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# Kupunn Springvale Coal Seam Gas (CSG) Deviated Well Paths Regional Interests Development Approval

Report to accompany an assessment application for a RIDA made under the *Regional Planning Interests Act 2014*



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Contents

# 1. Introduction

## 1.1 Purpose

The Applicants propose to undertake petroleum activities within an Area of Regional Interest (ARI) including Priority Agricultural Area (PAA) and Strategic Cropping Area (SCA). This report provides the required supporting information for an assessment application for a Regional Interests Development Approval (RIDA) under the *Regional Planning Interests Act 2014* (RPI Act) (the application).

## 1.2 Scope

Arrow Energy Pty Ltd (Arrow) is an integrated coal seam gas (CSG) company that explores and develops gas fields, produces and sells CSG and generates electricity. Arrow has been developing CSG since 2000 and supplying it commercially since 2004. The company delivers almost 20 per cent of Queensland's gas supply from its five CSG fields in the Surat Basin in south-east Queensland and the Bowen Basin in central Queensland.

A Gas Sales Agreement (GSA) between Arrow and the Shell operated QCLNG joint venture was announced in December 2017 which will see the commercialisation of most of Arrow's gas reserves in the Surat Basin through its Surat Gas Project (SGP). The collaboration between the parties relies upon the co-use of existing Arrow and QGC-operated infrastructure such as gas compression, processing and transmission infrastructure as well as water transport and treatment facilities. Utilising existing upstream infrastructure will reduce the potential for negative impacts to landholders and to communities.

In April 2020 Arrow received a Final Investment Decision from its shareholders to begin the construction and operation of the first phase of the SGP. This important decision from its shareholders allows Arrow to meet the commercial and technical obligations of the GSA.

This application addresses one component of the SGP, being 14 sub-surface well trajectories (paths) proposed on six Lots within Petroleum Leases (PL) 198, 238 and 252. The Lots the subject of this RIDA (subject land) are illustrated on Figure 2-1. Section 1.5 and Table 1-3 provides additional detail of the land holdings.

The proposed works occur wholly within PL198, 238 and 252 and are authorised under Environmental Authority (EA) EPPG00972513.

The scope of this assessment application is limited to the proposed activities under the subject land only. Resource activities on other/adjacent land associated with the installation or operation of any CSG wells, gathering lines and other associated infrastructure does not form part of the scope of this assessment application.

Arrow has undertaken an internal review of the well pads on adjacent land associated with the deviated well trajectories the subject of this application.

These well pads will be constructed and operated under an exemption pursuant to Section 22 of the RPI Act. Deviated well trajectories on land subject of this application will not be commenced until RPI Act requirements for the associated well pad have been satisfied.

## 1.3 Context

Section 29 of the RPIA requires that a RIDA be accompanied by a report that:

- Assesses the resource activity's impact on the ARI; and
- Identifies any constraints on the configuration or operation of the activity.

The *RPI Act Guideline 01/14 - How to make an assessment application for a regional interests development approval under the Regional Planning Interests Act 2014* provides further guidance about the matters to be addressed by an assessment application report. These requirements and the sections where they are addressed are listed in Table 1-1.

This report has also been drafted in accordance with the following additional RPI Act Guidelines:

- *RPI Act Guideline 02/14 - Carrying out activities in priority agricultural area;*
- *RPI Act Guideline 03/14 – Carrying out activities in the strategic cropping area;*
- *RPI Act Guideline 07/14 - How to identify a Priority Agricultural Land Use (PALU); and*
- *RPI Act Guideline 011/16 – Companion Guide.*

**Table 1-1: Assessment Report Information Requirements**

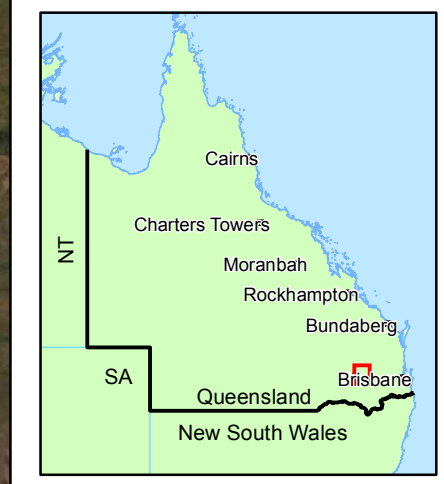
| Information Requirement | Section Addressed |
|---|---|
| The location, nature, extent (in hectares) and duration of the surface impacts of the proposed activity. | Refer Sections 3.2 (duration of activity) 4.4 & 5.2 |
| A description of the impact of the proposed activities on the feature, quality, characteristic or other attribute of the area. | Refer to sections 4 & 5 |
| Include a table identifying the location and surface area of each of the proposed activities. | Refer to Section 2 |
| The report must also include an explanation of how the proposed activity will meet the required outcome/s and address the prescribed solution/s contained in the assessment criteria for the area of regional interest. | Refer to Section 12 |
| Locality Map | Refer to Figures 1-1 & 2-1 |
| Site Plan(s) | Refer to Appendix 3 |

# ARROW ENERGY - SURAT BASIN

151°0'E

27°0'S

PL185
PL493
PL253
PL1053
PL194
PL1052
Kogan
PL230
PL252
PL260
DALBY
PL198
PL238
PL1039
ATP746
PL1040
PL258
Cecil Plains
PL1042
PL1041
PL1043
ATP683



Location Map

**Legend**

- Major Towns
- DXP EA Tenure
- PL (Arrow)
- ATP (Arrow Granted)

151°0'E

## DXP EA Tenures

**Source:** Arrow Energy Pty Ltd
Geoscience Australia
Dept. Natural Resources and Mines

0 5 10
Kilometres

Scale: 1:300,000 @ A3

Coordinate System: GCS GDA 1994

N

GDA

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The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

Date: 24/06/2022

Document: V:\Products\Australia\Queensland\Surat_Basin\Tenure\220624_RITM0422088_DXP_EA_Tenures_AH\220624_RITM0422088_DXP_EA_Tenures_AH.mxd

## 1.4 Applicant

The Applicants for the application are the following Arrow Energy entities (being the tenement holders for PLs 198, 238 and 252):

- Arrow (Tipton) Pty Ltd – ABN 17 114 927 507;
- Arrow (Tipton Two) Pty Ltd – ABN 36 117 853 755; and
- Arrow CSG (Australia) Pty Ltd – ABN 54 054 260 650.
- Arrow Energy Pty Ltd – ABN 73 078 521 936

## 1.5 Land Subject to the Application

Table 1-2 identifies the relevant Local Government Area, zoning and Regional Plan for the subject land.

**Table 1-2 – Land Description**

| | |
|---|---|
| **Local Government** | Western Downs Regional Council |
| **Zoning** | Rural and Rural Activity |
| **Regional Plan** | Darling Downs Regional Plan |
| **Areas of Regional Interest** | PAA, SCA |

The subject land is listed in Table 1-3 and illustrated on Figure 1-1.

**Table 1-3 - Lots the Subject of this Application**

| Lot | Mapped as Area of Regional Interest (ARI) | |
|---|---|---|
| | PAA | SCA |
| 1RP83755 | Yes | Yes |
| 55DY592 | Yes | Yes |
| 141AG4261 | Yes | Yes |
| 1RP78475 | Yes | Yes |
| 11SP191489 | Yes | Yes |
| 56DY592 | Yes | Yes |

The work scope the subject of this RIDA application is 14 subterranean (sub-surface) deviated well trajectories.

The depth of the sub-surface deviated well trajectories (well paths) on the subject land will range from approximately 190 m to 607 m.

The proposed activities will not involve any access to, or activities carried out on, the surface of the subject land, and operation of the well path infrastructure will be carried out remotely.

## 1.6 Background

### 1.6.1 Arrow Activities

Arrow is an integrated coal seam gas (CSG) company, exploring and developing gas fields, producing and selling CSG, and generating electricity. Arrow has been safely and sustainably developing CSG since 2000 and supplying it commercially since 2004. Arrow delivers approximately 20 per cent of Queensland's gas from CSG fields in the Bowen and Surat basins.

Arrow owns one of Queensland's largest power stations, Braemar 2 near Dalby, and has interests in a further two, with power generation capacity equivalent to the power requirements of around 800,000 homes. Arrow's first Surat Basin tenure was granted in March 2000 and Arrow drilled its first Surat Basin exploration well in June 2001.

### 1.6.2 Overview of the Surat Gas Project (SGP)

Arrow Energy is expanding its coal seam gas (CSG) operations in the Surat Basin through the SGP. The project seeks to commercialise gas reserves held in Arrow's petroleum tenements. The proposed wells and associated gathering infrastructure are essential infrastructure to the SGP.

On 1 December 2017, Arrow Energy and the Shell-operated QCLNG joint venture announced a Gas Sales Agreement (GSA) to commercialise the majority of Arrow's gas reserves in the Surat Basin. The collaboration between the parties will see the use of existing QGC-operated infrastructure such as gas compression, processing and transmission infrastructure as well as water transport and treatment facilities. Improving the utilisation of the existing upstream infrastructure will reduce impacts to landholders, communities and the environment.

The nature of the delivery points for the sales gas within this commercial agreement enables Arrow to develop and commercialise its Surat tenure while reducing the land disturbance footprint of its SGP development beyond that approved by the Australian and Queensland government in 2013. Arrow is also progressing a Water Services Agreement for the receipt of raw water, storage, processing and re-delivery of treated water, utilising capacity made available by the Water Services provider. This similarly reduces the land disturbance footprint of the SGP development in comparison to plans presented in 2013.

The SGP is being delivered via numerous 'batches' of work scope. Several batches have received all of the necessary regulatory approvals and landholder

agreements and accordingly, Arrow has either commenced the installation of infrastructure or is planning for installation in the coming months.

### 1.6.3 Applicant's co-existence commitments

Arrow considers coexistence to mean allowing Australia to enjoy the full benefits from both agricultural and resource industries. In collaboration with farmers of Intensively Farmed Land ("IFL"), Arrow co-created 12 commitments to coexistence in the Surat Basin in 2012:

1. No permanent alienation
2. Minimised operational footprint - less than 2% of total IFL area
3. Flexibility on CSG well locations, but all wells located by edge of farm paddocks
4. Pad drilling (up to 8 wells from a single pad) used where coal depth and geology allows
5. Spacing between wells maximised (average of between 800m - 1500m)
6. Pitless drilling only
7. No major infrastructure facilities on IFL (dams, compression stations, gas gathering stations, water treatment)
8. Treated CSG water used to substitute existing users' allocations on IFL[1]
9. No brine/salt treatment or disposal on IFL
10. Flexibility on power supply option - above or below ground
11. Fair compensation - including elements of 'added value'
12. Continued proactive engagements with community and transparency on coexistence field activities

These commitments are consistent with Table 3, Prescribed Solution (a) for Required Outcome 2 for PAA.

In the Surat Basin, Arrow's innovations support coexistence with land users, optimise gas production, reduce costs and minimise impacts.

Arrow's tenure uniquely overlies high-quality black soil farmland that includes irrigated, laser-levelled cropping farms (intensively-farmed land; IFL). To inform and co-develop innovation to minimise impact, Arrow established community reference groups. Members include stakeholders that provide robust feedback (irrigator groups, landholders, local and state governments).

[1] Commitment 8 refers to the area of greatest predicted drawdown on the Condamine Alluvium resulting from CSG extraction by Arrow Energy

Outcomes:

- Area wide planning: individuals and groups of neighbouring landholders contribute knowledge of land and farming requirements to collectively shape field development plans and improve coexistence.
- Land access rules: apply to all staff and contractors on farms, and enforced up to and including termination.
- 12 published coexistence commitments, including minimising Arrow's operational footprint to less than 2% of total IFL area (minimal footprint now adopted in legislation).
- Delivering government and landholder supported research trials on private properties to explore interconnectivity between target coal seams and overlaying farming aquifers.
- Simultaneous operations matrix - agreed prioritisation of landholder and Arrow activities during construction and operation phases.
- Technical innovations to demonstrate coexistence with established, multi-generational agricultural operations – allowing them to continue long after CSG development, including the use of deviated wells from multi-well pads (refer to Section 3 for additional details).

Surat Basin wells each target multiple coal seams, whose thickness is typically measured in centimetres not metres. Swellable packers have reduced solids production from interburden to negligible levels, reducing workover frequency and impacts on farming operations.

A number of forums including the Arrow Surat Community Reference Group and the IFL Committee along with multiple community meetings have been held for many years now to improve the flow of information to the community and to improve co-existence outcomes across the areas that Arrow operates. Through the IFL Committee, Arrow has developed a draft Construction and Operations simultaneous operations matrix (SIMOPS) to identify how Arrow can coexist with landholders throughout the construction and operations project phases. The draft SIMOPS will be tailored to individual property requirements, in collaboration with landholders.

To ensure Arrow coexists with agricultural interests, it continues to stand by 12 published coexistence commitments for Surat Basin intensively-farmed land (IFL). Arrow continues to actively demonstrate coexistence between landholders and CSG companies is possible and that, by working together, the benefits of both the agricultural and resource industries can be realised.

Arrows co-existence commitments and implementation of activities are consistent with Table 3, Prescribed Solution (a) for Required Outcome 2 for PAA by:

- providing for mutual benefits to the landholder (through compensation and infrastructure upgrades) and Arrow (through ability to access CSG resources);
- negotiating with landholders in regard to their land practices and schedules and developing simultaneous operations matrices to identify

how Arrow can coexist with landholders through the project phases and not cause agricultural activities to need to pause and restart;

- where practicable, construction activities will be undertaken during harvesting and planting or when the paddocks are in fallow;
- ensuring the land is returned to full productive capacity as quickly as possible and undertaking all activities with regard to the landholder and their operations.

### 1.6.4 Area Wide Planning

Area Wide Planning (AWP) is a unique program developed by Arrow to incorporate landholders' knowledge into our field development plans. Landholders and Arrow staff work together to identify locations for infrastructure, such as well pads, gathering lines and access tracks, across farming districts and on flood plains.

The process strengthens Arrow's ability to coexist with agricultural activities and allows landholders to influence the location of infrastructure early in our development planning phase. After an initial 'shed' meeting with the broader landholder group of an SGP batch, planning and discussions continue one-on-one with those landholders that express interest in working with Arrow and with landholders where infrastructure is proposed. Specific landholder agreements are then formalised in Conduct and Compensation Agreements ("CCAs"). The program demonstrates a commitment to genuine engagement and a commitment to preserving the values that are important to landholders.

## 1.7 Existing Authorities

The following sections outline the necessary approvals that Arrow already holds for the construction and operation of the proposed activities the subject of this RIDA application. Relevant extracts of these approvals are provided in Appendix 1.

### 1.7.1 EPBC Act Approval

On 19 December 2013, Arrow Energy received an approval from the Federal Government under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* for the Surat Gas Project (EPBC 2010/5344).

This approval covers the area the subject of this RIDA application. The relevant conditions from this approval are related to groundwater and the requirement for a CSG Water Monitoring and Management Plan (WMMP), conditions 13 – 25.

A copy of the EPBC approval is presented at Appendix 1 and a copy of Arrow's WMMP can be found on the company's website at the following location: https://www.arrowenergy.com.au/environment/groundwater/water-monitoringmanagement-plans. An extract of the WMMP is presented at Appendix 9.

### 1.7.2 Arrow's Petroleum Authorities

The following Petroleum Authorities issued under the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) and Environmental Authorities issued under the *Environmental Protection Act 1994* relate to the planned activities (refer to Figure 1-1).

**Table 1-5 – Arrow Petroleum Authorities**

| Tenure | Grant Date | Holder/s | EA Name | EA Number |
|---|---|---|---|---|
| PL 198 | 9 December 2004 | • Arrow (Tipton) Pty Ltd<br>• Arrow (Tipton Two) Pty Ltd<br>• Arrow CSG (Australia) Pty Ltd | Dalby Expansion Project (DXP) | EPPG00972513 |
| PL238 | 29 October 2009 | • Arrow (Tipton) Pty Ltd<br>• Arrow (Tipton Two) Pty Ltd<br>• Arrow CSG (Australia) Pty Ltd | | |
| PL252 | 20 September 2008 | • Arrow Energy Pty Ltd<br>• Arrow CSG (Australia) Pty Ltd | | |

### 1.7.3 Regional Interests Development Approvals

No existing RIDAs have been identified in association with the lots included within the scope of this application.

### 1.7.4 Other Approvals Required

The following agreements are required prior to the commencement of the gas field development on the land the subject of this RIDA application:

- 1RP83755 - Wayleave agreement with Queensland Rail and crossing agreement with the Department of Transport and Main Roads for the crossing beneath the Glenmorgan Branch Line.

# 2. Application Form Information

## 2.1 Parcel Details and Proposed Activity

Table 2-1 provides a summary of the proposed activity, location and proposed disturbance area in the context of the total area of the lot. Figures illustrating the location of the subterranean deviated drilling trajectories within each lot are provided in Appendix 3.

**Table 2-1 – Parcel Details and Proposed Activities**

| Parcel | Whole/Part | Activity | Area of Surface Disturbance (ha) | | Parcel Size (ha) |
|---|---|---|---|---|---|
| | | | PAA | SCA | |
| 1RP83755 | Part | 1 x Subterranean deviated drilling trajectories | 0 | 0 | 131.0 |
| 11SP191489 | Part | 2 x Subterranean deviated drilling trajectories | 0 | 0 | 135.6 |
| 55DY592 | Part | 3 x Subterranean deviated drilling trajectories | 0 | 0 | 300.3 |
| 141AG4261 | Part | 1 x Subterranean deviated drilling trajectory | 0 | 0 | 353.4 |
| 1RP78475 | Part | 3 x Subterranean deviated drilling trajectories | 0 | 0 | 345.9 |
| 56DY592 | Part | 4 x Subterranean deviated drilling trajectories | 0 | 0 | 330.6 |
| **Total Surface Disturbance** | | | **0 ha** | **0 ha** | |

The petroleum and gas resource activity of subterranean deviated drilling trajectories comprise the following activities:

- Drilling of the deviated well path beneath the subject land;
- Extraction/transfer of gas and water beneath the surface;
- Abandonment of the well path infrastructure.

The depth of the sub-surface deviated well trajectories (well paths) on the subject land will range from approximately 190 m to 607 m.

Section 3 provides additional details regarding the proposed activities. Section 4 provides further information regarding the extent of disturbance to SCA and PAA (construction vs operational) on each lot.

## 2.2 Property Details

Schedule 1 of the *RPI Act* defines a property as follows:

> *(a) if an area managed as a single agricultural enterprise consists of 1 lot—the lot; or*
>
> *(b) otherwise—all the lots that—*
>
> > *(i) are owned by the same person or have 1 or more common owners; and*
> >
> > *(ii) are managed as a single agricultural enterprise; and*
> >
> > *(iii) form a single discrete area because 1 lot is adjacent, in whole or part, to another lot in that single discrete area (other than for any road or watercourse between any of the lots).*

The results of title searches and landholder discussions undertaken to determine 'properties' associated with the subject land is provided in Table 2-2 and illustrated on Figure 2-1.

**Table 2-2 – Property Details**

| Lots with Well Path subject of this application | Is Lot Part of a Property >1 Lot (Yes/No) | Lots comprising the Property (*Lot contains Well Path subject of this application) |
|---|---|---|
| 1RP83755 | No | Property 1 - 1RP83755* |
| 11SP191489 | Yes | Property 2 - 11SP191489*, 956DER3479 |
| 55DY592 | No | Property 3 - 55DY592* |
| 141AG4261 | Yes | Property 4 - 141AG4261*, 3SP243187, 2RP152259, 364A34907 |
| 1RP78475 | No | Property 5 - 1RP78475* |
| 56DY592 | No | Property 6 – 56DY592* |

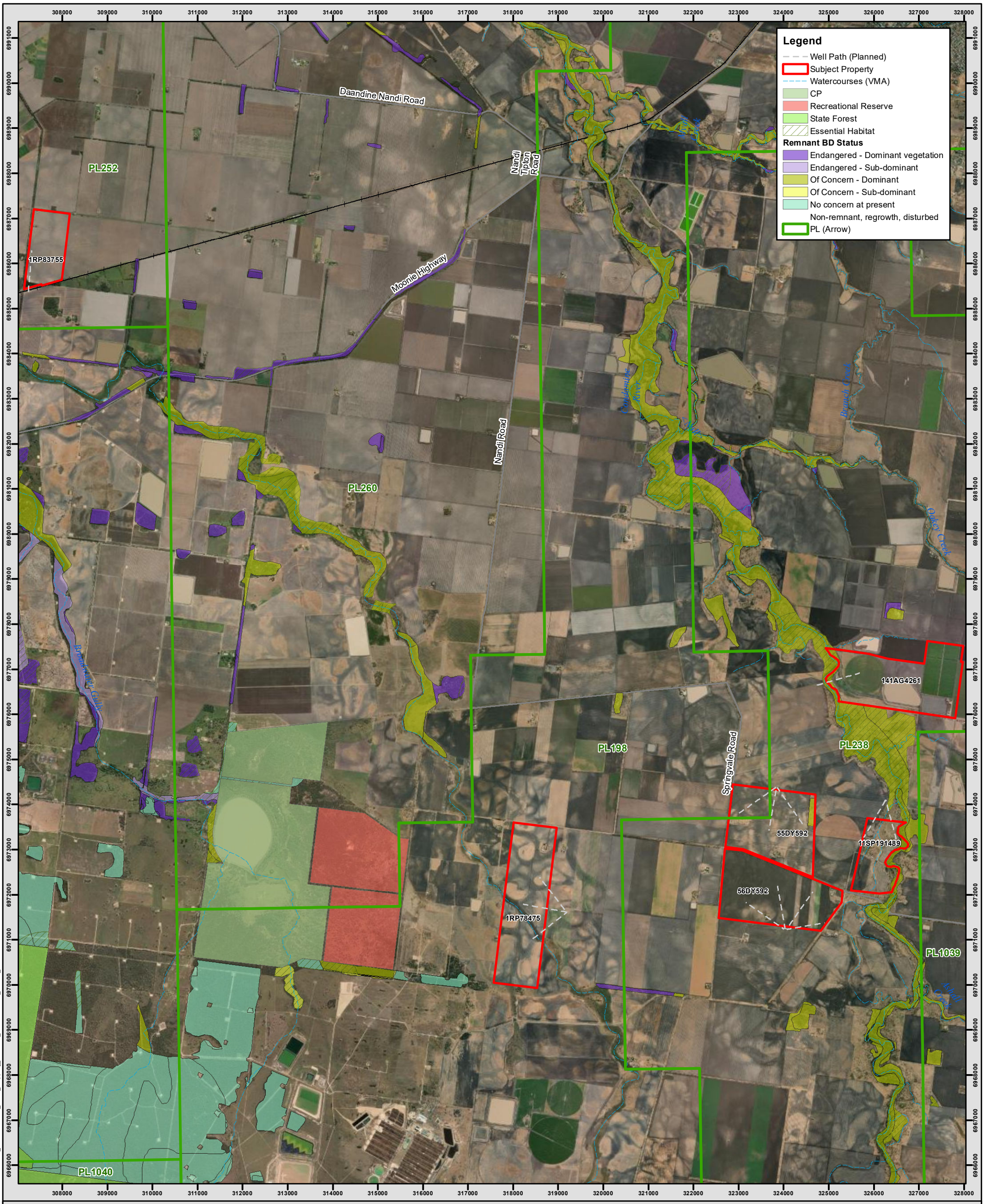
Appendix 3 provides additional details regarding the properties and additional details of subterranean deviated drilling trajectories on each land parcel.

## 2.3 Land Use

### 2.3.1 Current and Surrounding Land Use

The current land use of the subject land is dryland and irrigated cropping of grain, legumes, cotton and oilseed crops, with some isolated patches of remnant vegetation and areas utilized for rural residential purposes (refer to Figure 2-1).

Land use of the subject land identified in Table 2-2 is illustrated in Appendix 3 and the land use mapping (from Queensland Land Use Mapping Program (QLUMP)) for the subject land are provided in Appendix 4.




# RIDA - Properties associated with Application

**Source:** Arrow Energy Pty Ltd
Geoscience Australia
DNRME

**Date:** 12/07/2022
**Issued To:** A Hall
**Author:** coellermann

Kilometres
0 0.5 1 2 3 4

Scale 1:77,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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**Note:** The dimensions, areas, number of lots, size and location of corridor information are approximate only and may vary.

### 2.3.2 Easements

No easements have been identified on the lots included within the scope of this RIDA application.

### 2.3.3 Overlapping Resource Authorities

The only overlapping resource authority subject of this application is EPC1770 which overlaps Lot 1RP83755 and therefore the well path proposed to be drilled under this property. The Applicants do not have (and are not required to have) an overlapping Tenure Agreement with New Emerald Energy Pty Ltd, the holder of EPC1770, as only one party (the petroleum resource authority holder) holds a production tenure, i.e. the petroleum lease (PL252) held by Arrow.

A Joint Development Plan (the statutory overlapping tenure agreement) is only required in circumstances where both parties (the petroleum resource authority holder and the coal resource authority holder) hold, or are applicants for, a production tenure (i.e. a petroleum lease or a coal mining lease) – s130, s142 – *Mineral and Energy Resources (Common Provisions) Act 2014*.

Similarly, a Joint Interaction Management Plan is only required where the petroleum resource authority holder proposes to operate operating plant in the area of a petroleum tenure; and activities carried out, or proposed to be carried out, at the plant may adversely affect the safe mining of coal in the area of a coal mining tenement – s386(1)(a) & (b) – *Petroleum and Gas (Production and Safety) Act 2004*.

Given that New Emerald Energy have advised Arrow that they don't propose undertaking any activities on the tenement until 2023, there is no potential for any interaction, nor will the operation of operating plant adversely affect the safe mining of coal in the area of a coal mining tenement at any time.

### 2.3.4 SCL Protection Certificates

No SCL Protection Certificates are held for the well paths under the subject land.

### 2.3.5 Title Searches

Copies of titles searches for the subject land are presented in Appendix 2.

### 2.3.6 Road Reserves

There are no road reserves on the subject land. The proposed activities will not impact road use within the region.

# 3. Resource Activities

## 3.1 Definition of activities

As outlined in Section 2.1, the resource activity of underground subterranean deviated well trajectory comprises the following activities:

- Drilling of the deviated well path beneath the subject land;
- Extraction/transfer of gas and water beneath the surface;
- Abandonment of the well path infrastructure.

These activities will not require any access or disturbance to the subject land, as all activities will be sub-surface.

The following section provides additional details of the proposed activities. Appendix 3 provides details on the location and extent of resource activities specific to each lot the subject of this RIDA application.

## 3.2 Description of project and work activities

### 3.2.1 Deviated Wells

Traditionally, CSG wells were drilled vertically and spaced approximately 800m apart. However, the traditional 800m x 800m grid pattern field development is completely unsuitable for the intensively farmed land (IFL) which is the subject of this RIDA Application and accordingly, has been replaced with deviated wells.

Deviated wells are a way of minimising surface disturbance by locating multiple wells at a single location and drilling underground well trajectories across neighbouring properties, thereby reducing the number of sites required for above ground infrastructure.

The benefits of deviated drilling and multi-well pads include a smaller over-all footprint (between 25-50% of a traditional vertical well field design), by including:

- up to eight wells on one pad up to 110m x 200m, instead of eight separate well pads of 110m x 100m
- greater distance between pads (up to 2km)
- less gathering pipelines
- concentrated presence (infrastructure and staff access) in a smaller area

- well pads that can be located in paddock corners and less productive areas to reduce impact on farming practices.

As outlined in Section 1.5, the scope of this application is limited to the subterranean deviated well trajectories that will be located beneath the surface of the subject land.

There will be up to 14 deviated wells entering under the subject land. These wells will enter the land at a subterranean point at a depth of greater than 185 m and be drilled from neighbouring properties. The well trajectories from neighbouring properties are illustrated in Figure 2-1. The location, length and depth of the well trajectories beneath each lot is and illustrated in Appendix 3.

Note: only the well trajectories that lie beneath the subject land are illustrated. Well trajectories that lie beneath land which is not the subject of this RIDA application have not been illustrated as it is outside the scope of this application.

The wells will be constructed so as to enable water and gas production from the deeper coal seams of the Walloon Coal Measures. The depth of wells will range from approximately 190 m to 607 m, with an average depth of approximately 450-500 m. No hydraulic fracturing activities are proposed in any of the development areas as per condition 4 of Arrow's approval under the EPBC Act (EPBC 2010/5344).

Surat Basin wells each target multiple coal seams with thicknesses that are typically measured in centimetres not metres. To construct a 'deviated well', the surface section of the well is firstly drilled from ground level to a depth of between 50 and 120 metres. This section is cased with steel casing and cemented to the surface, sealing wells from shallow farming aquifers. Further down-hole, swellable packers installed above and below target coal seams, ensure zonal isolation.

A special angled drill bit is then inserted and is able to be 'steered' away from the other wells on the same pad. The deviated section of the well can reach coal seams to a vertical depth of around 600m and can extend to a horizontal length of up to 800m away from the well pad. This enables us to target multiple coal seams without impacting the agricultural land directly above.

Arrow assesses deviated well trajectories on a case-by-case basis to determine whether directional drilling is an advanced activity or a preliminary activity by having regard to the impact (if any) of the activity on the landowner's business or land use activities, as well as the size of the potentially impacted lot. Entry Notices under Section 39 of the Mineral and Energy Resources (Common Provisions) Act 2014 (QLD) and Regulation 17 Mineral and Energy Resources (Common Provisions) Regulation 2016 (QLD) are required to be provided to landholders prior to deviated well activities, unless this right is waived by the landholder.

Arrow will also issue a Deviated Well Agreement to landholders for any deviated wells on their property, or include the deviated wells within a CCA if required. Arrow ensures that deviated well trajectories are fully incorporated into the Dial-Before-You-Dig process and then also at the completion of drilling.

### 3.2.2 Well Integrity

Arrow adheres to the strict requirements outlined in the code of practice for the construction and abandonment of coal seam gas wells and petroleum wells. In Queensland, this is overseen by the Petroleum and Gas Inspectorate of Resources Safety and Health.

The well design and construction of a gas well is critical for ensuring well integrity and is therefore a staged process. It is broken into several parts in recognition of the different formations that are drilled through on the way to the target depth.

A typical well life is 12-15 years. Monitoring and maintenance preserve the condition of the well and its equipment for the entirety of its life.

Arrow Energy's Well Integrity Management Systems (AEWIMS) and associated documents for subsurface assets, aim to ensure that wells meet operational availability objectives and well integrity goals for the full life cycle of the well.

### 3.2.1 Operational activities

No operational activities will be required to be undertaken on the subject land. All operational activities associated with the subterranean deviated well trajectories will be undertaken remotely.

### 3.2.2 Decommissioning of the infrastructure

At the end of the well life, the deviated wells will be decommissioned by removal of the surface infrastructure and sub-surface capping of the wells. This activity is outside the scope of this application, as it will occur on the lot where the well pads are located. The subterranean deviated well trajectories are decommissioned via the sub-surface capping of the well sites (outside scope of this application) and the buried well path infrastructure will be abandoned in-situ.

## 3.3 CSG Water Management Strategy

Arrow has in place a CSG water management strategy (CSG WMS) for the Surat Gas Project (SGP). It is derived from Arrow Energy's corporate Coal Seam Gas Water and Salt Management Strategy (Arrow Energy, 2013), which summaries the overarching management framework implemented by Arrow for water and salt. This document outlines the management of CSG water resulting from activities arising from the SGP Field Development Plan. The CSG WMS provides a basis for compliance with government policy and sets out the method for managing produced water for Arrow's Surat Basin tenements.

Arrow's CSG Water Management Plan provides for the management of water across the PLs where the project will be constructed and operated (refer to Appendix 7). The Plan also includes information about net replenishment.

CSG water from the SGP will be treated at existing Arrow facilities and at QCLNG facilities operated by QGC. The majority of CSG water will be treated by QGC using its existing water management network of dams and transfer pipelines and will be treated at the existing Kenya water treatment facility. Water treated by QGC will then be returned to Arrow as treated water. Some water for the SGP will be treated at existing Arrow water treatment facilities at Daandine and Tipton.

The treated water will be prioritised for supply as substitution of existing Condamine Alluvium groundwater allocations, most likely for irrigation. This water will be returned to these end users via the condamine alluvium substitution scheme, with the exact route to be determined after consultation with end users. Remaining treated water will be supplied to existing users, including via the existing SunWater Chinchilla beneficial use scheme. More detailed information about the Condamine Alluvium is provided in Section 8.

# 4. Priority Agricultural Land Use (PALU)

## 4.1 Overview

PAAs are strategic areas, identified on a regional scale, that contain significant clusters of a region's high value intensive agricultural land uses. The PAA surrounding the land relevant to this application includes areas of high value agricultural land uses, in particular areas of dryland cropping and grazing.

Within the PAA, Priority Agricultural Land Use (PALU) is given priority by ensuring that the location of resource activities can coexist with these uses.

## 4.2 Land Use Designations

### 4.2.1 Regional Plan

The proposed well paths have been identified as being located on PAA under the Darling Downs Regional Plan (2013) (the Regional Plan).

### 4.2.2 Priority Agricultural Land Uses

The Regional Plan identifies the Priority Agricultural Land Use (PALU) within the region as:

> *Priority Agricultural Land Use (PALU) means a land use included in class 3.3, 3.4, 3.5, 4 or 5.1 under the Australian Land Use and Management (ALUM) Classification Version 7, May 2010 published by the Department of Agriculture, Fisheries and Forestry ABARES, Australian Government.*

The relevant ALUM land use classes are:

- Class 3.3 – Cropping
- Class 3.4 – Perennial horticulture
- Class 3.5 – Seasonal horticulture
- Class 4 – Production from Irrigated Agriculture and Plantations, which includes:
  - Class 4.1 Irrigated plantation forestry
  - Class 4.2 Grazing irrigate modified pastures
  - Class 4.3 Irrigated Cropping
  - Class 4.4 Irrigated perennial horticulture
  - Class 4.5 Irrigated seasonal horticulture
  - Class 4.6 Irrigated land in transition.
- Class 5.1 – Intensive Horticulture.

Land use mapping of the subject land (refer to Appendix 4) has identified a large number of land use classes, of which only the following are defined as a PALU under the Regional Plan:

- Class 3.3 – Cropping; and
- Class 4 - Production from Irrigated Agriculture and Plantations, secondary class 4.3 Irrigated cropping.

Other land uses identified in the Regional Plan as a PALU will not be impacted by the project.

### 4.2.3 Queensland Land Use Mapping Program

The Queensland Land Use Mapping Program (QLUMP) (refer to Appendix 4) classifies land use according to the *Australian Land Use and Management Classification Version 8, October 2016.*

As the Regional Plan classifies PALU based on V7 of ALUM, a comparison of the V7 and V8 of ALUM (primary and secondary level classes) has indicated that there was only one change to PALU land classes listed in the Regional Plan:

- 4.1 Irrigated plantation forestry (v7) was updated to Irrigated plantation forests (V8).

## 4.3 Identification of PALU

The RPI Act Guideline 07/14: *How to identify a priority agricultural land use* (PALU) was consulted to determine if the Land within the Darling Downs Regional Plan is, or has been, utilised as PALU.

Section 2 of the RPI Regulation states that:

> *For land or property in relation to PALU, means the land or property has been used for PALU for at least 3 years during the 10 years immediately before an assessment application is made in relation to the land.*

To determine the extent of PALU on land included within the scope of this application, an assessment of the historical and current land use within the study area was undertaken for the years 2012 - 2021 utilising the following information sources:

- Reference to GIS data and the Darling Downs Regional Plan (Department of State Development, Infrastructure and Planning, 2013) to confirm the Project is located within a PAA.
- Examination of available aerial photography and satellite imagery for years 2012-2022 (Appendix 3)
- Reference to the Queensland Land Use Mapping Program (QLUMP) to confirm dominant Australian Land Use and Management (ALUM)

classification for the area, cropping and grazing native vegetation (Appendix 4).

- Department of Science, Information Technology, Innovation and the Arts (DSITIA) Forage Crop Frequency Data for the years 2012 – 2021 (Appendix 5).

A summary of the findings is provided in Table 4-1 and additional details are provided in Appendices 3 to 6 as outlined above.

**Table 4-1 – Outcome of Identification of PALU on Lots (subject to RIDA Application) and associated properties**

| Property / Lot | QLUMP Classification (refer to Appendix 4) | Cropping Frequency at least 3 in past 10 years on Parcel (Appendix 5) | Field Review of Lot and Imagery (refer to Appendix 3) | PALU on Lot |
|---|---|---|---|---|
| **Property 1** | | | | |
| 1RP83755* | Cropping (Class 3.3) with area of Grazing / Native Vegetation | **Yes** | **Used for dryland cropping** | **Yes** |
| **Property 2** | | | | |
| 11SP191489* | Grazing / Native Vegetation with area of Cropping (Class 3.3) and Dam/Reservoir | **Yes** | **Used for dryland cropping / grazing** | **Yes** |
| 956DER3479 | Cropping (Class 3.3), Irrigated Cropping with areas of Grazing / Native Vegetation | **Yes** | **Used for dryland cropping / grazing** | **Yes** |
| **Property 3** | | | | |
| 55DY592* | Cropping (Class 3.3) with area of Grazing / Native Vegetation and other minimal use | **Yes** | **Used for dryland cropping** | **Yes** |
| **Property 4** | | | | |
| 141AG4261* | Irrigated Cropping, Dam/Reservoir and area of Grazing / Native Vegetation | **Yes** | **Used for dryland / irrigated cropping** | **Yes** |
| 3SP243187 | Irrigated Cropping and Dam/Reservoir | **Yes** | **Used for dryland / irrigated cropping** | **Yes** |

| Property / Lot | QLUMP Classification (refer to Appendix 4) | Cropping Frequency at least 3 in past 10 years on Parcel (Appendix 5) | Field Review of Lot and Imagery (refer to Appendix 3) | PALU on Lot |
|---|---|---|---|---|
| 2RP152259 | Irrigated Cropping | **Yes** | **Used for dryland / irrigated cropping** | **Yes** |
| 364A34907 | Irrigated Cropping | **Yes** | **Used for dryland / irrigated cropping** | **Yes** |
| **Property 5** | | | | |
| 1RP78475* | Cropping (Class 3.3) with area of Grazing / Native Vegetation and Residential and Farm Infrastructure | **Yes** | **Used for dryland cropping** | **Yes** |
| **Property 6** | | | | |
| 56DY592* | Cropping (Class 3.3) with area of Grazing / Native Vegetation and other minimal use | **Yes** | **Used for dryland cropping** | **Yes** |

*Note – lots containing subterranean deviated well trajectory are marked with **

### 4.3.1 Outcome of PALU Identification

As outlined in Table 4-1, PALU has been identified as occurring on all lots intersected by the subterranean deviated well trajectories subject of this RIDA application.

## 4.4 Extent and Impact to PALU

### 4.4.1 Nature and Extent of Surface Impacts

As outlined in Sections 1 to 3 of this report, the activities in the scope of this application will not require access to or any surface disturbance to the subject land (refer to Table 4-2). This is due to all activities being conducted sub-surface at a minimum depth of 1m, with all surface activities being undertaken on adjacent lots that are outside the scope of this application.

**Table 4-2 – Extent of Disturbance and Impact on PALU**

| Property / Lot | Infrastructure (refer to Appendix 3) | Lot Size (Ha) | PALU on Lot (Ha) | Disturbance to PALU (Ha) |
|---|---|---|---|---|
| **Property 1** | | | | |
| 1RP83755* | 3 Subterranean deviated drilling trajectories | 131.0 | 126.9 | 0 |
| | **Total Property Area** | **131.0 ha** | **Total Property PALU 126.9 ha** | **0 ha** |
| **Property 2** | | | | |
| 11SP191489* | 2 Subterranean deviated drilling trajectories | 135.6 | 12.7 | 0 |
| 956DER3479 | Nil | 510.5 | 233.0 | 0 |
| | **Total Property Area** | **646.1 ha** | **Total Property PALU 245.7 ha** | **0 ha** |
| **Property 3** | | | | |
| 55DY592* | 3 Subterranean deviated drilling trajectories | 300.3 | 272.2 | 0 |
| | **Total Property Area** | **300.3 ha** | **Total Property PALU 272.2 ha** | **0 ha** |
| **Property 4** | | | | |
| 141AG4261* | 1 Subterranean deviated drilling trajectory | 353.4 | 232.0 | 0 |
| 3SP243187 | Nil | 132.8 | 104.0 | 0 |
| 2RP152259 | Nil | 123.2 | 123.2 | 0 |
| 364A34907 | Nil | 99.2 | 99.2 | 0 |
| | **Total Property Area** | **708.6 ha** | **Total Property PALU 558.4 ha** | **0 ha** |
| **Property 5** | | | | |
| 1RP78475* | 4 Subterranean deviated drilling trajectories | 345.9 | 316.8 | 0 |
| | **Total Property Area** | **345.9 ha** | **Total Property PALU 316.8 ha** | **0 ha** |
| **Property 6** | | | | |
| 56DY592 | 1 Subterranean deviated drilling trajectory | 330.6 | 326.4 | 0 |
| | **Total Property Area** | **330.6 ha** | **Total Property PALU 326.4 ha** | **0 ha** |

*Note – lots containing subterranean deviated well trajectory are marked with **

### 4.4.2 Ongoing Conduct of PALU

The activities associated with the subterranean deviated well trajectories will not impact on the ongoing conduct of PALU and the subject land as:

- No access or surface disturbance will occur;
- All activities will be undertaken sub-surface at a minimum depth of 189m;
- No modifications or supplements to the existing land use activities will be required;
- Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts are not material to ongoing PALU activities.

### 4.4.3 Construction Timeframe

The construction timeframes for each activity on each parcel of land is presented in Table 4-3. The timeframes presented are at a high level and will be ultimately reduced once all inputs are known such as engineering requirements and timing to obtain materials.

Timeframes for the well path installation are at a high level at present and will be optimised closer to the start of construction based on some uncertainty including the conclusion of this RIDA application.

There will be no requirement to access the subject land and no change or disturbance to existing land use activities will occur doing the installation the subterranean deviated well trajectories due to the depth of the activities (minimum of approximately 190 m).

**Table 4-3 : Schedule of activities**

| Well name | Drill Start | Total Days |
|---|---|---|
| Stratheden 204 | 9/01/2023 | 5 days |
| Plainview 142 | 7/05/2023 | 5 days |
| Plainview 144 | 18/05/2023 | 5 days |
| Plainview 146 | 29/05/2023 | 5 days |
| Plainview 147 | 3/06/2023 | 5 days |
| Plainview 111 | 22/05/2023 | 5 days |
| Plainview 121 | 30/11/2023 | 5 days |
| Plainview 122 | 6/12/2023 | 5 days |
| Plainview 173 | 28/10/2023 | 5 days |
| Plainview 174 | 3/11/2023 | 5 days |
| Plainview 175 | 8/11/2023 | 5 days |
| Tipton 504 | 18/08/2023 | 5 days |
| Tipton 505 | 23/08/2023 | 5 days |
| Tipton 506 | 29/08/2023 | 5 days |

### 4.4.4 Overland Flow

Surface elevations decrease from approximately 335 mAHD to 330 mAHD in a southeast to northwest direction within 3 km of the subject land. Mapping of subject lots of this application with contour lines at 1 m intervals within a 3,000 m buffer of the properties included within the scope of this application is provided in Figure 4-1 and Arrow's Surface Elevation Baseline Reports for the subject land (refer to Appendix 6).

Slopes within 3 km of the subject land have been determined from a Digital Elevation Model (DEM) constructed at 1 m resolution from Light Detection and Ranging (LiDAR) data collected in 2020 over the area. Slopes were derived at a 10 by 10 m (100 $m^2$) resolution to limit over-representation of small features. The majority (>96%) of slope is greater than 0.03% (300 mm per km). The area of slope classes is presented in Table 4-4 with individual subject parcels' slope classes presented in Appendix 8.

**Table 4-4 : Slopes within 3km of the subject land, derived from the 2020 DEM.**

| Slope Class (Slope %) | Area (hectare) of the Parcels | Area (%) of the Parcels | Area (hectare) outside but within 3km of the Parcels | Area (%) outside but within 3km of the Parcels |
|---|---|---|---|---|
| < 0.01 | 5.67 | 0.4% | 58.48 | 0.3% |
| 0.01 – 0.03 | 47.21 | 3.0% | 444.48 | 2.6% |
| 0.03 – 0.06 | 120.95 | 7.6% | 1229.43 | 7.1% |
| 0.06 – 0.12 | 308.39 | 19.3% | 3137.02 | 18.0% |
| 0.12 – 0.5 | 779.05 | 48.8% | 8102.55 | 46.6% |
| > 0.5 | 335.38 | 21.0% | 4419.79 | 25.4% |
| Total | 1596.65 | 100.00 | 17391.75 | 100.00 |

The 2021 Underground Water Impact Report (UWIR) (Office of Groundwater Impact Assessment [OGIA], 2021) presents the outputs from OGIA's subsidence model. The model uses OGIA's predicted groundwater impacts from their groundwater model as an input into their subsidence model to predict CSG-influenced subsidence in the Walloon Coal Measures. OGIA's predictions of subsidence are based on a combination of geomechanical and groundwater flow modelling, which accounts for all existing and proposed development. The subsidence model is history-matched to ground movement data.

