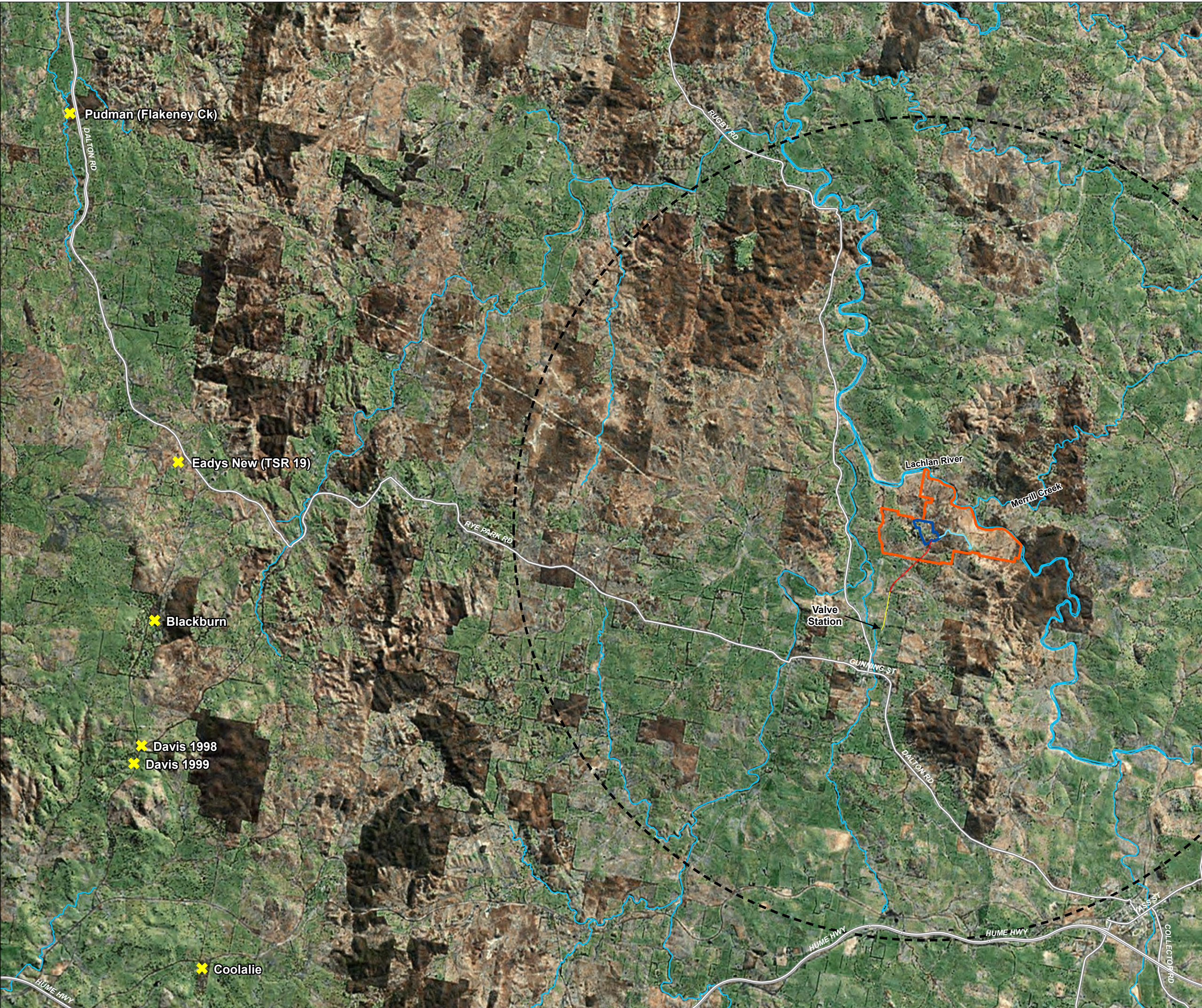
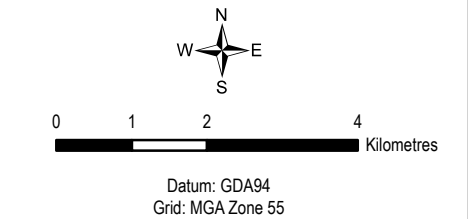


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- Legend**
- ✕ Known GSM Population Locations
  - Main Roads
  - Waterways
  - ▭ AGL Site Boundary
  - - - 10km Buffer
  - ▭ Plant Footprint
  - ▭ Gas Pipeline (northern) and Access Road
  - ▭ Gas Pipeline (southern)



Source:  
Aerial Photo - Bing Maps © 2010 Microsoft Corporation and its data suppliers.  
GSM Populations - Clarke GM and O'Dwyer (1999) Further survey in south-eastern New South Wales for the Endangered Golden Sun Moth, Synemon plana. A report prepared for the Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone. CSIRO Division of Entomology, Acton, Canberra.

Map compiled using MapInfo StreetPro and NPWS Data. © 2011 MapInfo Australia Pty Ltd and PSMA Australia Ltd. URS Australia, MapInfo Australia, NPWS or PSMA Australia do not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that these companies shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.

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DALTON POWER PROJECT

**GOLDEN SUN MOTH  
POPULATIONS NEAR  
DALTON, NSW**



## 2.4 Correspondence

In order to confirm the beginning and duration of the flying season for GSM in the Southern Tablelands, a number of contacts were established to source up to date species specific information regarding current species behaviour, and to track 'week to week' survey finding results from known reference sites throughout the 2011/2012 season (**Appendix A**). Information used to guide the timing of URS surveys was collected by continual liaison with a range of stakeholders, including consultant ecologists, government officers, community groups and local landowners, including:

- Rod Pietsch, Responsible Officer: Golden Sun Moth, NSW OEH (Queanbeyan);
- Rainer Rehwinkel, Senior Threatened Species Officer, NSW OEH (Queanbeyan);
- Melissa Maly Assistant Director NSW Assessment Section (DSEWPaC),
- Tim McGrath Threatened Species Officer (DSEWPaC),
- Alison Rowell, Biologist and Environmental consultant;
- Nathan Garvey, Biosis Research (Wollongong);
- Geoff Robertson, Friends of Grasslands (FOG) (Canberra);
- Bob Spiller, Secretary, Jerrawa Creek Landcare Group (JCLG);
- John Walsh, Landowner, Mt Pleasant, Dalton; and
- Michael Mulvaney, Conservation Planning and Research, Environment and Sustainable Development Directorate.

Furthermore, both Rod Pietsch and Rainer Rehwinkel (NSW OEH) were invited to join URS surveys conducted within the Project area. However, due to a high workload (Rod Pietsch *pers. comm.*), a joint survey did not eventuate.

## 2.5 Reference Sites

GSM has been recorded historically at a number of sites in and around the Southern Tablelands (**Figure 1A** and **1B**). A series of known GSM locations (**Table 1**) (described in Clarke and O'Dwyer 1999, Clarke 2000, Clarke and Whyte 2003, DEWHA 2008) were researched so to locate a reference site in close proximity to the Project area so as to facilitate examination of known GSM habitat.

However, a number of potential constraints were recognised in terms of utilising one of these sites as a reference site, including the duration of elapsed time since surveys were last conducted (12 – 13 years) on the sites closest to the Study Area (Clarke and Whyte 2003). In addition, many sites were located on privately-owned lands, hence limiting access by URS ecologists.

In the Southern Tablelands, a number of GSM populations are known to occur within travelling stock routes (TSRs) (JCLG 2009, Rehwinkel 2011). TSRs provide ideal reference sites, in so far as they avoid potential issues encountered with access to privately-owned lands.

**Table 1 Population Locations of GSM in the NSW Southern Tablelands**

Site Name	Easting	Northing	Elevation	Area	Land Tenure	RLPB	Survey
Binalong	648613	6161547	480	0.2	Private/Cemetery	Yass	1999
Blackburn	679584	6157088	660	25	TSR	Yass	1998/1999
Bookham	648968	6147495	650	< 1	Private/Cemetery	Yass	1999
Bowning	666722	6150700	560	20	Roadside/TSR	Yass	1999
Coolalie	680921	6147277	640	3	TSR	Yass	1998/1999
Costellos Ck	673423	6158169	660	5	TSR	Yass	1998
Davis 1999	678998	6153055	720	10	TSR	Yass	1999
Davis 1998	679215	6153555	700	10	TSR	Yass	1998

## 2 Background

Site Name	Easting	Northing	Elevation	Area	Land Tenure	RLPB	Survey
Deringullen	671981	6152177	590	5	TSR	Yass	1998/1999
Eadys New	680250	6161555	660	10	TSR	Yass	1999
Flakeney Ck	677194	6171387	680	5	TSR	Young	1998
Ginninderra Rd	698178	6108187	640	91	Private	Yass	1999
Glencoe	690856	6117960	640	5	Private	Yass	1998/1999
Glenlothian	654829	6162355	520	2.5	Private	Yass	1999
Gocup	610125	6097246	300	5	TSR	Gundagai	1999
Gounyan Rd	683316	6133801	680	20	Roadside/Private	Yass	1999
Graces Flat Rd	661426	6148614	580	> 100	Roadside/Private	Yass	1999
Gundaroo	707272	6121153	590	1	Crown Land	Braidwood	1999
Harrys Ck Rd	667442	6173883	530	10	Private	Young	1999
Jeir Ck	686684	6121784	590	20	Roadside/Private	Yass	1999
Kia-Ora	698750	6114328	620	25	Roadside/Private	Yass	1998/1999
Lagoon	655499	6172555	460	3	TSR	Yass	1998/1999
Lambs	673297	6147359	520	50	TSR	Yass	1998/1999
Laverstock Rd	670610	6161692	650	1	Private	Yass	1999
Letchworth	699592	6083683	600	55	Crown Land	Braidwood	1999
Marked Tree Rd	708477	6122574	630	10	Crown Land	Braidwood	1998/1999
McInerneys	664478	6158879	700	10	TSR	Yass	1998/1999
Merryville	679753	6129003	580	5	TSR	Yass	1998/1999
Moorbys Lane	667655	6165261	640	1	Private	Yass	1999
Nanima	691110	6123660	620	10	TSR	Yass	1998/1999
Poplars	698316	6082243	600	1	Private	Braidwood	1999
Pudman	677194	6171387	680	5	TSR	Young	1999
Rye Park	675114	6178732	530	0.5	Recreation Res.	Young	1999
Spring Range	691273	6110913	650	2	Private	Yass	1999
Springvale	666287	6177545	470	20	Roadside/Private	Young	1999
Sutton	705575	6106784	620	1	Private/Crown	Braidwood	1999
TSR19	680250	6161555	660	10	TSR	Yass	1998
Tallagandra Ln	698816	6112134	670	1	Roadside/Private	Yass	1999
Tarengo	652959	6184236	580	10	TSR	Young	1999
Valrosa	666359	6176807	530	50	Roadside/Private	Young	1999
Wargeila	673423	6158169	640	5	TSR	Yass	1999
Warroo	669440	6128227	510	10	TSR	Yass	1998/1999
Washpen Ck	661629	6144686	580	30	Private	Yass	1998/1999
Wolverhampton	672824	6185664	580	10	TSR	Young	1998/1999

The scope of the URS survey effort did not allow for GSM. surveys to be undertaken at known reference sites by URS ecologists. Instead, URS ecologists utilised information provided by independent sources to determine if GSM was flying at known reference sites at the time of URS

## 2 Background

surveys within the Project site. This is discussed in detail in **Section 4.1.1**. URS ecologists did, however, visit one known reference site, close to the Project site, to make a habitat based assessment to guide the GSM survey effort undertaken for the Project. This is discussed below.

### 2.5.1 Reference Site: TSR-19

The closest known GSM reference site to the Project site, within a TSR, is TSR-19, also referred to as Eady's New (**Table 1**). TSR-19 is located < 20 km straight west of the Project site (**Figure 1A**). According to GSM surveys undertaken at TSR-19 in 1998 (Clarke and O'Dwyer 1999), at the time of survey the reference site was dominated by *Austrodanthonia caespitosa* inside the gate and the adjacent paddock. Weeds were also present in large numbers including *Holcus lanatus*, *Phalaris sp.*, and *Lolium perenne* (**Table 2**). Since 1998 the weather in the region has been characterised by severe drought across central NSW, followed by higher than average rainfall over more recent years. Thus, due to historical variations in climatic conditions, it is likely that the site habitat suitability for GSM in terms of floristic assemblage at TSR-19 may have changed over time.

