Silver Springs Gas Storage Facility

Environmental Management Plan

Prepared by:

RPS AUSTRALIA EAST PTY LTD

743 Ann Street
PO Box 1559
FORTITUDE VALLEY QLD 4006

T: 617 3237 8899
F: 617 3237 8833
W: www.rpsgroup.com.au

Prepared for:

AGL GAS STORAGE PTY LIMITED

GPO Box 1048
BRISBANE QLD 4001

T: 617 3023 2489
F: 617 3220 1274
W: www.agl.com.au

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Summary

AGL Gas Storage Pty Limited (AGL) is proposing to construct a new gas storage facility to take ramp gas produced by QGC Limited (QGC), a British Gas (BG) Group business as part of their Queensland Curtis Island Liquefied Natural Gas (QCLNG) Project. The proposed storage facility will be located at the existing Silver Springs Processing Plant (SSPP) situated approximately 49 km south of Surat on Petroleum Lease (PL) 446 (formerly PL 16) (refer Figure 1). Up to 44 billion standard cubic feet (Bscf) of gas will be stored in the depleted Silver Springs / Renlim gas fields (hosted by the Showgrounds Formation). Gas will be supplied via the existing Berwyndale to Wallumbilla and Silver Springs Pipelines (PPL 123 and PPL 4 respectively). The project is known as the Silver Springs Storage Facility (SSSF). An initial injection phase is anticipated to occur over a three year period (2011 – 2014), with the withdrawal phase anticipated to occur over the subsequent three year period (2014 – 2017).

Current operations on PL 16 are authorised under the *Petroleum Act 1923* (a '1923 Act Lease') and Integrated Authority (IA) Number 150,120. As underground gas storage is not permitted under a '1923 Act Lease', an application is required to convert PL 16 to a lease under the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) (a '2004 Act Lease'). The application was made to the Department of Employment, Economic Development and Innovation (DEEDI) on 1 December 2010 and the Petroleum Lease was subsequently assigned a new lease number (PL 446).

AGL's preference is to utilise existing infrastructure on PL 446 (including existing wells and flowlines), wherever possible in order to minimise disturbance associated with the project. Existing infrastructure proposed for use as part of the SSSF project includes five wells (four existing and one new well) for injection and withdrawal activities, with an additional five wells for monitoring purposes. These wells will be subject to integrity testing prior to use, and where found unsuitable for injection, withdrawal or monitoring replacement wells will be drilled and short additional lengths of flowline may be required to connect the replacement wells to the existing PL 446 flowline system.

Additional infrastructure is required for the project and includes a new compressor, a short section of pipeline to connect the compressor to the existing Silver Springs Pipeline (SSP), and new process equipment for the withdrawal phase. This infrastructure will all be located at the existing Silver Springs Plant site on PL 446,

Geological and reservoir assessments identified the Showgrounds Formation as an ideal candidate for gas storage, due to the high porosity (12%) and good permeability at an average 600 millidarcies (mD) with a range of (10 – 6,000 mD). Injection will occur at a maximum gas flow rate of 40 million standard cubic feet per day (MMscf/d) using three injection wells over a period of three years. At this point the process will be reversed and the withdrawal phase will commence and gas withdrawal will occur at approximately the same rates as injection.

As well as the proposed SSSF activities, there are a number of existing operational activities on PL 446 associated with the Silver Springs, Renlim, Sirrah, Taylor, Tinker and Boggo Creek fields. In addition to continued production from mature assets, seismic surveys will be undertaken to assist with identifying new reserves over the Silver Springs / Renlim and Taylor fields. Dependant on the findings of the seismic survey, up to an additional five wells may be drilled in the Taylor Field, with a maximum of five further wells to be drilled elsewhere on PL 446.

AGL's EA application to the Department of Environment and Resource Management (DERM) is intended to authorise construction and operation of the proposed SSSF and also authorise continued exploration, development and production within PL 446. This Environmental Management Plan (EM Plan) together with the PL 446 Operational Environmental Management Plan (OEMP) (Appendix 1) have been prepared to support this EA application. This EM Plan specifically addresses the proposed gas storage activities (the SSSF project), whilst the OEMP specifically addresses existing approved operations on PL 446. Subject to securing the relevant approvals, operation of the injection phase of the SSSF is anticipated to commence by May 2011.

During pre-design meetings with DERM, air and noise emissions were identified as being key areas where significant impacts may occur from operation of the proposed SSSF project. Specialist air dispersion modelling undertaken by Katestone Environmental Pty Ltd predicted that cumulative air emissions from existing plant at Silver Springs and the proposed new compressor will be significantly lower than the relevant air quality objectives listed in the *Environmental Protection (Air) Policy 2008*.

Specialist noise assessment undertaken by Sonus Pty Ltd identified that some noise attenuation will be required to meet the noise assessment criterion derived from Rating Background Levels calculated in accordance with the DERM Noise Measurement Manual. Attenuation proposed includes air inlet and exhaust silencers and a noise barrier. AGL propose to incorporate the air inlet and exhausts silencers as part of compressor unit design. Noise monitoring will be undertaken once the new compressor is operational to verify the results of the noise modelling and where this identifies the need for further attenuation, AGL will implement appropriate additional measures as required.

Desktop and field based ecological assessment was undertaken and identified no significant fauna or flora species within the project area. Significant habitat values were limited to areas of "Of Concern" Regional Ecosystem in the vicinity of the proposed project but not intersected by any proposed activities. AGL propose to utilise existing infrastructure where possible, and locate new infrastructure in pre-existing cleared areas therefore minimal vegetation clearance is anticipated. The ecological assessment concluded that the risk of potential impacts to ecological values as a result of proposed SSSF project activities is low.

Hydrological and petroleum reservoir modelling have also been undertaken to address potential risks associated with aquifers, gas migration and reservoir integrity. These assessments identified that the Snake Creek Mudstone Member forms an effective capping unit and confining layer, preventing vertical migration from the Showgrounds Formation. Reservoir modelling has also shown that AGL's proposed injection pressures are achievable and the proposed pressures are significantly lower than the maximum original reservoir pressure. Impacts to reservoir integrity as a result of proposed gas injection or withdrawal activities are therefore not anticipated.

Should the casing of shut in wells previously completed to produce from the Showgrounds Formation be determined to be in poor condition or the annular cementing isolation of these wells show poor quality, then the potential for vertical fluid or gas transfer from the Showgrounds Formation to other formations and aquifers may exist. It is the intention of AGL to run Ultrasonic Imaging logs in all monitoring, injection and withdrawal wells to ascertain the quality of the casing and cement behind pipe. Repairs would be initiated if possible and if not deemed suitable the well or wells would be plugged and abandoned and a replacement well drilled.

Volumes of water produced during the withdrawal phase of the project are anticipated to be between 50 – 350 kL/day. Given the small volume of produced water and the fact that no bores within 20 km of the proposed SSSF location have been identified as tapping the Showgrounds Formation, impacts to other water users are anticipated to be negligible.

Overall, desktop and field based assessments have concluded that the proposed SSSF project presents a low risk of significant adverse environmental and community impacts. Potential impacts will be further reduced through the implementation of targeted control strategies and mitigation measures detailed in key project documentation (including this EM Plan and the PL 446 Operational Environmental Management Plan) and strict compliance with the conditions of the project Environmental Authority.

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1.0 Introduction

AGL Gas Storage Pty Limited (AGL) is proposing to construct a new gas storage facility to take ramp gas produced by QGC Limited (QGC) a British Gas (BG) Group business as part of their Queensland Curtis Island Liquefied Natural Gas (QCLNG) Project. Ramp gas is the gas produced during initial development (drilling) and dewatering of coal seams in the ramp up to the full field production phase. The gas storage project will enable gas to be stored until the QCLNG Facility is ready to receive commercially viable quantities of gas, at which point the gas can be withdrawn and transported to Gladstone for LNG production and export in approximately three years.

The proposed storage facility will be located at the existing Silver Springs Processing Plant (SSPP) situated approximately 49 km south of Surat (in a direct line) on Petroleum Lease (PL) 446[1] (formerly PL 16), (refer Figure 1) and will be used to store 44 billion standard cubic feet (Bscf) of gas. The project is known as the Silver Springs Storage Facility (SSSF). Surface disturbance associated with proposed new infrastructure (compressor and associated pipework) will be located entirely on freehold property owned by AGL (Lot 11 on Plan EG243) with wells and associated flowlines located on adjoining properties.

The proposed SSSF will facilitate the storage of natural gas in the depleted Silver Springs and Renlim gas reservoir which is hosted by the Showgrounds Formation. The scale of the proposed SSSF project surface infrastructure is small, with the project utilising some existing infrastructure on the Silver Springs field. The main components of the project required in addition to existing infrastructure located on PL 446 include:

- A new compressor unit, which will be located at the existing Silver Springs plant site;
- A short section of pipeline to connect the compressor to the existing Silver Springs Pipeline (SSP);
- A new short pipeline from the compressor outlet to the injection wells;
- A small concrete batching plant to provide the concrete required for the compressor station and other minor maintenance activities on PL 446; and
- New process equipment for the withdrawal phase including a three phase separator, Triethylene Glycol (TEG) dehydrator and gas heater.

AGL's preference is to utilise existing infrastructure on PL 446 (including existing wells and flowlines), wherever possible in order to minimise disturbance associated with the project. Five existing wells are planned to be used for injection and withdrawal activities, with an additional five wells to be used for monitoring purposes.

Should integrity testing demonstrate these wells are not suitable for injection up to five new wells may be required. Existing flowlines will be utilised to connect the injection and withdrawal wells to the new compressor, but should replacement wells be required, short sections of additional flowline may be constructed to connect the replacement wells to existing flowlines.

[1] PL 446 (to be authorised under *the Petroleum and Gas (Production and Safety) Act 2004)* will replace PL 16 (currently authorised under the *Petroleum Act 1923*).

During the gas injection phase no associated water will be produced however it is anticipated that approximately 50 kL/day of associated water will be produced during extraction of the first 88% of the stored gas, with this rising to 350 kL/day for extraction of the remaining stored gas phase. As the storage phase is anticipated to occur over three years, production of water from the withdrawal of gas is not anticipated until 2014.

Current operations on PL 16 are authorised under the *Petroleum Act 1923* (a '1923 Act Lease') and Integrated Authority (IA) Number 150,120. As underground gas storage is not permitted under a '1923 Act Lease', an application is required to convert PL 16 to a lease under the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) (a '2004 Act Lease'). The application was made to the Department of Employment, Economic Development and Innovation (DEEDI) on 1 December 2010 and the Petroleum Lease was subsequently assigned a new lease number (PL 446). The conversion of PL 16 to a '2004 Act Lease' (PL 446) must be supported by a relevant Environmental Authority (EA) approved under the *Environmental Protection Act 1994* (EP Act).

In addition to the proposed SSSF activities, there are a number of existing operational activities on PL 16 associated with the Silver Springs, Renlim, Sirrah, Taylor, Tinker and Boggo Creek gas fields. Activities currently being undertaken on PL 446 include:

- Seismic surveys which are required to assist with identifying new reserves over the Silver Springs / Renlim and Taylor fields; and
- Continued production from mature assets using existing infrastructure, including:
  - Sirrah producing intermittently from free flowing gas wells (Sirrah 4 and Sirrah 5);
  - Taylor producing from free flowing wells (Taylor 1, Taylor 20 and Taylor 22) and from the beam pump wells (Taylor 9 and Taylor 16) with periodic testing at the centralised well testing facility at Taylor Satellite. 3D seismic may be used to identify additional targets for development around the existing Taylor field reservoir; with potential for five new wells to be drilled in the Taylor field and five elsewhere on PL 16 to target both oil and gas (this will be dependent on seismic results and location and as a result the actual number of wells to be drilled is currently unknown);
  - Tinker producing from beam pump wells (Link 1 and East Glen 1) and intermittently from free flowing gas wells (Tinker 1 and Tinker 3); and
  - Production from Boggo Creek Field (Boggo Creek 2).

This Environmental Management Plan (EM Plan) and theOperational Environmental Management Plan (OEMP) (Appendix 1) have been prepared to support the EA application to the Department of Environment and Resource Management (DERM). This EM Plan addresses the proposed gas storage activities. The OEMP addresses the existing operations that were approved under PL 16.

1.1 Proponent

AGL has been operating in Australia for more than 170 years, being the country's leading renewable energy company and the largest private owner, operator and developer of renewable generation assets. AGL was listed as a member of the Dow Jones Sustainability World Index in 2007 and was the first Australian energy company to provide it's customers with an accredited green energy product. AGL has committed to a six per cent (6%) reduction in carbon emissions (based on 1998 / 2001 levels) and is a member of the Chicago Climate Exchange.

AGL has recently successfully purchased 100% ownership of Mosaic Oil NL (Mosaic) shares by way of a Scheme of Arrangement. Mosaic was a successful Australian explorer and producer of oil and gas, with its principal assets located in the Surat-Bowen Basin in south east Queensland. These assets include existing processing facilities which are strategically located to support existing producing fields and new discoveries. The Silver Springs Processing Plant, located on PL 446, separates water and oil from gas and is capable of treating up to 12 million standard cubic feet of gas a day (MMscf/d), storing 12thousand barrels (MBbls) of oil, and compressing gas for transfer to Wallumbilla via the Silver Springs to Wallumbilla Pipeline. Existing infrastructure and plant operations are detailed in the OEMP.

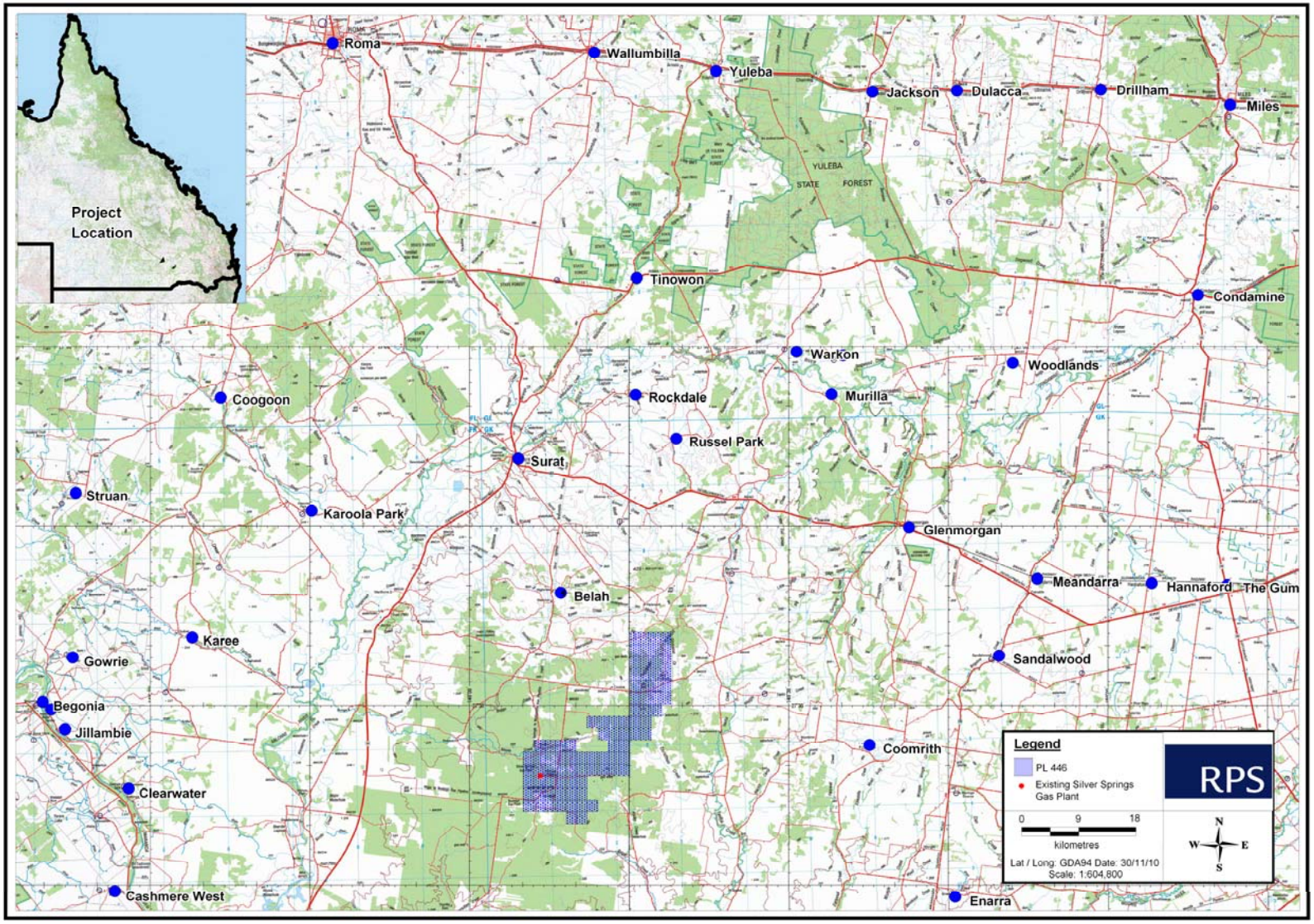


Figure 1: PL 446 Location Overview

1.2 Purpose and Scope of this EM Plan

1.2.1 Purpose

In accordance with Sections 309A(1)(b), 309D and 426A of the EP Act, activities authorised under a Resource Authority (e.g. Petroleum Lease) require an EA (Chapter 5A Activities), issued by the DERM, following their assessment of the EA application.

The EP Act further stipulates that a Chapter 5A EA must be supported by an EM Plan to allow the administering authority (DERM) to assess the application (Sections 310C and 310D of the EP Act). This EM Plan has been prepared to fulfil this requirement for the project and comprises the supporting information for the SSSF Level 1 EA application in respect of the SSSF for the converted PL 446, and existing activities authorised under PL 16.

While the EM Plan is primarily a regulatory document, it also describes practical environmental control measures and commitments that must be upheld throughout all project phases (from construction, through to operations and decommissioning). The EM Plan sets the minimum standard for environmental management. All subsequent management plans and procedures (e.g. construction environmental management plans and operational procedures) must comply with the commitments made in this EM Plan and the EA.

All existing activities on PL 446 are further discussed in the OEMP provided in Appendix 1 and will be managed in accordance with the measures contained therein.

1.2.2 Scope

This EM Plan describes only those potential environmental impacts associated with the SSSF project, as well as AGL's proposed management and mitigation measures to minimise potential impacts. Specifically, this EM Plan:

- Provides a description of the SSSF project, including the project rationale and details of the proponent and applicable legislation;
- Describes technical specifications of the SSSF and proposed construction methodology;
- Describes the existing natural and social environment within the project area;
- Describes potential environmental impacts associated with proposed activities;
- Proposes environmental protection objectives and control strategies;
- Proposes environmental management procedures for the project; and
- Includes calculations of Financial Assurance for the project.

This EM Plan has been prepared in accordance with the Queensland Government Guideline: *Preparing an environmental management plan for coal seam gas activities* (DERM 2010).

1.3 Relevant Resource (Petroleum) Authorities

The proposed SSSF project site is located on PL 446, with current activities authorised under the existing Later Development Plan (LDP) (April 2007 – May 2012) and IA 150,120, as authorised under the *Petroleum Act 1923* and the EP Act respectively.

1.3.1 Resource Authority (Petroleum Lease) Area

The Block Identification Map (BIM) sub-blocks comprising PL 446 are summarised in Table 1 and the location of PL 446 is shown in Figure 1.

Table 1: BIM Blocks covered by PL 446

BIM Block	Sub-Block
CHAR2944	V,W, X, Y
CHAR3016	A, B, C, D, F, G, H, J, L, M, N, O, Q, R, S, T, V, W, X, Y
CHAR3086	R, S, T, U, V, W, X, Y, Z
CHAR3087	G, H, J, K, N, O, P, T, U, V, W, X, Y, Z
CHAR3088	A, B, C, F, G, L, M
CHAR3158	A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, Z
CHAR3159	A, B, C, D, E, F, L, Q, R, V

1.4 Potentially Affected Properties

There are eighteen potentially affected properties covered by PL 446. The land use in the area surrounding PL 446 is mainly agricultural, with the nearest residence located approximately 1.8 km north east of the existing Silver Springs Plant. Properties within, or partially within, PL 446 are listed in Table 2. Surface disturbance associated with proposed new SSSF infrastructure (compressor and associated pipework) will be located entirely on freehold property owned by AGL (Lot 11 on Plan EG243) with wells and associated flowlines located on adjoining properties. Existing wells and flowlines anticipated to be utilised for the SSSF project are located on: Lot 1 on Plan BLM123; Lot 2 on Plan EG59; Lot 5 on Plan EG41 and Lot 3 on Plan EG243.

Table 2: Lot / Plan Numbers covered by the Project Area

Lot Number	Plan Number	Tenure
3	EG 243	Freehold
5	EG 41	Freehold
11	EG 243	Freehold
1	BLM 123	Freehold
10	EG 42	Freehold
2	EG 59	Leasehold
6	EG 59	Leasehold
1	SP 152692	Freehold
8	EG 59	Leasehold
4	SP209776	Freehold

Lot Number	Plan Number	Tenure
9	EG 40	Freehold
17	EG 94	Freehold
4	EG 40	Freehold
16	EG 94	Freehold
17	EG 148	Freehold
3	EG 92	Freehold
2	EG 32	Freehold
14	EG 145	Leasehold

1.5 Financial Assurance

The proposed rehabilitation and decommissioning Financial Assurance (FA) amount for the project EA (including justification and supporting calculations) is provided in Appendix 2. Financial Assurance for the proposed project has been calculated based on environmental and engineering estimates of costs associated with required rehabilitation and decommissioning activities for the SSSF. Calculations are generally consistent with the Ecoaccess Guideline: *Financial assurance for petroleum activities* although site-specific values have been incorporated where appropriate.

Restoration, rehabilitation and decommissioning programs are further discussed in Sections 3.6.1, 3.6.3 and 13.0.

2.0 Legislative Framework

2.1 Commonwealth Approvals

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment in relation to Matters of National Environmental Significance[2] (NES). Under the EPBC Act, if a development proposal involves an action that is likely to result in a significant impact on a Matter of NES, the proposal must be referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC[3]).

Where such a referral is submitted, DSEWPC provides a determination as to whether the project is considered a 'controlled action' or 'not a controlled action'. Controlled actions require assessment under the EPBC Act in accordance with a formal assessment and approval process set by DSEWPC. Subject to the assessment process, project approval is granted by DSEWPC.

As described in Section 8.0, desktop and field based ecological assessments of the proposed project area have been undertaken, including a comparison of the project area with mapped areas of Threatened Ecological Communities (TECs) and other Matters of NES. Desktop studies identified one possible TEC (Weeping Myall Woodlands) and a total of 18 threatened and eight migratory species which may occur within the project area. Field based ecological assessment and ground truthing (undertaken 20 – 22 September 2010) identified no TECs within the SSSF project area and concluded that no significant habitat for threatened species (as identified by desktop searches) was likely to occur within the project area.

Given these findings, and that virtually all project activities will be undertaken in pre-existing cleared areas, AGL does not consider that the project will have a significant impact on identified Matters of NES and therefore will not be lodging an EPBC referral.

2.1.2 Native Title Act 1993

Under the *Native Title Act 1993* (NT Act), indigenous land rights may exist in areas such as vacant or unallocated crown land, some reserve lands, some types of pastoral lease and waters that are not privately owned. Native title can be extinguished by certain actions (for example where the land is held under freehold title).

Native Title has been extinguished on PL 446, which currently falls within the Mandandanji People claim area (QC08/10). Although no claim exists, AGL will notify the Mandandanji People of the project in accordance with the NT Act and will maintain open communication in relation to any cultural heritage assessment and monitoring required.

2 Matters of National Environmental Significance include: listed threatened species and ecological communities; migratory species protected under international agreements; Ramsar wetlands of international importance; the Commonwealth marine environment; World Heritage properties; National Heritage places; and nuclear actions.

3 Formerly the Department of Environment, Water, Heritage and the Arts (DEWHA).

2.2 State Approvals

2.2.1 Petroleum and Gas (Production and Safety) Act 2004 and Petroleum Act 1923

Under the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act), a Petroleum Lease (PL) is required for the holder to have the right to explore for, test for production and produce petroleum within the PL area and also to authorise gas storage activities. The details of PL 446 are discussed further below.

Petroleum Lease

A PL authorised under the P&G Act gives its holder the right to explore for, test for production, and produce petroleum within the area of the PL for a maximum term of 30 years (DEEDI 2009) unless a renewal application is approved. The relevant lease to this application was authorised as PL 16 granted under the *Petroleum Act 1923 on 30 April 1977*. Underground gas storage is not permitted under a '1923 Act Lease', so PL 16 must be converted to a '2004 Act Lease' (under the P&G Act) to obtain the necessary tenure to undertake the proposed SSSF project.

An application to convert PL 16 to a 2004 Act Lease was made to DEEDI on 1 December 2010, and PL 16 was assigned a new lease number (PL 446). As part of the DEEDI application to convert to a 2004 Act Lease, a full term of 30 years will be granted for PL 446. The application to convert the lease can only be issued if supported by an approved EA issued by DERM (as described in Section 2.2.2).

A revised Later Development Plan, detailing existing activities on PL 446 and proposed gas storage activities has been submitted to DEEDI as supporting information to this tenure conversion application and a full copy has been provided in Appendix 3 of this document.

2.2.2 Environmental Protection Act 1994

The purpose of the *Environmental Protection Act 1994* (EP Act) is to *"protect Queensland's environment while allowing for development that improves the total quality of life, now and in the future, in a way that maintains ecological processes on which life depends"*.

Under Chapter 5A of the EP Act, petroleum activities authorised under a Petroleum Authority (including a PL) require an 'Environmental Authority (EA) – Chapter 5A Activity'. Thus the project requires an EA, which is issued by DERM following its assessment of the associated application.

Under the EP Act, petroleum activities are classed as Level 1 or Level 2 Activities, based on the expected risk of environmental harm. Proposed SSSF project activities and existing PL 446 activities (refer Section 2 Appendix 1) satisfy the criteria of a Level 1 Petroleum Activity, as described in Section 23(1) and Items 6 and 8, Schedule 5 of the *Environmental Protection Regulation 2008* (EP Regulation).

The EP Act (Section 310C(d)(i)) specifies that an EM Plan is required for a Level 1 EA application and stipulates that the application must be supported by enough information to allow the administering authority (DERM) to decide the application. This EM Plan has been prepared to fulfill the Level 1 EA application requirements, and in conjunction with the OEMP (Appendix 1) represents the primary supporting information for this EA application.

In accordance with Section 310E of the EP Act, following preliminary assessment of the EA application, DERM will formally determine if an Environmental Impact Statement (EIS) is required for the project within 10 business days of the application date (i.e. 20 days after submission – the application date is 10 days after submission date). In deciding an EIS requirement, DERM will consider the 'Standard Criteria' (as defined in Schedule 4 of the EP Act). Through consideration of the Standard Criteria, and given the low level of environmental disturbance proposed, it is considered unlikely that the proposed project will trigger an EIS under the EP Act.

2.2.2.1 Chapter 4 Activities

Chapter 4 Activities (formerly referred to as Environmentally Relevant Activities (ERA)) are those activities with the potential to release contaminants to the environment and cause environmental harm.

Chapter 4 Activities' are listed under Schedule 2 of the EP Regulation. Where a Chapter 4 Activity has an 'Aggregate Environmental Score' (AES) stated in Schedule 2 of the EP Regulation and is undertaken under a Petroleum Authority, it will make the petroleum activities a 'Level 1 Petroleum Activity[4]' as defined in Item 8 of Schedule 5 of the EP Regulation. The Chapter 4 Activities that apply specifically to the proposed SSSF[5] are:

- 15: Use of fuel burning equipment that is capable of burning at least 500 kg of fuel in an hour – AES is 35; and
- 43: Concrete Batching plant to produce 200 t or more of concrete or concrete products in a year – AES is 30.

2.2.2.2 Anticipated Notifiable Activities

Activities that have been identified as likely to cause land contamination are listed in Schedule 3 of the *Environmental Protection Act 1994*. Under the Act, landowners and local government must inform the department that land has been or is being used for a notifiable activity. Land that has been or is being used for a notifiable activity is recorded on the Environmental Management Register (EMR), which is maintained by DERM.

No notifiable activities for proposed SSSF activities have been identified. AGL are currently reviewing existing operations and will submit appropriate notifications where required.

2.2.3 Sustainable Planning Act 2009

The Integrated Development Approval System (IDAS) pursuant to the *Sustainable Planning Act 2009* (SPA) provides for the coordination of a range of State government and local government (Planning Scheme) approvals. The SPA regulates development in association with Local Government Planning Schemes and integrates the development control functions of various pieces of legislation through the Referral Agency system which provides a consolidated application, assessment, decision making and conditioning process for development approval under IDAS.

4 Chapter 5A activities relevant to existing activities conducted on PL 446 are listed in Table 2 of Appendix 1.

5 Chapter 4 activities (ERAs) relevant to existing activities conducted on PL 446 are listed in Table 2 of Appendix 1.

Under the SPA, the proposed project and associated incidental activities that are authorised under the P&G Act are exempt from assessment against the local planning scheme. AGL does not expect that it will need to undertake project activities outside the petroleum lease area or ahead of schedule (e.g. prior to PL and EA approval) that would necessitate a development approval under the SPA (and other relevant legislation).

2.2.4 Subsequent Approvals

A range of other legislation is potentially relevant to the project and a number of additional approvals may be required prior to construction and operation depending on the final approach. Key approvals may relate to, for example:

- Relevant IDAS triggers (e.g. vegetation clearing) under the SPA, for all ancillary activities associated with construction and operation, if undertaken outside of the PL area;
- Removal of wildlife from open trenches and excavations, may require a permit under the *Nature Conservation Act 1992* (NC Act);
- Clearing of native vegetation will require a Vegetation Clearing Permit under the NC Act (unless an exemption applies under Part 4 Division 2 of the *Nature Conservation (Protected Plants) Conservation Plan 2000*);
- Approval to collect any cultural heritage material (as a result of accidental discovery during construction) may be required under the *Aboriginal Cultural Heritage Act 2003* (ACH Act); and
- Quarrying or sales permit for borrow pits on Crown Land may be required under the *Forestry Act 1959*.

3.0 Project Description

All existing infrastructure and current operational activities (including proposed field development activities under the revised LDP) undertaken on PL 446 are addressed in Section 2 of Appendix 1. The project descriptions presented in Sections 3.1 to 3.5.3 therefore relate specifically to the proposed SSSF project.

3.1 Justification and Alternatives

The SSSF will facilitate the transport of gas from the Berwyndale to Wallumbilla Pipeline (BWP) under Petroleum Pipeline Licence (PPL) 123 to the SSPP via the Silver Springs Pipeline (SSP) under PPL 4, for re-injection into the depleted Silver Springs and Renlim gas reservoirs. The Silver Springs and Renlim gas fields are hosted within the Showgrounds Formation (refer Section 6.2.1 for more detailed information).

Development of the SSSF is a key element in AGL and QGC's strategy to capture ramp gas for preservation and use at a later date. Under a contractual arrangement with QGC, AGL will assist QGC to manage its ramp gas (through storage at the SSSF) in the lead up to the commissioning of its QCLNG Processing Facility planned for 2014.

The nature of the gas developments currently being undertaken by QGC requires a significant number of gas wells to be producing gas prior to the start up of the QCLNG Processing Facility in Gladstone. Due to the scale of the QCLNG project and the amount of gas likely to be produced during the ramp up phase there is limited potential for this gas to be utilised in conventional ways. Storing the ramp gas is a practical and environmentally appropriate option to ensure that this gas resource is preserved for use at a later date when it can be transported to the QCLNG Processing Facility.

The SSSF will be linked into a pipeline transmission network through the Wallumbilla Gas Hub which currently provides connection to gas markets in Brisbane, Gladstone and Mt Isa, as well as South Australia, Victoria and New South Wales. In addition to the immediate short term benefit of assisting with the management of ramp gas for the QCLNG project, the SSSF has the potential to store gas from a number of sources for later use. In the longer term the SSSF would have the ability to manage imbalances in the production and usage of gas arising from major disruptions to both gas producers and gas consumers in the Queensland market, further improving the security of gas supply within the state and assisting Queensland gas producers to smooth the peak seasonal variation in gas supply requirements.

3.1.1 Project Alternatives

In the absence of storage facilities or conventional uses for the ramp gas, flaring the gas at the wellhead is likely to be the main alternative considered. Storage of gas in the SSSF will minimise wastage of this resource and reduce Greenhouse Gas (GHG) emissions associated with the QCLNG project.

3.1.2 Design Alternatives

Due to the large quantities of gas to be stored there is no other practical and cost effective design alternative to underground gas storage.

3.1.3 Construction Alternatives

Due to the nature of the project and the lack of depleted underground reservoirs available in the area there are no current construction alternatives for the proposed SSSF project.

Where appropriate, alternate construction techniques and technologies will be used to reduce potential project related impacts (e.g. locating the compressor in a pre-existing disturbed area). All subcontractors, construction and project managers and specialist service providers will deliver the project in accordance with AGL's requirements for Health, Safety and the Environment. All activities will be undertaken to reduce any potential risk during construction activities to as low as reasonably practicable.

3.2 Project Timing and Life

AGL's contractual agreement with QGC to provide storage services from the SSSF requires the proposed project to be operational by early to mid 2011. AGL is proposing storage of up to 40 MMscf/d of gas, for up to three years, for a total injected gas volume of approximately 44 Bscf.

The three year injection phase will be followed by a three year production phase, with commencement of the gas withdrawal phase proposed to occur in 2014. This is designed to coincide with QGC's ability to use this gas to supply its QCLNG Processing Facility in Gladstone. The SSSF project timeframe has been set to meet the demands of QGC's ramp up gas schedule.

Further to the QGC contract, AGL expects to use the storage facility to provide both short term (seasonal) and long term storage services. The storage facility is expected to have an operational life consistent with the operational life of PL 446, after which decommissioning and rehabilitation will occur. The Lease was renewed in April 1998 for a period of 21 years and will expire on 29 April 2019, and will be renewed for a further period. However, should the application to convert PL 16 to a 2004 Act Lease be approved, the new lease will have a full 30 year term from the date the lease is granted.

3.3 Site Selection

The compressor unit will be constructed within the existing (and pre-disturbed) Silver Springs plant site footprint adjacent to the existing compressor station. Existing wells and flowlines will be used wherever practicable (subject to planned integrity testing) to further minimise project impacts.

Indicative locations of the proposed new compressor station, existing injection / withdrawal / monitoring wells and associated flowlines are shown in Figure 2 and Figure 3.

Where integrity testing identifies that existing wells do not meet the project requirements, replacement wells will be drilled as close as possible to the existing well. Where this occurs, additional short lengths of flowline may be constructed to connect the replacement well to the existing flowline system. Any new wells required will utilise existing disturbed and cleared areas to the greatest extent practicable.

