graders in km/h	7,096	grader hours								

Total TSP emissions for Year 2 (kg/year)	**1,476,612**
TSP:ROM (includes Duralie)	**0.31**

Year 6 Inventory

ACTIVITY	TSP emission for Year 6 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West)	11,052	3,252	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East)	11,052	3,252	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West)	6	13,560	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East)	13	31,143	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
Topsoil removal - Hauling topsoil from Roseville West to south soil stockpile	186	13,560	t/y	0.1370	kg/t	63.5	t/load	78	Vehicle gross mass (t)	5.1	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
Topsoil removal - Hauling topsoil from Stratford East to south soil stockpile	1,196	31,143	t/y	0.3842	kg/t	63.5	t/load	78	Vehicle gross mass (t)	14.3	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
Topsoil removal - Emplacing topsoil at south soil stockpile	6	13,560	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %								
OB - Drilling Roseville West Pit	1,045	5,902	holes/y	0.59	kg/hole					70	% control						
OB - Drilling Stratford East Pit	3,041	17,183	holes/y	0.59	kg/hole					70	% control						
OB - Blasting Roseville West Pit	1,841	56	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Blasting Stratford East Pit	5,359	164	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Sh/Ex/FELs loading from Roseville West Pit OB to trucks	3,894	9,221,183	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Sh/Ex/FELs loading OB from Stratford East Pit to trucks	11,337	26,845,518	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Hauling OB from Roseville West Pit to Main Pit	81,750	4,610,592	t/y	0.1773	kg/t	64	t/load	78	Vehicle gross mass (t)	6.6	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
OB - Hauling OB (backfill) from Roseville West Pit to top of pit	59,455	4,610,592	t/y	0.1290	kg/t	64	t/load	78	Vehicle gross mass (t)	4.8	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement (daytime)	162,474	12,304,196	t/y	0.1320	kg/t	136	t/load	181	Vehicle gross mass (t)	7.2	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement (evening/night	165,346	14,541,322	t/y	0.1137	kg/t	136	t/load	181	Vehicle gross mass (t)	6.2	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Emplacing OB from Roseville West Pit at Main Pit	1,947	4,610,592	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB (backfill) from Roseville West Pit to top of pit	1,947	4,610,592	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB from Stratford East Pit to Stratford Waste Emplacement (daytime)	5,196	12,304,196	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Emplacing OB from Stratford East Pit to Stratford Waste Emplacement (night-time)	6,141	14,541,322	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Dozers on OB - Main Pit Waste Emplacement (waste from Roseville West) (daytime	22,104	6,504	h/y	6.8	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Roseville West (backfill) (daytime)	11,052	3,252	h/y	6.8	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Stratford Waste Emplacement (24 hours)	48,226	14,191	h/y	6.8	kg/h	10	% silt content	4	moisture content in %	50	% control						
IB - Dozers ripping/pushing/clean-up (Roseville West Open Pit)	59,680	8,781	h/y	6.8	kg/h	10	silt content in %	4	moisture content of coal in %								
IB - Dozers ripping/pushing/clean-up (Stratford East Open Pit) (24 hours)	43,404	6,386	h/y	6.8	kg/h	10	silt content in %	4	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Roseville West Open Pit) (daytime)	36,108	976	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Stratford East Open Pit) (24 hours)	26,260	710	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Loading ROM coal from Roseville West Pit to trucks	42,109	750,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading ROM coal from Stratford East Pit to trucks	58,952	1,050,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading coal for Co-Disposal area to trucks	11,229	200,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM coal from Roseville West Pit to ROM stockpile	9,671	750,000	t/y	0.129	kg/t	63.5	t/load	78	Vehicle gross mass (t)	4.8	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
CL - Hauling ROM coal from Stratford East Pit to ROM stockpile	19,257	1,050,000	t/y	0.183	kg/t	136	t/load	181	Vehicle gross mass (t)	10.0	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
CL - Hauling coal from Co-Disposal area to ROM stockpile area	660	200,000	t/y	0.033	kg/t	136	t/load	181	Vehicle gross mass (t)	1.8	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
CL - Unloading ROM coal to ROM Stockpile	56,145	1,000,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Unloading ROM coal directly to hopper	28,072	1,000,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - Loading ROM coal (incl. DCM coal) from ROM stockpile to hopper	70,181	2,500,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - Unloading DCM coal to conveyor	145	1,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	50	% Control						
CL - Unloading DCM coal to ROM stockpile	87	1,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %		% Control						
CL - ROM hopper unloading coal to conveyor	338	3,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	50	% Control						
CL - Crushing	4,725	3,500,000	t/y	0.003	kg/t					50	% Control						
CL - Conveyer from hopper to CHPP	203	3,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	70	% Control						
CL - Conveyor unloading ROM coal to CHPP	338	3,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	50	% Control						
CL - Dozer on product stockpiles	131,302	7,096	h/y	37.009	kg/h	10	silt content in %	7	moisture content of coal in %	50	% Control						
CL - Handling coal at CHPP	203	3,500,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	70	% Control						
CL - Unloading coal to product stockpile	280	2,900,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content of coal in %	50	% Control						
CL - Conveyor unloading to trains	280	2,900,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	7	moisture content in %	50	% Control						
WE - Stratford East Pit	46,839	48.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Stratford East Waste Emplacement	38,252	78.4	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Stratford East Waste Emplacement (partial rehabilitation)	1,952	4.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Main Pit (waste emplacement)	23,029	23.6	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Roseville West Pit	58,842	60.3	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Roseville West Active Emplacement	42,448	43.5	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50					
WE - Roseville West Active Emplacement (partial rehabilitation)	55	5.6	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Roseville West Active Emplacement (backfill)	2,440	5.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Bowens Rd North exposed area down to pit water	10,734	11	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Avon North Pit	15,613	16.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Co-disposal Area	32,202	33	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - North Soil Stockpile	2,147	2.2	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - ROM Coal Stockpile	2,586	5.3	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Product Coal Stockpile	1,415	2.9	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
Grading roads (Roseville West) (daytime)	43,671	70,956	km	0.6155	kg/km	8	speed of graders in km/h	8,870	grader hours								
Grading roads Main Pit (Nighttime)	13,101	21,287	km	0.6155	kg/km	8	speed of graders in km/h	2,661	grader hours								
Grading roads (Stratford East) (24 hours)	34,937	56,765	km	0.6155	kg/km	8	speed of graders in km/h	7,096	grader hours								

Total TSP emissions for Year 6 (kg/yr)	**1,585,557**
TSP:ROM (includes Duralie)	**0.5**