A site visit was undertaken to TSR-19 by URS ecologists on 2/11/2011 to examine the current habitat and conditions at the reference site and to use this information to guide the selection of GSM survey sites within the Project area. At the time of the site visit, TSR-19 was supporting a relatively disturbed grassland community, with signs of recent grazing, soil compaction and tyre tracks (**Plate 2**). The dominant grasses within the TSR were Speargrass (*Austrostipa scabra*), Kangaroo Grass (*Themeda australis*), and the exotic Quaking Grass (*Briza maxima*). However, where the site extended to the south west, it appeared to be dominated by *Themeda australis*. In this area, a lot of the canopy species and shrubs appear to be regenerating (< 10 years age) (**Table 2**) and it was evident there was change since the 1998 survey.

## 2 Background

**Plate 2**      **TSR-19 Reference site (2/11/2011)**



**Table 2**      **Comparison of Site Floristic Assemblage of TSR-19 Over the Last Decade**

Scientific name	Common name	Clarke & O'Dwyer, 1999	URS site visit, 2011
<i>Acacia irrorata</i>	Green Wattle		
<i>Austrodanthonia caespitosa</i>	Ringed Wallaby Grass	++	
<i>Austrostipa scabra</i>	Speargrass		++
<i>Briza maxima</i> *	Quaking Grass		++
<i>Eucalyptus blakelyi</i>	Blakely's Red Gum		
<i>Eucalyptus cinerea</i>	Argyle Apple		
<i>Eucalyptus macrorhyncha</i>	Red Stringybark		
<i>Eucalyptus melliodora</i>	Yellow Box		
<i>Holcus lanatus</i> *	Yorkshire Fog	++	
<i>Juncus usitatus</i>	-		
<i>Leptorhynchus squamatus subsp. alpinus</i>	Scaly Buttons		
<i>Lolium perenne</i> *	Perennial Ryegrass	++	
<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush		
<i>Nassella trichotoma</i> *	Serrated Tussock		
<i>Phalaris sp.</i> *	Canary Grass	++	
<i>Plantago lanceolata</i>	Plantago		

## 2 Background

Scientific name	Common name	Clarke & O'Dwyer, 1999	URS site visit, 2011
<i>Poa sp.</i>	Tussock Grass		
<i>Themeda australis</i>	Kangaroo Grass		++

\* Denotes exotic species

++ Indicate dominant species

## Methodology

### 3.1 Field Survey

The URS field survey effort was conducted under the authority of a current NSW Scientific Licence issued under Clause 23 of the *National Parks and Wildlife Regulation 2002* and section 132C of the National Parks and Wildlife Act 1974 by the NSW Department of Environment, Climate Change and Water (now NSW Office of Environment and Heritage), and an Animal Research Authority issued by the Director-General's Animal Care and Ethics Committee (ACEC) of NSW Department of Primary Industries (now NSW Industry and Investment). GSM surveys were carried out in accordance with the 'Background Paper to EPBC Policy Statement 3.12 – Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*)' (DEWHA 2009), which includes recommended survey effort.

The recommended survey effort included targeted survey for GSM within areas of potentially suitable habitat between 10am and 2pm on cloudless, relatively still days where the temperature is above 20°C by 10am, and when it had not rained for two days prior to survey (as per DEWHA (2009) guidelines).

#### 3.1.1 Survey Effort and Timing

Following literature reviews and expert advice (outlined in **Section 2.3** and **2.4**), the peak flight activity of GSM occurs annually from mid-November until early January. Between years there is seasonal variation with flights occurring earlier in some years, where warm dry springs take place, and later (accompanied by an extended season) when cool moist spring periods are encountered (Cook and Edwards 1994). As a result of an above average number of cold and rainy days during November and into December 2011, which presumably delayed moth emergence, surveys were undertaken between December 2011 and January 2012 by suitably qualified and experienced ecologists.

#### 3.1.2 Weather Conditions

The results of surveys undertaken in 2008 and 2009 (FOMC 2009) suggest that although the surveys were undertaken on days with similar temperature ranges, the number of GSM observed at sites was significantly greater on windless days, when compared to windy days. These findings outline the importance of surveying in optimum weather conditions in order to increase the chances of observing maximum numbers of the species at a given site.

The nearest weather station to the Project site that is able to provide forecast details is located at Yass, followed by the station at Goulburn. Rainfall data is collected at Dalton Post Office.> However no temperature or forecast data is available from this site.

Local weather conditions for Yass, approximately 30 km south-west of the Project area (with similar elevations), and Goulburn, were tracked closely in order to identify the most favourable days to undertake targeted GSM surveys as part of the current survey (BOM 2011). Weather forecasts for the Yass and Goulburn region were downloaded daily using the Weatherzone iPhone application (Weather Company 2011). The application uses data obtained directly from the Bureau of Meteorology resources. This weather data was also compared to data sourced directly from the Bureau of Meteorology website for confirmation of predicted weather conditions. **Appendix B** provides details of weather conditions during URS surveys as recorded at the Yass weather station. **Appendix B** also provides rainfall data for Dalton Post Office. The rainfall data collected from Dalton Post Office is not quality checked (BOM 2012).



## 3 Methodology

### 3.1.3 Survey Methods

URS Ecologists employed a number of visual sampling techniques in the survey design in order to maximise detection success of GSM within the Project area. Visual surveys included a combination of fixed observation point surveys (Sites 1 – 9) along with random meander traverses and opportunistic surveys throughout the Project area (**Figure 2**). Surveys were conducted within areas of potential suitable habitat on warm days with little or no wind between 10:00am and 2:00pm, as per the DEWHA (2009) guidelines for the species.

A recent publication (FOG 2009) identified the success of opportunistically identifying GSM while traversing to sample pre-determined monitoring plots. This suggested that walking transects are a more productive methodology for sampling the presence of the species in a given area, than quadrats. This is probably due to the fact that walking encourages moths into flight (generally referred to as “flushing”), and thus greatly improves the chances of detecting the species (TAMS 2010). Consequently, URS ecologists aimed to undertake opportunistic surveys when travelling to and from fixed monitoring points.

### 3.1.4 Survey Sites

A site reconnaissance was undertaken on 7 December, 2011 to identify suitable GSM survey sites within the Project area. Survey sites were chosen based on the presence of potentially suitable GSM habitat and key habitat features. The following key habitat features were taken into consideration when identifying suitable survey sites:

- Presence of native grasses suitable for GSM habitat, such as; *Austrodanthonia spp.*, *Austrostipa scabra* and *A. bigeniculata*.
- North east facing aspect;
- Availability of inter-tussock space; and
- Low ratio of exotic flora species.

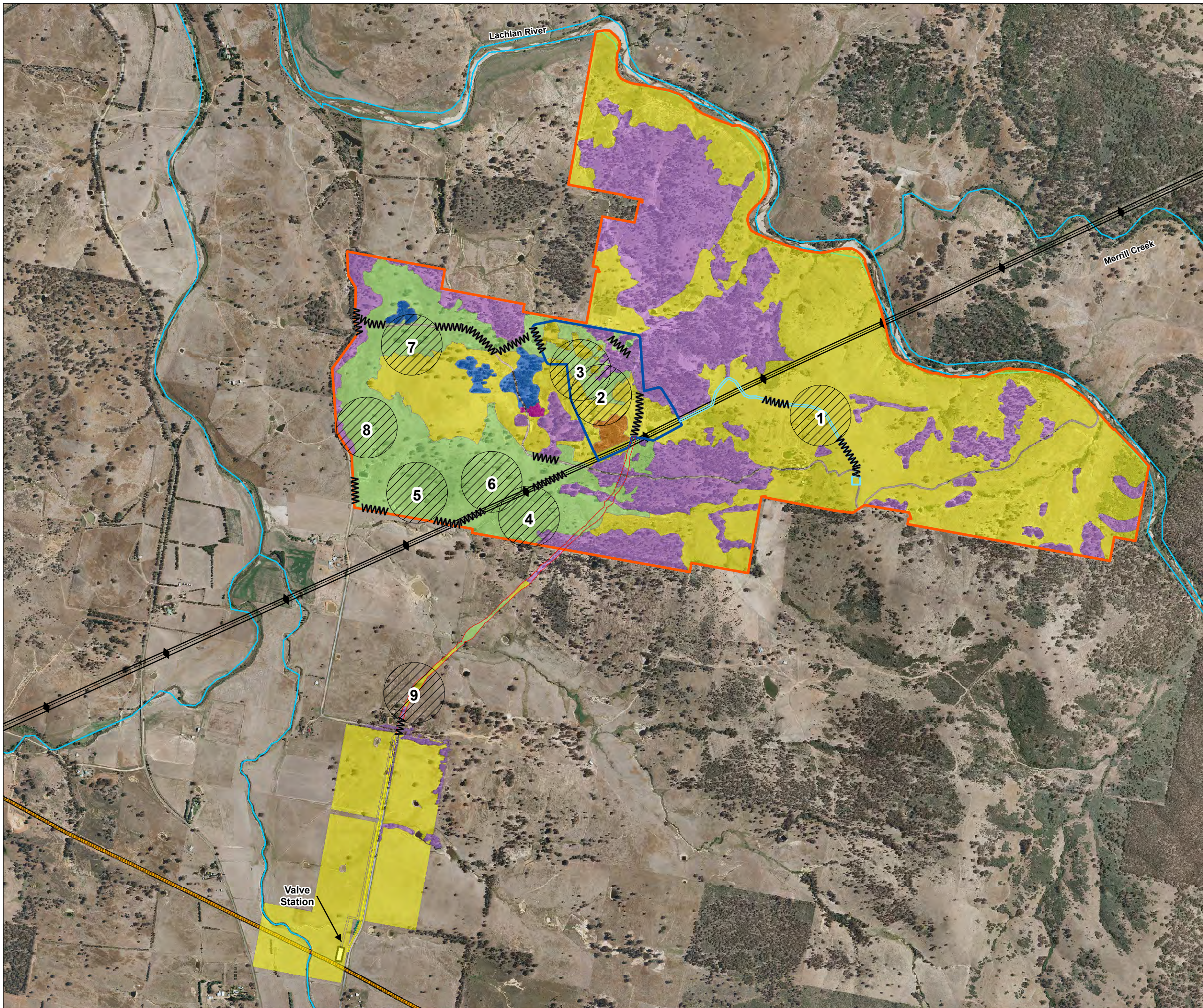
Survey sites were also selected so as to avoid impacts from vehicle movement on site, edge effect, and particularly disturbed or degraded locations.

As a result of this, a total of nine survey sites were chosen to conduct targeted GSM surveys (**Figure 2**).

Survey sites were also positioned so as to include survey effort within areas proposed for the offset site to accompany the project, as well as portions of the development footprint. Sites were also selected on the basis of good visibility (e.g. slightly raised locations that provided good vision of surrounding areas). All sites were located within vegetation classified as either Natural Temperate Grassland (as listed under the EPBC Act) or Box Gum Woodland (as listed under the TSC Act). The majority of sites were selected within vegetation classified as Natural Temperate Grassland due to the presence of better condition understorey vegetation within this community, corresponding with GSM suitable habitat.



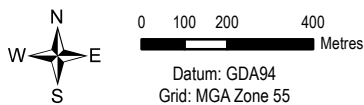
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## Legend

- AGL Site Boundary
- Plant Footprint
- Gas Pipeline (northern and Access Road)
- Gas Pipeline (southern)
- Communications Tower and Hut Footprint
- Communications Tower Services and Access Track
- Moomba-Sydney Pipeline
- Transmission Line
- Vegetation Communities (URS):**
  - Natural Temperate Grassland<sup>^</sup>
  - Box Gum Woodland<sup>\*</sup>
  - Grey Box Over Exotic Pasture
  - Red Stringybark over Exotic Pasture
  - Disturbed Shrubland
  - Exotic Pasture
  - Plantation
- Survey Sites (incl. random meanders)
- Random Meander Traverses

\* TSC Listed Community  
<sup>^</sup> EBPC Listed Community



Source: Aerial Image from AGL

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DALTON POWER PROJECT

**GOLDEN SUN MOTH  
SURVEY LOCATIONS**

**URS**

Figure: 2  
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## 3 Methodology

### 3.2 Survey Limitations

Surveys aimed to cover as much ground as possible during the survey period. Consequently, random meanders were undertaken to provide as much coverage as possible. However, given the size of the Project area, surveys were not undertaken across the entire site. Rather, surveys were performed in a series of survey sites selected on the basis of what was considered to be preferred habitat for the species.

Surveys were undertaken during the optimal survey period recommended for the species, based on extensive consultation with OEH and DSEWPaC. Each survey was carried out by two experienced ecologists, both of whom are very familiar with the site.