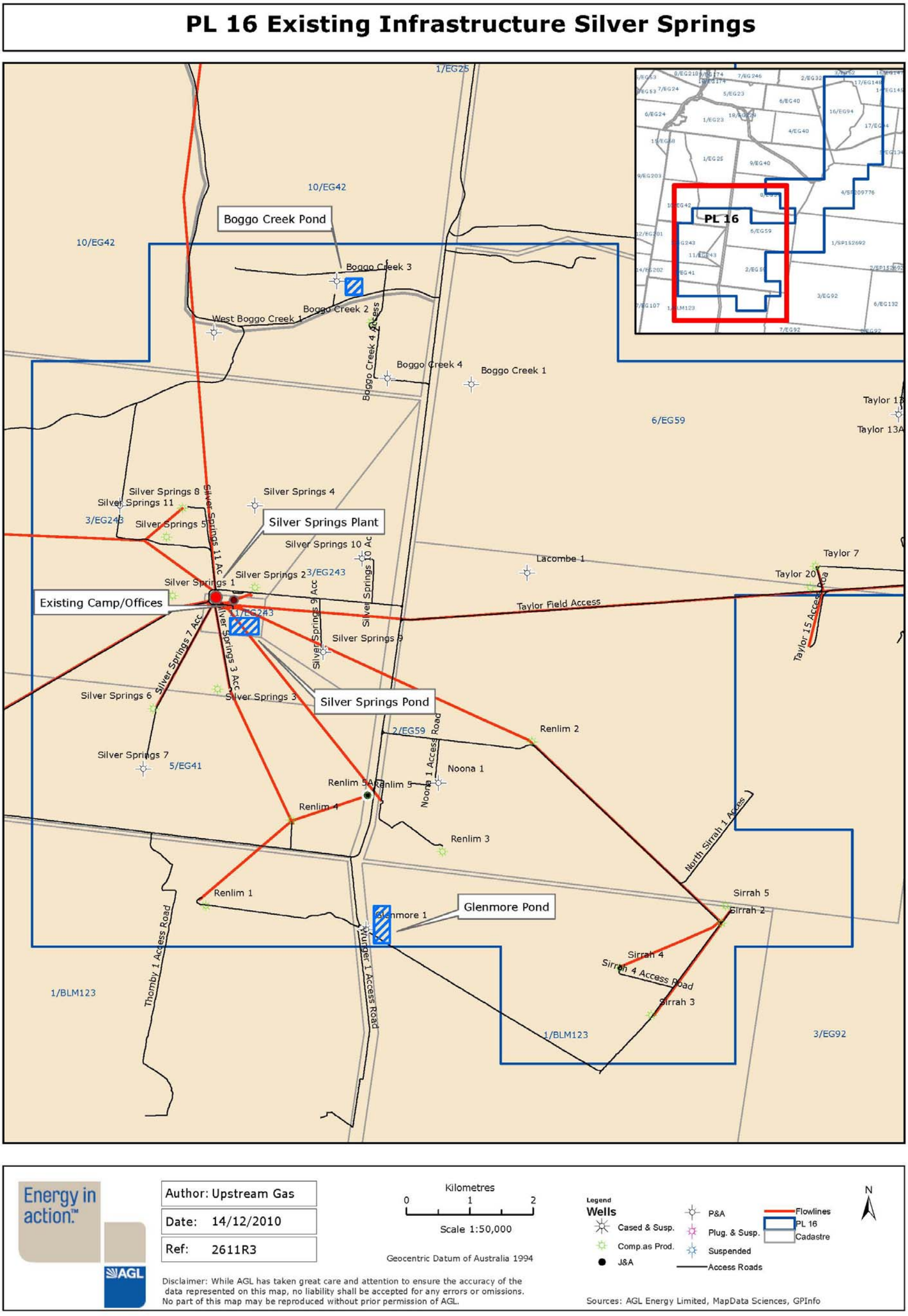


Figure 2: Indicative Locations of SSSF Project Facilities and Existing Infrastructure

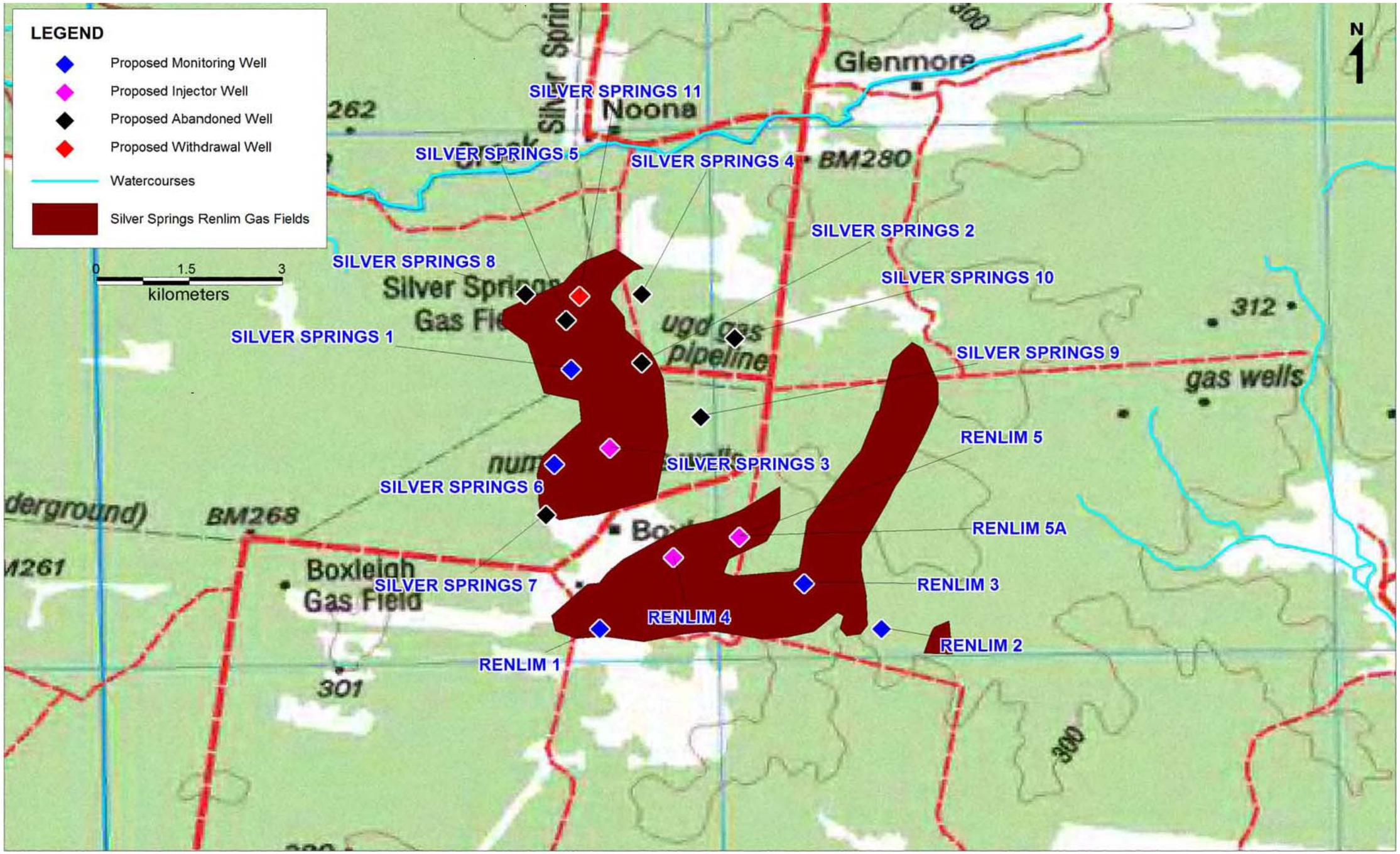


Figure 3: SSSF Well Type and Location

3.4 Design and Engineering

3.4.1 Compressor

Key design features of the compressor station are outlined in Table 3.

Table 3: Compressor Engineering and Design Features

Parameters	Proposed Design
Design Pressure	19,550 kPa
Design Max Temp	65^{o}C
Design Min Temp	-45 ^{o}C
Design Gas Flow Rate (Discharge)	40 MMscf/d
Design Gas Flow to SS 12	25 MMscf/d
Design Gas Flow to SS 3 and Renlim 4	15 MMscf/d
Min Pressure required at Well Head	17,250 kPa
Max Pressure required at Well Head	19,550 kPa
Flow Line Size	DN150

The compressor unit and station piping will be constructed in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code B31.3 (ASME 2010).

3.4.2 Wells and Flowlines

AGL's preference is to utilise existing infrastructure on PL 446 wherever possible for the SSSF project. Therefore, proposed construction activities for the SSSF will be limited to the construction of one new compressor, a concrete batching plant, new process piping and new process equipment including a three phase separator, TEG hydrator and gas heater.

A total of five existing wells are planned to be used for injection and withdrawal activities, with a further five wells to be used for monitoring purposes (refer Table 4 and Figure 18). These wells are already connected to the gathering network (flowlines) at Silver Springs minimising project related disturbance.

Table 4: Existing Infrastructure to be utilised for the SSSF

Well	Current Status	Underground Gas Storage (UGS) Well Status
Injection / Withdrawal Wells		
Silver Springs 11	Shut in	Withdrawal (back up)
Silver Springs 12	Under Construction	Injection / Withdrawal (primary)
Silver Springs 3	Shut In	Injection / Withdrawal
Renlim 5A	Producer (intermittent)	Injection / Withdrawal (back up)
Renlim 4	Shut In	Injection / Withdrawal
Monitoring Wells		
Silver Springs 1	Shut In	Monitoring
Silver Springs 6	Shut In	Monitoring
Renlim 1	Shut In	Monitoring
Renlim 2	Shut In	Monitoring
Renlim 3	Shut In	Monitoring

Existing wells will be subject to integrity testing prior to operation of the SSSF (refer Sections 3.4.3.3 and 12.2.4.1), and where this demonstrates existing wells are not suitable for injection, replacement wells will be drilled as close as possible to the existing proposed injection well. Where replacement wells are required, short sections of additional flowline may also be constructed to connect the replacement well to the existing gathering network.

Indicative locations of all existing infrastructure to be used as part of the SSSF are shown in Figure 2 and Figure 3. Construction of above ground and flowline infrastructure is discussed in Sections 3.5.1 and 3.5.2.

3.4.3 Reservoir Modelling and Capacity

A specialist review of existing AGL reservoir modeling for the proposed SSSF was undertaken (RPS 2010c). A summary of key findings with regard to reservoir characteristics and proposed injection and production activities is included below, with other key aspects being discussed at more relevant points throughout this report (i.e. Sections 6.2.1 and 12.1.3). A full copy of this review is contained in Appendix 4 of this EM Plan,

3.4.3.1 Historical Reservoir Pressures and Production

The Silver Springs gas field was first discovered in 1970 with the Renlim gas field being discovered in 1982. The original gas volume stored within the Silver Springs / Renlim field is thought to have been 115 Bscf (with partial and tortuous pressure support from a regional aquifer). Initial reservoir pressure was found to be 2,790 pounds per square inch absolute (psia) at 5,300 feet (1,615.44 m) True Vertical Depth sub-sea (TVDss) and 82^{o}C.

A number of studies, including material balance calculations, volumetric assessments and reservoir simulation have defined a “joining area” between the Silver Springs and Renlim accumulations. Gas and water within the Showgrounds Sandstone reservoir can move through this joining area according to the imposed pressure gradient resulting from gas off-take / pressure drawdown at the producing wells (AGL 2010).

Production from the Silver Springs field began in 1978 and to date (November 2010) the Silver Springs / Renlim gas field has produced over 90 Bscf gas and 0.4 million barrels (MMbbls) condensate. The field complex had produced almost all of its remaining reserves of gas by the year 2000 (90.2 Bscf), and reservoir pressure in the Showgrounds Sandstone reservoir had declined to 1,550 psi (AGL 2010).

3.4.3.2 Proposed Injection and Withdrawal

The pressure between the perforations in the well casing and the formation (hosting the reservoir) during injection is called the sand face injection pressure. Maximum sand face injection pressure is the injection pressure at which formation failure may occur, or at which the reservoir seal (confining layer) may leak. For the purposes of this review, maximum sand face injection pressure was taken to be the original reservoir pressure.

Based on a dynamic reservoir simulation (run by AGL) of an anticipated three year injection and three year withdrawal cycle the maximum gas volume which can be injected into the Silver Springs / Renlim gas field without exceeding the original reservoir pressure is 70 Bscf. This is a significantly larger volume than the 44 Bscf AGL are proposing to inject; therefore, there is sufficient margin not to exceed maximum sand face injection pressure.

To store 44 Bscf of gas over three years AGL are proposing an injection rate of up to 40 MMscf/d across three wells (excluding the backup well), with each well injecting approximately one third of the total daily volume. Prosper^{TM} modelling was undertaken for injection to the reservoir using three different well tubing sizes (2.875, 3.5 and 4.5 inch) and at two different reservoir pressures (to account for increased reservoir pressure as a result of gas injection):

- Injection at a reservoir pressure of 1,800 psia; and
- Injection at a reservoir pressure of 2,600 psia.

For each scenario, Flowing Well Head Pressures (FWHP) of 1,800 and 2,400 psia were used.

Table 5: Prosper™ Maximum Gas Injection Rates

Tubing Size	2.875		3.50		4.50	
Skin	2					
FWHP – Injection pounds per square inch gauge (psig)	1,800	2,400	1,800	2,400	1,800	2,400
Reservoir Pressure (psig)	1,800					
Maximum Gas Injection Rate (MMscf/d)	7	15	12	25	23	46
Bottom Head Pressure – Injection (psig)	1,810	1,821	1,817	1,836	1,836	1,887
Reservoir Pressure	2,600					
Maximum Gas Injection Rate (MMscf/d)	3	7	3	12	3	23
Bottom Head Pressure – Injection (psig)	2,603	2,607	2,603	2,613	2,603	2,628

The results of this modeling (Table 5) suggests that the proposed injection rates are achievable except where 2.875 inch well tubing is used at the higher reservoir pressure (2,600 psia). As the primary injection well will utilise 4.5 inch tubing, the proposed injection rates can be achieved.

3.4.3.3 Well Integrity

AGL's preference is to utilise existing infrastructure where possible, including wells. Corrosion of steel well casings due to water is possible, therefore, prior to their use in the SSSF project AGL will undertake the following checks on the condition of the production casing to ensure existing wells are suitable for injection / withdrawal purposes:

- Wall thickness checks of the production casing using equipment such as the Schlumberger Ultrasonic Imager Tool (USIT™); and
- Confirmation of top of cement and condition of existing cement using equipment such as the Schlumberger CBL / VDL (a sonic device).

Where existing well integrity is confirmed, these will be cemented up to 400 m above the Silver Springs / Renlim reservoir, except Silver Springs 12 which will be cemented to the surface.

3.4.4 Reservoir Monitoring

As discussed in Section 3.4.3 impacts to reservoir integrity (i.e. damage to the formation) are anticipated to be minimal given that fraccing will not be used and injection pressures will be below the original reservoir pressure. Additionally, gas migration is considered unlikely to occur given that the Snake Creek Mudstone Member is regarded as a regionally significant seal, which acts as an effective capping and confining layer to the Showgrounds Formation which hosts the Silver Springs / Renlim reservoir (refer Section 12.1.4.2 and RPS 2010b and c). Wells proposed for use in the SSSF project will also be subject to integrity testing prior to operation to determine their suitability for use. Where proposed wells are deemed unsuitable, replacement wells will be drilled. Despite these findings and precautions, AGL will also implement an ongoing program to monitor reservoir integrity, injection and withdrawal pressures and

gas water ratio's to allow for early identification of unanticipated scenarios. This monitoring program will include but not be limited to:

- Well integrity testing prior to operations (refer Section 3.4.3.3);
- Monitoring of FWHP at injection wells to ensure original reservoir pressure is not exceeded and prevent damage to the formation;
- All injection wells will have meters installed in order to monitor gas temperature and injection flow rate allowing the cumulative volume of injected gas to be tracked;
- Periodic well logging to monitoring gas-water contact movements;
- Daily Monitoring for gas front breakthrough in down-dip monitoring wells via wellhead pressure gauges; and
- Sniffer tests will be conducted internally on a regular basis (every 3 month for the first twelve months and then every 6 months ongoing) and annually externally audited once the SSSF becomes operational to enable detection of potential surface leaks at wellheads, fugitive emissions and ingress to buildings or structures should these occur.

No tracers will be used at any time as part of AGL's reservoir monitoring program.

3.5 Construction and Operations

3.5.1 Above Ground Infrastructure

3.5.1.1 New Compressor Unit

Compressor Construction

The new compressor unit will be installed within a pre-existing cleared area on a concrete slab of approximate dimension 12 m x 3.5 m and concrete piers will be installed to support the slab. A 30 day cure period is required for the concrete to reach full strength prior to installation of the compressor. The new compressor unit will be composed of the following major equipment:

- Gas and engine water jacket cooling;
- Pulsation control devices;
- Valve assemblies to facilitate capacity control, start-up, shutdown, blow-down and emergency shutdown of the units;
- Inlet filters and a discharge coalescer;
- Gas supply including filtration, regulation and metering equipment;
- Skid mounted control system capable of being connected to the local control system and control room;
- Instrumentation and safety systems;
- Oil system including supply and storage / make-up tanks, filtration and heating as required; and
- Catalytic converters.

A shelter will be built over the compressor skid with process vents and a gantry crane to be mounted off the structure.

Significant construction activities at the site will include the following:

- Earthworks (including clear and grade), excavation of site slabs and footings, piling, and grading of plant site and access tracks);
- Laying compressor slab foundations and slab;
- Installing / constructing compressor plant, machinery and associated pipework; and
- Hydrostatic testing and flushing of the compressor piping.

Compressor Operation

The proposed compressor will be designed for unmanned, remote operation and can be operated from the local control room at Silver Springs. Once built and commissioned, the compressor will operate continuously with maintenance staff undertaking regular inspections and maintenance.

The compression process at the proposed SSSF involves the following:

- Gas from the SSP is supplied to the compressor at the SSPP;
- Gas is compressed via a two stage compressor and cooled via heat exchangers;
- Gas is then processed through a discharge coalescer; and
- Gas then enters the injection system headers for transportation to the injection wells.

Key impacts and mitigation measures associated with the operation of the compressor station are addressed in Sections 4.0 (Air Quality) and 9.0 (Noise).

3.5.1.2 Withdrawal Phase

During the withdrawal phase gas will be processed through the SSPP. The new compressor unit will be configurable for use in withdrawal service at later stages of the withdrawal phase when well head pressures reduce. New process equipment may be required to be installed including a three phase separator, TEG dehydrator, and gas heating may be installed if existing equipment is unsuitable.

The withdrawal process will operate in the same way as the existing production process:

- Gas from withdrawal wells is collected in the inlet manifold;
- Gas is processed through a gas heater;
- Heated gas is passed through a three phase separator;
- Gas is compressed (as required); and
- Gas is dehydrated and enters the Silver Springs Pipeline.

3.5.1.3 Concrete Batching Plant

AGL is proposing to install a temporary portable concrete batching plant in a pre-existing cleared area at the SSPP. This plant will be designed for the production of up to 800 t of concrete, for construction of the new compressor facility and to upgrade the on-going operations to improve existing PL 446 infrastructure. This plant will occupy an area of approximately 0.25 ha and is anticipated to be similar in design to the batching plant shown in Plate 1.

In consultation with DERM, AGL will install the batching plant and produce a maximum of 199 t for the compressor slab. As this amount will not trigger the Chapter 4 Activity 43 (or ERA 43) under the *Environmental Protection Regulation 2008*, AGL propose to undertake this activity prior to approval of this EA. AGL will provide documented evidence of production volumes to DERM to support this approach. The remaining 600 t of concrete will be produced after approval of the EA application.

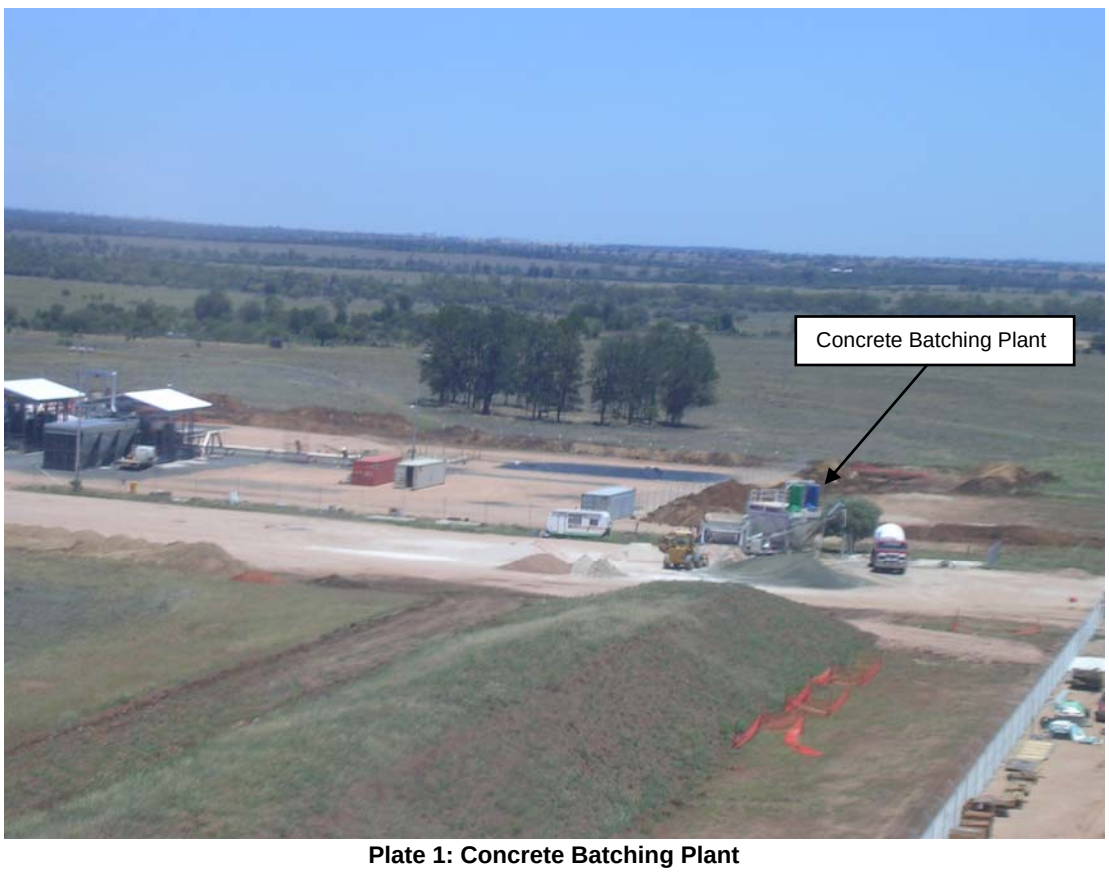


Plate 1: Concrete Batching Plant

3.5.1.4 Injection, Withdrawal and Monitoring Well Construction

Should integrity testing of existing wells determine that any of these are not suitable for injection at the proposed SSSF new wells will have to be drilled as replacements. The preparation and construction of well sites would be undertaken within a typical footprint of up to 1 ha (typically 100 m x 100 m) per well, (likely to be less given the use of existing disturbed areas). Each well site will also be fenced to limit stock access and minimise the extent of site disturbance. The construction footprint would incorporate access to the centre of the site, stockpiling and storage areas, and allow space for plant and equipment to be maneuvered on site. Some well site locations may also be designed to include a small temporary camp to house rig-site workers. Temporary camps will usually be located away from work areas.

As the area surrounding the existing wells proposed for SSSF use was cleared for the original drill pad and associated works, AGL's preference to locate replacement wells, as close as possible to existing wells should limit clearing to small areas of regrowth.

Site Preparation

Site preparation and construction works at new well site locations within the construction footprint will generally include the following:

- Removal of topsoil and establishment of topsoil stockpile area;
- Installation of environmental controls, stock proof fencing and silt fences;
- Installation of a lined ground sump to capture run-off from the site;
- Construction of lined turkeys nest (storage pit for water for drilling operations);
- Construction of drilling sump;
- Installation of well cellars;
- Installation of conductor pipe (16 inch casing down to approximately 10 m);
- Upgrade or installation of access roads, if required;
- Earthworks as required (on a site-specific basis) to form a flat operating area for drill pads located on slopes. This generally includes an up-slope diversion drain around the site to manage surface runoff, with the profile returned as near as possible to the original profile during rehabilitation;
- Placement of temporary hard surface, such as gravel with approximately 0.3 m depth, within construction compound for vehicle access and drill pad;
- Levelling and grading within construction footprint for placement of the drill rig;
- Installation of storage tanks and/or lined pits at each well site for the storage of drilling fluids; and
- Rehabilitation of the surplus construction area surrounding the permanent hardstand wellhead at the completion of construction.

Drilling, Drilling Fluids and Drill Cuttings

Conventional rotary drilling of new vertical wells is anticipated, however, future activity may also include the use of multi-lateral and horizontal techniques for enhanced production. Horizontal drilling practices also have the benefit of being able to utilise existing locations. Additional techniques such as Underbalanced Drilling or Managed Pressure Drilling may be considered when penetrating depleted reservoirs. Such operations would require additional equipment to that for normal operations. Well depths are not anticipated to exceed 2,800 m True Vertical Depth (TVD).

It is anticipated that wells will be drilled with a mobile drilling rig which will provide power, rotary transmission, pumps and all other equipment necessary to safely drill a well. Equipment (including the rig) will be certified to meet relevant industry standards.

Drilling operations may be implemented with either one or two 12-hour shifts per 24-hour period. The workforce required will generally be eight to ten people, but this may increase from time to time depending on operational requirements. Personnel may be housed remotely or on a small temporary

camp sited nearby to the drilling rig location. For 24-hour operations the well site will be illuminated using flood lighting.

New boreholes will be drilled utilising a water based fluid with additives (drilling fluid). Drilling fluid is used as a circulation agent predominantly to remove cuttings from the well during the drilling process. The drilling fluid will include additives such as Potassium Chloride (a corrosion inhibitor), weighting agents such as Bentonite (a naturally occurring clay) or Calcium Carbonate and biodegradable polymers to manage fluid properties. Residrill may also be added to the drilling fluid. Residrill is a product designed to give any drilling fluid non invasive properties and also reduces dynamic filtration loss, stabilises wellbores and protects reservoirs from damage during the drilling process. Air or foam may be used as a drilling fluid specifically designed for drilling depleted reservoirs, although this would require additional equipment at the drill site, such as compressor units. No drilling operations undertaken on PL 446 will utilise hydrocarbon or synthetic oil based products as a drilling fluid.

Drilling fluid losses may be encountered after entering reservoirs, where this occurs Lost Circulation Material (LCM) may be added to the drilling fluid to minimise or eliminate loss of drilling fluid to the reservoir formation. Commonly used LCM includes cedar bark and mineral fibre, or granular material such as ground and sized limestone or nut hulls. Where used, and assuming well integrity is good, LCM will remain within the well bore and be recovered in drilling rig tanks (RPS 2010c).

Drilling fluids will be stored in mud tanks (part of rig equipment) or lined pits at the location. Chemicals will be transported to site by the supplier as required or will be appropriately stored at the existing SSGP and transported to the drill site as required.

It is proposed that drill cuttings will be dried and used in the rehabilitation of the well site after the departure of the drilling rig.

Casing

The borehole diameter and casing architecture may vary from field to field and will be designed on well objectives; however a typical casing scheme may involve the following:

- Conductor casing: This typical seals off loose upper sediments;
- Surface casing: Seals off upper water zones, and provides installation for blowout prevention. Typically set 10% minimum of total depth;
- Intermediate casing: Whilst not always run this may be required to seal off any troublesome zones;
- Production casing: This casing string penetrates the reservoir and provides isolation from overlying formations. After cementation this casing is normally perforated at reservoir depth; and
- Production tubing: Conduit for hydrocarbon transportation. Run inside production casing and secured with permanent packer (above reservoir) and in wellhead at surface. All casing will be cemented (grouted) according to industry best practice, with pump trucks being required on site for grouting activities.

Borehole Geophysical Logging

Once the borehole has been drilled, geophysical logging will be undertaken to record strata characteristics. Geophysical logging will involve the lowering of special purpose tools into the boreholes to record strata characteristics and verify the quality of the casing grout.

After well drilling and completions (installation of well heads and associated infrastructure), any new well sites are likely to be reduced in area to approximately 20 m x 20 m (0.04 ha) containing the well head, pipeline connections and well head telemetry (controls). The location of existing wells proposed to be used is indicated in Figure 3.

3.5.1.5 Workforce

A peak construction workforce of approximately 30 people is expected during the installation of the compressor to be accommodated at an existing camp site in the Silver Springs field (Section 3.5.1.6). Local contractors will be used where possible for supply of subcontract services. Examples of areas where local subcontracts could be utilised are:

- Supply of concrete;
- Fencing;
- Management of sewerage and other construction waste materials;
- Transport services;
- Vehicle hire; and
- Supply of general labourers.

The compressor will be operated by the existing Silver Springs operations personnel.

3.5.1.6 Construction Camps and Laydown Area

The compressor construction workforce will be accommodated at an existing camp located at Silver Springs authorised under the existing IA (refer Figure 2 and Appendix 1). Small temporary drilling camps may be used as required to house drill rig workers, and will be located within the 1 ha construction disturbance footprint for each well.

3.5.1.7 Power Supply

Electrical power to the proposed SSSF site will be provided by the existing site generators at the Silver Springs plant. Power supply to well heads will be provided by battery and solar power.

3.5.1.8 Access

Access to the proposed project site will be via existing roads and access tracks in preference to the creation of new tracks wherever possible. The main access roads likely to be used are the Surat Developmental Road and Thomby Road, with adjoining local roads and approved private landholder tracks to be utilised where required. All project related access will be restricted to approved access roads,

tracks, and approved turn-around or laydown areas. Where additional flowlines are required, the right-of-way (ROW) will be utilised as an access track to minimise disturbance.

All access tracks utilised will be maintained during construction and rehabilitated to the pre-existing state (or better) following completion of construction activities (where ongoing operational access is not required) and in accordance with landholder requirements. Although not anticipated to be required, any construction of new access tracks will avoid Environmentally Sensitive Areas (ESAs) and will be scheduled to minimise disturbance to landholders. All temporary construction tracks will be rehabilitated in accordance with regulator and landholder requirements.

The contractor will record the condition of all roads before and after use and make good any damage which can be shown to result from contract activities. During the construction period, the contractor will liaise with the Local Government Authority (LGA) on the use of local roads and the Department of Transport and Main Roads (DTMR) for all state-controlled roads.

3.5.1.9 Waste

Portable sewage systems will be utilised during construction with no permanent sewage facilities constructed on site for the proposed SSSF. Waste generated will be transported by an appropriately licensed contractor and disposed of at an appropriately licensed facility in consultation with the LGA.

Relatively small amounts of domestic and industrial wastes will be generated during the construction and operation of the SSSF (refer Table 6). Waste management will be based on a hierarchy beginning with waste avoidance, minimisation and recycling before disposal. On site wastes will be removed during construction. The volumes of waste generated during construction are generally small, and efforts will be made to reduce, reuse and recycle materials. Potential wastes generated from construction and operations are detailed in Table 6, while management and mitigation measures are discussed in Section 11.0.

Table 6: Typical Wastes and Disposal Options

Waste Type	Disposal
Construction	
Packaging (ropes, cardboard), timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Recycling facility or licensed landfill
Used chemicals and oils – e.g. lube oil, chemicals, used tins from solvents, rust proofing agents or primer	Licensed disposal facility
Scrap – welding rods, pipe offcuts, nut, bolts, gaskets etc	Licensed landfill
Hydrotest water (< 1,000 L)	Waste water will be disposed of to existing dams on site
Drilling fluids and drill cuttings	Non-toxic drilling fluids and cuttings will be dried either in pits at the well head and remain at the site or will be contained in mud tanks on the drill rig.
Operation	
Filters (non-oily, oily and gas)	Licensed landfill
Sludge (pigging)	Licensed recycling or landfill facility if pigging is undertaken in the future.
Packaging and waste oils and greases (maintenance)	Licensed disposal facility
Oil contaminated soil	Remediation in situ for small quantities. Advice sought from DERM regarding treatment options for larger spills (e.g. >200L). Bioremediation in on-site landfarm (refer Appendix 1) or removal of soil under disposal permit if required.

3.5.2 Flowlines Construction

As discussed in Section 1.0, existing flowlines and wells will be used wherever practicable for the SSSF, subject to the results of integrity testing. Where replacement wells are required, short additional sections of flowline may be constructed to link the replacement well to the existing flowline system. It is not anticipated that flowline construction will be necessary for the SSSF; however, as a conservative approach the construction techniques involved have been further discussed in the following sub-sections.

Where required, additional flowlines will be a constructed in accordance with AS 2885 '*Pipelines – Gas and Liquid Petroleum*' and will consist of a six inch diameter buried, coated welded steel pipe to transport gas between the wells and the compressor stations.

Water for construction uses (e.g. washdowns and dust suppression) is likely to be sourced from a bore on PL 446.

Key design and engineering features of the flowlines are provided in Table 7.

Table 7: Indicative Flowline Engineering and Design Features

Parameters	Proposed Flowline Design
Maximum Allowable Operating Pressure (MAOP)	19,550 kPa
Nominal Flowline Capacity	40 MMscf/d
Flowline	API 5L X52 Electric Resistance Welded Steel Pipeline
External Diameter	DN150
Wall Thickness	11.0 mm
Design Temperature	-10 to 65^{o}C
Required Design Life	20 years
Depth of Cover	In accordance with AS 2885.1, typically: ▪ 750 mm in cross country sections; ▪ 1200 mm beneath roads, in road easements and in heavy industrial areas.
Pipe Coating	Dual Layer Fusion Bonded Epoxy
Buried Marker Tape	Buried marker tape is installed at crossings, throughout Heavy Industrial Secondary Land Classification and other risk areas as defined in the project risk assessment.
Type of Cathodic Protection System	Impressed current or galvanic systems.

3.5.2.1 Fencing

Any existing fences intersected by the additional flowline alignments will be severed and temporary construction gates will be installed. This involves a fencing crew and associated vehicles accessing the flowline route via the surveyed construction ROW and/or access tracks. Fencing will be undertaken in consultation with landholders such that any impacts to stock movements or property maintenance will be minimised. Crews will be instructed on the need for gates to be closed in accordance with landholder requirements.

3.5.2.2 Clear and Grade

Clear and grade will be carried out to provide a safe construction ROW for vehicular movement, trenching and other construction activities. As replacement wells, if required, will be drilled as close as possible to existing wells, the length of additional flowline required will be minimal. Such flowline sections may not extend beyond the area originally cleared for construction of the existing well however, some minimal clearing may still be required. A ROW width of 20 m will generally be required to enable construction to be undertaken safely and efficiently and (subject to construction safety) will be reduced to 15 m in width for limited distances through sensitive areas.

Graders and bulldozers will be used to clear the construction ROW of vegetation and topsoil. Topsoil will typically be graded to a depth of 50 to 150 mm for a blade-width over the flowline trench line or the full ROW, depending on factors such as the soil type, terrain, construction requirements and weather conditions. It is not anticipated that clearing will be required for additional flowlines, however, should clearing occur, vegetation will be stockpiled for re-spreading to assist with erosion and sediment control, ROW stabilisation, and seed stock where required as part of the restoration and natural regeneration

process. Large mature trees along the ROW margins will be preserved where practicable and trimmed in preference to removal. If tree removal cannot be avoided, they will typically be pushed over and windrowed alongside the ROW. Breaks will be left in stockpiled vegetation to allow continued access to stock, fence lines, property tracks and drainage lines. Vegetation and topsoil will be stockpiled separately to sub-soil on the ROW for later use during rehabilitation.

3.5.2.3 Trenching

After the ROW is cleared, a trench will be dug for the flowline using either a wheel trencher, chain digger or an excavator in accordance with the minimum pre-defined depths of burial (refer to Table 7). The required depths are determined by the AS 2885.1 risk assessment process and recorded on construction alignment sheets. It is anticipated that additional flowlines will be less than 100 m in length and that trenching for this can be completed within one day. The short distance of trench potentially required represents a low potential erosion risk and is anticipated to keep fauna mortalities associated with trench entrapment as low as reasonably practicable (methods adopted to minimise fauna entrapment in the trench are detailed in Section 8.0).

Soil from the trench will be stockpiled along the ROW (on the non working side) and kept separate to the topsoil stockpile. Figure 4 below shows a typical ROW layout, as defined by the APIA '*Code of Environmental Practice – Onshore Pipelines*' (APIA 2009), with which the project will generally be consistent. However, it should be noted that flowlines are smaller in diameter than gas transmission pipelines and typically require a narrower ROW for construction. As such the flowline ROW will typically be 20 m wide and will be narrowed to 15 m wherever practicable (subject to construction safety) through any sensitive areas.

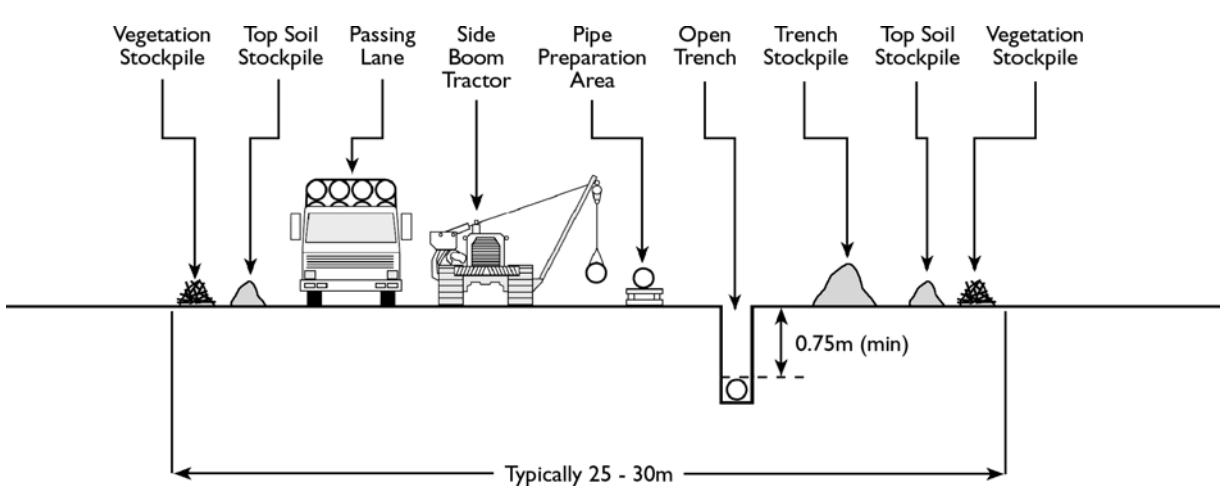


Figure 4: Schematic of a Typical Corridor Layout for Pipeline Construction

3.5.2.4 Stringing

Sections of steel pipe (approximately 18 m long) will be trucked to the construction ROW and placed end-to-end next to the trench in preparation for welding ('stringing'). The sections will be placed on sandbags and raised on blocks of wood (timber skids) to prevent corrosion and damage to the external flowline coating. Where required, flowline sections are bent to match changes either in elevation or direction of the route.