Year 10 Inventory

ACTIVITY	TSP emission for Year 10	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West)	15,071	4,435	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil Removal - Dozers/Excavators stripping topsoil (Stratford East)	15,071	4,435	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %	50	% control						
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West)	2	4,991	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
Topsoil removal - Sh/Ex/FELs loading topsoil (Stratford East)	2	5,817	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
Topsoil removal - Hauling topsoil from Roseville West to north soil stockpile	114	4,991	t/y	0.2278	kg/t	63.5	t/load	181	Vehicle gross mass (t)	5.8	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
Topsoil removal - Hauling topsoil from Stratford East to north soil stockpile	356	5,817	t/y	0.6128	kg/t	63.5	t/load	181	Vehicle gross mass (t)	15.6	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
Topsoil removal - Emplacing topsoil from Roseville West at North soil stockpile	2	4,991	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
Topsoil removal - Emplacing topsoil from Stratford East at North soil stockpile	2	5,817	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m/	4	moisture content in %								
OB - Drilling Roseville West Pit	1,030	5,821	holes/y	0.59	kg/hole					70	% control						
OB - Drilling Stratford East Pit	3,184	17,989	holes/y	0.59	kg/hole					70	% control						
OB - Blasting Roseville West Pit	1,815	56	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Blasting Stratford East Pit	5,611	172	blasts/y	33	kg/blast	2,800	Area of blast in square metres	105	holes/blast								
OB - Sh/Ex/FELs loading from Roseville West Pit to trucks	3,840	9,093,691	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	4	moisture content in %								
OB - Sh/Ex/FELs loading OB from Stratford East Pit to trucks	11,869	28,104,655	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	4	moisture content in %								
OB - Hauling OB from Roseville West Pit to Roseville West Emplacement	127,037	9,093,691	t/y	0.1397	kg/t	64	t/load	78	Vehicle gross mass (t)	5.2	km/return trip	1.7	kg/VKT	2	% silt content	90	% control
OB - Hauling OB from Stratford East Pit to Stratford Waste Emplacement	268,028	28,104,655	t/y	0.0954	kg/t	136	t/load	181	Vehicle gross mass (t)	5.2	km/return trip	2.5	kg/VKT	2	% silt content	90	% control
OB - Emplacing OB from Roseville West Pit at Roseville West waste emplaceme	3,840	9,093,691	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	4	moisture content in %								
OB - Emplacing OB from Stratford East Pit at Stratford Waste Emplacement	11,869	28,104,655	t/y	0.0004	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	4	moisture content in %								
OB - Dozers on OB - Roseville West (daytime)	22,104	6,504	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
OB - Dozers on OB - Stratford East (24 hours)	48,226	14,191	h/y	6.80	kg/h	10	% silt content	4	moisture content in %	50	% control						
IB - Dozers ripping/pushing/clean-up (Roseville West Pit) (daytime)	79,573	11,708	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %								
IB - Dozers ripping/pushing/clean-up (Stratford East Pit) (24 hours)	43,404	6,386	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %								
CL - Dozers ripping/pushing/clean-up (Roseville West Pit) (daytime)	48,144	1,301	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Dozers ripping/pushing/clean-up (Stratford East Pit) (24 hours)	26,260	710	h/y	37.01	kg/h	10	silt content in %	7	moisture content of coal in %								
CL - Loading ROM coal from Roseville West Pit to trucks	42,109	750,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Loading ROM coal from Stratford East Pit to trucks	103,868	1,850,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Hauling ROM coal from Roseville West Pit to ROM stockpile	9,671	750,000	t/y	0.129	kg/t	64	t/load	78	Vehicle gross mass (t)	4.8	km/return trip	1.7	kg/VKT	2	% silt	90	% control
CL - Hauling ROM coal from Stratford East Pit to ROM stockpile	36,983	1,850,000	t/y	0.200	kg/t	136	t/load	181	Vehicle gross mass (t)	10.9	km/return trip	2.5	kg/VKT	2	% silt	90	% control
CL - Unloading ROM coal to ROM Stockpile	72,988	1,300,000	t/y	0.056	kg/t	7	moisture content in %										
CL - Unloading ROM coal directly to hopper	36,494	1,300,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - Loading ROM coal from ROM stockpile to hopper	36,494	1,300,000	t/y	0.056	kg/t	7	moisture content in %					50	% control				
CL - ROM hopper unloading coal to conveyor	251	2,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content of coal in %	50	% Control						
CL - Crushing	3,510	2,600,000	t/y	0.003	kg/t					50	% Control						
CL - Conveyer from hopper to CHPP	150	2,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content in %	70	% Control						
CL - Conveyor unloading ROM coal to CHPP	150	2,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content in %	70	% Control						
CL - Dozer on product stockpiles	131,302	7,096	h/y	37.009	kg/h	10	silt content in %	7	moisture content of coal in %	50	% Control						
CL - Handling coal at CHPP	150	2,600,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content of coal in %	70	% Control						
CL - Unloading coal to product stockpile	138	1,426,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content in %	50	% Control						
CL - Conveyor unloading to trains	138	1,426,000	t/y	0.0002	kg/t	0.94	average of (wind speed/2.2)^1.3 in m	7	moisture content in %	50	% control						
WE - Stratford East Pit	55,426	56.8	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Straford East Waste Emplacement (partial rehabilitation)	98	10.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Straford East Waste Emplacement (active)	10,246	21.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Roseville West Pit	57,085	58.5	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - Roseville West Active Emplacement (backfill)	7,514	15.4	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Roseville West Waste Emplacement (partial rehabilitation)	65	6.7	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Avon North (partial rehabilitation)	208	21.3	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	99	% control				
WE - Co-disposal Area	32,202	33.0	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f)						
WE - ROM Coal Stockpile	2,586	5.3	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
WE - Product Coal Stockpile	1,415	2.9	ha	976	kg/ha/year	10	silt content in %	117	days >0.25mm rainfall (p)	3	% time ws>5.4 m/s (f	50	% control				
Grading roads (Roseville West) (daytime)	32,025	52,034	km	0.6155	kg/km	8	speed of graders in km/h	6,504	grader hours								
Grading roads (Stratford East) (24 hours)	34,937	56,765	km	0.6155	kg/km	8	speed of graders in km/h	7,096	grader hours								

Total TSP emissions for Year 10 (kg/year)	**1,444,662**
TSP:ROM	**0.6**

APPENDIX C - FY2011 MODELLING SCENARIO RESULTS

C.1 OVERVIEW OF FY2011 MODELLING

The current mining activities at the Stratford Mining Complex include coal extraction from the Roseville West Pit and Bowens Road North Open Cut. Run-of-mine coal mined at the Duralie Coal Mine is transported on the North Coast Railway to the Stratford Mining Complex where it is unloaded and processed at the Coal Handling and Processing Plant. Stratford Coal Pty Ltd has provided the mining plans for the financial year (FY) 2011 and a detailed emissions inventory has been prepared. The estimated quantities of total suspended particulates released for FY2011 is presented in **Table C1**. Source locations are shown in **Figure C1**.