Surveys were undertaken following the passing of at least two days since the last rainfall wherever possible. However, it should be noted that weather forecasts for the Yass and Goulburn region are not completely representative of the microclimatic conditions experienced at the Dalton site. Therefore, the accuracy of rainfall predictions for the region could not be completely guaranteed. **Appendix B** provides data for December rainfall in Dalton, as well as Yass.

The survey was limited by the current weather conditions being experienced as a result of the La Niña event, which has resulted in higher than average rainfall over the 2011/2012 spring and summer periods. Consequently, weather conditions were not always ideal for survey. However, survey effort was undertaken on what were considered to be the most appropriate days weather-wise, given the current weather conditions.

In addition, where surveys were limited by sporadic wet weather, URS ecologists were advised to correlate URS survey dates with reference sites that had recorded GSM 'flying' on that same day (pers comm Rod Pietsch, NSW OEH). This correlation strengthened URS's survey effort, via verification from independent GSM observers. As a result, URS survey effort was undertaken either on days that met the requirements for survey as outlined by DEWHA (2009), or on days when GSM was sighted elsewhere at reference sites within the region.



## Results

### 4.1 Field Survey

#### 4.1.1 Survey Effort and Timing

GSM were observed to be flying on 24 November, 2011 in Melbourne, Victoria (Nathan Garvey, *pers. comm.*) and the survey season was confirmed to have started in the ACT and Southern Tablelands in the week of November 21 – 27 2011 (*pers. comm.* Rod Pietsch NSW OEH) URS surveys for GSM commenced within the study area soon after the former date, pending suitable weather conditions, and continued until the second week of January 2012 (**Table 3**).

While GSM surveys on each day were conducted in suitable weather conditions as per the *Survey Guidelines* (DEWHA 2009), it should be noted that the weather conditions experienced during the broader survey period were atypical due to the prevalence of a La Niña event across the Southern Hemisphere. La Niña events are typified by above average rainfall in the eastern part of Australia over the spring and summer period, and in 2011 produced the third wettest year on record in Australia (BOM 2012).

This period of extensive rain and cool temperatures experienced in the region limited the number of suitable survey days across the recommended survey period. Even so, the recommended survey guidelines of four suitable days, staggered at least a week apart to increase the likelihood of detection of the species, was met (**Table 5**).

A total survey effort of 56 hours was expended by two ecologists undertaking targeted GSM surveys within the Project site, over eight mostly non-consecutive days (**Table 3**). An additional 98 hours was expended by two ecologists undertaking random meander transects throughout areas of suitable GSM habitat, which constitutes opportunistic GSM surveys, to bring the total survey effort to 154 hours (**Table 3**).

Of this total, 17 hours and 13 minutes was spent searching for GSM when it was active on other sites in the ACT and NSW during 2011-12 surveys (**Table 5**, **Table 6**).

No GSM were found within the Project site during URS surveys. A number of additional species not previously recorded on the site but recorded during GSM surveys is provided in **Appendix C**.

**Table 6** provides a summary of the dates of URS survey that coincide with observations of GSM at reference sites in the ACT.

**Table 3 Total Survey Effort for GSM**

Dates	Survey Method	Person Hours*
December 7, 8, 14, 21, 22 and 29, 2011 & January 3 and 10, 2012	Random meander transects in and around Survey sites (1-9)	56
October 24, 25, 26 and 31, 2011 November 1, 2 and 3, 2011	Random meander transects throughout areas of suitable habitat	98
<b>Total Effort</b>		<b>154</b>
*total time spent on site doubled to account for presence of two ecologists.		

## 4 Results

### 4.1.2 Weather Conditions

In order to determine the most suitable weather conditions for GSM survey in Dalton for each upcoming week, and hence what days survey would be carried out on, weather forecasts for the Yass and Goulburn region were downloaded daily using the Weatherzone iPhone application (Weather Company 2011). These were also compared to predictions on the Bureau of Meteorology website.

Microclimatic conditions were recorded at each survey site, using a handheld weather station (Kestrel 2500) and, and are summarised in **Table 4**. Full details of weather conditions recorded at the Yass weather station during GSM surveys are found in **Appendix B**.

**Table 4** provides a summary of weather conditions as recorded by URS ecologists on the days of GSM surveys. Survey 1b was abandoned due to cloud cover.

**Table 4** Summary of survey effort and weather during URS GSM surveys

Survey	Date	Temp (°C) at 10:00am	Wind speed (km/hr)	Cloud cover (% average)	Survey hours
Survey 1a	7/12/2011	21.9°C	1.7km/ hr	40%	4:27 hours
Survey 1b	8/12/2011	20.8°C	1.0km/ hr	90%	1:00 hour
Survey 2	14/12/2011	21.8°C	3km/ hr	20%	4:56 hours
Survey 3a	21/12/2011	25°C	1.9km/ hr	80%	4:20 hours
Survey 3b	22/12/2011	29.2°C	1km/ hr	25%	3:22 hours
Survey 4	29/12/2011	28.8°C	3.2 km/ hr	0%	3:11 hours
Survey 5	3/01/2012	35.8°C	4 km/ hr	0%	3:10 hours
Survey 6	10/01/2012	26.9°C	2.9 km/ hr	30%	3:32 hours

\*Grey highlight denotes surveys that did not meet the environmental requirements for survey under Survey Guidelines for GSM (DEWHA 2009)

**Table 5** provides details of weather conditions on days when GSM survey was undertaken by URS. Only those days when weather met survey guidelines as per DEWHA (2009) are shown in this table.



## 4 Results

**Table 5** Details of weather conditions of GSM surveys

Date		14/12/2011	22/12/2011	29/12/2011	3/1/2012	10/1/2012
Surveyors		Alex Cave & Kathryn Chesnut	Alex Cave & Kathryn Chesnut	Alex Cave & Jane Murray	Alex Cave & Kathryn Chesnut	Alex Cave & Kathryn Chesnut
Temp Range During URS Survey ( °C)		21.1 – 25.9	22.9 – 29.2	22.1 – 28.8	29.5 – 38.6	20 – 26.9
Wind During URS Survey		Light, intermittent (1.4 – 4.7 km/ hr)	Light, intermittent (1 – 3.3 km/ hr)	Light, intermittent (2.3 – 5.4 km/ hr)	Light, intermittent (2.6 – 4.3 km/ hr)	Light to medium winds (2.3 – 6.8 km/ hr)
Date of Last Rain (according to BOM, 2011)*		12/12/2011	20/12/2011	28/12/2011	28/12/2011	28/12/2011
Cloud Cover During URS Survey (average)		20%	25%	0%	0%	30%
Time of URS Survey	Start	10.23am	9.59am	10.12am	10.10am	9.55am
	Finish	3.19pm	1.21pm	1.23pm	1.20pm	1.27pm
	Total Hours	4 hrs 56 mins X 2	3 hrs 22 mins X 2	3hrs 11 mins X 2	3 hrs 10 mins X 2	3 hrs 32 mins X 2
GSM	URS Survey Locations	1 – 9	1 – 9	1 – 9	1 – 9	1 – 9
	GSM Sightings at Reference Sites	(4) @ Crace Grassland Reserve, Gungahlin (pers. comm. Tom O’Sullivan)	N/A	(4) @ York Park, Canberra (pers. comm. Alison Rowell)	(37) @ Canberra Airport, Canberra (pers. comm. Alison Rowell); (2) @ Mulanggari (pers. comm. Kris Nash);	N/A

\*see Survey Limitations (Section 3.2).

As outlined in **Section 2.5** and **3.2**, reference sites that were being surveyed by independent researchers were utilised to strengthen URS survey effort, given the less than ideal weather conditions during much of the usual flying period. **Table 6** shows the dates of URS surveys and the number of moths sighted at reference sites.

**Table 6** Dates of URS surveys compared with sightings of GSM by independent researchers at reference sites.

URS Survey Date	Date	Number of Moths Sighted at Reference Site	Location of Reference Site
Survey 1a	7/12/2011	18	Mulligans Flat Nature Reserve (Gungahlin ACT)
Survey 1b	8/12/2011	9	York Park, ACT
Survey 2	14/12/2011	4	Crace Nature Reserve, ACT
Survey 3a	21/12/2011	30	Macgregor West, ACT
Survey 3b	22/12/2011	N/A	N/A
Survey 4	29/12/2011	N/A	N/A

## 4 Results

URS Survey Date	Date	Number of Moths Sighted at Reference Site	Location of Reference Site
Survey 5	3/01/2012	2	Mulanggari Nature Reserve, ACT
		37	Canberra Airport, ACT
Survey 6	10/01/2012	N/A	N/A

### 4.1.3 Survey Sites

The Project site is dominated by extensive areas of moderate to high quality woodland, native grasslands and derived grasslands, particularly in the western portions of the site (**Figure 2**). Vegetation across the nine survey sites was in moderate condition, with only light grazing having taken place within sections of the offset site (predominately site 4 and 9). Grazing has resulted in a slight reduction in diversity compared to some previous field surveys, with reductions in herbaceous and forb complexity, and a slight increase in the density of exotic species in some locations.

The majority of the vegetation throughout the site has relatively low species diversity, possibly resulting from previous land uses. Vegetation mapped as Natural Temperate Grassland generally has a high percentage of ground coverage throughout much of its occurrence, with a dominance of the following grass species:

- *Spear grass (Austrostipa scabra)*;
- *Kangaroo Grass (Themeda australis)*;
- *Wallaby Grass (Austrodanthonia spp.)*;
- *Spear grass (Austrostipa scabra)*; and
- *Spear grass (Austrostipa bigeniculata)*.

#### 4.1.3.1 Site Characteristics

##### Site One – Communications Tower Services

**Easting 702416.8946 ; Northing 6159448.3585**

Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
601 m	Southerly	20%	15%	Recent & historical grazing	Upper slope, close to ridge	10%	50 : 50
Scientific name			Common name		(%) Cover	Native/ Exotic	
<i>Austrodanthonia sp.</i>			Wallaby Grass		50%	Native	
<i>Austrostipa sp.</i>			Speargrass		30%	Native	
<i>Acetosella vulgaris</i>			Sheep sorrel		10%	Exotic	
<i>Taraxacum officinale</i>			Dandelion		< 5%	Exotic	
<i>Holcus lanatus</i>			Yorkshire Fog		< 5%	Exotic	
<i>Elymus scaber</i>			Common Wheatgrass		< 5%	Exotic	

##### Site Two – Development Footprint (south)

**Easting 701336.8310; Northing 6159549.5675**



## 4 Results

Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
562 m	Easterly	5%	5%	Historical grazing	Gentle side slope	5%	10 : 90
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		85%		Native	
<i>Acetosella vulgaris</i>		Sheep Sorrel		5%		Exotic	
<i>Austrostipa scabra</i>		Speargrass		5%		Native	
<i>Taraxacum officinale</i>		Dandelion		< 5%		Exotic	

### Site Three – Development Footprint (north)

Easting 701234.4660; Northing 6159672.7873							
Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
601 m	Northerly	5%	15%	Historical grazing	Lower slope	5%	10 : 90
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		45%		Native	
<i>Austrostipa scabra</i>		Speargrass		30%		Native	
<i>Taraxacum officinale</i>		Dandelion		5%		Exotic	
<i>Kunzea ambigua</i>		Tick Bush		5%		Native	
<i>Acetosella vulgaris</i>		Sheep's sorrel		5%		Exotic	
<i>Poa sieberiana</i>		Grey Tussock Grass		5%		Native	
<i>Lolium perenne</i>		Perennial Ryegrass		5%		Exotic	

### Site Four – Powerline Easement Gully, Offset Area

Easting 700797.8277; Northing 6159122.8683							
Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
542 m	North-westerly	10%	5%	Current and historical grazing	Lower slope, south of gully	5%	10 : 90
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		30%		Native	
<i>Austrostipa scabra</i>		Speargrass		25%		Native	
<i>Themeda australis</i>		Kangaroo Grass		15%		Native	
<i>Acetosella vulgaris</i>		Sheep Sorrel		15%		Exotic	
<i>Lomandra filiformis</i>		Wattle Mat-rush		5%		Native	
<i>Briza maxima</i>		Blowfly Grass		5%		Exotic	
<i>Lolium perenne</i>		Perennial Ryegrass		5%		Exotic	
<i>Wahlenbergia gracilis</i>		Australian Bluebell		< 5%		Native	
<i>Taraxacum officinale</i>		Dandelion		< 5%		Exotic	