3.5.2.5 Line-Up, Welding, Radiography and Joint Coating

Once the flowline is 'strung', a line-up crew will position the line using side boom tractors and internal line-up clamps. Flowline sections will be welded together and each weld will be inspected using x-ray or ultrasonic equipment as per AS 2885.2. The area around the weld is cleaned and then coated with a protective coating to prevent corrosion.

3.5.2.6 Lowering-in and Backfill

Side booms (bulldozers with cranes) or excavators will be used to lower the welded flowline into the trench and interconnecting sections of the line are welded together.

Where required, padding machines will be used to sift the excavated trench spoil to remove coarse materials. The remaining fine material will be used as padding beneath and on top of the buried flowline in order to protect the flowline coating during backfilling. No additional padding material will be required for backfill.

Backfilled material is wheel-rolled to provide compaction and/or a small crown left over the trench to minimise subsequent settlement.

3.5.2.7 Hydrostatic Testing (Hydrotesting)

Pipe integrity is verified using hydrostatic testing in accordance with AS 2885.5. During hydrostatic testing (hydrotesting), the flowline is capped with test manifolds, filled with water and pressurised to a minimum of 125% of Specified Minimum Yield Stress (SMYS) for a minimum of two hours. A 24-hour leak test at a lower pressure then follows. Hydrotesting results in the generation of waste water that, depending on its chemical constituents (including biocide content), may result in localised impacts to water quality if incorrectly disposed of or treated.

It is anticipated that hydrotesting will only be required for the pipes connecting the flowlines and the SSP to the proposed compressor. This will require less than 1,000 L of water, which will be potable quality water sourced from Surat (via a licensed water carrier) and trucked to the site.

Given that high quality potable water will be used, it is considered unlikely that any additional chemicals (e.g. oxygen scavengers or biocides) will be added. AGL's preferred disposal method is to discharge used hydrotest water to an existing dam at the Silver Springs plant location. This preference will not alter if chemicals are added to hydrotest water.

3.5.3 Scale of Disturbance

If new wells are drilled at Taylor and elsewhere on PL 446, the maximum construction footprint may extend to a maximum of 11.65 ha, assuming no existing wells are suitable and all new wells will have to be drilled, which is unlikely. Additional flowline has not been included in these calculations as scale of disturbance is entirely dependent on well location, which is not known. After construction of new wells (where required) the 1 ha construction footprint for each well will be predominantly rehabilitated, leaving only an approximate 0.04 ha area (20 x 20 m) of permanent disturbance.

The operational footprint for project activities has been calculated based on the largest anticipated final footprint (i.e. a well footprint of approximately 0.04 ha) and is likely to be 1.65 ha (Table 8). Although final disturbance areas for operational activities may differ from calculated values, the difference is not expected to be significant.

Table 8: Potential Area of Disturbance – Operational Footprint

Facility	Footprint (ha)	Number	Total Area of Disturbance (ha)
Injection / Withdrawal Wells* (includes 2 backup wells)	0.04	4	0.16
Backup Withdrawal Well*	0.04	1	0.04
Monitoring Wells*	0.04	5	0.20
Concrete Batching Plant	0.25	1	0.25
Compressor Unit	1	1	1.0
Potential New Wells (5 at Taylor and 5 elsewhere on PL 446)**	1	10	10.0
		Total	11.65

* Wells have been included to represent a maximum case.

** Potential new wells are dependent on findings of seismic survey, but are included to represent a maximum case scenario.

3.6 Seismic Survey

AGL may undertake seismic survey works over PL 446. Modern seismic activities are considered low impact, requiring minimal clearing as GPS locators eliminate the need for line-of-sight surveys. Some vegetation removal may still be necessary to enable vehicle access, but this will be on a case-by-case basis and clearing will be selective.

Due to the depth of the target reservoirs, dynamite charges may be used (as an alternative to vibroseis) to generate the waves or vibrations for the survey to be conducted. Typically, relatively small amounts of explosives are buried in 15 – 30 m deep ‘shot holes’ along a seismic line, which once detonated creates a small pulse on the surface up to approximately 100 m away (Milligan 2004). Environmental sensitivities such as dams, watercourses, pipelines, wells and bores and third party infrastructure such as tanks and residences are considered when determining the placement of shot holes (RLMS 2009).

At the completion of seismic surveys, seismic lines are rehabilitated through the removal of all temporary markers, wires and the like and where necessary the natural drainage and topsoils are reinstated and shotholes are backfilled. At the completion of rehabilitation activities, landholders are requested to sign agreements / release to indicate their satisfaction with the rehabilitation efforts.

3.6.1 Restoration and Rehabilitation

3.6.1.1 Compressor Unit, Wells and Flowlines

As soon as practicable and within twelve months (or for a longer period agreed in writing by the administering authority) of the completion of activities causing disturbance to land, and in accordance with the DERM guideline ‘*Model conditions for coal seam gas activities*’, AGL will likely be required to undertake the following rehabilitation measures:

- Remediate contaminated land in accordance with *Environmental Protection Act 1994* requirements;
- Re-shape all significantly disturbed land to a stable landform similar to that of the surrounding undisturbed areas; and
- On all significantly disturbed land:
  - Re-establish surface drainage lines;
  - Reinstate the top layer of the soil profile; and
  - Promote establishment of vegetation of the same species and density of cover to that of the surrounding undisturbed areas.

AGL undertakes to complete all reinstatement and rehabilitation works necessary to return the land to a stable landform consistent with surrounding land and encourage native vegetation regrowth in accordance with regulatory requirements and best industry practice.

3.6.2 Planned Operation and Maintenance Program

The operation of the project will be in accordance with approval documentation (i.e. the PL and EA), AGL's Environmental Management System (EMS refer to Section 14.0) and AS 2885.

A routine operation and maintenance program for the SSSF will be implemented, which will include regular ground patrols (every three months), leak surveys (every 12 months) flowline cleaning, coating defect repairs, and corrosion monitoring for flowlines and wells. Ground inspections will include checking vegetation for discolouration (an indicator of a gas leak), monitoring erosion and rehabilitation success and detecting weed species. Repair or replacement of faulty equipment will also be undertaken.

More significant maintenance activities e.g. flowline dig-ups, well workovers or compressor overhauls are likely to be infrequent. All operational activities and maintenance on PL 446 will be undertaken in accordance with relevant legislation, the conditions of the EA and those measures contained in the OEMP (Appendix 1). Landholders will be advised of all access requirements to properties while regulatory authorities will be consulted as appropriate prior to commencing extensive work, or where numerous sites are involved.

Existing access tracks will allow inspection and maintenance to well sites, along flowline ROWs and other aboveground facility sites and for low level maintenance to rectify erosion, subsidence and weeds as necessary.

Regular consultation will be maintained with landowners / landholders whose properties are accessed or traversed by project vehicles and equipment, or are otherwise potentially affected by new infrastructure (e.g. wells and associated infrastructure) located beyond the boundary of the AGL owned property (Lot 11 on Plan EG243).

A summary of operational activities is provided in Table 9. All operational activities will be conducted in accordance with the OEMP.

Table 9: Summary of Project Operational and Maintenance Activities

Activity / Issue	Description of Management
Compressor Station Operation and Maintenance	
Compressor Station Blow Downs	Uncontrolled venting which is a result of equipment failure (e.g. regulator failure). Duration would depend on type and duration of failure. May also be required for emergency / unplanned station maintenance.
Emissions	Gas is released to the atmosphere as a result of maintenance operations (i.e. unit blow downs / venting, valve opening / testing). Small volumes are released. Occurs for duration of operational life.
Production of Hazardous Waste	Waste hydrocarbons are generated from maintenance / pigging operations. Contaminated filters, waste and oils will be removed from site for disposal by a licensed contractor.
Waste Disposal	General operational waste is collected on-site and removed to AGL's licensed refuse pit (located at the site of the old seismic camp) for disposal. Small volumes of putrescible wastes will be disposed on-site in AGL's licensed refuse pit, other wastes will be collected and disposed of to local landfills as required or through licensed contractors.
Weed Control	Localised spraying of weeds is undertaken in and around compounds, typically 1-2 times per year.
Injection / Withdrawal / Monitoring Well Operation and Maintenance	
Emissions	Gas is released to the atmosphere as a result of maintenance operations. Small volumes are released. Maintenance will be ongoing for duration of operational life.
Erosion Events	Following major rainfall events run-off areas can experience soil erosion. Repairs are initiated immediately following the erosion event and include the replacement of similar materials and re-profiling.
Waste Disposal	General operational waste will be collected on-site and removed to AGL's licensed refuse pit for disposal. Small volumes of putrescible wastes will be disposed on-site in AGL's licensed refuse pit, other wastes will be collected and disposed of to local landfills as required or through licensed contractors. A small quantity of grease will be expelled from wellheads during greasing and should be removed by wellhead greasing contractor. Vents from chemical pumps at wellheads for corrosion inhibitor (if required).
Weed Control	Localised spraying of weeds is undertaken in and around compounds, typically 1-2 times per year.
Well Incident	The main threats to public safety from well operation and maintenance are fire, explosion or radiation exposure as a result of an uncontained release due to equipment failure. Monitoring and maintenance activities and well protection systems significantly reduce these risks.
Flowline Operation and Maintenance	
Cathodic Protection Surveys	Routine inspection of the cathodic protection systems are completed (typically on an annual basis) to ensure cathodic protection system levels are within design limits.
Coating	Sleeves or tape are expected to be used to coat welds or repair areas of flowline or above ground pipework. Epoxy painting (spray) may be used.
Emissions	Methane gas can be released to the atmosphere as a result of flowline and facility maintenance operations (i.e. venting, valve opening / testing). Small volumes are released. Occurs for duration of operational life.
Erosion Events	Following major rainfall events run-off areas on the easement can experience soil erosion. Repairs are initiated immediately following the erosion event and include the replacement of similar materials and re-profiling.

Activity / Issue	Description of Management
Excavations, Including Coating Refurbishment, Installation of Anode Beds, Emergency Response Exercises and New Tie-Ins	Excavations of the flowline follow the same processes as those described during construction but are generally on a much smaller scale. Once vegetation and topsoil have been cleared and stockpiled, excavation is performed and spoil stockpiled. The flowline maintenance is then undertaken (this may include welding, painting, sand blasting). Once complete the trench is then backfilled, the ground surface is re-contoured and the topsoil and vegetation respread. Some re-seeding may be undertaken if necessary. These activities may occur during the first year of operation to rectify defects, but expected to be very rare during the life of the flowline.
Flowline Incident	The main threats to public safety from flowline operation and maintenance are fire, explosion or radiation exposure as a result of flowline rupture. Monitoring and maintenance activities and flowline protection systems significantly reduce these risks.
Leakage Surveys	Annual leakage inspection of flowline right-of-ways and associated pipeline with Flame Ionisation Detectors.
Pigging	Routine pigging operations may be undertaken in the future to clean flowlines. A flowline 'pig' is placed in the line via a launching facility. The pig travels inside the flowline before being removed at a pig receiving facility. Removal of a pig from the flowline results in minor venting of gas to atmosphere and the collection of some water, hydrocarbons and debris.
Pressure Testing	Pressure testing is required when a section of flowline is replaced. Pressure testing, even for small sections of the line, follows the same processes as those identified during construction.
Replacement of Flowline Section	A section of the flowline is isolated and a controlled release of gas is undertaken from the affected section. The affected area is then purged and excavated, the old flowline removed and replaced (includes welding, blasting, coating) and the site reinstated. This is expected to be very infrequent.
Testing and Inspection of Relief Valves	Relief valves are inspected and tested in accordance with mandatory inspection requirements (removed and tested with nitrogen). Controlled venting of minimal quantities of gas to atmosphere is involved. Typically occurs once per year for approximately 30 seconds.
Flowline Easement Maintenance	
Line-of-Sight Clearance	Clearance of the easement to maintain line-of-sight may not be required for the whole alignment (e.g. agricultural land and low open grassland or shrubland areas), but will be undertaken where necessary. Trees retained on the easement during construction will not be removed however it may be necessary to remove trees that regenerate within 3 m from the flowline as they pose a threat to flowline integrity and access.
Patrolling / Inspections – Easement Access	Inspections are conducted every three months and are undertaken by travelling along the easement and include a ROW report.
Weed Control	Localised spraying of weeds is undertaken along the easement as required. All project activities will be undertaken in accordance with AGL's OEMP (refer Appendix 1).

3.6.3 Decommissioning

The SSSF is expected to have an operational life consistent with the operational life of PL 446. If and when the SSSF is no longer required, the wells, compressor station and associated facilities will be decommissioned in accordance with the legislative requirements of the day. Current decommissioning procedures would require the removal of above ground infrastructure, the restoration of associated disturbed areas and in-situ decommissioning of underground flowlines. Rehabilitation and decommissioning are discussed in further detail in Section 13.0.

4.0 Air Quality

Katestone Environmental was commissioned by RPS, on behalf of AGL Energy Limited (AGL), to undertake an air quality impact assessment of emissions associated with the operation of the proposed SSSF. A copy of this report is presented in Appendix 5.

This assessment examined the potential air quality impacts of the Project on the local atmospheric environment by:

- Describing the existing air quality in the region;
- Estimating the emissions to air associated with the construction and operation of the proposed compressor unit in isolation and including existing Silver Springs infrastructure;
- Quantifying meteorological parameters, land-uses and terrain features in the region that may impact the dispersion of air pollutants released from the Project;
- Predicting ground-level air pollutant concentrations using the air dispersion model CALPUFF; and
- Assessing and comparing predicted impacts against the relevant air quality objectives used in Queensland.

Ground-level concentrations have been modelled given the predominantly agricultural nature of the proposed SSSF project area, so that potential air quality impacts to crops can also be assessed.

4.1 Existing Air Environment

Land use in the project area is a mix of sparse pasture and grassland and it is anticipated that air quality in the project area will be representative of a rural area with a low population density. Apart from the existing SSPP there are no other large combustion sources within 40 km of the proposed SSSF location. Emissions from the SSPP have been included as part of the air dispersion modelling assessment, therefore background concentrations for Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO) have not been included.

Apart from the SSPP, air quality in the project area is likely to be influenced by a number of activities including (but not limited to) the following:

- Dust from pastoral and gas exploration and production activities including, stock and vehicle movements;
- Environmental factors (including wind-borne dust, seed, pollen and smoke); and
- Limited vehicle and equipment exhaust fumes from roads and operating industries and towns.

4.2 Air Quality Modelling

Atmospheric dispersion modelling was carried out using the CALPUFF Version 6.267 dispersion model (EarthTec). CALPUFF is a non-steady-state puff dispersion model and is accepted for use by DERM.

The modelling was conducted assuming constant operations of each source over twelve months of modelled meteorological data (1 January 2008 – 31 December 2008). This encompasses all weather

conditions likely to be experienced at the site during a typical year, including minimum case dispersion conditions.

Modelling was conducted using a 10 km domain around the proposed SSSF project site. Only three sensitive receptors were identified within this area (refer Table 10 and Figure 5).

Table 10: Receptor Location, Type and Distance from SSSF

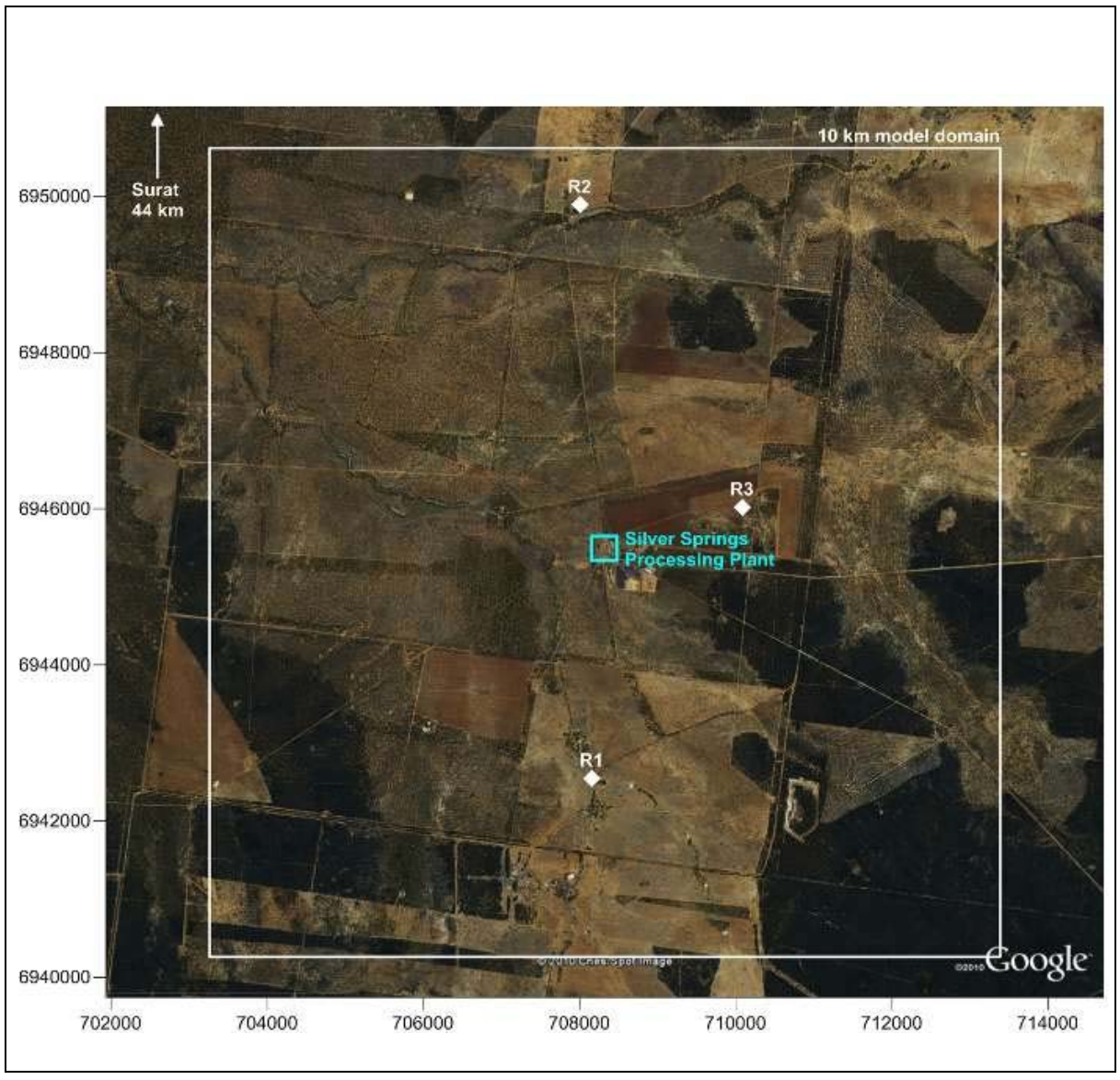
Receptor ID	Type	Distance / Direction from Project Site
Boxleigh (R 1)	Dwelling	2.9 km South
Noona (R 2)	Dwelling	4.6 km North
The Little Homestead (R 3)	Dwelling	1.8 km North East

4.2.1 Air Quality Objectives

The EP Act gives the Minister of the DERM the power to create Environmental Protection Policies that identify, and aim to protect, environmental values of the atmosphere that are conducive to the health and wellbeing of humans and biological integrity. The Environmental Protection (Air) Policy (EPP (Air)) was revised and reissued in 2008.

Emissions of air pollutants considered in the air dispersion assessment are associated with combustion of fuel in the compressor engines. Fugitive emissions, on-site vehicle emissions and construction dust emissions are considered to have a negligible impact compared to combustion impacts and have not been modelled. In accordance with Schedule F, Table 1 of the DERM 'Model Conditions for Level 1 Environmental Authorities for Coal Seam Gas Activities', only ground level concentrations of NO_2 and CO_2 have been modelled as reproduced as Table 11. Emissions of nitrogen oxides ($NO_{x)}$ have been used to define NO_2 ground level concentrations based on the use of an empirical Nitric Oxide / Nitrogen Dioxide conversion ratio (conservative ratio of 30% used).

Trace amounts of other pollutants (e.g. Volatile Organic Compounds (VOCs) Particulate Matter (PM_{10} and $PM_{2.5}$) and Sulphur Dioxide (SO_2), may be emitted from existing and proposed plant, but ground level concentrations of these trace pollutants are expected to be very low (well below EPP (Air) objectives) and as such have not been modelled.



Katestone 2010

Figure 5: Location of Closest Sensitive Receptors

Table 11: EPP (Air) Ambient Air Quality Objectives

Indicator	Environmental Value	Averaging Period	Air Quality Objective (µg/m3)[6]	Number of Days Exceedence Allowed Per Year
Nitrogen Dioxide	Health and Wellbeing	1-hour	250	1
		1-hour	62	N/A
	Health and Biodiversity of Ecosystems	1-year	33	N/A
Carbon Monoxide	Health and Wellbeing	8-hour	11,000	1

Source: Katestone 2010

6 ug/m^3 – micrograms per cubic metre.

4.2.2 Air Quality Modelling Scenarios

The existing SSPP is comprised of four operational compressors, of which only three typically operate at any one time. The fourth compressor is utilised for back-up purposes and may only operate for one day a month or less.

To better gauge the potential impacts to air quality of the proposed SSSF project, three scenarios were modelled as follows:

- Emissions from existing plant at the SSPP;
- Emissions from the proposed new compressor; and
- Cumulative emissions from existing and proposed plant.

Background air monitoring was undertaken by EML Air Pty Ltd (21 October 2010) and data collected was used in conjunction with manufacturers specifications to model existing site emissions. Predicted site emissions were derived from manufacturer's specifications for the proposed CAT G3612 compressor engine.

4.2.3 Compressor Emissions

The source characteristics and emission rates used as input for the CALPUFF dispersion modelling are presented in Table 12.

Table 12: Stack Characteristics and Emission Rates

Parameter	Units	Silver Springs Processing Plant (Existing)			Silver Springs Gas Storage Facility (Proposed)
Compressor		CM200A	CM200B	CM200C	CAT G3612
Stack Height	m	6.6	6.7	7.3	7
Stack Diameter	m	0.35	0.35	0.4	0.5
Temperature	^{o}C	248.85	248.85	267.85	459.3
Exit Velocity	m/s	12.9	12.9	15.4	27.6
NOx Emission Rate	g/s	0.91	0.91	1.37	0.69
NOx Concentration	mg/Nm^{3}[7]	1,400	1,400	1,400	N/A*
CO Emission Rate	g/s	0.07	0.07	0.11	1.4
CO Concentration	mg/Nm^{3}	110	110	110	N/A*
Oxygen Content	%	16.2	16.2	16.2	N/A*

* Requires testing once operational

Source: Modified from Katestone 2010

7 Nm^{3} – Normal cubic metre

4.2.4 Greenhouse Gas Emissions

Katestone also undertook a Greenhouse Gas (GHG) assessment of the existing SSPP and proposed SSSF project to assess the contribution of the existing SSPP compressors and the proposed new compressor. The full GHG assessment is included as Appendix 6.

In December 2007, the Australian government ratified the Kyoto Protocol, an international agreement designed to restrict the growth in the emission of greenhouse gases in developing countries to the quantity being emitted in 1990. Australia committed to monitor and report greenhouse gas emissions and set a target emission level of 108% of estimated emissions for 1990 (598.076 Mt CO_2-e).

Stationary fuel combustion of fossil fuels (direct emissions) in existing and proposed gas compressor engines is the major activity on PL 446 which generates GHGs. Stationary fuel combustion quantities for existing and proposed compressors were identified from the 2009 / 2010 National Pollution Inventory Report for the site and manufacturers specifications and are reproduced in Table 13.

Table 13: Annual Stationary Fuel Combustion (SSPP and SSSF)

Source	Fuel	Annual Quantity	Units
Existing Gas Compressors	Diesel	551	kL/yr
	Fuel Oil	8,175	kL/yr
	Natural Gas	2,821,145	m^3/yr
Proposed Gas Compressor	Natural Gas	6,281,179	m^3/yr

Source: Modified from Katestone 2010b

Greenhouse gas emissions for existing SSPP, proposed SSSF and combined operations were calculated using the Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) methodology as shown below:

GHG = E x EF x CF

Where:

- GHG: Annual GHG emissions in tonnes of CO_2 equivalent (t CO_2-e);
- E: Annual fuel input energy;
- EF: Emissions Factors for CO_2, CH_4 and N_2O (kg CO_2-e/GJ); and
- CF: Capacity Factor (%).

The predicted GHG emissions have been calculated on maximum annual fuel usage for each source and as a combined (cumulative) total to represent maximum case GHG emissions (Table 14).

Table 14: Estimated Annual GHG Emissions

Source	Greenhouse Gas Emissions (tonnes $C0_2e$)	% of Australia's Kyoto Target
Existing	30,904	0.005
Proposed	12,671	0.002
Cumulative	43,575	0.007

Source: Modified from Katestone 2010b

The peak annual cumulative (maximum case) emission rate of GHG from operation of the existing SSPP and proposed SSFF is estimated to be 0.043 Mt CO2-e or 0.007% of Australia's assigned amount under the Kyoto protocol, with the proposed SSSF contributing an estimated 0.002%.

Based on the above the proposed SSSF project is considered unlikely to significantly contribute towards Australia's assigned Kyoto GHG emissions target.

4.3 Potential Adverse or Beneficial Impacts on Existing Air Environment

4.3.1 Air Quality Modelling Results

The results of the dispersion modelling show the ground level concentrations of NO_2 and CO for all modelled scenarios to be significantly below the relevant EPP (Air) objectives (refer Table 15).

Table 15: Predicted Maximum Ground-Level Concentrations of Pollutants

Pollutant	Averaging Period	EPP (Air) Objective	Receptor 1	Receptor 2	Receptor 3**
Scenario 1 (existing)					
Nitrogen Dioxide	1-hour	250	33.6	28.9	46.5
	Annual	62 (33*)	0.2	0.1	0.4
Carbon Monoxide	8-hour	11,000	3.6	2.6	5.8
Scenario 2 (proposed)					
Nitrogen Dioxide	1-hour	250	1.6	1.8	4.8
	Annual	62 (33*)	0.02	0.01	0.03
Carbon Monoxide	8-hour	11,000	8.6	7.3	11.9
Scenario 3 (combined)					
Nitrogen Dioxide	1-hour	250	24.4	21.3	32.0
	Annual	62 (33*)	0.2	0.1	0.3
Carbon Monoxide	8-hour	11,000	9.7	9.1	15.5

: Modified from Katestone 2010

* EPP (Air) Objectives for the protection of ecosystems

** Location of Receptor 3 was provided after dispersion modelling was completed and as a result the predicted ground level concentrations are only indicative and have not been explicitly modelled.

4.3.2 Potential Impacts to Air Quality

Emissions of NO_2 and CO generated by the proposed new compressor constitute the main potential impact to air quality from the proposed SSSF project. Cumulative assessment of NO_2 and CO emissions from the existing SSPP and the proposed new compressor has shown that the predicted ground level concentrations of NO_2 and CO are significantly lower than the EPP (Air) objectives.

Generation of airborne dust during construction, and to a lesser extent during operations, may also represent a potential impact to local air quality. Sources of airborne dust are likely to be construction activities (e.g. clear and grade) with general vehicle movements during construction and operations expected to generate lesser amounts. Where additional flowlines are required, dust may also be generated via trenching and backfilling,

Given that construction is anticipated to occur over a short period (<6 months), and minimal construction activities are anticipated, dust generation as a result of proposed SSSF project activities at any given point is expected to be short-term and localised. Water will be used to suppress dust and manage localised impacts to air quality resulting from the generation of airborne dust particularly during dry and windy periods or when works are conducted in proximity to residences. Dust nuisance impacts are generally limited to receptors in the immediate locality of earthworks. Given that the closest sensitive receptor is 1.8 km away, no significant dust nuisance is anticipated at sensitive receptors.

Predicted GHG emissions from the proposed SSSF are not considered to be a significant contributor to Australia's assigned quota under the Kyoto protocol.

Based on the above, it is considered that the proposed SSSF project is unlikely to significantly impact local air quality at identified sensitive receptors (pollutant ground level concentrations and dust) or contribute significantly to Australia's GHG emissions.

4.4 Environmental Protection Commitments, Objectives and Control Strategies – Air Quality

Environmental Protection Objective	To construct and operate the Facility in a manner that maintains the long-term ambient air quality of the local area and ensures that air emissions, including dust do not result in nuisance or other adverse impacts to sensitive receptors.
Specific Objectives	To minimise the generation of dust and GHG emissions. To eliminate uncontrolled atmospheric emissions. To maintain point source emissions within relevant acceptable limits and legislative requirements. To achieve consistency with the objectives of the *Environmental Protection (Air) Policy 2008*.
Control Strategies	Dust suppression measures (e.g. water trucks) will be used as required during construction and operations. Access routes will be maintained to minimise dust. All vehicles and equipment including compressors will be well maintained and fitted with appropriate exhaust systems and devices. Exposed surfaces will be stabilised and/or rehabilitated as rapidly as practicable after construction. Vehicle speeds will be limited along access roads, at facilities and along flowline ROWs (to reduce dust and fauna fatalities). Smoke generation will be avoided by a strict no burning policy. Fire control procedures will be implemented during welding operations. All complaints will be investigated, recommendations actioned and closed out. A program of regular monitoring, inspection and maintenance of flowlines, wells and other infrastructure during operations will be implemented to ensure optimal efficiency and minimise potential malfunction thereby reducing the potential occurrence of minor leaks from infrastructure.
Performance Indicators	No complaints in relation to dust nuisance at sensitive receptors (namely residences). Any recorded complaints are actioned and closed out. No fires on site (or in adjacent areas) as a result of project activities. Maintenance records demostrate regular servicing in accordance with manufacturers requirements is undertaken.

5.0 Dams

Whilst dams do exist on PL 446, they are not considered to be a component of the proposed SSSF project, with the exception that AGL's preference is to discharge less than 1,000 L of used hydrotest water to one of these dams. This option is discussed further in Section 12.1.3.1 with appropriate management and control measures discussed in Section 12.3.

The existing dams along with their current use and purpose are otherwise discussed in Section 2.6.13.1 of the OEMP (Appendix 1) and are not included in this EM Plan.

A Water Management Plan (including management of produced water from existing and on-going PL 446 activities) will be developed and submitted to DERM for approval within 18 months of the grant of this EA application (refer Section 12.1.3).

6.0 Land Management

6.1 Climate

The proposed project area is located in the subtropical climatic zone with mean daily temperatures at Surat (located approximately 49 km to the north of the SSGP, and the closest meteorological station to the project area), ranging from 20.6°C to 34.2°C in January (summer) and 4.2°C to 19.7°C in July (winter). St George (located approximately 65 km south south west of the project area), has mean daily temperatures ranging from 21.5°C to 34.5°C in January (summer) and 5.4°C to 19.0°C in July (winter). Annual average temperatures are relatively stable throughout the region with minimal differences between the two townships (Surat averages 13.0°C to 27.8°C and St George 13.9°C to 27.5°C).

Rainfall varies seasonally, with wetter summers and drier winters. Surat averages 74.2 mm of rain in the wettest month (February) and 27.4 mm in the driest month (August), compared to St George which averages 74.6 mm of rain in January and 25.3 mm in August. Rainfall statistics indicate a marginal variation across the region, with the average annual rainfall for Surat of 577.2 mm, compared to 517.1 mm for St George.

Light winds averaging speeds of 10.9 km/hr (Surat) and 10.4 km/hr (St George) in the morning and 11.9 km/hr (Surat) and 10.2 km/hr (St George) in the afternoon are common throughout the year, with winter mornings typically having calmer winds (BoM 2010).

A summary of annual rainfall and temperature details for Surat and St George meteorological stations is provided in Table 16.

Table 16: Annual Temperature and Rainfall Data for Surat Township and St George Post Office

Parameter	J	F	M	A	M	J	J	A	S	O	N	D	Av	Years
Surat Township														
Mean max temp (°C)	34.2	33.4	31.8	28.3	23.6	20.2	19.7	21.7	25.7	29.2	32.0	33.9	27.8	1938 - 2010
Mean min temp (°C)	20.6	20.3	17.8	13.2	8.9	5.6	4.2	5.6	9.3	13.8	17.0	19.3	13.0	1938 - 2010
Mean rainfall (mm)	72.0	74.2	58.3	31.3	34.5	36.8	38.7	27.4	29.4	49.8	54.3	70.7	577.2	1881 - 2010
Median rainfall (mm)	57.4	48.4	37.8	18.8	24.0	26.4	28.7	20.6	18.0	42.8	41.4	57.8	538.7	1992 - 2009
St George Post Office														
Mean max temp (°C)	34.5	33.4	31.5	27.6	23.0	19.6	19.0	21.0	25.0	28.7	31.9	34.3	27.5	1938 - 1997
Mean min temp (°C)	21.5	21.1	18.5	14.1	9.9	6.7	5.4	6.9	10.2	14.6	17.6	20.1	13.9	1938 - 1997
Mean rainfall (mm)	74.6	61.3	54.4	32.7	39.0	33.3	33.3	25.3	26.7	38.8	45.8	51.8	517.1	1881 - 1997
Median rainfall (mm)	56.3	45.0	35.3	16.3	23.5	25.3	26.6	16.8	21.0	29.4	33.2	43.4	498.4	1881 - 1997

Source: BoM (2010)

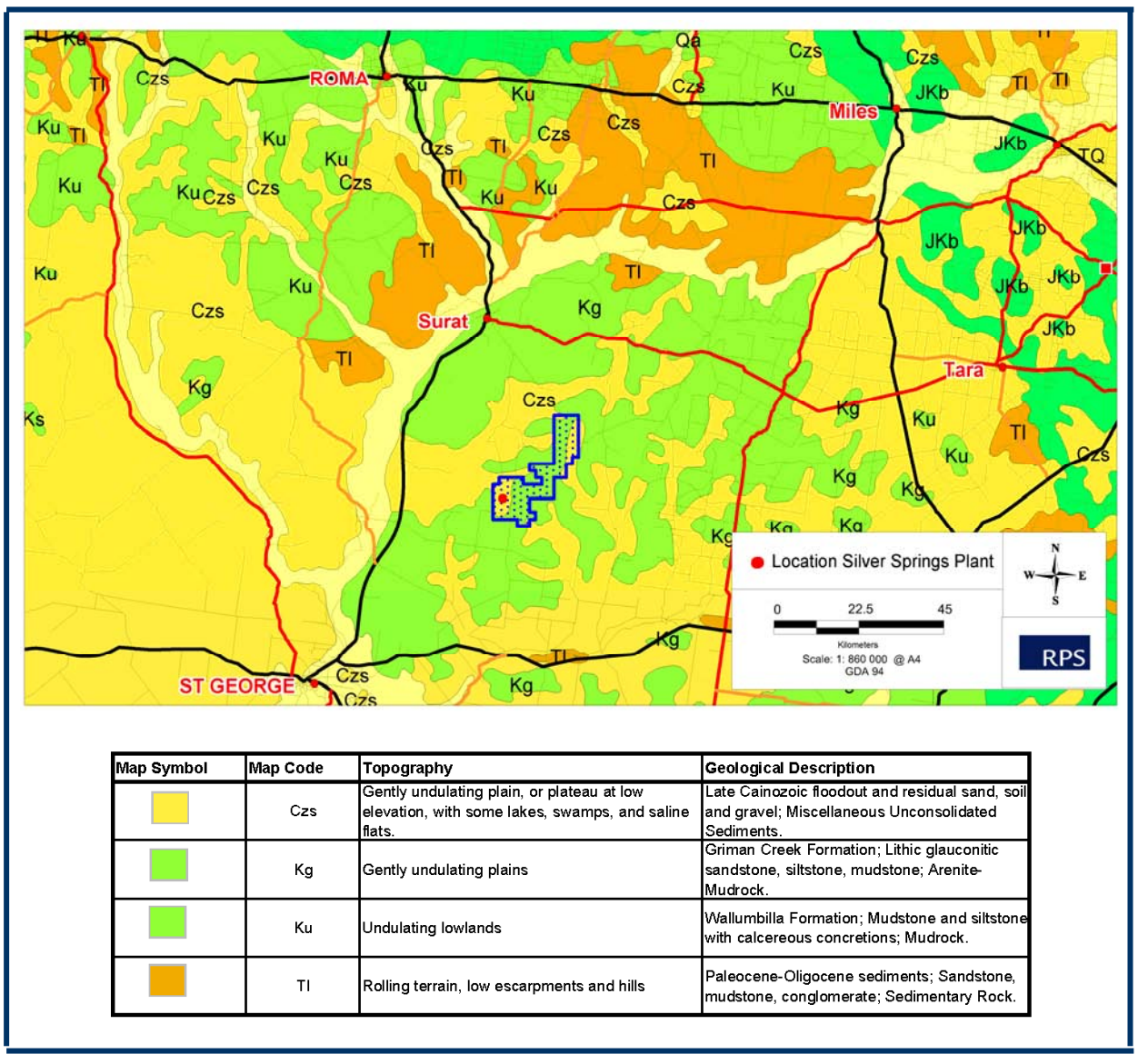
6.2 Geology, Landform and Soils

A review of the underlying geology of the proposed SSSF project site was undertaken as part of specialist hydrological assessment (RPS 2010b). The findings of this assessment have been summarised in Section 6.2.1.