Table C1: Estimated Emissions for FY2011

ACTIVITY	TSP emission for FY 2011 (kg/y)
Topsoil Removal - Dozers/Excavators stripping topsoil (Bowens Road North)	12,132
Topsoil Removal - Dozers/Excavators stripping topsoil (Roseville West)	2,141
Topsoil removal - Sh/Ex/FELs loading topsoil (Bowens Road North)	193
Topsoil removal - Sh/Ex/FELs loading topsoil (Roseville West)	34
Topsoil removal - Hauling topsoil from Bowens Road North to topsoil stockpile (1)	1,230
Topsoil removal - Hauling topsoil from Bowens Road North to topsoil stockpile (2)	2,145
Topsoil removal - Hauling topsoil from Bowens Road North to topsoil stockpile (3)	751
Topsoil removal - Hauling topsoil from Bowens Road North to topsoil stockpile (4)	397
Topsoil removal - Hauling topsoil from Bowens Road North to topsoil stockpile (5)	158
Topsoil removal - Hauling topsoil from Roseville West to topsoil stockpile (6)	908
Topsoil removal - Emplacing topsoil from Bowens Road North at topsoil stockpile (1)	57
Topsoil removal - Emplacing topsoil from Bowens Road North at topsoil stockpile (2)	64
Topsoil removal - Emplacing topsoil from Bowens Road North at topsoil stockpile (3)	27
Topsoil removal - Emplacing topsoil from Bowens Road North at topsoil stockpile (4)	27
Topsoil removal - Emplacing topsoil from Bowens Road North at topsoil stockpile (5)	19
Topsoil removal - Emplacing topsoil from Roseville West at topsoil stockpile (6)	34
OB - Drilling Bowens Road North Pit	350
OB - Drilling Roseville West Pit	631
OB - Blasting Bowens Road North Pit	651
OB - Blasting Roseville West Pit	1,825
OB - Sh/Ex/FELs loading from Bowens Road North Pit OB to trucks	1,272
OB - Sh/Ex/FELs loading from Roseville West Pit OB to trucks	2,294
OB - Hauling OB from Bowens Road North Pit to Bowens Road North Waste Emplacement	67,734
OB - Hauling OB from Roseville West Pit to StratfoRoad Main Pit	206,077
OB - Emplacing OB from Bowens Road North Pit to Bowens Road North Waste Emplacement	1,272
OB - Emplacing OB from Roseville West Pit to StratfoRoad Main Pit	2,294
OB - Dozers on OB - Bowens Road North	24,113
OB - Dozers on OB - Roseville West	30,141
IB - Dozers ripping/pushing/clean-up (Bowens Road North)	30,141
IB - Dozers ripping/pushing/clean-up (Roseville West)	27,127
CL - Dozers ripping/pushing/clean-up (Bowens Road North)	13,130
CL - Dozers ripping/pushing/clean-up (Roseville West)	16,413
CL - Loading ROM coal from Bowens Road North Pit to trucks	36,606
CL - Loading ROM coal from Roseville West Pit to trucks	12,857
CL - Loading coal for Co-Disposal area to trucks	17,349
CL - Hauling ROM coal from Bowens Road North Pit to ROM stockpile	38,463
CL - Hauling ROM coal from Roseville West Pit to ROM stockpile	12,696
CL - Hauling coal from Co-Disposal area to ROM stockpile area	6,704
CL - Unloading ROM coal to ROM Stockpile	24,732
CL - Unloading ROM coal directly to hopper	12,366
CL - Loading ROM coal (incl. DCM coal) from ROM stockpile to hopper	73,859
CL - Unloading DCM coal to conveyor	101
CL - Unloading DCM coal to ROM stockpile from conveyor	338
CL - ROM hopper unloading coal to conveyor	152
CL - Crushing	3,552
CL - Conveyer from hopper to CHPP	152
CL - Conveyor unloading ROM coal to CHPP	152
CL - Dozer on product stockpiles	131,302
CL - Handling coal at CHPP	152
CL - Unloading coal to product stockpile	197
CL - Conveyor unloading to trains	197
WE - Bowens Road North Pit	72,708
WE - Roseville West Pit	33,734
WE - Stratford Main Pit (waste from Roseville West Pit)	28,435
WE - Co-disposal Area	62,911
WE - Topsoil Stockpile 1	1,464
WE - Topsoil Stockpile 2	1,659
WE - Topsoil Stockpile 3	683
WE - Topsoil Stockpile 4	683
WE - Topsoil Stockpile 5	488
WE - Topsoil Stockpile 6	878
WE - ROM Coal Stockpile	5,172
WE - Product Coal Stockpile	2,830
Grading roads (Bowens Road North)	21,835
Grading roads (Roseville West) (daytime)	21,835

Total TSP emissions for FY2011 (kg/yr)	**1,073,028**
TSP:ROM (includes Duralie)	**0.4**