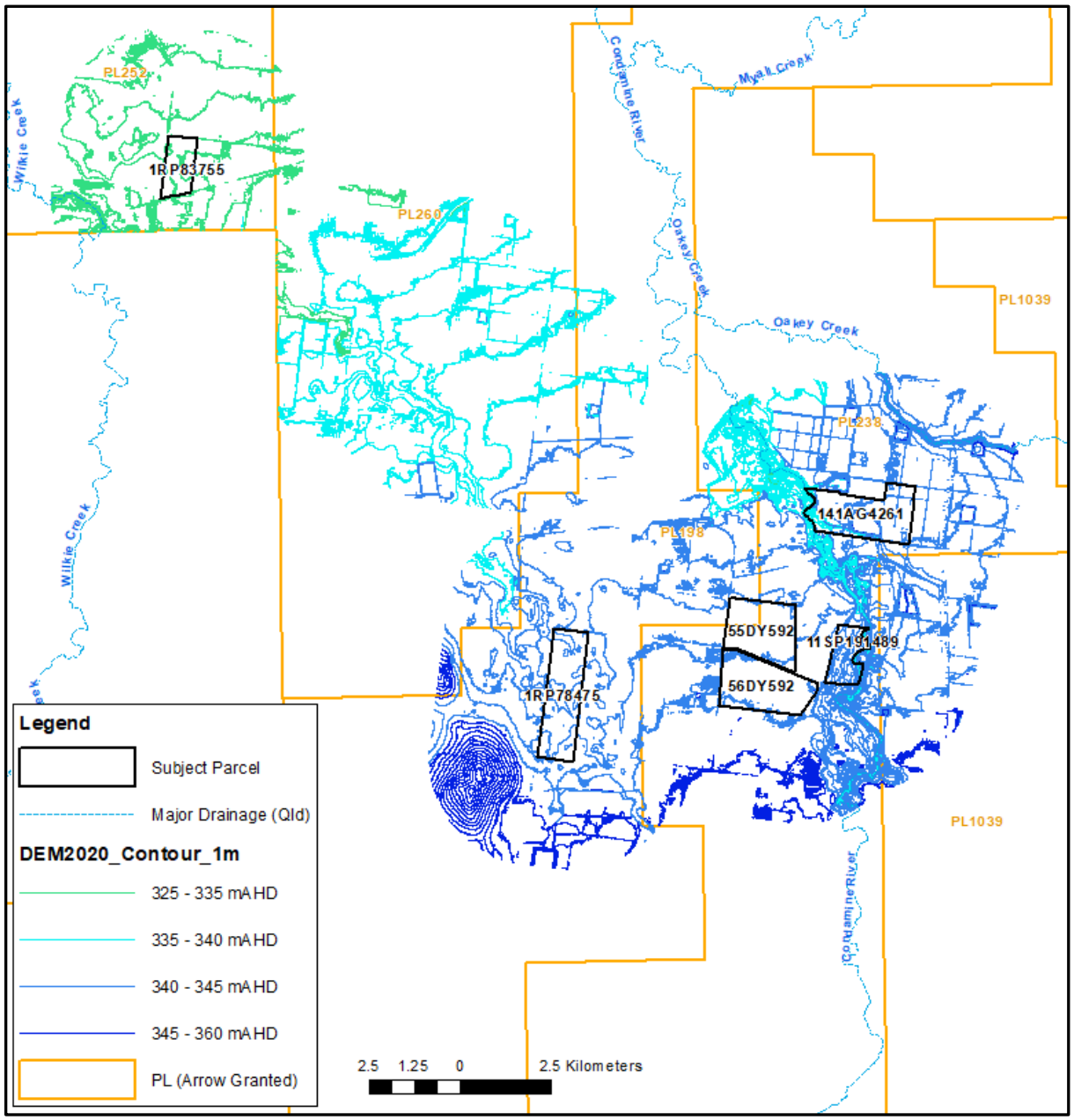


**Figure 4-1: Surface elevation contour lines at 1 m intervals within a 3 km buffer of the subject land**

OGIA used the output from this model to calculate a predicted change in slope within cropping land across the Condamine Alluvium. Predictions of subsidence within the Condamine Alluvium footprint suggest that most of the cropping area is likely to experience less than 100 mm of subsidence by the end of 2060. In comparison, natural or 'background' ground movement not affected by CSG development is in the order of ±25 mm/year. The maximum all-time change in ground slope from CSG-induced subsidence in most areas is predicted to be less than 0.0001% (10 mm over 1 km) but can be up to 0.004% (40 mm/km) in some areas. This prediction of change in slope is communicated to the landholder through Arrow's Surface Elevation Baseline Reports which show the location of a subject parcel on OGIA's illustration of predicted maximum change in ground slope (Figure 7-5 of the 2021 UWIR [OGIA, 2021]). Further information on Arrow's Surface Elevation Baseline Reports is provided below.

OGIA further note in Section 7.4.4 of the 2021 UWIR that of the environmental values that could be potentially affected by subsidence, irrigation of cropping land is the key consideration because subsidence may, depending upon the magnitude and rate of change over time, potentially affect the ground slope of irrigated cropping land and hence the irrigation practices. A key parameter for this assessment is the change in ground slope resulting from subsidence.

Arrow commissioned Data Farming (2021) to undertake an assessment of how CSG induced ground movement can impact farm productivity. The main points from this report were:

- most cropping paddocks of the Darling Downs have slopes ranging from 0.12% to 0.5%, which equates to 1.8m to 7.5m vertical drop over a typical 1500m long paddock;
- in the 'technically' flattest of furrow irrigation paddocks which have a slope of 0.06%, the average vertical difference from top to bottom is 0.42 m for a 700 m long field;
- seven percent (7%) of dryland and nine percent (9%) of irrigated land has slopes of less than 0.06%, which is considered too flat to drain effectively; and
- areas of dryland cropping lands that are farmed at less than 0.06% will suffer waterlogging losses in heavy rainfall years, though during drought years with limited rainfall, the ponded areas may in fact lead to the highest yields due to soil water accumulation in these areas.

Arrow additionally commissioned Coffey (2021) to further build upon their Subsidence Technical Memorandum prepared in 2018 to support the Arrow Stage 1 Water Monitoring and Management Plan (WMMP). This assessment included predictions of future subsidence based on InSAR ground movement monitoring data and the 2019 UWIR regional groundwater model, and recommendations for additional subsidence monitoring.

As part of this assessment, Coffey undertook an assessment of potential impacts on farmland resulting from changes in slope, including a review of the Data Farming report (2021), and concluded the following:

- Changes in slope for farmland which has low existing slope is more significant than for fields with steep gradient. Data farming (2021) assesses that with Surat Gas Project (SGP) tenements that most cropping paddocks have slopes ranging from 0.12% to 0.5%. It is therefore appropriate to consider

farmland steeper than 0.03% (300 mm per km) separately from farmland with flatter slope. For the farmland with existing slope in excess of 300 mm per km a slope change of 100 mm per km is considered unlikely to affect overall performance. For farmland with shallower slopes changes in slope the land would already be poorly draining so small changes in slope would not change the poorly draining nature of the land.

- Data farming (2021) advise that the flattest slopes for furrow irrigated paddocks is 0.06% and also notes that dryland cropping lands farmed with slopes at less than 0.06% will be subject to waterlogging in heavy rainfall years and ponding of rainfall during low rainfall periods. It is therefore considered that slopes on existing irrigated farmland less than 0.06% could be considered as essentially flat. Small changes in slope would seem unlikely to be detrimental to farmland in this category. For land with slope close to 0.06% a change of 100 mm over 1 km (0.01%) is considered a reasonable trigger level. For land with slope greater than 0.09% a change of slope of 15% is not anticipated to affect performance significantly.
- Using the existing topographic gradient for the Condamine River plain it is assessed that subsidence leading to changes in gradient of less than 10% of the existing gradient (10% x 0.5 m/km = 0.05 m/km) would be unlikely to have significant impact on the performance of the Condamine River or tributary watercourses.

Applying OGIA's (2021) predicted maximum change in ground slope (0.001% to 0.004%) to the above framework, it is apparent that farming operations and flood flow in major water courses within the subject parcels and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence.

OGIA's predicted change in slope for each of the subject land is provided in Appendix 8 along with the mapped land use (QLD Land Use Mapping, Queensland Government, 2021), 2020 imagery and the 10m by 10m slope (generated from the 2020 DEM).

To assist with identifying any gradient changes over time on each of the subject land, Arrow has prepared Surface Elevation Baseline Reports for all subject land associated with this RIDA application (provided in Appendix 6). The Baseline Report provides historical surface elevation data obtained from LiDAR and InSAR monitoring and is made up of five sections, namely:

1. Digital Elevation Models (DEMs)
2. Contour Lines
3. Drainage Lines
4. InSAR
5. OGIA predicted maximum change in ground slope

A summary of each section is provided below noting that the method used to generate these has been reviewed by OGIA.

1. DEM

- The DEMs are derived from LiDAR point clouds and have been collected from aerial surveys in 2012, 2014 and 2020.

- The DEMS indicate the relative accuracy, the change in elevation across the landscape for these periods of time.
- This is relevant because at a farm level, if an area of the farm changes due to observable ground movement (e.g. a depression) or land form change (e.g. a new dam) the DEM will be depict the relative change in the landscape.

2. Contour Lines

- 10cm contour lines have been generated from each DEM for the periods of 2012, 2014 and 2020.
- This is a visual representation of the slope across the DEM.
- This again is based on the relative accuracy of the DEM.
- This is relevant because any changes on the landscape will change the contour lines.
- As this is a very fine resolution of contour lines, farming activities will have an effect on the contour lines to some extent.

3. Drainage Lines

- The overland flow of the bare earth was modelled into drainage lines, to indicate how water would accumulate and flow over the surface of the property based on each DEM.
- Any major change to the slope or surface of the land will change the direction and accumulation of water.
- Agricultural practices, such as furrowing and contouring will have an effect on these drainage lines.
- Changes in these lines' direction or intensity may affect flow across the surface.

4. InSAR

- Interferometric synthetic aperture radar (InSAR) is a remote-sensing technique whereby radar signal data is collected from satellites to determine the change in ground elevation (i.e. relative ground movement).
- The InSAR map represents the location of InSAR scatter points, which contain time series data on the cumulative relative ground movement since 2015. A selection of scatter points has been plotted in a graph to demonstrate the available time series data.

5. OGIA predicted maximum change in ground slope

- This figure provides a regional context for the lot on plan regarding OGIA's predicted maximum change in ground slope from CSG-induced subsidence. This figure is presented in the 2021 UWIR (Figure 7-5).
- OGIA used their predicted groundwater impacts from their groundwater model as an input into their subsidence model to predict CSG-influenced subsidence in the Walloon Coal Measures. The output from this model was used to calculate a predicted change in slope within cropping land across the Condamine Alluvium.

The SGP was approved by the Australian Government under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC) decision 2010/5344

on 19 December 2013. A Stage 1 CSG Water Monitoring and Management Plan (WMMP) (Arrow Energy, 2018) and the Updated CSG WMMP (Arrow Energy, 2019) which incorporated and improved upon what was included in the 2018 WMMP, have been prepared and were approved by the Minister on 18 December 2018 and 22 November 2019 respectively.

The WMMPs address the Australian Government approval conditions relating to the assessment, management and mitigation of surface and groundwater impacts as a result of project development, including subsidence caused by depressurisation of the CSG reservoir, and also addresses relevant Arrow commitments in the SGP environmental impact statement (EIS) (Arrow Energy, 2012) and Supplementary Report to the EIS (SREIS) (Arrow Energy, 2013).

The WMMP describes the cause of subsidence due to depressurisation of the CSG reservoir:

> *"Coal seam gas occurs within coal formations through adsorption to the surface of the coal under hydrostatic pressure. Depressurisation of the coal seams below a threshold (by groundwater extraction) reduces hydrostatic pressure and liberates the gas from the formation.*
>
> *As the pressure falls, the gas migrates to the extraction wells. This process requires substantial lowering of groundwater pressure. At any point below the ground surface, the weight of overlying strata is supported partly by water pressure and partly by the fabric of the rock mass. Any reduction in water pressure therefore results in an increased proportion of the load being carried by the rock mass, leading to compression of the rock. The combined compression over the thickness of rock strata affected by reduced water pressure results in subsidence at the ground surface.*

A Subsidence Technical Memorandum (Coffey Environments Australia Pty Ltd, hereafter referred to as Coffey, 2018) was prepared to support Arrow's Stage 1 WMMP. This provided modelling of the predicted magnitude of subsidence, including a review of ground movement observations and groundwater level monitoring carried out in proximity to existing Arrow domestic CSG projects, as well as an assessment of risks posed by subsidence to assets within or in close proximity to operations. Similar to OGIA's subsidence modelling (2021), Coffey's modelling indicates that any subsidence that occurs will be relatively widespread and even.

Since the Subsidence Technical Memorandum (Coffey, 2018), Arrow has undertaken further analysis of Interferometric Synthetic Aperture Radar (InSAR) data collected from ongoing monitoring. InSAR measurements provide data on movement of the ground surface and are recorded at fixed time periods from points across the landscape within the Surat Basin.

The spatial variation from these measurements indicates that natural ground movement is not static and varies both spatially and temporally. In order to describe how the potential ground movement correlates to CSG activities, Arrow has analysed InSAR measurements based on the distance to the closest existing CSG well and the duration that each well had been operating, as shown in Figure 4-2 for Arrow's existing Daandine production field.

This analysis indicates a clear correlation between the magnitude of CSG subsidence and the proximity to the wells. When looking at the average ground movement from the Sentinel InSAR dataset between 2015 and 2020 the area that had the most subsidence is within 500 m of the wells, decreasing to background ground movement at around 3,000 m from the wells. It is apparent that the rate of subsidence also decreases with time as the water production rate of a well decreases.

This CSG related subsidence results in a change in slope of approximately 25 mm per kilometre (0.0025%) at Daandine, with the change in slope observed at Arrow's existing Tipton production field being lower. In comparison, approximately 95% of the area in the vicinity of the subject land has an existing slope of greater than 300 mm per kilometre (0.03%) as presented inTable 4-4.

OGIA (2021) state that, as is the case for groundwater level decline, the rate of subsidence is likely to be higher in the initial stages of development, gradually stabilising over the following three to seven years.

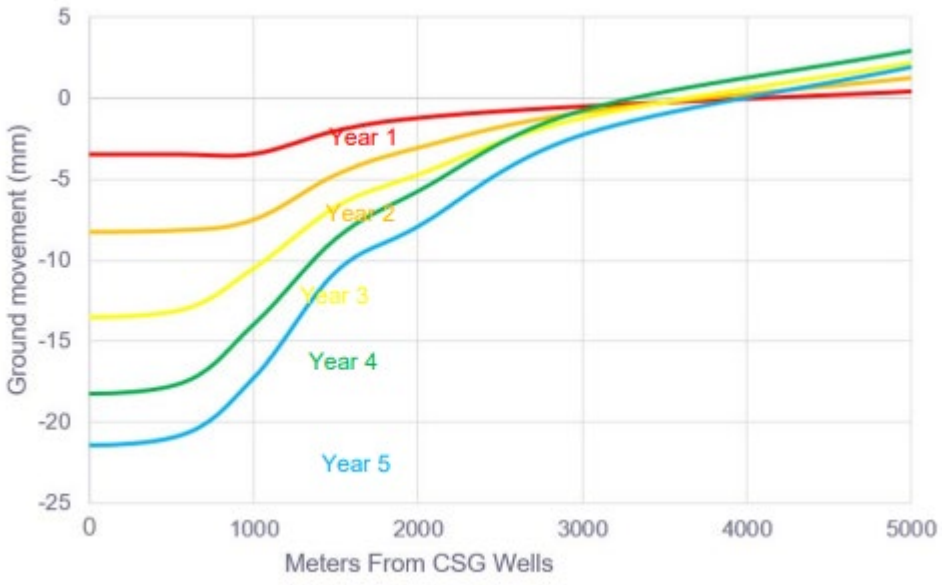


**Figure 4-2 : Ground movement at Daandine with time and distance from well**

### 4.4.5 Production and Productive Capacity

The activities associated with the subterranean deviated well trajectories will not impact on the production or productive capacity of the subject land as:

- No access or surface disturbance will occur;
- All activities will be undertaken sub-surface at a minimum depth of approximately 190m;
- No modifications or supplements to the existing land use activities will be required;

- As outlined in Section 4.4.4, farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence;

Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts are not material to ongoing PALU activities.

## 4.5 Measures to Minimise Impacts to PALU

Arrow typically starts our engagement with landholders via Area Wide Planning approximately 2 years before planned activities. This engagement generally results in fruitful discussions that result in infrastructure placement and construction practices that are tailored to a particular lot by taking into consideration current and future landholder infrastructure and farming

Arrow has determined that lots subject to this RIDA application are not suitable for infrastructure requiring surface infrastructure (either due to land constraints or inability to reach agreement with the landholder). However, Arrow is proposing to install sub-surface infrastructure on these lots in the form of subterranean deviated well trajectories, which avoids direct surface impacts to these lots.

Further measures which will be implemented to minimise the potential for adverse impacts to PALU on these lots include:

- Preparation a Subsidence Baseline Pack for each lot which
  - Contains Property specific baseline data;
  - Provides transparency on any gradient changes (subsidence) over time;
  - Shares bi-annual LiDAR data for monitoring.
- Insurance Deed Poll
  - Protects farm insurance cover by indemnifying landowners for public liability associated with deviated wells as per CCA's
- Provide Entry Notices prior to drilling any deviated wells where landholder agreements/waivers are not in place. This will include:
  - Relevant maps
  - Deed Poll
  - Subsidence Baseline Pack
  - Notice of Intention to Drill
  - Code of Practice for construction and abandonment of bores in Queensland.
- Provision of detailed maps with as-built diagrams, location, depths and trajectory of wells.
- Well trajectories logged in Dial Before you Dig.

Refer also to Section 7.

# 5. Strategic Cropping Areas

## 5.1 Overview

SCAs consist of the areas shown on the strategic cropping land (SCL) trigger map as SCL. SCL is land that is, or is likely to be, highly suitable for cropping because of a combination of the land's soil, climate and landscape features.

## 5.2 Extent of SCL

For purpose of application, Arrow accepts the extent of SCL as mapped. The extent of SCL on the subject land is summarised in Table 5-1.

## 5.3 Nature of Surface Impacts to SCL

As outlined in Sections 1 to 3 of this report, the activities in the scope of this application will not require access to or any surface disturbance to the subject land (refer to Table 5-1). This is due to all activities being conducted sub-surface at a minimum depth of approximately 190m, with all surface activities being undertaken on adjacent lots, which are outside of the scope of this application.

The location of the deviated well paths beneath the lots is illustrated in Appendix 3.

**Table 5-1 – Scale of Impact to SCA**

| Property / Lot | Infrastructure (refer to Appendix 3) | Lot Size (Ha) | SCA on Lot (Ha) | Disturbance to SCL (Ha) |
|---|---|---|---|---|
| **Property 1** | | | | |
| 1RP83755* | 3 Subterranean deviated drilling trajectory | 131.0 | 131.0 | 0 |
| | **Total Property Area** | **131.0 ha** | **Total Property SCA 131.0 ha** | **0 ha** |
| **Property 2** | | | | |
| 11SP191489* | 2 Subterranean deviated drilling trajectories | 135.6 | 125.2 | 0 |
| 956DER3479 | Nil | 510.5 | 296.8 | 0 |
| | **Total Property Area** | **646.1 ha** | **Total Property SCA 622.0 ha** | **0 ha** |
| **Property 3** | | | | |
| 55DY592* | 3 Subterranean deviated drilling trajectories | 300.3 | 292.4 | 0 |
| | **Total Property Area** | **300.3 ha** | **Total Property SCA 292.4 ha** | **0 ha** |
| **Property 4** | | | | |
| 141AG4261* | 1 Subterranean deviated drilling trajectory | 353.4 | 300.2 | 0 |
| 3SP243187 | Nil | 132.8 | 126.8 | 0 |
| 2RP152259 | Nil | 123.2 | 123.2 | 0 |
| 364A34907 | Nil | 99.2 | 99.2 | 0 |
| | **Total Property Area** | **708.6 ha** | **Total Property SCA 649.4 ha** | **0 ha** |
| **Property 5** | | | | |
| 1RP78475* | 4 Subterranean deviated drilling trajectories | 345.9 | 345.9 | 0 |
| | **Total Property Area** | **345.9 ha** | **Total Property SCA 345.9 ha** | **0 ha** |
| **Property 6** | | | | |
| 56DY592 | 1 Subterranean deviated drilling trajectory | 330.6 | 330.6 | |
| | **Total Property Area** | **330.6 ha** | **Total Property SCA 330.6 ha** | **0 ha** |

Table 5-1 illustrates there will be no surface disturbance to SCA associated with the subterranean deviated well paths reduction and therefore no surface impacts.

The activities associated with the subterranean deviated well trajectories will not impact on the SCA on the subject land as:

- No access or surface disturbance will occur;
- All activities will be undertaken sub-surface at a minimum depth of approximately 190 m;
- The activities will not impact or alter the pre-activity condition of the land due to the depth of the well paths;
- No modifications or supplements to the existing land use activities will be required.

Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts to SCL are not material as the pre-existing land condition and land use can be maintained.

# 6. Landholder Consultation

### 6.1.1 Consultation Process

Consultation with the majority landowners regarding the deviated well paths the subject of this application commenced in 2021 and will continue throughout the duration of the project. The land mapped as SCA and PAA subject of this application is listed in Section 1.5 of this report. Arrow is seeking voluntary agreements with each of the landowners. Arrow's land access process involves four steps which are included in Table 6-1.

**Table 6-1 – Arrow Energy Access Process**

| Step | Activities |
|---|---|
| Area Wide Planning (AWP) | • First landholder engagement including discussion of proposal and identification of areas of concern<br>• Concept layout<br>• Site scouting<br>• Issued For Site Assessment (IFSA) GIS layer |
| Site Assessment | • Subject Matter Experts review IFSA GIS layer to identify required agreements<br>• Site assessment including review and assessment of concerns raised by landholder<br>• Released From Survey (RFS) GIS layer |
| Drafting and presenting Conduct and Compensation Agreements (CCAs) / Deviated Well Agreements (DWAs) | • RFS GIS layer reviewed, scope is locked, budget approved - termed Final Layout Approval (FLA)<br>• Drafting of CCA/AA/DWA<br>• Presenting CCA/AA/DWA to landholder including proposed measures to address concerns raised |
| Negotiating and executing CCAs / DWAs | • Negotiating on measures to address any outstanding concerns<br>• Negotiations to settle terms and conditions and compensation amount<br>• Execution (signing) of CCA/AA by landholder and Arrow |

The strategy to engage with the landholders of the subject land for deviated well trajectories is as follows:

- Land Liaison Officers (LLO) contact the landholder to discuss the proposed deviated well paths and arrange a suitable time to visit the landholder;

- LLO undertakes a visit to the landholder on a date agreed between both parties and provides a Deviated Well Agreement Pack (includes proposed

map, Deviated Well Agreement, title search, Baseline Data, Indemnity Deed Poll, RPI Factsheets and Deviated Wells fact sheet);

- Meeting with landholder 2 weeks after initial contact about the deviated wells to discuss the Deviated Well Agreement and any landholder concerns;
- Periodic follow up with landholder for a period of up to 3 months in regards to concerns and Deviated Well Agreement.
- Questions raised by the landholder are answered by the LLO either by phone or email-depending on the nature of the question and detail required. All interactions are captured in file notes.
- Arrow always respond to any concerns about the proposed development or other issues identified by the landholder.
- Arrow will negotiate in good faith with landholders and aim to reach voluntary agreement. This means that each of our engagements with landholders and their legal representatives are to be undertaken in a manner that:
    - demonstrates respect
    - demonstrates open and transparent dialogue
    - adopts the technique of active listening
    - is empathetic to grievances/complaints and seeks to resolve disputes in a timely manner
    - provides transparency of our proposed activities and potential impacts
    - allows sufficient time to negotiate and reach agreement (e.g. recognising that an agreement will not be resolved in a single or even a few meetings)
    - Seeks to be as efficient as possible in the use of time and provides an acceptable outcome for both parties.

## 6.2 Status of Consultation

A summary of the progress of consultation with the landowner is provided in Appendix 10. This Appendix is considered confidential and not subject to public release.

# 7. Management of Mitigation Measures

## 7.1 Site Selection and Alternatives

The initial stages site selection for the gas field infrastructure involved a desktop assessment of topographical and ecological mapping, preliminary landholder discussions and field scouting where access to the field was available.

Key steps involved:

- Site scouting activities;
- Ecological and cultural heritage desktop analyses;
- Ecological field assessments;
- Engineering and constructability assessments;
- Desktop soil assessment;
- Detailed landholder discussions; and
- Cultural heritage field assessments.

As previously stated, Arrow develops deviated wells, whereby a multi-well pad will be located on an adjacent lot and a deviated well trajectory will be drilled beneath the subject land. Deviated wells are used on farming land to minimise surface impacts and avoid disruptions to landholders' business and personal activities.

The well trajectories the subject of this application have been selected to target multiple coal seams to enable gas to be extracted and to avoid the need to drill multiple single vertical wells. The majority of Arrow's Production Lease (PL) 198, 238 and 252 are mapped as PAA and therefore PAA is not possible to avoid.

Disturbance to SCA, PAA and PALU have been avoided for the subterranean deviated well trajectories on land subject of this RIDA application through the use of deviated well trajectories and well pads on adjacent properties.

## 7.2 Monitoring and Management of Subsidence

The WMMP is the primary document which outlines how Arrow will monitor for and manage subsidence within the SGP, if it occurs.

The primary framework for the monitoring and management of subsidence caused by CSG production, which may alter existing ground slopes and therefore overland flow as discussed in Section 4.4.4, is provided in the Stage 1 WMMP (refer to extract in Appendix 9 (Section 7 Subsidence Assessment and Monitoring)). The Technical Memorandum (Coffey, 2018) in the Stage 1 WMMP addressed Interferometric Synthetic Aperture Radar (InSAR) observations and groundwater monitoring data available in 2018, (covering the period July 2012 to December 2015), and provided:

- Assessment of the long-term subsidence associated with proposed Arrow SGP operations based on:

  - A review of ground movement observations and groundwater level monitoring carried out in proximity to existing Arrow domestic CSG projects (these current domestic CSG projects do not form part of the SGP)
  - Estimates of subsidence based on predicted groundwater drawdown from the Environmental Impact Statement (EIS) and the Supplementary Report to the EIS (SREIS).
- An assessment of risks posed by subsidence to assets within or in close proximity to Arrow SGP operations
- Recommendations for additional ground movement monitoring such as strategically located geodetic monitoring and extensometers
- Recommended trigger levels derived from the calculated assessments of potential subsidence and taking into account the outcomes of the risk assessment process
- Recommendations for continuing monitoring for the Arrow SGP.

Coffey (2021) subsequently built upon their 2018 Technical Memorandum to cover the following items which will be used for future updates to the WMMP subsidence monitoring and management plan:

- InSAR ground movement monitoring data over the period August 2015 to June 2019
- Historical InSAR ground movement monitoring data over the period December 2006 to March 2011 and July 2012 to November 2017
- Assessment of the uniformity of ground movement
- Groundwater level monitoring and its relation to observed ground movement
- Assessment of the compressibility of the Walloon Coal Measures based on observed relationships between groundwater drawdown and ground movement at several locations
- Discussion of natural ground movements not related to CSG extraction
- Discussion of the theoretical mechanism of subsidence and the results of illustrative numerical modelling
- Predictions of future subsidence based on InSAR ground movement monitoring data to June 2019 and predicted groundwater drawdowns from the 2019 UWIR regional scale three-dimensional numerical model.
- A comparison on aquifer compressibility parameters based on observed drawdown and settlement with those based on unconfined compressive strength (UCS) test results in the relevant units.
- Recommendations for additional subsidence monitoring methods.

The WMMPs describe a program for monitoring ground movement that Arrow has been implementing and will continue to implement. The WMMP also describes the process for annual reporting of the results of the ongoing monitoring to the regulator.

The WMMP includes a three-tier subsidence management framework.

- Tier one is a screening level and involves comparison of satellite data at a 1 km x 1 km grid to identify areas of downward ground movement of more than 8 mm per year.
- Tier two is an investigation level and involves comparison of changes in the slope of the ground or differential movement, with criteria specific to each asset class (e.g. linear infrastructure, cultivated lands).
- Tier three is the trigger threshold and is developed based on a site specific assessment of impacts changes to drainage and impacts to farming.

Any exceedance of the trigger threshold requires Arrow to implement an action plan, including mitigation measures, to minimise impact of CSG related subsidence. The mitigation measures, if required, will be tailored to site specific conditions, impact cause, timing and magnitude.

The program for monitoring ground movement provided in the Stage 1 WMMP includes satellite imaging using InSAR, groundwater level monitoring, geodetic ground movement monitoring monuments and an extensometer array. Arrow has proposed amendments to the Commonwealth Department of Agriculture, Water and Environment (DAWE) for the Stage 1 WMMP. These amendments are to provide additional monitoring methods, including bi-annual collection of LiDAR where there is insufficient reliable InSAR data, and bi-annual surveying of benchmark locations to cross-check the LiDAR and InSAR data.

Arrow has acquired InSAR monitoring data back to 2006. Current InSAR monitoring is conducted using the European Space Agency Sentinel satellite constellation, with an acquisition frequency of every six days. Arrow has also acquired airplane borne LiDAR in 2012, 2014 and 2020. This InSAR and LiDAR monitoring provides a baseline from which future data can be assessed to determine changes in vertical ground elevation and slopes, and also provides a snapshot of current non-CSG ground movement.

Arrow has also installed six permanent geodetic ground movement monitoring stations. These stations are Global Navigation Satellite System (GNSS) Continuously Operating Reference Stations (CORS), and provide centimetre level accuracy at these stations for comparison to InSAR and LiDAR data.

Three of the stations are co-located at one site and independently monitor the soil movement compared to the deeper Condamine Alluvium aquifer and the Surat Basin formations from which the CSG subsidence propagates.

Monitoring of subsidence is carried out by Altamira using satellite borne InSAR, a radar technique used in geodesy and remote sensing which provides change in ground elevation over time.

Arrow has acquired InSAR data since 2006, with the most recent satellite system (Sentinel) providing data since 2015. The Sentinel satellite system passes every 12 days (every 6 days since 2017) providing high frequency ground motion monitoring, with a vertical resolution to approximately 8mm/year. The metadata for the InSAR data is provided in Table 7-1.

The location of InSAR data points on the subject properties and associated time series plots of available data are provided in the Surface Elevation Baseline Reports attached in Appendix 6.

Regionally, the 2021 UWIR (OGIA, 2021) presents the available point cloud around the eastern gas fields and along the western edge of the Condamine Alluvium (Figure 7-1). This figure shows ground movement over a period from early 2015 to mid-2021 as mm/year in different colours (red – higher downward ground movement; yellow – medium downward ground movement; green – neutral or upward ground movement). Charts of ground movement over time at representative locations with respect to proximity to gas fields are also shown as insets. For example, the insets in the bottom figure are from four locations around a CSG field. Moving from east to west, these are: away from the field, margins of the field, centre of the field and then again away from the field. At those locations, ground movement is averaged from all data points within an area of about 250×250 m.

To demonstrate local-scale and natural variations in ground movement, similar data is also shown in Figure 2 at a local scale at two different locations in and around the Condamine Alluvium.

The 2021 UWIR notes the following based on Figure 7-1:

- Within the gas fields (concentration of red points), total ground movement of about 100 mm is noted so far and is attributed to CSG depressurisation as it corelates well with the commencement of CSG depressurisation around 2014, and corresponding depressurisation.

- Ground movement gradually reduces at the margins of gas fields (yellow points), changing to a nearly flat rate (green points) further away from the gas fields.

- The rate of subsidence is higher in the early stages of development but is likely to stabilise to near zero in the later years as is suggested from the long-term predictions.

- Ground movement unrelated to CSG depressurisation and away from existing CSG development, both within and outside the Condamine Alluvium, suggests that the ground can frequently move up and down by around 25 mm/year and the ground movement can also vary significantly at a local scale (by up to 25 mm within 100 m). This is likely to be due to variations in soil type and associated changes in moisture content.

- Despite local variations in the rate of movement, the average trend from all data points within a local area shows a more consistent pattern of observed ground movement.

- Rising trends are observed in some eastern parts of the Condamine Alluvium with multi-year trends in ground movement which appear to correlate with rainfall pattern. This is likely due to overall moisture content that influences ground movement through drying and swelling of soil.

Arrow has acquired airplane borne LiDAR in 2012, 2014 and 2020 and will conduct LiDAR surveys twice a year. Collected LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertake surveying of a ground control network across the acquisition area to provide information on accuracy of the

DEM.  The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture. The absolute vertical accuracies of the DEM datasets are 0.12m (2012), 0.07m (2014) and 0.05m (2020).

The LiDAR data is presented in the Surface Elevation Baseline Reports (Appendix 6) for each subject property and the metadata for the LiDAR data is provided in Table 7-2.

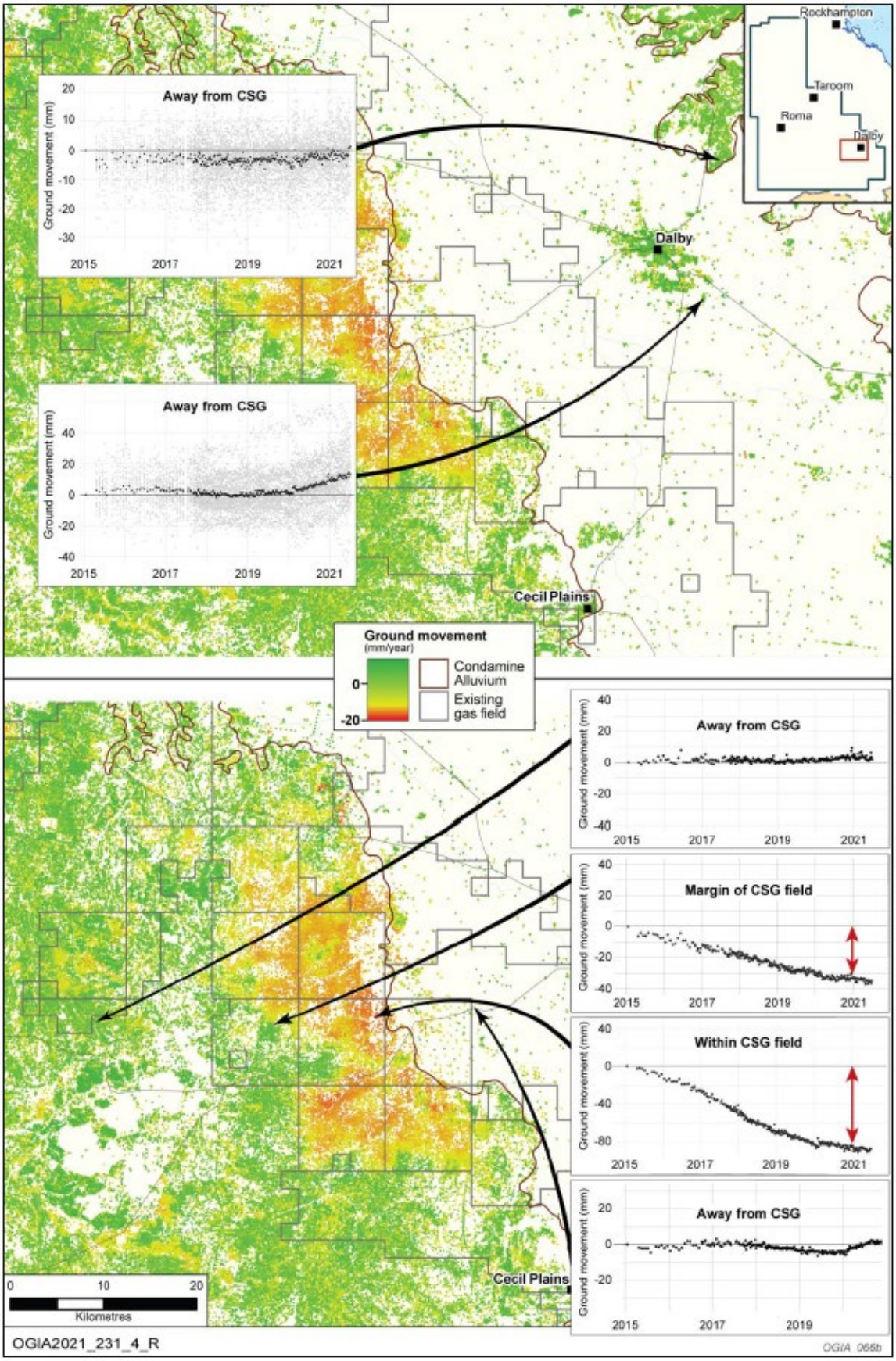


**Figure 7-1: Spatial and temporal pattern of ground movement around the easter gas fields in the Surat Cumulative Management Area (CMA) as measured through InSAR (OGIA, 2021)**

**Table 7-1: InSAR Metadata**

| | InSAR |
|---|---|
| Satellite | Sentinel Constellation |
| Satellite Track | 45 |
| Satellite Track Geometry | Descending |
| Satellite Image Resolution | 20m in range and 5m in azimuth |
| Acquisition Start | 4 August 2015 |
| Acquisition End | Ongoing |
| Acquisitions | 320 at date of dataset presented (27 June 2021) |
| Processing | TreAltamira SqueeSAR |
| Horizontal Datum | GDA94 |
| Map Projection | MGA Zone 56 |

**Table 7-2: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| Company | FUGRO | AAM | AAM |
| Acquisition Start | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| Acquisition End | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| Spatial Accuracy (Hz) | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| Spatial Accuracy (Vt) | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| Device Name | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| Half Scan Angle | not reported | 29 degrees | 25 degrees |
| Laser Pulse Rate | up to 150 kHz[2] | 400 kHz | 450 kHz |
| Laser Scan Frequency | up to 90 Hz[1] | 32 Hz | 40 Hz |
| Horizontal Datum | GDA94 | GDA94 | GDA2020 |
| Map Projection | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| Vertical Datum | AHD | AHD | AHD |
| Geoid Model | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

[2] These values are based on the range of Leica ALS50-2

## 7.3 Biosecurity Measures

Arrow is aware of the potential impact of the introduction of weeds and/or pathogens on land holdings as a result of their activities and have existing procedures in place to manage this such as Arrow's Biosecurity Guideline (ORG-ARW-HSM-GUI-00123). Comprehensive biosecurity measures will be introduced for the proposed gasfield development and will include:

- Discussion of property specific biosecurity requirements with landholders;
- Wash down of vehicles and equipment prior to arrival on site and maintenance of 'clean' status;
- Brush down / clean down of equipment between properties to prevent the transfer of soil or pathogens between properties;
- Pre and post construction monitoring and control as required.

It is not intended that any access to the subject land will be required. However, if access is requested by a landholder or is required due to unforeseen circumstances, the above measures will be applied.

# 8. Potential Impact to Condamine Alluvium Aquifer

The groundwater resources of the Condamine Alluvium have been extensively developed and are used for a range of water supply purposes including irrigation, urban use, commercial use, industrial use, stock-intensive, aquaculture, and stock and domestic uses. The Condamine Alluvium is incised into the Walloon Coal Measures in most of the central part of the alluvium.

The Walloon Coal Measures is the target for coal seam gas (CSG) production along the western margins of the Condamine Alluvium footprint, including in the area of the subject land, which can therefore potentially impact the groundwater resources of the Condamine Alluvium. The degree of impact will depend partly upon the hydraulic connectivity between the Condamine Alluvium and the Walloon Coal Measures.

The Office of Groundwater Impact Assessment (OGIA) initiated the Condamine Connectivity Project following the publication of the first Surat Underground Water Impact Report (UWIR) in 2012. This project has been progressively improving knowledge about the connectivity in the Condamine Alluvium. The project has used multiple lines of investigation, including: reinterpreting geology with particular focus on the contact between the Condamine Alluvium and the Walloon Coal Measures; mapping regional groundwater level differences between the two systems; and analysing the hydrochemistry of the two systems.

Arrow undertook a direct evaluation of the connectivity at two sites in 2013 and 2014, including drilling, coring and running pumping tests and numerically analysing the test data, with this data provided to OGIA as part of the project.

Details of the investigations, approach and outcomes were compiled in an investigation report (Groundwater connectivity between the Condamine Alluvium and the Walloon Coal Measures: a hydrogeological investigation report, OGIA 2016).

The project concluded that there was a low level of connectivity between the Condamine Alluvium and the Walloon Coal Measures. It was conceptualised that vertical flow and interaction between the Condamine Alluvium and the upper parts of the Walloon Coal Measures is impeded by a combination of the undifferentiated clay transition zone at the base of the alluvium and the firm mudstone/siltstone interburden of the Walloon Coal Measures, in which its coal seams are embedded.

The degree to which flow is impeded therefore depends upon the combined thickness and vertical hydraulic conductivity of these two units. Assessment of the potential for connectivity between the Condamine Alluvium and underlying Walloon Coal Measures has continued, with more recent data reaffirming previous findings that suggested low connectivity, as modelled in the 2016, 2019 and 2021 versions of the UWIR.

Modelling in the most recent UWIR (OGIA, 2021) indicates that the maximum impact to the Condamine Alluvium as a result of CSG production is expected to be less than 0.3 m for most of the area and, while the footprint of predicted impact is similar to that in the 2019 UWIR, the 2021 UWIR shows a larger area (than the 2019 UWIR) of maximum predicted impact, as shown in Figure 8-1.

It is predicted that there will be a net loss of water from the Condamine Alluvium to the Walloon Coal Measures of about 1,270 ML/year over the next 100 years due to CSG development. This is higher than predictions in the 2019 UWIR but comparable to predictions in the 2012 and 2016 UWIRs. The volume that is due to Arrow's activity is estimated at about 58 GL over the next 100 years. For comparison, the total potential take from Condamine Alluvium licences and stock and domestic users is about 52 GL per year (or 5200 GL over 100 years).

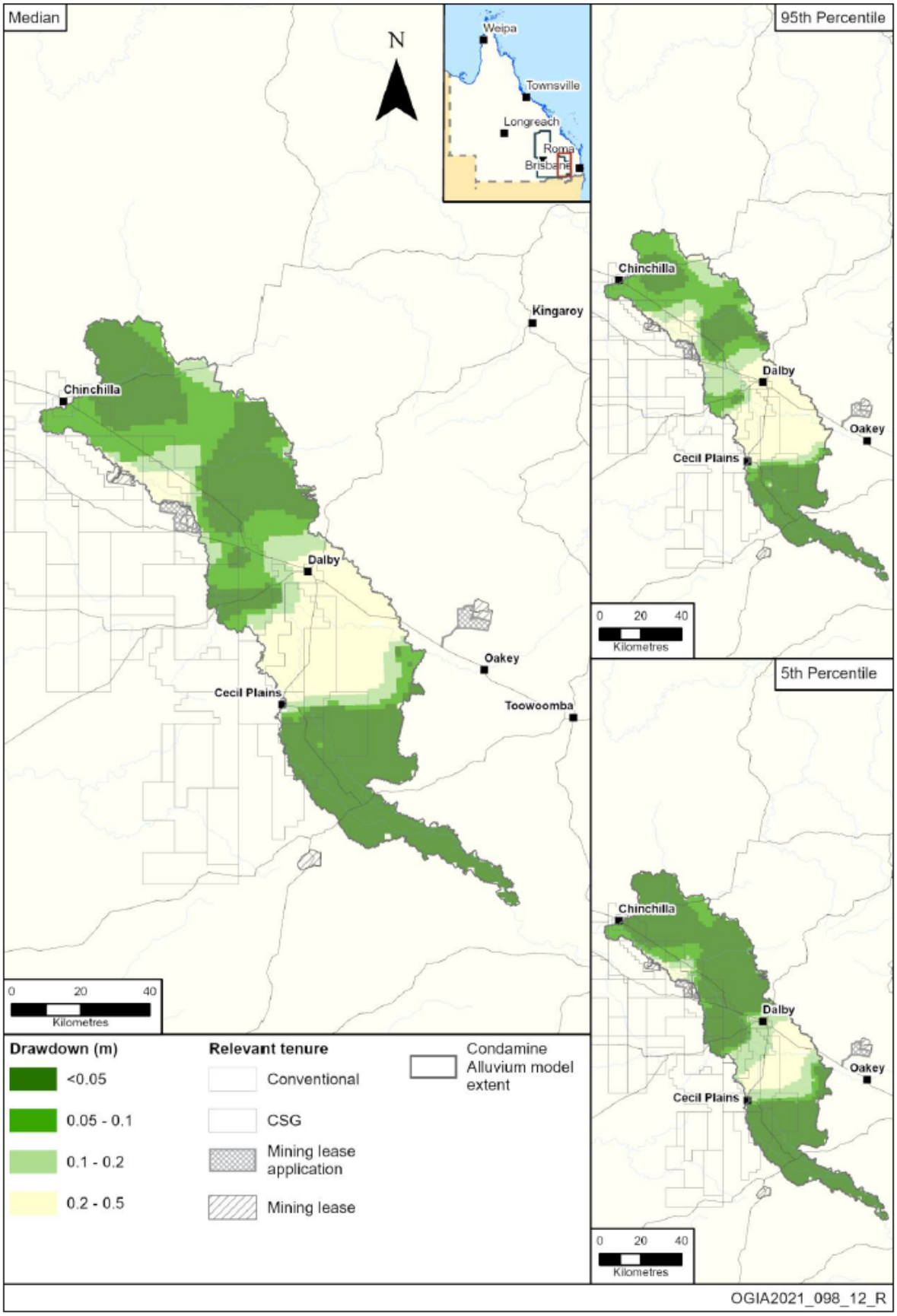


**Figure 8-1: Modelled drawdown of the Condamine Alluvium aquifer as a result of CSG production (OGIA, 2021).**

**Mitigation of Potential Impact to the Condamine Alluvium Aquifer**

To mitigate the loss of groundwater from the Condamine Alluvium as a result of Arrow's activities, Arrow has committed to:

1. Maximise beneficial use of produced water,

2. Where practical, return water to the region from which it is produced, and

3. Offset our impact on the Condamine Alluvium in the area of greatest predicted Arrow drawdown.

Following community consultation, Arrow committed to achieving this mitigation through substitution of allocation. Substitution of allocation is the beneficial use of coal seam water by providing it to existing Condamine Alluvium groundwater licence holders as a substitute to their approved entitlements. Instead of pumping groundwater from the Condamine Alluvium, a number of irrigators will be able to use Arrow's treated water through the Condamine Alluvium Substitution Scheme.

Arrow is conditioned in its federal EPBC approval to have a plan for mitigating its impact to the Condamine Alluvium.

Construction of the scheme will enable Arrow to offset its predicted impact to the Condamine Alluvium in accordance with regulatory approval granted under Environmental Protection and Biodiversity Conservation Act 1999 (Cwth) (EPBC Act). Arrow's plan submitted to DAWE describes achieving this via substitution of allocation in the first instance or by purchase of allocation if substitution does not achieve the required volume.

Arrow is not undertaking the scheme under any specific legislation and the possible use of seasonal assignments is to improve transparency and confidence to the community that substitution is being achieved and not because of a legislative requirement to do so. The scheme will ensure Arrow maximises local beneficial use of coal seam water taken from the Walloon Coal Measures during gas production from this area, whilst the water that would have otherwise been pumped from the Condamine Alluvium will remain in the aquifer to offset Arrow's impact to the Condamine Alluvium.

The location of greatest predicted drawdown has been modelled by OGIA in the 2012, 2016, 2019 UWIRs to occur on the western edge of the Condamine Alluvium. The exact location of the maximum predicted impact has been predicted to occur in slightly different parts of the western edge of the Condamine Alluvium and future UWIRs may predict different locations as well.

Nevertheless, Arrow has designed the Substitution Scheme to supply water to this area. If there is insufficient interest in the Substitution Scheme to meet the Substitution Target, Arrow may offset its impact to the Condamine Alluvium by purchasing allocations for the Condamine Alluvium to reduce extraction of groundwater from the alluvium.

# 9. Public Notification

The Land is not mapped as Priority Living Area (PLA). Accordingly, this assessment application does not meet the definition of a notifiable application pursuant to Section 34(2) of the RPI Act or section 13 of the *Regional Planning Interests Regulation 2014*.