## 4 Results

### Site Five – Southern Spur, Offset Area

Easting 700981.8664; Northing 6158951.3898							
Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
539 m	South-west	5%	15%	Historical grazing	Mid-slope	10%	10 : 90
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		45%		Native	
<i>Austrostipa scabra</i>		Speargrass		20%		Native	
<i>Lomandra filiformis</i>		Wattle Mat-rush		10%		Native	
<i>Themeda australis</i>		Kangaroo Grass		10%		Native	
<i>Juncus usitatus</i>		Tussock Rush		5%		Native	
<i>Dichelachne hirtella</i>		Plumegrass		5%		Native	
<i>Holcus lanatus</i>		Yorkshire Fog		5%		Exotic	
<i>Taraxacum officinale</i>		Dandelion		< 5%		Exotic	

### Site Six – Powerline Easement South-east Slope, Offset Area

Easting 700430.8296; Northing 6159069.0604							
Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
543 m	South-east	5%	5%	Historical grazing	Mid-slope	10-15%	15 : 85
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		35%		Native	
<i>Austrostipa scabra</i>		Speargrass		30%		Native	
<i>Lolium perenne</i>		Perennial Ryegrass		10%		Exotic	
<i>Echinopogon ovatus</i>		Forest Hedgehog Grass		5%		Native	
<i>Holcus lanatus</i>		Yorkshire Fog		5%		Exotic	
<i>Acetosella vulgaris</i>		Sheep's sorrel		5%		Exotic	
<i>Eragrostis</i>		Brown's Lovegrass		5%		Native	
<i>Themeda australis</i>		Kangaroo Grass		5%		Native	
<i>Lomandra filiformis</i>		Wattle Mat-rush		< 5%		Native	

### Site Seven – Cocky's Gate, Offset Area

Easting 700183.2255; Northing 6159389.8164							
Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
554 m	North-west	5%	5%	Recent and Historical grazing	Mid-slope	5%	40 : 60
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Phalaris aquatica</i>		Phalaris		25%		Exotic	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		20%		Native	
<i>Austrostipa bigeniculata</i>		Knead Speargrass		20%		Native	
<i>Acetosella vulgaris</i>		Sheep's sorrel		10%		Exotic	



## 4 Results

<i>Themeda australis</i>	Kangaroo Grass	10%	Native
<i>Lolium perenne</i>	Perennial Ryegrass	5%	Exotic
<i>Taraxacum officinale</i>	Dandelion	5%	Exotic
<i>Trifolium sp.</i>	Clover	< 5%	Exotic

### Site Eight – Walsh’s Fenceline, Offset Area

**Easting 700416.5380; Northing 6158084.2568**

Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
554 m	North-west	20%	20%	Historical grazing	Upper slope	10%	5 : 95
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Themeda australis</i>		Kangaroo Grass		40%		Native	
<i>Austrostipa bigeniculata</i>		Kneel Speargrass		30%		Native	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		20%		Native	
<i>Austrostipa scabra</i>		Speargrass		30%		Native	
<i>Phalaris aquatica</i>		Phalaris		10%		Exotic	
<i>Taraxacum officinale</i>		Dandelion		5%		Exotic	
<i>Wahlenbergia gracilis</i>		Australian Bluebell		< 5%		Native	

### Site Nine – Gas Pipeline (south)

**Easting 702586.9015; Northing 6159177.5332**

Altitude	Aspect	Bare-ground	Exposed rock	Land use	Position	Slope	Weed : native
528 m	South-west	10%	5%	Current grazing	Lower-slope	5%	10 : 90
Scientific name		Common name		(% Cover)		Native/ Exotic	
<i>Austrostipa scabra</i>		Speargrass		50%		Native	
<i>Austrodanthonia caespitosa</i>		Ringed Wallaby Grass		40%		Native	
<i>Themeda australis</i>		Kangaroo Grass		10%		Native	
<i>Eucalyptus melliodora</i>		Yellow Box		5%		Native	
<i>Juncus usitatus</i>		Tussock Rush		5%		Native	
<i>Lolium perenne</i>		Perennial Ryegrass		5%		Exotic	

## Conclusion

URS ecologists completed a survey for GSM to meet requirements outlined by NSW OEH, DSEWPaC and DP&I as part of the approvals process for the proposed Dalton Power Project.

Survey was undertaken within areas of suitable habitat for the species, based on habitats found in known reference sites documented within scientific literature. URS survey effort was considered to have met survey requirements for the species as outlined in *Background Paper to EPBC Policy Statement 3.12 – Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (Synemon plana)* (DEWHA 2009). The survey effort was also informed by expert guidance throughout the survey from:

- Rod Pietsch/Rainer Rehwinkle (NSW OEH);
- Melissa Maly/Tim McGrath (DSEWPaC);
- Michael Mulvaney (ACT - Environment and Sustainable Development Directorate);
- Alison Rowell (Biologist and Environmental consultant);
- Bob Spiller (Jerrawa Creek Landcare Group);
- John and Mary Walsh (landowners);
- Geoff Robertson (Friends of Grasslands); and
- Nathan Garvey (Biosis Research).

No GSM were found within the Project area, which included the plant footprint, communications tower and access road, gas pipeline (northern portion) and proposed offset site.

Based on the above survey results, it is concluded that survey requirements for the species have been adequately met and that GSM **does not occur** within the Project area.



## References

- BOM (2011) Yass Forecast. Australian Government Bureau of Meteorology. Accessed online - <http://www.bom.gov.au/nsw/forecasts/yass.shtml>
- BOM (2012) Annual Australian Climate Statement 2011. Bureau of Meteorology. Accessed online 12/1/2012 - [http://www.bom.gov.au/announcements/media\\_releases/climate/change/20120104.shtml](http://www.bom.gov.au/announcements/media_releases/climate/change/20120104.shtml)
- Braby and Dunford (2006) Field Observations on the Ecology of the Golden Sun Moth *Synemon plana* (Lepidoptera: Castniidae). Australian Entomologist **33**: 103-110
- Clarke GM and O'Dwyer (1999) Further survey in south-eastern New South Wales for the Endangered Golden Sun Moth, *Synemon plana*. A report prepared for the Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone. CSIRO Division of Entomology, Acton, Canberra.
- Clarke (2000) Survey and Genetic Analysis of NSW Populations of the Endangered Golden Sun Moth *Synemon plana* 1999. A report prepared for the Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone. CSIRO Entomology, Canberra.
- Clarke G and Whyte L (2003) Phylogeography and population history of the endangered Golden Sun Moth (*Synemon plana*) revealed by allozymes and mitochondrial DNA analysis. Conservation Genetics 4: 719 – 734
- Cook and Edwards (1994) Population monitoring of endangered moth *Synemon plana* 1993 – 1994, York Park, Barton. Report to the Capital National Planning Authority. CSIRO Division of Entomology, Acton, Canberra.
- CSIRO (2012) Australian National Insect Collection Database. Commonwealth Scientific and Industrial Research Organisation. Accessed online 13/1/2012 - [http://anic.ento.csiro.au/database/search\\_all.aspx](http://anic.ento.csiro.au/database/search_all.aspx)
- DEWHA (2008) Golden Sun Moth, ACT – NSW Area. Viewed online 19/10/2011 – EPBC Act Policy Statement. Map 1. Accessed at <http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth-map1.pdf>
- DEWHA (2009) Background Paper to EPBC Policy Statement 3.12 – Nationally Threatened Species and Ecological Communities: Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*). Department of Environment, Water, Heritage and the Arts. Viewed online 19/10/2011 - <http://www.environment.gov.au/epbc/publications/pubs/background-paper-golden-sun-moth.rtf>.
- DSEWPac (2011) *Synemon plana* in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities. Viewed online 20/10/2011 - [http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=25234](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234)
- FOG (2009) Community Monitoring of Golden Sun Moths in the Australian Capital Territory Region, 2008-2009. Friends of Grasslands and the University of Canberra. Funded by the Threatened Species Network, a community-based program of the Australian Government and WWF Australia. Viewed online 19/10/2011 - <http://www.fog.org.au/Reports/GSM%20final%20report%2020100100.pdf>
- FOMC (2009) Golden Sun Moth: Erratic Golden Sun-moth surveys. Friends of Merri Creek. Viewed online 20/10/2011 - <http://home.vicnet.net.au/~fomc/pages/golden-sun-moth.php>
- GAA March (2010) Sub Regional Fauna Surveys: Golden Sun Moth. Biosis Research

## 6 References

- Gilmore D, Koehler S, O'Dwyer C, Moore W (2008) Golden Sun Moth *Synemon plana* (Lepidoptera: Castniidae). Results of a broad survey of populations around Melbourne. The Victorian Naturalist **125**(2): 39 - 46
- JCLG (2009) Land Water Life: Jerrawa Creek Catchment Renewal Plan 2010 – 2020. Jerrawa Creek Landcare Group, Lachlan Catchment Management Authority. Viewed online 20/10/2011 - [http://yan.org.au/doc/LandWaterLife - Jerrawa Creek Catchment Renewal Plan 2010.pdf](http://yan.org.au/doc/LandWaterLife_-_Jerrawa_Creek_Catchment_Renewal_Plan_2010.pdf)
- NSW DEC (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft. NSW Department of Environment and Conservation. Viewed online 19/10/2011 - <http://www.environment.nsw.gov.au/resources/nature/TBSAGuidelinesDraft.pdf>
- O'Dwyer and Attiwill (1999) A comparative study of the habitats of the Golden Sun Moth *Synemon plana* (Lepidoptera: Castniidae): Implications for Restoration. Biological Conservation **89**: 132-41
- O'Dwyer C and Attiwill PM (2000) Restoration of a Native Grassland as habitat for the Golden Sun Moth *Synemon plana* (Lepidoptera: Castniidae) at Mt Piper, Australia. Restoration Ecology **8**: 170-74
- Rehwinkel R (2011) The Biodiversity Values of Travelling Stock Route's (TSR's). Australian Network for Plant Conservation (ANPC) TSR Workshop 7/7/2011. Viewed online 20/10/2011 - [http://www.anbg.gov.au/anpc/courses/TSR\\_Workshops/Biodiversity\\_Values\\_TSRs\\_RRehwinkel\\_May%202011%20v3.pdf](http://www.anbg.gov.au/anpc/courses/TSR_Workshops/Biodiversity_Values_TSRs_RRehwinkel_May%202011%20v3.pdf)
- SEWPaC (2011) Species Profile and Threats Database: *Synemon Plana* – Golden Sun Moth. Department of Sustainability, Environment, Water, Populations and Communities. Accessed online 13/1/2012 - <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=14>
- TAMS (2010) Survey Guidelines for the Golden Sun Moth. Conservation Planning and Research, ACT Government Territory and Municipal Services.
- Weather Company (2011) Weatherzone: iTunes Application. The Weather Company Pty Ltd. Downloaded online 3/11/2011 - <http://itunes.apple.com/au/app/weatherzone/id409060691?mt=8>



## Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of AGL and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared in January 2012 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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## Appendix A Stakeholder Liaison

## Appendix A - Stakeholder Liaison

### Jerrawa Creek Landcare Group Newsletter



# Jerrawa Creek Landcare Group

[www.jcm.org.au](http://www.jcm.org.au)

## NEWSLETTER

November 2011

PO Box 23  
GUNNING NSW 2581  
Ph: 4845 8217  
[bobandrosemary@op.tasnet.com.au](mailto:bobandrosemary@op.tasnet.com.au)

### Golden Sun Moth

Do people use the website so well maintained by our webmaster? Well, I was recently contacted by a fauna ecologist who was wanting help in finding places where the Golden Sun Moth [*Synemon plana*] might be present in our district. Googling brought her to our website on which Don has placed *LandWaterLife* which she read and found that the Golden Sun Moth was among the endangered species that have been recorded here.

As Rainer Rehwinkel and his department was the main source of the endangered species information in *LandWaterLife* I have referred her to him. However, if you think you have seen the Golden Sun Moth, particularly around Dalton, and are willing to share your information with the researcher please let me know so I can put her in touch with you. A description of the Golden Sun Moth follows.



Male Golden Sun Moth



Female Golden Sun Moth

**Scientific name:** *Synemon plana*

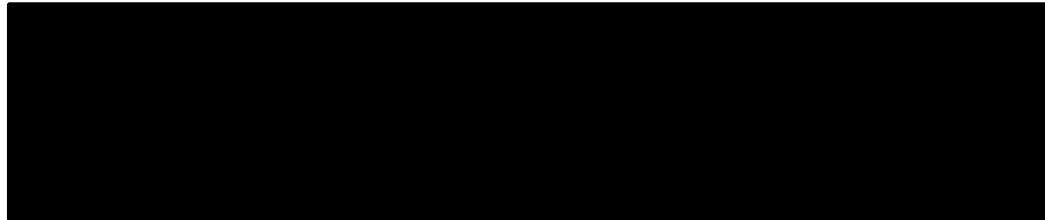
**Conservation status in NSW:** Endangered

**National conservation status:** Critically Endangered



## Appendix A - Stakeholder Liaison

### Ecological Consultants Association (ECA) Forum



There are 35 messages under the topic 'General'

Posted by : Nathan Garvey

28/11/11 12:12 pm

Hi Kath,

GSM has started flying in Victoria, but I have not heard of any flying around Canberra as yet. the report Steve refers to is from 2010. Rob Speirs has informed me that his preferred reference site in Canberra is York Park in Barton, across the road from the Press Club (as per Steve's post).