kg/year = kilograms per year

OB = overburden

IB = interburden

CL = coal

WE = wind erosion

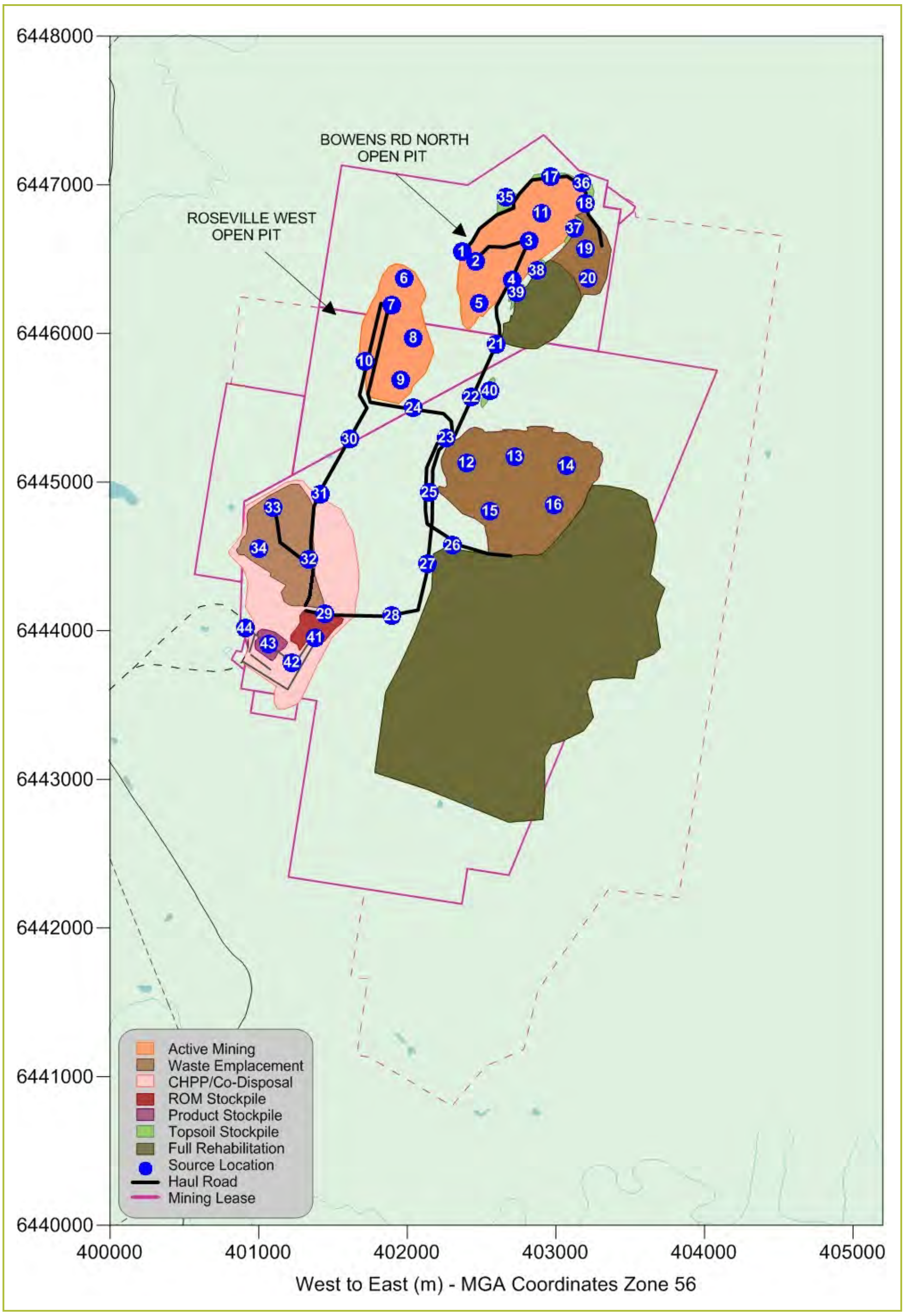


Figure C1: Source Locations for FY2011

C.2 2010 / 2011 MODELLING RESULTS

Emission estimates have been made for all dust sources at the Stratford Mining Complex for July 2010 to June 2011, based on mine plan information and the amount of material handled (coal and waste rock) for that year. Meteorological data from July 2010 to June 2011 were used in the dispersion modelling to predict the off-site ground level concentration of dust for that period.

Modelling predictions of PM_{10} were made at the exact locations of the Stratford Mining Complex high volume air sampler (HVAS) and compared to the actual levels recorded for that same period. By subtracting the modelling prediction for the Stratford Mining Complex from the actual level recorded at the HVAS (observed), an estimation of background without the existing contribution from the Stratford Mining Complex can be made.

The modelling predictions for existing operations at the Stratford Mining Complex are presented in **Table C2**. The modelling indicates that the contribution from the Stratford Mining Complex mining in 2010 – 2011 was 1 to 3 micrograms per cubic metre (µg/m^3) as an annual average. When subtracted from the actual measured values at the HVAS, the background contribution from all other sources is estimated to be between 6 - 8 µg/m^3 as an annual average and suggests that the contribution from the Stratford Mining Complex to existing levels is a small percentage.

Table C2: Annual Average – Measured versus Modelled

Site	Annual Average PM_{10} – Measured	Annual Average PM_{10} – SCM Contribution (as modelled)	Difference (Observed - Predicted)
HVD2	9	2	7
HVD3	9	3	6
HVD4	8	1	7
HVD5	8	0.3	7.7

Modelling predictions for 24-hour PM_{10} at each of these locations are shown in **Figure C2** to **Figure C5**. It is noted that model predictions made for July 2010 were excluded from analysis because the measured meteorological data contained inconsistencies in that month.

As is the case for annual average, at 24-hour PM_{10} concentrations are generally driven by other sources with existing operations of the Stratford Mining Complex contributing a small proportion.