Arrow has also undertaken consultation with the relevant landholders as part of the Area Wide Planning process and negotiations related to the gas field infrastructure. Pursuant to s35(1)(b) of the Act, if the application is to be notified, Arrow will provide a copy of the notice to each impacted landholder. Regardless of whether this application is required to be notified under legislation, Arrow will provide a full copy of the application to each owner of the subject land.

# 10. Financial Assurance

Arrow is required to provide estimated rehabilitation costs (ERC) for the gas field infrastructure prior to any disturbance as per the conditions of the relevant EAs which authorise activities on the petroleum authorities where the infrastructure will be situated. This ERC provides for the rehabilitation of land back to its original landform.

# 11. Assessment Application Fees

This assessment application is accompanied by the fee prescribed under the RPI Regulation 2014.

Schedule 4 of the RPI Regulation provides a definition of the expected area of impact for an assessment application, which means the area in which:

- The activity is proposed to be carried out; and
- Carrying out the activity is likely to have an impact

Given the authorised petroleum activities and the expected area of impact (0 ha) on lots subject to this application, the following assessment application fees have been calculated and were paid.

| Area of Regional Interest | Nature of assessment application | Fee |
|---|---|---|
| Priority Agricultural Area | For an assessment application with an expected area of impact of less than 30 hectares | $ 7,000.00 |
| Strategic Cropping Area | For an assessment application with an expected area of impact of less than 30 hectares | $ 7,000.00 |
| **Total** | | **$14,000.00** |

# 12. Required Outcome Assessment

## 12.1 Priority Agricultural Area

The PAA Assessment Criteria provides a required outcome for activities in PAAs that deals with impacts on a property level and a regional level. As the authorised petroleum activities are situated on more than one property across the region, impacts on a regional level (Required Outcome 2) apply for the purposes of this assessment application.

Schedule 2, Part 2 of the RPI Regulation set out the Required Outcomes and prescribed solutions for activities carried out in a PAA. Please refer to Table 12-2 for evidence associated with the prescribed solution of Required Outcome 2.

**Table 12-1 PAA Assessment Criteria – Required Outcome 2**

| **Part 2, 4 Required Outcome 2 - managing impacts on a region in relation to use of an area in the region for a priority agricultural land use**<br>The activity will be carried out on out on 2 or more properties in a priority agricultural area in a region.<br>The activity will not result in a material impact on the region because of the activity's impact on the use of land in the priority agricultural area for 1 or more priority agricultural land uses. | |
|---|---|
| **Part 2, 5 Prescribed Solution** | **Evidence/Response** |
| The application demonstrates all of the following | |
| (1) (a) if the activity is to be carried out in a priority agricultural area identified in a regional plan—the activity will contribute to the regional outcomes, and be consistent with the regional policies, stated in the regional plan | The Darling Downs Regional Plan PAA co-existence criteria enable compatible resource activities to co-exist with high-value agricultural land uses within PAAs. This will in turn maximise opportunities for economic growth to ensure that the Darling Downs remains a resilient, diversified and prosperous region.<br>The key drivers for preparing the plan included the following factors which are supported by Arrow's SGP and the proposed gasfield project which will deliver gas and water to existing facilities and provide economic and employment outcomes for the region while respecting and co-existing with the agricultural users of the area:<br>• enable opportunities for economic growth to ensure our regions are resilient and prosperous |

| | |
|---|---|
| | • protect areas of regionally significant agricultural production from incompatible resource activities while maximising opportunities for co-existence of resource and agricultural land uses<br>• safeguard the areas required for the growth of towns<br>• drive the region's economic diversity and opportunity<br>• identify infrastructure outcomes that will support economic growth<br><br>Further, the proposed construction and operation of the SGP is consistent with Regional policy 2 which is to:<br>*Maximise opportunities for co-existence of resource and agricultural land uses within Priority Agricultural Areas.*<br>As discussed in Section 1.6.2, Arrow considers coexistence to mean allowing Australia to enjoy the full benefits from both agricultural and resource industries. Arrow has made 12 commitments to coexistence on Intensively Farmed Land ("IFL") in the Surat Basin:<br>1. No permanent alienation<br>2. Minimised operational footprint - less than 2% of total IFL area<br>3. Flexibility on CSG well locations, but all wells located by edge of farm paddocks<br>4. Pad drilling (up to 8 wells from a single pad) used where coal depth and geology allows<br>5. Spacing between wells maximised (average of between 800m - 1500m)<br>6. Pitless drilling only<br>7. No major infrastructure facilities on IFL (dams, compression stations, gas gathering stations, water treatment)<br>8. Treated CSG water used to substitute existing users' allocations on IFL<br>9. No brine/salt treatment or disposal on IFL<br>10. Flexibility on power supply option - above or below ground<br>11. Fair compensation - including elements of 'added value' |

| | |
|---|---|
| | 12. Continued proactive engagements with community and transparency on coexistence field activities<br>*Commitment 8 refers to the area of greatest predicted drawdown on the Condamine Alluvium resulting from CSG extraction by Arrow Energy. |
| (b) the activity can not be carried out on other land in the region that is not used for a priority agricultural land use, including, for example, land elsewhere on a property, on an adjacent property or at another nearby location | As outlined in Section 7.1, the majority of Arrow's Production Lease (PL) 198, 238, 252 are mapped as PAA and therefore PAA is not possible to avoid.<br>Disturbance to PAA and PALU have been avoided for the subterranean deviated well trajectories on land subject of this RIDA application through the use of deviated well trajectories and well pads located on adjacent properties.<br>Refer to Section 3 for additional information as to how the use of deviated wells within the overall gas field will reduce the overall impacts on PALU. |
| (c) the construction and operation footprint of the activity on the area in the region used for a priority agricultural land use is minimised to the greatest extent possible | As outlined in Section 4, the carrying out of the activity on each property will not require any access or surface disturbance to the subject land – thereby minimising the footprint on PALU to the greatest extent possible for the activities the subject of this RIDA application. |
| (d) the activity will not result in widespread or irreversible impacts on the future use of an area in the region for 1 or more priority agricultural land uses | Arrow's first co-existence commitment states, No permanent alienation. Arrow is committed to co-existence with regional communities and in particular agricultural practices in the areas where it operates.<br>Arrow has constructed and operated multiple gasfield wells and pipelines over the past 15 years or more and is confident that this project will have no great impact on the area and certainly would not foresee any widespread or irreversible impact from its operation.<br>As outlined in Section 4, the proposed activities on the subject land will have minimal to no impacts as all activities are sub-surface at a minimum depth of approximately 190 m. |

| | |
|---|---|
| | The potential for impacts to land as a result of subsidence or changes to overland flow have been presented in Sections 4.4.4 and Section 7.2 and demonstrated that farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence.<br>The future use of an area in the region for one or more PALU will not be impacted by the proposed activities due to widespread or irreversible impacts. |
| (e) the activity will not constrain, restrict or prevent the ongoing use of an area in the region for 1 or more priority agricultural land uses, including, for example, infrastructure essential to the operation of a priority agricultural land use | Arrow employs AWP to discuss its proposed development activities and to understand the operations, needs and requirements of an individual landholder. Information obtained during AWP and at shed meetings with local communities is used to best locate infrastructure to ensure impacts to the individuals and communities lifestyles, and employment and economic activities are minimised as much as possible. This is particularly so when co-existence with farming practices is required. Details of existing farming practices, machinery operation and future aspirations are key considerations to ensure co-existence but also for factors such as ensuring the safety of Arrow staff, contractors and personal but more importantly the safety and security of landholders, their families and their visitors as well as the local community.<br>As outlined in Section 5, the carrying out of the activity under each property will not require any access or surface disturbance to the property and therefore will not constrain, restrict or prevent the ongoing use of the properties subject to the application or other properties for PAUL's. |
| (2) Subsection (3) applies if the activity is to be carried out in a priority agricultural area that includes a regionally significant water source and—<br><br>(a)if the activity is to be carried out under an authority to prospect or a petroleum lease under the | The Condamine Alluvium is prescribed as a regionally significant water source under the RPI Regulations 2014.<br>Appendix 7 is Arrow's CSG Water Management Plan which provides for the management of water across the PLs where the project will be constructed and operated. The Plan also includes information about net replenishment. |

| | |
|---|---|
| *Petroleum and Gas (Production and Safety) Act 2004*—the activity is likely to produce CSG water; or<br><br>(b)if the activity is to be carried out under a mineral development licence or a mining lease under the *Mineral Resources Act 1989*—the activity is likely to produce associated water. | The Plan states that Arrow has committed to offsetting its component of modelled likely flux impacts to the Condamine Alluvium in the area of greatest predicted drawdown as a result of CSG water extraction from the Walloon Coal Measures and is conditioned to do so under its Federal environmental approval. |
| (3) Also, the application must demonstrate the applicant has in place a strategy or plan for managing the CSG water or associated water that provides for the net replenishment of the regionally significant water source.<br><br>(4) For subsection (3), ***net replenishment*** of a regionally significant water source is the replacement to the water source, whether directly or indirectly, of all water that is no longer available for a priority agricultural land use in a priority agricultural area because carrying out a resource activity in the area produces CSG water or associated water. | The offsetting mechanism will be through substitution of allocations and/or purchase of allocations.<br>Modelled flux impact will vary with the development of successive groundwater models. The 'final' modelled flux impact will be predicted immediately prior to completion of the SGP. Any discrepancy between the 'final' model prediction and the amount Arrow has actually offset (through substitution or purchase of allocation) will be addressed at the end of the SGP. Arrow will review the 'final' quantum of flux to be offset having regard to updated model predictions and information obtained from relevant hydrogeological investigations. If required, Arrow will then undertake additional offset.<br>Refer to Section 8 for additional details. |
| (5) Subsection (6) applies for each property on which the activity is to be carried out if the applicant is not the owner of the land and has not entered into a voluntary agreement with the owner.<br><br>(6) The application must demonstrate the matters listed in this schedule, section 3 for a prescribed solution for required outcome 1 for the property. | The proposed activities will be carried out on six properties, as identified in Table 2-2.<br>A response to the assessment criteria for Required Outcome 1 for each/all properties is provided in Table 12-2. |

**Table 12-2 - PAA Assessment Criteria – Required Outcome 1**

| | |
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| **Part 2, 2 Required Outcome 1 - Managing impacts on use of property for priority agricultural land use in a priority agricultural area**<br>This section applies if the activity is to be carried out on a property in a priority agricultural area.<br>The activity will be carried out on a property in a priority agricultural area and will not result in a material impact on the use of the property for a priority agricultural land use. | |
| **Part 2, 3 Prescribed Solution** | **Evidence/Response** |
| (1) Subsections (2) and (3) each state a prescribed solution for required outcome 1. | |
| **PS (2)** The application demonstrates the activity will not be located on land that is used for a priority land use. | All land is mapped as PAA. |
| **PS (3)** The application demonstrates all of the following<br>i. If the applicant is not the owner of the land and has not entered into a voluntary agreement with the owner:<br>a. The applicant has taken all reasonable steps to consult and negotiate with the owner about the expected impact of carrying out the activity on each priority agricultural land use for which the land is used; and | The Applicants are not the owner of the subject land (refer to Appendix 2) and the Applicants have not entered into a voluntary agreement with the owners of the subject land.<br>A summary of landholder consultation undertaken is provided in Section 6 and Appendix 10. |
| ii. Carrying out the activity on the property will not result in a loss of more than 2% of both:<br>a. The land on the property used for a priority agricultural land use; and<br>b. The productive capacity of any priority agricultural land use on the property | As outlined in Section 5, the carrying out of the activity on each property will not result in a loss of more than 2% of both property used for a PALU and productive capacity of a PALU as:<br>• No access or surface disturbance will occur on any of the properties and therefore there will be no change or loss of land on any property for a PALU ;<br>• All activities will be undertaken sub-surface at a minimum depth of approximately 190 m; |

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| | | • No modifications or supplements to the existing land use activities will be required;<br>• The proposed activities are sub-surface and will not change the productive capacity of the overlying land on each property;<br>• Farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence (refer to Section 4.4.4);<br>• Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts are not material to ongoing PALU activities. No surface disturbance will occur. |
| iii. | the activity cannot be carried out on other land that is not used for a priority agricultural land use, including for example, land elsewhere on the property, on an adjacent property or at another nearby location; | As illustrated in Figure 1-1, the majority of Arrow's Production Lease (PL) 198, 238, 252 are mapped as PAA and therefore PAA and associated PALU on the impacted properties is not possible to avoid.<br>The extent of the areas not used for a PALU on the impacted properties is limited and does not provide a practical option for locating of well paths included in this application.<br>However, disturbance to PAA and PALU has been entirely avoided for the subterranean deviated well trajectories on the subject land through the use of deviated well trajectories and well pads situated on adjacent properties.<br>As noted above:<br>• No access or surface disturbance will occur on any of the properties and therefore there will be no change or loss of land on any property for a PALU ;<br>• All activities will be undertaken sub-surface at a minimum depth of approximately 190 m;<br>• No modifications or supplements to the existing land use activities will be required;<br>• The proposed activities are sub-surface and will not change the productive |

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| | capacity of the overlying land on each property. |
| iv. the construction and operation footprint of the activity on the part of the property used for a priority agricultural land use is minimised to the greatest extent possible. | As outlined in Section 5, the proposed activities each property will not require any access or surface disturbance to the property – thereby minimising the footprint on PALU to the greatest extent possible. |
| v. the activity will not constrain, restrict or prevent the ongoing conduct on the property of a priority agricultural land use, including, for example, everyday farm practices and an activity or infrastructure essential to the operation of a priority agricultural land use on the property | As outlined in Section 5, the carrying out of the activity on each property will not require any access or surface disturbance to the property and therefore will not constrain, restrict or prevent the ongoing conduct on the property of a PALU. |
| vi. the activity is not likely to have a significant impact on the priority agricultural area | The activity is not likely to have a significant impact on the priority agricultural area as:<br>• No access or surface disturbance will occur on either property and therefore there will be no change or loss of land on each property for a PALU;<br>• All activities will be undertaken sub-surface at a minimum depth of 192m;<br>• No modifications or supplements to the existing land use activities will be required to enable existing PALU to continue on each property;<br>• The proposed activities are sub-surface and will not change the productive capacity of the overlying land on each property;<br>• Farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence (refer to Section 4.4.4);<br>Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts are not material to ongoing PALU activities or activities within |

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| | | the priority agricultural area. No surface disturbance will occur. |
| vii. | the activity is not likely to have an impact on land owned by a person other than the applicant or the land owner mentioned in paragraph (a). | The authorised petroleum activities, due to the nature and extent of the expected area of impact, will not have an impact upon other landowners or neighbours.<br>As outlined in Section 4, the proposed activities on the subject land will not require any access or disturbance to the subject land. These activities on the subject land (sub-surface well paths) are also not likely to impact on land owner by a person other than the owners of the subject land (other land)as no surface disturbance is proposed.<br>The potential for impacts to other land as a result of subsidence or changes to overland flow have been presented in Section 4.4.4 and demonstrated that Farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence. |

## 12.2 Strategic Cropping Area

The SCA Assessment Criteria provides a required outcome for activities in SCAs that deals with impacts on Strategic Cropping Land (SCL).

As the Applicants accept the extent of SCL across the subject land for the purposes of this assessment application, the Applicants do not seek to demonstrate the prescribed solution for Outcome 1 i.e. the applicant does not seek to demonstrate that the land within the SCA is not SCL.

As the proposed activities on the subject land are being carried out over more than one Property (refer to Table 2-2), Required Outcome 3 will apply.

Schedule 2, Part 4 of the RPI Regulation sets out the Required Outcomes and prescribed solutions for activities carried out in a SCA. Please refer to Table 12-3 for evidence associated with the prescribed solution of Required Outcome 3.

**Table 12-3 - SCA Assessment Criteria – Required Outcome 3**

| **Part 4, 12 Required Outcome 3 - managing impacts on strategic cropping land in the strategic cropping area**<br>(1) This section applies if the activity—<br>(a) does not meet required outcome 1; or<br>(b) is being carried out on 2 or more properties (SCL) in the strategic cropping area.<br>(2) The activity will not result in a material impact on strategic cropping land in an area in the strategic cropping area. | |
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| **Part 4, 13 Prescribed Solution** | **Evidence/Response** |
| The application demonstrates all of the following | |
| (1) The application demonstrates all of the following—<br>(a) the activity cannot be carried out on other land in the area that is not strategic cropping land, including, for example, land elsewhere on the property (SCL), on adjacent land or at another nearby location; | As discussed in the report, the majority of Arrow's Production Lease (PL) 198, 238, 252 are mapped as SCA and therefore SCL is not possible to avoid. Disturbance to SCA and SCL has been avoided for the subterranean deviated well trajectories on the subject land through the use of deviated well trajectories and well pads situated on adjacent properties.<br>Refer to Section 3 for additional information as to how the use of deviated wells within the overall gas field will reduce the overall impacts on SCL. |
| (b) if there is a regional plan for the area in which the activity is to be carried out—the activity will contribute to the regional outcomes, and be consistent with the regional policies, stated in the regional plan; | The Darling Downs Regional Plan encourages co-existence between compatible resource activities with high-value agricultural land uses. This will in turn maximise opportunities for economic growth to ensure that the Darling Downs remains a resilient, diversified and prosperous region.<br>The key drivers for preparing the plan included the following factors which are supported by Arrow's SGP and the proposed gasfields project which will deliver gas and water to existing facilities and provide economic and employment outcomes for the region while respecting and co-existing with the agricultural users of the area:<br>• enable opportunities for economic growth to ensure our regions are resilient and prosperous<br>• protect areas of regionally significant agricultural production from incompatible resource activities while maximising |

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| | opportunities for co-existence of resource and agricultural land uses<br>• safeguard the areas required for the growth of towns<br>• drive the region's economic diversity and opportunity<br>• identify infrastructure outcomes that will support economic growth<br><br>Further, the proposed construction and operation of the SGP is consistent with Regional policy 2 which is to:<br>*Maximise opportunities for co-existence of resource and agricultural land uses within Priority Agricultural Areas.*<br>As discussed in Section 1.6.2, Arrow considers coexistence to mean allowing Australia to enjoy the full benefits from both agricultural and resource industries. Arrow has made 12 commitments to coexistence on Intensively Farmed Land ("IFL") in the Surat Basin:<br>1. No permanent alienation<br>2. Minimised operational footprint - less than 2% of total IFL area<br>3. Flexibility on CSG well locations, but all wells located by edge of farm paddocks<br>4. Pad drilling (up to 8 wells from a single pad) used where coal depth and geology allows<br>5. Spacing between wells maximised (average of between 800m - 1500m)<br>6. Pitless drilling only<br>7. No major infrastructure facilities on IFL (dams, compression stations, gas gathering stations, water treatment)<br>8. Treated CSG water used to substitute existing users' allocations on IFL<br>9. No brine/salt treatment or disposal on IFL<br>10. Flexibility on power supply option - above or below ground<br>11. Fair compensation - including elements of 'added value'<br>12. Continued proactive engagements with community and transparency on coexistence field activities<br>*Commitment 8 refers to the area of greatest predicted drawdown on the Condamine |

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| | Alluvium resulting from CSG extraction by Arrow Energy. |
| (c) the construction and operation footprint of the activity on strategic cropping land is minimised to the greatest extent possible; | As outlined in Section 5, the carrying out of the activity on each property will not require any access or surface disturbance to the property – thereby minimising the footprint on SCL to the greatest extent possible. |
| (d) either—<br>(i) the activity will not have a permanent impact on the strategic cropping land in the area; or<br>(ii) the mitigation measures proposed to be carried out if the chief executive decides to grant the approval and impose an SCL mitigation condition. | Arrow's first co-existence commitment states, No permanent alienation. Arrow is committed to co-existence with regional communities and in particular agricultural practices in the areas where it operates.<br>As outlined in Section 5, the carrying out of the activity on each property will not require any access or surface disturbance to the property and will therefore not have a permanent impact on SCL on the property – either through disturbance or any change to the productive capacity of the land. |
| (2) Subsection (3) applies for each property (SCL) on which the activity is to be carried out if the applicant is not the owner of the land and has not entered into a voluntary agreement with the owner.<br>(3) The application must demonstrate the matters listed in this schedule, section 11 for a prescribed solution for required outcome 2 for the property (SCL). | The Applicants are not the owner of the land (refer to Appendix 2) and has not entered into a voluntary agreement with the owner.<br>The proposed activities will be carried out on six (6) properties, as identified in Table 2-2.<br>A response to the assessment criteria for SCA Assessment Criteria for Required Outcome 2 for the six properties is provided in Table 12-4. |

**Table 12-4 - SCA Assessment Criteria – Required Outcome 2**

| **Part 4, 10 Required Outcome 2 - managing impacts on strategic cropping land in the strategic cropping area**<br>(1) This section applies if the activity—<br>(a) does not meet required outcome 1; and<br>(b) is being carried out on a property (SCL) in the strategic cropping area.<br>(2) The activity will not result in a material impact on strategic cropping land on the property (SCL). | |
|---|---|
| **Part 4, 11 Prescribed Solution** | **Evidence/Response** |
| The application demonstrates all of the following | |
| (a) if the applicant is not the owner of the land and has not entered into a voluntary agreement with the owner—the applicant has taken all reasonable steps to consult and negotiate with the owner of the land about the expected impact of carrying out the activity on strategic cropping land; | The Applicants are not the owner of the subject land (refer to Appendix 2). A summary of landholder consultation undertaken is provided in Section 6 and Appendix 10. |
| (b) the activity cannot be carried out on land that is not strategic cropping land, including, for example, land elsewhere on the property (SCL), on adjacent land or at another nearby location; | The vast majority of the layout is mapped as SCL and could not be avoided.<br>However, as discussed in Section 3 and 7.1, the proposed subterranean deviated well trajectories provide for the least impacts to landholders in the region and does not involve disturbance to SCL on any lots subject to this application, as all activities will be sub-surface.<br>As described earlier, the activity is not likely to have a significant impact on the land as:<br>• No access or surface disturbance will occur on either property and therefore there will be no change or loss of land on each property; |

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| | • All activities will be undertaken sub-surface at a minimum depth of approximately 190m;<br>• No modifications or supplements to the existing land use activities will be required to enable existing SCL to continue on each property;<br>• The proposed activities are sub-surface and will not change the productive capacity of the overlying land on each property;<br>• Farming operations and flood flow in major water courses within the subject land and/or within the 3 km buffer are not expected to be impacted by CSG induced subsidence (refer to Section 4.4.4);<br>Measures outlined in Section 3, 4.5 and 7 will minimise the potential for impacts and ensure that impacts are not material to ongoing SCL activities or activities within the strategic cropping area as no surface disturbance will occur. |
| (c) the construction and operation footprint of the activity on strategic cropping land on the property (SCL) is minimised to the greatest extent possible; | As outlined in Section 5, the carrying out of the activity on each property will not require any access or surface disturbance to the property – thereby minimising the footprint on SCL to the greatest extent possible. |

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| (d) if the activity will have a permanent impact on strategic cropping land on a property (SCL)—no more than 2% of the strategic cropping land on the property (SCL) will be impacted. | As outlined in Section 5, the carrying out of the activity on each property will not require any access or surface disturbance to the property and will therefore not impact on SCL on the property – either through disturbance or any change to the productive capacity of the land. |

# 13. References


Arrow Energy, 2012. SGP Environmental Impact Statement. Available at: https://www.arrowenergy.com.au/environment/groundwater/water-monitoring-management-plans/_nocache

Arrow Energy, 2013. Supplementary Report to the EIS. Available at: https://www.arrowenergy.com.au/environment/groundwater/water-monitoring-management-plans/_nocache

Arrow Energy, 2018. Stage 1 Water Monitoring and Management Plan. Available at: https://www.arrowenergy.com.au/environment/groundwater/water-monitoring-management-plans/_nocache

Arrow Energy, 2019. Updated Water Monitoring and Management Plan. Available at: https://www.arrowenergy.com.au/environment/groundwater/water-monitoring-management-plans/_nocache

Code of Environmental Practice Onshore Pipelines, Australian Pipeline Industry Association, June 2013

Coffey, 2018. SGP Stage 1 CSG WMMP: Subsidence Technical Memorandum. Report to Arrow Energy. Coffey Environments Australia Pty Ltd (Coffey), 2018.

Coffey, 2021. Surat Gas Project – Subsidence Monitoring and Prediction. Report to Arrow Energy. Coffey Environments Australia Pty Ltd (Coffey), 2021.

Data Farming, 2021. Ground Movements in Agricultural Production. Report to Arrow Energy. Data Farming, 2021.

RPI Act Statutory Guideline (11/16), specifically guidelines 2, 3, 6 and 7, Department of State Development, Infrastructure, Local Government and Planning, 2014

# 14. Definitions

Definitions of terms used in this standard:

| Term | Definition |
|---|---|
| Applicants | The relevant tenement holders being:<br>• Arrow (Tipton) Pty Ltd – ABN 17 114 927 507;<br>• Arrow (Tipton Two) Pty Ltd – ABN 36 117 853 755; and<br>• Arrow CSG (Australia) Pty Ltd – ABN 54 054 260 650.<br>• Arrow Energy Pty Ltd – ABN 73 078 521 936 |
| Application | Assessment application for a RIDA made under the RPI Act (this application) |
| Arrow | Arrow Energy Pty Ltd |
| AS | Australian standard |
| BUN | Beneficial Use Network |
| CSG | Coal seam gas |
| DSDILGP | Department of State Development, Infrastructure, Local Government and Planning (Queensland) |
| DoE | Department of Environment (Commonwealth) |
| EA | Environmental Authority |
| EIS | Environmental impact statement |
| EMP | Environmental management plan |
| EPBC Act | Commonwealth Environmental Protection and Biodiversity Conservation Act 1994 |
| EP Act | Environmental Protection Act 1994 |
| EPC | Exploration Permit - Coal |
| PPL | Petroleum pipeline licence |
| Proposed Activities | The construction and operation of sub-surface well paths on the subject land as outlined in Section 3 |
| RIDA | Regional interests development application |
| ROW | Right of way |
| RPI Act | *Regional Planning Interests Act 2014* |
| Subject Land | Collectively describes the lots to which this application relates |
| The/this application | Refers to this assessment application made under the RPI Act for the proposed activities on the subject land. |

# Appendices

# Appendix 1: Existing Approvals - Extracts

# PL 198 Resource authority public report

## Table of Contents

# PL 198 Resource authority public report

Queensland Government

## Permit details

| | |
|---|---|
| **Permit ID:** | PL 198 |
| **Status:** | Granted |
| **Lodged date:** | 29/01/2003 |
| **Grant date:** | 09/12/2004 |
| **Commencement date:** | 09/12/2004 |
| **Expiry date:** | 08/12/2034 |
| **Plan/program expiry date:** | 30/06/2025 |
| **Current term:** | 30 years |
| **Work program type:** | |
| **Conditions:** | |
| **Locality:** | Clarence Morton Basin, TIPTON WEST FIELD, TOWN OF DALBY |
| **Remarks:** | |
| **Act permit granted under:** | Petroleum Act 1923 |
| **Act now administered under:** | Petroleum and Gas (Production and Safety) Act 2004 |

## Holders

### Authorised holder representative (AHR)

FERGUSON, Suzanne
C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001

### Holders

| | Holder name | Share % | Status | Held from | Held to | Authorised holder |
|---|---|---|---|---|---|---|
| * | ARROW CSG (AUSTRALIA) PTY LTD<br>C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001 | 30.000000000000 | Current | 05/10/2010 | | No |
| * | ARROW (TIPTON TWO) PTY LTD<br>GPO Box 5262 Brisbane QLD 4001 | 28.000000000000 | Current | 09/03/2010 | | No |
| * | ARROW (TIPTON) PTY. LTD.<br>GPO Box 5262 Brisbane QLD 4001 | 42.000000000000 | Current | 18/01/2010 | | Yes |
| | SHELL CSG (AUSTRALIA) PTY LTD | 12.000000000000 | Former | 09/03/2010 | 05/10/2010 | |
| | SHELL CSG (AUSTRALIA) PTY LTD | 18.000000000000 | Former | 18/01/2010 | 05/10/2010 | |
| | ARROW (TIPTON TWO) PTY LTD | 40.000000000000 | Former | 09/09/2009 | 09/03/2010 | |
| | ARROW (TIPTON) PTY. LTD. | 60.000000000000 | Former | 22/02/2008 | 18/01/2010 | |
| | BEACH PETROLEUM (SURAT) PTY LTD | 40.000000000000 | Former | 22/02/2008 | 09/09/2009 | |
| | ARROW (TIPTON) PTY. LTD. | 100.000000000000 | Former | 03/10/2007 | 22/02/2008 | |
| | ARROW ENERGY NL | 100.000000000000 | Former | 23/04/2007 | 03/10/2007 | |
| | ARROW ENERGY NL | 80.000000000000 | Former | 09/12/2004 | 23/04/2007 | |
| | COMET RIDGE LTD | 20.000000000000 | Former | 09/12/2004 | 23/04/2007 | |
| | ARROW ENERGY NL | 100.000000000000 | Former | 29/01/2003 | 09/12/2004 | |

**Tenancy type:** Tenancy in Common

## Area

| | |
|---|---|
| **Location:** | View Map |
| **Mining district:** | Dalby |
| **Local authority:** | Toowoomba Regional Council, Western Downs Regional Council |
| **Area:** | 85 Sub-blocks |
| **Exclusions:** | |
| **Marked out date:** | |

### Sub-blocks

| BIM | Block | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brisbane | 2751 | A | B | | | | | G | H | J | K | L | M | N | O | P | Q | R | | | | V | W | | | |
| Brisbane | 2752 | A | B | | | | F | G | H | | | L | M | N | | | | | | | | | | | | |
| Brisbane | 2822 | | | | | | | | | | | | | | | | | | | | | | | | | Z |
| Brisbane | 2823 | A | B | | | | F | G | | | | L | M | | | | Q | R | | | | V | W | X | | |
| Brisbane | 2894 | | | | | E | | | | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
| Brisbane | 2895 | A | B | C | | | F | | | | | L | | | | | Q | | | | | V | W | | | |
| Brisbane | 2966 | A | B | C | D | E | F | G | H | J | | L | M | N | O | | Q | R | S | T | | V | W | X | Y | Z |
| Brisbane | 2967 | A | B | | | | | | | | | | | | | | | | | | | | | | | |

### Background land

No data available

### Survey plans

| Plan No. | Description | Date received | Locality | Volume | Folio |
|---|---|---|---|---|---|
| MP39185 | PWL - "Tipton #153" | | SPRINGVALE | | |
| MP37933 | PWL TIPTON 24, TIPTON 23 | 07/09/2006 | GRASSDALE & CECIL PLAINS | | |
| MP38286 | PWLs - "Tipton #26(A), 103, 120, 121, 122, 123 & 124" | 04/01/2008 | CECIL PLAINS | | |
| MP38290 | PWL - TIPTON 31, 33, 34, 41, 108 | 04/01/2008 | SPRINGVALE & GRASSDALE | | |
| MP38303 | PWLs - "Tipton #35, #36, #42, #43, #50 & #51' | 04/01/2008 | GRASSDALE | | |
| MP38304 | PWLs - "Tipton #93, 94, #95, #98, #99 & #102" | 04/01/2008 | CECIL PLAINS | | |
| MP38297 | PWL - TIPTON 64, 65, 72, 109, 111 | 04/01/2008 | GRASSDALE | | |
| MP38298 | PWL - TIPTON 61, 62, 63, 70, 71 | 04/01/2008 | GRASSDALE | | |
| MP38299 | PWLs - "Tipton #39, #40, #47, #54, #54A,#55 & #105." | 04/01/2008 | GRASSDALE | | |
| MP38300 | PWLS - " TIPTON #37, #38, #44, 45, #46, #52 & #53." | 04/01/2008 | GRASSDALE | | |
| MP38301 | PWLs - " Tipton #45, #69 & #76" | 04/01/2008 | GRASSDALE | | |
| MP38302 | PWL - TIPTON 96, 97, 100, 101, 104 | 04/01/2008 | GRASSDALE | | |

| Plan No. | Description | Date received | Locality | Volume | Folio |
|---|---|---|---|---|---|
| MP38291 | PWL - TIPTON 30, 32, 110, 113, 125, 126, 127, 128 | 04/01/2008 | SPRINGVALE | | |
| MP38292 | PWLs "Tipton #48, #49, #56, #57, #57A, #106 & 107" | 04/01/2008 | GRASSDALE | | |
| MP38293 | PWLs " Tipton #79, #85, #86, #92 & #112" | 04/01/2008 | GRASSDALE | | |
| MP38294 | PWLs "Tipton #77, #78, #83, #84, #90 & #91" | 04/01/2008 | GRASSDALE | | |
| MP38295 | PWLs " Tipton #73, 74, 75, 80, 81, 82, 87, 88 & 89" | 04/01/2008 | GRASSDALE & CECIL PLAINS | | |
| MP38296 | PWLs - " Tipton #58, 59, 60 & 66, 67, 68" | 04/01/2008 | GRASSDALE | | |
| MP38501 | PWLs - "Tipton #114, 115, 116, 117, 118, 119" | 02/03/2009 | SPRINGVALE | | |
| MP38502 | PWLs "Tipton #130, #134, 135, 136" | 02/03/2009 | GRASSDALE- CECIL PLAINS | | |
| MP38503 | PWLs - "Tipton #137, 138, 139, 140, 141, 142" | 02/03/2009 | GRASSDALE | | |
| MP38504 | PWLs - "Tipton #145 & #147, 148, 149" | 02/03/2009 | CECIL PLAINS | | |
| MP38498 | PWL - "Tipton #37T, 38T, 39T & #44T, 45T, 46T" | 02/03/2009 | GRASSDALE | | |
| MP38497 | PWLs - " Tipton #25 & #28T" | 02/03/2009 | CECIL PLAINS | | |
| MP38499 | PWLs - "Tipton #60T, #61T, #68T & #69T" | 02/03/2009 | GRASSDALE | | |
| MP38500 | PWLs - "Tipton #95T, #96T, #98T, #99T, #100T & #102T" | 02/03/2009 | GRASSDALE | | |
| MP38506 | PWLs - " Tipton #131, #132, #132A,#133 & #144" | 12/03/2009 | CECIL PLAINS | | |
| MP38507 | PWL "Tipton #129" | 12/03/2009 | GRASSDALE | | |
| MP38743 | PWL - "Tipton #143V1 & #143V(2) and #143L" | 09/03/2010 | CECIL PLAINS | | |
| MP38736 | PWL - "Tipton #146" | 09/03/2010 | CECIL PLAINS | | |
| MP38746 | PWL - "Tipton #68A" | 09/03/2010 | GRASSDALE | | |
| MP39175 | PWL - "Tipton #156" | 07/04/2011 | SPRINGVALE | | |
| MP43667 | PWL - TIPTON 193 & 194 | 05/11/2013 | GRASSDALE | | |
| MP43664 | PWL - TIPTON 195, 196, 196A, 197 | 05/11/2013 | NANDI | | |
| MP44007 | PWL - TIPTON 157, 158 & 159A | 10/12/2014 | GRASSDALE | | |
| MP44701 | PWL - TIPTON 211, 213, 214, 216 | 20/10/2016 | GRASSDALE | | |
| MP44714 | PWL - TIPTON 210, TIPTON 212, TIPTON 217, TIPTON 218, TIPTON 219 | 18/01/2018 | GRASSDALE | | |
| MP45814 | PWL OF TIPTON 233, TIPTON 240, TIPTON 245, TIPTON 283 & TIPTON 316 | 05/10/2018 | GRASSDALE & CECIL PLAINS | | |

| Plan No. | Description | Date received | Locality | Volume | Folio |
|---|---|---|---|---|---|
| MP45824 | PWL OF TIPTON 255, TIPTON 258, TIPTON 261 & TIPTON 310 | 26/09/2019 | SPRINGVALE | | |
| MP45825 | PWL OF TIPTON 242, TIPTON 270, TIPTON 271, TIPTON 282, TIPTON 291 & TIPTON 294 | 26/09/2019 | CECIL PLAINS & GRASSDALE | | |
| MP45829 | PWL OF TIPTON 248, TIPTON 249, TIPTON 250, TIPTON 265, TIPTON 268, TIPTON 269, TIPTON 272, TIPTON 273, TIPTON 280, TIPTON 293 & TIPTON 300 | 30/12/2019 | GRASSDALE | | |

### Relinquishment details

No data available

### Sub-blocks retained

No data available

## Term history

| Term | Date notice issued | Date lodged | Date approved | Date commenced | Date term ends | Term | Act granted under |
|---|---|---|---|---|---|---|---|
| 2004 - 2034 | | 29/01/2003 | 09/12/2004 | 09/12/2004 | 08/12/2034 | 30 years | Petroleum Act 1923 |

## Native title

| Outcome | Process |
|---|---|
| Land subject to Native Title is excluded from the permit area | Predominantly Exclusive Land |

## Purpose and minerals

| Purpose |
|---|
| PETROLEUM |

| Minerals |
|---|
| Coal Seam Gas |

## Related permits

| | |
|---|---|
| **Pre-requisite permits:** | ATP 683P |

## Financial

### Rent details

| | |
|---|---|
| **Area units:** | 255 |
| **Rate/unit area:** | $162.00 |

# PL 198 Resource authority public report

Queensland Government

## Activities

| Activity name | Activity / Dealing No | Status | Date received | Expected completion | Date completed | Remarks |
|---|---|---|---|---|---|---|
| Later Development Plan Due | | Requested | 12/06/2014 | 08/12/2015 | | LDP DUE 8/12/2015. |
| Later Development Plan | | Closed | 07/10/2010 | 08/12/2010 | 19/11/2010 | LDP DUE ON 8/12/2010. LDP LODGED ON 07/10/2010 WITHIN REQUIRED TIMEFRAME, FOR A FIVE (5) YEAR PERIOD COMMENCING 09/12/2010. CHECKLIST COMPLETED. FORWARDED TO TAS FOR ASSESSMENT ON 13/10/2010. LDP APPROVED 19/11/10. |
| Change of holder name | 1019581 | Closed | 05/10/2010 | 05/10/2010 | 05/10/2010 | Changed name from SHELL CSG (AUSTRALIA) PTY LTD to ARROW CSG (AUSTRALIA) PTY LTD |
| Change of holder name | 1016426 | Closed | 09/09/2009 | 09/09/2009 | 09/09/2009 | Changed name from BEACH PETROLEUM (SURAT) PTY LTD to ARROW (TIPTON TWO) PTY LTD |
| Agreement | | Closed | 12/07/2007 | 31/12/2008 | 12/07/2007 | PRIORITY DEED FOR PL 198 AND ATP 683 - JOINT OPERATING AGREEMENT - TIPTON WEST JOINT VENTURE - BETWEEN BEACH PETROLEUM (SURAT) PTY LTD, ARROW (TIPTON) PTY LTD, COMMONWEALTH BANK OF AUSTRALIA AND CBA CORPORATE SERVICES (NSW) PTY LTD. |
| Later Development Plan | | Closed | 18/12/2005 | 25/04/2007 | 03/10/2007 | REQUEST FOR FEE OF $4400 SENT TO HOLDER - 28/02/06. LDP LODGED IN QDEX ON 18-DEC-2005. FEE OF $440 PAID BY EFT, LATE PENALTY NOT REQUIRED. ASSESSED BY TAS, READY FOR APPROVAL. APPROVED - 3/10/2007. |

# PL 238 Resource authority public report

## Table of Contents

# PL 238 Resource authority public report

Queensland Government

## Permit details

| | |
|---|---|
| **Permit ID:** | PL 238 |
| **Status:** | Granted |
| **Lodged date:** | 12/04/2006 |
| **Grant date:** | 29/10/2009 |
| **Commencement date:** | 29/10/2009 |
| **Expiry date:** | 28/10/2039 |
| **Plan/program expiry date:** | 30/06/2025 |
| **Current term:** | 30 years |
| **Work program type:** | |
| **Conditions:** | Entry into relevant arrangement (a) The holders of PL 238 must enter into contract(s), coordination arrangement(s) or other arrangement(s) (relevant arrangement(s)) to supply petroleum produced from the area of PL 238, where the relevant arrangement(s) provide for: i. the supply of petroleum produced from the area of PL 238 to occur by no later than 31 December 2018; and ii. the volume of petroleum produced from the area of PL 238 to equal or exceed 300TJ by 31 December 2019. (b) The holders of PL 238 must provide the following to the department administered by the Minister by no later than 30 June 2017: i. evidence of the relevant arrangement(s) to supply petroleum produced from the area of PL 238 which meets the requirements of clause (a); and ii. a written declaration that the petroleum produced from the area of PL 238 will meet all or some of the petroleum required to be supplied under the relevant arrangement. (c) The Minister may determine that s/he is not satisfied that the holders of PL 238 have entered into relevant arrangement(s) if the Minister reasonably believes: i. a relevant arrangement relating to PL 238 is not an arms-length commercial transaction; or ii. supply under the relevant arrangement is unlikely to be carried out. |
| **Locality:** | Clarence Morton Basin, SOUTH OF DALBY |
| **Remarks:** | |
| **Act permit granted under:** | Petroleum and Gas (Production and Safety) Act 2004 |
| **Act now administered under:** | Petroleum and Gas (Production and Safety) Act 2004 |

## Holders

### Authorised holder representative (AHR)

FERGUSON, Suzanne
C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001

### Holders

| | Holder name | Share % | Status | Held from | Held to | Authorised holder |
|---|---|---|---|---|---|---|
| * | ARROW CSG (AUSTRALIA) PTY LTD<br>C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001 | 30.000000000000 | Current | 05/10/2010 | | No |
| * | ARROW (TIPTON) PTY. LTD.<br>GPO Box 5262 Brisbane QLD 4001 | 42.000000000000 | Current | 26/03/2010 | | Yes |
| * | ARROW (TIPTON TWO) PTY LTD<br>GPO Box 5262 Brisbane QLD 4001 | 28.000000000000 | Current | 26/03/2010 | | No |
| | SHELL CSG (AUSTRALIA) PTY LTD | 30.000000000000 | Former | 26/03/2010 | 05/10/2010 | |
| | ARROW (TIPTON TWO) PTY LTD | 40.000000000000 | Former | 09/09/2009 | 26/03/2010 | |
| | ARROW (TIPTON) PTY. LTD. | 42.000000000000 | Former | 02/04/2009 | 26/03/2010 | |
| | SHELL CSG (AUSTRALIA) PTY LTD | 18.000000000000 | Former | 02/04/2009 | 26/03/2010 | |
| | ARROW (TIPTON) PTY. LTD. | 60.000000000000 | Former | 12/04/2006 | 02/04/2009 | |
| | BEACH PETROLEUM (SURAT) PTY LTD | 40.000000000000 | Former | 12/04/2006 | 09/09/2009 | |

**Tenancy type:** Tenancy in Common

# PL 238 Resource authority public report

Queensland Government

## Area

| | |
|---|---|
| **Location:** | View Map |
| **Mining district:** | Dalby |
| **Local authority:** | Toowoomba Regional Council, Western Downs Regional Council |
| **Area:** | 75 Sub-blocks |
| **Exclusions:** | |
| **Marked out date:** | |

### Sub-blocks

| BIM | Block | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brisbane | 2751 | | | | | | | | | | | | | | | | | | S | T | | | | X | Y | Z |
| Brisbane | 2823 | | | C | D | E | | | H | J | K | | | N | O | P | | | S | T | U | | | | Y | Z |
| Brisbane | 2824 | A | | | | | F | G | | | | L | M | N | | | Q | R | S | | | V | W | X | Y | |
| Brisbane | 2895 | | | | D | E | | G | H | J | K | | M | N | O | P | | R | S | T | U | | | X | Y | Z |
| Brisbane | 2966 | | | | | | | | | | K | | | | | P | | | | | U | | | | | |
| Brisbane | 2967 | | | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

### Background land

No data available

### Survey plans

| Plan No. | Description | Date received | Locality | Volume | Folio |
|---|---|---|---|---|---|
| MP38843 | PWL "Plainview #4" | 18/08/2010 | ST RUTH | | |
| MP38748 | PWL - PLAINVIEW 27, PLAINVIEW 28 | 18/01/2018 | GRASSDALE | | |
| MP45807 | PWL OF PLAINVIEW 34 | 20/04/2018 | GRASSDALE | | |
| MP45816 | PWL OF PLAINVIEW 29, PLAINVIEW 30, PLAINVIEW 31, PLAINVIEW 32, PLAINVIEW 33 & PLAINVIEW 35 | 23/10/2018 | SPRINGVALE | | |
| MP45822 | PWWL OF PLAINVIEW 36 AND PLAINVIEW 37 | 26/06/2019 | SPRINGVALE | | |

### Relinquishment details

No data available

### Sub-blocks retained

No data available

## Term history

| Term | Date notice issued | Date lodged | Date approved | Date commenced | Date term ends | Term | Act granted under |
|---|---|---|---|---|---|---|---|
| 2009 - 2039 | | 12/04/2006 | 29/10/2009 | 29/10/2009 | 28/10/2039 | 30 years | Petroleum and Gas (Production and Safety) Act 2004 |

# PL 238 Resource authority public report

Queensland Government

## Native title

| Outcome | Process |
|---|---|
| Land subject to Native Title is excluded from the permit area | Predominantly Exclusive Land |

## Purpose and minerals

| Purpose |
|---|
| PETROLEUM |

| Minerals |
|---|
| Coal Seam Gas |

## Related permits

| | |
|---|---|
| **Pre-requisite permits:** | ATP 683 |

## Financial

### Rent details

| | |
|---|---|
| **Area units:** | 225 |
| **Rate/unit area:** | $162.00 |

## Activities

| Activity name | Activity / Dealing No | Status | Date received | Expected completion | Date completed | Remarks |
|---|---|---|---|---|---|---|
| Add excluded land | 213514 | Approved | 19/07/2017 | | 23/08/2017 | Approval given to add excluded land namely land that may be subject to native title. |
| Later Development Plan Due | | Closed | 28/10/2014 | 28/10/2014 | 28/10/2014 | LDP DUE 28/10/2014. LATER DEVELOPMENT PLAN RECEIVED 28/10/2014 FOR THE PERIOD OF 29/10/2014 - 28/10/2019. |
| Change of holder name | 1019581 | Closed | 05/10/2010 | 05/10/2010 | 05/10/2010 | Changed name from SHELL CSG (AUSTRALIA) PTY LTD to ARROW CSG (AUSTRALIA) PTY LTD |
| Change of holder name | 1016426 | Closed | 09/09/2009 | 09/09/2009 | 09/09/2009 | Changed name from BEACH PETROLEUM (SURAT) PTY LTD to ARROW (TIPTON TWO) PTY LTD |