6.2.1 Geology

6.2.1.1 Regional Geology

The Silver Springs gas field is underlain by unconsolidated quaternary age alluvium and possibly tertiary age sediments. The quaternary and tertiary age sediments include unconsolidated sand, gravel and silt (DNDGSQ 1971) (Figure 6). The Roma Land Management Manual mapping (DNRM 1993) has identified the geology as weathered Quartzose, sandstones and ferruginised sediment which is consistent with the previous description.



Map Symbol	Map Code	Topography	Geological Description
	Czs	Gently undulating plain, or plateau at low elevation, with some lakes, swamps, and saline flats.	Late Cainozoic floodout and residual sand, soil and gravel; Miscellaneous Unconsolidated Sediments.
	Kg	Gently undulating plains	Griman Creek Formation; Lithic glauconitic sandstone, siltstone, mudstone; Arenite-Mudrock.
	Ku	Undulating lowlands	Wallumbilla Formation; Mudstone and siltstone with calcereous concretions; Mudrock.
	Tl	Rolling terrain, low escarpments and hills	Paleocene-Oligocene sediments; Sandstone, mudstone, conglomerate; Sedimentary Rock.

Figure 6: Geology of the Region (DNDGSQ 1971)

6.2.1.2 Silver Springs / Renlim Stratigraphy

The underlying stratigraphy of the Silver Springs / Renlim gas field has been identified as comprising a total of 15 mappable geological units, with the actual gas field being hosted within the Triassic age Showgrounds Formation of the upper section of the Bowen Basin. The Showgrounds formation is a coarse conglomeratic package, with inter-bedded shale and is considered an ideal candidate for UGS due to its high porosity (12%) and good permeability (10 – 6000 millidarcies (mD)) (RPS 2010c). The Showgrounds Formation is part of the Clematis Group (refer Figure 7) and occurs at a depth of between 1,900 and 2,300 m at the proposed SSSF project site.

A summary of the stratigraphy at Silver Springs, including a description of the main geological units is provided in Table 17.

Table 17: Major Geological Units of the Project Area

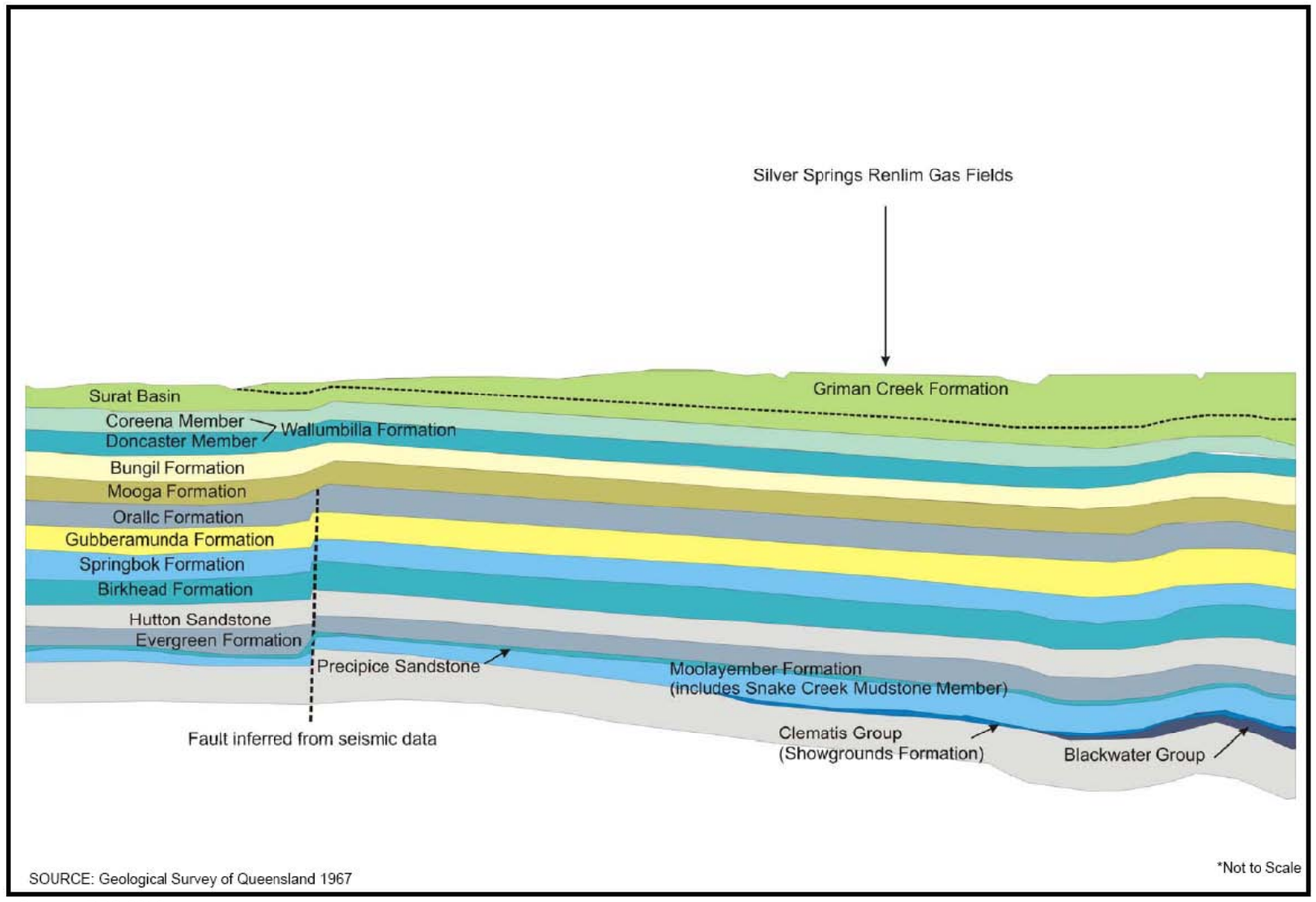
Geological Unit	Age	Description	Regional Thickness	SS 1+ Depth to Top of Formation (m AHD)	SS 10+ Depth to Top of Formation (m AHD)
Griman Creek Formation	Cretaceous	Lithic glauconitic sandstone, siltstone and mudstone.	Up to 480 m	NA	NA
Surat Basin (Siltstone Formation)	Cretaceous	Siltstone, mudstone, and some fine glauconitic sandstone.	Up to 150 m	NA	-56.5
Wallumbilla Formation (including Coreena Member and Doncaster Member)	Cretaceous	Siltstone, mudstone, and commonly glauconitic and calcareous sandstone.	Up to 290 m	-72.4	-76.3
Bungil Formation	Cretaceous	Glauconitic, labile to quartzose, siltstone, mudstone and siltstone.	Up to 200 m	-273.7	-277.0
Mooga Formation	Cretaceous	Sandstone, siltstone and mudstone.	Up to 300 m	-432.2	-475.3
Orallo Formation	Cretaceous	Sandstone, siltstone, mudstone, conglomerate and coal.	Up to 250 m	-615.4	-575.0
Gubberamunda Formation	Cretaceous	Sandstone, siltstone and mudstone.	Up to 250 m	-773.1	-751.6
Westbourne Formation*	Jurassic	Interbedded shales, siltstones, very fine-grained quartzose sandstone and rare coal.	Up to 220 m	-928.7	-928.8
Springbok Formation	Jurassic	Labile sandstone, siltstone, mudstone, with some coal.	Up to 250 m	-1,012.2	-1,023.3
Birkhead Formation (Walloons Formation)	Jurassic	Shale, siltstone, sandstone, coal, mudstone and limestone.	Up to 500 m	-1,085.4	-1,069.6
Hutton Sandstone	Middle Jurassic	Poorly sorted, medium-grained, feldspathic sub-labile sandstone (at base) and fine-grained, well-sorted quartzose sandstone (at top). It also consists of minor dark grey carbonaceous siltstone, mudstone and rare pebble conglomerate.	Up to 180 m	-1,248.1	-1,273.3

Geological Unit	Age	Description	Regional Thickness	SS 1+ Depth to Top of Formation (m AHD)	SS 10+ Depth to Top of Formation (m AHD)
Evergreen Formation	Early Jurassic	Calcareous mudstone and siltstone with minor sandstone and coal beds.	Up to 300 m	-1,412.4	-1,412.0
Precipice Sandstone	Early Jurassic	Poorly sorted, thick-bedded, cross-bedded, fine to very coarse-grained, pebbly quartzose sandstone with minor white to yellowish brown, laminated siltstones, carbonaceous shale, lithic sub labile sandstone and a granule conglomerate.	Up to 150 m	-1,487.7	-1,491.3
Moolayember Formation (including the Snake Creek Mudstone Member)	Middle Triassic	Lacustrine mudstones (Snake Creek Member).	Up to 50 m	-1,496.2 (Snake Creek Mudstone -1,592.2)	-1,506.7 (Snake Creek Mudstone -1,593.3)
Showgrounds Formation (part of the Clematis Group)	Middle Triassic	Medium to very coarse-grained quartzose sandstone.	Up to 100 m	-1,606.6	-1,607.8
Timbury Hills Formation	Devonian	Basement medisediments	NA	-1,662.7	-1,608.9

* This is recorded as present in a layer up to 100 m thick in well stratigraphy for SS 1 and SS 10, however this formation has not been mapped by Queensland geosciences and is therefore not included in Figure 7.

+ Data taken from Stratigraphic Tops Geographical Survey Queensland - QPED (reproduced in RPS 2010b).

Source: Modified from RPS 2010



Source: RPS 2010

Figure 7: Geological Cross Section of Project Area

6.2.2 Soils

A desktop assessment based on soil, land management datasets and basic analysis of soils samples (collected 22 September 2010) was undertaken for the SSSF project area. This information has been interpreted using a functional soil science perspective: assessing the soils production capacity and environmental risks within a landscape and climate setting.

The following data sources were utilised:

- Australia 1:250,000 Geology Series (DNDGSQ 1971);
- Land Systems of the Balonne-Maranoa Area (CSIRO 1974);
- Roma District Land Management Manual (DNRM 1993);
- Salinity Risk Assessment for the Qld Murray Darling Region (Biggs *et al* 2010); and
- Digital Atlas of Australian Soils (NRIC 1991).

Information obtained from the above datasets was further enhanced by including factors such as climate, rainfall, and current land use.

Soils in the project area are confined to a single major soil unit and a single soil type for the proposed areas of disturbance (refer Figure 8, Figure 9 and Figure 10). A general description of soil group and type has been sourced from the Digital Atlas of Australian Soils (NRIC 1991) and a summary has been provided in Table 18.

Table 18: Major Soil Types of the Proposed SSSF Project Area

Soil Group	Soil Type	Description
Ferrosols	Loams	Hills, ranges of hills, low hilly ridges, or dissected tableland remnants: chief soils are shallow loams usually containing or covered by siliceous gravel, with many rock outcrops and boulders of siliceous or ferruginous materials. Associated soils include shallow sands and red earths.
	Massive Earths	Gently undulating plains with occasional high ridges and cuesta-like scarps: chief soils of the gently sloping to flat areas are red earths with some yellow earths, all often with surface scattering of ironstone gravel; on the higher ridges and scarps shallow loams occur with some ferruginous rock outcrops, while in the lower-lying situations soils occur along with small areas of soils or adjacent units.
	Red Duplex	Very undulating plains or occasional low flat terraces fringing drainage lines: chief soils are hard alkaline red soils. Associated soils are red earths on the more elevated areas, and cracking clays and also hard alkaline brown soils in the lower lying sites.

A review of the Land Systems of the Balonne – Maranoa (CSIRO 1974) and the Roma Land Management Manual (DNRM 1993), both of which cover the proposed SSSF project location identified that soils were mapped as gravely loamy red earths, shallow gravelly red earths; duplex soils, with some skeletal soils, massive earths and duplex soils (Figure 8, Figure 9 and Figure 10).

Soil sampling was undertaken during the ecological site visit (20 – 22 September 2010 (as shown in Plate 2). A representative soil profile was collected (in 0 – 10 cm, 10 – 30 cm, 30 – 60 cm and 60 – 75 cm

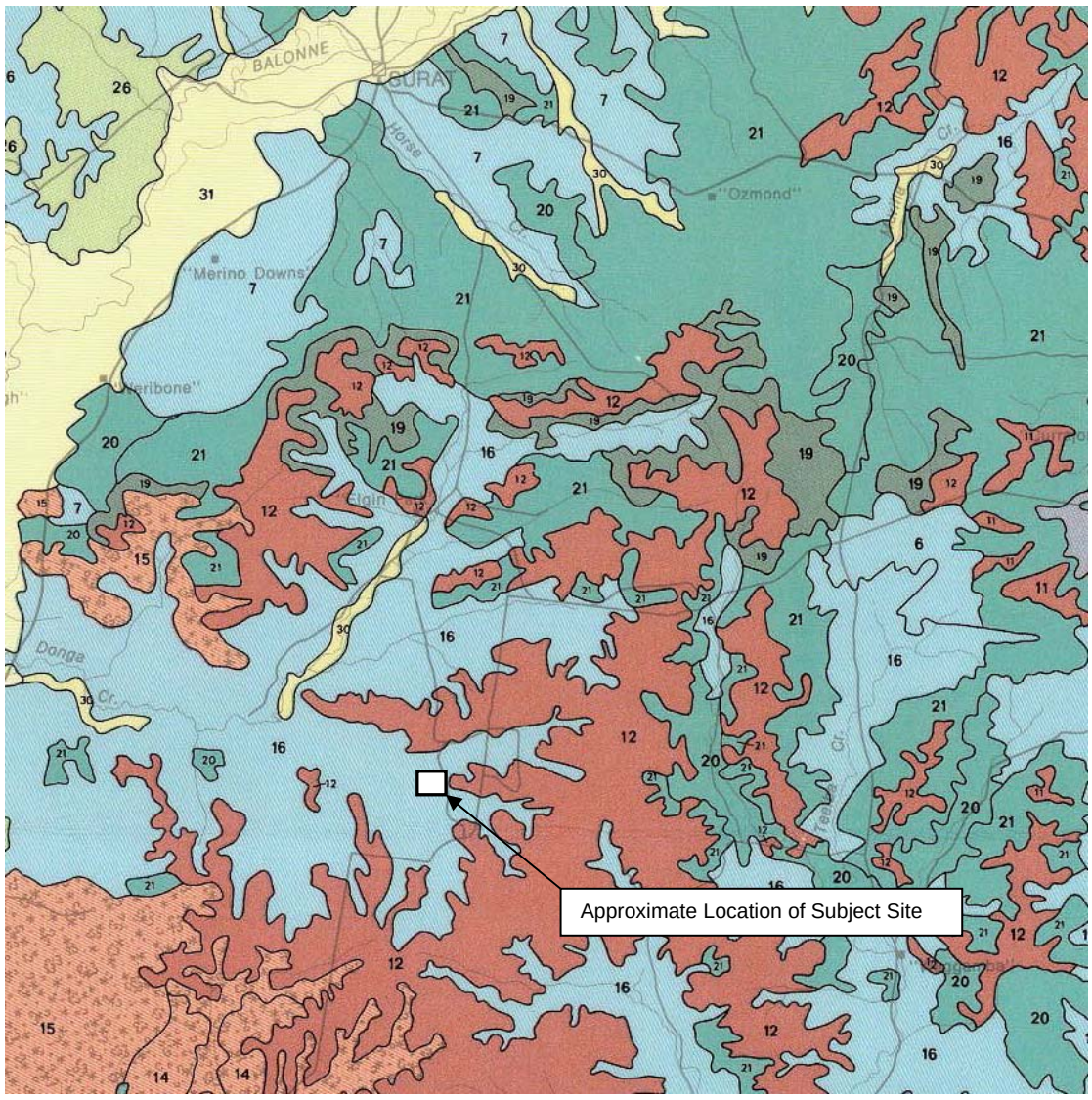
increments). Basic analysis of these samples (including soil texture analysis and pH) was undertaken and samples were found to be consistent with the above descriptions (well drained red and red brown earths).

No acid sulphate soils or potential acid sulphate soils have been identified within the proposed SSSF project area (elevations greater than 5 m AHD).

Plate 2: Soil collected to 75 cm depth.
The profile is uniform in texture (clay loam) and colour and displayed a friable soil structure.

6.2.3 Topography

The Roma Land Management Manual mapping (Figure 10) associates the site with gently undulating plains of the Coogoon land system with gradients of 1 – 2%, with ridges and crests comprising short slopes to 5% gradient.



MODERATELY RESISTANT WEATHERED SEDIMENTS

14 **(S)uM (2280 km²).** Lowlands; mulga open-forest; massive earths
Land units 22, 3%; 24, 87%; 26, 10%

15 **(S)uXM (3980 km²).** Lowlands; poplar box woodland with mulga; massive earths
Land units 7, 2%; 8, 5%; 24, 60%; 26, 5%; 32, 10%; 33, 10%; 34, 2%; 37, 3%; 64, 3%

16 **(S)uX (8630 km²).** Undulating lowlands; poplar box woodland usually with few shrubs; massive earths and duplex soils
Land units 8, 2%; 25, 10%; 26, 40%; 29, 3%; 30, 5%; 31, 2%; 33, 24%; 37, 5%; 48, 5%; 53, 1%; 64, 3%

17 **(S)ulX (430 km²).** Undulating country; silver-leaved ironbark and poplar box woodland; massive earths and duplex soils
Land units 8, 10%; 25, 3%; 26, 2%; 27, 43%; 33, 30%; 34, 10%; 64, 2%

18 **(S)uBu (2215 km²).** Undulating lowlands; bull-oak and poplar box woodland; duplex soils
Land units 5, 5%; 7, 15%; 8, 5%; 25, 10%; 30, 5%; 31, 53%; 33, 5%; 64, 2%

Figure 8: Land Systems of the Balonne-Maranoa (CSIRO 1974)

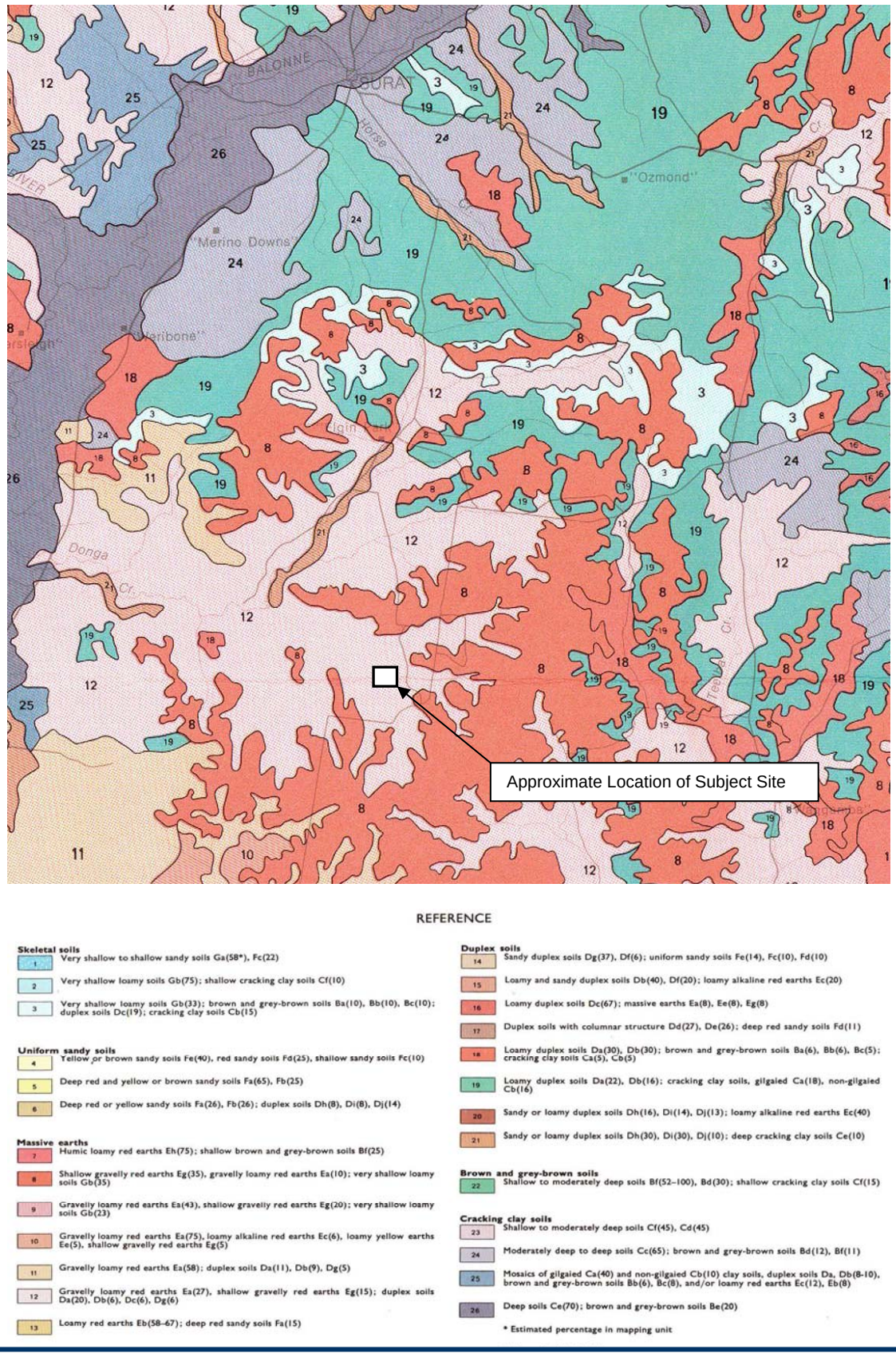
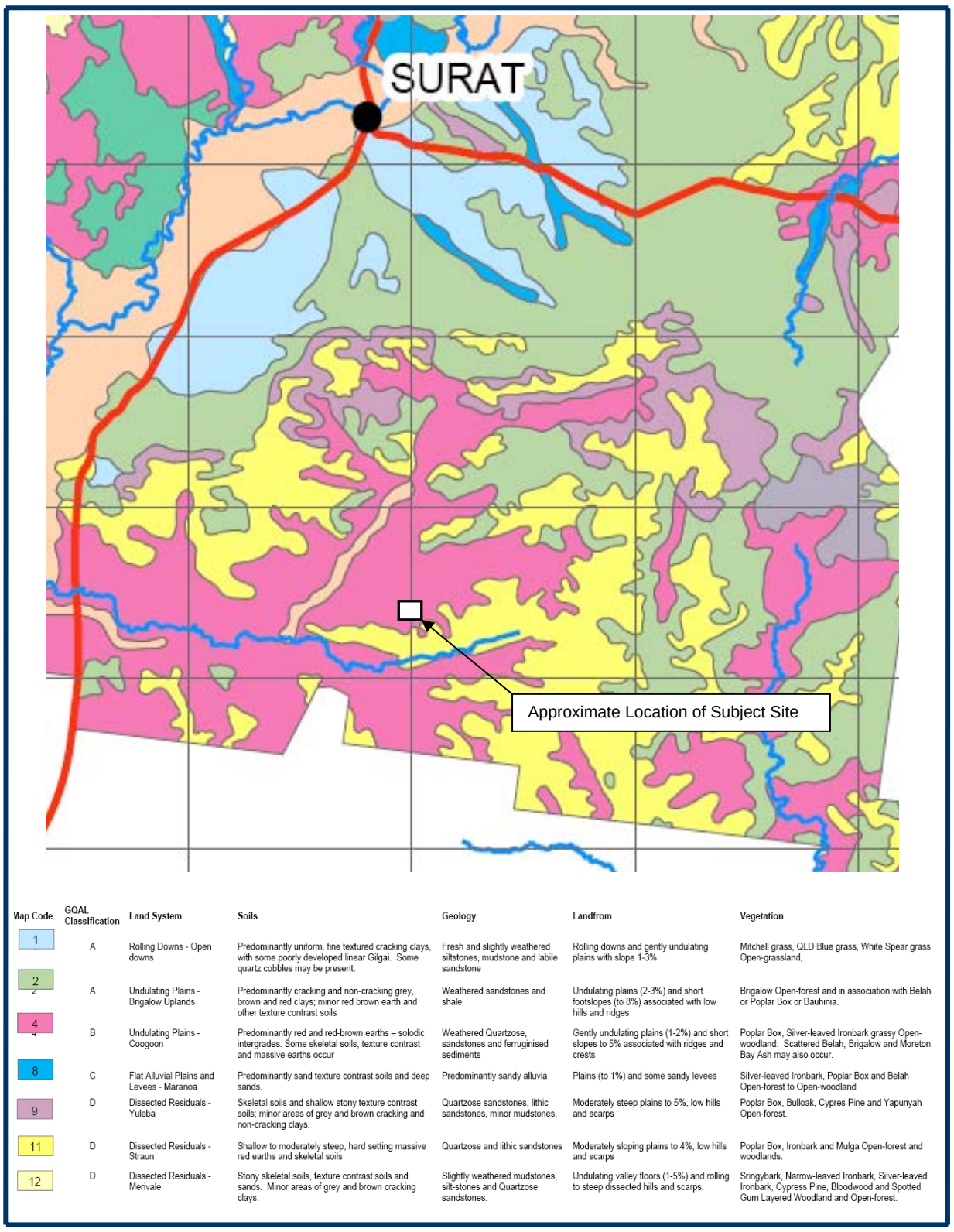


Figure 9: Soils of the Balonne-Maranoa (CSIRO 1974)



Map Code	GQAL Classification	Land System	Soils	Geology	Landfrom	Vegetation
1	A	Rolling Downs - Open downs	Predominantly uniform, fine textured cracking clays, with some poorly developed linear Gilgai. Some quartz cobbles may be present.	Fresh and slightly weathered siltstones, mudstone and labile sandstone	Rolling downs and gently undulating plains with slope 1-3%	Mitchell grass, QLD Blue grass, White Spear grass Open-grassland,
2	A	Undulating Plains - Brigalow Uplands	Predominantly cracking and non-cracking grey, brown and red clays; minor red brown earth and other texture contrast soils	Weathered sandstones and shale	Undulating plains (2-3%) and short footslopes (to 8%) associated with low hills and ridges	Brigalow Open-forest and in association with Belah or Poplar Box or Bauhinia.
4	B	Undulating Plains - Coogoon	Predominantly red and red-brown earths – solodic intergrades. Some skeletal soils, texture contrast and massive earths occur	Weathered Quartzose, sandstones and ferruginised sediments	Gently undulating plains (1-2%) and short slopes to 5% associated with ridges and crests	Poplar Box, Silver-leaved Ironbark grassy Open-woodland. Scattered Belah, Brigalow and Moreton Bay Ash may also occur.
8	C	Flat Alluvial Plains and Levees - Maranoa	Predominantly sand texture contrast soils and deep sands.	Predominantly sandy alluvia	Plains (to 1%) and some sandy levees	Silver-leaved Ironbark, Poplar Box and Belah Open-forest to Open-woodland
9	D	Dissected Residuals - Yuleba	Skeletal soils and shallow stony texture contrast soils; minor areas of grey and brown cracking and non-cracking clays.	Quartzose sandstones, lithic sandstones, minor mudstones.	Moderately steep plains to 5%, low hills and scarps	Poplar Box, Bulloak, Cypres Pine and Yapunyah Open-forest.
11	D	Dissected Residuals - Straun	Shallow to moderately steep, hard setting massive red earths and skeletal soils	Quartzose and lithic sandstones	Moderately sloping plains to 4%, low hills and scarps	Poplar Box, Ironbark and Mulga Open-forest and woodlands.
12	D	Dissected Residuals - Merivale	Stony skeletal soils, texture contrast soils and sands. Minor areas of grey and brown cracking clays.	Slightly weathered mudstones, silt-stones and Quartzose sandstones.	Undulating valley floors (1-5%) and rolling to steep dissected hills and scarps.	Sringybark, Narrow-leaved Ironbark, Silver-leaved Ironbark, Cypress Pine, Bloodwood and Spotted Gum Layered Woodland and Open-forest.

Figure 10: Roma Land Management Manual – Land Resource Areas Description (DNRM 1993)

6.2.4 Good Quality Agricultural Land (GQAL)

In conjunction with *State Planning Policy 1/92: Development and Conservation of Agricultural Land* (SPP1/92), the Planning Guidelines for the Identification of Good Quality Agricultural Land (The Planning Guidelines) defines Good Quality Agricultural Land (GQAL) as '*land which is capable of sustainable use for agriculture, with a reasonable level of inputs, and without causing degradation of land or other natural resources*' (DIP and DHLGP 1993, pg 1). The Planning Guidelines define four classes of GQAL, as outlined in Table 19.

Table 19: Agricultural Land Classes (DIP and DHLGP 1993)

Class	Description
A	**Crop Land** - Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.
B	**Limited Crop Land** - Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.
C	**Pasture Land** - Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.
D	**Non-agricultural Land** - Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.

The Planning Guidelines for the Identification of Good Quality Agricultural Land identify the site as Class B GQAL within the Roma Land Management Manual (Figure 10). This is considered to be suitable for limited cropping, and suitable for pastures. The Planning Guidelines classifies the Lands of the Balonne-Maranoa descriptions as a Class C, suitable only for improved or native pastures.

Based on the prevailing climatic conditions of the project area, soils of the area (refer Section 6.2.2) are considered to be limited by their relatively low Plant Available Water Capacity (PAWC). Low PAWC combined with erratic rainfall and high evaporative conditions result in frequent crop failures and in general these soils are not used for cropping.

While the soils of the project areas are suitable for cropping in areas of high rainfall, viable cropping is compromised by the climate in this region. The absence of cropping (generally more profitable per hectare than grazing) on land surrounding the project area supports this assessment.

Given the constraints identified above it is considered that, at best, the project site could be considered suitable for use as improved pasture and that the appropriate GQAL classification is Class C.

6.2.5 Strategic Cropping Land

The Department of Infrastructure and Planning (DIP) are developing a new policy direction for Strategic Cropping Land, which is defined as "*land that is suitable and available for current and potential future cropping with limitations to production that range from moderate to none*" (DIP 2010). The general aim of the new policy direction is to protect strategic cropping land from development that leads to its permanent alienation or diminished productivity.

Although this policy is still under development, the criteria used by DIP (2010) to identify preliminary candidate areas for strategic cropping land were employed to determine potential areas of strategic cropping land which may potentially be disturbed by the proposed SSSF, namely:

- Dryland cropping on Class A GQAL; and
- Irrigated cropping on Class A GQAL.

Figure 11 shows the preliminary mapping produced by the Queensland Government and shows that the proposed SSSF project area does not lie within an area where Strategic Cropping Land is expected to exist; however, it should be noted that this mapping is preliminary only and the actual extent of Strategic Cropping Land may vary significantly from the current mapping. On-ground assessment against site specific criterion which will be contained in the new legislation (due 2011) will be required to confirm Strategic Cropping Land status and extent.

6.2.6 Salinity and Erosion Potential

An assessment of soil related risks (erosion and salinity) for the project area was conducted using reports available from the Queensland Digital Exploration Reports System (QDEX), the site visit and a visual soil profile inspection.

The area is considered to have a low risk of salinity. Constructed sites typically lead to lower infiltration and reduced deep drainage. Therefore, the proposed works are not expected to alter the salinity risk of the area.

As confirmed by the site assessment, the proposed project area is flat to gently undulating, with slopes of less than two percent. Where soil cover is maintained at greater than 30% and pasture cover is allowed to remain, it is considered that the risk of erosion is low; however, areas disturbed during construction (as with any areas of bare soil) may be vulnerable to low rates of sheet erosion.

6.2.7 Contaminated Land

The primary area of the proposed impact for the SSSF (Lot 11 on Plan EG243) is currently not listed on either the Contaminated Land Register (CLR) or the EMR. CLR and EMR searches were also undertaken on the remaining lots covered by PL 446, none of which were listed on either register.

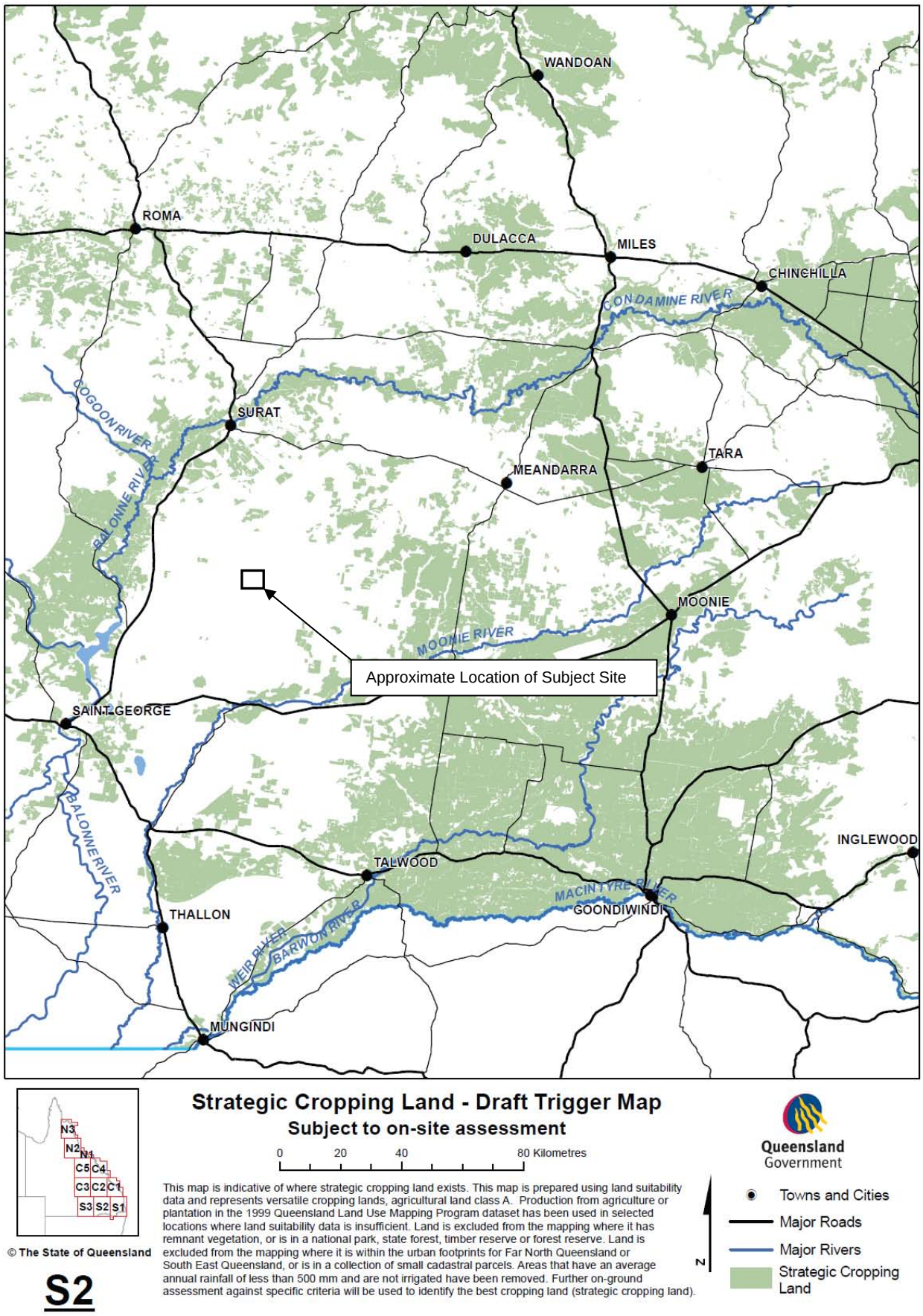


Figure 11: Draft Trigger Map for Identification of Strategic Cropping Land

6.3 Potential Adverse or Beneficial Impacts to Land Management

6.3.1 Potential Erosion and Sedimentation Impacts

Construction activities (particularly clear and grade and trenching) have the potential to exacerbate erosion within the project area and to contribute to sedimentation of land and waterways. However, the proposed project area has been classed as having a low erosion risk due to the relatively flat to gently undulating terrain and soil type (refer Section 6.2.6).

Given the small scale of proposed surface disturbance, a project specific Erosion and Sediment Control Management Plan (ESCP) is not considered necessary, however all necessary erosion and sediment control measures will be implemented during construction and operation in accordance with the International Erosion Control Association Australasia Guidelines (IECA 2008).