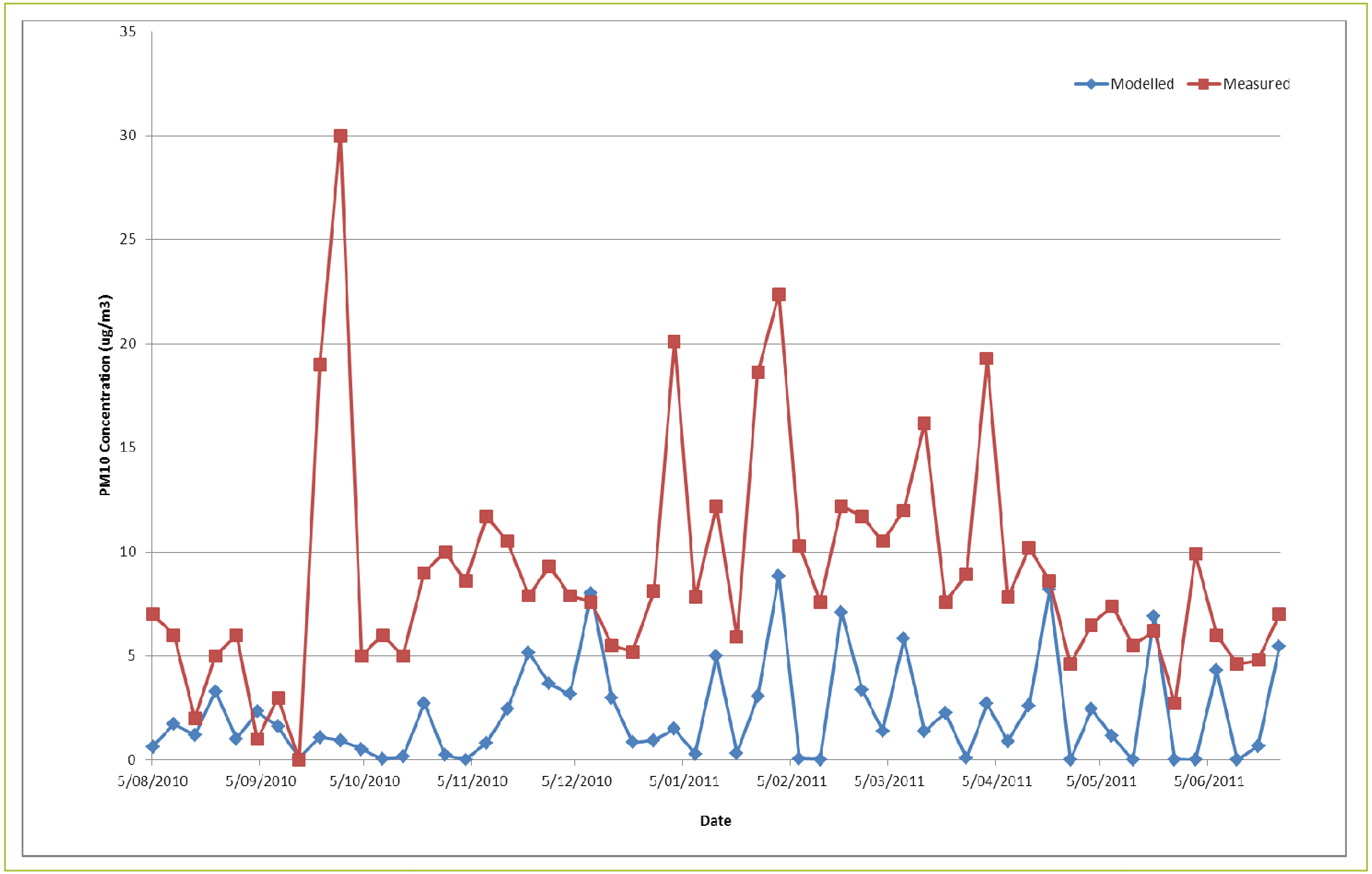


Figure C2: Modelled and Monitored 24-hour PM_{10} for HVD2

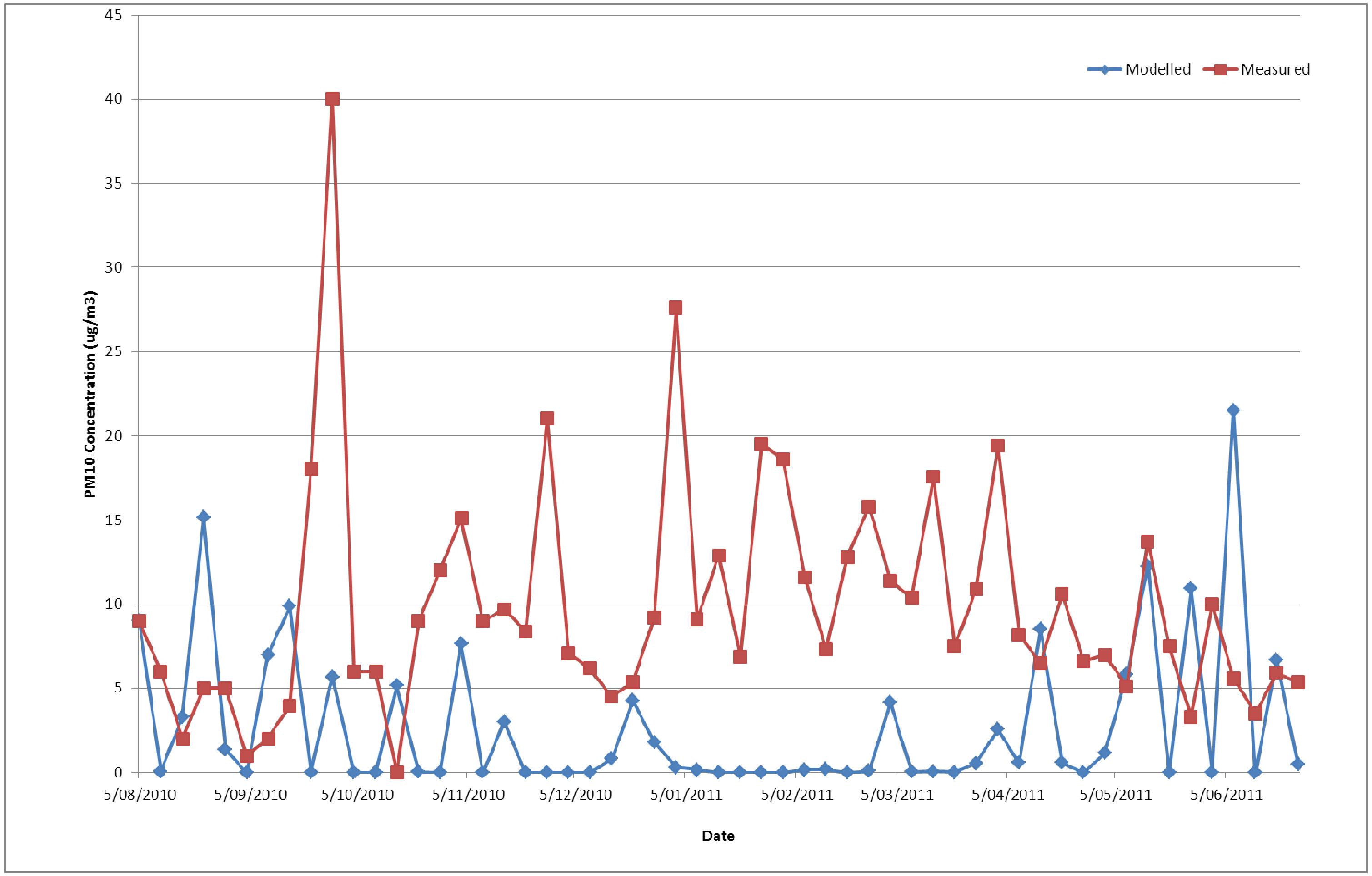


Figure C3: Modelled and Monitored 24-hour PM_{10} for HVD3

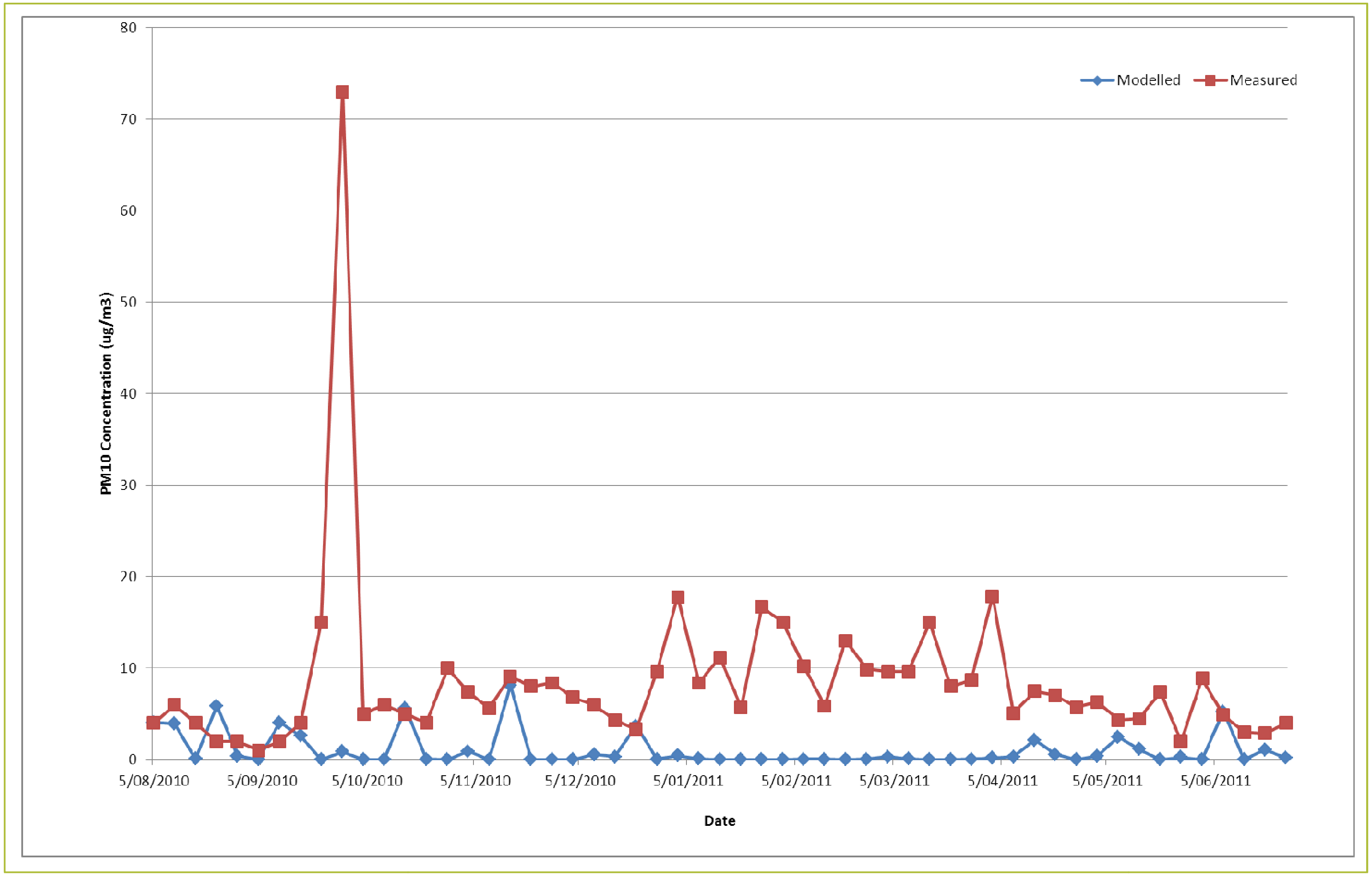


Figure C4: Modelled and Monitored 24-hour PM_{10} for HVD4

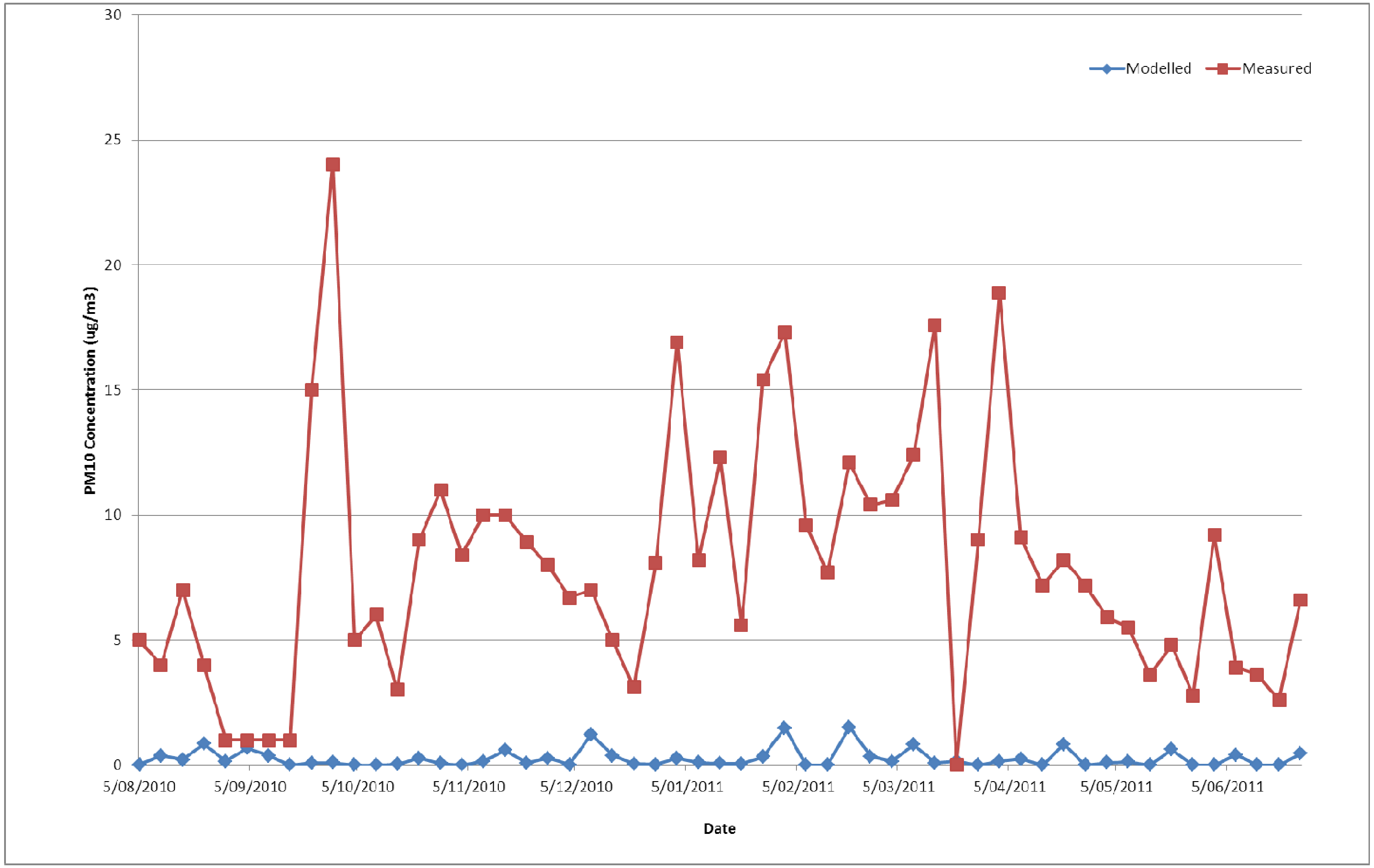


Figure C5: Modelled and Monitored 24-hour PM_{10} for HVD5

Contour plots for FY2011 scenario are shown in **Figure C6**, presented along with the contours for the worst case year for the Project. The contours indicate that the modelled predictions for existing operations are not significantly greater than the modelled predictions for the worst case year of the Project.

Monitoring data for existing operations demonstrate compliance with air quality goals and the inference from the modelling results is that the Project should therefore not result in unacceptable air quality for the local area.