# PL 252 Resource authority public report

## Table of Contents

# PL 252 Resource authority public report

Queensland Government

## Permit details

| | |
|---|---|
| **Permit ID:** | PL 252 |
| **Status:** | Granted |
| **Lodged date:** | 19/02/2007 |
| **Grant date:** | 20/09/2008 |
| **Commencement date:** | 20/09/2008 |
| **Expiry date:** | 19/09/2038 |
| **Plan/program expiry date:** | 30/06/2025 |
| **Current term:** | 30 years |
| **Work program type:** | |
| **Conditions:** | |
| **Locality:** | Surat Basin; SOUTH-WEST OF DALBY WITHIN THE WALLOON COAL MEASURES |
| **Remarks:** | . |
| **Act permit granted under:** | Petroleum and Gas (Production and Safety) Act 2004 |
| **Act now administered under:** | Petroleum and Gas (Production and Safety) Act 2004 |

## Holders

### Authorised holder representative (AHR)

FERGUSON, Suzanne
C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001

### Holders

| | Holder name | Share % | Status | Held from | Held to | Authorised holder |
|---|---|---|---|---|---|---|
| * | ARROW ENERGY PTY LTD<br>GPO Box 562 Brisbane QLD 4001 | 70.000000000000 | Current | 06/01/2011 | | Yes |
| * | ARROW CSG (AUSTRALIA) PTY LTD<br>C/- Tenement Manager GPO Box 5262 Brisbane QLD 4001 | 30.000000000000 | Current | 05/10/2010 | | No |
| | ARROW ENERGY LTD | 70.000000000000 | Former | 21/12/2009 | 06/01/2011 | |
| | SHELL CSG (AUSTRALIA) PTY LTD | 30.000000000000 | Former | 21/12/2009 | 05/10/2010 | |
| | ARROW ENERGY LTD | 100.000000000000 | Former | 08/07/2008 | 21/12/2009 | |
| | ARROW ENERGY NL | 100.000000000000 | Former | 19/02/2007 | 08/07/2008 | |

**Tenancy type:** Tenancy in Common

# PL 252 Resource authority public report

Queensland Government

## Area

| | |
|---|---|
| **Location:** | View Map |
| **Mining district:** | Dalby |
| **Local authority:** | Western Downs Regional Council |
| **Area:** | 25 Sub-blocks |
| **Exclusions:** | |
| **Marked out date:** | |

### Sub-blocks

| BIM | Block | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brisbane | 2749 | A | B | C | D | E | F | G | H | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

### Background land

No data available

### Survey plans

| Plan No. | Description | Date received | Locality | Volume | Folio |
|---|---|---|---|---|---|
| MP38492 | PWLs - "Stratheden #10, 11, 12, 13, 14" | 02/03/2009 | DUCKLO | | |
| MP38493 | PWL - STRATHEDEN 16, 18, 19 | 02/03/2009 | DUCKLO | | |
| MP38744 | PWL - "Stratheden #15" | 09/03/2010 | DUCKLO | | |
| MP38734 | PWL - "Stratheden #17, 20, 22 & 24, 25, 26, 27" | 09/03/2010 | DUCKLO | | |
| MP38853 | PWL - "Stratheden #5" | 18/08/2010 | DUCKLO | | |
| MP39583 | PWL - Stratheden #60 & 61 | 12/11/2012 | RANGES BRIDGE | | |
| MP39593 | PWL - Stratheden #40, 41, 42, 43, 44, 45, 46 | 14/12/2012 | RANGES BRIDGE | | |
| MP43663 | PWL - STRATHEDEN 62, 63, 64, 65, 66, 67, 68, 69 | 14/10/2013 | DUCKLO | | |
| MP45812 | PWL OF STRATHEDEN 111, STRATHEDEN 112, STRATHEDEN 113, STRATHEDEN 114, STRATHEDEN 115 AND STRATHEDEN 116 | 23/08/2018 | RANGES BRIDGE | | |

### Relinquishment details

No data available

### Sub-blocks retained

No data available

## Term history

| Term | Date notice issued | Date lodged | Date approved | Date commenced | Date term ends | Term | Act granted under |
|---|---|---|---|---|---|---|---|
| 2008 - 2038 | | 19/02/2007 | 20/09/2008 | 20/09/2008 | 19/09/2038 | 30 years | Petroleum and Gas (Production and Safety) Act 2004 |

# PL 252 Resource authority public report

Queensland Government

## Native title

| Outcome | Process |
|---|---|
| All land subject to Native Title (<10%) is excluded from the permit area | Predominantly Exclusive Land |

## Purpose and minerals

| Purpose |
|---|
| PETROLEUM |

| Minerals |
|---|
| Coal Seam Gas |

## Related permits

| | |
|---|---|
| **Pre-requisite permits:** | ATP 790 |
| **Applied from permits:** | WMA 2014; WMA 2015; WMA 2016 |
| **Dependent permits:** | WMA 2; WMA 3; WMA 4; WMA 5; WMA 2017 |

## Financial

### Rent details

| | |
|---|---|
| **Area units:** | 75 |
| **Rate/unit area:** | $162.00 |

# PL 252 Resource authority public report

Queensland Government

## Activities

| Activity name | Activity / Dealing No | Status | Date received | Expected completion | Date completed | Remarks |
|---|---|---|---|---|---|---|
| Coordination arrangement | 367017 | Under assessment | 08/12/2021 | | | |
| Coordination arrangement | 347504 | Approved | 28/04/2021 | | 30/07/2021 | Coordination Arrangement between the holders of PLs 252 and 230 has been approved by the Minister's delegate on 27/07/21. |
| Add excluded land | 213520 | Approved | 19/07/2017 | | 23/08/2017 | Approval given to add excluded land namely land that may be subject to native title. |
| Later Development Plan Due | | Requested | 24/06/2014 | 19/09/2018 | | LDP DUE 19/09/2018. |
| Later Development Plan | | Closed | 06/06/2013 | 30/06/2014 | 18/06/2014 | LDP DUE 19-SEP-2013. LDP RECEIVED 06/06/13, WITHIN TIMEFRAME, FOR PERIOD OF 5 YRS FROM 20/09/2013 TO 19/09/2018. CHECKLIST COMPLETED. TAS REQUIRED. LDP FORWARDED TO DELEGATE FOR APPROVAL 20/05/14.LDP APPROVED BY REGIONAL DIRECTOR ON 18/06/14 FOR THE PERIOD TILL 19/09/2018. |
| Change of holder name | 1020891 | Closed | 06/01/2011 | 06/01/2011 | 06/01/2011 | Changed name from ARROW ENERGY LTD to ARROW ENERGY PTY LTD |
| Coordination arrangement | 131810 | Approved | 11/10/2010 | | 20/03/2019 | Coordination Arrangement cancelled by Ministers Delegate on 27/07/2021. New Coordination Arrangement has been approved 27/07/2021 between the holders of PLs 230 and 252 refer to activity number 347504 for further details. |
| Change of holder name | 1019581 | Closed | 05/10/2010 | 05/10/2010 | 05/10/2010 | Changed name from SHELL CSG (AUSTRALIA) PTY LTD to ARROW CSG (AUSTRALIA) PTY LTD |
| Change of holder name | 1012587 | Closed | 08/07/2008 | 08/07/2008 | 08/07/2008 | Changed name from ARROW ENERGY NL to ARROW ENERGY LTD |
| Later Development Plan | | Closed | 22/02/2007 | 19/04/2007 | 20/09/2008 | INITIAL DEVELOPMENT PLAN LODGED WITH APPLICATION FOR A TERM OF 5 YEARS TO COMMENCE 20 SEP 2008 TO EXPIRE 19 SEP 2013 |

# Permit

Environmental Protection Act 1994

## Environmental authority EPPG00972513

*This environmental authority is issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.*

### Environmental authority number: EPPG00972513

**Environmental authority takes effect on 19 August 2021**

### Environmental authority holder(s)

| Names(s) | Registered address |
|---|---|
| ARROW ENERGY PTY LTD | Level 39 111 Eagle Street BRISBANE QLD 4001 |
| AUSTRALIAN CBM PTY LTD | Level 39 111 Eagle Street BRISBANE CITY QLD 4000 Australia |
| ARROW (TIPTON) PTY. LTD. | Level 39 111 Eagle Street BRISBANE CITY QLD 4000 Australia |
| ARROW (DAANDINE) PTY. LTD. | Level 39 111 Eagle St BRISBANE CITY QLD 4000<br>Australia |
| ARROW CSG (AUSTRALIA) PTY LTD | Level 39 111 Eagle Street BRISBANE CITY QLD 4000 Australia |
| ARROW (TIPTON TWO) PTY LTD | Level 39 111 Eagle Street BRISBANE CITY QLD 4000 Australia |
| CLEANCO QUEENSLAND LIMITED | Comalco Place Level 32 12 Creek St BRISBANE CITY QLD 4000 Australia |

### Environmentally relevant activity and location details

| Environmentally relevant activity/activities | Location(s) |
|---|---|
| Resource Activity, Ancillary 63 - Sewage Treatment, 1: Operating sewage treatment works, other than no- release works, with a total daily peak design capacity of, (a-i) 21 to 100EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme | PL252 |



ABN 46 640 294 485

Queensland Government

| | |
|---|---|
| Resource Activity, Ancillary 14 - Electricity Generation, 1: Generating electricity by using gas at a rated capacity of 10MW electrical or more | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Ancillary 15 - Fuel burning, Using fuel burning equipment that is capable of burning at least 500kg of fuel in an hour | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Ancillary 56 - Regulated Waste Storage Receiving and storing regulated waste | PL230 |
| Resource Activity, Ancillary 63 - Sewage Treatment, 1: Operating sewage treatment works, other than no- release works, with a total daily peak design capacity of, (a-i) 21 to 100EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme. | PL198, PL230, PL260, PL238, PL258 |
| Resource Activity, Ancillary 63 - Sewage Treatment, 1: Operating sewage treatment works, other than no- release works, with a total daily peak design capacity of, (b-i) more than 100 but not more than 1500EP if treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Ancillary 64 - Water treatment, 2: Desalinating, in a day, the following quantity of water, allowing the release of waste to waters other than seawater, (b) more than 5ML | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Schedule 3, 06: A petroleum activity carried out on a site containing a high hazard dam or a significant hazard dam | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Schedule 3, 07: A petroleum activity involving injection of a wastefluid into a natural underground reservoir or aquifer | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |
| Resource Activity, Schedule 3, 08: A petroleum or GHG storage activity, other than items 1 to 7, that includes an activity from Schedule 2 with an AES | PL238, PL258, PL252, PL194, PL198, PL230, PL260 |

**Additional information for applicants**

Environmentally relevant activities

The description of any environmentally relevant activity (ERA) for which an environmental authority (EA) is issued is a restatement of the ERA as defined by legislation at the time the EA is issued. Where there is any inconsistency between that description of an ERA and the conditions stated by an EA as to the scale, intensity or manner of carrying out an ERA, the conditions prevail to the extent of the inconsistency.

An EA authorises the carrying out of an ERA and does not authorise any environmental harm unless a condition stated by the EA specifically authorises environmental harm.

A person carrying out an ERA must also be a registered suitable operator under the *Environmental Protection Act 1994* (EP Act).

Contaminated land

It is a requirement of the EP Act that an owner or occupier of contaminated land give written notice to the administering authority if they become aware of the following:

- the happening of an event involving a hazardous contaminant on the contaminated land (notice must be given within 24 hours); or
- a change in the condition of the contaminated land (notice must be given within 24 hours); or
- a notifiable activity (as defined in Schedule 3) having been carried out, or is being carried out, on the contaminated land (notice must be given within 20 business days);

that is causing, or is reasonably likely to cause, serious or material environmental harm.

For further information, including the form for giving written notice, refer to the Queensland Government website www.qld.gov.au, using the search term 'duty to notify'.

Take effect

Please note that, in accordance with section 200 of the EP Act, an EA has effect:

a) if the authority is for a prescribed ERA and it states that it takes effect on the day nominated by the holder of the authority in a written notice given to the administering authority-on the nominated day; or

b) if the authority states a day or an event for it to take effect-on the stated day or when the stated event happens; or

c) otherwise-on the day the authority is issued.

However, if the EA is authorising an activity that requires an additional authorisation (a relevant tenure for a resource activity, a development permit under the *Sustainable Planning Act 2009* or an SDA Approval under the *State Development and Public Works Organisation Act 1971*), this EA will not take effect until the additional authorisation has taken effect.

If this EA takes effect when the additional authorisation takes effect, you must provide the administering authority written notice within 5 business days of receiving notification of the related additional authorisation taking effect.

If you have incorrectly claimed that an additional authorisation is not required, carrying out the ERA without the additional authorisation is not legal and could result in your prosecution for providing false or misleading information or operating without a valid environmental authority.

Clancy Mackaway
Department of Environment and Science
Delegate of the administering authority
*Environmental Protection Act 1994*

**Date issued:** 19 August 2021

**Enquiries:**
Energy and Extractive Resources
Department of Environment and Science
Phone: 3330 5715
Email: EnergyandExtractive@des.qld.gov.au

**Obligations under the *Environmental Protection Act 1994***

In addition to the requirements found in the conditions of this environmental authority, the holder must also meet their obligations under the EP Act, and the regulations made under the EP Act. For example, the holder must comply with the following provisions of the Act:

- general environmental duty (section 319)
- duty to notify environmental harm (section 320-320G)
- offence of causing serious or material environmental harm (sections 437-439)
- offence of causing environmental nuisance (section 440)
- offence of depositing prescribed water contaminants in waters and related matters (section 440ZG)
- offence to place contaminant where environmental harm or nuisance may be caused (section 443)

This environmental authority incorporates the following schedules:

Schedule A – General
Schedule B – Water
Schedule BE – Coal Seam Gas Water Injection Trial
Schedule C – Regulated Dams
Schedule D – Land
Schedule E – Acoustic
Schedule F – Air
Schedule G – Waste
Schedule H – Rehabilitation
Schedule I – Definitions

Words and phrases which are underlined are defined in *Schedule I – Definitions*.

**Schedule A – General**

General 1 This environmental authority authorises the carrying out of the following resource activities:

(a) The petroleum activities listed in *Schedule A, Table 1 – Authorised Petroleum Activities* to the extent they are carried out in accordance with the activity's corresponding total number and maximum disturbance;

(b) The following specified relevant activities:
   i. Regulated waste storage – receiving and storing regulated waste other than tyres;
   ii. Sewage treatment – operating sewage treatment works, other than no-release works, with a total daily peak design capacity of 21 to 100 EP;

(c) For the specified relevant activities listed in (General 1 (b)) above, another activity where Schedule 2 of the Environmental Protection Regulation 2008 (the Regulation) provides exemption for the activity, but only to the extent of the circumstances stated in Schedule 2 of the Regulation; and

(d) Incidental activities that are not otherwise specified relevant activities.

General 2 This environmental authority does not authorise environmental harm unless a condition contained in this environmental authority explicitly authorises that harm. Where there is no condition, the lack of a condition shall not be construed as authorising harm.

General 7 All monitoring must be undertaken by a suitably qualified person.

General 8 If requested by the administering authority in relation to investigating a complaint, monitoring must be commenced within 10 business days.

General 9 All laboratory analyses and tests must be undertaken by a laboratory that has NATA accreditation for such analyses and tests.

General 10 Notwithstanding condition (General 9), where there are no NATA accredited laboratories for a specific analyte or substance, then duplicate samples must be sent to at least two separate laboratories for independent testing or evaluation.

*Schedule A, Table 1 - Authorised Petroleum Activities*

| Petroleum Activity(ies) | Total Number of Authorised Petroleum Activities | Maximum Disturbance Authorised |
|---|---|---|
| Total coal seam gas wells, including:<br>Core wells<br>Exploration wells<br>Development wells<br>Production wells | 1,566 wells | 1,566 ha |
| Communication towers | 10 | 10 units, 10 ha |
| Injection well(s) and associated facilities | 1 | 4 ha |
| Compressor units | 40 | 40 units, 8 ha |
| Central gas processing facilities | 2 | 2 facilities, 8 ha |
| Regulated structures | 22 | 22 dams |
| Water treatment facilities | 2 | 12 ML/d (each), 2 ha |
| Sewage treatment plants | 2 | Less than 450 EP (each), 0.15 ha |
| Sewage treatment plants | 10 | Less than 100 EP (each), 0.15 ha |
| Power stations | 1 | 40 MW, 1.2 ha |

General 11 Monitoring and sampling must be carried out in accordance with the requirements of the following documents (as relevant to the sampling being undertaken), as amended from time to time:

(a) for waters and aquatic environments, the Queensland Government's Monitoring and Sampling Manual 2009 – *Environmental Protection (Water) Policy 2009*

(b) for groundwater, Groundwater Sampling and Analysis – A Field Guide (2009:27 GeoCat #6890.1)

(c) for noise, the *Environmental Protection Regulation 2008*

(d) for air, the *Queensland Air Quality Sampling Manual* and/or Australian Standard 4323.1:1995 *Stationary source emissions method 1: Selection of sampling positions*, as appropriate for the relevant measurement

(e) for soil, the *Guidelines for Surveying Soil and Land Resources*, 2nd edition (McKenzie et al. 2008), and/or the *Australian Soil and Land Survey Handbook*, 3rd edition (National Committee on Soil and Terrain, 2009)

(f) for dust, Australian Standard AS3580.

General 12 In addition to the requirements under Chapter 7, Part 1, Division 2 of the *Environmental Protection Act 1994*, the administering authority must be notified through the Pollution Hotline and in writing, as soon as possible, but within 48 hours of becoming aware of any of the following events:

(a) any unauthorised significant disturbance to land

(b) potential or actual loss of structural or hydraulic integrity of a dam

(c) when the level of the contents of any regulated dam reaches the mandatory reporting level

(d) when a regulated dam will not have available storage to meet the design storage allowance on 1 November of any year

(e) potential or actual loss of well integrity

(f) when the seepage trigger action response procedure required under condition (Water 13(g)) is or should be implemented

(g) unauthorised releases of any volume of prescribed contaminants to waters

(h) unauthorised releases of volumes of contaminants, in any mixture, to land greater than:

i. 200 L of hydrocarbons; or

ii. 1 000 L of brine; or

iii. 5 000 L of untreated coal seam gas water; or

iv. 5 000 L of raw sewage; or

v. 10 000 L of treated sewage effluent.

(i) groundwater monitoring results from a landholder's active groundwater bore monitored under the stimulation impact monitoring program which is a 10% or greater increase from a previous baseline value for that bore and which renders the water unfit for its intended use

(j) monitoring results where two out of any five consecutive samples do not comply with the relevant limits in the environmental authority.

General 13 Petroleum activities that cause significant disturbance to land must not be carried out until financial assurance has been given to administering authority as security for compliance with

the environmental authority and for any costs or expenses, or likely costs or expenses, mentioned in section 298 of the *Environmental Protection Act 1994.*

General 16 Petroleum activities involving significant disturbance to land cannot commence until the development of written contingency procedures for emergency environmental incidents which include, but are not necessarily limited to:

(a) a clear definition of what constitutes an environmental emergency incident or near miss for the petroleum activity.

(b) consideration of the risks caused by the petroleum activity including the impact of flooding and other natural events on the petroleum activity.

(c) response procedures to be implemented to prevent or minimise the risks of environmental harm occurring.

(d) the practices and procedures to be employed to restore the environment or mitigate any environmental harm caused.

(e) procedures to investigate causes and impacts including impact monitoring programs for releases to waters and/or land.

(f) training of staff to enable them to effectively respond.

(g) procedures to notify the administering authority, local government and any potentially impacted landholder.

General 17 All plant and equipment must be maintained and operated in their proper and effective condition.

General 18 The following infrastructure must be signed with a unique reference name or number in such a way that it is clearly observable:

(a) regulated dams and low consequence dams

(b) exploration, appraisal and development wells

(c) water treatment facilities

(d) brine encapsulation facilities

(e) landfill cells

(f) sewage treatment facilities

(g) specifically authorised discharge points to air and waters

(h) any chemical storage facility associated with the environmentally relevant activity of chemical storage

(i) field compressor stations

(j) central compressor stations

(k) gas processing facilities; and

(l) pipeline compressor stations.

General 19 Measures to prevent fauna being harmed from entrapment must be implemented during the construction and operation of well infrastructure, dams and pipeline trenches.

General 20 For activities involving significant disturbance to land, control measures that are commensurate to the site- specific risk of erosion, and risk of sediment release to waters must be implemented to:

(a) allow stormwater to pass through the site in a controlled manner and at non-erosive flow velocities

(b) minimise soil erosion resulting from wind, rain, and flowing water

(c) minimise the duration that disturbed soils are exposed to the erosive forces of wind, rain, and flowing water

(d) minimise work-related soil erosion and sediment runoff; and

(e) minimise negative impacts to land or properties adjacent to the activities (including roads).

General 21 Petroleum activities must not cause environmental nuisance at a sensitive place, other than where an alternative arrangement is in place.

General 22 A certification must be prepared by a suitably qualified person within 30 business days of completing every plan, procedure, program and report required to be developed under this environmental authority, which demonstrates that:

(a) relevant material, including current published guidelines (where available) have been considered in the written document

(b) the content of the written document is accurate and true; and

(c) the document meets the requirements of the relevant conditions of the environmental authority.

General 23 All plans, procedures, programs, reports and methodologies required under this environmental authority must be written and implemented.

General 24 All documents required to be developed under this environmental authority must be kept for five years.

General 25 All documents required to be prepared, held or kept under this environmental authority must be provided to the administering authority upon written request within the requested timeframe.

General 26 A record of all complaints must be kept including the date, complainant's details, source, reason for the complaint, description of investigations and actions undertaken in resolving the complaint.

**Schedule B – Water**

| | |
|---|---|
| Water 1 | Contaminants that will or may cause environmental harm must not be directly or indirectly released to any waters, except as authorised by condition (B15). |
| Water 2 | The extraction of groundwater as part of the petroleum activity(ies) from underground aquifers must not directly or indirectly cause environmental harm to a wetland. |
| Water 3 | Petroleum activities must not occur in or within 200m of a:<br>(a) wetland of high ecological significance, other than that authorised by *Schedule D, Table 3 — Significant residual impacts to prescribed environmental matters*<br>(b) Great Artesian Basin Spring<br>(c) subterranean cave GDE. |
| Water 3A | Despite condition (Water 3), petroleum activities may occur within 200m of a wetland of high ecological significance, provided they are directly associated with activities authorised per condition (Water 3(a)). |
| Water 4 | Only construction or maintenance of linear infrastructure is permitted in or within any wetland of other environmental value or in a watercourse. |
| Water 5 A | The construction or maintenance of linear infrastructure in a wetland of other environmental value must not result in the:<br>(a) clearing of riparian vegetation outside of the minimum area practicable to carry out the works; or<br>(b) ingress of saline water into freshwater aquifers; or<br>(c) draining or filling of the wetland beyond the minimum area practicable to carry out the works. |
| Water 5 B | After the construction or maintenance works for linear infrastructure in a wetland of other environmental value are completed, the linear infrastructure must not:<br>(a) drain or fill the wetland<br>(b) prohibit the flow of surface water in or out of the wetland<br>(c) lower or raise the water table and hydrostatic pressure outside the bounds of natural variability that existed before the activities commenced<br>(d) result in ongoing negative impacts to water quality<br>(e) result in bank instability; or<br>(f) result in fauna ceasing to use adjacent areas for habitat, feeding, roosting or nesting. |

Water 6 The construction or maintenance of linear infrastructure activities in a watercourse must be conducted in the following preferential order:

(a) firstly, in times where there is no water present

(b) secondly, in times of no flow

(c) thirdly, in times of flow, providing a bankfull situation is not expected and that flow is maintained.

Water 7 The construction or maintenance of linear infrastructure authorised under condition (Water 4) must comply with the water quality limits as specified in *Schedule B, Table 1 – Release limits for construction or maintenance of linear infrastructure*.

*Schedule B, Table 1 – Release limits for construction or maintenance of linear infrastructure*

| Water quality parameters | Units | Water quality limits |
|---|---|---|
| Turbidity | Nephelometric Turbidity Units (NTU) | For a wetland of other environmental value, if background water turbidity is above 45 NTU, no greater than 25% above background water turbidity measured within a 50m radius of the construction or maintenance activity. For a watercourse, if background water turbidity is above 45 NTU, no greater than 25% above background water turbidity measured within 50m downstream of the construction or maintenance activity. |
| | | For a wetland of other environmental value, if background water turbidity is equal to, or below 45 NTU, a turbidity limit of no greater than 55 NTU applies, measured within a 50m radius of the construction or maintenance activity. For a watercourse, if background water turbidity is equal to, or below 45 NTU, a turbidity limit of no greater than 55 NTU applies, measured within 50m downstream of the construction or maintenance activity. |
| Hydrocarbons | - | For a wetland of other environmental value, or watercourse, no visible sheen or slick |

Water 8 Monitoring must be undertaken at a frequency that is appropriate to demonstrate compliance with condition (Water 7).

Water 9 A register must be kept of all linear infrastructure construction and maintenance activities in a wetland of other environmental value and watercourses, which must include:

(a) location of the activity (e.g. GPS coordinates (GDA94) and watercourse name)

(b) estimated flow rate of surface water at the time of the activity

(c) duration of works, and

(d) results of impact monitoring carried out under condition (Water 8).

Water 10 Measures must be taken to minimise negative impacts to, or reversal of, any river improvement works carried out in River Improvement Areas by Queensland's River Improvement Trusts.

Water 11 Petroleum activity(ies) on floodplains must be carried out in a way that does not:

(a) concentrate flood flows in a way that will or may cause or threaten a negative environmental impact; or

(b) divert flood flows from natural drainage paths and alter flow distribution; or

(c) increase the local duration of floods; or

(d) increase the risk of detaining flood flows.

Water 12 A seepage monitoring program must be developed by a suitably qualified person which is commensurate with the site-specific risks of contaminant seepage from containment facilities, and which requires and plans for detection of any seepage of contaminants to groundwater as a result of storing contaminants by 1 August 2019.

Water 13 The seepage monitoring program required by condition (Water 12) must include but not necessarily be limited to:

(a) identification of the containment facilities for which seepage will be monitored

(b) identification of trigger parameters that are associated with the potential or actual contaminants held in the containment facilities

(c) identification of trigger concentration levels that are suitable for early detection of contaminant releases at the containment facilities

(d) installation of background seepage monitoring bores where groundwater quality will not have been affected by the petroleum activities authorised under this environmental authority to use as reference sites for determining impacts

(e) installation of seepage monitoring bores that:

i. are within formations potentially affected by the containment facilities authorised under this environmental authority (i.e. within the potential area of impact)

ii. provide for the early detection of negative impacts prior to reaching groundwater dependent ecosystems, landholder's active groundwater bores, or water supply bores

iii. provide for the early detection of negative impacts prior to reaching migration pathways to other formations (i.e. faults, areas of unconformities known to connect two or more formations)

(f) monitoring of groundwater at each background and seepage monitoring bore at least annually for the trigger parameters identified in condition (Water 13(b))

(g) seepage trigger action response procedures for when trigger parameters and trigger levels identified in conditions (Water 13(b)) and (Water 13(c)) trigger the early detection of seepage, or upon becoming aware of any monitoring results that indicate potential groundwater contamination

(h) a rationale detailing the program conceptualisation including assumptions, determinations, monitoring equipment, sampling methods and data analysis; and

(i) provides for annual updates to the program for new containment facilities constructed in each annual return period.

Water 14 A bore drill log must be completed for each seepage monitoring bore in condition (Water 13) which must include:

(a) bore identification reference and geographical coordinate location

(b) specific construction information including but not limited to depth of bore, depth and length of casing, depth and length of screening and bore sealing details

(c) standing groundwater level and water quality parameters including physical parameter and results of laboratory analysis for the possible trigger parameters

(d) lithological data, preferably a stratigraphic interpretation to identify the important features including the identification of any aquifers; and

(e) target formation of the bore.

B15 The release of treated CSG water is authorised to occur in accordance with:

(a) *Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters;*

(b) *Schedule B Table 3 – Treated CSG Water Release Limits for Monitoring Point M1 – Daily Monitoring;* and

(c) *Schedule B, Table 4 – Treated CSG Water Release Limits for Monitoring Point M1 – Quarterly Monitoring*.

B16 The quality of the treated CSG water being released must be:

(a) monitored at the frequency specified, and

(b) comply with each quality characteristic release limit and limit type,

specified in *Schedule B Table 3 – Treated CSG Water Release Limits for Monitoring Point M1 – Daily Monitoring* and *Schedule B, Table 4 – Treated CSG Water Release Limits for Monitoring Point M1 – Quarterly Monitoring* when measured at the monitoring point M1 specified in *Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters*.

*Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters*

| Water Source and Location | Release Point | Location (GDA94, MGA zone 56) | Monitoring Point | Receiving Waters Description |
|---|---|---|---|---|
| Treated CSG Water from the reverse osmosis water treatment plant and treated water dam located on PL230 | R1, defined as the outlet of discharge pipe to Wilkie Creek | 6995465 mN 303004 mE | M1, defined as the sample point in the discharge pipeline point to release into Wilkie Creek | Wilkie Creek |

*Schedule B, Table 3 – Treated CSG Water Release Limits for Monitoring Point (M1) – Daily Monitoring*

| Quality Characteristic | Unit | Release Limit(s) | Limit Type | Monitoring Frequency |
|---|---|---|---|---|
| Electrical conductivity | µS/cm | 580 | 80$^{th}$ percentile, based on at least 5 samples with not less than 60 minutes between samples | Daily during release |
| pH | pH Unit | 6.5 - 9 | Range | Daily during release |
| Suspended Solids | mg/L | 180 | Maximum | Daily during release |
| Boron | mg/L | 0.37 | Maximum | Daily during release |

*Schedule B, Table 4 – Treated CSG Water Release Limits for Monitoring Point (M1) – Quarterly Monitoring*

| Quality characteristic | Unit | Maximum Release limit | Monitoring frequency |
|---|---|---|---|
| Aluminium | mg/L | 0.2 | The first release day of each quarter |
| Antimony | ml/L | 0.003 | |
| Arsenic | mg/L | 0.007 | |
| Barium | mg/L | 0.7 | |
| Bisphenol A | mg/L | 0.2 | |
| Boron | mg/L | 4 | |
| Bromide | mg/L | 7 | The first release day of each quarter |
| BTEX | | | |
| Benzene | mg/L | 0.001 | |
| Toluene | mg/L | 0.8 | |
| Ethylbenzene | mg/L | 0.3 | |
| Xylene (m & p) | mg/L | 0.6 | |
| Cadmium | mg/L | 0.002 | |
| Chromium | mg/L | 0.05 | |
| Copper | mg/L | 2 | |

| Quality characteristic | | Unit | Maximum Release limit | Monitoring frequency |
|---|---|---|---|---|
| Cyanide | | mg/L | 0.08 | The first release day of each quarter |
| Fluoride | | mg/L | 1.5 | |
| Iodide | | mg/L | 0.5 | |
| Iron | | mg/L | 0.3 | |
| Lead | | mg/L | 0.01 | |
| Manganese | | mg/L | 0.5 | |
| Mercury | | mg/L | 0.001 | |
| Molybdenum | | mg/L | 0.05 | |
| Nickel | | mg/L | 0.02 | |
| Nonylphenol | | mg/L | 0.5 | |
| PAH (as B(a)P TEF)<br>Species:<br>benz[a]anthracene<br>benzo[b+j]fluoranthene<br>benzo[k]fluoranthene<br>benzo[a]pyrene<br>chrysene<br>dibenz[a,h]anthracene<br>indeno[1,2,3-cd]pyrene | <br>TEF:<br>0.1<br>0.1<br>0.1<br>1.0<br>0.1<br>1.0<br>0.1 | µg/L | 0.01 | |
| Selenium | | mg/L | 0.01 | The first release day of each quarter |
| Silver | | mg/L | 0.1 | |
| Strontium | | mg/L | 4 | |
| Total Petroleum Hydrocarbons (TPH) | | mg/L | 0.2 | |
| Vanadium | | mg/L | 0.05 | |
| Zinc | | mg/L | 3 | |
| Radium-226<br>Lead-210<br>Polonium-210<br>Radium-228 | | mSv/year | 0.5<br>The dose for each parameter is summed to give the total dose which must be less than or equal to 0.5 mSv/year | |

B17 If the monitoring required by condition (B16) indicates that any of the quality characteristic release limits specified in *Schedule B, Table 4 – Treated CSG Water Release Limits for Monitoring Point M1 – Quarterly Monitoring* have been exceeded at any time during any release of treated CSG water, the environmental authority holder must, within five (5) business days of notifying the administering authority of the exceedance, unless a longer time is agreed to by the administering authority:

(a) complete an investigation into the exceedance, which includes an analysis of the (potential and actual) causes for the exceedance; and

(b) provide a written report to the administering authority on completion of the investigation that includes:

i. details of the investigation carried out;

ii. any actions taken to prevent impacts to waters that may be used for drinking water;

iii. the cause for the exceedance;

iv. all water quality monitoring results pertaining to the investigation;

v. any general observations;

vi. methodology(ies) and any relevant calculations used; and

vii. corrective actions to rectify the cause of the exceedance.

B18 Where an exceedance of a quality characteristic release limit specified in *Schedule B, Table 4 – Treated CSG Water Release Limits for Monitoring Point M1 – Quarterly Monitoring* is being investigated in accordance with condition (B17), the investigation and reporting required by condition (B17) is not required if a subsequent exceedance occurs, during investigation of the initial exceedance, which has resulted from the same cause that triggered the initial exceedance.

B19 Prior to commencing any release of treated CSG water authorised under this environmental authority, a stream flow gauging station (GP1) must be installed.

B20 The stream flow gauging station (GP1) must be installed in accordance with *Schedule B, Table 5 – Contaminant Release During Flow Events*.

*Schedule B, Table 5 – Contaminant Release During Flow Events*

| Receiving water description | Gauging station description | Latitude or northing (GDA94) | Longitude or easting (GDA94) | Minimum Flow in Receiving Water Required for a Release Event | Flow recording Frequency |
|---|---|---|---|---|---|
| Wilkie Creek | Gauging station 1 (GP1 ) | 50-100 metres upstream of Release Point R1 | 50-100 metres upstream of Release Point R1 | 0.14 $m^3/s$ | At 6 hour intervals during discharge (minimum twice daily) |

B21 The flow rate of treated CSG water released from the release point authorised in *Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters* must not exceed a ratio of 1 part of the flow rate of the treated CSG water being released to 4 parts of the measured upstream receiving water flow rate.

B22 The volume of treated CSG water released from the release point authorised in *Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters* must not exceed a maximum of 8ML/day.

B23 The following characteristics of the treated CSG water released must be measured and recorded daily during all release events:

(a) the volume of treated CSG water released through the release point R1;

(b) the date and time of release commencing and ceasing;

(c) the release rate;

(d) for any change in the release rate:

i. the date and time of the change;

ii. the new release rate; and

iii. water levels and flow rate during the discharge event.

(e) water levels and flow rate during the discharge event;

(f) water quality characteristics monitoring results; and

(g) details of any observed impacts/conditions.

B24 Prior to commencing any release of treated CSG water authorised under this environmental authority, each monitoring and release point specified in *Schedule B, Table 2 – Treated CSG Water Release Point, Source and Receiving Waters* must be marked and readily identifiable from the banks of Wilkie Creek.

B25 The quality of the receiving waters must be monitored daily during release of treated CSG water at locations representative of the receiving waters determined in accordance with condition (B31), for the following water quality characteristics:

(a) Electrical conductivity (µS/cm);

(b) pH (pH Unit);

(c) Turbidity (NTU);

(d) Suspended Solids (mg/L);

(e) Calcium (mg/L);

(f) Magnesium (mg/L);

(g) Fluoride (mg/L);

(h) Sulphate (mg/l); and

(i) Boron (mg/L).

B26 If water has been released from authorised release points listed in *Schedule B, Table 2 – Contaminated Release Points, Sources and Receiving Waters*, the holder of this environmental authority must undertake an annual assessment of the contaminants of treated CSG water to determine the risk of environmental harm from release of treated CSG water to surface waters. This should consider the contaminants mentioned in the ANZECC & ARMCANZ 2000 guidelines. This annual assessment must be included in the Annual Return.

B27 Prior to the release of treated CSG water to Wilkie Creek a Receiving Environment Monitoring Program (REMP) must be developed and implemented to monitor, identify and describe any adverse impacts to surface water environmental values, water quality and flows due to the authorised release of treated CSG water to Wilkie Creek.

B28 The REMP required by condition (B27) must include periodic monitoring for the effects of the release on the receiving environment as a result of treated CSG water releases to waters from the release location (R1) specified in Table B15 - Treated CSG Water Release Point, Source and Receiving Waters.

B29 The quality of the receiving waters must be monitored at the locations specified in Schedule B, *Table 6 – Receiving Water Upstream Background Sties and Downstream Monitoring Points.*

*Schedule B, Table 6 – Receiving Water Upstream Background Sites and Downstream Monitoring Points*

| Monitoring Points | Receiving Waters | Northing (GDA94) | Easting (GDA94) |
|---|---|---|---|
| ***Upstream background monitoring point*** | | | |
| Monitoring Point (M2) | Wilkie Creek | 50 – 100 metres upstream of Release Point R1 | 50 – 100 metres upstream of Release Point R1 |
| ***Downstream monitoring point*** | | | |
| Monitoring Point (M3) | Wilkie Creek | 150 – 200 metres downstream of Release Point R1 | 150 - 200 metres downstream of Release Point R1 |

B30 The REMP required by Condition (B27) must:

(a) assess the condition or state of receiving waters, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);

(b) be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;

(c) include monitoring from background reference sites (e.g. upstream or background) and downstream sites from the release;

(d) specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the Queensland Water Quality Guidelines 2006. This should include monitoring during periods of natural flow irrespective of other discharges;

(e) include monitoring and assessment of dissolved oxygen saturation and temperature and all water quality parameters listed in Condition (B25);

(f) include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ 2000, BATLEY and/or the most recent version of *AS5667.1 Guidance on Sampling of Bottom Sediments*);

(g) include, where appropriate, monitoring of macroinvertebrates in accordance with the AusRivas methodology;

(h) apply procedures and/or guidelines from ANZECC and ARMCANZ 2000 and other relevant guideline documents;

(i) describe sampling and analysis methods and quality assurance and control; and

(j) incorporate stream flow and hydrological information in the interpretations of water quality and biological data.

B31 A report outlining the findings of the REMP, including all monitoring results and interpretations in accordance with conditions (B27) to (B30) must be prepared annually. This must include a determination of the risk of environmental harm from release of treated CSG water to the receiving environment waters.

## Schedule BE – Coal Seam Gas Water Injection Trial

BE1 The only fluids authorised to be injected into an aquifer(s) are those fluid types specified in *Schedule BE, Table 1 – Details of Authorised Fluid Injection*.

*Schedule BE, Table 1 – Details of Authorised Fluid Injection*

| Well Location (GDA94, MGA zone 56) | Injection Well Number / Reference | Target Formation and Perforated Zone | Fluid Type | Maximum Injection Rate ML/d | Hydraulic Impact Zone | Water Quality Impact Zone |
|---|---|---|---|---|---|---|
| 313669 mE 6967949 mN | Tipton-193 | Precipice Formation, between 1040m to 1110m depth | Treated CSG water[1] | 4 | 9,340 m radius from injection well | 148 m radius from injection well |

[1] Treated CSG water means any fluid that contains any proportion of treated CSG water, blended or otherwise.

BE2 Fluid injection must be in accordance with the quantities and locations listed in *Schedule BE, Table 1 – Details of Authorised Fluid Injection*.

BE3 The holder of this environmental authority must notify the administering authority the commencement date of the trial at least seven (7) days prior to its commencement.

BE4 The injection trial is limited to a period of 180 days of injection, followed by a six-month recovery period.

BE5 Injection must cease immediately upon becoming aware that environmental harm is caused or threatened to be caused as a result of the injection activities.

BE6 The construction of the Tipton-193 injection well must be carried out in accordance with the well construction requirements described in the most recent version of the Department of Environment and Heritage Protection's "CSG Water Injection Well Construction Requirements", as amended from time to time.

BE7 The Tipton-193 injection well must be mechanically functional such that there is no significant fluid movement into a water resource aquifer through vertical channels adjacent to the well bore hole.

BE8 The construction, operation and maintenance of the injection well specified in *Schedule BE, Table 1 – Details of Authorised Fluid Injection* must be undertaken in a way that prevents and/or minimises impacts to the environmental values of the target formation and ensures the integrity of the bore.

BE9 The injection pressure must not exceed 90 percent of the formation fracture pressure.

BE10 The quality of the fluid being injected into the injection well specified in *Schedule BE, Table 1 – Details of Authorised Fluid Injection* must comply with the contaminant limits prescribed in *Schedule BE, Table 2 – Specific Contaminant Limits for Injection Fluid*.

*Schedule BE, Table 2 – Specific Contaminant Limits for Injection Fluid*

| Quality Characteristics | Release Limits | Limit Type |
|---|---|---|
| pH (pH units) | Minimum 6.5, Maximum 10 | Range |
| Total Dissolved Solids (TDS)[1] | Mean TDS of injection fluid must not exceed median TDS of formation water measured in background water quality monitoring well | Maximum |
| Dissolved Oxygen | 500 µg/L | Maximum |
| Total suspended solids | 25 mg/L | Maximum |

[1] Electrical conductivity is an acceptable proxy measurement for measuring TDS of the injection fluid. If used, the conversion from EC to TDS must be stated and confirmed with laboratory monitoring results.

BE11 A The quality of the fluid being injected into the injection well specified in *Schedule BE, Table 1 – Details of Authorised Fluid Injection* must be monitored at the frequency specified in *Schedule BE, Table 3 – Monitoring Parameters and Frequencies for Injection Fluid*.

BE11 B The administering authority must be notified in writing as soon as reasonably practicable, but within 48 hours of becoming aware of:

(a) migration of injected fluid out of the target formation; or

(b) a loss of hydraulic isolation of the target formation; or

(c) the detection of groundwater contaminants that were not detected in background samples; or

(d) an injection fluid monitoring result that does not comply with any one of the parameters in *Schedule BE, Table 2 – Specific Contaminant Limits for Injection Fluid*.

*Schedule BE, Table 3 – Monitoring Parameters and Frequencies for Injection Fluid*

| Monitoring parameter | Unit | Monitoring frequency during injection |
|---|---|---|
| Temperature of target formation | °C | N/A |
| Injection fluid temperature | °C | Continuous |
| Inlet pressure | KPa | Continuous |
| Fluid flow rate | L/sec | Continuous |
| | ML/day | Daily |
| Dissolved Oxygen (DO) | µg/L | Daily |
| Electrical Conductivity | µS/cm | Daily |
| pH | pH units | Daily |
| Turbidity | NTU | Daily |
| Sodium | mg/L | Weekly |
| Potassium | mg/L | Weekly |
| Calcium | mg/L | Weekly |
| Magnesium | mg/L | Weekly |
| Chloride | mg/L | Weekly |
| Sulphate as $SO_4$ | mg/L | Weekly |
| Carbonate / Bicarbonate | mg/L | Weekly |
| Bromine | mg/L | Monthly |
| Fluoride | mg/L | Monthly |
| Iodide | mg/L | Weekly |
| Silica | mg/L | Monthly |
| Iodine | mg/L | Monthly |
| Nitrate | mg/L | Monthly |
| Total organic carbon | mg/L | Weekly |
| Total Dissolved Solids | mg/L | Weekly |
| Redox Potential | mV | Weekly |
| Total Hardness as CaCO3 | mg/L | Weekly |

| Monitoring parameter | Unit | Monitoring frequency during injection |
|---|---|---|
| Total Alkalinity as CaCO3 | mg/L | Weekly |
| Hydroxide alkalinity as CaCO3 | mg/L | Weekly |
| Carbonate Alkalinity as CaCO3 | mg/L | Weekly |
| Bicarbonate Alkalinity as CaCO3 | mg/L | Weekly |
| Total suspended solids | mg/L | Weekly |
| Bromide | mg/L | Weekly |
| Aluminium | mg/L | Monthly |
| Arsenic | mg/L | Monthly |
| Barium | mg/L | Monthly |
| Boron | mg/L | Monthly |
| Copper | mg/L | Monthly |
| Iron | mg/L | Monthly |
| Manganese | mg/L | Monthly |
| Mercury | mg/L | Monthly |
| Nickel | mg/L | Monthly |
| Strontium | mg/L | Monthly |
| Zinc | mg/L | Monthly |
| Total Petroleum Hydrocarbons | µg/L | Monthly |
| BTEX | µg/L | Monthly |

BE12 Notwithstanding conditions (BE9) and (BE10), the injection of treated CSG water into the injection well specified in *Schedule BE, Table 1 – Details of Authorised Fluid Injection* must have considered the recommendations for water blending described in the following documents, where appropriate:

(a) Surat Gas Project – Geochemical Blending and Compatibility Study: Tipton Injection Trials, March 2013; and

(b) Surat Gas Project – Geochemical Blending and Compatibility Study: Tipton Injection Trials – Phase 2, March 2013.

BE13 The holder of this environmental authority must provide for non-chemical disinfection of injection fluid if results of six-monthly testing of injected fluid show levels of coliform bacteria, sulphate reducing bacteria or iron fixing bacteria that has potential to cause adverse impacts on the groundwater within the target formation.

BE14 An Injection Management Plan which has been certified by a suitably qualified person must be developed and implemented prior to the carrying out of the trial fluid injection activity(ies).

BE15 The Injection Management Plan must include but not necessarily be limited to:

(a) estimated volumes and rates of water to be injected;

(b) a description of the physical, chemical and biological components and their concentrations of the water to be produced;

(c) details of how and where the fluid will be produced, aggregated, stored and kept separate from other waters until it is treated and injected;

(d) details of where the fluid is proposed to be treated including a description of the treatment process;

(e) a water quality compatibility assessment which demonstrates that the injection fluid has inconsequential reactivity with the target formation and native groundwater it will come into contact with;

(f) the regional characteristics of the receiving environment;

(g) identification of the water quality impact zone and the hydraulic impact zone;

(h) identification of any fluid injection well, all existing bores, springs, lakes, wetlands, environmental assets and watercourses connected to groundwater, faults and other geologic features that occur within the water quality impact zone and the hydraulic impact zone;

(i) identification of the environmental values and water quality objectives of the potential water quality impact zone of the target formation in accordance with the *Environmental Protection (Water) Policy 2009* and the *Queensland Water Quality Guidelines 2009*;

(j) an assessment of the potential for migration of injection fluid or native groundwater out of the target formation through wells, bores, springs, connected watercourses, faults or other geologic features likely to impact on other aquifers;

(k) a risk assessment identifying potential hazards, their inherent risk, preventative measures for the management of potential hazards and details on sampling and analysis methods to verify preventative measures of potential hazards, including frequency and locations and quality assurance and control;

(l) control measures that will be implemented for fluid storage, treatment and injection to prevent or control the release of a contaminant or waste to the environment other than the release authorised in *Schedule BE, Table 1 – Details of Authorised Fluid Injection* and *Schedule BE, Table 2 – Specific Contaminant Limits for Injection Fluid*;

(m) verification methods to assess performance of the injection activities;

(n) the indicators or other criteria against which the performance of fluid injection will be assessed;

(o) procedures that will be adopted to regularly review the monitoring program;

(p) reporting procedures to management and the administering authority should unforeseen or non-compliant monitoring results be recorded; and

(q) procedures that will be implemented to prevent unauthorised environmental harm from unforeseen or non-compliant monitoring results.