Cheers,

Nathan

Posted by : Steve Sass

25/11/11 9:57 am

Hey Kath,

this link

[http://www.actpla.act.gov.au/\\_\\_data/assets/pdf\\_file/0017/21572/APPENDIX\\_6\\_-\\_Letter\\_of\\_advice\\_from\\_Bluegum\\_-\\_Golden\\_Sun\\_Moth\\_-\\_13\\_October\\_2010.pdf](http://www.actpla.act.gov.au/__data/assets/pdf_file/0017/21572/APPENDIX_6_-_Letter_of_advice_from_Bluegum_-_Golden_Sun_Moth_-_13_October_2010.pdf)

provides a report by Biosis for a site in Canberra, and states detection of GSM at the intersection of Captain Cook Crescent and Austin Street, Griffith (in the middle of Canberra)! Field surveys for that report were done in November.

Other locations they discuss within the central Canberra area are York Park, St Marks Church in Barton, St Johns Church in Reid, and at the corner of Stuart St and McIntyre Street, Griffith.

Hope this helps.....

Cheers,

Steve Sass

Posted by : Kath Chesnut

07/10/11 3:28 pm

Does anyone have any hot tips on current surveys for Golden Sun Moth around the Southern Tablelands?

I'm interested to try and find a reference site, or for any information anyone local might have on when the species starts flying in the area.

If you have any information, I'd love to hear it - [kathryn\\_chesnut@urscorp.com](mailto:kathryn_chesnut@urscorp.com) / (02) 8925 5563.

## **Appendix B Weather conditions during survey period**

## Appendix B - Weather conditions during survey period

Table 1\_ Weather Conditions for Yass (November)

## Yass, New South Wales

## November 2011 Daily Weather Observations

Observations from a site just north of the centre of Yass.



Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Tu	4.5	23.2	0						13.5	78	6	SE	2		22.5	83	1	W	15	
2	We	10.8	23.4	0						13.8	85	3	W	9		23.1	78	4	SW	17	
3	Th	8.0		0						14.7	86	5		Calm		22.8	75	1	SW	7	
4	Fr			0												24.3	78	0	W	2	
5	Sa			0																	
6	Su		30.5	0																	
7	Mo	5.0	28.5	0						19.8	92	8	N	7		27.5		7	W	7	
8	Tu	16.5		14.6						22.5	96	3	WSW	2		23.9	98	8	N	7	
9	We		30.2	7.4						29.1	99	6	WNW	19		29.1	99	6	WNW	19	
10	Th	15.8	21.9	11.0						16.7	100	8	NNW	19		20.8	98	3	W	26	
11	Fr	5.0		0						13.7	96	0		Calm		22.8		1		Calm	
12	Sa			0																	
13	Su			0																	
14	Mo		31.0	0						19.5	100	0		Calm		29.5	97	5	NNW	30	
15	Tu	8.0	30.1	0						15.1	97	8		Calm		28.8	95	0	W	7	
16	We	7.6	20.8	0						17.4	98	6	E	7		19.4	98	8	NNE	2	
17	Th	10.8	27.0	0						17.5	95	7		Calm		24.8		4		Calm	
18	Fr	10.5		0												29.5		3	WNW	11	
19	Sa																				
20	Su		32.0																		
21	Mo	8.5	24.0	3.2						11.0	100	7		Calm		23.0	100	8	SW	4	
22	Tu	9.0	17.0	0						14.0	100	8		Calm							
23	We	10.5	22.0	9.0						15.0	94	7	SSE	7		21.5	95	4	NNE	11	
24	Th	10.5	17.5	0						14.5	94	8	ESE	11		16.0	95	8	E	17	
25	Fr	11.0		14.2						13.5	94	8	SE	9		15.5	100	8	SE	7	
26	Sa																				
27	Su		24.5																		
28	Mo	8.5	31.0	28.0						21.5	95	3		Calm		29.5	98	4	WSW	2	
29	Tu	13.5	32.0	0						23.0		5		Calm		31.0		3	N	20	
30	We	16.5	25.5	12.6						24.0	96	8	W	9		19.0	95	8	NW	8	
Statistics for November 2011																					
Mean		9.9	25.9							16.9	94	5		4		24.0	92	4		10	
Lowest		4.5	17.0							11.0	78	0		Calm		15.5	75	0		Calm	
Highest		16.5	32.0	28.0						24.0	100	8	NNW	19		31.0	100	8	NNW	30	
Total				100.0																	

Observations were drawn from Yass (Rural Fire Service) (station 070358)

Observations for Yass used to be taken at a different site about 1 km to the south; if you require these please contact us. The closest station with pressure and sunshine observations is at Canberra, about 60 km to the southeast. The closest station with evaporation is at Burrinjuck Dam, about 35 km to the southwest.

IDCJDW2152.201111 Prepared at 16:10 GMT on 2 Jan 2012

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## Appendix B - Weather conditions during survey period

Table 2\_ Weather Conditions for Yass (December)

**Yass, New South Wales**  
**December 2011 Daily Weather Observations**

Observations from a site just north of the centre of Yass.


 Australian Government  
 Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	5.0	22.5	15.2						12.5	88	3		Calm		20.5	100	1	W	2	
2	Fr	9.5		0						13.8	97	7	SE	6		19.0	95	6		Calm	
3	Sa			0																	
4	Su		25.5	0																	
5	Mo	3.5	20.0	0						12.5	100	0	SE	9		19.0	100	3	ESE	9	
6	Tu	5.5		0						14.0	63	4	SE	4							
7	We		23.0	0																	
8	Th	6.8	23.5	0						17.0	71	8		Calm		22.0	55	7	NE	7	
9	Fr	11.0		0						18.5	68	2	SE	4		24.5	39	7	NE	7	
10	Sa																				
11	Su		27.0																		
12	Mo	13.0	26.2	7.8						17.0	80	8		Calm		24.0	51	3		Calm	
13	Tu	13.0	24.0	0						16.5	70	8	S	9		22.5	45	3	SSW	4	
14	We	7.0	24.0	0						16.0	61	1	ESE	4		21.5	37	2	WSW	7	
15	Th	9.5	25.0	0						15.5	69	4	NNE	2		23.5	43	1	E	2	
16	Fr	9.5		0						17.0	66	0	SE	9		24.5	44	4	ESE	22	
17	Sa																				
18	Su		26.6																		
19	Mo	11.3	21.0	20.0						17.0	95	8		Calm		16.5	95	8	WSW	4	
20	Tu	11.0	27.5	19.5						17.5		3		Calm		26.0		3	WSW	4	
21	We	15.5	25.0	0						20.5		6	ESE	7		23.0		6	SE	11	
22	Th	14.5	25.0	0						20.0		4		Calm		23.5		7	NE	9	
23	Fr	10.0		0						19.5	82	1	SE	7		27.0	85	4		Calm	
24	Sa																				
25	Su																				
26	Mo		31.0																		
27	Tu																				
28	We	11.0	26.0	1.2						17.0	66	8	SE	7		23.5	47	1	S	4	
29	Th	10.0	26.0	0						19.0	52	0	E	11		25.6	30	0	NNE	9	
30	Fr	11.0		0						18.5	59	2	SE	11		24.0	44	2	NE	6	
31	Sa			0																	
Statistics for December 2011																					
Mean		9.9	24.9							16.8	74	4		4		22.8	60	3		5	
Lowest		3.5	20.0							12.5	52	0		Calm		16.5	30	0		Calm	
Highest		15.5	31.0	20.0						20.5	100	8	#	11		27.0	100	8	ESE	22	
Total				63.7																	

Observations were drawn from Yass (Rural Fire Service) (station 070358)

Observations for Yass used to be taken at a different site about 1 km to the south; if you require these please contact us. The closest station with pressure and sunshine observations is at Canberra, about 60 km to the southeast. The closest station with evaporation is at Burrumbidgee Dam, about 35 km to the southwest.

IDCJOW2152.201112 Prepared at 13:11 GMT on 7 Jan 2012

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<http://www.bom.gov.au/info/metadata/IDCJOW0008.pdf>

## Appendix B - Weather conditions during survey period

Table 3\_ Weather Conditions for Yass (January)

### Yass, New South Wales January 2012 Daily Weather Observations

Observations from a site just north of the centre of Yass.



Australian Government  
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			8am					3pm						
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Su			0																	
2	Mo		34.5	0																	
3	Tu	8.5	35.0	0						24.0	65	1		Calm		34.5	27	2	SW	9	
4	We	16.0	32.5	0						24.5	65	6	WSW	4		30.0	35	8	SSW	7	
5	Th	15.0	31.0	0						19.5	60	1		Calm		29.2	43	5	NNW	6	
6	Fr	14.0		0						17.5	76	7	E	6		25.0	36	1	E	6	
7	Sa			0																	
8	Su		32.0	0																	
9	Mo	10.0	23.5	0						18.0	42	1		Calm		22.0	31	2	WNW	17	
10	Tu	9.2	24.0	0						18.5	47	4	WSW	6		23.3	34	4	W	9	
11	We	12.0		0						14.0	53	6	W	19							
Statsbcs for the first 11 days of January 2012																					
Mean		12.1	30.4							19.4	58	3		5		27.3	34	3		9	
Lowest		8.5	23.5							14.0	42	1		Calm		22.0	27	1	#	6	
Highest		16.0	35.0	0						24.5	76	7	W	19		34.5	43	8	WNW	17	
Total				0.0																	

Observations were drawn from Yass (Rural Fire Service) (station 070358)

Observations for Yass used to be taken at a different site about 1 km to the south; if you require these please contact us. The closest station with pressure and sunshine observations is at Canberra, about 60 km to the southeast. The closest station with evaporation is at Burrinjuck Dam, about 35 km to the southwest.

IDCJDIW2152.201201 Prepared at 23:37 UTC on 10 Jan 2012

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## Daily rainfall

Observations of Daily rainfall are nominally made at 9 am local clock time and record the total for the previous 24 hours. Rainfall includes all forms of precipitation that reach the ground, such as rain, drizzle, hail and snow. [About rainfall data](#)

Station: Dalton Post Office      Number: 70112      Opened: 1898      Now: Open  
 Lat: 34.72° S      Lon: 149.18° E      Elevation: 530 m

Key: Units = mm 12.3 = Not quality controlled. ↓ = Part of accumulated total

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1st	0	0	0	0	0	2.4	0	0	0	6.6	0	0
2nd	0	0	0	0	0	0	0	0	0	0	0	0
3rd	0	34.0	0	0	3.2	0	5.6	0	0	0	0	0
4th	4.6	0	0	0	0	0	5.0	0	0	0	0	0
5th	0	7.0	0	0	0	2.4	0	0	1.6	0	0	0
6th	0	14.6	0	0	0	0	3.1	6.2	8.8	9.6	0	0
7th	0	0	0	0	0	0	8.0	1.8	0	0.6	0	0
8th	0	0	0	0	0	0	0	1.0	0	0	0	0
9th	0	0	0	0	0	0	0	0	2.3	0	6.8	0
10th	0	0	↓	↓	0	0	0	0	1.1	0	9.2	1.2
11th	0	0	24.4 2 days	21.2 2 days	0	0	0	9.0	0	0	0	18.0
12th	3.0	18.0	0	5.0	4.0	0	0	0	0	0	0	0
13th	0	0	0	0	0	0	0	0	0	0	0	0
14th	0	0	2.2	0	0	2.0	0	0	0	3.8	0	0
15th	0	0	0	0	0	0	0	0	0	0	0	0
16th	0	0	0	0	0	0	3.2	0	0	0	2.2	0
17th	0	26.4	5.8	0	0	0	2.6	32.0	0	0	0	0
18th	0	3.8	0	0	0	0	2.6	2.8	0	0	0	0
19th	0	0	0	0	0	0	0	1.2	0	0	0	29.2
20th	0	3.8	0	0	0	0	0	0.4	2.0	0	5.8	0
21st	0	0	0	2.4	0	10.4	0	0	0	0	0	0
22nd	0	0	8.8	0	0	0	0	0	0	0	8.1	8.4
23rd	13.0	0	0	0	24.6	2.6	5.8	0	0	0	0	0
24th	0	0	0	0	7.8	0	1.2	0	0	2.6	3.4	0
25th	0	0	3.4	0	0	0	1.0	0	1.8	4.0	40.2	0
26th	0	0	0	0	0	0	0	0	0	0	0	2.4
27th	0	0	0	0	0	0	0	0	0	0	0	0
28th	0	2.6	0	0	0	0	0	0	8.6	0	0	0
29th	0		0	0	0	0	0	0	10.2	4.8	6.6	0
30th	0		0	0	0	0	0	0	7.6	0	27.2	0
31st	0		0		0		0	0		0		0
Highest Daily	13.0	34.0	8.8	5.0	24.6	10.4	8.0	32.0	10.2	9.6	40.2	29.2
Monthly Total	20.6	110.2	44.6	28.6	39.6	19.8	38.1	54.4	44.0	32.0	109.5	59.2