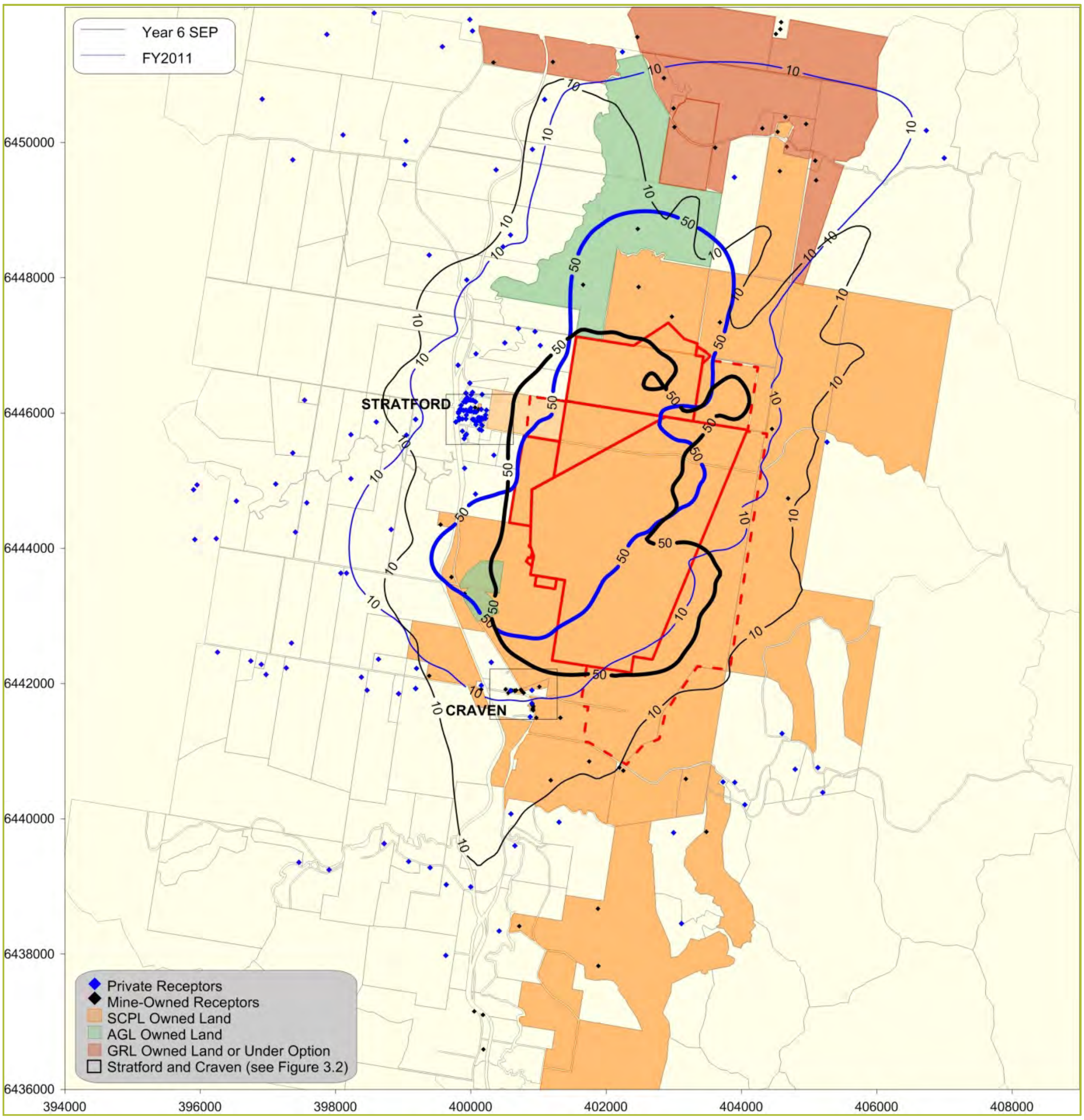


Figure C6: 24-hour PM_{10} Modelling predictions for FY2011 and Year 6 of the Project (no background)

APPENDIX D - MODEL SET UP

Model Set Up

TAPM (v 4.0.4)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km)
Number of grid points	40 x 40 x 40
Year of analysis	November 2010 – October 2011
Centre of analysis (local co-ordinates)	Stratford Coal Mine (403417, 6449769)
CALMET (v. 6.333)	
Meteorological grid domain	14 km x 20 km
Meteorological grid resolution	0.2 km
Input data	Prognostic 3D.dat extracted from TAPM at 3 km grid

CALMET Model Options used

Flag	Descriptor	Default	Value Used
IEXTRP	Extrapolate surface wind observations to upper layers	Similarity theory	Similarity theory
BIAS (NZ)	Relative weight given to vertically extrapolated surface observations versus upper air data	NZ * 0	-1 for first layer, 0 for all other layers
TERRAD	Radius of influence of terrain	No default (typically 5- 15km)	10 km
RMAX1 and RMAX2	Maximum radius of influence over land for observations in layer 1 and aloft	No Default	2 km
R1 and R2	Distance from observations in layer 1 and aloft at which observations and Step 1 wind fields are weighted equally	No Default	1.5 km

CALPUFF Model Options used

Flag	Flag Descriptor	Value Used	Value Description
MCHEM	Chemical Transformation	0	Not modelled
MDRY	Dry Deposition	1	Yes
MTRANS	Transitional plume rise allowed?	1	Yes
MTIP	Stack tip downwash?	1	Yes
MRISE	Method to compute plume rise	1	Briggs plume rise
MSHEAR	Vertical wind Shear	0	Vertical wind shear not modelled
MPARTL	Partial plume penetration of elevated inversion?	1	Yes
MSPLIT	Puff Splitting	0	No puff splitting
MSLUG	Near field modelled as slugs	0	Not used
MDISP	Dispersion Coefficients	2	Based on micrometeorology
MPDF	Probability density function used for dispersion under convective conditions	0	No
MROUGH	PG sigma y,z adjusted for z	0	No
MCTADJ	Terrain adjustment method	3	Partial Plume Adjustment
MBDW	Method for building downwash	1	ISC method

APPENDIX E - ESTIMATION OF GHG EMISSIONS

E.1 FUEL CONSUMPTION

Greenhouse gas (GHG) emissions from diesel consumption were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	=	Emissions of GHG from diesel combustion	(t CO_2-e)[1]
Q	=	Estimated combustion of diesel	(GJ)[2]
EF	=	Emission factor (scope 1 or scope 3) for diesel combustion	(kg CO_2-e/GJ)[3]

1 tCO_2-e = tonnes of carbon dioxide equivalent.

2 GJ = gigajoules.

3 kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule.

The quantity of diesel consumed (Q) in each year is based on a diesel intensity rate (kL diesel/tpa production), derived from the 2010/2011 diesel consumption (6,074 kL) and a combined production rate (ROM plus waste of 9.6 Mtpa). The quantity of diesel consumed in gigajoules (GJ) (Q) is then calculated using an energy content factor for diesel of 38.6 gigajoules per kilolitre (GJ/kL).

Greenhouse gas emission factors and energy content for diesel were sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Project total GHG emissions from diesel usage are presented in the table below.