BE16 A Receiving Environment Monitoring Program (REMP) for Injection Activities which has been certified by a suitably qualified person must be developed and implemented to monitor, identify and describe any adverse impacts to the following values of the target formation due to the injection of treated CSG water:

(a) hydraulic response;

(b) water quality response; and

(c) any other groundwater environmental values identified.

BE17 The REMP for Injection Activities required by condition (BE16) must be developed and implemented prior to the carrying out of the trial fluid injection activity(ies).

BE18 The REMP for Injection Activities required by condition (BE16) must include, but not necessarily be limited to:

(a) methods to validate the assumptions, predicted impacts and the effectiveness of the proposed preventative measures associated with the modelled water quality impact zone and hydraulic impact zone;

(b) monitoring of the hydraulic response to the trial injection at the well(s) referred to in condition (BE18)(f)(ii);

(c) monitoring of the water quality of the injection fluid during injection for the parameters listed in *Schedule BE, Table 3 – Monitoring Parameters and Frequencies for Injection Fluid*;

(d) monitoring of the water quality response following the completion of the injection trial recovery period through sampling of the target aquifer, within the water quality impact zone, for the parameters listed in *Schedule BE, Table 3 – Monitoring Parameters and Frequencies for Injection Fluid*;

(e) a definition of the background water quality of the Precipice Sandstone to be used for monitoring compliance with *Schedule BE, Table 2 – Specific Contaminant Limits for Injection Fluid* and for reporting in the Injection Trial Report required by condition (BE19);

(f) the installation and use of a minimum of two wells:

i. one of which accesses the target aquifer within the water quality impact zone; and

ii. the other of which is placed at an adequate distance to determine the extent of the hydraulic response to the injection;

(g) methods for the analysis and interpretation and a description of the statistical basis on which conclusions will be drawn to verify the assumptions of the injection proposal; and

(h) a demonstration of how the REMP will validate assumptions, predicted impacts and the effectiveness of quality assurance and control measures.

BE19 Upon completion and within two (2) months of the completion of the injection trial's recovery period the holder of the authority must submit to the administering authority an Injection Trial Report prepared by a suitably qualified person.

BE20 The Injection Trial Report must include, but not necessarily be limited to:

(a) details of the injection well including but not limited to:

i. location details (GDA94);

ii. the inferred lithology *;

iii. casing details including type, outer diameter (mm), wall thickness (mm) and locations (depth from and to in metres);

iv. cementing details including type, hole diameter (mm), casing outer diameter (mm) and locations (depth from and to in metres);

v. calculated target formation fracture pressure; and

vi. target formation pressure prior to injection;

(b) a detailed interpretation of the logs and other tests conducted during drilling and construction or refurbishment of the well against their specific objectives;

(c) a completed well schematic diagram;

(d) a temperature survey;

(e) a cement integrity log;

(f) outcomes of the injection trial including, but not limited to:

i. well head injection rates versus formation pressure;

ii. target formation pressure within the hydraulic impact zone during and upon completion of the trial;

iii. hydraulic gradient of the target formation within the hydraulic impact zone upon completion of the trial;

iv. the effectiveness of aquitards (including the stability of the aquitard) and aquicludes of confining the injected fluid within the target formation; and

v. a detailed interpretation of the logs and other tests conducted during the injection trial against their specific objectives;

vi. validation of conceptual framework for injection; and

vii. additional hazards that were not identified earlier;

(g) the results of the REMP for Injection Activities;

(h) analysis of monitoring and operational data in terms of:

i. validation of conceptual framework for injection; and

ii. additional hazards that were not identified earlier;

(i) a revised risk analysis that identifies all potential hazards, likelihood of various risk elements and associated consequences;

(j) a revised water quality compatibility assessment which demonstrates that the injection fluid has inconsequential reactivity with the target formation and native groundwater it will come into contact with;

(k) a re-evaluation of the hydraulic impact zone; and

(l) a re-evaluation of the water quality impact zone.

* Inferred lithology means the best available description of the lithology based upon historical drilling records, interpretation of logs and any other information that the suitably qualified person may have discovered.

BE21 Following completion of the injection trial, a fluid injection cessation report which has been certified by a suitably qualified person must be submitted to the administering authority within two (2) months of completion of the injection trial's recovery period.

BE22 The fluid injection cessation report must include, but not necessarily be limited to:

(a) volumes of fluid injected at each well;

(b) a risk assessment statement providing details on identified hazards including their inherent risk, summary of the results from the verification monitoring, preventative measures and the residual risk; and

(c) a monitoring report outlining the methods and results of verification monitoring undertaken to assess the performance of the injection activities and preventative measures for identified hazards.

**Schedule C – Regulated Dams**

Dams 1 The consequence category of any structure must be assessed by a suitably qualified and experienced person in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933)* at the following times:

(a) prior to the design and construction of the structure, if it is not an existing structure; or

(b) prior to any change in its purpose or the nature of its stored contents.

Dams 2 A consequence assessment report and certification must be prepared for each structure assessed and the report may include a consequence assessment for more than one structure.

Dams 3 Certification must be provided by the suitably qualified and experienced person who undertook the assessment, in the form set out in the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933)*.

Dams 4 Conditions (Dams 5) to (Dams 9) inclusive do not apply to existing structures.

Dams 5 All regulated structures must be designed by, and constructed under the supervision of, a suitably qualified and experienced person in accordance with the requirements of the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/19338)*.

Dams 6 Construction of a regulated structure is prohibited unless:

(a) the holder of this environmental authority has submitted a consequence category assessment report and certification to the administering authority; and

(b) certification for the design, design plan and the associated operating procedures has been certified by a suitably qualified and experienced person in compliance with the relevant condition of this authority.

Dams 7 Certification must be provided by the suitably qualified and experienced person who oversees the preparation of the design plan in the form set out in the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/19338)*, and must be recorded in the Register of Regulated Structures.

Dams 8 Regulated structures must:

(a) be designed and constructed in compliance with the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/19338)*;

(b) be designed and constructed with due consideration given to ensuring that the design integrity would not be compromised on account of:

i. floodwaters from entering the regulated dam from any watercourse or drainage line; and

ii. wall failure due to erosion by floodwaters arising from any watercourse or drainage line.

(c) have the floor and sides of the dam designed and constructed to prevent or minimise the passage of the wetting front and any entrained contaminants through either the floor or sides of the dam during the operational life of the dam and for any period of decommissioning and rehabilitation of the dam.

Dams 9 Certification by the suitably qualified and experienced person who supervises the construction must be submitted to the administering authority on the completion of construction of the regulated structure, and state that:

(a) the 'as constructed' drawings and specifications meet the original intent of the design plan for that regulated structure;

(b) construction of the regulated structure is in accordance with the design plan.

Dams 10 All affected persons must be provided with a copy of the emergency action plan in place for each regulated structure

(a) for existing structures that are regulated structures, within 10 business days of this condition taking effect;

(b) prior to the operation of the new regulated structure; and

(c) if the emergency action plan is amended, within 5 business days of it being amended.

Dams 11 Operation of a regulated structure, except for an existing structure, is prohibited.

Dams 12 For existing structures that are regulated structures:

(a) where the existing structure that is a regulated structure is to be managed as part of an integrated containment system for the purpose of sharing the DSA volume across the system, the holder of this environmental authority must submit to the administering authority within 12months of the commencement of this condition a copy of the certified system design plan including that structure; and

(a) there must be a current operational plan for the existing structures.

Dams 13 Each regulated structure must be maintained and operated, for the duration of its operational life until decommissioned and rehabilitated, in compliance with the current operational plan and, if applicable, the current design plan and associated certified 'as constructed' drawings.

Dams 14 Conditions Dams 15 to Dams 18 inclusive only apply to Regulated Structures which have not been certified as low consequence category for 'failure to contain – overtopping'.

| | |
|---|---|
| Dams 15 | The Mandatory Reporting Level (the MRL) must be marked on a regulated dam in such a way that during routine inspections of that dam, it is clearly observable. |
| Dams 16 | The holder of this environmental authority must, as soon as practical and within forty-eight (48) hours of becoming aware, notify the administering authority when the level of the contents of a regulated dam reaches the MRL. |
| Dams 17 | The holder of this environmental authority must, immediately on becoming aware that the MRL has been reached, act to prevent the occurrence of any unauthorised discharge from the regulated dam. |
| Dams 18 | The holder of this environmental authority must record any changes to the MRL in the Register of Regulated Structures. |
| Dams 19 | The holder of this environmental authority must assess the performance of each regulated dam or linked containment system over the preceding November to May period based on actual observations of the available storage in each regulated dam or linked containment system taken prior to 1 July of each year. |
| Dams 20 | By 1 November of each year, storage capacity must be available in each regulated dam (or network of linked containment systems with a shared DSA volume), to meet the Design Storage Allowance (DSA) volume for the dam (or network of linked containment systems). |
| Dams 21 | The holder of this environmental authority must, as soon as possible and within forty-eight (48) hours of becoming aware that the regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, notify the administering authority. |
| Dams 22 | The holder of this environmental authority must, immediately on becoming aware that a regulated dam (or network of linked containment systems) will not have the available storage to meet the DSA volume on 1 November of any year, act to prevent the occurrence of any unauthorised discharge from the regulated dam or linked containment systems. |
| Dams 23 | Each regulated structure must be inspected each calendar year by a suitably qualified and experienced person. |
| Dams 24 | At each annual inspection, the condition and adequacy of all components of the regulated structure must be assessed and a suitably qualified and experienced person must prepare an annual inspection report containing details of the assessment and include a recommendations section, with any recommended actions to ensure the integrity of the regulated structure or a positive statement that no recommendations are required. |

Dams 25 The suitably qualified and experienced person who prepared the annual inspection report must certify the report in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933).*

Dams 26 The holder of this environmental authority must, within 20 business days of receipt of the annual inspection report, provide to the administering authority:

(a) The recommendations section of the annual inspection report; and

(b) If applicable, any actions being taken in response to those recommendations; and

(c) If, following receipt of the recommendations and (if applicable) recommended actions, the administering authority requests a copy of the annual inspection report from the holder of this environmental authority, provide this to the administering authority within 10 business days of receipt of the request.

Dams 27 The holder of this environmental authority must provide a copy of any reports, documentation and certifications prepared under this environmental authority, including but not limited to any Register of Regulated Structures, consequence assessment, design plan and other supporting documentation, to a new holder on transfer of this environmental authority.

Dams 30 A Register of Regulated Dams must be established and maintained by the holder of this environmental authority for each regulated dam.

Dams 31 The holder of this environmental authority must provisionally enter the required information in the Register of Regulated Dams when a design plan for a regulated dam is submitted to the administering authority.

Dams 32 The holder of this environmental authority must make a final entry of the required information in the Register of Regulated Structures once compliance with conditions Dams 11 and Dams 12 has been achieved.

Dams 33 The holder of this environmental authority must ensure that the information contained in the Register of Regulated Dams is current and complete on any given day.

Dams 34 All entries in the Register of Regulated Dams must be approved by the chief executive officer for the holder of this environmental authority, or their delegate, as being accurate and correct.

Dams 35 The holder of this environmental authority must, at the same time as providing the annual return, supply to the administering authority a copy of the records contained in the Register of Regulated Dams, in the electronic format required by the administering authority.

Dams 36 All existing structures that have not been assessed in accordance with either the Manual or the former *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* must be assessed and certified in accordance with the Manual within 6 months of amendment of the authority adopting this schedule.

Dams 37 All existing structures must subsequently comply with the timetable for any further assessments in accordance with the Manual specified in *Schedule C, Table 1 – Transitional requirements for existing structures*, depending on the consequence category for each existing structure assessed in the most recent previous certification for that structure.

Dams 38 *Schedule C, Table 1 – Transitional requirements for existing structures* ceases to apply for a structure once any of the following events has occurred:

(a) it has been brought into compliance with the hydraulic performance criteria applicable to the structure under the Manual; or

(b) it has been decommissioned; or

(c) it has been certified as no longer being assessed as a regulated structure.

Dams 39 Certification of the transitional assessment required by conditions Dams 36 and Dams 37 (as applicable) must be provided to the administering authority within 6 months of amendment of the authority adopting this schedule.

*Schedule C, Table 1 - Transitional hydraulic performance requirements for existing structures*

| **Transition period required for existing structures to achieve the requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Dams*** | | | |
|---|---|---|---|
| **Compliance with criteria** | **High** | **Significant** | **Low** |
| >90% and a history of good compliance performance in last 5 years | No transition required | No transition required | No transitional conditions apply. Review consequence assessment every 7 years. |
| >70% - ≤90% | Within 7 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases. | Within 10 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases. | No transitional conditions apply. Review consequence assessment every 7 years. |
| >50 -≤70 percent | Within 5 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases. | Within 7 years, unless otherwise agreed with the administering authority, based on no history of unauthorised releases. | Review consequence assessment every 7 years. |
| ≤50% | Within 5 years or as per compliance requirements (e.g. TEP timing) | Within 5 years or as per compliance requirements (e.g. TEP timing) | Review consequence assessment every 5 years. |
| Regulated levee designed to prevent the ingress of clean flood water <100% compliant[1] | Within 5 years unless otherwise agreed with the administering authority. | | |

[1] Levees designed for the diversion of contaminated waters or protection of the structural integrity of a dam are not to be considered as part of this provision. These levees are considered a key design element of the relevant dam and transitional periods should as such align to that relevant compliance criteria and consequence category.

## Schedule D – Land

| | |
|---|---|
| Land 1 | Contaminants must not be directly or indirectly released to land except for those releases authorised by this environmental authority. |
| Land 2 | Top soil must be managed in a manner that preserves its biological and chemical properties. |
| Land 3 | Land that has been significantly disturbed by the petroleum activities must be managed to ensure that mass movement, gully erosion, rill erosion, sheet erosion and tunnel erosion do not occur on that land. |
| Land 4 | Acid sulfate soils must be treated and managed in accordance with the latest edition of the *Queensland Acid Sulfate Soil Technical Manual*. |
| Land 5 | Chemicals and fuels stored, must be effectively contained and where relevant, meet Australian Standards, where such a standard is applicable. |
| Land 6 | Pipeline operation and maintenance must be in accordance, to the greatest practicable extent, with the relevant section of the *APGA Code of Environmental Practice: Onshore Pipelines (2017)* (or more recent editions). |
| Land 7 | Pipeline trenches must be backfilled and topsoils reinstated within three months after pipe laying. |
| Land 8 | Reinstatement and revegetation of the pipeline right of way must commence within 6 months after cessation of petroleum activities for the purpose of pipeline construction. |
| Land 9 | Backfilled, reinstated and revegetated pipeline trenches and right of ways must be:<br>(a) a stable landform;<br>(b) re-profiled to a level consistent with surrounding soils;<br>(c) re-profiled to original contours and established drainage lines; and<br>(d) vegetated with groundcover which is not a pest species, and which is established and growing. |
| Biodiversity 1 | Prior to undertaking activities that result in significant disturbance to land in areas of native vegetation, confirmation of on-the-ground biodiversity values of the native vegetation communities at that location must be undertaken by a suitably qualified person. |
| Biodiversity 2 | A suitably qualified person must develop and certify a methodology so that condition (Biodiversity 1) can be complied with and which is appropriate to confirm on-the-ground biodiversity values. |

Biodiversity 3 For conditions (Biodiversity 4) to (Biodiversity 9), where mapped biodiversity values differ from those confirmed under conditions (Biodiversity 1) and (Biodiversity 2), petroleum activities may proceed in accordance with the conditions of the environmental authority based on the confirmed on-the-ground biodiversity value.

Biodiversity 4 The location of the petroleum activity(ies) must be selected in accordance with the following site planning principles:

(a) maximise the use of areas of pre-existing disturbance;

(b) in order of preference, avoid, minimise or mitigate any impacts, including cumulative impacts, on areas of native vegetation or other areas of ecological value;

(c) minimise disturbance to land that may result in land degradation ;

(d) in order of preference, avoid then minimise isolation, fragmentation, edge effects or dissection of tracts of native vegetation; and

(e) in order of preference, avoid then minimise clearing of native mature trees.

Biodiversity 5 Linear infrastructure construction corridors must:

(a) maximise co-location;

(b) be minimised in width to the greatest practicable extent; and

(c) for linear infrastructure that is an essential petroleum activity authorised in an environmentally sensitive area or its protection zone, be no greater than 40m in total width.

Biodiversity 6 Despite Biodiversity 5 (c), Should the quality of protection zone land be deemed historically disturbed (subject to assessment by a suitably qualified person), or of low environmental value, then Biodiversity 5 (c) is silent.

Biodiversity 8A Where petroleum activities are to be carried out in environmentally sensitive areas or their protection zones, the petroleum activities must be carried out in accordance with *Schedule D, Table 1— Authorised petroleum activities in environmentally sensitive areas and their protection zones*.

Biodiversity 8B The petroleum activities authorised under condition (Biodiversity 8A) must not exceed the maximum footprint for the activities specified in *Schedule D, Table 2 – Maximum significant disturbance in environmentally sensitive areas and their protection zones*.

*Schedule D, Table 1— Authorised petroleum activities in environmentally sensitive areas and their protection zones*

| **Environmentally sensitive area** | **Within the environmentally sensitive area** | **Primary protection zone of the environmentally sensitive area** | **Secondary protection zone of the environmentally sensitive area** |
|---|---|---|---|
| Category A environmentally sensitive areas | No petroleum activities permitted. | Only low impact petroleum activities permitted. | Only essential petroleum activities permitted. |
| Category B environmentally sensitive areas that are other than 'endangered' regional ecosystems | Only low impact petroleum activities permitted. | Only low impact petroleum activities permitted. | Only essential petroleum activities permitted. |
| Category B environmentally sensitive areas that are 'endangered' regional ecosystems | Only low impact petroleum activities permitted. | Only essential petroleum activities permitted. | Only essential petroleum activities permitted. |
| Category C environmentally sensitive areas that are 'nature refuges' or 'koala habitat' | Only low impact petroleum activities permitted. | Only low impact petroleum activities permitted. | |
| Category C environmentally sensitive areas that are 'essential habitat', 'essential regrowth habitat', or 'of concern' regional ecosystems | Only low impact petroleum activities permitted. | Only essential petroleum activities permitted. | |
| Category C environmentally sensitive areas that are 'regional parks' (previously known as 'resources reserves') | Only essential petroleum activities permitted. | Only essential petroleum activities permitted. | |
| Category C environmentally sensitive areas that are 'state forests' or 'timber reserves' | Only essential petroleum activities permitted. | Petroleum activities permitted. | |
| Areas of vegetation that are 'critically limited' | Only low impact petroleum activities permitted. | Only essential petroleum activities permitted. | |

*Schedule D, Table 2 – Maximum significant disturbance in environmentally sensitive areas and their protection zones*

| Activity | Maximum Footprint |
|---|---|
| Ground disturbance within a Category B Environmentally Sensitive Area | 0 ha |
| Ground disturbance within a protection zone of a Category B Environmentally Sensitive Area | 6 ha |
| Ground disturbance within a Category C Environmentally Sensitive Area | 14 ha |
| Ground disturbance within a protection zone of a Category C Environmentally Sensitive Area | 70 ha |

Biodiversity 9 A report must be prepared for each annual return period for all petroleum activities that involved clearing of any environmentally sensitive area or protection zone which includes:

(a) records able to demonstrate compliance with conditions (Biodiversity 4), (Biodiversity 5), (Biodiversity 8A) and (Biodiversity 8B);

(b) a description of the works;

(c) a description of the area and its pre-disturbance values (which may include maps or photographs, but must include GPS coordinates for the works); and

(d) based on the extent of environmentally sensitive areas and primary protection zones on the relevant resource authority(ies), the proportion of native vegetation cleared per environmentally sensitive area and primary protection zone, including regional ecosystem type, over the annual return period.

Biodiversity 10 Significant residual impacts to prescribed environmental matters (other than if the impacts were authorised by an existing authority issued before the commencement of the *Environmental Offsets Act 2014*) are not authorised under this environmental authority or the *Environmental Offsets Act 2014* unless the impact(s) is specified in *Schedule D, Table 3 — Significant residual impacts to prescribed environmental matters.*

Biodiversity 11 Records demonstrating that each impact to a prescribed environmental matter not listed in *Schedule D, Table 3 — Significant residual impacts to prescribed environmental matters* did not, or is not likely to, result in a significant residual impact to that matter must be:

(a) completed by an appropriately qualified person; and

(b) kept for the life of the environmental authority.

*Protecting biodiversity values, Table 3 — Significant residual impacts to prescribed environmental matters*

| Prescribed environmental matter | Location of impact | Maximum extent of impact |
|---|---|---|
| **REGULATED VEGETATION** | | |
| Endangered regional ecosystem | | |
| RE 11.3.21 | PL260 | 3 ha |
| RE 11.4.2 | PL194 | 2 ha |
| Of concern regional ecosystem (not within an urban area) | | |
| RE 11.3.2 | PL194, PL198, PL230, PL238, PL260 | 20 ha |
| RE 11.3.4 | PL194, PL198, PL230, PL238, PL252, PL260 | 18 ha |
| RE 11.3.17 | PL252, PL260 | 15 ha |
| Regional ecosystems (not within an urban area) that intersect a wetland on the vegetation management wetlands map | | |
| RE 11.3.4 | PL260 | 1 ha |
| RE 11.3.27 | PL260 | 2 ha |
| Regional ecosystems (not within an urban area) within the defined distance from the defining banks of a relevant watercourse on the vegetation management watercourse map | | |
| RE 11.3.2 (BVG 17a) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 1 ha |
| 11.3.4 (BVG 16c) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 5 ha |
| 11.3.18 (BVG 17a) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 3 ha |
| 11.3.25 (BVG 16a; 22c) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 15 ha |
| 11.4.12 (BVG 17a) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 1 ha |
| 11.5.1 (BVG 17a; 18b) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 5 ha |

| Prescribed environmental matter | Location of impact | Maximum extent of impact |
|---|---|---|
| 11.7.4 (BVG 12a) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 0.5 ha |
| 11.7.7 (BVG 12a) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 1 ha |
| Essential habitat (not in an urban area) for endangered wildlife | | |
| *Hemiaspis damelii* | PL230, PL260 | 6 ha |
| Essential habitat (not in an urban area) for vulnerable wildlife | | |
| *Calyptorhynchus lathami* | PL260 | 1 ha |
| *Jalmenus eubulus* | PL260 | 0.5 ha |
| **CONNECTIVITY AREAS** | | |
| Connectivity area that is a regional ecosystem (not in urban area) | | |
| PL194 | PL194 | 6.7 ha |
| PL198 | PL198 | 2.3 ha |
| PL230 | PL230 | 1.3 ha |
| PL260 | PL260 | 1 ha |
| **WETLANDS AND WATERCOURSES** | | |
| A wetland in a wetland protection area shown on the Map of referable wetlands (HES wetlands in GBR) | PL198, PL238, PL260 | 2.5 ha |
| A wetland of high ecological significance shown on the Map of referable wetlands | PL260 | 1.5 ha |
| **PROTECTED WILDLIFE HABITAT** | | |
| An area shown as a high risk area on the flora survey trigger map that contains plants that are endangered or vulnerable wildlife | | |
| *Picris barbarorum* | PL260 | 2.5 ha |
| *Solanum papaverifolium* | PL260 | 3 ha |
| Habitat for an animal that is vulnerable wildlife | | |

| Prescribed environmental matter | Location of impact | Maximum extent of impact |
|---|---|---|
| *Acanthophis antarcticus* | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 370 ha |
| *Calyptorhynchus lathami* | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 110 ha |
| *Jalmenus eubulus* | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 20 ha |
| *Tachyglossus aculeatus* | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 67 ha |
| Habitat for an animal that is endangered wildlife | | |
| *Hemiaspis damelii* | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 255 ha |
| **FISH HABITAT AREAS** | | |
| Fish passage (not in an urban area) | PL194, PL198, PL230, PL238, PL252, PL258, PL260 | 7 ha |

Biodiversity 12 An environmental offset made in accordance with the *Environmental Offsets Act 2014* and Queensland Environmental Offsets Policy, as amended from time to time, must be undertaken for the maximum extent of impact to each prescribed environmental matter authorised in *Schedule D, Table 3— Significant residual impacts to prescribed environmental matters*, unless a lesser extent of the impact has been approved in accordance with condition (Biodiversity 14).

Biodiversity 13 The significant residual impacts to a prescribed environmental matter authorised in condition (Biodiversity 10) for which an environmental offset is required by condition (Biodiversity 12) may be carried out in stages. An environmental offset can be delivered for each stage of the impacts to prescribed environmental matters.

Biodiversity 14 Prior to the commencement of each stage, a report completed by an appropriately qualified person, that includes an analysis of the following must be provided to the administering authority:

(a) for the forthcoming stage—the estimated significant residual impacts to each prescribed environmental matter; and

(b) for the previous stage, if applicable—the actual significant residual impacts to each prescribed environmental matter, to date.

Biodiversity 15 The report required by condition (Biodiversity 14) must be approved by the administering authority before a notice of election for the forthcoming stage, if applicable, is given to the administering authority.

Biodiversity 16 A notice of election for the staged environmental offset referred to in condition (Biodiversity 15), if applicable, must be provided to the administering authority no less than three months before the proposed commencement of that stage, unless a lesser timeframe has been agreed to by the administering authority.

Biodiversity 17 Within six months from the completion of the final stage of the project, a report completed by an appropriately qualified person, that includes the following matters must be provided to the administering authority:

(a) an analysis of the actual impacts on prescribed environmental matters resulting from the final stage; and

(b) if applicable, a notice of election to address any outstanding offset debits for the authorised impacts.

D17 Despite (Biodiversity 8A), the Daandine Brine Dam 2 with its associated activities necessary for construction, operation, maintenance and monitoring of the dam, are permitted to be located within the area bound by the coordinates prescribed in *Schedule D, Table 4 - Coordinates Enclosing the Disturbance Area for Daandine Brine Dam 2*.

D18 Despite (Biodiversity 8A), the water release outlet and pipeline, with its associated activities necessary for construction, operation, maintenance and monitoring for the release of treated CSG water to Wilkie Creek, are permitted to be located within the area bound by the coordinates prescribed in *Schedule D Table 5 - Coordinates Enclosing the Disturbance Area for the Water Release Outlet and Pipeline*.

D19 The construction of the water release outlet and pipeline must be located within the area bound by the coordinates prescribed by *Schedule D Table 5 - Coordinates Enclosing the Disturbance Area for the Water Release Outlet and Pipeline*.

D20 Despite (Biodiversity 8A), the Tipton Treated Water Pipeline, with its associated activities necessary for construction, operation, maintenance, are permitted to be located within the area bound by the coordinates prescribed in *Schedule D, Table 6 – Coordinates Enclosing the Disturbance Area for Tipton Treated Water Pipeline*.

D21 Despite (Biodiversity 8A), the disturbance footprints for the 'Longswamp 31 monitoring bore' and the 'Tipton 253 gas well' are permitted to be located within the areas prescribed in *Schedule D, Table 7 – Authorised footprint for disturbance to environmentally sensitive areas*.

D22 Condition D21 does not authorise clearing of vegetation and requires that all waste, including residual drilling material, must be removed from the site.

*Schedule D, Table 4 – Coordinates Enclosing the Disturbance Area for Daandine Brine Dam 2*

| Point | Northing (GDA94, Zone 56) | Easting (GDA94, Zone 56) |
|---|---|---|
| 1 | 7001708 | 297524 |
| 2 | 7001153 | 297384 |
| 3 | 7001051 | 298345 |
| 4 | 7001418 | 298444 |
| 5 | 7001601 | 298406 |
| 6 | 7001620 | 298190 |

*Schedule D Table 5 – Coordinates Enclosing the Disturbance Area for the Water Release Outlet and Pipeline*

| Point | Northing (GDA94, Zone 56) | Easting (GDA94, Zone 56) | Area of disturbance |
|---|---|---|---|
| Valve Pit | 6995424 | 302897 | 0.18 ha |
| High Point on Bank | 6995460 | 302991 | |
| Outlet at Creek | 6995465 | 303004 | |

*Schedule D, Table 6 – Coordinates Enclosing the Disturbance Area for Tipton Treated Water Pipeline*

| Point | Easting (GDA94 Zone 56) | Northing (GDA94 Zone 56) |
|---|---|---|
| Section 1 | 310653 | 6969687 |
| | 310656 | 6969747 |
| | 310696 | 6969745 |
| | 310661 | 6970448 |
| | 310621 | 6970453 |
| | 310651 | 6970652 |
| | 310611 | 6970657 |
| | 310642 | 6970846 |
| | 310602 | 6970846 |
| | 310707 | 6971627 |
| | 310667 | 6971630 |
| | 310659 | 6972161 |
| | 310618 | 6972167 |
| | 310621 | 6973392 |
| | 310581 | 6973399 |
| | 310613 | 6973550 |
| | 310573 | 6973550 |

| Point | Easting (GDA94 Zone 56) | Northing (GDA94 Zone 56) |
|---|---|---|
| | 310639 | 6973650 |
| | 310539 | 6973550 |
| | 310608 | 6973650 |
| | 310568 | 6973650 |
| | 310639 | 6973550 |
| | 310539 | 6973650 |
| Section 2 | 310617 | 6973719 |
| | 310577 | 6973724 |
| | 310722 | 6974060 |
| | 310682 | 6974065 |
| | 310717 | 6974172 |
| | 310677 | 6974177 |
| | 310714 | 6974221 |
| | 310675 | 6974217 |
| | 310692 | 6974378 |
| | 310654 | 6974365 |
| | 310692 | 6974378 |
| | 310567 | 6974521 |
| | 310617 | 6974514 |
| | 310563 | 6974528 |
| | 310613 | 6974522 |
| | 310499 | 6974536 |
| | 310594 | 6974610 |
| | 310497 | 6974636 |
| Section 3 | 310534 | 6974847 |
| | 310494 | 6974835 |
| | 310534 | 6974857 |
| | 310494 | 6974862 |
| | 310528 | 6975192 |
| | 310488 | 6975197 |
| | 310526 | 6975351 |
| | 310486 | 6975347 |

*Schedule D, Table 7 – Authorised footprint for disturbance to environmentally sensitive areas*

| Activity | Latitude | Longitude | Maximum operational footprint | ESA Type |
|---|---|---|---|---|
| Longswamp 31 shallow monitoring bore | 151.095733°E | -27.343471°S | 9 $m^2$ | Category A ESA |
| Tipton 253 gas well | 151.13539°E | -27.36818°S | 19600 $m^2$ | Primary protection zone of Category C ESA |

## Schedule E – Acoustic

Noise 1 Notwithstanding condition (General 21), emission of noise from the petroleum activity(ies) at levels less than those specified in *Schedule E, Table 1—Noise nuisance limits* are not considered to be environmental nuisance.

Noise 2 If the noise subject to a valid complaint is tonal or impulsive, the adjustments detailed in *Schedule E, Table 2—Adjustments to be added to noise levels at sensitive receptors* are to be added to the measured noise level(s) to derive $L_{Aeq,\ adj,\ 15\ min}$.

*Schedule E, Table 1—Noise nuisance limits*[1]

| Time period | Metric | Short term noise event | Medium term noise event | Long term noise event |
|---|---|---|---|---|
| 7:00am—6:00pm | $L_{Aeq,adj,15\ min}$ | 45 dBA | 43 dBA | 40 dBA |
| 6:00pm—10:00pm | $L_{Aeq,adj,15\ min}$ | 40 dBA | 38 dBA | 35 dBA |
| 10:00pm—6:00am | $L_{Aeq,adj,15\ min}$ | 28 dBA | 28 dBA | 28 dBA |
| | Max $L_{pA,\ 15mins}$ | 55 dBA | 55 dBA | 55 dBA |
| 6:00am—7:00am | $L_{Aeq,adj,15\ min}$ | 40 dBA | 38 dBA | 35 dBA |
| Drilling activities undertaken from 10:00pm – 7:00am[2] | $L_{Aeq,\ adj,\ 15min}$ | 28 dBA (measured indoors)<br>33 dBA (measured outdoors) | | |

[1] The noise limits in *Schedule E, Table 1 – Noise nuisance limits* have been set based on the following deemed background noise levels (LABG)*:*

*7:00am—6:00 pm: 35 dBA*

*6:00pm—10:00 pm: 30 dBA*

*10:00pm—6:00 am: 25 dBA*

*6:00am—7:00 am: 30 dBA*

[2] Drilling activities (e.g. drilling, workover, completion activities) undertaken from 10:00 pm – 7:00 am must be temporary and mobile in nature, and must not contribute to long-term background noise creep.

*Schedule E, Table 2—Adjustments to be added to noise levels at sensitive receptors*

| Noise characteristic | Adjustment to noise |
|---|---|
| Tonal characteristic is just audible | + 2 dBA |
| Tonal characteristic is clearly audible | + 5 dBA |
| Impulsive characteristic is detectable | + 2 to + 5 dBA |

Noise 3 Notwithstanding condition (Noise 1), emission of any low frequency noise must not exceed either (Noise 3(a)) and (Noise 3(b)), or (Noise 3(c)) and (Noise 3(d)) in the event of a valid complaint about low frequency noise being made to the administering authority:

(a) 60 dB(C) measured outside the sensitive receptor; and

(b) the difference between the external A-weighted and C-weighted noise levels is no greater than 20 dB; or

(c) 50 dB(Z) measured inside the sensitive receptor; and

(d) the difference between the internal A-weighted and Z-weighted (Max $L_{pZ, 15\ min}$) noise levels is no greater than 15 dB.

E10 Within 12 months of commissioning the units listed in Schedule E, Table 3 – Tipton Expansion Project units, the EA holder must, conduct noise monitoring under worst case noise propagation conditions to validate the pre-commissioning noise predictions at sensitive receptors.

E11 The holder of this environmental authority must provide the administering authority with a report of the monitoring results required under condition (E10) that evaluates the accuracy of the pre-commissioning model predictions at sensitive receptors.

*Schedule E, Table 3 – Tipton Expansion Project units*

| Resource Authority | Field | Facility | Unit Description |
|---|---|---|---|
| PL198 | Tipton | Tipton Central Gas Processing Facility | K-0007 Compressor 7 |
| | | | K-0007 Compressor 8 |
| | | | K-0007 Compressor 9 |
| | | | K-0007 Compressor 10 |
| | | | K-0015 Inlet Fuel Gas Compressor Engine |
| | | Tipton Water Treatment Facility | Generator 1 |
| | | | Generator 2 |
| | | | Generator 3 |
| | | | Generator 4 |

| Resource Authority | Field | Facility | Unit Description |
|---|---|---|---|
| | | | Generator 5 |

Noise 4 A Blast Management Plan must be developed for each blasting activity in accordance with Australian Standard 2187.

Noise 5 Blasting operations must be designed to not exceed an airblast overpressure level of 120 dB (linear peak) at any time, when measured at or extrapolated to any sensitive place.

Noise 6 Blasting operations must be designed to not exceed a ground-borne vibration peak particle velocity of 10mm/s at any time, when measured at or extrapolated to any sensitive place.

## Schedule F – Air

Air 1 Unless venting is authorised under the *Petroleum and Gas (Production and Safety) Act 2004* or the *Petroleum Act 1923*, waste gas must be flared in a manner that complies with all of (Air 1(a)) and (Air 1(b)) and (Air 1(c)), or with (Air 1(d)):

(a) an automatic ignition system is used, and

(b) a flame is visible at all times while the waste gas is being flared, and

(c) there are no visible smoke emissions other than for a total period of no more than 5 minutes in any 2 hours, or

(d) it uses an enclosed flare.

Air 2A A fuel burning or combustion facility must not be operated unless it is listed in *Schedule F, Table 1– Authorised point sources*.

Air 2B If a fuel burning or combustion facility is listed in *Schedule F, Table 1—Authorised point sources*, the fuel burning or combustion facility must be operated so that the releases to air do not exceed the limits specified in *Schedule F, Table 1—Authorised point sources* at the specified release point reference.

Air 3 Point source air monitoring for each fuel burning or combustion facility listed in *Schedule F, Table 1– Authorised point sources* must:

(a) be undertaken:

i. once in the first three months after each facility is first commissioned, and then

ii. annually or biennially thereafter at the frequency specified in *Schedule F, Table 2 – Annual Air Quality Monitoring*

(b) be carried out when the facility the subject of the sampling is operating under maximum operating conditions for the annual period; and

(c) demonstrate compliance with the limits listed in *Schedule F, Table 1– Authorised point sources* at each release point reference.

*Schedule F, Table 1 — Authorised point sources*

| Tenure | Facility | Release Point Reference | Unit Description | Minimum Release Height (m) | Minimum Efflux Velocity (m/sec)[1] | $NO_x$ as Nitrogen Dioxide | Carbon Monoxide |
|---|---|---|---|---|---|---|---|
| | | | | | | Maximum Mass Emission Rate (g/sec)[1] | Maximum Mass Emission Rate (g/sec)[1] |
| PL 230 | Daandine Central Gas Processing Facility | A1 | K-0001 Compressor 1 | 10 | 30 | 3.0 | 5.5 |
| | | A2 | K-0002 Compressor 2 | | | | |
| | | A3 | K-0003 Compressor 3 | | | | |
| | | A4 | K-0004 Compressor 4 | | | | |
| | | A5 | K-0005 Compressor 5 | | | | |
| | | A6 | K-0006 Compressor 6 | | | | |
| | | A7 | K-0007 Compressor 7 | | | | |
| | | A8 | K-9008 Compressor 8 | 17 | 17 | 1.4 | 4.8 |
| | | A9 | K-9009 Compressor 9 | | | | |
| | | A10 | K-9010 Compressor 10 | | | | |
| | | A11 | K-9011 Inlet Fuel Screw Compressor Engine 11 | 8.5 | 30 | 1.5 | 1.0 |
| PL 198 | Tipton West Central Gas Processing Facility | A14 | K-0001 Compressor 1 | 7.6 | 30 | 6.8 | 5.5 |
| | | A15 | K-0002 Compressor 2 | | | | |
| | | A16 | K-0003 Compressor 3 | | | | |
| | | A17 | K-0004 Compressor 4 | | | | |

| Tenure | Facility | Release Point Reference | Unit Description | Minimum Release Height (m) | Minimum Efflux Velocity (m/sec)[1] | $NO_X$ as Nitrogen Dioxide | Carbon Monoxide |
|---|---|---|---|---|---|---|---|
| | | | | | | Maximum Mass Emission Rate (g/sec)[1] | Maximum Mass Emission Rate (g/sec)[1] |
| | | A18 | K-0005 Compressor 5 | | | | |
| | | A19 | K-0006 Compressor 6 | | | | |
| | | A20 | K-0007 Compressor 7 | 17 | 17 | 1.4 | 4.8 |
| | | A21 | K-0008 Compressor 8 | | | | |
| | | A22 | K-0009 Compressor 9 | | | | |
| | | A23 | K-0010 Compressor 10 | | | | |
| | Tipton Water Treatment Facility[2] | A24 | K-0015 Inlet Fuel Gas Compressor Engine | 8.5 | 38 | 1.5 | 1.0 |
| | | A25 | Generator 1 | 7.5 | 27 | 1.5 | 1.5 |
| | | A26 | Generator 2 | | | | |
| | | A27 | Generator 3 | | | | |
| | | A28 | Generator 4 | | | | |
| | | A29 | Generator 5 | | | | |

[1] Minimum efflux velocity, maximum mass emission and maximum concentration limits relate to plant maximum continuous ratings.
[2] The Water Treatment Facility's aggregated fuel consumption exceeds the 500 kg per hour threshold when all five generators are in simultaneous operation.

*Schedule F, Table 2 – Annual Air Quality Monitoring*

| Release Point | Parameter[1] | | Minimum Monitoring Frequency |
|---|---|---|---|
| | Mass emission rate (g/s) | Concentration (mg/Nm$^3$) | |
| A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20, A21, A22, A23, A24, A25[2], A26[2], A27[2], A28[2], A29[2] | oxides of nitrogen (measured as $NO_2$)<br>carbon monoxide | oxides of nitrogen (measured as $NO_2$)<br>carbon monoxide | Biennial from commission |

[1] Measured in flue gas at the 5% oxygen reference level
[2] Biennial monitoring is not required until at least four of the five generators are commissioned.

## Schedule G – Waste

Waste 1 Measures must be implemented so that waste is managed in accordance with the waste and resource management hierarchy and the waste and resource management principles.

Waste 2 Waste, including waste fluids, but excluding waste used in closed-loop systems, must be transported off-site for lawful re-use, remediation, recycling or disposal, unless the waste is specifically authorised by conditions of this environmental authority to be disposed of or used on site.

Waste 3 Waste fluids, other than flare precipitant stored in flare pits, or residual drilling material or drilling fluids stored in sumps, must be contained in either:

(a) an above ground container; or

(b) a structure which contains the wetting front.

Waste 4 Green waste may be used on-site for either rehabilitation or sediment and erosion control, or both.

Waste 5 Vegetation waste may be burned if it relates to a state forest, timber reserve or forest entitlement area administered by the *Forestry Act 1959* and a permit has been obtained under the *Fire and Rescue Service Act 1990*.

Waste 6 Pipeline waste water may be released to land provided that it:

(a) can be demonstrated it meets the acceptable standards for release to land; and

(b) is released in a way that does not result in visible scouring or erosion or pooling or run-off or vegetation die-off.

Waste 7 Produced water may be re-used in drilling and well hole activities.

Waste 8 Produced water may be used for dust suppression provided the following criteria are met:

(a) The amount applied does not exceed the amount required to effectively suppress dust; and

(b) The application:

i. Does not cause on-site ponding or runoff;

ii. Is directly applied to the area being dust suppressed;

iii. Does not harm vegetation surrounding the area being dust suppressed; and

iv. Does not cause visible salting.

Waste 9 Produced water may be used for construction and operation purposes provided the use:

(a) Does not result in negative impacts on the composition and structure of soil or subsoils;

(b) Is not directly or indirectly released to waters;

(c) Does not result in runoff from the construction site; and

(d) Does not harm vegetation surrounding the construction site.

Waste 10 If there is any indication that any of the circumstances in condition (Waste 8)(b)(i) to (Waste 8(b)(iv)) or (Waste 9)(a) to (Waste 9(d)) is occurring, the use must cease immediately and the affected area must be remediated without delay.

Waste 11 Treated sewage effluent or greywater can be released to land provided it:

(a) meets or exceeds secondary treated class B standards for a treatment system with a daily peak design capacity of between 150 EP and 1500 EP; or

(b) meets or exceeds secondary treated class C standards for a treatment system with a daily peak design capacity of less than 150 EP.

Waste 12 The release of treated sewage effluent or greywater authorised in condition (Waste 11) must:

(a) be to a fenced and signed contaminant release area(s);

(b) not result in pooling or run-off or aerosols or spray drift or vegetation die-off;

(c) be to a contaminant release area(s) that is kept vegetated with groundcover, that is:

i. not a pest species;

ii. kept in a viable state for transpiration and nutrient uptake; and

iii. grazed or harvested and removed from the contaminant release area as needed, but not less than every three months.

Waste 13 Notwithstanding condition (Waste 11), treated sewage effluent that meets or exceeds secondary treated class A standards may be used for dust suppression or construction activities, provided the use meets the criteria in condition (Waste 8) or (Waste 9), as relevant to the use.

Waste 14 Sewage pump stations must be fitted with a:

(a) stand-by pump; and

(b) high level alarm to warn of imminent pump station overflow, that operates without mains power or with a back-up power source that starts automatically in the event of a power failure.

Waste 15 If sumps are used to store residual drilling material or drilling fluids, they must only be used for the duration of drilling activities.

Waste 16 Residual drilling material can only be disposed of on-site:

(a) by mix-bury-cover method if the residual drilling material meets the approved quality criteria; or

(b) if it is certified by a suitably qualified third party as being of acceptable quality for disposal to land by the proposed method and that environmental harm will not result from the proposed disposal.

Waste 17 Records must be kept to demonstrate compliance with condition (Waste 15) and (Waste 16).

G12 Coal seam gas water may be transferred to a third party to be used for the following purposes subject to compliance with conditions (G13) and (G14):

(a) dust suppression if the coal seam gas water quality complies with the limits specified in *Schedule G, Table 1 – Water Contaminant Release Limits*;

(b) construction and operational purposes if the coal seam gas water quality complies with the limits specified in *Schedule G, Table 1 – Water Contaminant Release Limits*;

(c) irrigation and livestock watering purposes;

(d) the following industrial purposes:

i. coal washing;

ii. power stations; and

iii. water treatment facilities.

G13 Any coal seam gas water supplied to a third party for irrigation and/or livestock watering purposes in accordance with Condition (G12)(c) must comply with the relevant trigger values contained in ANZECC and ARMCANZ Water Quality Guidelines 2000, or subsequent versions thereof.

*Schedule G, Table 1 – Water Contaminant Release Limits*

| Water Quality Characteristics | Unit | Limit | Limit Type |
|---|---|---|---|
| pH | pH units | 6.0 to 9.0 | Range |

| Water Quality Characteristics | Unit | Limit | Limit Type |
|---|---|---|---|
| Sodium Adsorption Ratio | ratio | 6 | 80th Percentile |
| | | 12 | Maximum |
| Total Dissolved Solids | mg/L | 1500 | Maximum |
| Total Petroleum Hydrocarbons | mg/L | 10 | Maximum |

G14 If the responsibility of coal seam gas water is given or transferred to a third party in accordance with Condition (G12), the holder of environmental authority must ensure that:

(a) the responsibility of the coal seam gas water is given or transferred in accordance with a written agreement (the third party agreement); and

(b) the third party is made aware of the General Environmental Duty under section 319 of the *Environmental Protection Act 1994*.

## Schedule H – Rehabilitation

Rehabilitation 1

A Rehabilitation Plan must be developed by a suitably qualified person and must include the:

(a) rehabilitation goals; and

(b) procedures to be undertaken for rehabilitation that will:

i. achieve the requirements of conditions (Rehabilitation 2) to (Rehabilitation 8), inclusive; and

ii. provide for appropriate monitoring and maintenance.

Rehabilitation 2

Significantly disturbed areas that are no longer required for the on-going petroleum activities, must be rehabilitated within 12 months (unless an exceptional circumstance in the area to be rehabilitated (e.g. a flood event) prevents this timeframe being met) and be maintained to meet the following acceptance criteria:

(a) contaminated land resulting from petroleum activities is remediated and rehabilitated;

(b) the areas are:

i. non-polluting;

ii. a stable landform;

iii. re-profiled to contours consistent with the surrounding landform;

(c) surface drainage lines are re-established;

(d) top soil is reinstated; and

(e) either:

i. groundcover, that is not a pest species, is growing; or

ii. an alternative soil stabilisation methodology that achieves effective stabilisation is implemented and maintained.