Annual total for 2011 = 600.6 mm

### Summary statistics for all years

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	52.3	42.0	46.0	42.7	43.0	51.2	55.0	54.2	53.5	59.4	50.9	60.8
Median	43.4	30.6	39.2	27.7	35.9	44.2	46.6	54.4	46.9	48.8	43.9	50.0
Highest Daily	72.0 2nd 1992	88.0 20th 1974	92.0 15th 1989	87.6 8th 1921	72.0 30th 1989	63.5 10th 1915	85.3 26th 1922	44.0 28th 1974	47.8 13th 1915	67.2 17th 1976	84.6 20th 1961	78.5 8th 1922

Product Code: IDCJAC0009 reference: 05806518

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## Appendix C Additional Fauna - Species list

## Appendix C - Additional Fauna - Species list

### Additional Fauna species observed since the *URS Targeted Threatened Flora Survey Report (21/11/2011)*

Common name	Scientific name
Aves	
Dusky Woodswallow	<i>Artamus cyanopterus</i>
Rufous Songlark	<i>Cincloramphus mathewsi</i>
White-fronted Chat†	<i>Epthianura albifrons</i>
Invertebrates	
Australian Sheep Blowfly	<i>Lucilia cuprina</i>
Black-headed Pasture Cockchafer	<i>Aphodius tasmaniae</i>
Cabbage White Butterfly	<i>Pieris rapae</i>
Carrion Beetle	<i>Ptomaphila perlata</i>
Christmas Beetle	<i>Anoplognathus sp.</i>
Common Brown Butterfly	<i>Heteronympha merope</i>
Common Grass Blue Butterfly	<i>Zizina labradus</i>
Darkling Beetle	<i>Adelium simalitum</i>
Dragonfly sp. (+)	-
Common Garden Katydid	<i>Caedicia simplex</i>
Gasteruptiid Wasp	<i>Gasteruptiidae sp.</i>
Grasshopper sp. (+)	-
Leaf Case Moth (pupae)	<i>Hyalarcta huebneri</i>
Plague Soldier Beetle	<i>Chauliognathus lugubris</i>
Praying Mantis sp. (+)	-
Robber Fly	<i>Colepia rufiventris</i>
Scorpion Fly	<i>Harpobittacus australis</i>
Slender Gumleaf Grasshopper (nymph)	<i>Goniaea vocans</i>
Spider-hunting Wasp	<i>Heterodotonyx bicolor</i>
Yellow-banded Dart	<i>Ocybadistes walkeri</i>

† -threatened species listed as, Vulnerable (TSC Act)



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## Appendix E Estimated Frequency of G Class Stability Conditions

14 October 2011  
Project No. 43177661

AGL Energy Limited  
Level 22, 101 Miller Street  
North Sydney NSW 2060

Attention: Neil Cooke  
AGL Dalton - Project Manager

Dear Neil,

**Subject: Results and notes of G Class Stability Analysis**

This letter provides details in response to OEH submission detailed in **Excerpt 1**.

**Excerpt 1 – OEH Submission**

In our adequacy review, OEH noted that the use of TAPM meteorological data in noise assessment has been known to underestimate the occurrence of conditions most likely to enhance noise propagation (inversions and low wind speeds). OEH recommended that the proponent demonstrate that this potential underestimation is not occurring by presenting cumulative distribution functions of wind speeds for the TAPM-generated "site" data versus cumulative distribution functions of wind speeds from surrounding "real" meteorological stations. This information does not appear to have been included in the exhibited NIA, therefore unless the proponent provides further information regarding the occurrence of inversions, OEH has included by way of the suggested conditions below that the noise limits apply under all Stability Class temperature inversions conditions, including G class.

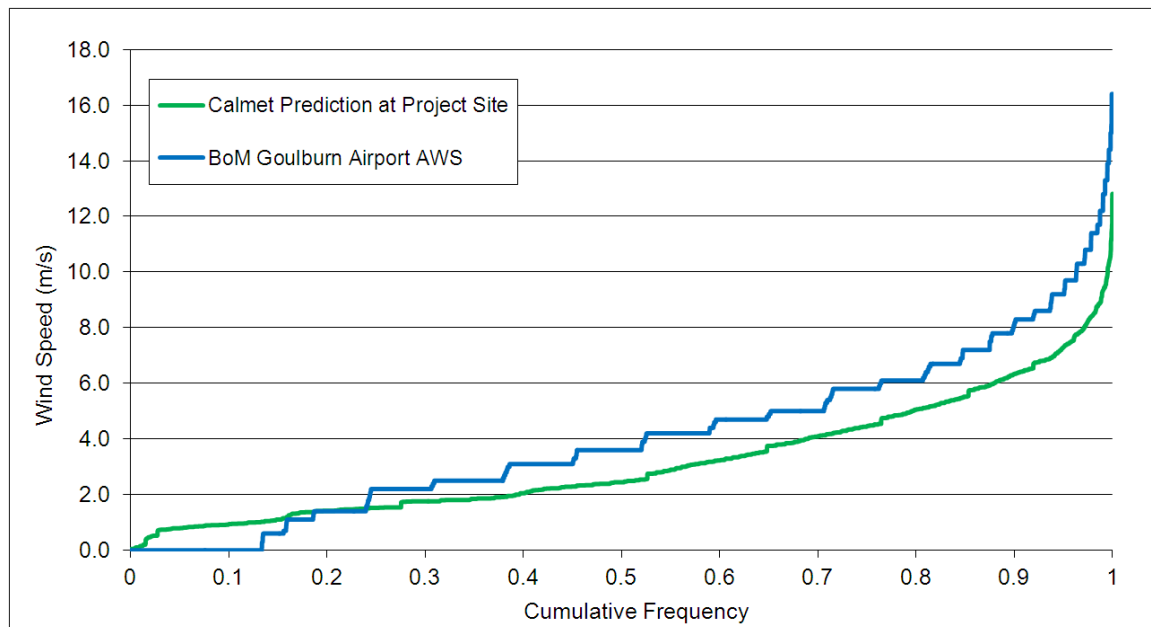
**1.1 Differences between TAPM V4, and earlier versions.**

The meteorological dataset adopted in the Noise Impact Assessment (NIA) was generated using the CSIRO's TAPM Version 4. It is noted that Version 4 of TAPM features revisions to the parameterisation of the surface layer under stable low wind speed conditions, which relevant to earlier versions, provides a more accurate correlation with a range of datasets from meteorological monitoring campaigns. Relevant to earlier versions of the TAPM model, during night time hours, this has also resulted in an increase in the prediction of frequency of stable conditions, a corresponding reduction in D stability class. It is noted that the data adopted in the NIA featured stable meteorological conditions (E and F) during approximately 50% of the year. Given the requirement of no (or minimal) sunlight for the presence of a stable condition (where the accumulation of stable air occurs due to radiative heat loss from the surface in the absence of winds), this is approaching the theoretical upper limit for the occurrence of stable conditions.

## 1.2 Comparison of Wind Speed Cumulative Distribution Functions for Goulburn Airport and Project Site

Given the relatively remote nature of the site, there was limited meteorological monitoring data available to the NIA. On this basis, the NIA adopted meteorological data from the Air Quality Impact Assessment (AQIA) for the Project. In accordance with guidance from OEH (air quality technical advisory services unit) on similar projects, this data was prepared using the CSIRO's TAPM model, with the assimilation of wind data from the Bureau of Meteorology (BoM) Automatic Weather Station (AWS) data, which in this case, was sourced from Goulburn airport. These predictions were then incorporated into the Calmet meteorological model, where TAPM predictions were incorporated, and diagnostic wind effects were incorporated on a finer scale. In response to the submission, URS has prepared a chart of wind speed cumulative distributions as predicted by Calmet for the Project Site, and as measured at Goulburn Airport. These are shown in **Figure 1**.

**Figure 1 - Cumulative Frequency Distribution**



There are a range of factors that require consideration when comparing the model predictions to the BoM data. These include:

- **Averaging Period** - The BoM data is understood to consist of averages of wind data collected during the final 10 minutes of each hour. In comparison, the Calmet data represents an hourly averaged statistic. In principle, two identical datasets of 1 hour and 10 minute averaging periods should exhibit the same mean, whilst the 10 minute averaged dataset will exhibit a higher standard deviation (which includes an increased observed frequency of calm conditions).
- **AWS Siting** - Surface roughness at Goulburn Airport is lower than at the Project site due to the relatively flat nature of the landing strip, and a lower amount of obstructions (such as large trees). For a given regional flow, this effect would result in an increase in observed wind speeds, including a reduction in the observed frequency of calm conditions.



- **Geographic Separation** - Goulburn Airport is located approximately 50km east south-east of the Project site. Slight differences in regional winds would be expected between these two locations.
- **Instrumentation** - Instrumentation used by the BoM is expected to be less sensitive than instrumentation which is used for the measurement of wind for air quality purposes. This would lead to an increased in the observed frequency of calm conditions.

Given these factors, the ability to make a meaningful comparison of cumulative frequency distributions is limited. Noting this, the data do not appear inconsistent, in that calms are higher at Goulburn despite the presence of a higher 50<sup>th</sup> percentile wind speed.

### 1.3 Estimated Frequency of G Class Stability Conditions

Given that the meteorological data included in the NIA was prepared for air quality purposes, stability class predictions were limited from A through to F. In order to investigate the frequency of G class stability implicit in this dataset, the synthetic meteorological data was processed to provide an estimation of the lapse rate. Appendix E of the INP provides details on methods for estimating stability class. This includes the measurement of the lapse rate using a meteorological monitoring tower with temperature sensors at two levels: One at between 1.5m and 10m, and another at between 50m and 60m.

The wind data from Layer 1 (10 mAGL) and Layer 3 (50 mAGL) of the Calmet meteorological fields was compared for night time hours (6pm to 7am) during the winter months. The differences in temperature were divided by the distance between the layers, in order to provide the lapse rate in units of °C/100m. Stability classes were then derived in accordance with the criteria contained in Table E1 of the INP as shown in **Table 1** below.

**Table 1 – Adopted Criteria for the Derivation of Stability Class**

Stability category	Range of vertical temperature gradient (°C/100 m)
A	$DT/DZ < -1.9$
B	$-1.9 \leq DT/DZ < -1.7$
C	$-1.7 \leq DT/DZ < -1.5$
D	$-1.5 \leq DT/DZ < -0.5$
E	$-0.5 \leq DT/DZ < 1.5$
F	$1.5 \leq DT/DZ < 4.0$
G	$4.0 \leq DT/DZ$

Source: NSW Industrial Noise Policy

Further, the results of the analysis are provided in **Table 2**.

**Table 2 – Derived stability classes during night time winter hours**

Stability Class	Frequency of Occurrence	
Other	206	17%
E	294	25%
F	522	44%
G	174	15%

The site-specific synthetic meteorological data adopted in the NIA estimates that the frequency of winter night time G class stability would be below the 30% threshold which the INP has adopted as indicating that G class inversions are of significance. It should be noted that temperature data below 10m was not available for this analysis. Whilst this is within the range (of 1.5-10m) specified in the INP, it is at the limit, and that the use of a lower elevation (e.g. 1.5m) would likely result in the estimation of a higher frequency of winter night time G class stability.