Table E1: Estimated CO_2-e (tonnes) for Diesel Consumption

Year	On-site Diesel (kL)	Diesel Water Transfers (kL)	Diesel Total (kL)	Emissions (t CO_2-e)		
				Scope 1	Scope 3	Total
1	18,957	0	18,957	50,856	3,878	54,734
2	21,333	233	21,566	57,854	4,412	62,266
3	19,822	129	19,951	53,521	4,081	57,603
4	20,144	110	20,255	54,337	4,144	58,481
5	21,033	93	21,126	56,674	4,322	60,996
6	24,585	229	24,814	66,568	5,076	71,644
7	25,020	0	25,020	67,120	5,119	72,239
8	25,753	0	25,753	69,087	5,268	74,355
9	25,785	0	25,785	69,174	5,275	74,449
10	26,106	0	26,106	70,035	5,341	75,376
11	10,444	0	10,444	28,017	2,137	30,154
Total						**692,298**

E.2 ELECTRICITY

Greenhouse gas emissions from electricity usage were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	=	Emissions of greenhouse gases from electricity usage	(tCO_2-e/annum)
Q	=	Estimated electricity usage	(kWh/annum)[1]
EF	=	Emission factor (Scope 2 or Scope 3) for electricity usage	($kgCO_2$-e/kWh)[2]

[1] kWh/annum = kilowatt hours per annum

[2] $kgCO_2$-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour

The quantity of electricity used each year is based on an intensity rate (kWh/tpa product coal) derived from the 2010/2011 electricity use (21,500,312 kWh) and product coal rate of 1.7 Mtpa. Greenhouse gas emission factors were sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and project total GHG emissions from electricity usage are presented in the table below.

Table E2: Estimated CO_2-e (tonnes) for Electricity

Year	Electricity (kWhr)	Emissions (t CO_2-e)		
		Scope 2	Scope 3	Total
1	35,494,715	31,590	6,389	37,979
2	42,838,449	38,126	7,711	45,837
3	33,046,804	29,412	5,948	35,360
4	34,270,759	30,501	6,169	36,670
5	37,942,626	33,769	6,830	40,599
6	28,150,981	25,054	5,067	30,122
7	18,359,335	16,340	3,305	19,644
8	18,359,335	16,340	3,305	19,644
9	18,359,335	16,340	3,305	19,644
10	19,583,291	17,429	3,525	20,954
11	12,239,557	10,893	2,203	13,096
Total				**319,550**

E.3 FUGITIVE METHANE

Emissions from fugitive CH_4 were estimated using the following equation:

$$E_{co2-e} = Q \times EF$$

where:

E_{CO2-e}	=	Emissions of greenhouse gases from fugitive CH_4	(t CO_2-e/annum)
Q	=	ROM coal extracted during the year	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne)

The default emission factor for fugitive emissions from open cut mines was sourced from the NGA Factors (**DCCEE, 2011**). The estimated annual and Project total GHG emissions from fugitive methane are presented in the table below.

Table E3: Estimated CO_2-e (tonnes) for Fugitive Methane

Year	ROM (tpa)	Scope 1 Emissions (t CO_2-e)
1	1,826,310	82,184
2	1,700,000	76,500
3	1,650,000	74,250
4	1,700,000	76,500
5	1,958,763	88,144
6	1,800,000	81,000
7	2,100,000	94,500
8	2,249,999	101,250
9	2,350,000	105,750
10	2,600,000	117,000
11	1,473,917	66,326
Total		**963,405**

E.4 COAL TRANSPORTATION

The scope 3 emissions associated with product coal transportation have been estimated based on all product coal being transported to Newcastle for export by rail. Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 grams per net tonne per kilometre (**Queensland Rail Network Access, 2002**).

Emission factors were not available for unloaded trains so the factor for loaded trains is conservatively applied for the return trip. The return rail trip from Stratford to the Port of Newcastle is estimated to be 250 km.

The total estimated GHG emissions from rail transport of product coal are provided in the table below.

Table E4: Estimated CO_2-e (tonnes) for Rail Transportation

Year	Product Coal (tpa)	Scope 3 Emissions (t CO_2-e)
1	1,300,000	3,998
2	1,200,000	3,690
3	1,300,000	3,998
4	1,300,000	3,998
5	1,400,000	4,305
6	1,300,000	3,998
7	1,500,000	4,613
8	1,500,000	4,613
9	1,500,000	4,613
10	1,600,000	4,920
11	1,000,000	3,075
Total		**45,818**

E.5 ENERGY PRODUCTION - USE OF PRODUCT COAL

It is assumed that 36% of product coal would be sold as thermal coal, with the remaining 64% sold as coking coal. The scope 3 emissions associated with the combustion of product coal were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EC \times EF}{1000}$$

Where:

E_{CO2-e}	=	Emissions of GHG from coal combustion	(t CO_2-e)
Q	=	Quantity of product coal burnt	(GJ)
EC	=	Energy Content Factor for black/coking coal	(GJ/t)[1]
EF	=	Emission factor for black/coking coal combustion	(kg CO_2-e/GJ)

[1] GJ/t = gigajoules per tonne

The quantity of thermal coal burnt in Mtpa is converted to GJ using an energy content factor for black coal of 27 GJ/t. The quantity of coking coal burnt in Mtpa is converted to GJ using an energy content factor for coking coal of 30 GJ/t.

The greenhouse gas emission factor and energy content for coal were sourced from the NGA Factors (**DCCEE, 2011**). The emissions associated with the use of the product coal are presented in the table below.

Table E5: Estimated CO_2-e (tonnes) for Energy Production

Year	Product Coal (tpa)		Scope 3 Emissions (t CO_2-e)		
	Thermal	Coking	Thermal	Coking	Total
1	465,307	834,693	1,110,971	2,259,180	3,370,152
2	429,514	770,486	1,025,512	2,085,397	3,110,909
3	465,307	834,693	1,110,971	2,259,180	3,370,152
4	465,307	834,693	1,110,971	2,259,180	3,370,152
5	501,100	898,900	1,196,431	2,432,964	3,629,394
6	465,307	834,693	1,110,971	2,259,180	3,370,152
7	536,893	963,107	1,281,890	2,606,747	3,888,637
8	536,893	963,107	1,281,890	2,606,747	3,888,637
9	536,893	963,107	1,281,890	2,606,747	3,888,637
10	572,685	1,027,315	1,367,349	2,780,530	4,147,879
11	357,928	642,072	854,593	1,737,831	2,592,424
Total					**38,627,124**

E.6 VEGETATION CLEARING

GHG emissions due to vegetation clearance have been calculated based on estimated areas of vegetation communities to be cleared and are presented in the table below. In practice, these emissions would be temporary as the proposed mine site rehabilitation would likely offset emissions associated with vegetation clearance. This assessment conservatively considers emissions from vegetation clearance only (i.e. without considering the effects of rehabilitation).

Assumptions have been made as to the biomass density for woodland and grassland based on information presented in the Australian Greenhouse Office Technical Report No.17 (**Australian Greenhouse Office, 2000**). It is assumed that 50% of the biomass in the vegetation cleared is carbon.

Table E6: Estimated CO_2-e (tonnes) for Vegetation Clearance

Community	Area (ha)	Biomass Density (t/ha)	Carbon (t/ha)	Total Carbon (t)	Emission Factor (t CO_2-e/t carbon)	Total Emission (t CO_2-e)
Woodland	114	200	100	11,360	3.67	41,691
Grassland	430	2	1	430	3.67	1,579
Total						**43,270**