Wherever practicable, work will be postponed during heavy rainfall events to maintain soil stability and progressive reinstatement of disturbed areas that are not required for ongoing operations, will occur during construction to reduce the potential erosion risk.

Given that disturbance to land as a result of project related construction activities is likely to be confined to the footprint associated with the compressor unit and associated process equipment, and that mitigation measures (as detailed in Section 6.4) including appropriate stormwater management at facilities will be implemented, it is considered that the risk of significant erosion or sedimentation impacts as a result of proposed project activities is negligible.

Ongoing maintenance requirements for sediment and erosion control at well and facility sites, and along flowline easements will be in strict accordance with the measures contained in the OEMP (Appendix 1) and extensive, long term or recurrent erosion, as a result of the proposed SSSF project is considered unlikely.

6.3.2 Potential Soil Inversion Impacts

Where short sections of flowlines may be required, trenching activities have the potential to result in soil inversion. Soil inversion involves the replacement of the fertile top-soil layer with less fertile sub-soil and may occur where effective top soil management measures are not practiced. Soil inversion can result in the effective “loss” of top soil and may arise due to the mixing of top soil with trench spoil during stockpiling, covering topsoil with sediment washed in from adjacent areas or returning topsoil and trench spoil to the trench in the wrong order.

Soil inversion can adversely affect easement restoration and revegetation as it limits nutrient availability, biomass and productivity. Soil inversion can also affect soil permeability and water holding capacity.

Given that significant flowlines are not anticipated to be constructed as part of this project it is considered highly unlikely that soil inversion will occur. However, should any additional flowlines be required, the implementation of proven management measures to minimise soil inversion (including effective topsoil separation and reinstatement) as described in Section 6.4, means that the risk of long term soil inversion and associated impacts is considered negligible. The absence of GQAL or strategic cropping land in the project area means that the severity of any potential inversion impacts will be minimal.

6.3.3 Potential Soil Compaction Impacts

Soil compaction involves the formation of dense layers of well packed soil which are less permeable to both plant roots and to water. Compaction of soils may result in changes to local drainage patterns and could negatively affect restoration and re-vegetation of disturbed areas.

The potential for soil compaction is greatest during the construction phase, particularly in areas which may have a heavy vehicle traffic load (such as access tracks, the construction sites and designated stockpile / camp sites). Construction sites that will remain as operational facilities (e.g. compressor station) will be compacted prior to laying the slab to ensure stable foundations for heavy equipment. These sites will not require rehabilitation until the end of the operational life of the facilities.

Project activities which may result in soil compaction will be restricted to approved areas such as access tracks camp and stockpile sites and construction areas for new infrastructure. Standard industry control measures (including scarification or ripping during restoration of disturbed areas), as described in Section 6.4, will be implemented to reduce the risk of soil compaction in areas to be rehabilitated (e.g. flowline easements).

During operational maintenance activities, vehicles will adhere to designated tracks and facility sites to minimise the area of potential soil compaction and avoid compaction impacts outside of the operational footprint.

6.3.4 Potential Salinity Impacts

Expressions of dry land salinity typically require changes in the water balance of extensive areas, leading to rising water tables and mobilisation of salts. The relatively small disturbance area of the proposed SSSF project (1.65 ha assuming no new wells or flowlines) and little or no anticipated change in water balance means salinity risks are low.

6.3.5 Potential Soil Contamination Impacts

Soil contamination as a result of project activities is normally associated with a loss of containment of chemicals and/or fuel stored on site.

During construction of the compressor slab, compressor and associated process equipment, no bulk fuel storage will occur on the project site, with diesel being stored on site in fully bunded tanks of <10,000 L capacity. All fuel storage will be undertaken in compliance with relevant legislation and standards (including the *Dangerous Goods (Safety Management) Act 2002* and AS 1940: Storage and Handling of Flammable and Combustible Liquids). Should a quantity of fuel greater than 10,000 L be required to be stored on site, this will be implemented in accordance with relevant legislation, including the conditions of the EA.

During the drilling process, drilling fluids containing some additives (refer Section 3.5.1.4) will be stored at the drill site either in a mud tank or within a lined pit. Where fluids are stored in a pit, at the completion of drilling, fluids and cuttings will be dried and remain at the site. These fluids are non-toxic and will not result in contamination of soils.

As discussed in Section 3.5.2.7, hydrotesting of compressor station piping or additional flowline is unlikely to result in soil contamination, due to the use of potable water (with no biocides or oxygen scavengers added), minimal volume required and disposal to an existing licensed dam.

Compressors require ongoing operational maintenance which may involve the use of lubricants and transmission fluids. Operational flowlines may be subject to routine pigging in the future, which could result in the generation of small volumes of regulated waste (e.g. hydrocarbon sludge and pipeline fines). Under the *Environmental Protection (Waste Management) Regulation 2000* waste of this nature (with a mass <250 kg) can be disposed of at licensed facilities without additional approvals. For quantities greater than 250 kg, appropriate disposal permits will be obtained and licensed contractors will be used.

Given the above, and the implementation of soil protection measures as described in Section 6.4 the SSSF project is considered unlikely to result in significant soil contamination. Whilst AGL are committed to a no spill project area, some minor, localised spills or fuels of chemicals may occur from project-related activities, however the volumes of chemicals anticipated to be utilised by the proposed project are relatively small and as such any spills are likely to be minor.

6.3.6 Potential Impacts to GQAL and Strategic Cropping Land

A desktop assessment of GQAL and Strategic Cropping Land (Sections 6.2.4and 6.2.5) concluded that the proposed project area is comprised of Class C GQAL and suited to use as improved pasture at best, and based on draft trigger mapping for the SSSF project site is not located within any potential areas of Strategic Cropping Land. Therefore, project related impacts to GQAL and SCL are considered to be negligible.

6.4 Proposed Environmental Protection commitments, Objectives and Control Strategies – Land Management

Environmental Protection Objective	To avoid or minimise adverse impacts to soils and terrain during construction, and maintain soil stability/ integrity on project area during operations. To avoid land contamination.
Specific Objectives	To minimise soil erosion and sedimentation as a result of compressor and process equipment construction and remediate soil erosion occurring during operations, in a timely manner. To mitigate soil compaction if necessary by remedial action. To reinstate soil and terrain to pre-construction contours and conditions. To prevent spills occurring and if they occur to minimise their impact. To ensure that rubbish and waste material are disposed of in an appropriate manner.
Control Strategies	**Land and Soil Management** **Access** Access tracks and turn around points for vehicles will be identified prior to construction. The construction site will be accessed, as far as is practicable, via existing roads / tracks. The number of planned access tracks will be minimised as far as practicable. Where additional access tracks may be required, these will be restricted to the minimum practical width subject to safe vehicle movement. All vehicle and equipment movements will be restricted to designated access tracks and roads. Speed restrictions will be applied to project vehicles as appropriate. **Clear and Grade** Alteration to topography or drainage will be minimised during the clearing phase and restored to original condition during cleanup and rehabilitation.

	All clearing boundaries will be clearly shown on project drawings. Topsoil will be graded from the compressor and batching plant sites, typically to a depth of 100 – 150 m. Where additional flowline is required, topsoil will be graded from the right-of-way, typically to a depth of 100 - 150 mm, for either a blade-width over the trench line, or the entire non-working side or the full right-of-way, depending on factors such as soil type, subsoil depth, terrain, construction requirements and weather conditions. Topsoil will be stockpiled where it can be readily recovered for respreading during reinstatement, and where loss through wind or water erosion, or other means, will be minimised. Where appropriate, containment devices (e.g. silt fences) will be used to preserve stockpiled soils. **Trenching and Excavation** Trench spoil (subsoil) will be stockpiled separately to topsoil and vegetation. The pipeline trench will be left open for the minimum time practicable. Appropriate Erosion and Sedimentation measures will be implemented where soil is stockpiled. **Backfill (where additional flowline is required)** Appropriate means such as trench blocks (i.e. trench / sack breakers) and compaction of backfilled soils will be used to prevent erosion along the backfilled trench. A gentle crown may be left over the trench line to allow for future settlement of soils above the pipe, with appropriate breaks to allow for natural surface water flows across the right-of-way. Topsoil will not be used as padding material. Topsoil will only be reinstated after the trench has been backfilled with excavated spoil and compacted. The trench will be compacted to a level approximately consistent with surrounding soils. **Drilling** Ensure that rig selection identifies discharges from leaking mud tanks, valves, inspection / dump hatches, dresser sleeves and other circulating system leaks. Ensure that rig is fitted with efficient solids control equipment such as shale shakers, de-sanders, de-silter etc. Drilling fluid mixing system including hopper and pumps should be efficient and free of leaks. Ensure that rig bell nipple, flow line and drilling fluid collection system is satisfactory and free of leaks. Choke, kill and flare lines should be tested and free of leaks. Minimise the surface area of the well site to that necessary for the safe operation of the rig. Stockpile topsoil and cleared vegetation from the well site for respreading after completion of drilling and subsequent rehabilitation. Avoid drainage alteration and provide drainage on disturbed areas where runoff may concentrate. Avoid the creation of fire hazards (e.g. through stockpiling of cleared vegetation, use of equipment without mufflers or spark arresters, etc.). Avoid disturbance of third party property and leave infrastructure in an "as found" condition. Identify and implement any special procedures such as cleaning of vehicles and equipment to prevent introduction of weeds and pathogens. **Erosion Management** Adequate erosion and sediment controls shall be designed in accordance with IECA (2008) and with consideration to site specific conditions such as soil type, erosion risk, slope, vegetation cover, proximity to sensitive environments (i.e. watercourses, significant vegetation) and climatic conditions. Erosion and sedimentation controls will be monitored, maintained and repaired to ensure they remain effective, particularly after heavy rainfall events and during periods of prolonged rainfall. Limiting the duration of exposure, and timing exposure to occur between April and September

	will further reduce erosion risk. Silt fences will be installed for interim on-site erosion control, as required. Ground disturbance and vegetation clearing will be limited to the minimum extent necessary for safe construction. Monitoring of storm and flood warnings will be undertaken throughout construction and a contingency plan developed for such events. The period between clear-and-grade and restoration (or construction of infrastructure) will be limited to the minimum practicable (to limit the duration of soil exposure). Erosion and sediment controls will be installed at construction locations and maintained until these sites are stabilised, as required. All activities will be suspended during periods of heavy rainfall where erosion and sedimentation are likely to result in pollution of the environment (i.e. the impacts cannot be adequately controlled). **Reinstatement** Rehabilitation of disturbed areas will be undertaken progressively as works are completed. Restoration will be managed to minimise the period for which disturbed areas are unremediated to limit potential for soil erosion and water quality reduction from any unanticipated adverse weather conditions. Topsoil will be respread across the site, at the completion of reinstatement works. Any remaining topsoil will be used by AGL for ongoing maintenance activities or may be made available to potentially affected landholders. Compacted areas will be ripped or scarified where necessary to facilitate vegetation growth with consideration given to soil type and land system. Stockpiled topsoil and seed stock (i.e. cleared vegetation) will be respread on graded surfaces in an even layer to assist natural regeneration. Minor surface roughness will be encouraged when spreading topsoil to trap water and seed. Subsoil and rock displaced by project infrastructure, and not utilised, may be stockpiled in locations for use during operations. Physical and biological stabilisation and site rehabilitation measures will be implemented where appropriate. Erosion and sediment controls (e.g. berms, silt fences, jute matting) will be installed, monitored and maintained as necessary during, and after construction, until stabilisation is achieved. Excavations will be re-contoured and rehabilitated to minimise erosion potential, encourage vegetation regrowth and minimise water holding capacity. Vehicle movement on the restored flowline easement will be restricted until vegetation is re-established. Temporary access roads (where required) will be closed and rehabilitated to a condition compatible with the surrounding land use, in accordance with landholder requirements. Ground stability will be maintained on all unsealed areas at above ground facilities, either by vegetation, other cover (e.g. gravel) or compaction. Above ground infrastructure shall be fenced to discourage third party, stock and wildlife entry. All waste materials and equipment will be removed from the construction area once construction is completed (see also waste management measures in Section 11.0). Flagging, used to identify clearing boundaries and sensitive features, will be removed. Disused silt fences will be removed. After construction is completed: ▪ Construction generated rubbish / equipment will be removed; ▪ The project site will be inspected to ensure that any minor spills that may have occurred have been appropriately remediated; ▪ Erosion and sediment control structures will be routinely inspected and maintained, particularly after heavy or prolonged rainfall; ▪ The project site will be regularly inspected during operations to monitor rehabilitation; and ▪ Appropriate measures will be implemented to permanently solve any recurring erosion problems.

	Hydrotest Water Disposal Refer to Section 11.4 and 12.3. **Hazardous Materials and Wastes** Refer to Section 11.4. **Sewage Management** Refer to Section 12.3. **Decommissioning** The compressor and concrete batching plant will be decommissioned in accordance with the regulatory requirements and accepted current environmental best practices of the day. (Note: Current decommissioning procedures require the removal of all above ground infrastructure and the restoration of associated disturbed areas).
Performance Indicators	No complaints in relation to soil erosion and sedimentation. Any recorded complaints are actioned and closed out. Appropriate soil stockpiling and segregation of topsoil and subsoil. Effective reinstatement of soil profiles and surface contours. No evidence of erosion on the project site. Appropriate handling and treatment of contaminated land should it be identified. No evidence of contamination / spills. Any contamination or spill incidents are effectively documented and closed out. Appropriate storage and handling of fuel and chemicals. Long term success of rehabilitation measures.

7.0 Land Tenure and Use

7.1.1 Easements

In accordance with the *Petroleum Act 1923*, easements are not required for flowlines within a PL instead Land Access Agreements are already in place with each Landholder for the existing flowlines and wells proposed to be used as part of the SSSF. The proposed compressor will be located on freehold land owned by AGL and as such a separate Land Access Agreement will not be required.

Where replacement wells and additional flowlines may be required on property not owned by AGL, Land Access Agreements will be negotiated with the relevant landholder to ensure that the company's assets are adequately protected. Under this arrangement no encumbrances in the form of an easement will become registered on the Certificate of Title.

The Land Access Agreement provides rights of access for monitoring and maintenance and prevents certain land uses (such as excavations and construction of permanent buildings) from occurring over the flowline. The occupier of the land retains certain rights to continue utilising the subject area i.e. agricultural activities.

All affected landholders will be consulted regarding the project well in advance of any construction activity to agree on construction and restoration requirements.

7.1.2 Land Tenure

Land tenure of PL 446 comprises of thirteen freehold and five leasehold parcels, as detailed in Table 2. There are eighteen potentially affected properties covered by PL 446. The land use in the area surrounding PL 446 is mainly agricultural, with the nearest residence located approximately 1.8 km north east of the existing Silver Springs Plant. Properties within, or partially within, PL 446 are listed in Table 2. Surface disturbance associated with proposed new infrastructure (compressor and associated pipework) and batching plant will be located entirely on freehold property owned by AGL (Lot 11 on Plan EG243) with wells and associated flowlines located on adjoining properties. Wells and flowlines anticipated to be utilised for the SSSF project are located on: Lot 1 on Plan BLM123; Lot 2 on Plan EG59; Lot 5 on Plan EG41 and Lot 3 on Plan EG243.

7.1.2.1 Resource Tenures

The proposed project is located entirely within the PL 446 area, which is not overlapped by any other resource tenements. PL 446 is bordered by PL 66 to the northwest, PL 15 to the west, PL 48 to the south and PL 49 to the south east, as indicated on Figure 12 below.

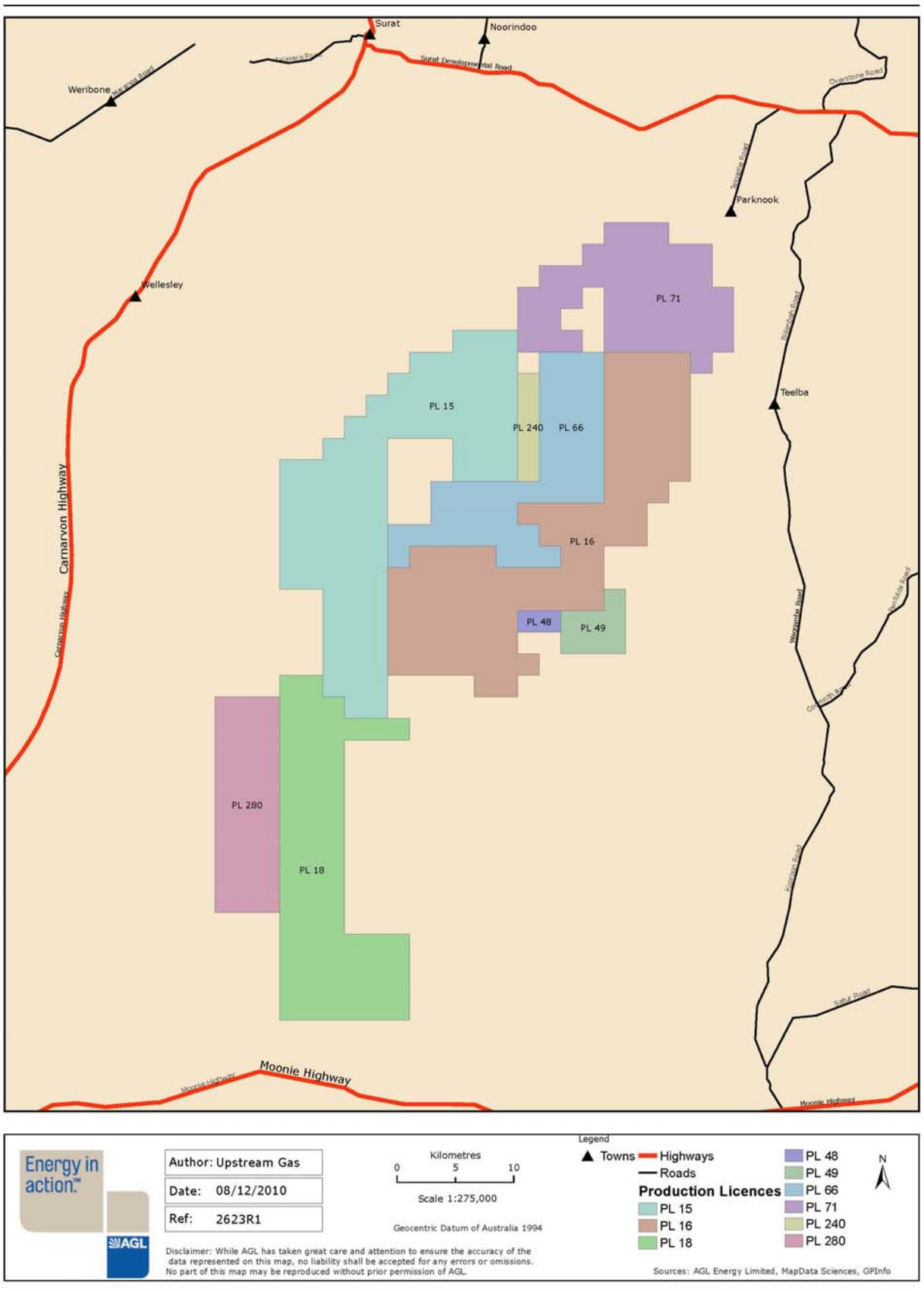


Figure 12: Petroleum Leases Surrounding PL 446

7.1.3 Land Use

The key industries in the Maranoa Regional area (and the wider region surrounding the project area) include agriculture, tourism, forestry, oil and gas exploration and production. The town of Roma (located approximately 112 km to the north west of the project area), is the largest town in the Maranoa. The traditional industry base for the region has been agriculture, however petroleum, oil and gas is now becoming a more significant contributor to the region's economy. These industries are described in further detail below.

Agriculture

The Maranoa Region supports a wide variety of agricultural practices, in particular sheep and cattle grazing and grain and cereal cropping. The Roma Saleyards is currently the largest cattle selling centre in Australia, with more than 409,100 cattle sold through the Saleyards in 2008 (RS 2009).

Oil and Gas Exploration and Production

The southern portion of the Bowen Basin lies beneath the Surat and was formed up to 290 million years ago, with the Surat Basin formed 90 million years later. Both basins hold vast hydrocarbon resources including coal and CSG which are continually being explored, assessed and extracted for energy users across Australia.

Known as the 'cradle of the Australian Oil and Gas Industry', Roma was the site of Australia's first gas strike in the 1900's, when gas was discovered by accident at Hospital Hill by a drilling crew boring for water. The oil and gas industry (including exploration, production and transmission) has continued to expand in the region, with exploration commencing in the 1920's. Recent increases in demand for natural gas have seen strong industry development throughout the region (VM 2010). The oil and gas produced in the Maranoa Region services both domestic and international markets.

Forestry

Forestry is a traditional industry still in practice in the Maranoa Region, with cypress pine being the main timber harvested. A number of state forests are situated within the broader region surrounding the SSSF project area, those within close proximity of PL 446 include:

- Ula Ula State Forest (8,500 ha) located approximately 55 km south east at the closest point;
- Colgoon State Forest (900 ha) located approximately 55 km north, north west at the closest point; and
- Yalebone State Forest 1 and 2 (2,500 and 1,100 ha respectively) located approximately 70 km north at the closest point.

Recreation and Tourism

Recreation and tourism in the broader region is mainly associated with Roma and its surrounds, where tourism is a key growth industry and includes attractions such as the 'Big Rig Tourist Facility', a memorial to the pioneers of Australia's oil and gas industry, the historic Romaville Winery and Mt Abundance Homestead. The surrounding area provides opportunities for camping, walking, water and jet skiing. The following National Parks are situated in close proximity to the SSSF project area:

- Alton National Park (558 ha) located approximately 49 km south east at the closest point; and
- Erringibba National Park (877 ha) located 68 km north east at the closest point.

7.1.4 Population Centres and Nearby Residences

Whilst PL 446 is located in both the Maranoa Regional Council and Balonne Regional Council areas, the SSSF project area itself is located entirely within the Maranoa Regional Council area. The Maranoa Regional Council area is approximately 58,817 km^2 and had an estimated resident population of 13,223 persons in 2009 (OESR 2010). The areas surrounding the SSSF project site are mainly rural and sparsely populated.

The area surrounding the SSSF is relatively remote from major residential communities, with the closest township to the project area being Surat, (located approximately 49 km to the north). The main towns in the vicinity of the Facility and their populations are summarised in Table 20 below.

Table 20: Nearby Townships to the SSSF

Town	Approximate proximity to SSS Facility	Population (2006)[8]	Population (2009)[9]
Surat	49 km to North	436	465
St George	65 km to South South West	3,120	2,524
Roma	112 km to North West	6,504	6,439

The area in the immediate vicinity of PL 446 is mainly agricultural, with the nearest residence located approximately 2 km north east of the existing Silver Springs Plant.

7.1.5 Infrastructure Crossings

There are no infrastructure crossings (e.g. roads or rail) within the project area. The closest graded road is Thomby Road located approximately 80 m directly east of Renlim 5A.

7.1.6 Easements and Major Infrastructure

Apart from existing AGL flowline easements and PPL 4 (which has a terminus point at the existing Silver Springs Plant) no easements or other major infrastructure (e.g. high voltage power lines, pipelines) traverse the proposed SSSF project area.

8 Figures taken from 2006 census (ABS 2010)

9 Figures taken from Office of Economic and Statistical Research (OESR 2010)

7.2 Potential Adverse or Beneficial Impacts on Environmental Values

7.2.1 Landholders and Land Use

The scale of the proposed SSSF project surface infrastructure is small (one new compressor, one concrete batching plant with associated infrastructure and ongoing operations and maintenance of a maximum of ten wells (five injection / withdrawal and five monitoring) and it is AGL's preference to utilise existing infrastructure where possible (subject to well integrity testing).

Existing infrastructure already has easements / tenures negotiated for them and the additional infrastructure proposed will be located entirely within land wholly owned by AGL. As a result it is considered unlikely that tenure negotiations with landholders will be required.

7.2.2 Community Safety

Adverse risks to the health and safety of the community will be reduced by conducting a detailed risk assessment in accordance with AS 2885.1. The outcome of this process will be a combination of physical and procedural measures that aim to ensure project design, construction, operation, maintenance and management meet appropriate safety standards and minimise the risk to employees, contractors and local communities. However, given the remote location of the proposed SSSF project is considered that public risk associated with construction and operational activities are minimal.

Due to the wooded nature of parts of PL 446, bushfires may represent the primary safety risk associated with project; however, the existing Silver Springs plant site is located within an existing cleared area and hot work (e.g. welding and grinding) associated with the project is anticipated to be minimal. Given the above and considering that fire prevention measures detailed in Section 7.3 will be implemented, the risk of bushfire from project related activities is anticipated to be minimal.

7.2.3 Visual Amenity

The project location is relatively remote, with the main access to the site being via a 100 km unsealed road and the closest sensitive receptor is approximately 1.8 km away. As such, the site is exposed to limited public observation.

In addition to this, the existing Silver Springs plant already hosts a variety of oil and gas processing infrastructure including compressors and dehydrator units. As such, it is considered unlikely that the addition of one compressor at this location will result in any significant adverse impacts to visual amenity.

The proposed SSSF will involve the installation of floodlights at the compressor location and where replacement wells may be required drill sites will also be illuminated to allow for 24-hour operation. Given the distance from the proposed SSSF to the closest sensitive receptor and that floodlights will be positioned to minimise light spill, it is considered that risk of light nuisance from the project is minimal. The short term nature of drilling operations, and the fact that AGL will be consulting potentially affected landholders regarding proposed activities (Section 7.1.1) also means that light nuisance from drilling operations is considered unlikely to occur.

7.2.4 Infrastructure

The proposed SSSF project are not anticipated to result in any physical disturbance to existing infrastructure as all proposed activities will be undertaken on land wholly owned by AGL, vehicle movements associated with the project will be minimal and no infrastructure easements have been identified within the proposed SSSF project area.

7.2.5 Beneficial Impacts

Local communities may benefit both directly and indirectly from local expenditure and employment opportunities during construction of the SSSF, and to a lesser extent, during operations. Economic benefits to local businesses and community groups may be provided through local sourcing of supplies and manpower as required.

7.3 Natural Hazards

State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslides defines a natural hazard as '*a naturally occurring situation or condition with the potential for loss or harm to the community or environment*' and generally applies throughout Queensland. The main threats associated with natural hazards in Queensland are cyclones / severe storms, floods, storm tide inundation, bushfire, landslide and earthquake.

SPP 1/03 applies to the certain development occurring within natural hazard management areas for flood, bushfire and/or landslide. Natural hazard management areas are generally defined as follows:

- **Flood:** land inundated by a Defined Flood Event;
- **Bushfire:** areas identified as Medium or High Hazard areas on the Bushfire Risk Analysis maps produced by Queensland Fire and Rescue Service; and
- **Landslide:** land with a slope of 15% of greater.

The proposed project area may potentially traverse several natural hazard management areas for flooding and bushfires. Within such areas, the SSSF requires that development minimises as far as practical the adverse impacts from natural hazards and does not result in unacceptable risk to people or property (Section 6, Outcome 2 of *SPP 1/03*).

Design and construction in accordance with AS 2885 will be used as the primary strategy to mitigate risks associated with natural hazards.

7.4 Environmental Protection Commitments, Objectives and Control Strategies – Land Tenure and Use

Environmental Protection Objective	To avoid significant impacts on the livelihood and well being of the community. To minimise the risk to public health and safety. To avoid unnecessary, and minimise to the greatest extent possible, disturbance to third party infrastructure, landholders, land use and amenity.
Specific Objectives	To adequately protect public safety during construction and operations. To avoid fires associated with pipeline construction and operations / maintenance activities. To prevent unauthorised activity on the easement that may impact on the pipeline integrity. To minimise disturbance or damage to infrastructure/ land use and remediate where disturbance cannot be avoided. To minimise disturbance to landholders. To appropriately reinstate and rehabilitate the ROW to allow continuation of current land use activities post construction. To maintain visual amenity of rural landscapes.
Control Strategies	**Socio-economic and Public Risk and Safety** Targeted consultation will be undertaken to ensure that stakeholder issues are understood and addressed. A risk assessment will be undertaken in accordance with AS 2885, and mitigation measures as detailed in previous Sections will be implemented. Permanent pipeline warning signs shall be erected along additional flowline ROW in accordance with AS 2885 and marker tape will be buried at infrastructure crossing points. **Landholders and Land Use** Where additional flowline is required outside of AGL owned land, Land Access Agreements will be negotiated with all affected landholders, outlining the legal responsibilities of both parties. AGL will work closely with landholders and managers to minimise impacts to existing land use activities. A complaints register will be established and maintained and complaints followed up. Property access for landholders will be provided at all times. Private property access to additional flowline ROW will be arranged with individual landholders, managers and/or lessees. Signage will be installed at road crossings and entry points disguised as necessary to discourage public access. Impacts to landholders will be minimised (e.g. installation of gates and cattle grids to allow access to flowline easements, and temporary fencing to control livestock where appropriate). Temporary fencing will be erected where appropriate to prevent stock access to fuel or potential contaminants. Gaps are to be left in soil and vegetation stockpiles in appropriate locations (coinciding with designated access roads or tracks, fence lines) to allow vehicular, stock and wildlife access. Vehicular movement over stockpiled topsoil will not be allowed. Breaks in the trench (trench plugs) will be left to allow stock access across the trench, particularly near watering points. Measures outlined in Sections 8.8.2 and 8.9 to monitor excavations and trenches for stock and provide ramps / escape routes will be implemented. Procedures for fuel and chemical storage and handling and spill management that prevent stock access to fuel, chemicals or spills (if they occur) will be implemented. ▪ Weed management will be conducted in accordance with procedures as outlined in the OEMP. Vehicles and personnel are to remain on the flowline ROW at designated work areas or campsites. The flowline ROW will be rehabilitated in consultation with landholders and in accordance with EA conditions. Appropriate erosion and sediment control measures will be implemented in accordance with

	IECA guidelines and the OEMP. Appropriate traffic management procedures will be developed and implemented in consultation with local and state authorities. **Fire Management** Open fires will be banned on the project. Fires include open barbecues, billy fires, brush burning and rubbish burning. Unnecessary build-up of flammable material in work areas will be prevented, with vegetation and other flammable material being stockpiled well clear of hot work activities. Vehicle and machinery exhaust systems shall be inspected regularly for leaks and accumulated vegetation debris. Fuel systems shall also be inspected for leaks. All vehicles will be equipped with portable fire extinguishers. Emergency Response Plan shall include details on local contacts for fire fighting assistance. All relevant bylaws with regard to fire management shall be adhered to. All welding, welding procedures, welder qualifications, the use of welding consumables, and the removal of weld defects will conform to relevant Australian Standards. Fire extinguishers and a water cart will be available to the welding crew. All appropriate crew members will be trained in the use of fire-fighting equipment. The strip of land along the flowline ROW over which welding will take place will be cleared of combustible vegetation to reduce the risk of fire. Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire. **Infrastructure** Where additional flowline is required, the location of existing third party infrastructure will be accurately identified on the alignment sheets and then marked physically on the ground prior to trenching activities. Normal operations inspections will be undertaken during daylight hours as part of the structured inspection and monitoring program. <u>Transport</u> Equipment and material transport routes and storage areas will be planned in consultation with local and state authorities to minimise disruption to residents and industry. Project related equipment will be delivered during daylight hours, where practicable. Any damage caused to roads or bridges by construction or associated activities (including ongoing maintenance of roads in liaison with road authorities where appropriate) will be rectified. <u>Public Utilities</u> Close liaison will be maintained with Powerlink and other utility managers to identify existing overhead and buried cables, lines and pipes. Standard clearance for service crossings will be obtained from utility managers. Preventative flagging will be used to mark the location of services and infrastructure. Equipment and pipe will be appropriately earthed at established intervals. <u>Private Property</u> Close liaison will be maintained with all affected landholders. Agreed impacts or modifications will be appropriately noted. Pre-construction agreement will be obtained on the type and extent of impact to occur. Land Access Agreement will be obtained regarding strategies and responsibilities for rectification of, or compensation for, damage. **Visual Amenity** Existing roads and access tracks will be utilised, wherever possible. Material and equipment will be stockpiled in areas away from general public view, where

	practicable. Compressor compound floodlights will be designed / placed to minimise light spill (i.e. pointed down). All working areas will be maintained in a neat and orderly manner. Appropriate waste management practices will be adopted. The construction site will be restored, reinstated and rehabilitated as soon as practicable following backfill. Dust emissions, and erosion and sedimentation of land will be minimised through implementation of mitigation measures outlined in previous Sections.
Performance Indicators	No complaints received from stakeholders re project activities. Any complaints received are appropriately actioned and closed out. All vehicles on site have certification of appropriate washdowns / cleanliness. If Indigenous Cultural Heritage material is discovered, evidence shows that relevant procedures were followed (e.g. AGL's existing CHMP).

8.0 Flora and Fauna

8.1 Bioregions

The pipeline area lies within the Brigalow Belt South Bioregion. Brigalow (*Acacia harpophylla* dominant and co-dominant) is a mosaic of open forest and woodland communities. Semi-evergreen vine thickets, heath and eucalypt open woodlands are scattered throughout this region, with small pockets of eucalypt open forests. The project area is also located within the Weribone High Bioprovince.

Weribone High contains downs and low ridges on the Cretaceous Griman Creek Formation lithic sandstones, fine-grained sediments and areas of floodout. Soils include earths, texture contrast soils and cracking clays. The vegetation of downs and plains is predominately belah *(Casuarina cristata)*, brigalow *(Acacia harpophylla)* and poplar box *(Eucalyptus populnea)* communities with narrow-leaved ironbark *(E.creba)* and bendee *(Acacia catenulate)* on ridges and residuals. Mulga *(Acacia aneura)* occurs in the south-west of the province.

The major impacts to biodiversity in the Brigalow Belt South Bioregion to date have included historical vegetation clearance (for agricultural purposes), the introduction and spread of weeds and animal pests, changed fire regimes and altered hydrology regimes. The major vegetation groups cleared are acacia forests and woodlands, eucalypt woodlands, eucalypt open woodlands, tussock grasslands, rainforests and vine thickets (DEWHA 2009).

8.2 Ecological Assessment

A desktop and field based ecological assessment (RPS 2010a) was conducted within the project area 20 – 22 September 2010 and focused on the anticipated areas of disturbance for the proposed SSSF. This assessment included:

- A desktop assessment of significant flora and fauna attributes within the wider project area utilising available literature and government databases, including the DSEWPC Protected Matters Search Tool (DEWHA 2010), DERM Regional Ecosystem (RE) Mapping (Version 6) (DERM 2009), DERM High Value Regrowth Mapping (DERM 2010a), DERM Environmentally Sensitive Area mapping (DERM 2010b) and DERM Wildnet database (DERM 2010c);
- Ground truthing of representative sample sites within significant vegetation and high habitat value communities (e.g. regional ecosystems) identified through desktop studies;
- Field based surveys for flora and fauna, with a particular emphasis on listed significant species and communities (e.g. endangered, vulnerable or rare species / communities) and exotic plants and animals; and
- Field based observations regarding habitat values and relevant environmental sensitivities.

Flora surveys were designed to collect floristic data at representative sites throughout the study area in order to determine the composition and condition of vegetation communities as well as identify any threatened species. Quaternary surveys were conducted in accordance with Queensland Herbarium vegetation survey methodology (Nelder *et al*. 2005) at selected sites identified in Figure 13.

The survey largely consisted of incidental fauna observations and habitat assessments; however targeted searches were conducted at quaternary survey sites for diurnal fauna species as well as evidence of scats and tracks. Incidental fauna observations were undertaken continually during the field survey. Habitat assessments were undertaken at Quaternary sample sites.

Identified flora and fauna attributes within the existing project area are summarised in the following subsections, while potential impacts and associated management recommendations are described in Sections 8.8 and 8.9. The full ecological assessment report is provided in Appendix 7.