Yours sincerely  
**URS Australia Pty Ltd**

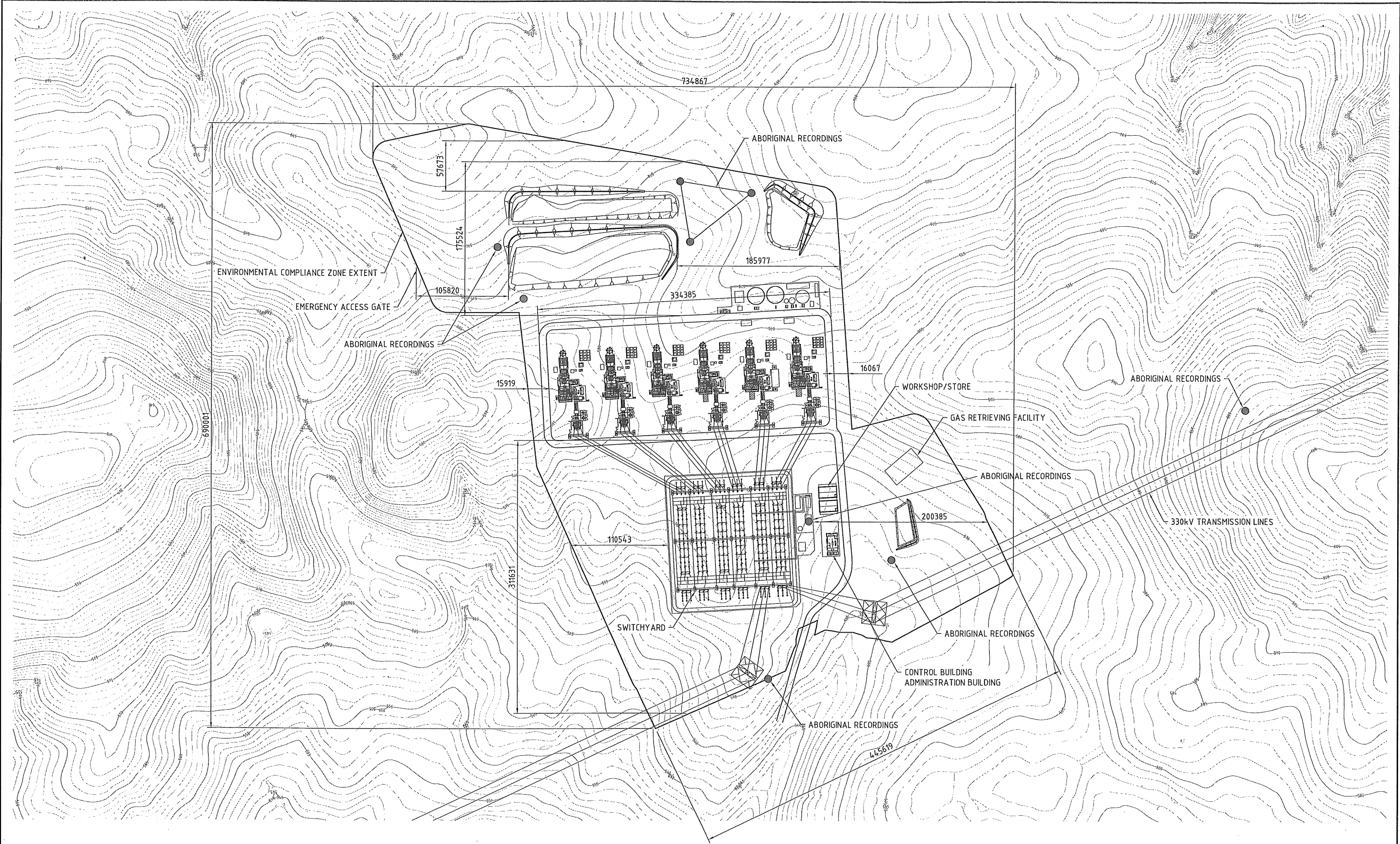
Sean Flaherty  
Senior Acoustic Engineer

James Grieve  
Air Quality Engineer

## Appendix F Additional Facility Layout & Elevation Plans



FIGURE F-1 – PROPOSED LAYOUT WITH PLANT SCALE AND SETBACK DISTANCES

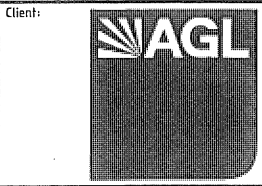


20 0 40 80m  
SCALE 1:2000

**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev.	Date	Revision Details	Drn	Ver.	App.
03	12.03.12	SITE DIMENSIONS ADDED	AP		
02	19.01.12	SUBSTATION LOCATION ALTERED	AP		
01	19.01.12	TRANSMISSION TOWER LOCATION ALTERED	AP		
0	18.01.12	PRELIMINARY ISSUE	AP		

**aurecon**  
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Project: DALTON GAS TURBINE POWER STATION

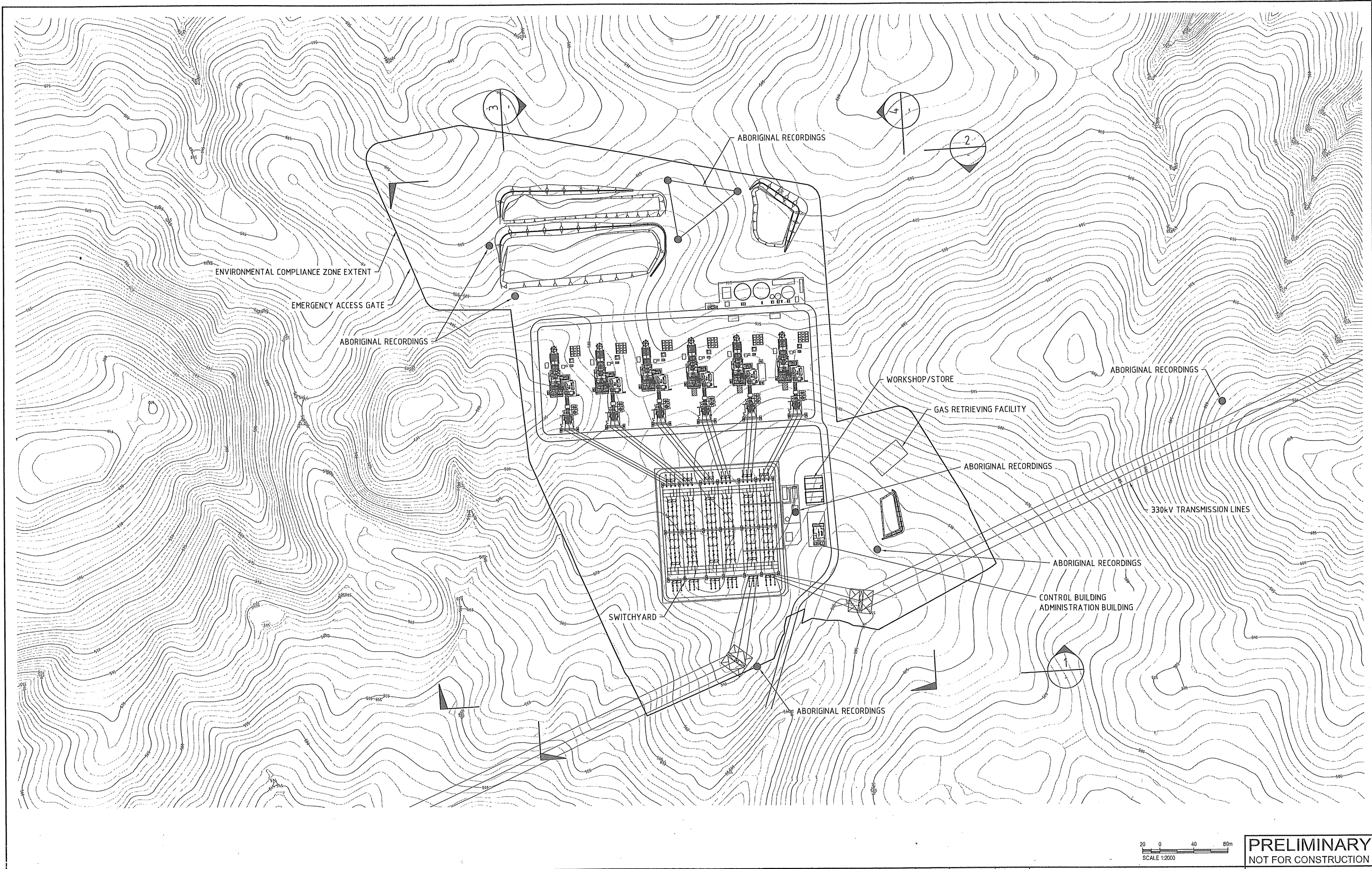
Drawn	Signed	Date
AP	Signed	Date
Designed	Signed	Date
NW	Signed	Date
Verified	Signed	Date
PW	Signed	Date
Approved	Signed	Date
LK	Signed	Date

Drawing Title: PROPOSED DALTON POWER STATION LAYOUT PLAN


Project No.	205245
Scale	1:2000
Sheet Size	A1
Drawing No.	DPS-G-002
Rev.	03

20 10 0 10 20 30 40 50 100mm

FIGURE F-2 – LAYOUT SHOWING ELEVATION SERIES VIEW POINT



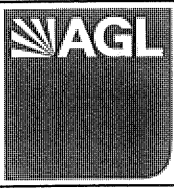
Rev.	Date	Revision Details	Drn	Ver.	App.
04	15.03.12	SECTIONS/ELEVATIONS ADDED			TB
03	12.03.12	SITE DIMENSIONS ADDED			AP
02	19.01.12	SUBSTATION LOCATION ALTERED			AP
01	19.01.12	TRANSMISSION TOWER LOCATION ALTERED			AP
0	18.01.12	PRELIMINARY ISSUE			AP



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Client:



Project:

DALTON GAS TURBINE  
POWER STATION

Drawn	Signed	Date
AP		
Designed	Signed	Date
NW		
Verified	Signed	Date
PW		
Approved	Signed	Date
LK		

Drawing Title:

PROPOSED DALTON POWER STATION  
LAYOUT PLAN

**PRELIMINARY  
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Project No. 205245

Scale 1:2000

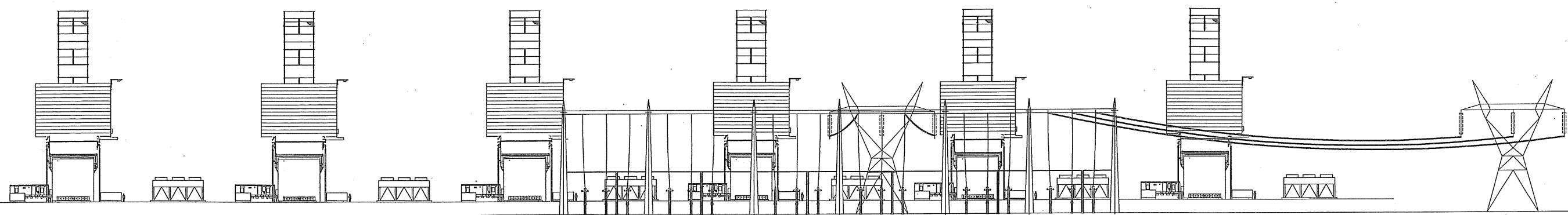
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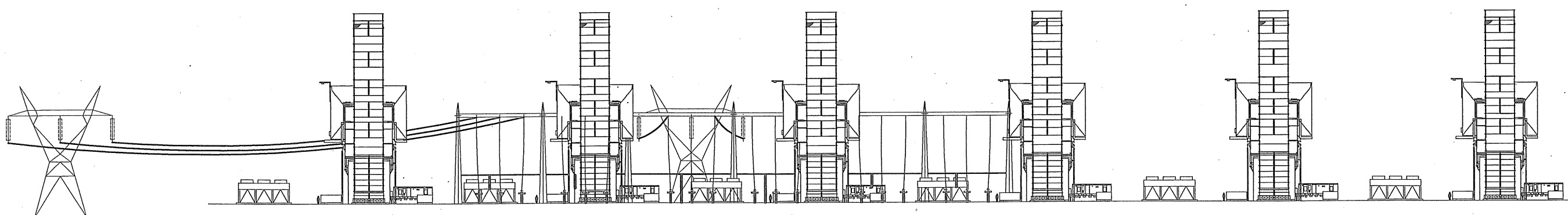
Rev. 04

20 0 40 80m  
SCALE 1:2000  
20 0 10 20 30 40 50 100m

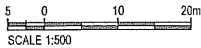
FIGURE F-3 – INDICATIVE ELEVATIONS LOOKING NORTH (ELEVATION 1)  
AND SOUTH (ELEVATION 2)



ELEVATION 1 – LOOKING NORTH  
DPS-G-002



ELEVATION 2 – LOOKING SOUTH  
DPS-G-002



**PRELIMINARY**  
NOT FOR CONSTRUCTION

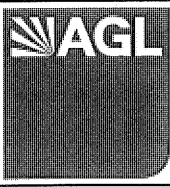
Rev.	Date	Revision Details	Drn	Ver.	App.
01	15.03.12	ELEVATIONS UPDATED			
0	14.03.12	PRELIMINARY ISSUE			