Rehabilitation 3

All significantly disturbed areas caused by petroleum activities which are not being or intended to be utilised by the landholder or overlapping tenure holder, must be rehabilitated to meet the following final acceptance criteria measured either against the highest ecological value adjacent land use or the pre-disturbed land use:

(a) greater than or equal to 70% of native ground cover species richness

(b) greater than or equal to the total per cent of ground cover

(c) less than or equal to the per cent species richness of plant pest species; and

(d) where the adjacent land use contains, or the pre-clearing land use contained, one or more regional ecosystem(s), then at least one regional ecosystem(s) from the same broad vegetation group, and with the equivalent biodiversity status or a biodiversity status with a higher conservation value as any of the regional ecosystem(s) in either the adjacent land or pre-disturbed land, must be present.

Rehabilitation 4 — Where significant disturbance to land has occurred in an environmentally sensitive area, the following final rehabilitation criteria as measured against the pre-disturbance biodiversity values assessment (required by conditions (Biodiversity 1) and (Biodiversity 2)) must be met:

(a) greater than or equal to 70% of native ground cover species richness;

(b) greater than or equal to the total per cent ground cover;

(c) less than or equal to the per cent species richness of plant pest species;

(d) greater than or equal to 50% of organic litter cover;

(e) greater than or equal to 50% of total density of coarse woody material; and

(f) all predominant species in the ecologically dominant layer, that define the pre-disturbance regional ecosystem(s) are present.

Rehabilitation 5 — Conditions (Rehabilitation 2), (Rehabilitation 3) and (Rehabilitation 4) continue to apply after this environmental authority has ended or ceased to have effect.

Rehabilitation 8 — Where there is a dam (including a low consequence dam) that is being or intended to be utilised by the landholder or overlapping tenure holder, the dam must be decommissioned to no longer accept inflow from the petroleum activity(ies) and the contained water must be of a quality suitable for the intended on-going uses(s) by the landholder or overlapping tenure holder.

**Schedule I – Definitions**

Words and phrases used throughout this environmental authority are defined below except where identified in the *Environmental Protection Act 1994* or its Regulations and Environmental Protection Policies. Where a word or term is not defined, the ordinary English meaning applies, and regard should be given to the Macquarie Dictionary.

| Word or Phrase | Definition |
|---|---|
| acceptable standards for release to land | means wastewater of the following quality as determined by monitoring results or by characterisation:<br>a) electrical conductivity (EC) not exceeding 3000µS/cm;<br>b) sodium adsorption ratio (SAR) not exceeding 8;<br>c) pH between 6.0 and 9.0;<br>d) heavy metals (measured as total) meets the respective short term trigger value in section 4.2.6, Table 4.2.10—*Heavy metals and metalloids in Australian and New Zealand Guidelines for Fresh and Marine Water Quality;*<br>e) does not contain biocides. |
| acid sulfate soil(s) | means a soil or soil horizon which contains sulfides or an acid soil horizon affected by oxidation of sulfides. |
| adjacent land use(s) | means the ecosystem function adjacent to an area of significant disturbance, or where there is no ecosystem function, the use of the land. An adjacent land use does not include an adjacent area that shows evidence of edge effect. |
| administering authority | means:<br>a) for a matter, the administration and enforcement of which has been devolved to a local government under section 514 of the *Environmental Protection Act 1994*—the local government; or<br>b) for all other matters—the Chief Executive of the Department of Environment and Science; or<br>c) another State Government Department, Authority, Storage Operator, Board or Trust, whose role is to administer provisions under other enacted legislation. |
| alternative arrangement | means a written agreement about the way in which a particular environmental nuisance impact will be dealt with at a sensitive place, and may include an agreed period of time for which the arrangement is in place. An alternative arrangement may include, but is not limited to, a range of nuisance abatement measures to be installed at the sensitive place, or provision of alternative accommodation for the duration of the relevant nuisance impact. |
| analogue site(s) | means an area of land which contains values and characteristics representative of an area to be rehabilitated prior to disturbance. Such values must encompass land use, topographic, soil, vegetation, vegetation community attributes and other ecological characteristics. Analogue sites can be the pre- |

<table>
<tr><th>Word or Phrase</th><th>Definition</th></tr>
<tr><td></td><td>disturbed site of interest where significant surveying effort has been undertaken to establish benchmark parameters.</td></tr>
<tr><td>annual return period</td><td>means the most current 12-month period between two anniversary dates.</td></tr>
<tr><td>appraisal well</td><td>means a petroleum well to test the potential of one (1) or more natural underground reservoirs for producing or storing petroleum. For clarity, an appraisal well does not include an exploration well.</td></tr>
<tr><td>appropriately qualified person / suitably qualified person</td><td>means a person who has professional qualifications, training or skills or experience relevant to the nominated subject matters and can give authoritative assessment, advice and analysis about performance relevant to the subject matters using relevant protocols, standards, methods or literature.</td></tr>
<tr><td>Approved quality criteria</td><td>for the purposes of residual drilling materials, means the residual drilling material meet the following quality standards:<br><br>Part A In all cases:<br><br>
<table>
<tr><th>Parameter</th><th>Maximum concentration</th></tr>
<tr><td>pH</td><td>6 to 10.5 (range)</td></tr>
<tr><td>Electrical Conductivity</td><td>20 dS/m (20,000 µS/cm)</td></tr>
<tr><td>Chloride*</td><td>8000 mg/L</td></tr>
</table>
*Chloride analysis is only required if an additive containing chloride was used in the drilling process The limits in Part A must be measured in the clarified filtrate of oversaturated solids prior to mixing.<br><br>Part B If any of the following metals are a component of the drilling fluids, then for that metal:<br><br>
<table>
<tr><th>Parameter</th><th>Maximum concentration</th></tr>
<tr><td>Arsenic</td><td>20 mg/kg</td></tr>
<tr><td>Selenium</td><td>5 mg/kg</td></tr>
<tr><td>Boron</td><td>100 mg/kg</td></tr>
<tr><td>Cadmium</td><td>3 mg/kg</td></tr>
<tr><td>Chromium (total)</td><td>400 mg/kg</td></tr>
<tr><td>Copper</td><td>100 mg/kg</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Word or Phrase</th><th>Definition</th></tr>
<tr><td></td><td>
<table>
<tr><td>Lead</td><td>600 mg/kg</td></tr>
</table>
<br>The limits in Part B and Part C refer to the post soil/by-product mix.<br><br>Part C If a hydrocarbon sheen is visible, the following hydrocarbon fractions:
<table>
<tr><th>TPH</th><th>Maximum concentration</th></tr>
<tr><td>C6-C10</td><td>170 mg/kg</td></tr>
<tr><td>C10-C16</td><td>150 mg/kg</td></tr>
<tr><td>C16-C34</td><td>1300 mg/kg</td></tr>
<tr><td>C34-C40</td><td>5600 mg/kg</td></tr>
<tr><td>Total polycyclic aromatic hydrocarbons (PAH)</td><td>20 mg/kg</td></tr>
<tr><td>Phenols (halogenated)</td><td>1 mg/kg</td></tr>
<tr><td>Phenols (non-halogenated)</td><td>60 mg/kg</td></tr>
<tr><td>Monocyclic aromatic hydrocarbons (total sum of benzen, toluene, ethyl benzene, xylenes (includes ortho, para, and meta xylenes) and styrene)</td><td>7 mg/kg</td></tr>
<tr><td>Benzene</td><td>1 mg/kg</td></tr>
</table>
</td></tr>
<tr><td>areas of pre-existing disturbance</td><td>means areas where environmental values have been negatively impacted as a result of anthropogenic activity and these impacts are still evident. Areas of pre-disturbance may include areas where legal clearing, logging, timber harvesting, or grazing activities have previously occurred, where high densities of weed or pest species are present which have inhibited re-colonisation of native regrowth, or where there is existing infrastructure (regardless of whether the infrastructure is associated with the authorised petroleum activities). The term ‘areas of pre-disturbance’ does not include areas that have been impacted by wildfire/s, controlled burning, flood or natural vegetation die-back.</td></tr>
<tr><td>associated water</td><td>means underground water taken or interfered with, if the taking or interference happens during the course of, or results from, the carrying out of another authorised activity under a petroleum authority, such as a petroleum well, and</td></tr>
</table>

| Word or Phrase | Definition |
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| | includes waters also known as produced formation water. The term includes all contaminants suspended or dissolved within the water. |
| associated works | in relation to a dam, means:<br>• operations of any kind and all things constructed, erected or installed for that dam; and<br>• any land used for those operations. |
| Australian Standard 3580 | means any of the following publications:<br>• AS3580.10.1 Methods for sampling and analysis of ambient air—Determination of particulate matter—Deposited matter—Gravimetric method.<br>• AS3580.9.6 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter—PM10 high volume sampler with size-selective inlet— Gravimetric method<br>• AS3580.9.9 Methods for sampling and analysis of ambient air—Determination of suspended particulate matter— PM10 low volume sampler—Gravimetric sampler. |
| background noise level | means the sound pressure level, measured in the absence of the noise under investigation, as the $L_{A90,T}$ being the A-weighted sound pressure level exceeded for 90% of the measurement time period T of not less than 15 minutes (or $L_{A\ 90,\ adj,\ 15\ mins}$), using Fast response. |
| bankfull | means the channel flow rate that exists when the water is at the elevation of the channel bank above which water begins to spill out onto the floodplain. The term describes the condition of the channel relative to its banks (e.g. overbank, in-bank, bankfull, low banks, high bank). |
| bed | of any waters, has the meaning in Schedule 12 of the *Environmental Protection Regulation 2008* and—<br>a) includes an area covered, permanently or intermittently, by tidal or non-tidal waters; but<br>b) does not include land adjoining or adjacent to the bed that is from time to time covered by floodwater. |
| being or intended to be utilised by the landholder or overlapping tenure holder | for significantly disturbed land, means there is a written agreement (e.g. land and compensation agreement) between the landholder or the overlapping tenure holder and the holder of the environmental authority identifying that the landholder or the overlapping tenure holder has a preferred use of the land such that rehabilitation standards for revegetation by the holder of the environmental authority are not required. For dams, means there is a written agreement (e.g. land and compensation agreement) between the landholder or the overlapping tenure holder and the holder of the environmental authority identifying that the landholder or the overlapping tenure holder has a preferred use for the dam such that rehabilitation standards for revegetation by the holder of the environmental authority are not required. |

| Word or Phrase | Definition |
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| biodiversity values | for the purposes of this environmental authority, means environmentally sensitive areas, prescribed environmental matters and wetlands. |
| BTEX | means benzene, toluene, ethylbenzene, ortho-xylene, para-xylene, meta-xylene and total xylene. |
| Category A Environmentally Sensitive Area | means any area listed in Schedule 19, Section 3 of the Environmental Protection Regulation 2019. |
| Category B Environmentally Sensitive Area | means any area listed in Schedule 19, Section 3 of the Environmental Protection Regulation 2019. |
| Category C Environmentally Sensitive Area | means any of the following areas:<br>• nature refuges as defined in the conservation agreement for that refuge under the Nature Conservation Act 1992<br>• koala habitat areas as defined under the Nature Conservation (Koala) Conservation Plan 2006<br>• state forests or timber reserves as defined under the Forestry Act 1959<br>• regional parks (previously known as resource reserves) under the Nature Conservation Act 1992<br>• an area validated as 'essential habitat' from ground-truthing surveys in accordance with the Vegetation Management Act 1999 for a species of wildlife listed as endangered or vulnerable under the Nature Conservation Act 1992<br>• 'of concern regional ecosystems' that are remnant vegetation and identified in the database called 'RE description database' containing regional ecosystem numbers and descriptions. |
| certified or certification | in relation to any matter other than a design plan, 'as constructed' drawings or an annual report regarding dams means, a Statutory Declaration by a suitably qualified person or suitably qualified third party accompanying the written document stating:<br>• the person's qualifications and experience relevant to the function<br>• that the person has not knowingly included false, misleading or incomplete information in the document<br>• that the person has not knowingly failed to reveal any relevant information or document to the administering authority<br>• that the document addresses the relevant matters for the function and is factually correct; and<br>• that the opinions expressed in the document are honestly and reasonably held. |

| Word or Phrase | Definition |
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| clearing | has the meaning in the dictionary of the *Vegetation Management Act 2000* and for vegetation—<br>a) means remove, cut down, ringbark, push over, poison or destroy in any way including by burning, flooding or draining; but<br>b) does not include destroying standing vegetation by stock, or lopping a tree. |
| closed-loop systems | means using waste on site in a way that does not release waste or contaminants in the waste to the environment. |
| coal seam gas water | means underground water brought to the surface of the earth, or moved underground in connection with exploring for, or producing coal seam gas. |
| control measure | has the meaning in section 47 of the *Environmental Protection Regulation 2008* and means a device, equipment, structure, or management strategy used to prevent or control the release of a contaminant or waste to the environment. |
| critically limited regional ecosystem | means the regional ecosystems defined and listed in Appendix 5 of the Queensland Biodiversity Offset Policy. |
| daily peak design capacity | for sewage treatment works, has the meaning in Schedule 2, section 63(4) of the *Environmental Protection Regulation 2008* as the higher equivalent person (EP) for the works calculated using each of the formulae found in the definition for EP. |
| dam(s) | means a land-based structure or a void that contains, diverts or controls flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works. |
| design storage allowance or DSA | means an available volume, estimated in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/19337)*, published by the administering authority, as amended from time to time, that must be provided in a dam to an annual exceedance probability specified in that Manual. |
| designated precinct | has the meaning in Part 5 section 15(3) of the *Regional Planning Interests Regulation 2014* and means:<br>• for a strategic environmental area mentioned in section 4(1) – the area identified as a designated precinct on the strategic environmental area map for the strategic environmental are; or<br>• if a strategic environmental area is shown on a map in a regional plan – the area identified on the map as a designated precinct for the strategic environmental area |
| development wells | means a petroleum well which produces or stores petroleum. For clarity, a development well does not include an appraisal well. |

| Word or Phrase | Definition |
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| document | has the meaning in the *Acts Interpretation Act 1954* and means:<br>• any paper or other material on which there is writing; and<br>• any paper or other material on which there are marks; and<br>• figures, symbols or perforations having a meaning for a person qualified to interpret them; and<br>• any disc, tape or other article or any material from which sounds, images, writings or messages are capable of being produced or reproduced (with or without the aid of another article or device). |
| ecologically dominant layer | has the meaning in the *Methodology for Surveying and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Version 5.1 March 2020) and means the layer making the greatest contribution to the overall biomass of the site and the vegetation community (National Land and Water Resources Audit 2001). This is also referred to as the ecologically dominant stratum or the predominant canopy in woody ecosystems. |
| ecosystem function | means the interactions between and within living and nonliving components of an ecosystem and generally correlates with the size, shape and location of the vegetation community. |
| enclosed flare | means a device where the residual gas is burned in a cylindrical or rectilinear enclosure that includes a burning system and a damper where air for the combustion reaction is admitted. |
| environmental harm | has the meaning in section 14 of the *Environmental Protection Act 1994* and means any adverse effect, or potential adverse effect (whether temporary or permanent and of whatever magnitude, duration or frequency) on an environmental value, and includes environmental nuisance. Environmental harm may be caused by an activity—<br>a) whether the harm is a direct or indirect result of the activity; or<br>b) whether the harm results from the activity alone or from the combined effects of the activity and other activities or factors. |
| environmental nuisance | has the meaning in section 15 of the *Environmental Protection Act 1994* and means unreasonable interference or likely interference with an environmental value caused by—<br>a) aerosols, fumes, light, noise, odour, particles or smoke; or<br>b) an unhealthy, offensive or unsightly condition because of contamination; or<br>c) another way prescribed by regulation. |
| environmental offset | has the meaning in section 7 of the *Environmental Offsets Act 2014.* |
| environmentally sensitive area | means Category A, B or C environmentally sensitive areas (ESAs) |
| equivalent person or EP | has the meaning under section 3 of the *Planning Guidelines For Water Supply and Sewerage*, 2005, published by the Queensland Government. It is |

| Word or Phrase | Definition |
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| | calculated in accordance with Schedule 2, Section 63(4) of the *Environmental Protection Regulation 2008* where:<br>• EP = V/200 where V is the volume, in litres, of the average dry weather flow of sewage that can be treated at the works in a day; or<br>• EP = M/2.5 where M is the mass, in grams, of phosphorus in the influent that the works are designed to treat as the inlet load in a day. |
| essential petroleum activities | means activities that are essential to bringing the resource to the surface and are only the following:<br>• low impact petroleum activities<br>• geophysical, geotechnical, geological, topographic and cadastral surveys (including seismic, sample / test / geotechnical pits, core holes)<br>• single well sites not exceeding 1 hectare disturbance and multi-well sites not exceeding 1.5 hectare disturbance<br>• well sites with monitoring equipment (including monitoring bores):<br>  ○ for single well sites, not exceeding 1.25 hectares disturbance<br>  ○ for multi-well sites, not exceeding 1.75 hectares disturbance<br>• well sites with monitoring equipment (including monitoring bores) and tanks (minimum 1 ML) for above ground fluid storage:<br>  ○ for single well sites, not exceeding 1.5 hectares disturbance<br>  ○ for multi-well sites, not exceeding 2.0 hectares disturbance<br>• well sites with slope considerations (>2% slope) for cut and fill earthworks and drainage:<br>  ○ for single well sites, not exceeding 1.5 hectares disturbance<br>  ○ for multi-well sites, not exceeding 2.5 hectares disturbance<br>• swell sites including a Communications Tower:<br>  ○ for single well sites, not exceeding 1.5 hectare disturbance<br>  ○ for multi-well sites, not exceeding 3.0 hectare disturbance<br>• associated infrastructure located on a well site necessary for the construction and operations of wells:<br>  ○ water pumps and generators<br>  ○ flare pits<br>  ○ chemical / fuel storages<br>  ○ sumps for residual drilling material and drilling fluids<br>  ○ tanks, or dams which are not significant or high consequence dams to contain wastewater (e.g. stimulation flow back waters, produced water)<br>  ○ pipe laydown areas<br>  ○ soil and vegetation stockpile areas<br>  ○ a temporary camp associated with a drilling rig that may involve sewage treatment works that are no release works<br>  ○ temporary administration sites and warehouses |

| Word or Phrase | Definition |
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| | ○ dust suppression activities using water that meets the quality and operational standards approved under the environmental authority<br>• communication and power lines that are necessary for the undertaking of petroleum activities and that are located within well sites, well pads and pipeline right of ways without increasing the disturbance area of petroleum activities<br>• on site disposal of residual drilling material as per condition (Waste 16)<br>• communications towers, not exceeding 1.0 hectares disturbance<br>• supporting access tracks<br>• gathering / flow pipelines from a well head to the initial compression facility<br>• activities necessary to achieve compliance with the conditions of the environmental authority in relation to another essential petroleum activity (e.g. sediment and erosion control measures, rehabilitation). |
| existing authority | has the meaning in section 94 of the *Environmental Offsets Act 2014.* |
| exploration well | means a petroleum well that is drilled to:<br>• explore for the presence of petroleum or natural underground reservoirs suitable for storing petroleum; or<br>• obtain stratigraphic information for the purpose of exploring for petroleum.<br>For clarity, an exploration well does not include an appraisal or development well. |
| flare pit | has the meaning in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/19338*), and means containment area where any hydrocarbon that is discovered in an over-pressured reservoir during a drilling operation is diverted to, and combusted, The flare pit is only used during the drilling and work over process on a petroleum well. |
| flare precipitant | means waste fluids which result from the operation of a flare. |
| floodplains | has the meaning in the *Water Act 2000* and means an area of reasonably flat land adjacent to a watercourse that—<br>• is covered from time to time by floodwater overflowing from the watercourse; and<br>• does not, other than in an upper valley reach, confine floodwater to generally follow the path of the watercourse; and<br>• has finer sediment deposits than the sediment deposits of any bench, bar or in-stream island of the watercourse. |
| flowable substance | means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can |

| Word or Phrase | Definition |
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| | include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension. |
| fuel burning or combustion facility | means a permanent fuel burning or combustion equipment which in isolation, or combined in operation, or which are interconnected, is, or are capable of burning more than 500 kg of fuel in an hour. |
| GDA | means Geocentric Datum of Australia. |
| Great Artesian Basin (GAB) spring | means an area protected under the *Environment Protection and Biodiversity Conservation Act 1999* because it is considered to be a Matter of National Environmental Significance and identified as a:<br>• community of native species dependent on natural discharge of groundwater from the Great Artesian Basin; or<br>• Great Artesian Basin spring; or<br>• Great Artesian Basin discharge spring wetland.<br>A GAB spring includes a spring vent, spring complex or watercourse spring and includes the land to which water rises naturally from below the ground and the land over which the water then flows.<br>*Note: The Australian Government's Protected Matters Search Tool should be used to get an indication of whether the area of interest may contain an MNES spring.*<br>*Note: The GAB springs dataset can be requested from the Queensland Government Herbarium* |
| green waste | means waste that is grass cuttings, trees, bushes, shrubs, material lopped from trees, untreated timber or other waste that is similar in nature but does not include pest species. |
| greywater | means wastewater generated from domestic activities such as laundry, dishwashing, and bathing. Greywater does not include sewage. |
| groundwater dependent ecosystem (GDE) | means ecosystems which require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services.<br>For the purposes of the environmental authority, groundwater dependent ecosystems do not include those mapped as "unknown". |
| growing | means to increase by natural development, as any living organism or part thereof by assimilation of nutriment; increase in size or substance. |

| Word or Phrase | Definition |
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| hydraulic integrity | refers to the capacity of a dam to contain or safely pass flowable substances based on its design. |
| impulsive (for noise) | means sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the background sound pressure. The duration of a single impulsive sound is usually less than one second. |
| LA 90, adj, 15 mins | means the A-weighted sound pressure level, adjusted for tonal character that is equal to or exceeded for 90% of any 15 minutes sample period equal, using Fast response. |
| LAeq, adj, 15 mins | means an A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 15 minute period has the same square sound pressure as a sound level that varies with time. |
| land degradation | has the meaning in the *Vegetation Management Act 1999* and means the following:<br>• soil erosion<br>• rising water tables<br>• the expression of salinity<br>• mass movement by gravity of soil or rock<br>• stream bank instability<br>• a process that results in declining water quality. |
| landholder's active groundwater bore | means bores that are able to continue to provide a reasonable yield of water in terms of quantity for the bores authorised purpose or use. This term does not include monitoring bores owned by the administering authority of the *Water Act 2000*. |
| linear infrastructure | means powerlines, pipelines, roads and access tracks. |
| liquid | means a substance which is flowing and offers no permanent resistance to changes of shape. |
| long term noise event | means a noise exposure, when perceived at a sensitive receptor, persists for a period of greater than five (5) days, even when there are respite periods when the noise is inaudible within those five (5) days. |
| low consequence dam | means any dam that is not classified as high or significant as assessed using the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*, published by the administering authority, as amended from time to time. |
| low impact petroleum activities | means petroleum activities which do not result in the clearing of native vegetation, cause disruption to soil profiles through earthworks or excavation or result in significant disturbance to land which cannot be rehabilitated immediately using hand tools after the activity is completed. Examples of such activities include but are not necessarily limited to soil surveys (excluding test |

| Word or Phrase | Definition |
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| | pits), topographic surveys, cadastral surveys and ecological surveys, may include installation of monitoring equipment provided that it is within the meaning of low impact and traversing land by car or foot via existing access tracks or routes or in such a way that does not result in permanent damage to vegetation. |
| Map of referable wetlands | has the meaning in Schedule 12 of the *Environmental Protection Regulation 2008* and means the 'Map of referable wetlands', a document approved by the chief executive on 4 November 2011 and published by the department, as amended from time to time by the chief executive under section 144D. |
| Max $L_{pA, 15\ min}$ | means the absolute maximum instantaneous A-weighted sound pressure level, measured over 15 minutes. |
| Max $L_{pZ, 15\ min}$ | means the maximum value of the Z-weighted sound pressure level measured over 15 minutes. |
| maximum extent of impact | means the total, cumulative, residual extent and duration of impact to a prescribed environmental matter that will occur over a project's life after all reasonable avoidance and reasonable on-site mitigation measures have been, or will be, undertaken. |
| medium term noise event | is a noise exposure, when perceived at a sensitive receptor, persists for an aggregate period not greater than five days and does not re-occur for a period of at least four weeks. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a difference source or source location. |
| methodology | means the science of method, especially dealing with the logical principles underlying the organisation of the various special sciences, and the conduct of scientific inquiry. |
| mix-bury-cover method | means the stabilisation of residual drilling solids in the bottom of a sump by mixing with subsoil and which occurs in accordance with the following methodology:<br>- the base of the subsoil and residual solid mixture must be separated from the groundwater table by at least one metre of a continuous layer of impermeable subsoil material (kw=10-8m/s) or subsoil with a clay content of greater than 20 percent; and<br>- the residual solids is mixed with subsoil in the sump and cover; and<br>- the subsoil and residual solids is mixed at least three parts subsoil to one part waste (v/v); and<br>- a minimum of one metre of clean subsoil must be placed over the subsoil and residual solids mixture; and<br>- topsoil is replaced. |

| Word or Phrase | Definition |
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| month | has the meaning in the *Acts Interpretation Act 1954* and means a calendar month and is a period starting at the beginning of any day of one (1) of the 12 named months and ending—<br>• immediately before the beginning of the corresponding day of the next named month; or<br>• if there is no such corresponding day—at the end of the next named month. |
| NATA accreditation | means accreditation by the National Association of Testing Authorities Australia. |
| notice of election | has the meaning in section 18(2) *Environmental Offsets Act 2014.* |
| pest | Means a plant or animal, other than a native species of plant or animal, that is –<br>a) an ***Invasive biosecurity matter*** under the *Biosecurity Act 2014**<br>b) a Controlled biosecurity matter or regulated biosecurity matter under the *Biosecurity Act 2014* or<br>c) a Locally significant invasive species declared under *Local Government Act 2009* as local law.<br>*See Biosecurity Act 2014, schedule 1, part 3 or 4 or schedule 2, part 2. See also the notes to the Biosecurity Act 2014, schedules 1 and 2.<br>***Invasive biosecurity matter*** is defined to include invasive plants and animals as listed as prohibited and restricted matter in schedules 1 and 2 of the *Biosecurity Act 2014*. |
| pipeline waste water | means hydrostatic testing water, flush water or water from low point drains. |
| pre-disturbed land use | means the function or use of the land as documented prior to significant disturbance occurring at that location. |
| predominant species | has the meaning in the *Methodology for Surveying and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Version 5.1 March 2020) and means a species that contributes most to the overall above-ground biomass of a particular stratum |
| prescribed contaminants | has the meaning in section 440ZD of the *Environmental Protection Act 1994*. |
| prescribed environmental matters | has the meaning in section 10 of the *Environmental Offsets Act 2014*, limited to the matters of State environmental significant listed in schedule 2 of the *Environmental Offsets Regulation 2014*. |

| Word or Phrase | Definition |
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| primary protection zone | means an area within 200m from the boundary of any Category A, B or C ESA. |
| produced water | has the meaning in Section 15A of the *Petroleum and Gas (Production and Safety) Act 2004* and means CSG water or associated water for a petroleum tenure. |
| protection zone | means the primary protection zone of any Category A, B or C ESA or the secondary protection zone of any Category A or B ESA. |
| regional ecosystem | has the meaning in the *Methodology for Surveying and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Version 5.1 March 2020) and means a vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil. Regional ecosystems of Queensland were originally described in Sattler and Williams (1999). The *Regional Ecosystem Description Database* (Queensland Herbarium 2013) is maintained by Queensland Herbarium and contains the current descriptions of regional ecosystems. |
| regulated dam | means any dam in the significant or high consequence category as assessed using the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/19339)*, published by the administering authority, as amended from time to time. |
| rehabilitation or rehabilitated | means the process of reshaping and revegetating land to restore it to a stable landform and in accordance with acceptance criteria and, where relevant, includes remediation of contaminated land. For the purposes of pipeline rehabilitation, rehabilitation includes reinstatement, revegetation and restoration |
| reinstate or reinstatement | for pipelines, means the process of bulk earth works and structural replacement of pre-existing conditions of a site (i.e. soil surface typography, watercourses, culverts, fences and gates and other landscape(d) features) and is detailed in the *Australian Pipeline Industry Association (APIA) Code of Environmental Practice: Onshore Pipelines* (2013). |
| reporting limit | means the lowest concentration that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions. For many analytes, the reporting limit is selected as the lowest non-zero standard in the calibration curve. Results that fall below the reporting limit will be reported as “less than” the value of the reporting limit. The reporting limit is also referred to as the practical quantitation limit or the limit of quantitation. For polycyclic aromatic hydrocarbons, the reporting limit must be based on super-ultra trace methods and, depending on the specific polycyclic aromatic hydrocarbon, will range between 0.005 µg/L–0.020 µg/L. |

| Word or Phrase | Definition |
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| residual drilling material | means waste drilling materials including muds and cuttings or cement returns from well holes and which have been left behind after the drilling fluids are pumped out. |
| restoration | means the replacement of structural habitat complexity, ecosystem processes, services and function from a disturbed or degraded site to that of a pre-determined or analogue site. For the purposes of pipelines, restoration applies to final rehabilitation after pipeline decommissioning. |
| restricted stimulation fluids | has the meaning in section 206 of the *Environmental Protection Act 1994* and means fluids used for the purpose of stimulation, including fracturing, that contain the following chemicals in more than the maximum amount prescribed under a regulation—<br>a) petroleum hydrocarbons containing benzene, ethylbenzene, toluene or xylene<br>b) chemicals that produce, or are likely to produce, benzene, ethylbenzene, toluene or xylene as the chemical breaks down in the environment. |
| revegetation or revegetating or revegetate | means to actively re-establish vegetation through seeding or planting techniques in accordance with site specific management plans. |
| secondary protection zone | in relation to a Category A or Category B ESA means an area within 100 metres from the boundary of the primary protection zone. |
| secondary treated class A standards | means treated sewage effluent or greywater which meets the following standards:<br>• total phosphorous as P, maximum 20mg/L<br>• total nitrogen as N, maximum 30mg/L<br>• 5-day biochemical oxygen demand (inhibited) (e.g. release pipe from sewage treatment plant), maximum 20mg/L<br>• suspended solids, maximum 30mg/L<br>• pH, range 6.0 to 8.5<br>• e-coli, 80$^{th}$ percentile based on at least 5 samples with not less than 30 minutes between samples, 100cfu per 100mL, maximum 1000cfu per 100mL. |
| secondary treated class B standards | means treated sewage effluent or greywater which meets the following standards:<br>• total phosphorous as P, maximum 20mg/L<br>• total nitrogen as N, maximum 30mg/L<br>• 5-day biochemical oxygen demand (inhibited) (e.g. release pipe from sewage treatment plant), maximum 20mg/L<br>• suspended solids, maximum 30mg/L<br>• pH, range 6.0 to 8.5 |

| Word or Phrase | Definition |
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| | • e-coli, 80th percentile based on at least 5 samples with not less than 30 minutes between samples, 1000cfu per 100mL, maximum 10000cfu per 100mL. |
| secondary treated class C standards | means treated sewage effluent or greywater which meets the following standards:<br>• total phosphorous as P, maximum 20mg/L<br>• total nitrogen as N, maximum 30mg/L<br>• 5-day biochemical oxygen demand (inhibited) (e.g. Release pipe from sewage treatment plant), maximum 20mg/L<br>• suspended solids, maximum 30mg/L<br>• pH, range 6.0 to 8.5<br>• e-coli, 80th percentile based on at least 5 samples with not less than 30 minutes between samples, 10 000cfu per 100mL, maximum 100000cfu per 100mL. |
| sensitive place | means:<br>• a dwelling (including residential allotment, mobile home or caravan park, residential marina or other residential premises, motel, hotel or hostel)<br>• a library, childcare centre, kindergarten, school, university or other educational institution<br>• a medical centre, surgery or hospital<br>• a protected area<br>• a public park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment<br>• a work place used as an office or for business or commercial purposes, which is not part of the petroleum activity(ies) and does not include employees accommodation or public roads<br>• for noise, a place defined as a sensitive receptor for the purposes of the *Environmental Protection (Noise) Policy 2008*. |
| sensitive receptor | is defined in Schedule 2 of the *Environmental Protection (Noise) Policy 2008*, and means an area or place where noise is measured. |
| short term noise event | is a noise exposure, when perceived at a sensitive receptor, persists for an aggregate period not greater than eight hours and does not re-occur for a period of at least seven (7) days. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or source location. |
| significant residual impact | has the meaning in section 8 *Environmental Offsets Act 2014.* |

| Word or Phrase | Definition |
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| significantly disturbed<br>or<br>significant disturbance<br>or<br>significant disturbance to land or areas | has the meaning in Schedule 12, section 4 of the *Environmental Protection Regulation 2008*. Land is significantly disturbed if—<br>(a) it is contaminated land; or<br>(b) it has been disturbed and human intervention is needed to rehabilitate it—<br>I. to a condition required under the relevant environmental authority; or<br>II. if the environmental authority does not require the land to be rehabilitated to a particular condition—to the condition it was in immediately before the disturbance. |
| species richness | means the number of different species in a given area. |
| stable | has the meaning in Schedule 5 of the *Environmental Protection Regulation 2008* and, for a site, means the rehabilitation and restoration of the site is enduring or permanent so that the site is unlikely to collapse, erode or subside. |
| statement of compliance | for a condition in an environmental authority has the meaning in section 208 of the *Environmental Protection Act 1994* and is a condition that requires the holder to give the administering authority a statement of compliance about a document or work relating to a relevant activity. The condition must also state—<br>(a) the criteria (the compliance criteria) the document or work must comply with; and<br>(b) that the statement of compliance must state whether the document or work complies with the compliance criteria; and<br>(c) the information (the supporting information) that must be provided to the administering authority to demonstrate compliance with the compliance criteria; and<br>(d) when the statement of compliance and supporting information must be given to the administering authority. |
| stimulation | means a technique used to increase the permeability of natural underground reservoir that is undertaken above the formation pressure and involves the addition of chemicals. It includes hydraulic fracturing / hydrofraccing, fracture acidizing and the use of proppant treatments. |
| stimulation fluid | means the fluid injected underground to increase permeability. For clarity, the term stimulation fluid only applies to fluid injected down well post-perforation. |
| stimulation impact zone | means a 100m maximum radial distance from the stimulation target location within a gas producing formation. |
| strategic environmental area | has the meaning in section 11(1) of the *Regional Planning Interest Act 2014*. |
| structure | means dam or levee. |

| Word or Phrase | Definition |
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| subterranean cave GDE | • means an area identified as a subterranean cave in the mapping produced by the Queensland Government and identified in the Queensland Government Information System, as amended from time to time; and<br>• means a cave ecosystem which requires access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain its communities of plants and animals, ecological processes and ecosystem services. Subterranean cave GDEs are caves dependent on the subterranean presence of groundwater. Subterranean cave GDEs have some degree of groundwater connectivity and are indicated by either high moisture levels or the presence of stygofauna, or both, referred to in the Queensland Government WetlandsInfo mapping program, as amended from time to time.<br><br>*Note: the Subterranean GDE (caves) dataset can be displayed through the Queensland Government WetlandInfo mapping program.*<br><br>*Note: the Subterranean GDE (caves) dataset can be obtained from the Queensland Government Information System.* |
| suitably qualified third party | means a person who:<br>(a) has qualifications and experience relevant to performing the function including but not limited to:<br>i. a bachelor's degree in science or engineering; and<br>ii. 3 years' experience in undertaking soil contamination assessments; and<br>(b) is a member of at least one organisation prescribed in Schedule 8 of the *Environmental Protection Regulation 2008*; and<br>not be an employee of, nor have a financial interest or any involvement which would lead to a conflict of interest with the holder(s) of the environmental authority. |
| sump | means a pit in which waste residual drilling material or drilling fluids are stored only for the duration of drilling activities. |
| synthetic based drilling mud | means a mud where the base fluid is a synthetic oil, consisting of chemical compounds which are artificially made or synthesised by chemically modifying petroleum components or other raw materials rather than the whole crude oil. |
| top soil | means the surface (top) layer of a soil profile, which is more fertile, darker in colour, better structured and supports greater biological activity than underlying layers. The surface layer may vary in depth depending on soil forming factors, |

| Word or Phrase | Definition |
|---|---|
| | including parent material, location and slope, but generally is not greater than about 300mm in depth from the natural surface. |
| total density of coarse woody material | means the total length of logs on the ground greater than or equal to 10cm diameter per hectare and number of logs on the ground greater than or equal to 10cm diameter per hectare. |
| valid complaint | means all complaints unless considered by the administering authority to be frivolous, vexatious or based on mistaken belief. |
| void | means any constructed, open excavation in the ground. |
| waste and resource management hierarchy | has the meaning provided in section 9 of the *Waste Reduction and Recycling Act 2011* and is the following precepts, listed in the preferred order in which waste and resource management options should be considered—<br>a) AVOID unnecessary resource consumption<br>b) REDUCE waste generation and disposal<br>c) RE-USE waste resources without further manufacturing<br>d) RECYCLE waste resources to make the same or different products<br>e) RECOVER waste resources, including the recovery of energy<br>f) TREAT waste before disposal, including reducing the hazardous nature of waste<br>g) DISPOSE of waste only if there is no viable alternative. |
| waste and resource management principles | has the meaning provided in section 4(2)(b) of the *Waste Reduction and Recycling Act 2011* and means the:<br>a) polluter pays principle<br>b) user pays principle<br>c) proximity principle<br>d) product stewardship principle. |
| waste fluids | has the meaning in section 13 of the Environmental Protection Act 1994 in conjunction with the common meaning of “fluid” which is “a substance which is capable of flowing and offers no permanent resistance to changes of shape”. Accordingly, to be a waste fluid, the waste must be a substance which is capable of flowing and offers no permanent resistance to changes of shape. |
| watercourse | has the meaning in Schedule 4 of the *Environmental Protection Act 1994* and means:<br>a) a river, creek or stream in which water flows permanently or intermittently—<br>i. in a natural channel, whether artificially improved or not; or<br>ii. in an artificial channel that has changed the course of the watercourse.<br>b) Watercourse includes the bed and banks and any other element of a river, creek or stream confining or containing water. |

| Word or Phrase | Definition |
|---|---|
| waters | includes all or any part of a creek, river, stream, lake, lagoon, swamp, wetland, spring, unconfined surface water, unconfined water in natural or artificial watercourses, bed and bank of any waters, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and underground water. |
| well integrity | the ability of a well to contain the substances flowing through it. |
| wetland | for the purpose of this environmental authority, wetland means:<br>• areas shown on the Map of referable wetlands which is a document approved by the chief executive on 4 November 2011 and published by the department, as amended from time to time by the chief executive under section 144D of the *Environmental Protection Regulation 2008*; and<br>• areas defined under the Queensland Wetlands Program as permanent or periodic / intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six (6) metres, and possess one or more of the following attributes:<br>o at least periodically, the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their life cycle, or<br>o the substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers, or<br>o the substratum is not soil and is saturated with water, or covered by water at some time.<br>The term wetland includes riverine, lacustrine, estuarine, marine and palustrine wetlands; and it does not include a Great Artesian Basin Spring or a subterranean wetland that is a cave or aquifer. |
| wetland of high ecological significance | means a wetland that meets the definition of a wetland and that is shown as a wetland of 'high ecological significance' or wetland of 'high ecological value' on the Map of referable wetlands. |
| wetland of other environmental value | means a wetland that meets the definition of a wetland and that is shown as a wetland of 'general environmental significance' or wetland of 'other environmental value' on the Map of referable wetlands. |

**END OF PERMIT**

Australian Government
Department of Agriculture, Water and the Environment

# VARIATION OF CONDITIONS ATTACHED TO APPROVAL

Surat Gas Expansion Project (EPBC 2010/5344)

This decision to vary conditions of approval is made under section 143 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

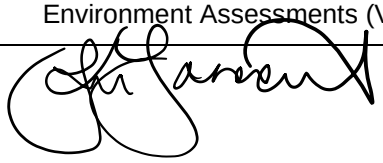
## Approved action

| | |
|---|---|
| **Approval holder** | Arrow Energy Pty Ltd<br><br>ABN: 73 078 521 936 |
| **Approved action** | To expand coal seam gas operations in the Surat Basin, Queensland, as described in the referral received under the EPBC Act on 2 February 2010; and as described in the Surat Gas Project Environmental Impact Statement (March 2012) and Supplementary Report to the Environmental Impact Statement (June 2013). |

## Variation

| | |
|---|---|
| **Variation of conditions attached to approval** | The variation is:<br><br>Delete conditions 5 and 6 attached to the approval and substitute with conditions 5 and 6 specified in the table below. |
| **Date of effect** | This variation has effect on the date the instrument is signed |

## Person authorised to make decision

| | |
|---|---|
| **Name and position** | Kim Farrant<br>Assistant Secretary<br>Environment Assessments (Vic, Tas) and Post Approvals Branch |
| **Signature** |  |
| **Date of decision** | 29 March 2022 |