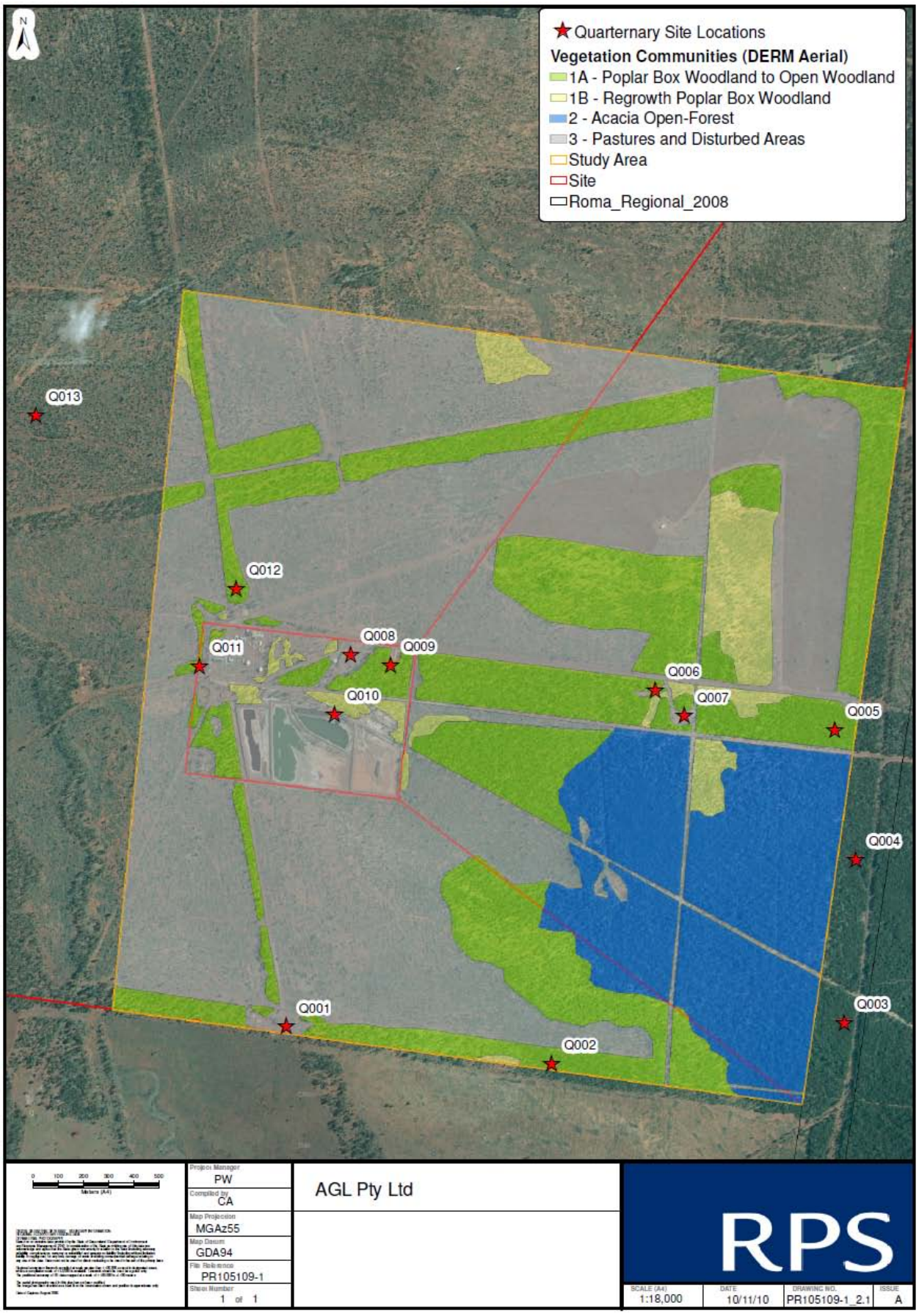


Figure 13: Quaternary Site Locations

8.3 Flora

8.3.1 Vegetation Communities

To help determine the significance of clearing and project related impacts, the area of vegetation to be cleared was combined with the assessment of the scale of potential impacts to vegetation communities and species. The likely area of disturbance was identified by overlaying the proposed construction sites over the current mapped REs (DERM, 2009) as well as ground-truthed vegetation communities.

The majority of the study area has been previously cleared for rural land-uses, particularly grazing and agriculture, and gas exploration and production, and is therefore heavily degraded in areas. Numerous existing utility corridors have also fragmented and cleared vegetation communities within the study area. However, some larger areas of remnant vegetation do exist in proximity to the proposed project area.

8.3.2 Regional Ecosystems

As discussed in Section 3.3 and 3.4, all proposed project activities will be conducted in pre-existing cleared areas. As such, project related vegetation clearance is anticipated to be negligible.

Desktop review of the DERM Regional Ecosystem Mapping (DERM 2009) identified a total of three REs occurring within the project area. However, ground-truthing undertaken as part of the ecological assessment (RPS 2010a) only identified two REs within in the project area (refer Table 21). The full ecological assessment is provided in Appendix 7 of this report.

Table 21: Summary of Project Site Vegetation

RE	RE Description	VM Act Status	Mapped	Ground-truthed
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	Of Concern	Yes	No
11.5.13	*Eucalyptus populnea* +/- *Acacia aneura* +/- *E. melanophloia* woodland on Cainozoic sand plains / remnant surfaces.	Of Concern	Yes	Yes
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone.	Least Concern	Yes	Yes

8.3.3 Endangered, Vulnerable, Rare or Near Threatened Species

Desktop analysis using the DERM Wildnet (DERM 2010c) and EPBC Protected Matters (DEWHA 2010) databases identified a possible three species (listed as Endangered, Vulnerable or Rare (EVR) under the EPBC and NC Acts) that have previously been recorded or have the potential to occur within the project area, being:

- *Acacia wardellii* (listed as Vulnerable under the EPBC and NC Acts);
- *Cadellia pentastylis* (listed as Vulnerable under the EPBC and NC Acts); and
- *Tylophora linearis* (listed as Endangered under the EPBC and NC Acts).

Ground truthing did not identify any of these species within the study area. A detailed list of these species is provided in Table 3.3 of Appendix 7.

8.3.4 Essential Habitat

No Essential Habitat for threatened flora species has been identified at the proposed SSSF location from government mapping (DERM 2010a) however an area (1 km radius with a 500 m buffer) based on a point source (a single location where individuals of the species where identified) of habitat for *Acacia wardellii* is mapped approximately 6 km to the east of the existing SSGP site. Disturbance associated with the proposed SSSF project will not impact upon this area of essential habitat.

8.3.5 Matters of National Environmental Significance (NES)

EPBC search results (DEWHA 2010) identified two Matters of NES:

- Narran Lake Nature Reserve, a Wetland of International Significance, located approximately 280 km south of the project area. Narran Lake Nature Reserve is discussed in greater detail in Section 12.1.2; and
- Weeping Myall Woodlands, a TEC not identified within the project area. Weeping Myall Woodlands are discussed in greater detail in Section 8.7.1.1.

8.3.6 Introduced / Pest Species

The Commonwealth Government classifies Weeds of National Significance (WONS) within Australia, based on their:

- Invasiveness and impact characteristics;
- Potential and current area of spread; and
- Current primary industry, environmental and socio-economic impacts.

The *Land Protection (Pest and Stock Route) Management Act 2002* (LP Act) lists those declared species known to be present in Queensland and assigns three classes (Class 1, 2 or 3) based on abundance and potential environmental and socio-economic risk.

The only WONS identified on the project site was Prickly Pear (*Opuntia stricta*), which is also a Class 2 declared species under the LP Act.

The highly disturbed nature of the majority of the site has facilitated extensive weed invasions. Land management practices such as grazing, cultivation, cropping, maintenance and management of gas exploration and production infrastructure, as well as the ongoing access to the study area is likely to have facilitated the spread of weeds throughout the study area. Grazing areas are particularly prone to large numbers of weed species and these have spread into surrounding bushlands.

All environmental weed and exotic flora species observed during the ecological field survey are listed in Appendix G of the Ecological Assessment Report (Appendix 7).

8.4 Fauna

8.4.1 Common and Threatened Species

8.4.1.1 Common Species

A total of 48 native fauna species were identified during the field assessment, including one mammal, 37 birds, five reptiles and five amphibians. A full list of all fauna observed during the ecological assessment is provided in Appendix H of the Ecological Assessment (Appendix 7). Of these identified species, eight are listed as threatened under Commonwealth or State legislation (see Section 8.4.1.2) and a further eight are listed a migratory under Commonwealth legislation (see Section 8.4.1.3).

The majority of the study area has been disturbed and modified by historical and current land uses including cattle grazing and gas production meaning that generalist and disturbance tolerant fauna species have been able to outcompete specialist fauna for limited food and habitat resources. Common generalist species observed during the ecological assessment were Noisy Miner (*Manorina melanocephala*), Torresian Crow (*Corvus orru*), Magpie-lark (*Grallina cyanoleuca*) and Pied Butcherbird (*Cracticus nigrogularis*).

Additionally, the conversion of woodland to open grazing pastures as part of disturbance and land use changes within the study area has also increased the habitat availability and foraging resources for grazing mammals such as Eastern Grey Kangaroo (*Macropus giganteus*) as well as several bird species such as Galah (*Eolophus roseicapillus*), Cockatiel (*Nymphicus hollandicus*), Australian Pipit (*Anthus novaeseelandiae*).

8.4.1.2 Threatened Species

A total of eight threatened species (listed as EVR under the EPBC and NC Acts) were identified as potentially occurring or having suitable habitat within the study area from desktop review of Commonwealth and State environmental databases (EPBC protected matters search and Wildlife Online search). A full list of these species is provided in Table 4.1 of Appendix 7.

No threatened species were identified within the study area during the ecological assessment, and based on an assessment of suitable habitat within the project area, no threatened species (as identified by desktop assessment) are considered likely to inhabit the project area (refer Table 4.1 of Appendix 7).

8.4.1.3 Migratory Species

Desktop searches of the EPBC protected matters and the DERM Wildnet Online databases identified a total of eight migratory (or listed over-fly) species which may potentially occur within the project area; however none were identified during the ecological field assessment and none are considered likely to occur within the project area (refer Table 4.1 in Appendix 7).

8.4.2 Animal Breeding Places

As discussed in Section 3.3, it is anticipated that clearing will not occur as part of project activities; therefore, adverse impacts to animal breeding places / habitat are considered highly unlikely. However, in order to provide an accurate picture of the project site, the available habitat types identified during the ecological assessment are further discussed below.

A total of four broad habitat types were identified as occurring within the proposed SSSF project area. Assessment of their functional value as habitat for native species was based on analysis of the floristic composition, condition and quality of the vegetation communities. Habitat types identified were:

- Open forest and woodland;
- Artificial Wetlands;
- Regrowth; and
- Grazing pastures and cleared or disturbed land.

Of these, grazing pastures and cleared disturbed land predominates within the study area (refer Figures 3.2 and 3.4 of Appendix 7). The habitat resources and functional values of grazing pastures and cleared disturbed land are considered to be low.

Open Forest and Woodlands within the study area are generally fragmented, with disturbance and degradation resulting from historical and ongoing land management practices evident within this habitat type. The understorey was often modified through weed and exotic pasture encroachment. Mature hollow bearing trees were generally sparse, reducing the availability of habitat for hollow dependant species. Some large intact remnants of Open forest and woodlands can be found to the east of the proposed SSSF location which were identified as providing higher habitat values and connectivity.

Artificial wetland habitat is provided within the project area by dams and settling ponds. Water quality associated with these is anticipated to be low and coupled with the lack of fringing riparian vegetation meant that habitat value was classified as poor. However, these artificial wetlands may provide water and food resources, shelter and breeding habitat for a range of species including waterbirds and frogs.

Areas of regrowth vegetation generally lack structural complexity as well as important habitat elements such as mature canopy or hollow-bearing trees and fallen woody debris. Due to the lack of a continuous canopy layer exotic pasture grasses and weeds were found to proliferate in the understorey of this habitat and as such associated habitat resources were considered to be limited. Despite this, regrowth may provide shelter and food resources for a variety of species, particularly small birds and reptiles.

8.4.3 Essential Habitat

No essential habitat for threatened fauna species has been mapped within or surrounding the study area.

8.4.4 Introduced / Pest Species

One introduced species (the European Rabbit (*Oryctolagus cuniculus*)) was observed during the ecological field assessment, with potential tracks of Red Fox (*Vulpes vulpes*) and Cat (*Felis cattus*) also being identified.

8.5 Protection of Koala Habitat

Within Queensland, Koala's (*Phascolarctos cinereus*) and Koala habitat are protected under the following legislation:

- South East Queensland Regional Plan;
- Nature Conservation (Koala) Management Plan 2006-2016; and
- Nature Conservation (Koala) Conservation Plan 2006 (NCCP (Koala)).

Under the NCCP (Koala) Koala districts have been established within South East Queensland (refer Figure 14).

The SSSF lies within Koala District C. Within Koala District C the threat to Koalas is considered to be moderate to low (DERM 2010d). Clearing activities within Koala districts are governed by a series of conditions contained in the NCCP (Koala) and must be undertaken in strict compliance with these.

However, as no significant clearing is anticipated as part of the proposed project, adverse impacts to Koala's or Koala Habitat as a result of project activities are considered highly unlikely.

Given its geographic location, no state planning polices or regulatory provisions for Koala conservation apply to the project area.

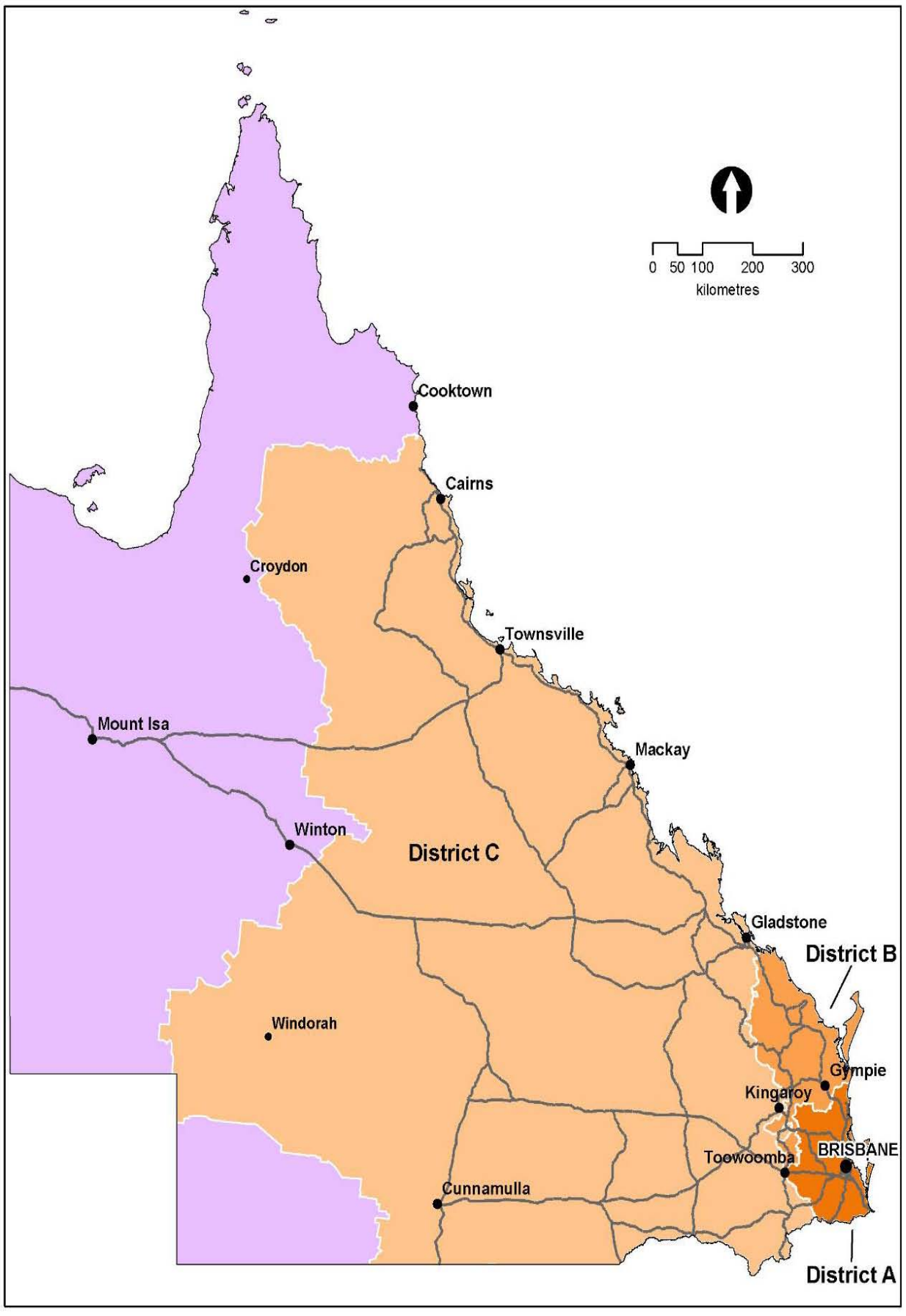


Figure 14: NCCP (Koala) Koala Districts (DERM 2010d)

8.6 Environmentally Sensitive Areas (ESAs)

For the purposes of this assessment, Category A and B ESAs have been defined pursuant to Sections 25 and 26 of the *Environmental Protection Regulations 2008*. Category C ESAs have been defined pursuant to the DERM guideline *"Preparing an Environmental Management Plan (EM Plan) for Coal Seam Gas (CSG) activities"*. Of these ESA categories, only 'Of Concern' REs (Category C ESA) were identified as occurring within the proposed SSSF project area from DERM ESA mapping (DERM 2010b).

8.7 Other High Ecological Significance Areas

8.7.1.1 Threatened Ecological Communities (TEC)

A search of the EPBC protected matters database identified one TEC (Weeping Myall Woodlands) as potentially occurring within the proposed SSSF project area. Ground-truthing undertaken as part of the ecological field assessment did not identify this community.

8.7.1.2 Bioregional Corridors

The Bioregional Corridor network is a landscape scale attempt to identify important habitat pathways which may represent a reasonable level of connectivity in bioregions, and/or contain ecological values deemed important.

While the EP Act and subordinate legislation do not refer specifically to the bioregional corridor network, the general preference of the administering authority (DERM) is to ensure that infrastructure projects avoid, minimise and mitigate impacts (in that order of preference) to such areas. The DERM encourages where possible, the enhancement of values associated with bioregional connectivity and continuity through the implementation of infrastructure projects (*pers. comm.* Stephen Trent, DERM (Biodiversity (GIS) Officer) 2010).

A single terrestrial corridor of State significance intersects the southeast corner of PL 446 (refer Figure 15) however this corridor is to the east of the proposed SSSF project site and is not anticipated to be impacted as a result of proposed project activities.

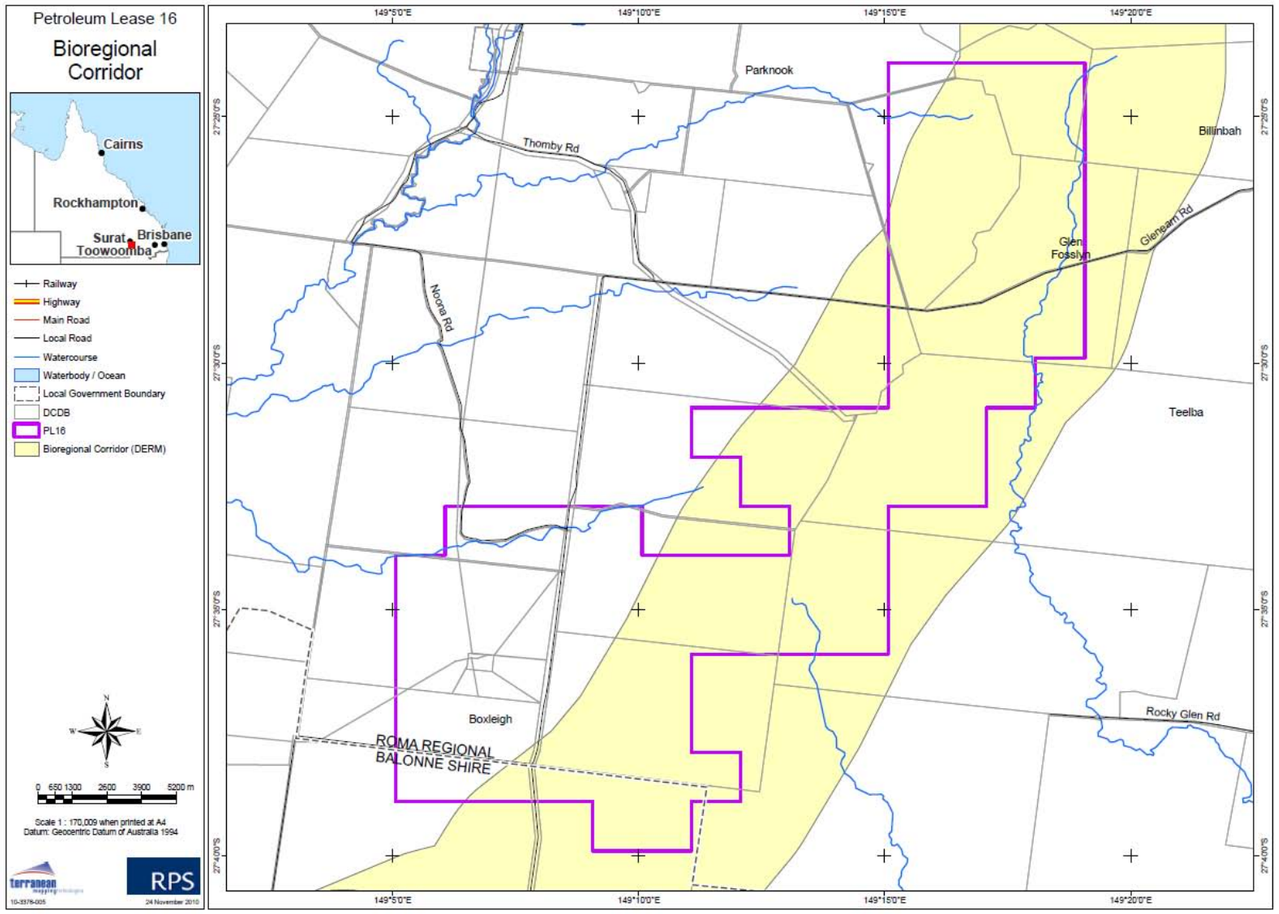


Figure 15: Brigalow Belt Terrestrial State Significant Corridor (Bioregional Corridor) (DERM 2010a)

8.8 Potential Adverse or Beneficial Impacts on Environmental Values

8.8.1 Potential Flora Impacts

Vegetation identified on the project site is limited to two Of Concern REs (Category C ESA) and areas of high value regrowth, with ground truthing and assessment identifying no threatened species, TECs or essential habitat within the proposed SSSF project area.

Project activities are proposed to be undertaken in pre-existing cleared areas such that no significant clearing is anticipated to occur. The risk of significant impacts to potential EVR flora species (or their habitat), REs or vegetation communities is therefore considered to be negligible.

Should replacement wells and additional flowlines be required, these will be located as close as possible to existing wells to minimise clearing, and given the implementation of control strategies and mitigation measures as outlined in Section 8.9, it is considered that significant flora impacts will be unlikely.

8.8.2 Potential Fauna Impacts

Loss of habitat is generally the main potential impact to fauna species within project areas; however, as discussed in Section 8.8.1, activities are proposed to be undertaken in pre-existing cleared areas and a reduction in the availability of fauna habitat is not anticipated as a result of the SSSF project activities.

No threatened species were identified within the study area during the ecological assessment, and none are considered likely to inhabit the project area due to an absence of significant habitat. As such, it is considered unlikely that proposed project activities will result in any adverse impacts to threatened species.

Should replacement wells and additional flowlines be required, some loss of fauna habitat may occur through associated vegetation clearance; however, these will be located as close as possible to existing wells to minimise clearing. Given the implementation of control strategies and mitigation measures as outlined in Section 8.9 and the minimal clearing anticipated, it is considered that project related impacts to fauna habitat will be minor.

Fauna mortality from entrapment in open flowline trenches may also occur where additional flowline is required. Given the anticipated minimal length of additional flowline, the risk of fauna entrapment is considered to be low; however, this will be further reduced through regular fauna inspections of open trenches and other excavations undertaken by appropriately qualified personnel throughout the construction period.

8.9 Environmental Protection Commitments, Objectives and Control Strategies – Flora and Fauna

Environmental Protection Objective	To minimise adverse impacts to vegetation and fauna, and avoid the spread of weeds and pathogens. To promote and maintain native vegetation cover site during operations.
Specific Objectives	To minimise clearing of remnant vegetation during construction of replacement wells and additional flowline (where these are required). To minimise disturbance to fauna during construction. To appropriately rehabilitate site to pre-construction condition, as soon as reasonably practical after construction. To avoid the introduction or spread of weeds and pathogens and undertake weed control where required during construction. Where additional flowlines are required, regrowth will be promoted and maintained on the easement over the long-term to be consistent with the surrounding area. To minimise additional clearing of native vegetation as part of operational activities. To ensure that maintenance activities are planned and conducted in a manner that minimises impacts on native fauna. To ensure that weeds and pathogens are controlled during operations at a level that is at least consistent with adjacent land.
Control Strategies	Additional flora and fauna assessment will be conducted where appropriate (e.g. significant change to project scope or location of potential replacement wells within ESAs). Where replacement wells or additional flowlines may be required and cannot practicably be located in existing cleared areas, an environmental clearance inspection of the sites will be undertaken prior to construction to identify and mark any issues requiring specific management (e.g. to identify trees or vegetation to be retained, check for rare or threatened flora and fauna). **Vegetation Management** Disturbance (including vehicle access) to designated work areas / access tracks will be restricted to the greatest extent possible. Where additional flowline may be required, the ROW width will be restricted to the minimum required to safely construct the pipeline and meet other environmental requirements (e.g. erosion control, spoil storage). The width of the additional flowline ROW will be reduced where practicable, in areas of higher ecological significance (e.g. through ESAs). Trees on additional flowline or facility footprints will be retained where possible, particularly significant plant species and habitat trees if present. Where additional flowline may be required, branches that overhang the ROW will be trimmed rather than completely removing trees, whilst ensuring that safe access is maintained. Where replacement wells and additional flowlines may be required, vegetation clearing boundaries will be clearly defined in the field, particularly areas of reduced ROW and within woodland areas. Individual trees to be trimmed or retained will be marked (e.g. using flagging tape). Fire prevention procedures will be implemented and fire prevention and control equipment maintained on site for high risk activities (e.g. welding). Cleared vegetation will be stockpiled (not burnt or mulched) for respreading during rehabilitation (note this excludes declared pest species), subject to landholder approval. Cleared vegetation and soil will be stockpiled outside of watercourses behind the floodline. Rehabilitation of disturbed areas will be undertaken progressively wherever practicable during construction. Where additional flowline may be required, native vegetation will be allowed to regenerate over the ROW, with the exception of trees and large shrubs on the area above the pipe that must remain clear for pipeline protection and maintenance purposes. Where additional flowline may be required the condition of revegetation on the ROWs will be inspected during regular surveys and patrols.

	Clearing of vegetation during operations will be minimised, and typically restricted to large vegetation regrowth occurring within defined flowline ROW areas and areas on flowline ROWs where dig-ups or maintenance are required. Where replacement wells or additional flowlines may be required and vegetation clearance is undertaken, appropriate offsets (if required) will be implemented in accordance with the Qld Government Environmental Offsets Policy. **Weeds** All vehicles and plant will be inspected to ensure that they are weed free prior to their initial commencement of works, and conduct washdowns where required. Weed management during construction and operation will be conducted in strict accordance with the weed management measures detailed in the OEMP. **Fauna** Vehicles will travel at safe speeds, and minimise travel at night, to reduce fauna mortalities, wherever practical. Sedimentation impacts to habitats will be minimised by implementing erosion and sediment control measures as per IECA guidelines. Where replacement wells and additional flowlines may be required clearing hollow-bearing trees will be avoided wherever possible. Significant trees that can be retained will be flagged for avoidance. Where additional flowline may be required, additional measures to minimise fauna fatality in the trench will be installed, as appropriate, (e.g. sawdust filled hessian sacks soaked in water, branches or ramped gangplanks), particularly in areas of high fauna density. The period for which the trench is open, and the length of open trench, will be minimised, where new flowline sections are constructed. Appropriate protocols will be implemented to inspect the trench, monitor construction activities for fauna, and retrieve, record and release trapped fauna. Trenches and significant excavations must be checked daily and fauna handling and identification must be carried out by appropriately trained / qualified and experienced personnel. Fauna will be prevented from accessing food scraps through the careful management of waste materials and prevention of direct feeding by pipeline personnel. Access tracks and the compressor site will be managed to avoid causing alterations to hydrological characteristics. Spreading of cleared vegetation and dead timber across disturbed areas, particularly within woodland and shrubland fauna habitats, to reduce the barrier to fauna movement, will be undertaken subject to landholder approval. Measures in accordance with the IPA pest guideline (Minimising pest spread advisory guidelines) will be implemented to control those pest species listed under the LP Act (i.e. European Rabbit).
Performance Indicators	No evidence of vehicle deviation from designated access tracks. No clearing outside marked clearing boundaries. No mortalities of fauna or livestock as a result of project activities. No proliferation of weeds on the project site or immediate surrounds. Evidence of appropriate vegetation stockpiling and respreading during and following construction. All onsite vehicles have certification of appropriate washdown / cleanliness.

9.0 Noise

Sonus Pty Ltd (Sonus) was commissioned by RPS, on behalf of AGL, to undertake an impact assessment of the expected noise emissions associated with the construction, installation and operation of the proposed SSSF at closest sensitive receptors. More specifically, the assessment consisted of:

- A survey of the existing acoustic environment and equipment on site at the SSPP;
- Identification of local meteorological parameters and topography that may impact on the propagation of noise generated by the SSSF;
- A prediction of the noise from the new compressor unit, the major noise source associated with the facility, at the closest sensitive receptor, using the CONCAWE noise propagation model and the *SoundPlan* noise modelling software;
- A comparison of the predicted noise levels with the relevant environmental noise criteria; and
- Recommendations for acoustic treatment measures.

A copy of this report is provided in Appendix 8.

9.1 Existing Noise Environment

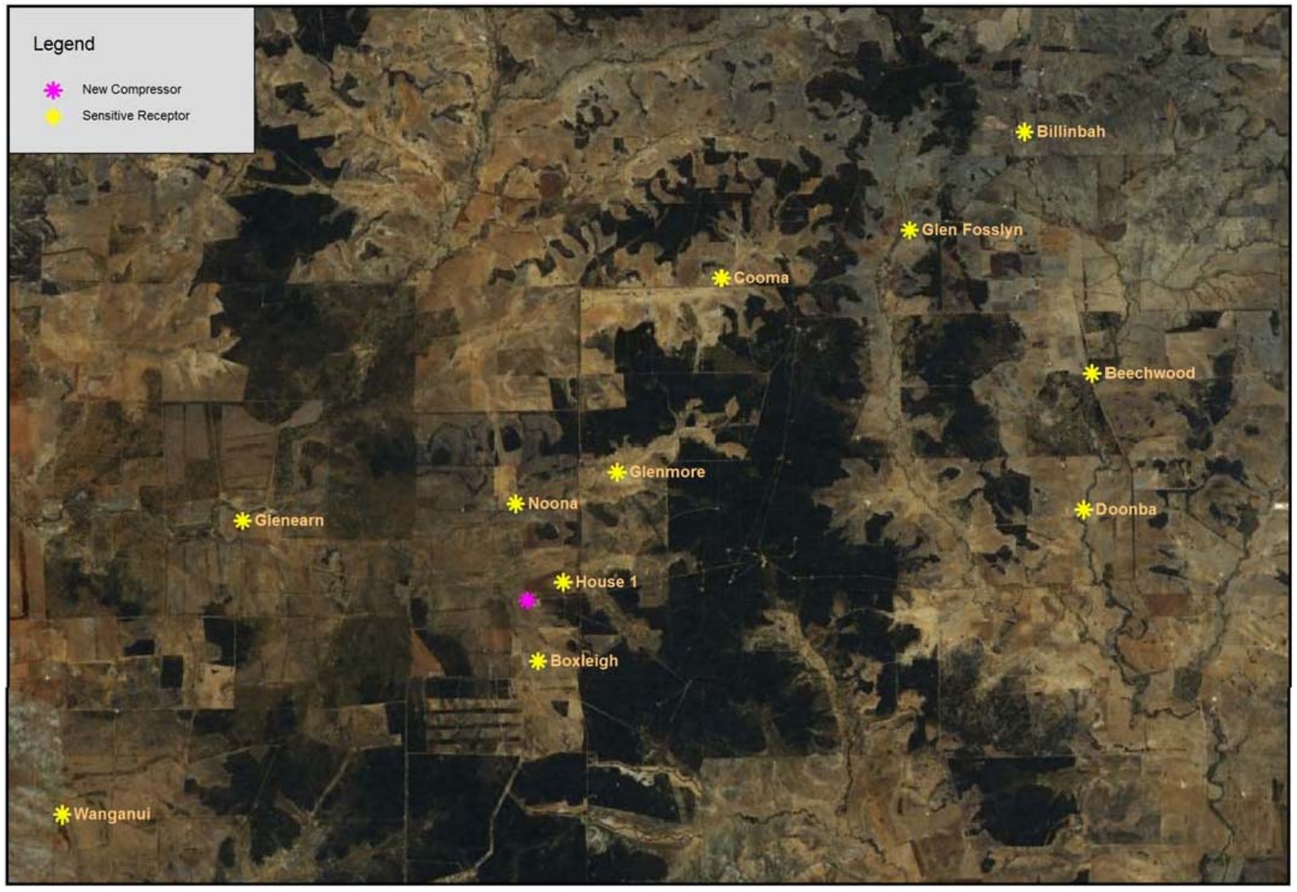
9.1.1 Noise Environment and Sensitive Receptors

The proposed SSSF is located in a rural environment and has an acoustic environment characterised by natural sounds such as birds and wind in trees, except those areas in close proximity to the existing plant (Sonus 2010). Ten sensitive receptors (dwellings) were identified in the vicinity of PL 446 (refer Table 22) with the closest sensitive receptor to the SSSF being located approximately 1.8 km north east of the site (refer Figure 16). The topography between the site and the sensitive receptors is relatively flat and it is expected that the topography will have negligible influence on the noise levels predicted at the closest sensitive receptor (Sonus 2010).

Table 22: Approximate Distances of Sensitive Receptors to the SSF

Sensitive Receptor Name	Approximate Distance from SSSF (km)
The Little Homestead (House 1)	1.8
Boxleigh	2.9
Noona	4.6
Glenmore	7.4
Glenearn	13.9
Cooma	17.8
Wanganui	24.1
Glen Fosslyn	25.1
Doonba	26.6
Beechwood	28.7
Billinbah	32.2

Source: Sonus 2010



Source: Sonus 2010

Figure 16: Sensitive Receptors in the Vicinity of SSSF

9.1.2 Existing Noise Sources

9.1.2.1 Transient Sources

Sources of transient or intermittent noise from the SSPP include campsites, vehicles, venting, purging, or flaring activities as well as non-routine and preventative maintenance works. These activities are typically temporary, short-term and will predominantly occur during daylight hours (7am – 6pm). The noise from these activities is anticipated to be negligible at any sensitive receptor and will not cause a nuisance.

Drilling activities are another recognised transient noise source that has potential to cause noise nuisance at sensitive receptors. At the time of submission of this application, noise associated with drilling activities had not been modelled, as final well locations were not confirmed. However, the number of wells to be drilled, (if any), is limited and will not be an ongoing source of noise. If a well is required to be drilled within 1 km of a sensitive receptor, AGL propose to undertake noise modelling to determine the potential noise nuisance caused by the drilling activity, prior to carrying out the activity. Furthermore, all potentially affected landholders will be fully consulted prior to and during the drilling activity, and where necessary, alternative arrangements will be put in place.

9.1.2.2 Fixed Sources

The existing compressor units located at SSPP have the potential to influence the surrounding acoustic environment through their continuous 24-hour operation. The SSPP is comprised of four operational compressors, of which only three typically operate at any one time. The fourth compressor is utilised for back-up purposes and may only operate for one day a month or less. Compressors generate noise on a continuous basis from the following components:

- Compressor Gas Turbines, including:
  - Engine air inlet;
  - Engine exhaust;
  - Engine mechanical; and
  - Cooling fan.

There are also four generators on site, of which only one typically operates. Noise from this equipment is considered negligible and would not create noise nuisance at the closest sensitive receptor.

9.1.3 Background Noise Monitoring

Sonus undertook measurements of background noise levels (L_{A90}) and ambient noise levels (L_{Aeq}) at the sensitive receptor “The Little Homestead” (see Table 22 and Figure 16). Continuous unattended measurements were made 20 – 28 September 2010 in accordance with DERMs Noise Measurement Manual. Using the measurement data obtained, the Rating Background Levels (RBL) were calculated in accordance with the “Planning for Noise Control” Guideline released by DERM. The RBL is the overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period (DERM 2004). The calculated RBL’s are summarised in Table 23. These levels are considered appropriate to prevent background creep and are also considered to be representative of

all of the sensitive receptors which are located in an environment dominated by noise from wind in trees, birds and other natural sounds, such as that recorded at 'The Little Homestead'.

Table 23: Calculated Rated Background Levels for Identified Sensitive Receptor located near the SSPP

Rated Background Levels (dB(A))		
Day	**Evening**	**Night**
29	33	28

Source: Sonus 2010

Sonus also undertook attended noise measurements on 20 September 2010, in the vicinity of the operational SSPP. At the time of the measurements, three compressors and two generators were operating. These measurements were used to estimate the noise contribution from the existing equipment to the Rated Background Levels determined in Table 23. The noise contribution from the existing equipment estimated under mild upwind weather conditions is shown in Table 24.