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Client:



Project:

DALTON GAS TURBINE  
POWER STATION

Drawn TB	Signed	Date
Designed TS	Signed	Date
Verified PW	Signed	Date
Approved LK	Signed	Date

Drawing Title:

PROPOSED DALTON POWER STATION  
ELEVATIONS  
SHEET 2

Project No. 205245	
Scale 500	Sheet Size A1
Drawing No. DPS-G-005	Rev. 01

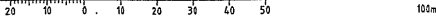
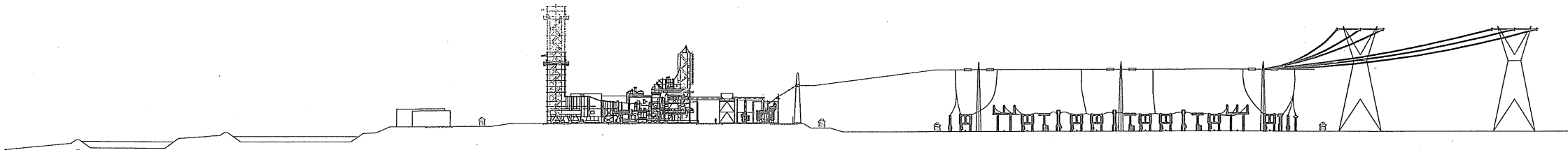
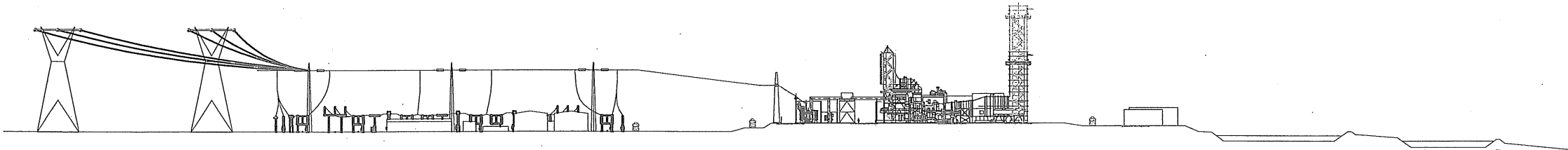




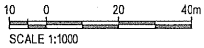
FIGURE F-4 – INDICATIVE ELEVATIONS LOOKING EAST (ELEVATION 3)  
AND WEST (ELEVATION 4)



ELEVATION 3  
DPS-G-002



ELEVATION 4  
DPS-G-002



**PRELIMINARY**  
NOT FOR CONSTRUCTION

Rev.	Date	Revision Details	Drn	Ver.	App.
0	18.03.12	PRELIMINARY ISSUE	TB		

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Client:



Project:

DALTON GAS TURBINE  
POWER STATION

Drawn TB	Signed	Date
Designed TS	Signed	Date
Verified PW	Signed	Date
Approved LK	Signed	Date

Drawing Title:

PROPOSED DALTON POWER STATION  
ELEVATIONS  
SHEET 1

Project No.

205245

Scale

1:1000

Drawing No.

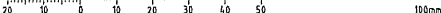
DPS-G-004

Sheet Size

A1

Rev.

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## Appendix G Hydrogeological Assessment



# **HYDROILEX**

Groundwater Geosciences

## **REPORT**

### **HYDROGEOLOGICAL ASSESSMENT INCORPORATING 24HR PUMPING TEST**

#### **BORE 1 & BORE 2**

**Proposed Dalton Power Station, Walsh Road,  
NSW, 2581**

**Lot 306 & 307 DP754111**

**BORE LICENCE: 70BL233651 & 70BL233652**

**PREPARED FOR: AURECON ON BEHALF OF AGL**

**REPORT NUMBER: HG.12.1.1.LA**

**DATE: 13 MARCH 2012**

***HYDROILEX PTY LTD***

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## DISTRIBUTION & REPORT STATUS

<b>Report Title:</b>	Hydrogeological Assessment –Bore 1 & Bore 2. Dalton Power Station, NSW.	
<b>Client:</b>	Aurecon on behalf of AGL	
<b>Report Number:</b>	HG.12.1.1.LA	
<b>Author:</b>	Rohan Last (Hydrogeologist)	
<b>Approved:</b>	John Lee (Principal Geoscientist & Director)	
<b>Issued:</b>	13 March 2012	
<b>Status:</b>	Revision 3 Edit 2	
<b>Distribution:</b>	Client	1 x PDF
	NOW	-
	File	1

## EXECUTIVE SUMMARY

*Hydroilex* was commissioned by *Aurecon* on behalf of *AGL* in December 2011 to manage the drilling, construction and pump testing of two (2) bores identified as ‘Bore 1’ and ‘Bore 2’, at the proposed Dalton Power Station, Walsh Road, Dalton, NSW, 2581 (*herein referred to as the site*).

*Hydoilex* understand the water demand requirements are somewhere in the order of 2-4L/s instantaneous demand. However, the annual demand is expected to be 11.2ML for Stage 1 and 25ML for Stage 2 depending on the operating pattern of the gas turbines. An aggregate yield of 2L/s is required to support a Site allocation for 25ML, assuming pumping duty at fifty per cent. The bores were initially subjected to 24 hour pumping tests immediately after drilling. A second round of pump testing was conducted with loggers installed to record water levels in selected bores, including existing farm bores and Town Water Supply Bores.

This report documents the findings of a hydrogeological assessment incorporating aquifer testing in accordance with requirements for water bores outlined by the *NSW Office of Water (NOW)* and consistent with the spirit and principles of the *NSW State Groundwater Policy Framework Document* (NSW Government 1997), the *NSW State Groundwater Quality Protection Policy* (NSW Government 1998) and the *NSW State Groundwater Dependent Ecosystems Policy* (NSW Government 2002).

This hydrogeological assessment incorporating aquifer test results indicates the subject bores may be operated under the following regime:

- **Bore 1 - 3.0L/s; 12hr Pumping; 12hrs Recovery; 50ML per year at 50% duty; and**
- **Bore 2 - 0.5L/s; 12hr Pumping; 12hrs Recovery; 10ML per year at 50% duty.**

The project objectives were to prepare a site specific hydrogeological assessment to demonstrate the sustainability of the proposed operation. Document the hydrogeological setting and aquifer properties. Provide recommendations on potential yields, sustainable pumping regimes and potential impacts in support of a license application to the *NSW Office of Water (NOW)*.

A hydrogeological assessment was conducted for the site by undertaking the following scope of work:

- Desktop review of available site data including; previous reports; aerial photographs; geological and topographic maps; *NOW* records; and *Hydroilex* groundwater database;
- Review of the proposed site application and operational requirements;
- Site walk over, observation of physical features, peg target sites;
- Drilling management and borehole design;
- Drawdown and recovery pumping test and analysis;
- Water level monitoring in selected existing bores during pump testing;
- Review of existing groundwater users and bores in the region, including potential impacts; and

- Compilation and review of project findings, preparation of hydrogeological report and recommendations for groundwater management and pumping regime.

### **Conclusions**

Based on the findings obtained during the scope of work the following conclusions may be made:

- The proposal is to license Bore 1 and Bore 2 for irrigation, commercial and industrial purposes to support the construction and long-term operation of the Dalton power station;
- The site is situated on the southern side of the Lachlan River approximately five (5) kilometres north of Dalton in an area underlain by the Ordovician Adaminaby Group which comprises inter-bedded sandstone, phyllite and siltstone sequences;
- Bore 1 was drilled in December 2011 to 114m and constructed with 150mm Class 9 PVC slotted from 54-114m. The drillers airlift reported a cumulative yield of 4.0L/s;
- Bore 2 was drilled in January 2012 to 120m and constructed with 150mm Class 9 PVC slotted from 18-90m. The drillers airlift reported a cumulative yield of 0.7L/s;
- The bores were subjected to two (2) rounds of 24 hour drawdown and recovery pumping tests conducted between December 2011 and February 2012. The aquifer test results indicate the bores are capable of sustaining the following long term pumping regime:
  - Bore 1 - 3.0L/s; 12hr Pumping; 12hrs Recovery; 50ML per year at 50% duty;
  - Bore 2 - 0.5L/s; 12hr Pumping; 12hrs Recovery; 10ML per year at 50% duty.
- Water level loggers were installed in six (6) existing bores during the second round of pump testing. The hydrographs show no drawdown was recorded in monitoring bores associated with pump testing in the production bores;
- Review of registered bores and pumping test results indicates that under the proposed extraction regime the subject bores are not expected to result in any significant measurable impact on the environment and adjoining groundwater users; and
- This hydrogeological assessment incorporating two (2) rounds of 24 hour pump testing concludes the bores are capable of sustaining a combined annual groundwater allocation of 60ML, supported by a significant level of available drawdown, and multiple aquifers with an extensive recharge zone.

### **Recommendations**

Based on the findings and conclusions outlined in this report the following recommendations are provided:

- A long-term program of water level monitoring in the production bores should be considered. Water level monitoring will provide important baseline water level data and facilitate the long-term sustainable management of the groundwater resource;
- Install a suitable on-line flow meter on the discharge of the proposed production bore. Record discharge volumes on a regular basis for the production bore. The *NSW Office of Water (NOW)* may require this as a condition of the bore licensing;



- Measure and record water levels in the production weekly if manual or daily with automated logger. The *NOW* may require this schedule as a condition of the bore licensing. *Hydroilex* can advise on the method and can review the water level data on an annual basis;
- Consider collecting groundwater discharge samples on a regular basis (summer and winter) and submit to a NATA registered laboratory for water quality testing; and
- Proceed with the licensing of the production bores for the intended purpose of Irrigation, commercial and industrial, and apply to transfer an annual allocation of:
  - Bore 1 - 50ML supported by 24 hour pumping test; and
  - Bore 2 - 10ML.

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Appendix B Pumping Test Results (Round 1)
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Appendix D Laboratory Certificates of Analysis
Appendix E Registered Bore Records



## 1.0 INTRODUCTION

### 1.1 BACKGROUND

*Hydroilex* was commissioned by *Aurecon on behalf of AGL* in December 2011 to manage the drilling, construction and pump testing of two (2) bores identified as ‘Bore 1’ and ‘Bore 2’, at the proposed Dalton Power Station, Walsh Road, Dalton, NSW, 2581 (*herein referred to as the site*).

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- **Bore 2 - 0.5L/s; 12hr Pumping; 12hrs Recovery; 10ML per year at 50% duty.**

### 1.2 OBJECTIVES

The project objectives were to prepare a site specific hydrogeological assessment to demonstrate the sustainability of the proposed operation. Document the hydrogeological setting and aquifer properties. Provide recommendations on potential yields, sustainable pumping regimes and potential impacts in support of a license application to the *NSW Office of Water (NOW)*.

### 1.3 SCOPE OF WORK

A hydrogeological assessment was conducted for the site by undertaking the following scope of work:

- Desktop review of available site data including; previous reports; aerial photographs; geological and topographic maps; *NOW* records; and *Hydroilex* groundwater database;

- Review of the proposed site application and operational requirements;
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- Water level monitoring in selected existing bores during pump testing;
- Review of existing groundwater users and bores in the region, including potential impacts; and
- Compilation and review of project findings, preparation of hydrogeological report and recommendations for groundwater management and pumping regime.

## 1.4 LOCATION

The site is situated on the southern side of the Lachlan River approximately five (5) kilometres north of Dalton. Access to the site is via Walsh Road. The site location is depicted in **Figure 1** and the key features required to identify the site are summarised in **Table 1**.

**Table 1 Site Identification**

Identifying Features	
<b>Address</b>	Walsh Road, Dalton, NSW, 2581
<b>Lot/DP</b>	306 & 307 / 754111
<b>Parish</b>	Dalton
<b>County</b>	King
<b>LGA</b>	Upper Lachlan Shire Council

## 2.0 TOPOGRAPHY

A review of the Dalton 1:50,000 topographic map sheet 8728N was conducted to assess the regional topography and to identify potential groundwater controls in the region. The site topography is shown in **Figure 1**. Generally topography presents a major indicator for groundwater controls including the location of structural lineaments, paleo-channels, recharge and discharge zones, and groundwater flow gradients.

The proposed power station site is situated on a relatively level hilltop. Elevations across the site range from around 500 to 600mAHD. The study area generally drains extending from the centre of the site. Dowlings Creek also flows west along the southern boundary of the site presenting significant control for local groundwater potential.