<table>
<tr><th>Date of decision</th><th>Conditions attached to approval</th></tr>
<tr><td>Original dated 19/12/2013</td><td>1. The Minister may determine that a plan, strategy or program approved by the Queensland Government satisfies a plan required under these conditions.</td></tr>
<tr><td>Original dated 19/12/2013</td><td><u>Disturbance Limits</u><br>2. For the purpose of the action, the approval holder must not take any action outside the project area.</td></tr>
<tr><td>Original dated 19/12/2013</td><td>3. The action is limited to a maximum of 6,500 coal seam gas production wells and associated infrastructure.</td></tr>
<tr><td>Original dated 19/12/2013</td><td>4. The approval holder must not undertake hydraulic fracturing.</td></tr>
<tr><td>As varied on the date this instrument was signed</td><td>5. To protect EPBC listed species and EPBC communities within the project area the maximum disturbance limits in Table 1 apply to the project. The approval holder must not exceed these disturbance limits.<br>Table 1: Whole of project maximum disturbance limits
<table>
<tr><th>Terrestrial species</th><th>Maximum disturbance (hectares) to core habitat</th></tr>
<tr><td>Curly-bark Wattle, Acacia curranii</td><td>1210</td></tr>
<tr><td>Hando’s Wattle, Acacia handonis</td><td>1210</td></tr>
<tr><td>Belson’s Panic, Homopholis belsonii</td><td>140</td></tr>
<tr><td>Prostanthera sp Dunmore</td><td>380</td></tr>
<tr><td>Small-leaved Denhamia, Denhamia parvifolia</td><td>50</td></tr>
<tr><td>Calytrix gurulmundensis</td><td>1210</td></tr>
<tr><td>Ooline, Cadellia pentastylis</td><td>No disturbance</td></tr>
<tr><td>Austral Toadflax, Thesium australe</td><td>160</td></tr>
<tr><td>Acacia lauta</td><td>990</td></tr>
<tr><td>Xerothamnella herbacea</td><td>110</td></tr>
<tr><td>Hawkweed, Picris evae</td><td>120</td></tr>
<tr><td>Austral Cornflower, Rhaponticum australe</td><td>160</td></tr>
<tr><td>Eucalyptus virens</td><td>170</td></tr>
<tr><td>King Blue-grass, Dichanthium queenslandicum</td><td>160</td></tr>
<tr><td>Queensland White-gum, Eucalyptus argophloia</td><td>10</td></tr>
<tr><td>Macrozamia machinii</td><td>No disturbance</td></tr>
<tr><td>South-eastern Long-eared Bat, Nyctophilus corbeni</td><td>4 080</td></tr>
<tr><td>Dunmall’s Snake, Furina dunmalli</td><td>4 400</td></tr>
<tr><td>Five-clawed Worm-skink, Anomalopus mackayi</td><td>560</td></tr>
<tr><td>Squatter Pigeon (Southern), Geophaps scripta scripta</td><td>3261</td></tr>
<tr><td>Regent Honeyeater, Anthochaera phrygia</td><td>20</td></tr>
<tr><td>Collared Delma, Delma torquata</td><td>90</td></tr>
<tr><td>Yakka Skink, Egernia rugosa</td><td>310</td></tr>
<tr><td>Australian Painted Snipe, Rostratula australis</td><td>5</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Date of decision</th><th>Conditions attached to approval</th></tr>
<tr><td></td><td>
<table>
<tr><th>EPBC Communities</th><th>Maximum disturbance (hectares)</th></tr>
<tr><td>Brigalow (Acacia harpophylla dominant and co-dominant)</td><td>106</td></tr>
<tr><td>Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions</td><td>8</td></tr>
<tr><td>Weeping Myall Woodlands</td><td>1</td></tr>
<tr><td>Natural Grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</td><td>No disturbance</td></tr>
<tr><td>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</td><td>No disturbance</td></tr>
<tr><td>Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions</td><td>No disturbance</td></tr>
</table>
</td></tr>
<tr><td>As varied on the date this instrument was signed</td><td>6. To protect EPBC listed species and communities within the project area the maximum disturbance limits in Table 2 apply to Stage 1. The approval holder must not exceed these disturbance limits.<br><br>Table 2: Maximum disturbance limits for Stage 1
<table>
<tr><th>Terrestrial species</th><th>Maximum disturbance (hectares) to core habitat</th></tr>
<tr><td>South-eastern Long-eared Bat, Nyctophilus corbeni</td><td>225</td></tr>
<tr><td>Dunmall’s Snake, Furina dunmalli</td><td>300</td></tr>
<tr><td>Five-clawed Worm-skink, Anomalopus mackayi</td><td>2</td></tr>
<tr><td>Squatter Pigeon (Southern), Geophaps scripta scripta</td><td>203</td></tr>
<tr><td>Regent Honeyeater, Anthochaera phrygia</td><td>1</td></tr>
<tr><td>Collared Delma, Delma torquata</td><td>11</td></tr>
<tr><td>Yakka Skink, Egernia rugosa</td><td>19</td></tr>
<tr><th>EPBC Communities</th><th>Maximum disturbance (hectares)</th></tr>
<tr><td>Brigalow (Acacia harpophylla dominant and co-dominant)</td><td>39</td></tr>
<tr><td>Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions</td><td>8</td></tr>
</table>
</td></tr>
<tr><td>Variation dated 31/10/2018</td><td>7. Revoked</td></tr>
<tr><td>Variation dated 31/10/2018</td><td>7A. Prior to the commencement of Stage 1, the approval holder must prepare and submit an EPBC Species Impact Management Plan for the Minister’s written approval. The EPBC Species Impact Management Plan must include:<br><br>a. measures that will be taken to avoid, mitigate and manage impacts to EPBC listed threatened species and their habitat during clearance of vegetation, including the involvement of a suitably qualified ecologist at all times during clearance of vegetation;</td></tr>
</table>

| Date of decision | Conditions attached to approval |
|---|---|
| | b. measures that will be taken to avoid and mitigate impacts to **EPBC listed threatened species** and their habitat and to **EPBC communities** during construction, operation and decommissioning of the action;<br>c. a monitoring program to determine the success of impacts avoidance and mitigation measures and that will inform adaptive implementation of the action for the duration of this approval; and<br>d. a description of how measures proposed in the EPBC Species Impact Management Plan are consistent with the measures in relevant **conservation advice, recovery plans** and **threat abatement plans**. |
| Variation dated 31/10/2018 | 7B. The approval holder must not **commence Stage 1** until an EPBC Species Impact Management Plan has been approved by the **Minister** in writing. The approved EPBC Species Impact Management Plan must be implemented by the **approval holder**. |
| Variation dated 31/10/2018 | 8. Revoked |
| Variation dated 31/10/2018 | **Offsets**<br>8A. If the **approval holder** has provided an offset in respect of **impacts** predicted for a **development stage** of the project which subsequently are not realised, such parts of the offset in excess of the obligation for that **development stage** can be applied towards offsets required for the **impacts** of subsequent **development stages**. |
| Variation dated 31/10/2018 | 8B. The Offset Strategy may be prepared and submitted to the **Minister** for approval in stages. Each stage of the Offset Strategy must provide information in respect of the subsequent **development stage** to commence and all earlier **development stages**. A **development stage** must not **commence** until an Offsets Strategy addressing offset obligations for that **development stage** has been approved by the **Minister**. |
| Variation dated 31/10/2018 | 8C. The Offset Strategy must:<br>a. include a strategy to secure the offsets proposed for the residual significant **impacts** to the **EPBC listed species** and **EPBC communities** for the subsequent **development stage;**<br>b. include a map of the location of each **EPBC listed threatened species** and its habitat and **EPBC community** in relation to infrastructure for the subsequent **development stage**;<br>c. describe potential risks to the successful implementation of the Offset Strategy, and the contingency measures that would be implemented to mitigate against these risks;<br>d. detail how the **approval holder** will address any residual significant impacts to any **EPBC listed threatened species** and its habitat and/or **EPBC communities** not identified in Table 1, in accordance with the **EPBC Act Offsets Policy;** and<br>e. specify the proposed legal mechanism and timeframe for securing the offset(s). |
| Variation dated 31/10/2018 | 8D. The **approval holder** must not **commence** the action until the Offset Strategy for **Stage 1** has been approved by the **Minister** in writing. The approved Offset Strategy must be implemented by the **approval holder**. |
| Variation dated 31/10/2018 | 9. Revoked |

| Date of decision | Conditions attached to approval |
|---|---|
| Variation dated 31/10/2018 | 9A. At least 3 months prior to the **commencement** of any **development stage** after **Stage** 1, the **approval holder** must submit a revised Offset Strategy for approval by the **Minister**. The updated Offset Strategy must include:<br>a. a strategy to secure the minimum offsets proposed for the residual significant **impacts** to the **EPBC listed species** and **EPBC communities** for the subsequent **development stage**;<br>b. a map of the location of each **EPBC listed threatened species** and its habitat and **EPBC community** in relation to infrastructure for the subsequent **development stage**;<br>c. the information required for the Offset Strategy at conditions 8Ca to 8Ce for the subsequent **development stage**;<br>d. demonstration of how any proposed offset builds on offsets already secured and will contribute to a larger strategic offset for whole of project **impacts**;<br>e. performance and completion criteria for evaluating the management of offset areas.<br>f. reconciliation of **impacts** predicted in the subsequent **development stage** and actual disturbance in preceding **development stages** against the maximum disturbance limits set out in Table 1. |
| Variation dated 31/10/2018 | 10. Revoked |
| Variation dated 31/10/2018 | 10A. Offsets for **development stages** must be provided in accordance with the mechanism identified in the approved Offset Strategy and must be registered and legally secured in accordance with Queensland legislation prior to **commencement** of any subsequent **development stage.** |
| Variation dated 31/10/2018 | 10B. Within 12 months of project commencement or the **Minister** approving the Offset Strategy for a subsequent **development stage**, the **approval holder** must submit for the approval of the **Minister** an Offset Area Management Plan which includes:<br>a. a description of the management measures that will be implemented to protect of **EPBC listed threatened species** and **EPBC communities** in each offset area,<br>b. details of how the proposed offset/s and Offset Area Management Plan are consistent with the principles of the **EPBC Act Offsets Policy**;<br>c. a field validation survey and baseline description of the current condition (prior to any management activities) of the offset area/s, including existing vegetation;<br>d. a description and map (including **shapefile/s**) to clearly define the location and boundaries of the offset area/s, accompanied by the **offset attributes**;<br>e. information about how the offset area/s provide connectivity with other relevant habitats and biodiversity corridors including a map depicting the offset areas in relation to other habitats and biodiversity corridors;<br>f. details of how proposed management measures take into account relevant **approved conservation advices** and are consistent with the measures contained in relevant **recovery plans** and **threat abatement plans**; |

| Date of decision | Conditions attached to approval |
|---|---|
| | g. completion criteria and performance targets for evaluating the effectiveness of Offset Area Management Plan implementation, and criteria for triggering corrective actions (if necessary);<br>h. a program to monitor, report on and review the effectiveness of the Offset Area Management Plan;<br>i. a description of potential risks to the successful implementation of the offset/s and Offset Area Management Plan, and contingency measures that would be implemented to mitigate against these risks. |
| Variation dated 31/10/2018 | 11. Revoked |
| Variation dated 31/10/2018 | 11A. The **approval holder** must not commence the subsequent **development stage** until the Offset Area Management Plan for the current **development stage** has been approved in writing by the **Minister**. |
| Variation dated 29/3/2017 | 12. Revoked |
| Variation dated 31/10/2018 | 12A. Revoked |
| Variation dated 31/10/2018 | 12B. Revoked |
| Variation dated 31/10/2018 | 12C. Revoked |
| Original dated 19/12/2013 | *Note 1: The Minister may determine that a plan, strategy or program approved by the Queensland Government satisfies the requirements for the EPBC Species Impact Management and Offset Plan under these conditions.* |
| Original dated 19/12/2013 | *Note 2: Offsets for some species may be accommodated within ecological communities or overlap State approval requirements or other species habitat requirements, as long as they meet the requirements of these conditions of approval in respect of each individual species being offset.* |
| Original dated 19/12/2013 | **Coal Seam Gas Water Monitoring and Management Plan**<br>*Stage 1 CSG Water Monitoring and Management Plan*<br>13. Prior to **commencement**, the proponent must submit a Stage 1 Coal Seam Gas Water Monitoring and Management Plan (Stage 1 CSG WMMP) for the approval of the **Minister,** who may seek the advice of an **expert panel**. The Stage 1 CSG WMMP must include:<br>a. an analysis of the results of the most recent **OGIA model** (built or endorsed by **OGIA**), relevant to all of the project's tenement areas;<br>b. a fit for purpose numerical simulation to assess potential impacts on water resources arising from the action in the project area, subsequent surface water-groundwater interactions in the Condamine Alluvium and impacts to dependent ecosystems;<br>c. an assessment of potential **impacts** from the action on non-spring based groundwater dependent ecosystems through potential changes to surface-groundwater connectivity and interactions with the sub-surface expression of groundwater;<br>d. an assessment of predicted project wide groundwater drawdown levels and pressures from the action, together with confidence levels; |

| Date of decision | Conditions attached to approval |
|---|---|
| | e. parameters and a sampling regime to establish baseline data for surface and groundwater resources that may be impacted by the action, including: surface water quality and quantity in the **project area**, and upstream and downstream of potential impact areas; groundwater quality, levels and pressures for areas that may be **impacted** by the project; and for determining connectivity between surface water and groundwater that may be **impacted** by the project;<br><br>f. a best practice baseline monitoring network that will enable the identification of spatial and temporal changes to surface water and groundwater. This must include a proposal for aquifer connectivity studies and monitoring of relevant aquifers to determine hydraulic connectivity (including potential groundwater dependence of Long Swamp and Lake Broadwater) and must also enable monitoring of all aquatic ecosystems that may be **impacted** by the action;<br><br>g. a program to monitor subsidence **impacts** from the action, including trigger thresholds and reporting of monitoring results in annual reporting required by condition 28. If trigger thresholds are exceeded, the **approval holder** must develop and implement an action plan to address impacts within 90 calendar days of a trigger threshold being exceeded;<br><br>h. provisions to make monitoring results publicly available on the **approval holder's** website to facilitate a greater understanding of cumulative **impacts**;<br><br>i. a discussion on how the **approval holder** is contributing to the **Joint Industry Plan,** including its periodic review. The **approval holder** must contribute to the **Joint Industry Plan** and comply with any part of the **Joint Industry Plan**, or future iterations of the **Joint Industry Plan**, that applies to the **approval holder**;<br><br>j. a groundwater early warning monitoring system, including:<br><br>i. groundwater drawdown limits for all consolidated aquifers potentially impacted by the action, excluding the Walloon Coal Measures;<br><br>ii. for the Condamine Alluvium, appropriate triggers and groundwater limits and a rationale for their selection;<br><br>iii. early warning indicators and trigger thresholds, including for Lake Broadwater, Long Swamp and other groundwater dependent ecosystems that may potentially be impacted by the action, including those that may occur outside the project area and may be impacted by the action; and<br><br>iv. investigation, management and mitigation actions, including substitution and/or groundwater repressurisation, for both early warning indicators and trigger thresholds to address flux impacts on the Condamine Alluvium.<br><br>k. early warning indicators and trigger thresholds, including corrective actions for both early warning indicators and trigger thresholds, for aquatic ecology and aquatic ecosystems;<br><br>l. a CSG water management strategy for produced salt/brine, which discusses how co-produced water and brine will be managed for the action, including in the context of other coal seam gas activities in the Surat Basin;<br><br>m. an analysis of how the **approval holder** will utilise beneficial use and/or groundwater repressurisation techniques to manage produced CSG water from the action, and how any potential adverse **impacts** associated with groundwater repressurisation will be managed; |

| Date of decision | Conditions attached to approval |
|---|---|
| | n. a discharge strategy, consistent with the recommendations and requirements of the Department of the Environment and Heritage Protection in its **Assessment Report** (pages 94 to 95 and pages 254 to 255) and that includes scenarios where discharge may be required, the quality of discharge water (including water treated by reverse osmosis), the number and location of monitoring sites (including upstream and downstream sites), frequency of monitoring and how the data from monitoring will be analysed and reported, including recommendations on any changes or remedial actions that would be required;<br>o. a flood risk assessment for processing facilities and any raw co-produced water and brine dams, which addresses flood risks to the environment from the action in the case of a 1:1000 ARI event. The risk assessment should estimate the consequences if major project infrastructure was subject to such an event, including release of brine and chemicals into the environment;<br>p. a cumulative **impact** assessment based on the outputs of the **OGIA model** which integrates groundwater model outputs with known and potential groundwater dependent ecosystems and presents the outputs in map form. Contribute to investigations coordinated through the OGIA to assess hydrological and ecological characteristics of **impacted** groundwater dependent ecosystems;<br>q. details of performance measures; annual reporting to the **Department**; and publication of reports on the internet; and<br>r. an explanation of how the Stage 1 CSG WMMP will contribute to work undertaken by other CSG proponents in the Surat Basin to understand cumulative **impacts**, including at the local and regional scale, and maximise environmental benefit. |
| Original dated 19/12/2013 | 14. The Stage 1 CSG WMMP must be peer reviewed by a **suitably qualified water resources expert/s** approved by the **Minister** in writing. The peer review must be submitted to the **Minister** together with the Stage 1 CSG WMMP and a statement from the **suitably qualified water resources expert/s** stating that they carried out the peer review and endorse the findings of the Stage 1 CSG WMMP. |
| Original dated 19/12/2013 | 15. The **approval holder** must not exceed the groundwater drawdown or groundwater limits for each aquifer specified in the Stage 1 CSG WMMP. |
| Original dated 19/12/2013 | 16. Unless otherwise agreed in writing by the **Minister**, the **approval holder** must not **commence** the action until the Stage 1 CSG WMMP is approved in writing by the **Minister**. The approved Stage 1 CSG WMMP must be implemented. |
| Original dated 19/12/2013 | *Note 3: to ensure efficiency the approval holder may prepare and align the Stage 1 WMMP with the requirements of the Queensland Government, as long as the relevant matters under the conditions of this approval are clearly and adequately addressed.* |
| Variation dated 2/7/2019 | *Updated CSG Water Monitoring and Management Plan*<br>17. The **approval holder** must submit an updated CSG Water Monitoring and Management Plan (Updated CSG WMMP) for the written approval of the **Minister**. The Updated CSG WMMP must:<br>a. include all matters in the Stage 1 CSG WMMP, and discuss how the Stage 1 CSG WMMP is informing adaptive management for the Updated CSG WMMP;<br>b. include any updated modelling for the project, including in respect of the **OGIA model** or any updates to the **OGIA model** by **OGIA**; |

| Date of decision | Conditions attached to approval |
|---|---|
| | c. include an explanation of how the **approval holder** will contribute to the **Condamine Interconnectivity Research Project**. The Updated CSG WMMP must present the findings of the Condamine Interconnectivity Research project and any modelling done by the **OGIA** to validate predicted drawdown and a review of trigger thresholds and corrective activities for the action;<br>d. report on the potential for flow reversal from the Condamine Alluvium to underlying aquifers, based on data obtained during the Stage 1 CSG WMMP;<br>e. review and update the monitoring network in Stage 1 WMMP to reflect changes in understanding of **impacts** to water resources, including from baseline monitoring and relevant research;<br>f. identify any predicted changes in stream connectivity due to groundwater drawdown from the action and assess potential impacts to groundwater dependent ecosystems due to any predicted changes in stream connectivity, including to water quality, quantity and ecology;<br>g. address any uncertainty in the groundwater-dependency of ecosystems and springs with supporting evidence from field-based investigations for any groundwater-dependent ecosystems and springs confirmed in the **OGIA model**;<br>h. provide details of an ongoing monitoring plan that:<br>i. sets out the frequency of monitoring and rationale for the frequency;<br>ii. includes continued collection of baseline data for each monitoring site over the life of the project;<br>iii. outlines the approach to be taken to analyse the results including the methods to determine trends to indicate potential impacts; and<br>iv. builds on the groundwater early warning system required at condition 13 (j) and sets out early warning indicators and trigger thresholds and limits for groundwater and surface water.<br>i. include a risk based exceedance response plan that details the corrective activities the **approval holder** will take and the timeframes in which those activities will be undertaken if: early warning indicators and trigger threshold values contained in the Updated CSG WMMP are exceeded, or there are any emergency discharges. |
| Variation dated 2/7/2019 | 18. The Updated CSG WMMP must be peer reviewed by a **suitably qualified water resources expert/s** approved by the **Minister** in writing prior to the plan being submitted to the **Minister** for approval. The **approval holder** must, at the same time as the Updated CSG WMMP is submitted for approval, provide to the **Minister**:<br>a. a copy of the peer review; and<br>b. a statement from the **suitably qualified water resources expert/s** stating that they carried out the peer review and endorse the findings of the Updated CSG WMMP. |
| Variation dated 2/7/2019 | 19. The **approval holder** must not exceed the groundwater drawdown or groundwater limits specified in the approved Updated CSG WMMP. |
| Variation dated 2/7/2019 | 20. The **Minister** may direct, in writing, that the **approval holder** cease water or gas extraction from one or more coal seam gas production wells, or water discharge or use, if: |

| Date of decision | Conditions attached to approval |
|---|---|
| | a. an early warning indicator, trigger threshold or limit is exceeded, and<br>b. the **Minister** is not satisfied that the corrective activities proposed or taken by the approval holder will reduce likely impacts on **matters of national environmental significance** (**MNES**) to acceptable levels. |
| Variation dated 2/7/2019 | 20A. If condition 20 applies, the **Minister** may direct the **approval holder** to implement alternative corrective activities at the expense of the **approval holder,** provided those corrective activities are unlikely to have a significant impact on **MNES**. |
| Variation dated 2/7/2019 | 20B. If condition 20 applies, the **approval holder** must not recommence such extraction or discharge or use until the **Minister** has given approval in writing for the recommencement of that extraction, discharge or use.<br>a. Approval to recommence such extraction, discharge or use may be subject to such conditions as the **Minister** considers reasonably necessary to ensure that impacts on **MNES** will be acceptable.<br>b. If the **Minister** approves the recommencement of extraction, discharge or use subject to conditions, the **approval holder** must comply with such conditions. |
| Variation dated 2/7/2019 | *Note 4: The proponent will be provided with a reasonable opportunity to comment on any such direction from the **Minister** before it is required to be implemented.* |
| Variation dated 2/7/2019 | 21. The **approval holder** must not commence the extraction of gas from any coal seam gas production wells unless the Updated CSG WMMP has been approved by the **Minister** in writing. The approved Updated CSG WMMP must be implemented. The Stage 1 CSG WMMP will apply until the commencement of the approved Updated CSG WMMP. |
| Variation dated 2/7/2019 | 21A. If the **Minister** has approved the Updated CSG WMMP, the **approval holder** may commence extraction of gas from:<br>a. 250 coal seam gas production wells<br>b. a larger number of coal seam gas production wells as specified by the **Minister** if he or she is satisfied that:<br>i. the **approval holder** has commenced gas extraction from at least 125 coal seam gas production wells;<br>ii. the **approval holder** has requested an increase in the number of wells from which gas can be extracted under the approved Updated CSG WMMP; and<br>iii. extraction of gas from the additional number of coal seam gas production wells will not have an unacceptable impact on **MNES**. |
| Variation dated 2/7/2019 | *Note 5: to ensure efficiency the approval holder may prepare and align the Updated CSG WMMP with the requirements of the Queensland Government, as long as the relevant matters under the conditions of this approval are clearly and adequately addressed.*<br>*Note 5A: The number of additional coal seam gas production wells requested under condition 21A(b) will be at least 200.* |
| Variation dated 2/7/2019 | 22. Revoked |
| Variation dated 2/7/2019 | 23. If the **OGIA model** ceases to exist, the **approval holder** must: |

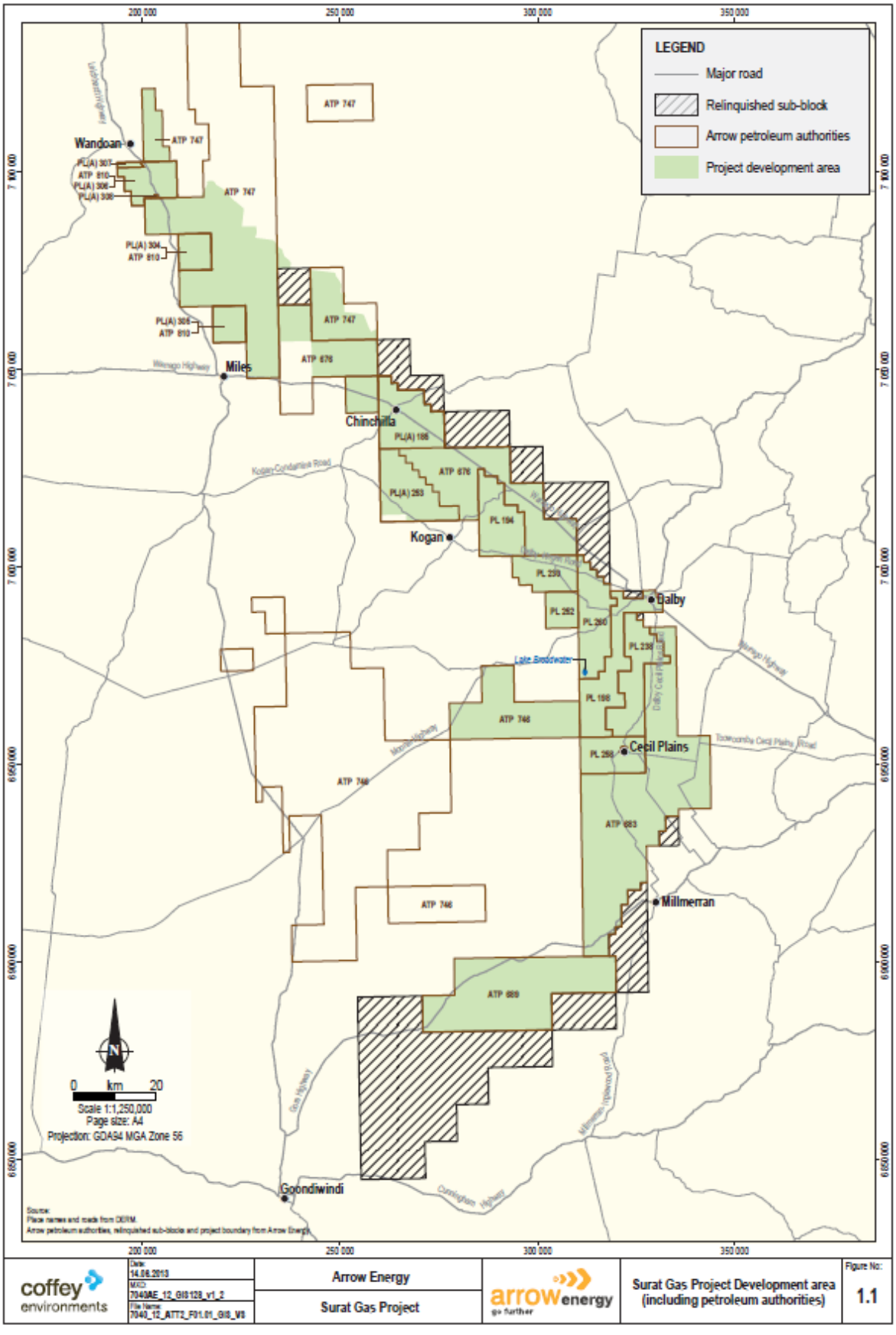
| Date of decision | Conditions attached to approval |
|---|---|
| | a. submit an alternate model that replaces the **OGIA model** for the approval of the **Minister**;<br>b. revise the Updated CSG WMMP to incorporate the approved alternate model, and submit the revised plan to the **Minister** for approval; and<br>c. implement the approved revised plan. |
| Variation dated 2/7/2019 | 24. Revoked |
| Variation dated 2/7/2019 | 25. The **Minister** may, by written request to the **approval holder**, require the Stage 1 CSG WMMP or the Updated CSG WMMP to be revised, including to address expert advice. Any request must be acted on by the **approval holder** within the timeframe specified in the request. |
| Variation dated 2/7/2019 | *Note 6: The Minister may throughout the life of the project life seek advice from experts, or an expert panel. As a consequence specific matters identified through such advice may need to be addressed in the CSG WMMP. Where such advice is sought the approval holder would be provided with opportunity to submit information and respond to the specific matters identified, in order to ensure the CSG WMMP is based on the best available information. Review requirements will facilitate adaptive management, align with Queensland Government approval requirements, and account for potential cumulative impacts as new scientific information becomes available over the life of the project.* |
| Original dated 19/12/2013 | **General**<br>26. Within 20 business days after the **commencement** of the action, the **approval holder** must advise the **Department** in writing of the actual date of **commencement.** |
| Original dated 19/12/2013 | 27. The **approval holder** must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the management plans, reports or strategies required by this approval, and make them available upon request to the **Department**. The annual report (condition 28) must state all confirmed cases of non-compliance along with details of any remedial actions. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act,** or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media. |
| Original dated 19/12/2013 | 28. Within three months of every 12 month anniversary of the **commencement** of the action, the **approval holder** must publish a report on its website for the life of the approval outlining how they have been compliant with the conditions of this approval over the previous 12 months, including implementation of any management plans as specified in the conditions. The **approval holder** must also report against disturbance limits. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** at the same time as the compliance report is published. |
| Variation dated 2/7/2019 | 29. The **approval holder** must notify the **Department** in writing of potential non-compliance with any condition of this approval as soon as practical and within no later than ten business days of becoming aware of the potential non-compliance. The notice provided to the **Department** under this condition must specify:<br>a. the condition which the **approval holder** has potentially breached;<br>b. the nature of the potential non-compliance; |

| Date of decision | Conditions attached to approval |
|---|---|
| | c. when and how the **approval holder** became aware of the non-compliance;<br>d. how the non-compliance will affect the approved action;<br>e. how the non-compliance will affect the anticipated **impacts** of the approved action, in particular how the non-compliance will affect the **impacts** on the **MNES**;<br>f. the measures the approval holder will take to address the **impacts** of the non-compliance on the **MNES** and rectify the non-compliance; and<br>g. the time by when the approval holder will rectify the non-compliance. |
| Original dated 19/12/2013 | 30. Upon the direction of the **Minister**, the **approval holder** must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister.** |
| Original dated 19/12/2013 | 31. If the **approval holder** wishes to carry out any activity other than in accordance with the management plans as specified in the conditions**,** the **approval holder** must submit to the **Department** for the **Minister's** written approval a revised version of that management plan. The approval holder must not **commence** the varied activity until the **Minister** has approved the varied management plan. The **Minister** will not approve a varied management plan unless the revised management plan would result in an equivalent or improved environmental outcome over time. If the **Minister** approves the revised management plan, that management plan must be implemented in place of the management plan originally approved. |
| Original dated 19/12/2013 | 32. If the **Minister** believes that it is necessary or convenient for the better protection of listed threatened species, listed migratory species or water resources to do so, the **Minister** may request that the **approval holder** make specified revisions to the management plans specified in the conditions and submit the revised management plan for the **Minister's** written approval. The **approval holder** must comply with any such request within the timeframe specified by the **Minister**. The revised approved management plan must be implemented. Unless the **Minister** has approved the revised management plan, then the person taking the action must continue to implement the management plan originally approved, as specified in the conditions. |
| Variation dated 29/5/2018 | 33. If at any time after seven years from the date of this approval, the **approval holder** has not commenced the action, then the **approval holder** must not **commence** the action without the written agreement of the **Minister**. |
| Original dated 19/12/2013 | 34. Unless otherwise agreed to in writing by the **Minister**, the **approval holder** must publish all management plans referred to in these conditions of approval on their website. Each management plan must be published on the website within 1 month of being approved and remain available on that website for the life of the approval. |

| Date of decision | Definitions attached to approval |
|---|---|
| Original dated 19/12/2013 | **Approval holder:** means the person to whom the approval is granted. |
| Original dated 19/12/2013 | **Assessment Report:** means the Queensland Department of Environment and Heritage Protection's report under the *Environmental Protection and Biodiversity Conservation Act 1994* for the action. |
| Variation dated 29/3/2017 | **Commence/commencement:** means any physical disturbance, including clearance of native vegetation, new road work and the establishment of well sites to develop the gas field project area. Commencement does not include:<br>a. minor physical disturbance necessary to undertake pre-clearance surveys or establish monitoring programs or geotechnical investigations; or<br>b. activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on matters of national environmental significance, and only if the proponent has notified the Department in writing before an activity is undertaken. |
| Original dated 19/12/2013 | **Core habitat:** means core habitat known and core habitat possible as defined in the rules for habitat mapping for each individual species in the *Supplementary Report to the Surat Gas Project EIS (March 2012), Attachment 1 – Matters of National Environmental Significance.* |
| Original dated 19/12/2013 | **Conservation advice:** means an approved conservation advice under the EPBC Act for an EPBC Act listed species or community. |
| Original dated 19/12/2013 | **Core habitat known:** means habitat where a spatially accurate confirmed record of a particular species exists (e.g. Herbrecs or survey record). Core habitat known is attributed to the particular habitat polygon in which it occurs, based on either regional ecosystem (RE) mapping provided by the Queensland Department of Environment and Heritage Protection (or successor agency) or high resolution habitat mapping developed for a specific purpose. Core habitat known also means a 1 km buffer around all spatially accurate (< 400 metres accuracy) species records. |
| Original dated 19/12/2013 | **Condamine Interconnectivity Research Project:** means the Condamine Interconnectivity Research Project being undertaken by the Queensland Office of Groundwater Impact Assessment as part of the implementation of the Surat Underground Water Impact Report (UWIR), which was prepared by the Queensland Water Commission (QWC) in 2012. |
| Original dated 19/12/2013 | **Core habitat possible:** means an area where previous records of a particular species are not known to occur within a given area or habitat, although specific habitat features are present which are known to be favoured by the species and the habitat occurs within the species known geographic range. |
| Original dated 19/12/2013 | **Department**: means the Australian Government Department administering the *Environment Protection and Biodiversity Conservation Act 1999*. |
| Original dated 19/12/2013 | **Department's survey guidelines:** means:<br>Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999 - http://www.environment.gov.au/epbc/publications/nes-guidelines.html.<br>Survey Guidelines for Australia's Threatened Frogs, Threatened Birds, Threatened Fish, Threatened Mammals, Threatened Reptiles and Threatened Bats: http://www.environment.gov.au/epbc/guidelines-policies.html. |
| Variation dated 29/3/2017 | **Development stage:** means Stage 1, Stage 2, Stage 3 or Stage 4 of project development, as defined in these conditions. |
| Original dated 19/12/2013 | **EPBC/ EPBC Act:** means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). |

| Date of decision | Definitions attached to approval |
|---|---|
| Original dated 19/12/2013 | **EPBC Act Offsets Policy:** means the *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy (October 2012) including the Offsets Assessment Guide. |
| Original dated 19/12/2013 | **EPBC community:** means an endangered ecological community listed under the EPBC Act. |
| Original dated 19/12/2013 | **EPBC listed threatened species:** means a threatened flora or fauna species listed under the EPBC Act. |
| Original dated 19/12/2013 | **Expert panel:** means an expert panel appointed by the Minister. |
| Original dated 19/12/2013 | **Fitzroy River Turtle:** means the Fitzroy River Turtle, *Rheodytes leukops*, listed as vulnerable under the EPBC Act. |
| Original dated 19/12/2013 | **General habitat:** means where a species has not been recorded in a given location and habitat accounts for some of the features favoured by a particular species. The habitat occurs on the margins of a species known geographic range. Otherwise, the habitat is suitable for the species |
| Variation dated 29/3/2017 | **Impact/s:** has the definition assigned to it in section 527E of the **EPBC Act**. |
| Original dated 19/12/2013 | **Joint Industry Plan:** means the *Joint Industry Plan for an Early Warning System for the Monitoring and Protection of EPBC Springs* established with other coal seam gas proponents operating within the Surat Cumulative Management Area. |
| Variation dated 2/7/2019 | **Matters of National Environmental Significance (MNES):** means matters protected by a provision of Part 3 for which the approval has effect. |
| Original dated 19/12/2013 | **Minister:** means the Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister. |
| Original dated 19/12/2013 | **Murray Cod:** means the Murray Cod, *Maccullochella peelii*, listed as vulnerable under the EPBC Act. |
| Variation dated 31/10/2018 | **Offset attributes** means the offset title, status, EPBC referral number, land parcel details and relevant protected matters. |
| Original dated 19/12/2013 | **OGIA:** means the Office of Groundwater Impact Assessment or its successor body |
| Original dated 19/12/2013 | **Pre-clearance surveys:** means surveys that are undertaken for EPBC species and EPBC communities for all areas of the project area that may be disturbed by project activities. |
| Original dated 19/12/2013 | **Project area:** means the area identified as the project area in Attachment A. |
| Variation dated 29/3/2017 | **Recovery plan/s:** means an approved recovery plan under the **EPBC Act** for an **EPBC listed species** or **EPBC community**. |
| Variation dated 31/10/2018 | **Shapefile** means an ESRI Shapefile containing '.shp, '.shx' and '.dbf' files and other files capturing attributes including the shape, the EPBC Act reference. ID number and EPBC Act protected matters present at the relevant site. Shapefile files must also include either a '.prj' file or specification of the projection/geographic coordinate system used. |
| Original dated 19/12/2013 | **Stage 1:** means year 1 to 3 (inclusive) of the action, starting at the date of commencement. |
| Original dated 19/12/2013 | **Stage 2:** means year 4 to 11 (inclusive) of the action. |
| Original dated 19/12/2013 | **Stage 3:** means year 12 to 20 (inclusive) of the action |
| Original dated 19/12/2013 | **Stage 4:** means year 21 to decommissioning (inclusive) of the action |

| Date of decision | Definitions attached to approval |
|---|---|
| Original dated 19/12/2013 | **Suitably qualified ecologist:** means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using relevant protocols, standards, methods and literature. |
| Original dated 19/12/2013 | **Suitably qualified water resources expert/s**: means a natural person with at least a postgraduate degree (or equivalent) in a suitable area (such as hydrology or hydrogeology) and a minimum of 10 years relevant experience in water resources assessment, including at least one year of experience in Australia. |
| Variation dated 29/3/2017 | **Threat abatement plan/s:** means an approved threat abatement plan under the **EPBC Act**. |

| Date of decision | Attachment A |
|---|---|
| Original dated 19/12/2013 |  |

# Appendix 2: Title Searches

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **15680101** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 23/08/1977 | **Request No:** | 41748235 |
| **Previous Title:** | 12999089, 12999090 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 1 REGISTERED PLAN 78475
Local Government: WESTERN DOWNS

## REGISTERED OWNER

Dealing No: 706490515 01/04/2003

JOHN WAYNE KARRASCH
DEBORAH LEANNE KARRASCH JOINT TENANTS

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 12965006 (POR 11)

2. MORTGAGE No 706490522 01/04/2003 at 15:02
ELDERS RURAL BANK LIMITED A.B.N. 74 083 938 416

## ADMINISTRATIVE ADVICES

NIL

## UNREGISTERED DEALINGS

NIL

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **16789193** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 16/08/1985 | **Request No:** | 41748228 |
| **Previous Title:** | 12950120, 12952128 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 1 REGISTERED PLAN 83755
Local Government: WESTERN DOWNS

## REGISTERED OWNER

Dealing No: 721656061 03/05/2022

WARAKIRRI ASSET MANAGEMENT LTD A.C.N. 057 529 370 TRUSTEE
UNDER INSTRUMENT 721656061

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 11848111 (POR 41)
Deed of Grant No. 11998204 (POR 54)

## ADMINISTRATIVE ADVICES

NIL

## UNREGISTERED DEALINGS

NIL

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **50610102** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 29/05/2006 | **Request No:** | 41748230 |
| **Previous Title:** | 13049145 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 11 SURVEY PLAN 191489
Local Government: WESTERN DOWNS

## REGISTERED OWNER

Dealing No: 709632833 29/05/2006

DOUGLAS JOHNSTONE BROWNE
ALEXIS JEAN BROWNE JOINT TENANTS

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 10369238 (POR 48)
Deed of Grant No. 10439245 (POR 969)

## ADMINISTRATIVE ADVICES

NIL

## UNREGISTERED DEALINGS

NIL

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **50233840** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 09/09/1998 | **Request No:** | 41748232 |
| **Previous Title:** | 40016722 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 55 CROWN PLAN DY592
Local Government: WESTERN DOWNS

## REGISTERED OWNER — INTEREST

Dealing No: 702887824 09/09/1998

RODNEY GREGOR PATERSON — 1/2
CELIA KATHLEEN KARP — 1/2

AS TENANTS IN COMMON

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 40016722 (Lot 55 on CP DY592)

## ADMINISTRATIVE ADVICES

NIL

## UNREGISTERED DEALINGS

NIL

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **51102505** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 14/07/2017 | **Request No:** | 41748233 |
| **Previous Title:** | 40073749 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 56 CROWN PLAN DY592
Local Government: WESTERN DOWNS

## REGISTERED OWNER

Dealing No: 718152868 14/07/2017

DALRUS PTY LTD A.C.N. 062 721 028 TRUSTEE
FOR THE BARELLAN PROPERTY TRUST UNDER INSTRUMENT 702083718

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 40073749 (Lot 56 on CP DY592)

## ADMINISTRATIVE ADVICES

| Dealing | Type | Lodgement Date | Status |
|---|---|---|---|
| 714628223 | VEG NOTICE<br>VEGETATION MANAGEMENT ACT 1999 | 20/08/2012 10:35 | CURRENT |

## UNREGISTERED DEALINGS

NIL

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Current Title Search

**Queensland Titles Registry Pty Ltd**
**ABN 23 648 568 101**

| | | | |
|---|---|---|---|
| **Title Reference:** | **17283161** | **Search Date:** | 21/07/2022 15:54 |
| **Date Title Created:** | 20/04/1989 | **Request No:** | 41748231 |
| **Previous Title:** | 16015023, 16015024, 16015025, 16015026, 16015027 | | |

## ESTATE AND LAND

Estate in Fee Simple

LOT 141 CROWN PLAN AG4261
Local Government: WESTERN DOWNS

## REGISTERED OWNER

Dealing No: 716094130 23/10/2014

BREZA FARMING PTY LTD A.C.N. 102 669 027 TRUSTEE
UNDER INSTRUMENT 716094130

## EASEMENTS, ENCUMBRANCES AND INTERESTS

1. Rights and interests reserved to the Crown by
Deed of Grant No. 10166018 (Lot 141 on CP AG4261)
Deed of Grant No. 10166020 (Lot 141 on CP AG4261)
Deed of Grant No. 10166021 (Lot 141 on CP AG4261)
Deed of Grant No. 10372042 (Lot 141 on CP AG4261)
Deed of Grant No. 10394021 (Lot 141 on CP AG4261)

2. MORTGAGE No 716094131 23/10/2014 at 13:56
NATIONAL AUSTRALIA BANK LIMITED A.B.N. 12 004 044 937

## ADMINISTRATIVE ADVICES

NIL

## UNREGISTERED DEALINGS

NIL

Caution - Charges do not necessarily appear in order of priority

** End of Current Title Search **


Requested by: D-ENQ CITEC CONFIRM

# Appendix 3: Land Parcel and Property Details

**Property 1: 1RP83755**

**Property Details**

- The property is comprised of a single lot.
- The land use of the property is mapped as cropping (Class 3.3) with a small area of grazing / native vegetation along the southern boundary.
- This property is presently utilised for dryland cropping.
- Surrounding land use is generally dryland cropping, with areas of irrigated cropping to the south as well as areas of grazing/native vegetation.

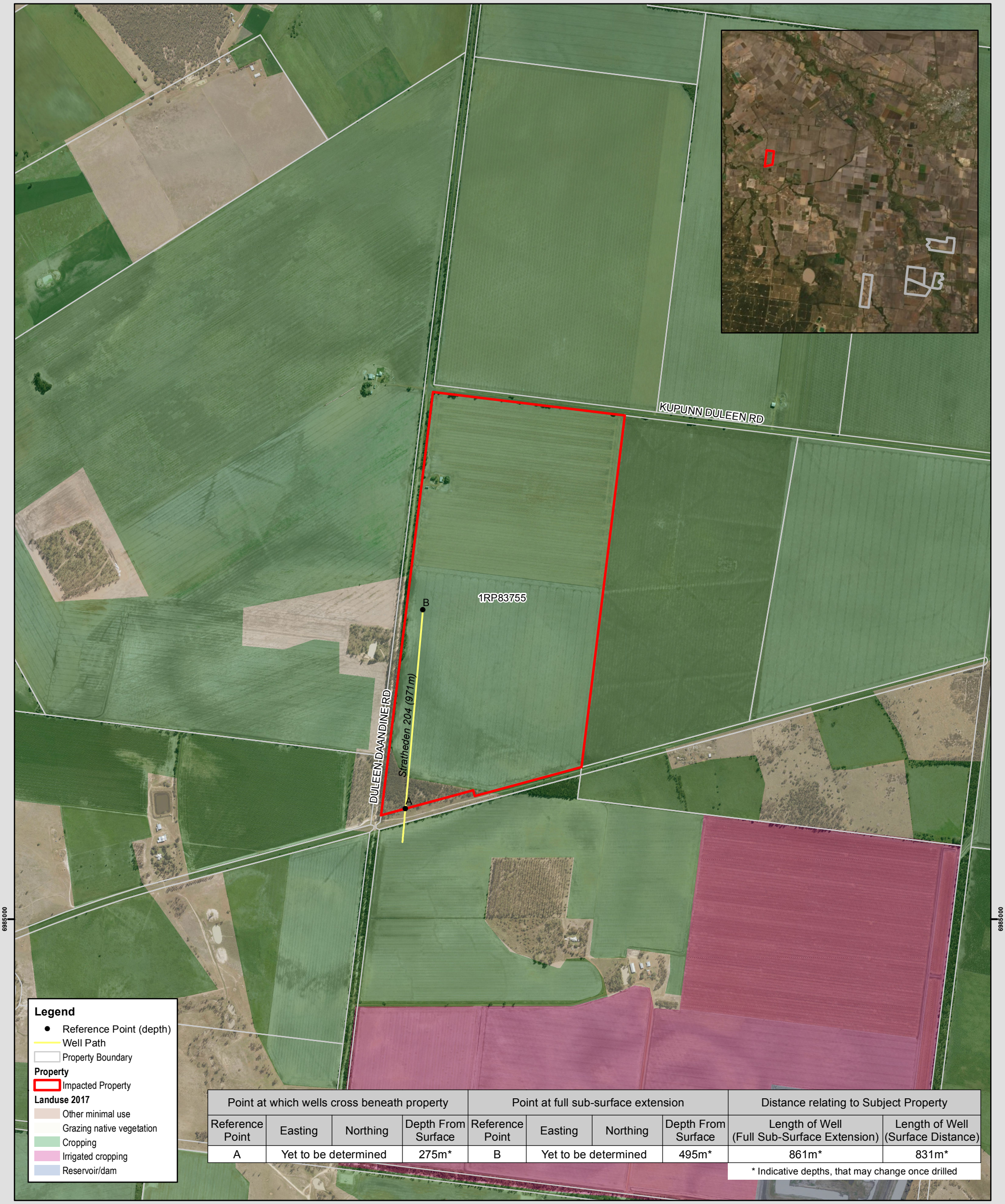
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- One (1) deviated well trajectory will be located on the lot, which will be drilled from a single drill pad located on the adjoining land parcel to the south.

**Infrastructure summary**

- One subterranean deviated well trajectory will be installed within the property from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectory on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory Name | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Stratheden 204 | 831 | 275 | 495 |




| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 275m* | B | Yet to be determined | | 495m* | 861m* | 831m* |
| | | | | | | | | * Indicative depths, that may change once drilled | |

# RIDA Application

# Lotplan: 1RP83755

**Source:** Arrow Energy Pty Ltd
Geoscience Australia
DNRME

**Date:** 22/06/2022
**Issued To:** A Hall
**Author:** jjensen

Metres
0 350 700 1,400

Scale 1:15,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

arrow energy
go further



**Note:** The dimensions, areas, number of lots, size and location of corridor

**Property 2: 11SP191489 & 956DER3479**

**Property Details**

- This property is comprised of two land parcels (11SP191489 & 956DER3479)
- The land use of the property is mapped as:
    - 11SP191489 - grazing / native vegetation with areas of Cropping (Class 3.3) and a dam/reservoir.
    - 956DER3479 – cropping (Class 3.3) and irrigated cropping with areas of grazing / native Vegetation.
- This property is presently utilised for dryland cropping & cattle grazing. The lot is bordered by the Condamine River.
- Surrounding land use is generally dryland cropping, with areas of irrigated cropping to the west and south as well as areas of grazing/native vegetation.

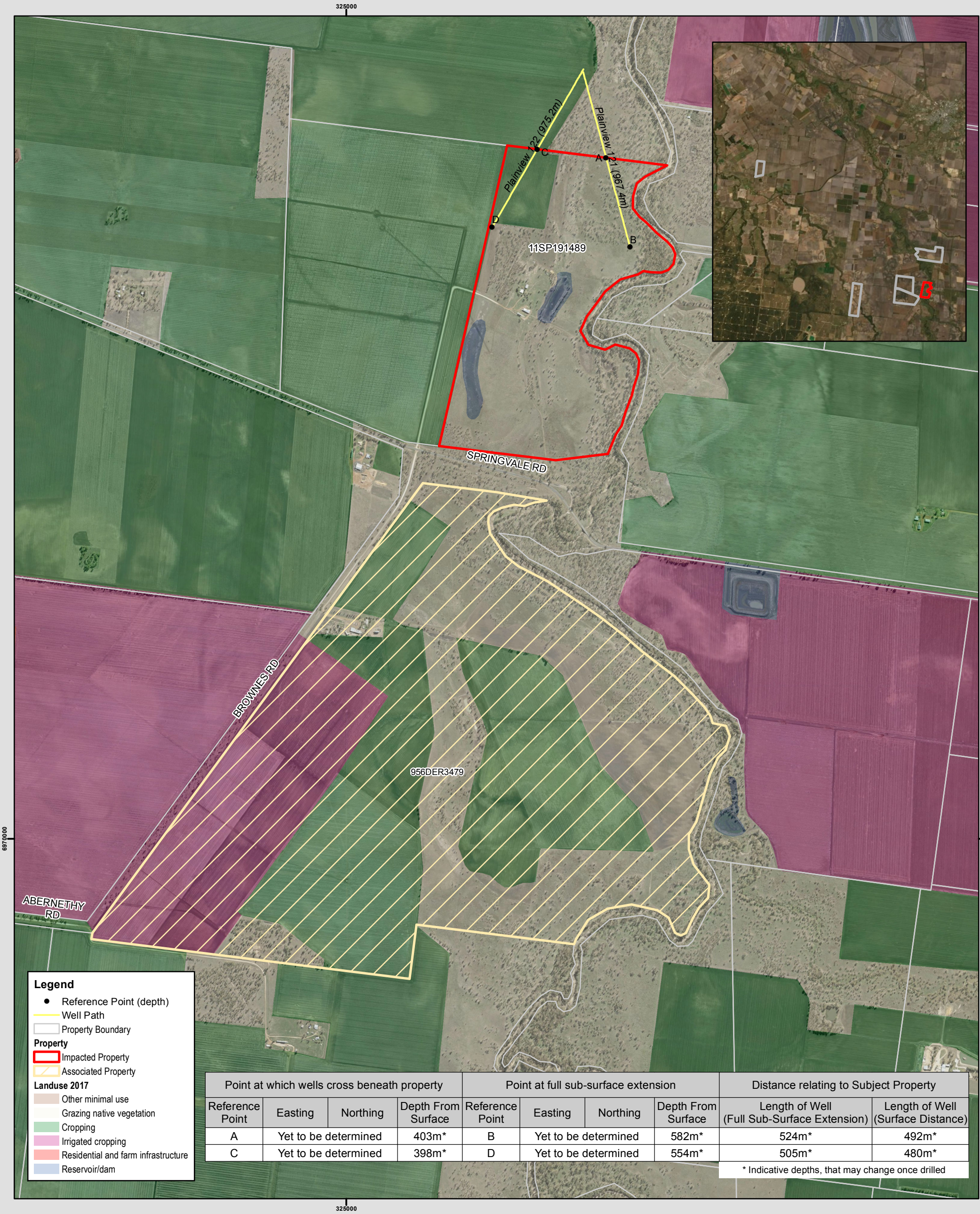
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- Two deviated well trajectories will be located 11SP191489, which will be drilled from a single drill pad located on the adjoining land parcel to the north.
- No infrastructure is proposed to be located on 956DER3479.