Table 24: Estimated Contribution of Existing Equipment to the Rated Background Level

Sensitive Receptor	Estimated Noise Level (dB(A))
The Little Homestead	53
Boxleigh	24
Noona	19
Glenmore	< 18
Glenearn	< 18
Cooma	< 18
Wanganui	< 18
Glen Fosslyn	< 18
Doonba	< 18
Beechwood	< 18
Billinbah	< 18

Source: Sonus 2010

9.2 Noise Modelling

Specialist noise modelling was undertaken to assess the potential noise related impacts from the construction and operation of the new compressor unit. The modelling was conducted using the CONCAWE noise propagation model and the *SoundPLAN* noise modelling software. The CONCAWE propagation model takes into account topography, ground absorption and meteorological conditions, and has been used and accepted around the world as an appropriate sound propagation model.

9.2.1 Noise Criteria

9.2.1.1 Construction Noise

Noise generated by the compressor construction and installation activities will be largely associated with the operation of vehicles and equipment. This will result in a temporary increase in ambient noise levels within the immediate vicinity of the construction site; however this impact is expected to be of a relatively short duration (approximately 6 months). Also given the temporary and transient nature of the noise, there is no potential for background noise creep. Construction activities (except drilling) will be conducted during daylight hours only (7am – 6pm).

The proposed appropriate noise criteria for construction activities is derived from the Environmental Protection (Noise) Policy 2008 (EPP (Noise)) and World Health Organisation Guidelines 1999 (WHO). A summary of the criteria is given in Table 25.

Table 25: Summary of Noise Criteria for Construction Activities from EPP (Noise) and WHO Guidelines

Time Period	Outdoor Noise Criterion (dB(A))
Day (7am -6pm)	50

Source: Sonus 2010

9.2.1.2 Operational Noise

To adequately model the noise associated with the operational plant, the assessment predicted noise levels within the normal frequency (>200 Hz) and low frequency (20 - 200Hz) bands at the sensitive receptors identified in Table 22. The relevant noise criteria were determined from a number of different guidelines including the (EPP (Noise)), the *WHO guidelines*, the Planning for Noise Control Guideline 2004 and the Low Frequency Noise Draft Guidelines (date unknown). Table 26 shows the noise criteria and guidelines determined as applicable to the operational plant.

Table 26: Applicable Noise Guidelines and Limits

Guideline	Maximum Day Noise Level	Maximum Evening Noise Level	Maximum Night Noise Level	Unit
EPP (Noise)	32	36	31	dB(A) $L_{Aeq,adj,1hr}$
Planning for noise control (planning noise levels)	40	35	30	dB(A) $L_{Aeq, 1hr}$
Planning for noise control (control background creep criteria))	29	33	28	dB(A) $L_{A90,T}$
Low Frequency Noise Draft Guideline	-	20	25	dB(A) $L_{pA, LF}$
World Health Organisation Guideline (indoors)	35	35	30	dB(A) $L_{Aeq,adj, 1hr}$

Source: Modified from Sonus 2010

In order to satisfy the intent of all of the applicable guidelines, the proposed noise criterion for the operation of the new gas compression unit at the SSSF is $L_{Aeq,1hr}$ of 28 dB(A), predicted outside all sensitive receptors. This is the most stringent of the applicable criteria presented in Table 26.

9.2.2 Noise Modelling Scenarios

To assess the potential noise impacts of the SSSF on sensitive receptors, two noise models were developed. The first was designed to assess potential noise impacts associated with the construction of the SSSF, whilst the second model assessed noise impacts from the operation of the SSSF.

As a conservative approach, the worst case meteorological conditions were used in both noise models. These conditions are reflective of a clear night sky, with wind blowing from the noise source towards the sensitive receptor. These conditions are also conducive to temperature inversions. Such conditions are considered to occur at the closest sensitive receptor, for 21% of the time over a 12 month period.

9.2.2.1 Construction Noise

The construction related noise modelling was predicted using typical equipment used throughout construction, including grinders, loaders, trucks, excavators, generators, air compressors and a crane. The worst case sound power level for each piece of equipment was used in the prediction. The sound power levels were derived from the *Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites.* All equipment was assumed to be operating simultaneously and continuously, but during daylight hours only (with the exception of drilling equipment).

9.2.2.2 Operational Noise

The noise model for operational noise was based on the sound power levels associated with the simultaneous operation of:

- One Ariel KBZ/4 compressor;
- One CAT G612 air inlet;
- Two CAT G3612 exhausts;
- One CAT G3612 mechanical engine; and
- One Moore CL10K fan.

9.3 Potential Adverse or Beneficial Impacts on Environmental Values

9.3.1 Noise Modelling Results

9.3.1.1 Construction Noise

The results of the noise modelling indicate that noise from construction activity will be no greater than 45 dB(A) under worst-case meteorological conditions at the closest sensitive receptor (The Little Homestead), therefore achieving the criterion for construction. No construction is anticipated to occur during the evening or night (6pm – 7am).

9.3.1.2 Operational Noise

Noise levels at the Little Homestead, Boxleigh and Noona sensitive receptors will exceed the proposed criteria of 28 dB(A), unless specific acoustic treatments are applied. To achieve the criterion at all sensitive receptors, it is recommended that standard noise attenuation measures on the compressor unit

are implemented (including exhaust muffler and air inlet silencer) and a noise barrier / enclosure which provides the following attenuation is also recommended to be constructed (Table 27).

Table 27: Predicted attenuation required for Proposed SSSF Compressor

Noise Source	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	Potential Treatment
	Required Noise Level Reduction (dB)							
Ariel KBZ/4	5	10	12	17	17	17	12	Enclosure / Barrier
CAT G3612 – Mechanical	5	10	12	17	17	17	12	Enclosure / Barrier
CAT G3612 - Exhaust	11	22	29	41	38	36	29	Silencer

Source: Sonus 2010

The low frequency noise level predicted inside The Little Homestead residence was 10 dB(A) and therefore the proposed criterion of $L_{pA,LF}$ of 20 dB(A) inside a dwelling is easily achieved. This level was predicted under worst-case meteorological conditions with the acoustic treatment in place. The level of low frequency noise inside the other sensitive receptors would be significantly less.

9.4 Environmental Protection Commitments, Objectives and Control Strategies – Noise

Given the results of the noise monitoring above, AGL recognise that some form of noise attenuation on the compressor plant will be necessary to avoid causing noise nuisance at the closest sensitive receptors. AGL propose to incorporate standard noise reduction measures such as the air inlet silencer and exhaust muffler as part of the unit design.

AGL propose to undertake noise monitoring once the new compressor is operational to verify the results of the noise modeling. Where this monitoring identifies the need for further attenuation, AGL will implement measures required to comply with the 28 dB(A) criterion at the closest sensitive receptors. AGL are committed to not causing a noise nuisance at sensitive receptors, and in the event that noise monitoring indicates the likelihood for a non-compliance with the conditions of the environmental authority, the installation of an appropriate noise attenuation structure will be undertaken as a matter of priority.

Environmental Protection Objective	To construct and operate the SSSF in a manner that minimises the impact of noise on sensitive receptors, including surrounding residences and industry.
Specific Objectives	To minimise noise impacts and nuisance associated with: ▪ Movement and operation of construction vehicles and equipment; and ▪ SSSF maintenance activities. To ensure operational activities comply with relevant noise standards. To achieve consistency with the principles of the *Environmental Protection (Noise) Policy 2008*.
Control Strategies	Earthmoving equipment and other vehicles will be fitted with appropriate noise control devices (e.g. mufflers) and such devices will be maintained. Vehicle speeds will be limited on all access roads in proximity to residences (and other sensitive receptors).

	Appropriate equipment will be selected for construction and operations. Construction and maintenance works will be conducted during daylight hours (7am - 6pm Monday – Saturday and 8am – 5pm Sunday) except for hydrotesting, drilling or emergency maintenance works. These can operate on a 24-hour basis. Potentially affected landholders will be notified of timing and duration prior to and during any construction, drilling, operational and/or maintenance activities creating excess noise. Where appropriate, alternative arrangements may be made with landholders for the period that the noise may cause a nuisance. Exhaust mufflers and inlet silencers will be installed and maintained at the SSSF consistent with the recommendations of the Sonus Noise Assessment Report (Appendix 8). Noise monitoring will be conducted at the closest sensitive receptor once the new compressor is operational. Dependent on the outcomes of the monitoring and the level of compliance achieved with environmental authority conditions, appropriate attenuation measures will be implemented as required. Prior to drilling at a well site, noise modelling will be carried out to determine the potential impact of noise at sensitive receptors located within 1 km of the drill site. Where a likely noise nuisance is identified, steps will be taken to mitigate the noise and consultation with potentially impacted landholders will be undertaken. Generators at the drill rig site will be orientated such that the noise producing components are directed away from the sensitive receptor. Noise monitoring will be conducted in accordance with the DERM *Noise Measurement Manual*. The requirements set by Qld EPA's *Planning for Noise Control* Guideline will be adhered to. Complaints will be documented, and immediately reported to the Project Manager who will negotiate an outcome with the complainant.
Performance indicators	No complaints in relation to noise nuisance at sensitive receptors. Any recorded complaints are actioned and closed out. Any required noise monitoring demonstrates compliance with regulatory requirements (including EA specified noise levels).

10.0 Existing Social Environment

10.1 Existing Heritage Environment

10.1.1 Indigenous Heritage and Native Title

Native Title has been extinguished on PL 446, which currently falls within the Mandandanji People claim area (QC08/10). Although no claim exists, AGL will notify the Mandandanji People of the proposed SSSF project in accordance with the NT Act and will maintain open communication and manage cultural heritage in accordance with the agreed CHMP in place for PL 446.

A search of the DERM Indigenous Cultural Heritage Database was undertaken and found that there are no known indigenous cultural heritage sites occurring within the proposed SSSF project area. Given the disturbed nature of the proposed location of the new compressor, concrete batching plant, and process equipment, it is considered unlikely that any new sites or artifacts of cultural significance will be discovered. However should any previously unknown indigenous cultural heritage sites or artifacts be identified during construction, they will be managed in accordance with the *Aboriginal Cultural Heritage Act 2003* and AGL's CHMP for PL 446.

10.1.2 Non-Indigenous Heritage

A desktop review of the Queensland Heritage Register (DERM 2010e) identified no historic heritage sites or artifacts located within the proposed SSSF project area. The closest identified heritage places to the SSSF project area are:

- The Anchorage, St George – a State Heritage Place located approximately 55 km to the south west of PL 446; and
- Myall Park Botanic Garden, Glenmorgan – a historic area located approximately 39 km north east of PL 446.

10.1.3 Potential Adverse or Beneficial Impacts on Environmental Values

Given the disturbed nature and the lack of any known sites of cultural significance within the proposed SSSF project area, it is considered unlikely that project related activities will result in impacts to indigenous or non-indigenous cultural heritage.

Should any additional values of indigenous cultural significance be identified prior to (or during) construction of the SSSF, these will be handled in accordance with the environmental protection objectives and control strategies contained in the Cultural Heritage Management Plans (CHMP) with the Mandandanji People and the *Aboriginal Cultural Heritage Act 2003*.

10.1.4 Environmental Protection Commitments, Objectives and Control Strategies – Heritage

Environmental Protection Objective	To minimise and manage impacts to heritage sites and values during construction and adequately protect such sites and values during operations and maintenance.
Specific Objectives	To ensure that identified heritage sites are not disturbed. To maintain visual amenity of rural landscapes.
Control Strategies	**Indigenous Cultural Heritage** Will be dealt with in accordance with appropriate State Legislation and AGL's existing CHMP with the Mandandanji People. Project inductions will address indigenous cultural heritage values and protection. **European Cultural Heritage** Historic heritage site disturbances will be avoided unless appropriate authorisation has been obtained and the disturbance is necessary to permit project construction. Basic instruction for historical heritage site identification and protection will be provided in the project induction package.
Performance Indicators	No complaints received from stakeholders regarding project activities. Any complaints received are appropriately actioned and closed out. All vehicles on site have certification of appropriate washdowns / cleanliness. If Indigenous Cultural Heritage material is discovered, evidence shows that relevant procedures (as per relevant CHMP) were followed.

11.0 Waste

11.1 Waste Generation

Relatively small amounts of domestic and industrial wastes (refer Table 6) will be generated during the construction and operation of the proposed SSSF project. Waste management will be based on a hierarchy beginning with waste avoidance, minimisation and recycling before disposal via existing onsite licensed facilities or an appropriately licensed contractor. Waste will be managed in accordance with the objectives of the *Environmental Protection (Waste Management) Policy 2000* (EPP Waste).

It is proposed that portable sewage systems will be utilised at the temporary construction camp, and sewage will be trucked out for disposal at existing local facilities by an appropriately licensed contractor.

11.2 Existing Environment Values Potentially Impacted

Existing environmental values which may be impacted by waste generated by project activities may include:

- Life, health and wellbeing of people and the community;
- Diversity of ecological processes and associated ecosystems; and
- Land use capability, having regard to economic considerations.

Given the nature of the proposed project (e.g. location of all proposed activities in pre-existing disturbed areas, utilisation of a depleted underground gas reservoir and utilisation of existing infrastructure), the risk of adverse impacts relating to waste is considered to be low.

It is proposed that sewage from the temporary construction camp be transported and disposed of to existing local treatment facilities by appropriately licensed contractors. Sewage management (and associated control strategies) is discussed in Section 11.4.

All waste materials (particularly hazardous and regulated substances) will be managed and disposed of in strict accordance with relevant legislation (including the EPP Waste) and the construction contractor's Waste Management Plan.

During operation of the SSSF it is possible that regulated wastes such as low volume, low level contaminated soil or gravel may be generated. While this waste can be disposed of at licensed facilities, DERM has been encouraging in-situ remediation as long as this can be safely managed.

11.3 Potential Adverse or Beneficial Impacts on Environmental Values

Relatively small volumes of typically inert building and work crew wastes will be generated during construction. Off-cut / excess materials (including concrete and packaging) could remain on site as building waste if not adequately disposed of, while refuse (food scraps and packing etc) from the work crew can have environmental and aesthetic impacts if not properly managed.

Where chemicals are added to hydrotest water this may represent another project waste stream and require specific management. Details of typical wastes relating to construction and operation and disposal options are summarised in Table 6.

Potable water proposed to be used for hydrotesting is unlikely to require addition of corrosion inhibiting chemicals and biocides. However, if such chemicals are required, localised soil or water contamination could occur if disposal of the hydrotest water is incorrectly managed.

To ensure minimal risk of environmental harm, all hydrotest activities (including discharge) will be conducted in compliance with all regulatory and landholder requirements. As such, the management of hydrotest water is not expected to result in any adverse environmental impacts. AGL's preferred hydrotest option is to source potable quality water from Surat via licensed water carters and dispose of used hydrotest water to an existing dam at the Silver Springs Plant. Hydrotest disposal and appropriate management measures are further discussed in Sections 12.1.3 and 12.3.

Operational activities associated with the SSSF will generate small quantities of wastes, including:

- Waste lubricant oil;
- Hydrocarbon sludge and flowline finings generated by pigging activities, where undertaken;
- Liquids from the inlet filter / separator; and
- Small amounts of solid waste (filter elements, packaging and cleaning equipment).

Wastes (including regulated wastes) will be stored, removed from site, transported and disposed of by appropriately licensed operators to licensed facilities and will be managed in accordance with the OEMP (Appendix 1).

Waste management associated with construction and operation of the SSSF is not considered to be a significant risk to the environment or public health.

11.4 Environmental Protection Commitments, Objectives and Control Strategies – Waste

Environmental Protection Objective	To minimise waste generation and maximise reuse and recycling of construction and operations waste products and avoid land and water contamination.
Specific Objectives	To prevent spills of waste materials occurring and if they occur to minimise their impact. To ensure that rubbish and waste material are disposed of in an appropriate manner. To achieve consistency with the objectives of the *Environmental Protection (Waste) Policy 2000*.
Control Strategies	**General Waste** All work areas will be maintained in a neat and orderly manner and free of litter and general waste (such as lunch wrappers). Lidded refuse containers will be located at each worksite. Bins will be covered to prevent access by fauna and the spread of rubbish by wind. All food wastes generated from construction of the proposed SSSF will be collected and disposed of in accordance with the OEMP (Appendix 1), taking into account health and hygiene issues. All litter and general waste disposal will be at a licensed disposal facility (including on PL 446). Where waste contractors are used they will be appropriately licensed. All bonding material and dunnage from transport vehicles and unloading areas is to be collected and transported off the easement to designated disposal areas. Reusable and recyclable wastes, such as timber skids, fibre / nylon rope spacers, pallets, drums and scrap metals, will be stockpiled and salvaged. All construction waste materials and equipment will be removed from the area once construction is completed. Hydrotest water, trench water and waste water (e.g. washdown water) will be disposed of in an appropriate manner to avoid soil and water contamination. **Hazardous Materials and Wastes** All project personnel will be instructed on prevention, safety and response practices as a component of the environment induction process. Flammable and combustible liquids (e.g. diesel) will be stored, handled, secured, separated and signed as required by AS 1940, including appropriate bunding. Chemicals will be handled and stored in accordance with Material Safety Data Sheet (MSDS) requirements. MSDS's and a dangerous goods register will be available, and easily accessible, for all hazardous and dangerous materials used. Fuels and lubricants will be stored within containment areas (e.g. lined, bunded areas) in accordance with AS 1940. Where appropriate, relevant local government permits will be held for fuel storages and conditions of permits met. Transportation of dangerous goods will be in accordance with the *Dangerous Goods Safety Management Act* and Regulations, the Australian Dangerous Goods Code, and AS 1678, AS 2809 and AS 2931, where relevant. Explosives (if required for seismic activities) will be stored in magazines constructed and located as prescribed in AS 2187. Refuelling of equipment will not occur within 100 m of a watercourse or a slope leading to a watercourse, excluding fixed plant (e.g. water pumps) located within an appropriate bund with an impermeable liner. Materials and equipment for responding to hazardous spill incidents will be provided and maintained. Spill mats and spill response kits will be available during refuelling and maintenance activities, and relevant personnel will be trained in their correct use. Machinery will be regularly inspected for fuel and oil leaks and will be maintained in good working order. Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils.

	Emergency response procedures will be developed and implemented. Small quantities (<250 kg) of contaminated soil may be transported to licensed facilities for disposal. Regulated waste transport (ir required based on waste type) and/or disposal permits for all contaminated materials (>250 kg) will be undertaken in consultation with DERM if soil is to be transferred off site (disposal permits may be required). Protective clothing, appropriate to the materials in use, will be provided. Regulated wastes e.g. hazardous wastes will be collected and removed from site (via a licensed waste contractor) for recycling, reuse or disposal at a facility licensed to accept such wastes. Onsite licensed dams may be used for disposal of some regulated wastes (e.g. produced water and hydrotest water with chemcials added). Waste oil and chemical storage areas will be suitably bunded in accordance with DERM requirements will be stored and handled in accordance with the relevant Australian Standards (e.g. AS 1940) and Fire Safety regulations. **Sewage** Refer to control strategies described in Section 11.4**.** **Hydrotest Wastes** Hydrotest water will only be discharged to appropriately licensed dams and will not be discharged to waters (including waterways and drainage lines that are not licensed to receive associated water). Management of hydrotest water shall not impact upon landholders and their property values. Additional hydrotest environmental protection commitments, objectives and control strategies are located in Section 12.3). **Training and Records** All personnel shall be instructed in project waste management practices as a component of the environmental induction process. Records of all regulated wastes stored, and removed from site (including disposal locations) will be maintained. Records of wastes disposed or treated on PL 446 will be maintained. Safety and response training will be provided for all personnel.
Performance Indicators	No complaints in relation to waste management. Any recorded complaints are actioned and closed out. Evidence of appropriate handling and treatment of contaminated land is maintained. Any contamination or spill incidents are effectively documented and closed out. Wastes are appropriately segregated and stored onsite. Regulated waste transport forms are kept on site. No evidence of uncontained contamination / spills and evidence maintained for the appropriate management of spills. Appropriate storage and handling of fuel and chemicals. No presence of flammable material in work areas.

12.0 Water Resources

Specialist surface water and groundwater assessment (RPS 2010b) has been undertaken for the proposed SSSF project, in particular, attention was focused on the underlying hydrogeology of the Silver Springs site, aquifers and aquifer connectivity and existing bores.

Potential impacts to water resources are discussed in Section 12.2 and associated control strategies and mitigation measures are discussed in Section 12.3. The full Hydrological report is provided in Appendix 9.

12.1 Description of Environmental Values

12.1.1 Surface Water

PL 446 extends in a generally southwest to northeast direction along the Thomby Range (a low rocky group of hills). The Thomby range acts as the watershed between two river basins, the Moonie River Basin and the Balonne – Condamine River Basin.

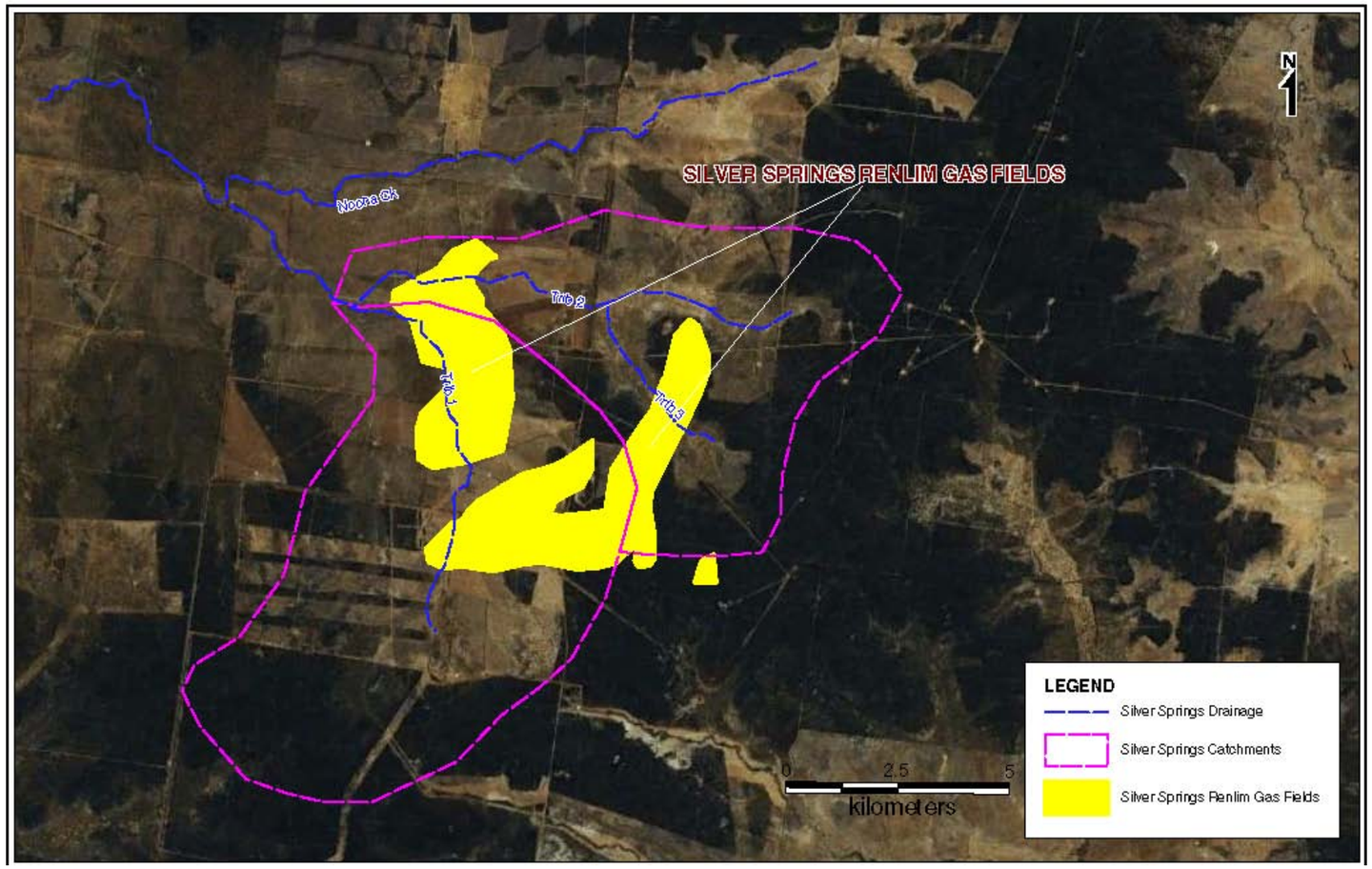
Those areas of PL 446 draining to the south and east, drain into Christmas Creek and Rocky Creek, which then flow into the Moonie River or its tributaries. Those areas of PL 446 which drain to the west, drain into Meroombil Creek, Boggo Creek and Noona Creek, which in turn drain into the Balonne River upstream of Beardmore Dam (refer Figure 17).

Given that a large part of the lease is located along the Thomby Range (a watershed boundary) it is considered unlikely that widespread or extended duration flooding would occur across the area. There is a general absence of information available in the vicinity of PL 446, with no stream gauging stations within PL 446 or on streams emanating from it and no historical records were identified during desktop searches. However, the Site Supervisor who has been involved with the site for over 20 years indicated that flooding has not been a significant issue on site:

"There is no site specific data for flooding on site. The Silver Springs operations plant site has never flooded. During the flood times Boxleigh Creek floods which is the nearest watercourse but does not cause an issue to the Silver Springs Plant or access to some wells. There are also a couple of the watercourses between the plant and Roma that flood restricting access to the site."

12.1.1.1 Water Resource Plans

As PL 446 effectively straddles two water catchment areas (one either side of the Thomby Range), it is also covered by two Water Resource Plans (ancillary legislation to the *Water Act 2000*): the *Water Resource (Condamine Balonne) Plan 2004* and the *Water Resource (Moonie) Plan (2003)*. Both of these plans restrict the take of overland flow; however, as no overland flow will be taken as part of proposed project activities, it is considered that they are not applicable to the project. Proposed project water for general use (e.g. dust suppression) will be sourced from existing bores on PL 446 with hydrotest water being potable quality water sourced from Surat (refer Section 3.5.2.7) via licensed water carriers.



Source: RPS 2010b

Figure 17: Surface Water Drainage of the Silver Springs Gas Field

12.1.2 Wetlands and Springs

12.1.2.1 Narran Lake Nature Reserve

A search of EPBC Protected Matters Database indicates that PL 446 occurs within the catchment of the Ramsar wetland - Narran Lake Nature Reserve, New South Wales (DEWHA 2010). The Narran Lake Nature Reserve covers part of a large terminal wetland of the Narran River in New South Wales at the end of the Condamine River system flowing from Queensland. It covers over 5,500 ha in north west New South Wales, approximately 75 km north west of Walgett. The area is internationally significant for waterbird breeding and as habitat for a number of species listed under the JAMBA and CAMBA conventions.

PL 446 is remote from this reserve, being located approximately 290 km to the north-east of Narran Lake. Given the distance to the Narran Lakes and the fact that there are no watercourses within the proposed SSSF project area, project activities are considered highly unlikely to have any direct impact on the wetland.

12.1.2.2 Great Artesian Basin

The Great Artesian Basin (GAB) hosts a large number of springs which are broadly classified by DERM as recharge or discharge springs.

Discharge springs of the GAB are located near areas where GAB aquifer units are exposed at the surface and, in relation to PL 446, typically occur in recharge areas northeast of the project site. The discharge springs of the GAB are generally located in areas well down gradient from recharge areas and manifest as groundwater discharge related to either structural (fault related) or stratigraphic (e.g. unconformities against basement inliers) features. The Thomby Range (traversing PL 446) is considered a recharge area of the GAB however no springs are documented in the Thomby Range area.

Faults have been mapped near the Silver Springs field however available data for GAB shows no springs within 100 km of the proposed SSSF location (BRS 2004).

12.1.3 Produced Water

Historical records of produced water volumes from the Silver Springs Field / Renlim Field (July 2006 to December 2009) (DEEDI 2010 in RPS 2010b), show that water production from the Silver Springs / Renlim field has declined from 6.4 ML over the six months from July – December 2006 to 1.13 ML over the six months from July – December 2009. Actual production data provided by AGL (refer LDP, Appendix 3) shows produced water generated in the previous two years has been between 0.24 and 0.31 ML/day. However, this period also coincides with depletion of the reservoir and winding down of production.

Production modelling (RPS 2010b) has identified that water production will be approximately 50 kL/day and relatively constant during extraction of the first 28.9 Bscf of gas (plateau phase) and then increase significantly during withdrawal of the remaining gas (decline phase) 350 kL/day.

AGL are currently investigating a range of potential disposal options for produced water generated by the proposed SSSF project. Options currently being assessed include (but are not limited to) re-injection and

beneficial re-use, with evaporation ponds being considered as a last resort. A Water Management Plan (including management of produced water from existing and on-going PL 446 activities) will then be developed and submitted to DERM for approval within 18 months of the grant of this EA application. As water production from the SSSF will not occur until commencement of the withdrawal phase in 2014, this will allow a further 18 months to implement the plan prior to the withdrawal phase.

Produced water from existing activities and current disposal methods are detailed in the OEMP (Sections 2.8.4 and 6.13.1 of Appendix 1) along with AGL's interim commitments regarding groundwater, water quality and dam certification. These measures will be captured in the AGL Water Management Plan and once developed and approved, all water on PL 446 will be managed in accordance with this plan.

12.1.3.1 Hydrotest Water

AGL propose to source potable quality water from Surat via a licensed water carter. As high quality water will be used for hydrotesting, the use of chemicals (e.g. biocides, corrosion inhibitors or oxygen scavengers) is not anticipated.

AGL's preferred hydrotest disposal option is to one of the existing licensed dams (Silver Springs 4) on PL 446. This dam has been operated in compliance with the conditions of IA 150,120 and will be operated in accordance with the conditions of the EA for the proposed SSSF and continued PL446 activities.

The volume of hydrotest water required for the proposed SSSF project is less than 1,000 L. This does not represent a significant volume in comparison to the capacity of the proposed destination dam and given that chemicals are unlikely to be added, it is considered that disposal of hydrotest water to this dam will not result in any significant impacts to available dam capacity or water quality.

12.1.4 Groundwater

12.1.4.1 Aquifers

A total of twelve geological formations considered to be aquifer units have been identified in the vicinity of the Silver Springs field (RPS 2010b). A summary of these aquifers and details of their associated recharge and discharge is provided below in Table 28.

12.1.4.2 Aquifer Connectivity

As shown in Figure 7, a geological fault has been inferred from historical seismic data and lies approximately 10 km to the west of the Silver Springs gas field. This fault is also shown on the 1:250,000 scale Surat geological sheet. The significance of this fault to regional groundwater flow is uncertain; however, it is unlikely that this feature impacts on either Showgrounds Formation or the Snake Creek Mudstone Member given that no leakage or seepage has been recorded from the Silver Springs / Renlim gas field. Where this fault may have intersected the Snake Creek Mudstone, it has not created a vertical pathway of sufficient permeability to allow vertical migration of hydrocarbons (RPS 2010b).

The Showgrounds Formation (the depleted reservoir) is considered to be effectively confined below the Snake Creek Mudstone Member of the Moolayember Formation. This argument is reinforced by the

results of a DEEDI study which rated of the gas sequestration potential of 35 basins in Queensland using the following criteria:

- A viable reservoir seal;
- A reservoir seal situated in the correct stratigraphic position;
- No fault or joins breeching the seal proximal to the shortage unit;
- The base of the seal below 800 m;
- Sufficient formation porosity; and
- Sufficient formation permeability

DEEDI identified that the Snake Creek Mudstone Member forms a regionally significant seal and concluded that the Showgrounds reservoir was a viable option for gas storage, based on the following:

- A viable seal located at a depth below 800 m;
- A formation located below the regionally contiguous Snake Creek Mudstone Member seal;
- Formation porosity greater than 10%; and
- A median formation permeability of 14 mD.

Based on the above, it is reasonable to conclude that the Showgrounds Formation aquifer / reservoir is effectively confined by the Snake Creek Mudstone Member and does not have any direct natural connections to surface water systems.

Any effective connection between this formation and the overlying, younger aquifer units of the Surat Basin section of the Great Artesian Basin could only occur via existing deep boreholes if the integrity of the annular cementing and casing has been compromised.

12.1.4.3 Bores

Searches of the DERM Groundwater Database (GWDB), Queensland Digital Exploration Reports (QDEX) and the Queensland Petroleum Exploration Data (QPED) identified numerous bores within 20 km of the project site. However, only 20 bores were identified as being located in or in the immediate vicinity (within 3 km) of the Silver Springs or Renlim fields (refer Figure 18). Of these, none are listed in the DERM GWDB as having been completed as water bores tapping the Showgrounds Formation; but six are shut-in petroleum wells and these remain open to the Showgrounds Formation.

If shut in wells originally drilled into the Showgrounds Formation have casing and annular cementing in sound condition, providing isolation to other overlying formations or aquifers, then there will be no means of communication from the Showgrounds Formation to other formations. Where casing or annular cementing may be in poor condition or of poor quality, then the potential for vertical fluid or gas transfer from the Showgrounds Formation to other formations may exist.

Table 28: Aquifers in the Vicinity of Silver Springs

Geological Formation	Average Salinity (mg/L)	Notes	Recharge	Discharge
Griman Creek Formation	3,500	Water hosted by this formation is generally unsuitable for human consumption.	Via direct precipitation where it is exposed at the surface, north, south and east of Silver Springs.	Occurs to Balonne River Alluvium during periods of very high storage. Otherwise via evapotranspiration or abstraction.
Surat Siltstone	870	Generally suitable for human consumption except for some brackish areas.	Via direct infiltration of precipitation where it outcrops well to the north and northwest of Silver Springs.	Dominated by groundwater abstraction. Otherwise discharge to Balonne River Alluvium during periods of high storage.
Bungil Formation	1,350	Water hosted by this formation is generally unsuitable for human consumption.	Infiltration of precipitation and ephemeral streamflow in its belt outcrop north of Roma.	Diffuse upwards flow and subsequent evaporation. Otherwise via springs in South Australia.
Mooga Sandstone	1,000	Water hosted by this formation is generally unsuitable for human consumption.	Infiltration of precipitation and ephemeral streamflow in its outcrop areas north of Roma.	Diffuse upwards flow and subsequent evaporation. Otherwise via springs.
Orallo Formation (minor aquifer only)	2,400	Water hosted by this formation is generally unsuitable for human consumption.	Infiltration of precipitation and ephemeral streamflow in its outcrop areas north of Roma.	Diffuse upwards flow and subsequent evaporation. Otherwise via springs.
Gubberamunda Sandstone	750	Water hosted by this formation is generally unsuitable for human consumption.	Infiltration of precipitation and ephemeral streamflow in its outcrop areas north of Roma.	Diffuse upwards flow and subsequent evaporation. Otherwise via springs, vertical leakage to overlying aquifers and abstraction. .
Westbourne Formation (minor aquifer only)	790	-	Expected to be similar to Gubberamunda Sandstone.	Expected to be similar to Gubberamunda Sandstone.
Springbok Sandstone	1,150	-	Occurs in north and eastern sections of Surat Basin.	Potential groundwater exchange with uppermost water bearing strata in the Walloon Coal Measures.
Walloon Formation (Walloon Coal Measures)	4,500	Frequently tapped for stock bores.	Most recharge will occur in eastern and north-eastern margins on the western slope of the Great Dividing Range.	Abstraction
Hutton Sandstone	900	-	Most recharge will occur in eastern and north-eastern margins on the western slope of the Great Dividing Range.	Major discharge route is via abstraction. Natural discharge occurs via springs and adjoining sedimentary formations south of Silver Springs.

Geological Formation	Average Salinity (mg/L)	Notes	Recharge	Discharge
Evergreen Sandstone (Boxvale sandstone member)	3,500	Water hosted by this formation is generally unsuitable for human consumption.	Most recharge will occur in eastern and north-eastern margins on the western slope of the Great Dividing Range.	Major discharge route is via abstraction. Occurs via spring discharge and ultimately upward migration into shallower formations.
Precipice Sandstone	175	Very good domestic quality water from outcrop areas.	Most recharge will occur in eastern and north-eastern margins on the western slope of the Great Dividing Range.	Significant discharge occurs close to outcrop areas (well to north of Silver Springs) to Dawson River and artesian springs. Otherwise via upward migration via major regional fault systems well to the east of Silver Springs (e.g. Leichardt – Burunga / Goondiwindi – Moonie fault systems).

Source: Modified from RPS 2010b

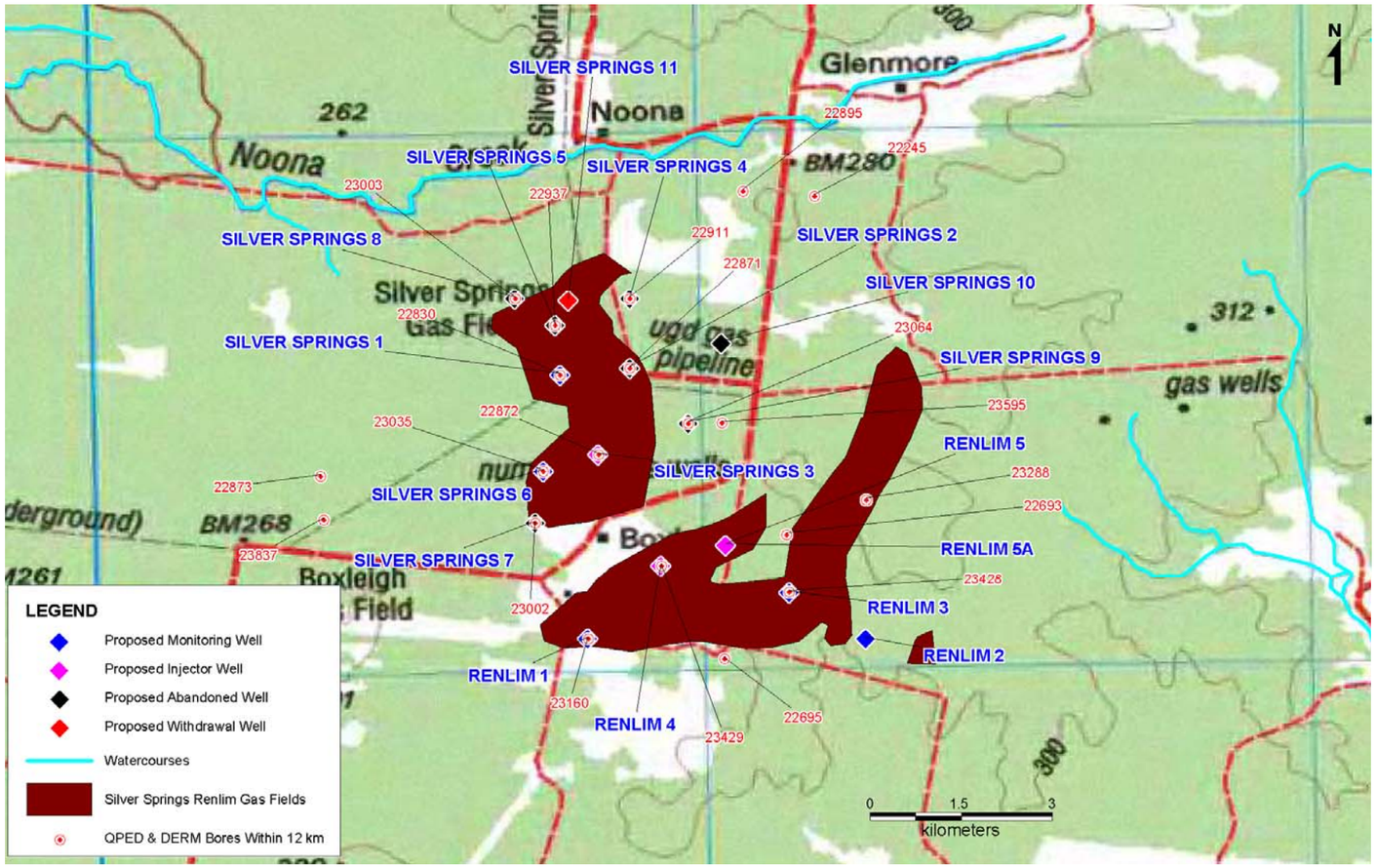


Figure 18: Potential Receptor Bores

12.2 Potential Adverse or Beneficial Impacts on Environmental Values

12.2.1 Surface Water

As no watercourse or drainage lines are intersected by proposed project infrastructure, impacts to surface water could result from diversion of overland flows, erosion and sedimentation during heavy rainfall events and potential water contamination.

The project was identified as being within the catchment area of one Ramsar Wetland (Narran Lakes); however, this area is approximately 280 km from the project site. Given the distance involved and the implementation of appropriate erosion and sedimentation controls as detailed in Section 6.4, no impacts to the Narran Lakes are anticipated as a result of proposed project activities.

Any topsoil stockpiled as part of construction activities (including preparation of drill pads for wells) may adversely impact overland flow / drainage patterns and where inappropriately protected may result in sedimentation impacts to the surrounding area. Soil stockpiles will have appropriate erosion and sediment controls (in accordance with IECA guidelines and given the fact that most topsoil will be used to rehabilitate construction areas outside of planned operational footprints, these stockpiles will be temporary in nature and impacts associated with altered overland flow and sedimentation are anticipated to be negligible.

Non-toxic, water based drilling fluids and cuttings utilised during well drilling operations may be stored in lined pits within the construction footprint of well sites. Where this occurs, drill fluids will be disposed into one of the evaporation ponds located at the Silver Springs Plant and cuttings will be left to dry in-situ and reused for site rehabilitation purposes.

Given the relatively flat site topography and the lack of watercourses in the vicinity of the proposed SSSF location coupled with the implementation of AGL's Spill Response Plan it is anticipated that even where contamination may occur it will be highly localised and minor.

12.2.1.1 Stormwater Management

Environmental protection commitments, objectives and control measures associated with stormwater management are mainly associated with implementation of appropriate erosion and sediment control measures and on-going maintenance to ensure ground stability. Erosion and sedimentation commitments, objectives and control strategies are detailed in Section 6.4.

12.2.2 Produced Water

As discussed in Section 12.1.3, AGL are still assessing a number of options with regard to disposal of produced water; However, AGL will develop and implement a Water Management Plan within 18 months of the grant of this EA and produced water generated during the withdrawal phase of the proposed project will be managed in strict accordance with this plan. Details of the proposed content of the Water Management Plan, interim monitoring measures and the proposed timeframe for its development are detailed in Section 2.8.4 of the OEMP (Appendix 1).

12.2.3 Hydrotest Water

Given that the proposed volume of hydrotest water required is less than 1,000 L, in comparison to the capacity of the receiving, it is considered that this does not represent a significant addition to the dam and is unlikely to impact on the ability of the dam to accept current produced water from existing PL 446 activities. As chemicals are unlikely to be added, the risk of adverse impacts to water quality as a result of hydrotest disposal are considered negligible.

12.2.4 Groundwater

Minor spills of fuel or chemicals represent potential sources of contamination to shallow groundwater, as does loss of containment from the drilling fluid pits, but as all chemicals will be stored in accordance with AS 1940 and measures to prevent contamination (as described in Section 6.4) will be implemented, contamination of groundwater as a result of project activities is considered unlikely.

12.2.4.1 Aquifers and Bores

There are two potential ways in which the proposed SSSF project may impact on aquifers within the project area and immediate vicinity. The first is through gas migration from the Showgrounds Formation into other vertically adjacent or connected aquifers and the second is via extraction of water during the withdrawal phase of the project.

Specialist assessment (RPS 2010b and RPS 2010c (petroleum reservoir assessment)) identified that the geological fault identified approximately 10 km from the Silver Springs gas field is not considered to adversely affect the confining nature of the Snake Creek Mudstone Member and there is no evidence that this fault represents a vertical migration pathway from the Showgrounds Formation.

In addition, the Snake Creek Mudstone Member has been identified as forming an effective capping unit and confining layer, preventing vertical migration from the Showgrounds Formation (RPS 2010b, 2010c and DEEDI 2009 in RPS 2010b). The presence of an intervening confining unit between the aquifers tapped and the very much deeper Showgrounds Formation also means that the 14 bores identified within the Silver Springs / Renlim gas field are unlikely to be adversely impacts by the proposed SSSF project.

If shut in wells that have been completed to produce from the Showgrounds Formation have casing and annular cementing in sound condition providing isolation to other overlying formations or aquifers, then there will be no means of communication from the Showgrounds Formation to other formations. It should be noted that in the production history of the Showground Formation, there has been no evidence of communication from overlying formations. Should the casing be determined to be in poor condition or the annular cementing isolation of these wells show poor quality, then the potential for vertical fluid or gas transfer from the Showgrounds Formation to other formations and aquifers may exist. It is the intention of AGL to run Ultrasonic Imaging Logs in all monitoring and injection, and production wells to ascertain the quality of the casing and cement behind pipe (refer also Section 3.4.3.3). Repairs would be initiated if possible and if not deemed suitable the well or wells would be plug and abandoned and a replacement well drilled.

The withdrawal phase of the project will produce between 50 – 350 kL/day of associated water, which is not considered to be a large volume of water. Given that no water bores within 20 km of the proposed

project location tap the Showgrounds Formation, it is considered that impacts e.g. aquifer drawdown to other water users will be minimal.

Associated water may also represent a significant waste stream for the proposed SSSF. Water management options for the proposed SSSF are currently being evaluated by AGL with re-injection being the preferred option. As associated water will not be produced until the withdrawal phase (commencing 2014), AGL propose to complete their evaluations then formulate a water management plan for the SSSF and submit it to DERM for approval prior to the commencement of the withdrawal phase.

12.2.5 Sewage Treatment and Disposal

It is proposed that portable sewage systems (i.e. port-a-loos) will be utilised by the proposed SSSF, with sewage to be transported and disposed of, to existing local treatment facilities by appropriately licensed contractors. As such, impacts to water resources as a result of sewage treatment and disposal are anticipated to be negligible.

12.3 Environmental Protection Commitments, Objectives and Control Strategies – Water

Environmental Protection Objective	To minimise and manage impacts to water resources, including avoiding degradation of water quality, and maintaining water access and surface and ground water values. To avoid water contamination. To avoid impacts to wetlands.
Specific Objectives	To minimise short-term, and prevent long-term, interruption or modification to surface drainage patterns from construction activity. To minimise erosion. The amount of sediment entering surface water features during construction. To maintain surface drainage patterns throughout operations. To minimise disruption to third party use of surface water. To prevent spills occurring and if they occur to minimise their impact. To ensure that rubbish and waste material are disposed of in an appropriate manner. To prevent impacts as a result of hydrotest water, produced water and waste water (e.g. washdown water) disposal. To ensure the safe and appropriate disposal of camp wastewater (greywater, sewage). To prevent contamination of ground and surface water due to the storage and use of hazardous materials. To achieve consistency with the objectives of the Environmental Protection (Water) Policy 2009. To achieve consistency with the goals and requirements of the Water Resource (Condamine Balonne) Plan 2004 and the Water Resource (Moonie) Plan 2003.
Control Strategies	**Erosion and Sediment Management** Refer to Section 6.4. **Drilling** Drilling equipment will be in good order. No hydrocarbon or synthetic oil based drilling fluids will be used. Drilling fluid containment pits (where used) will be appropriately lined and monitored to minimise risk of loss of containment. Drill cuttings may be dried and used for rehabilitation purposes or disposed of in accordance with approval requirements. Stockpiled soils will be protected with appropriate erosion and sedimentation controls in accordance with IECA guidelines (IECA 2008).

	Well Integrity Testing Wells proposed to be used as injection / withdrawal or monitoring wells will be integrity tested prior to use and where integrity has been compromised replacement wells will be drilled. Shut in wells known to tap into the Showgrounds Formation will be subject to integrity testing and either remediated, plugged and abandoned or temporarily suspended as potential future withdrawal wells. If wells are temporarily suspended, a bridge plug will be placed directly above the Showgrounds perforated interval ensuring isolation of the well. **Gas Injection and Monitoring** Injection pressures will be kept below the sand face injection pressure to minimise potential for damage to the reservoir formation. Monitoring of pressure development and degree of gas-water saturation will be undertaken during injection and withdrawal phases. **Hydrotest Water Sourcing and Disposal** Hydrotest water will only be discharged to appropriately licensed dams and will not be discharged to waters (including waterways and drainage lines that are not licensed to receive associated water). Management of hydrotest water shall not impact upon landholders and their property values. **Produced Water Disposal** Produced water will be disposed of in strict accordance with AGL's Water Management Plan which will be developed prior to commencement of the withdrawal phase of the project. **Sewage Treatment** Where drilling camps are required, portable facilities (i.e. port-a-loo) will be provided, with all to be transported and disposed of to existing local treatment facilities by an appropriately licensed contractor. **Hazardous Materials and Wastes** Refer to Section 11.4.
Performance Indicators	No complaints in relation to water resource impacts. Any recorded complaints are actioned and closed out Any contamination or spill incidents are effectively documented and closed out. No hydrocarbon or synthetic oil based drilling fluids used for drilling operations. No evidence of erosion at construction sites (compressor, wells and flowlines). Gas injection pressures maintained below sand face injection pressure.

13.0 Decommissioning and Rehabilitation

13.1 Construction

Details of post construction rehabilitation and decommissioning programs are provided in Sections 3.6.1, 3.6.3 and 6.4

13.2 Operation

The SSSF is expected to have an operational life consistent with the operational life of PL 446, after which decommissioning and rehabilitation will occur. At this time, the wells, compressor station and associated facilities will be decommissioned in accordance with the regulatory requirements and accepted current environmental best practices of the day. Currently, decommissioning procedures require the removal of all above ground infrastructure, the restoration of associated disturbed areas and in-situ decommissioning of underground flowlines.

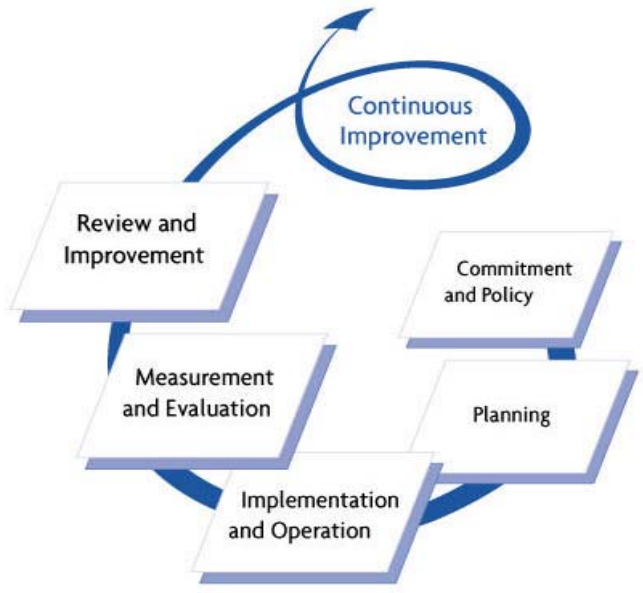
14.0 Environmental Management System

14.1 AGL Environmental Management System

The AGL Health, Safety and Environment (HSE) Policy is presented in Appendix 10. This policy governs the development of AGL's HSE Management System 'Life Guard' (AGL 2004) which together are the key tools used to manage environmental responsibilities, issues and risks. The HSE management system is designed to direct the establishment and implementation of a framework of requirements, policies, standards, compliance guides and management practices for consistent and continuous improvement in AGL's HSE performance. The main objectives of the Life Guard HSE management system are:

- To ensure the environment is protected from activities;
- To keep people well and safe, and
- To continuously improve performance in these areas.

The HSE continuous management improvement approach (see Figure 19) ensures that the level of HSE performance continuously improves and that best practice is regularly incorporated into the system and shared by all users.

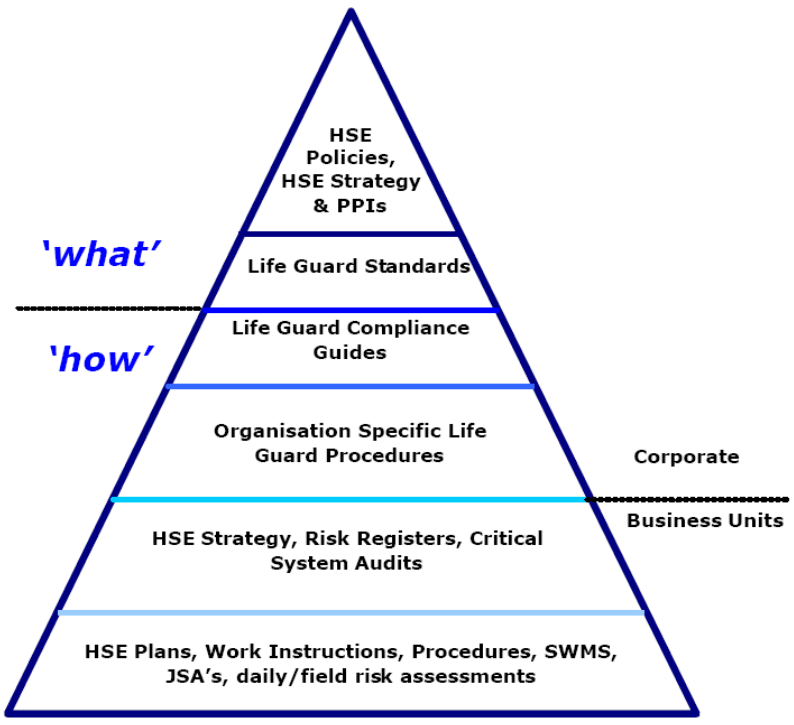


Source: AGL 2004

Figure 19: The Continual Improvement Model of the Life Guard HSE Management System

The principles of the HSE management framework are implemented through a hierarchical documented system as shown in Figure 20 which includes documentation such as corporate policies, strategies and standards as well as operational compliance guides, procedures, plans, audits and risk assessments.

The environmental standards and processes within the HSE Management System are aligned with the international standard AS/NZS ISO14001:2004. The HSE Management System has been established to ensure that each business unit within AGL identify environmental risks and implement controls throughout all stages of every activity. This EMP forms part of this environmental management framework.



Source: AGL 2004

Figure 20: A Diagrammatic Representation of the Life Guard Management System Hierarchy of Documentation

14.2 Roles and Responsibilities

AGL is responsible for overall environmental management of PL 446 through the implementation of this EMS and the leadership of the Head of Gas Operations and the Production Manager. However, all personnel and contractors are accountable through conditions of employment or contracts. Each individual is responsible for ensuring that their work complies with all regulatory requirements, AGL commitments and the appropriate procedures.

Some positions within AGL have specific responsibilities and obligations in terms of managing HSE matters associated with PL 446 operations. These key personnel and their responsibilities are outlined in Table 29.

Table 29: SSSF Organisation and Accountabilities

Role	Accountabilities
Head of Gas Operations	Directly responsible for the management of the field development and production activities, including implementation of environmental management. Reports to the Group General Manager Upstream Gas
Drilling Completions Manager	Directly responsible for the overseeing and fulfilment of commitments contained in this EMP.
Drilling Specialist	Directly responsible for the fulfilment of commitments contained in this EMP. Reports to the Completion / Drilling Engineer regarding the drilling operations environmental performance and due diligence.
Land and Approvals Manager	Directly responsible for the overseeing and fulfilment of commitments contained in this EMP. Responsible for landowner consultation and notification. Reports to the Head of Land and Approvals with a dotted line to the Head of Gas Operations regarding compliance with the Project's environmental and other requirements.
Environment Manager	Provides advice to the workforce, through the Head of Gas Operations, regarding the implementation of the EMP. Coordinates the monitoring and audit program.
Production Manager	Directly responsible for the fulfilment of commitments contained in this EMP and for ensuring Construction and Rehabilitation contractors comply with the environmental objectives and the EMP.
Health and Safety Manager	Directly responsible for health and safety of staff and contractors working on site are responsible to ensure compliance with AGL's HSE Contractor Management System. Responsible to ensure a safe work culture is being adhered to on site in order to achieve zero LTI's.
Construction Contractors	Responsible for ensuring that works are in compliance with the EMP, meeting regulatory requirements, and ensuring that all environmental objectives contained in the contracts are attained. Report to the Senior Project Engineer.
Drilling Contractors	Responsible for ensuring that works are in compliance with the EMP, meeting regulatory requirements, and ensuring that all environmental objectives contained in the contracts are attained. Report to the Drilling Specialist and the Completion / Drilling Engineer.
Petroleum Engineer/Operations Supervisors and Field Engineers	Field based personnel responsible for ensuring Production Operations comply with the environmental objectives and the EMP.
Environmental Auditors	External to AGL and contracted to conduct periodic audits according to the principles of this EMP and relevant environmental legislative compliance

14.3 Project Specific Documentation

14.3.1 Water Management Plan (WMP)

A WMP will be developed prior to withdrawal of gas from the reservoir to address volumes of water produced by the SSSF and the preferred disposal methods. The WMP will also contain details of AGL's proposed ground water and water quality sampling. Certification of the dams by an appropriately qualified engineer will also be undertaken prior to production of water from the SSSF and the relevant details will be included in the WMP.

14.3.2 Operations Environmental Management Plan (OEMP)

The OEMP includes a summary of legal and community requirements and the responsibilities of all levels of personnel involved with the project, along with guidance on the management of environmental impacts during operational activities on PL 446. Please see Appendix 1 for the OEMP.

The OEMP currently addresses only those activities previously authorised under PL 16 however, upon completion and commissioning of the SSSF, the OEMP will be updated to include this facility and all activities on PL 446 will then be conducted in accordance with the OEMP, other project specific documentation and the conditions of the relevant EA.

14.4 Induction and Training

All construction personnel, including contractors, must attend a Health Safety and Environment (HSE) induction. All personnel will be made aware during the induction of relevant environmental obligations and the need to perform all activities in an environmentally responsible manner.

Inductions and training will aim to outline a range of HSE issues including:

- Every person's general duty of environmental care in accordance with Section 319 of the *Environmental Protection Act 1994*;
- AGL's Environmental Policy and regulatory requirements;
- The significance and potential environmental effects associated with their work requirements;
- Personnel roles and responsibilities for environmental performance;
- The relevant objectives and requirements of the EM Plan, EA and other associated documents; and
- Emergency response system and incident reporting protocols.

Job specific training will also be undertaken where applicable and will cover general environmental management issues such as:

- Terrain and vegetation management;
- Fauna management;
- Watercourse drainage and stormwater management where applicable;
- Erosion prevention and control;
- Spill prevention, containment and equipment;

- Management of hazardous substances;
- Environmental monitoring;
- Landowner management; and
- Corrective actions and continual improvements.

It is the responsibility of each contractor to prepare and implement an induction and job specific training program appropriate to their methods of work that comply with AGL's requirements. Approval from AGL shall be obtained prior to implementation as per the EMS and all training will be recorded in a training register to ensure that all personnel are trained prior to commencing work.

14.5 Environmental Inspections and Audits

During construction, the construction sites will be regularly inspected and findings reported to AGL to ensure compliance with the EM Plan and EA Conditions. The construction contractor's environmental personnel will be required to report on compliance with environmental requirements. During environmental inspections, specific attention will be paid to aspects such as:

- Any complaints received and the management and close-out of such;
- Extensive or prolonged visible dust clouds in proximity to sensitive receptors;
- Integrity and function of erosion and sedimentation control measures;
- Visible turbid plumes in watercourses;
- Evidence of erosion on construction sites, flowline ROWs or drilling sites;
- Housekeeping, cleanliness of the site and appropriate waste disposal;
- Appropriate storage and handling of fuel and chemicals;
- Appropriate soil stockpiling and segregation of topsoil and subsoil where applicable (e.g. easements where new flowline sections are required);
- Evidence of soil inversion (colour) or contamination / spills;
- Reinstatement of soil profiles and surface contours outside those areas required for operations;
- Presence of flammable material in work areas where hot work (e.g. welding) is conducted and at operational facilities;
- Presence of declared weeds on construction sites, flowline ROWs or drilling sites;
- Effectiveness of vegetation protection measures (e.g. avoidance of remnant vegetation, topsoil and vegetation storage for reinstatement of construction sites and flora and fauna protection);
- Implementation of fauna protection measures on flowline ROW and where any other excavations are required (e.g. ramps, excavation inspections);
- Restriction of activities to construction sites, flowline ROWs, drilling sites and approved access and extra work areas;
- Appropriate handling and treatment of Contaminated Land should it be identified;
- Evidence of contamination / spills;

- Gas leak detection; and
- Implementation of heritage management procedures.

Actions arising from audits conducted during the construction phase are to be documented and reported to the Life Guard Committee. The Life Guard Committee shall be responsible for ensuring any actions are implemented.

Additional on-site inspections or investigations will be undertaken in the event of significant environmental incidents. The Environment Manager will be responsible for regular review of the environmental performance of each site and of site personnel during the construction phase.

Audits will be undertaken to ensure compliance with the EM Plan and EA. This will enable non conformances to be identified and preventative action implemented to prevent recurrence.

Operations management and auditing procedures undertaken during the operational phase will be as per the OEMP (Appendix 1).

14.6 Monitoring

Specific monitoring or reporting as required by the conditions of the EA will be undertaken. Monitored activities during the construction phase will include the following:

- Cultural heritage monitoring will be undertaken in accordance with duty of care guidelines and the CHMP. Monitoring of sites will be undertaken by Aboriginal Party representatives or other approved personnel;
- Run-off / erosion controls in susceptible areas during construction of the facility and associated infrastructure. The condition of these controls will be monitored during routine surveillance; and
- Standard operating procedures and maintenance and monitoring regimes for activities are in place to reduce the potential for a spill event.

Environmental monitoring may also be undertaken in response to nuisance complaints or as otherwise specified in the EA for the project. Specific monitoring, in accordance with recognised Australian standards and DERM guidelines, may be required in relation to:

- Dust nuisance (in response to a request by the DERM or reasonable complaints);
- Noise nuisance (in response to a request by the DERM or reasonable complaints);
- Monitoring of aquifers and reservoir pressure identify reservoir performance and potential integrity issues; and
- Gas metering and monitoring gas pressures to test for gas leaks.

Monitoring records will be maintained as required by the EA.

For details of monitoring undertaken during operations refer to the OEMP (Appendix 1).

14.7 Reporting, Recording and Auditing

An appropriate and auditable record system will be maintained for the construction phase. Environmental reporting will be conducted in accordance with licence conditions.

Environmental records will include:

- Non conformance reports;
- Complaints;
- Environmental incidents;
- Remedial actions taken following incident and non-conformance reports and complaints;
- Inspection reports;
- Training and induction attendance;
- Consultation records and meeting notes;
- Audit reports; and
- Monitoring results.

Incident reporting will be implemented as per AGL's Incident reporting and Management procedure (HSE-02_1 HSE Incident Reporting Procedure). Incidents shall initially be reported via radio / phone the followed up with a written report recorded on the incident report form contained as an appendix to HSE-02_1.

All such incidents shall be investigated by the site supervisor and where a major environmental incident occurs an investigation team will be appointed by the Production Manager.

Incidents shall be reported as per the statutory timeframes set out in Schedule 2 of the *Petroleum and Gas (Production and Safety) Regulation 2004*

Operational reporting, recording and auditing procedures will be in accordance with the OEMP (Appendix 1).

14.8 Preventative and Corrective Action

14.8.1 Emergency Response Procedures

AGL recognise that emergencies arising from PL 446 activities could have serious and long term HSE impacts. Environmental emergencies could include:

- Fire / explosion;
- Gas leaks;
- Chemical spills, including oil;
- Dam break;
- Well blowout;
- Bushfire; and
- Third party property damage.

An Emergency Response Plan (ERP) is currently in place. This plan is detailed within the site production operations safety management plan (SMP) in accordance with legislative requirements under the *Petroleum and Gas (Production and Safety) Act 2004*.

An emergency is any incident involving the SSPP, PL 446 infrastructure and all associated equipment, plant, personnel and vehicles that has caused, or has the potential to cause injury or damage and requires immediate corrective action. AGL has developed an Emergency Response Plan (ERP) designed to address emergency situations. The plan details the immediate corrective actions to be implemented in response to an emergency situation should one occur. It is the responsibility of the Production Manager and the Site Operations Supervisor to develop, implement and monitor the ERP and ensure that operators and visitors are aware of their responsibilities in case of an emergency.

14.8.1.1 Training and Simulations

Emergency response exercises and training drills are critical to test and practice crews in effective emergency response, notification, escalation and investigation. AGL ensures that:

- Desktop exercises are conducted at least every 3 months to test and validate emergency response procedures;
- Fire / emergency response drills are be completed once per month per shift; and
- Training drills challenge crews and put them under pressure to respond to potential real life situations that involve multiple events. The structure of the emergency response team for PL 446 and surrounding AGL tenures (e.g. PL 46, PL 119 and PL 192) in shown in Figure 21.

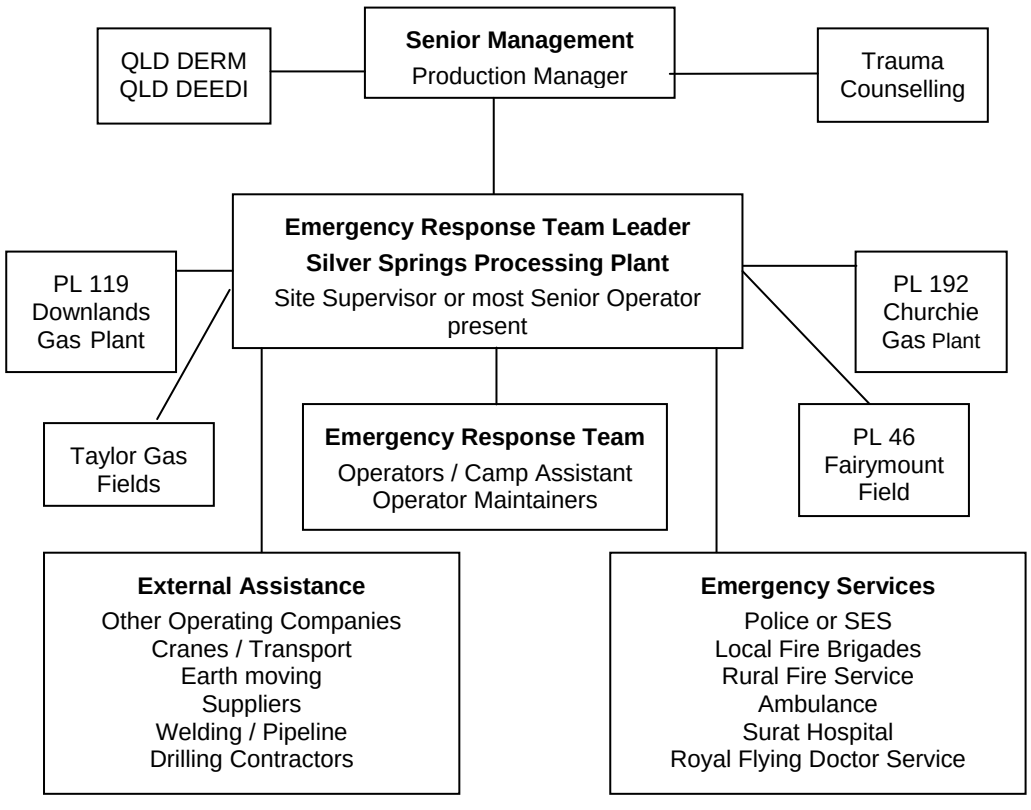


Figure 21: The structure of the emergency response team for PL 446 and surrounding AGL tenures

15.0 Conclusion

AGL is confident that the proposed construction and operation of the Silver Springs Gas Storage Facility will not cause significant disturbance to existing environmental or social values within the project area.

Specialist hydrology and petroleum reservoir assessments identified that the Showgrounds Formation which hosts the Silver Springs / Renlim gas field is an ideal candidate for gas storage with high porosity and good permeability. These assessments also confirmed that the Snake Creek Mudstone Member forms a regionally significant seal and acts as an effective capping and confining unit, limiting migration of water and gas between the Showgrounds Formation and shallower overlying formations.

Based on the results of reservoir modelling, bottom hole injection pressures required to pump the gas into the reservoir will not exceed the original reservoir pressure. Consequently, impacts to reservoir integrity as a result of the injection process are not expected.

Air emissions from the proposed project are significantly less than the relevant EPP (Air) guidelines and with the implementation of appropriate attenuation measures, noise emissions will not result in noise nuisance at the closest sensitive receptors.

Ecological impacts associated with the site have been minimised through the proposed use of existing flowlines and wells (subject to integrity testing). Construction activities are therefore likely to be limited to pre-existing cleared areas, with minimal or no clearing anticipated.

Overall, desktop and field based assessments have concluded that the proposed SSSF presents a low risk of significant, long term or irreversible environmental and community impacts. Potential impacts will be further reduced through the implementation of targeted control strategies and mitigation measures (in line with industry best practice) contained in this EM plan, as well as strict compliance with the conditions of the relevant EA and other all project documentation (i.e. the OEMP).

16.0 References

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17.0 Abbreviations and Units

1923 Act Lease	A Petroleum Lease authorised under the *Petroleum Act 1923* (Queensland)
2004 Act Lease	A Petroleum Lease authorised under the *Petroleum and Gas (Production and Safety) Act 2004* (Queensland)
ACH Act	*Aboriginal Cultural Heritage Act 2003* (Queensland)
AES	Aggregate Environmental Score
AGL	AGL Gas Storage Limited
AHD	Australian Height Datum
APIA	Australian Pipeline Industry Association
AS	Australian Standard
bcf	Billion Cubic Feet
BG	British Gas
BIM	Block Identification Map
Bscf	Billion Standard Cubic Feet
BWP	Berwyndale to Wallumbilla Pipeline
CEMP	Construction Environment Management Plan
CHMP	Cultural Heritage Management Plan
CLR	Contaminated Land Register
CSG	Coal Seam Gas
DEEDI	Department of Employment, Economic Development and Innovation (Queensland)
^{o}C	Degrees Celsius
DERM	Department of Environment and Resource Management (Queensland)
DEWHA	Department of Environment, Water, Heritage and the Arts (Federal) (now DSEWPC)
DIP	Department of Infrastructure and Planning (Queensland)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (Federal) (formerly DEWHA)
DTMR	Department of Transport and Main Roads (Queensland)
EA	Environmental Authority
EIS	Environmental Impact Statement
EM Plan	Environmental Management Plan
EMR	Environmental Management Register
EMS	Environmental Management System
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Federal)
EP	Equivalent Persons
EP Act	*Environmental Protection Act 1994* (Queensland)
EP Regulation	*Environmental Protection Regulation 1998* (Queensland)
EPP AIr	*Environmental Protection (Air) Policy 2008* (Queensland)
EPP Waste	*Environmental Protection (Waste Management) Policy 2000* (Queensland)
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
ESA	Environmentally Sensitive Area

ESCP	Erosion and Sediment Control Management Plan
EVR	Endangered, Vulnerable or Rare
FA	Financial Assurance
GAB	Great Artesian Basin
GHG	Greenhouse Gas
GIS	Geographic Information System
GQAL	Good Quality Agricultural Land
g/s	Gram per second
GWDB	Groundwater Data Base
ha	Hectares
HSE	Health Safety and Environment
IA	Integrated Authority
IDAS	Integrated Development Approval System
kL	Kilolitres
km	Kilometres
kPa	Kilopascals
LCM	Lost Circulation Material
LDP	Later Development Plan
LGA	Local Government Authority
LNG	Liquefied Natural Gas
LP Act	*Land Protection (Pest and Stock Route) Management Act 2002* (Queensland)
m	Metre
MBbls	Thousand barrels
mD	Millidarcies
mg/Nm^3	Milligrams per normal cubic metre
ML	Megalitres
MMbbls	Million barrels
MMscf	Million Standard Cubic Feet
MMscf/d	Million Standard Cubic Feet per day
Mosaic	Mosaic Oil N.L.
m/s	Metres per second
MSDS	Material Safety Data Sheet
NC Act	*Nature Conservation Act 1992* (Queensland)
NCCP (Koala)	*Nature Conservation (Koala) Conservation Plan 2006* (Queensland)
NES	(Matters of) National Environmental Significance
NT Act	*Native Title Act 1993* (Federal)
OEMP	Operational Environment Management Plan
P&G Act	*Petroleum and Gas (Production and Safety) Act 2004* (Queensland)
PAP	Potentially Affected Party
PAWC	Plant Available Water Capacity
PL	Petroleum Lease

PPL	Petroleum Pipeline Licence
PSIA	Pounds per Square Inch Absolute
PSIG	Pounds per Square Inch Gauge
QCLNG	Queensland Curtis Liquefied Natural Gas
QDEX	Queensland Digital Exploration Reports
QGC	Queensland Gas Company Limited
QPED	Queensland Petroleum Exploration Data
RE	Regional Ecosystem (as defined under the Queensland *Vegetation Management Act 1998*)
ROW	Right-of-Way
SMYS	Specified Minimum Yield Stress
SPA	*Sustainable Planning Act 2009* (Queensland)
SSP	Silver Springs Pipeline (existing)
SSP 1/03	*State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslides* (Queensland)
SSPP	Silver Springs Processing Plant (existing)
SSSF	Silver Springs Gas Storage Facility
t	Tonne
TEC	Threatened Ecological Community
TEG	Triethylene Glycol
TVDss	True Vertical Depth sub-sea
ug/m^3	Micrograms per cubic metre
UGS	Underground Gas Storage
VOC	Volatile Organic Compounds
WONS	Weed of National Significance
WMP	Water Management Plan