**Infrastructure summary**

- Two (2) subterranean deviated well trajectories will be installed on 11SP191489 from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectories on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory Name | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Plainview 121 | 492 | 403 | 582 |
| Plainview 122 | 480 | 398 | 554 |




| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 403m* | B | Yet to be determined | | 582m* | 524m* | 492m* |
| C | Yet to be determined | | 398m* | D | Yet to be determined | | 554m* | 505m* | 480m* |
| | | | | | | | | * Indicative depths, that may change once drilled | |

# RIDA Application

## Lotplan: 11SP191489

**Source:** Arrow Energy Pty Ltd, Geoscience Australia, DNRME

**Date:** 22/06/2022
**Issued To:** A Hall
**Author:** jjensen

Metres
0 437.5 875 1,750

Scale 1:19,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

arrow energy
go further



**Note:** The dimensions, areas, number of lots, size and location of corridor

**Property 3: 55DY592**

**Property Details**

- This property is designated as cropping (Class 3.3) with areas of grazing / native vegetation.
- This property is presently utilised for dryland cropping. Areas of timber on the property have been locked up.
- Surrounding land use is generally dryland cropping, with areas of irrigated cropping to the north and south as well as areas of grazing/native vegetation.

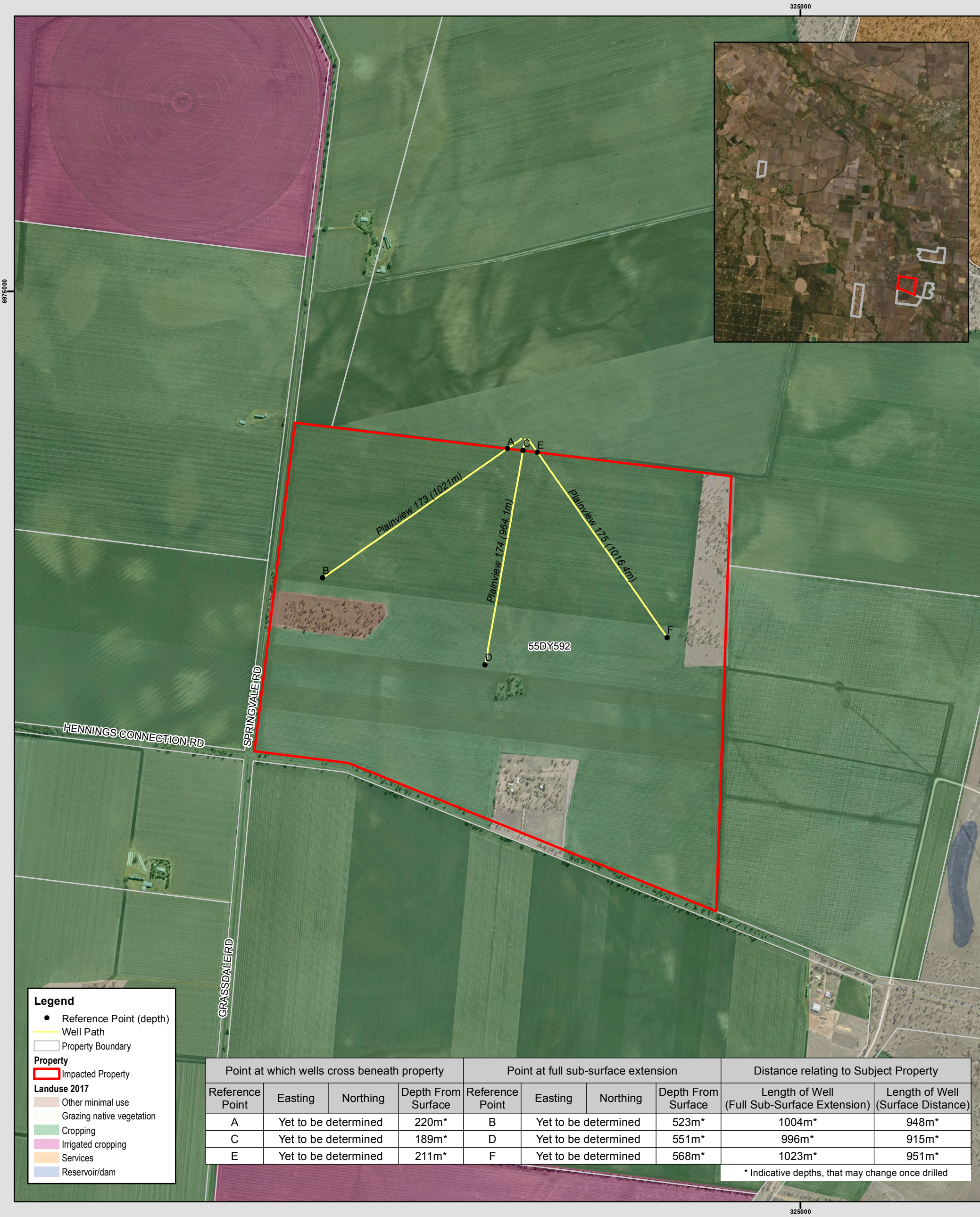
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- Three deviated well trajectories will be located on the lot, which will be drilled from a single drill pad located on the adjoining land parcel to the north.

**Infrastructure summary**

- Three (3) subterranean deviated well trajectories will be installed within the property from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectories on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory Name | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Plainview 173 | 948 | 220 | 523 |
| Plainview 174 | 915 | 189 | 551 |
| Plainview 175 | 951 | 211 | 568 |




| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 220m* | B | Yet to be determined | | 523m* | 1004m* | 948m* |
| C | Yet to be determined | | 189m* | D | Yet to be determined | | 551m* | 996m* | 915m* |
| E | Yet to be determined | | 211m* | F | Yet to be determined | | 568m* | 1023m* | 951m* |

* Indicative depths, that may change once drilled

# RIDA Application

**Lotplan: 55DY592**

**Source:** Arrow Energy Pty Ltd, Geoscience Australia, DNRME
**Date:** 22/06/2022
**Issued To:** A Hall
**Author:** jjensen

Metres: 0, 350, 700, 1,400

Scale 1:15,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N



**Note:** The dimensions, areas, number of lots, size and location of corridor

**Property 4: 141AG4261, 3SP243187, 2RP152259, 364A34907**

**Property Details**

- This property is comprised of two land parcels (11SP191489 & 956DER3479)
- The land use of the property is mapped as irrigated cropping, water reservoir/dam and small areas of grazing/native vegetation adjacent the Condamine River.
- This property is presently utilised for dryland and irrigated cropping. The lot contains a large irrigation dam and is bordered by the Condamine River.
- Surrounding land use is generally irrigated cropping, with areas of dryland cropping. Areas of grazing/native vegetation also occur, generally in association with the Condamine River. The parcel immediately to the south is a State Government Reserve.

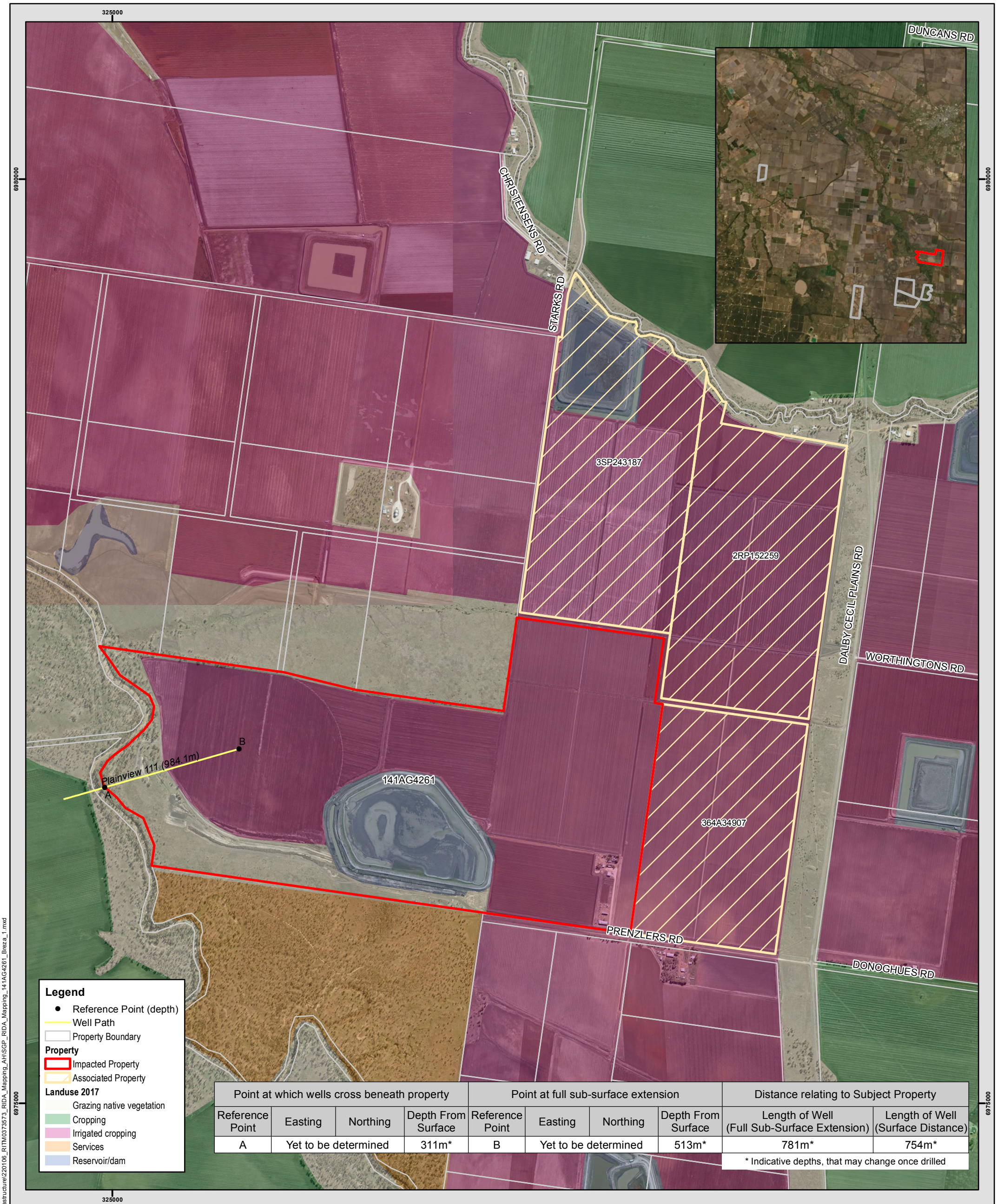
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- One deviated well trajectories will be located on 141AG4261, which will be drilled from a single drill pad located on the adjoining land parcel to the west.
- No infrastructure will be located on lots 3SP243187, 2RP152259, 364A34907.

**Infrastructure summary**

- One (1) subterranean deviated well trajectory will be installed within the property from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectory on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory Name | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Plainview 111 | 754 | 311 | 513 |




| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 311m* | B | Yet to be determined | | 513m* | 781m* | 754m* |

* Indicative depths, that may change once drilled

# RIDA Application

## Lotplan: 141AG4261

**Source:** Arrow Energy Pty Ltd, Geoscience Australia, DNRME
**Date:** 22/06/2022
**Issued To:** A Hall
**Author:** jjensen

Metres: 0 — 437.5 — 875 — 1,750

Scale 1:19,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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**Note:** The dimensions, areas, number of lots, size and location of corridor

**Property 5: 1RP78475**

**Property Details**

- This property is designated as cropping (Class 3.3) with area of grazing / native vegetation transecting the parcel.
- This property is presently utilised for dryland cropping.
- Surrounding land use is generally dryland cropping, with areas of irrigated cropping to the west and south as well as areas of grazing/native vegetation.

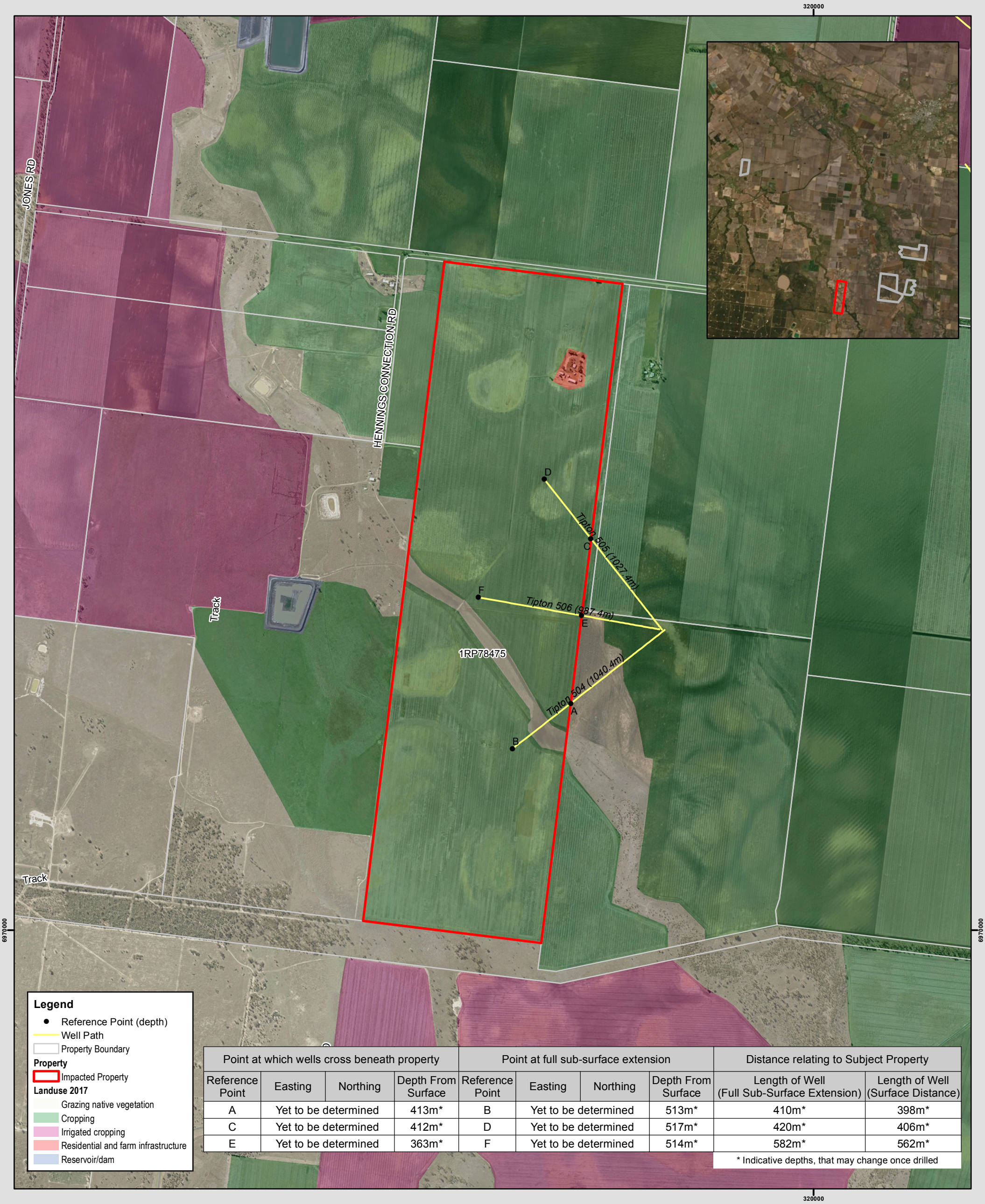
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- Three deviated well trajectories will be located on the lot, which will be drilled from a single drill pad located on the adjoining land parcel to the east.

**Infrastructure summary**

- Three (3) subterranean deviated well trajectories will be installed within the property from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectories on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory Name | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Tipton 504 | 398 | 413 | 513 |
| Tipton 505 | 406 | 412 | 517 |
| Tipton 506 | 562 | 363 | 514 |




**Legend**

- Reference Point (depth)
- Well Path
- Property Boundary

**Property**

- Impacted Property

**Landuse 2017**

- Grazing native vegetation
- Cropping
- Irrigated cropping
- Residential and farm infrastructure
- Reservoir/dam

| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 413m* | B | Yet to be determined | | 513m* | 410m* | 398m* |
| C | Yet to be determined | | 412m* | D | Yet to be determined | | 517m* | 420m* | 406m* |
| E | Yet to be determined | | 363m* | F | Yet to be determined | | 514m* | 582m* | 562m* |

* Indicative depths, that may change once drilled

# RIDA Application

## Lotplan: 1RP78475

**Source:** Arrow Energy Pty Ltd, Geoscience Australia, DNRME
**Date:** 22/06/2022
**Issued To:** A Hall
**Author:** jjensen

0 — 437.5 — 875 — 1,750 Metres

Scale 1:19,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

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**Note:** The dimensions, areas, number of lots, size and location of corridor

**Property 6: 56DY592**

**Property Details**

- This property is designated as cropping (Class 3.3) with area of grazing / native vegetation.
- This property is presently utilised for dryland cropping.
- Surrounding land use is generally dryland cropping, with areas of irrigated cropping to the south as well as areas of grazing/native vegetation.

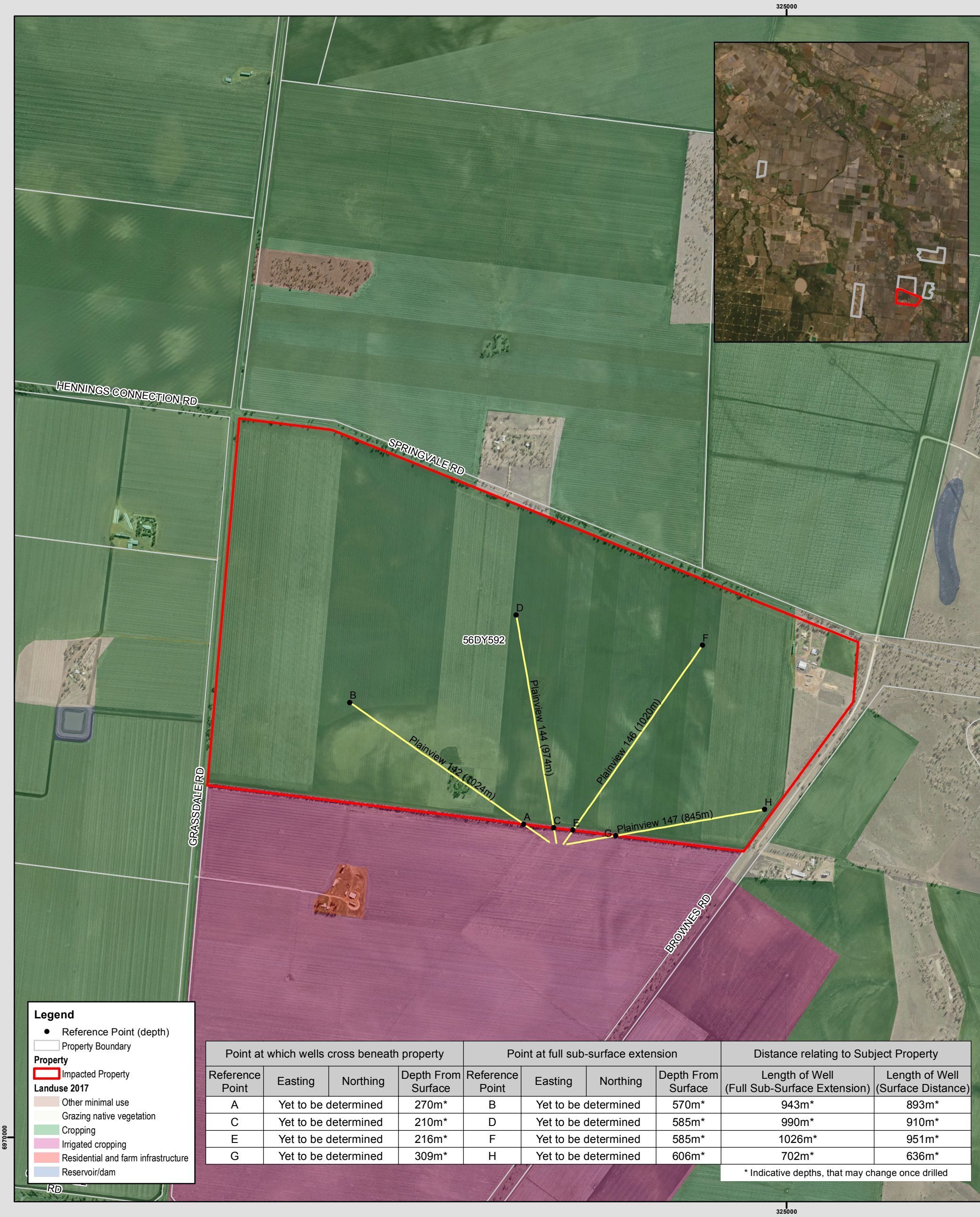
**Field Layout Summary**

- No surface infrastructure is proposed to occur on this property.
- Surface disturbance to the property has been avoided.
- Four deviated well trajectories will be located below the land parcel surface, which will be drilled from a single drill pad located on the adjoining land parcel to the south.

**Infrastructure summary**

- Four (4) subterranean deviated well trajectories will be installed within the property from the adjacent land parcel which is not part of the property.
- The length and depth of the deviated well trajectories on the property is detailed below.
- The location of the infrastructure is illustrated on the Property Figure.

| Trajectory | Length on Property (m) | Entry Depth on Property (m) | Termination Depth on Property (m) |
|---|---|---|---|
| Plainview 142 | 893 | 270 | 570 |
| Plainview 144 | 910 | 210 | 585 |
| Plainview 146 | 951 | 216 | 585 |
| Plainview 147 | 636 | 309 | 606 |




**Legend**

- Reference Point (depth)
- Property Boundary

**Property**

- Impacted Property

**Landuse 2017**

- Other minimal use
- Grazing native vegetation
- Cropping
- Irrigated cropping
- Residential and farm infrastructure
- Reservoir/dam

| Point at which wells cross beneath property | | | | Point at full sub-surface extension | | | | Distance relating to Subject Property | |
|---|---|---|---|---|---|---|---|---|---|
| Reference Point | Easting | Northing | Depth From Surface | Reference Point | Easting | Northing | Depth From Surface | Length of Well (Full Sub-Surface Extension) | Length of Well (Surface Distance) |
| A | Yet to be determined | | 270m* | B | Yet to be determined | | 570m* | 943m* | 893m* |
| C | Yet to be determined | | 210m* | D | Yet to be determined | | 585m* | 990m* | 910m* |
| E | Yet to be determined | | 216m* | F | Yet to be determined | | 585m* | 1026m* | 951m* |
| G | Yet to be determined | | 309m* | H | Yet to be determined | | 606m* | 702m* | 636m* |

* Indicative depths, that may change once drilled

# RIDA Application

## Lotplan: 56DY592

**Source:** Arrow Energy Pty Ltd, Geoscience Australia, DNRME
**Date:** 12/07/2022
**Issued To:** A Hall
**Author:** jjensen

Metres: 0 — 350 — 700 — 1,400

Scale 1:15,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

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**Note:** The dimensions, areas, number of lots, size and location of corridor

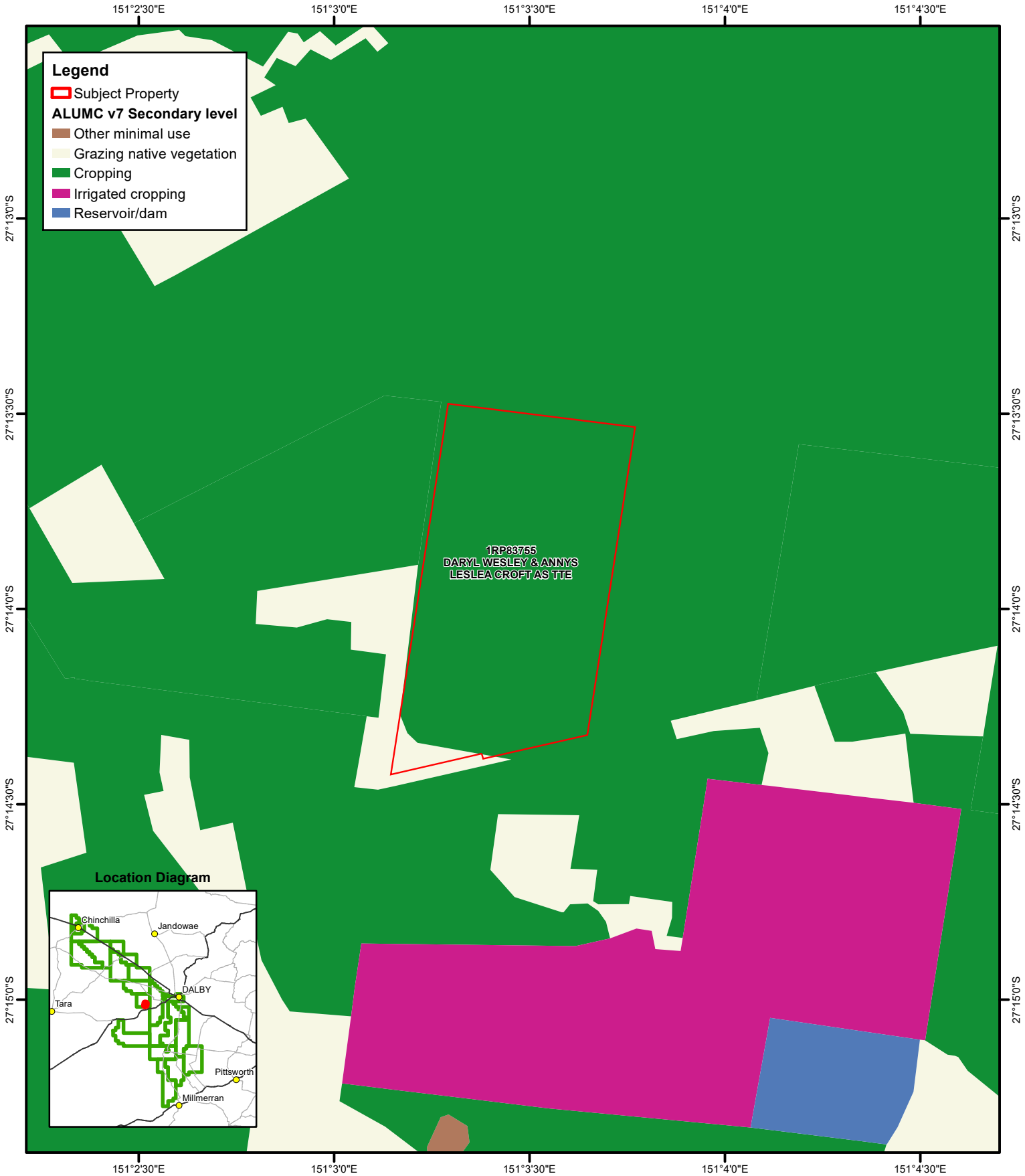


Document: R:\GIS\Geomatics_Team\WORK_REQUESTS\Infrastructure\220106_RITM0373573_RIDA_Mapping_AH\SGP_RIDA_Mapping_56DY592_Dalrus_1.mxd

**NOT FOR CONSTRUCTION**

# Appendix 4: Queensland Land Use Mapping Program (QLUMP)

Land use on this mapping is classified according to the Australian Land Use and Management Classification (ALUMC) Version 8, 2016, based upon land use within the Condamine natural resource management region as at 2012.




This dataset is a digital land use map of the Condamine NRM region, Queensland. As nearly as possible it shows land use in 2012. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Queensland Government. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50,000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.
In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

Meters 0 125 250 500 750 1,000

N



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| Rev | Date | Revision Description | Org | Chk | Eng | QA | Appr |
|---|---|---|---|---|---|---|---|
| 0 | 21.04.22 | First issue | AW | | | | AH |

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**Scale @ A4:** 1:24,000
**Coordinate System:** GCS GDA 1994

**Status:** IFI
**Issued To:** A Hall
**Author:** awolhuter

**Source:** Arrow Energy Limited
Geosciences Australia
Qld Gov.

# Land Use

## Queensland Land Use Mapping Program

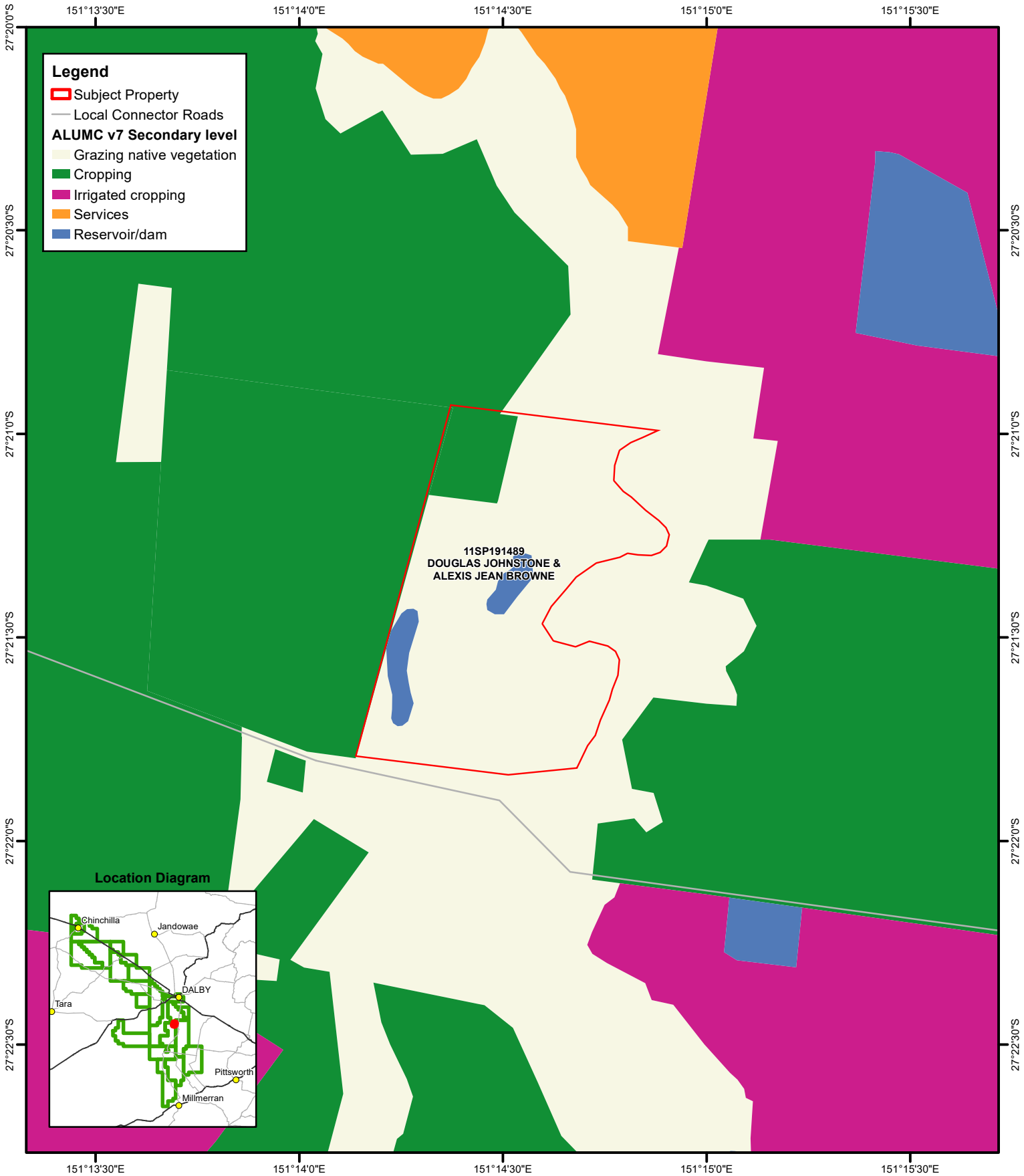
**1RP83755**

**Uncontrolled (0)**

**NOT FOR CONSTRUCTION**

Document: V:\Products\Australia\Queensland\Surat_Basin\General\220420_RITM0402111_RIDALandUseMaps_AH\LandUseMaps_141AG426_Owixd

Print Date: 21/04/2022




This dataset is a digital land use map of the Condamine NRM region, Queensland. As nearly as possible it shows land use in 2012. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Queensland Government. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50,000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.
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Meters 0 125 250 500 750 1,000

N



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| Rev | Date | Revision Description | AW Org | Chk | Eng | QA | AH App |
|---|---|---|---|---|---|---|---|
| 0 | 21.04.22 | First issue | | | | | |

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**Scale @ A4:** 1:23,000
**Coordinate System:** GCS GDA 1994

**Status:** IFI
**Issued To:** A Hall
**Author:** awolhuter

**Source:** Arrow Energy Limited
Geosciences Australia
Qld Gov.

# Land Use

## Queensland Land Use Mapping Program

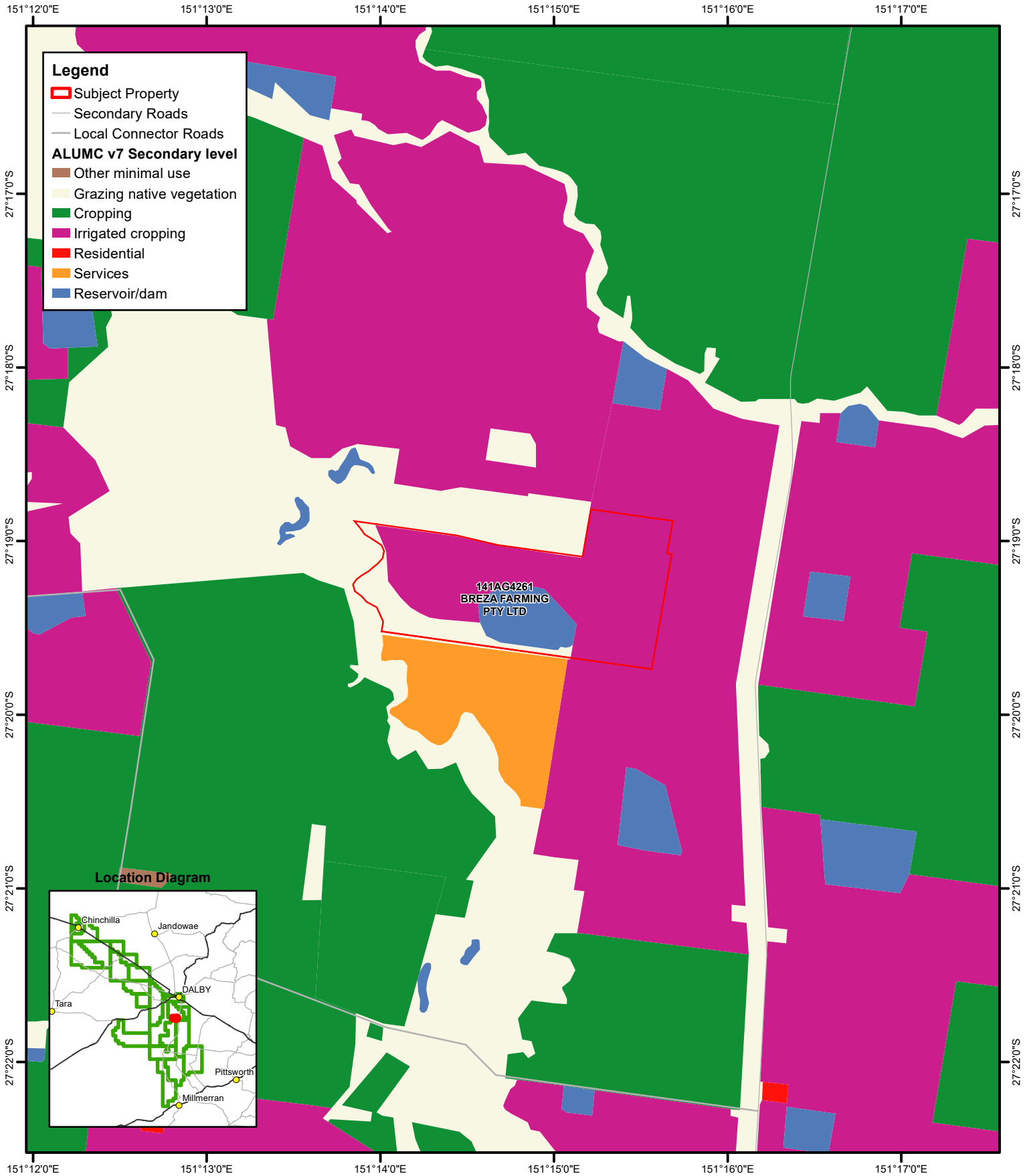
**11SP191489**

**Uncontrolled (0)**

**NOT FOR CONSTRUCTION**

Document: V:\Products\Australia\Queensland\Surat_Basin\General\220420_RITM0402111_RIDALandUseMaps_AH\LandUseMaps_141AG426_Owixd

Print Date: 21/04/2022




This dataset is a digital land use map of the Condamine NRM region, Queensland. As nearly as possible it shows land use in 2012. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Queensland Government. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50,000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.
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Meters 0 250500 1,000 1,500 2,000



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| Rev | Date | Revision Description | AW Org | Chk | Eng | QA | AH App |
|---|---|---|---|---|---|---|---|
| 0 | 21.04.22 | First issue | | | | | |

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**Scale @ A4:** 1:54,000
**Coordinate System:** GCS GDA 1994

**Status:** IFI
**Issued To:** A Hall
**Author:** awolhuter

**Source:** Arrow Energy Limited
Geosciences Australia
Qld Gov.

# Land Use

## Queensland Land Use Mapping Program

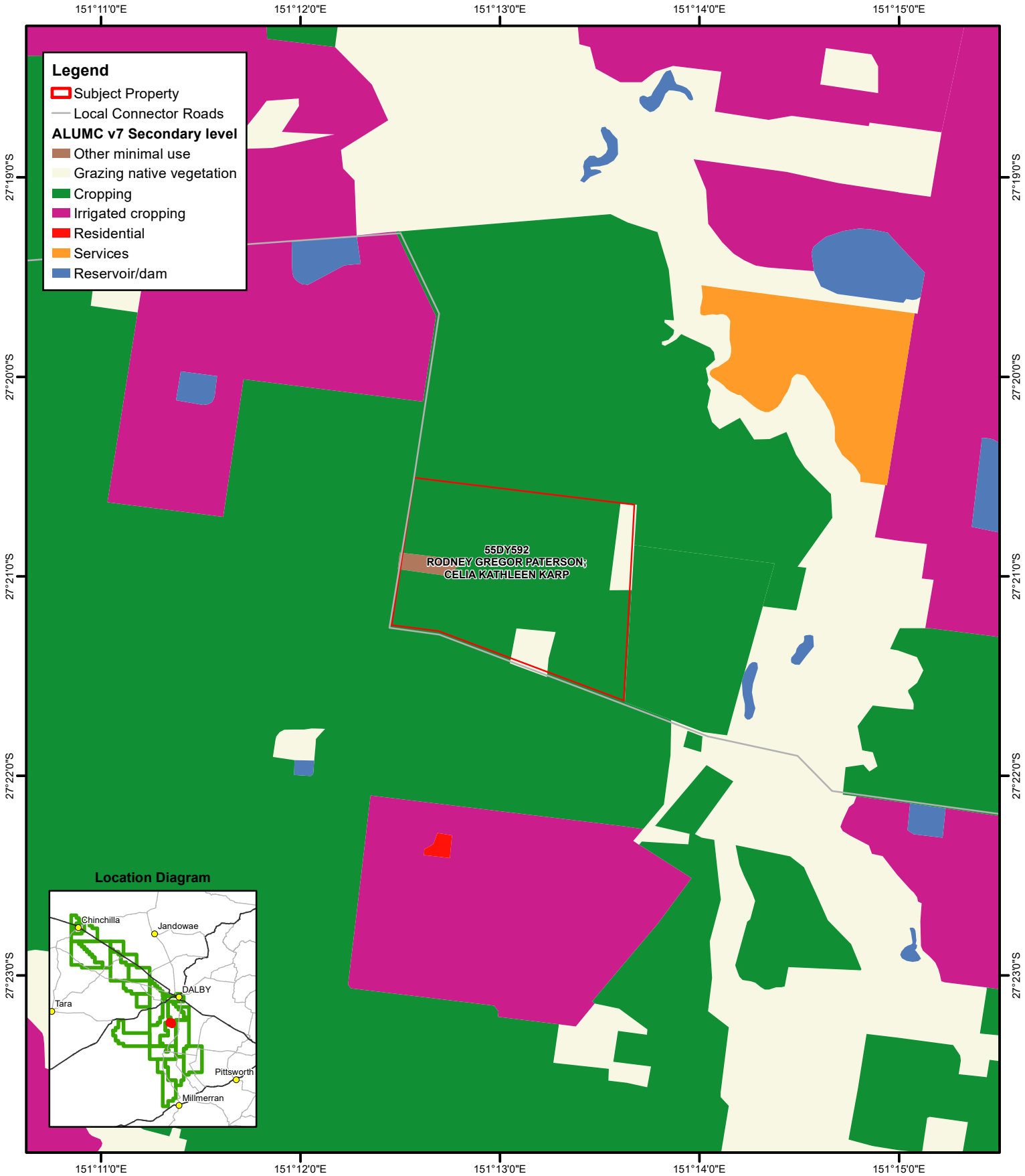
**141AG4261**

**Uncontrolled (0)**

**NOT FOR CONSTRUCTION**

Document: V:\Products\Australia\Queensland\Surat_Basin\General\220420_RITM0402111_RIDALandUseMaps_AH\LandUseMaps_141AG4261_Owned

Print Date: 21/04/2022




This dataset is a digital land use map of the Condamine NRM region, Queensland. As nearly as possible it shows land use in 2012. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Queensland Government. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50,000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.
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| Rev | Date | Revision Description | AW Org | Chk | Eng | QA | AH App |
|---|---|---|---|---|---|---|---|
| 0 | 21.04.22 | First issue | | | | | |

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**Scale @ A4:** 1:47,000
**Coordinate System:** GCS GDA 1994

**Status:** IFI
**Issued To:** A Hall
**Author:** awolhuter

**Source:** Arrow Energy Limited
Geosciences Australia
Qld Gov.

# Land Use

## Queensland Land Use Mapping Program

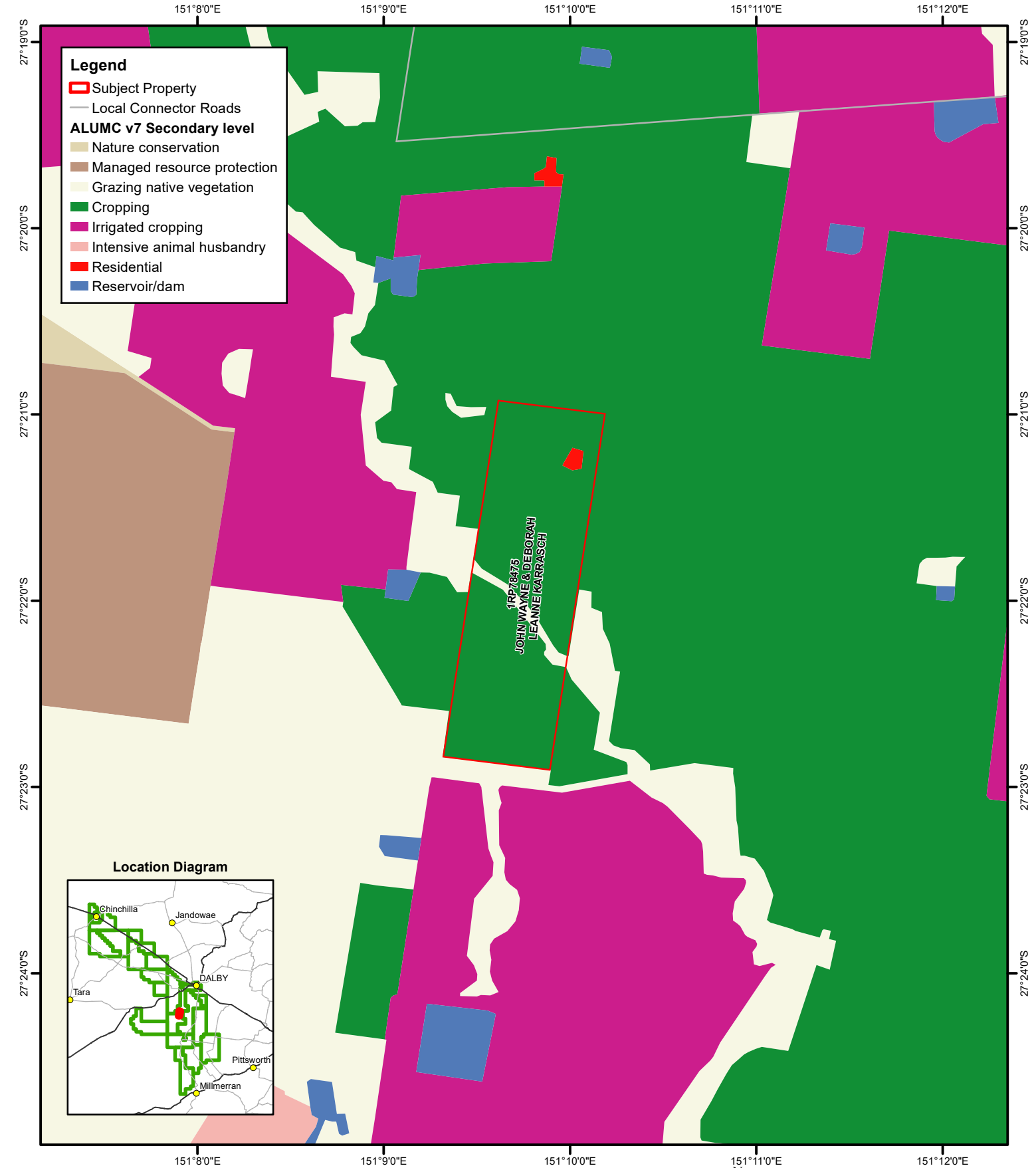
**55DY592**

**Uncontrolled (0)**

**NOT FOR CONSTRUCTION**

Document: V:\Products\Australia\Queensland\Surat_Basin\General\220420_RITM0402111_RIDALandUseMaps_AH\LandUseMaps_64DY972_0.mxd

Print Date: 21/04/2022




This dataset is a digital land use map of the Condamine NRM region, Queensland. As nearly as possible it shows land use in 2012. The dataset is a product of the Queensland Land Use Mapping Program (QLUMP) and was produced by the Queensland Government. The dataset comprises an ESRI vector geodatabase at a nominal scale of 1:50,000. The layer is a polygon dataset with each class having attributes describing land use. Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 7, May 2010.
In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

Meters 0 250 500 1,000 1,500 2,000

N



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| Rev | Date | Revision Description | AW Org | Chk | Eng | QA | AH App |
|---|---|---|---|---|---|---|---|
| 0 | 21.04.22 | First issue | | | | | |

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**Scale @ A4:** 1:50,000
**Coordinate System:** GCS GDA 1994

**Status:** IFI
**Issued To:** A Hall
**Author:** awolhuter

**Source:** Arrow Energy Limited
Geosciences Australia
Qld Gov.

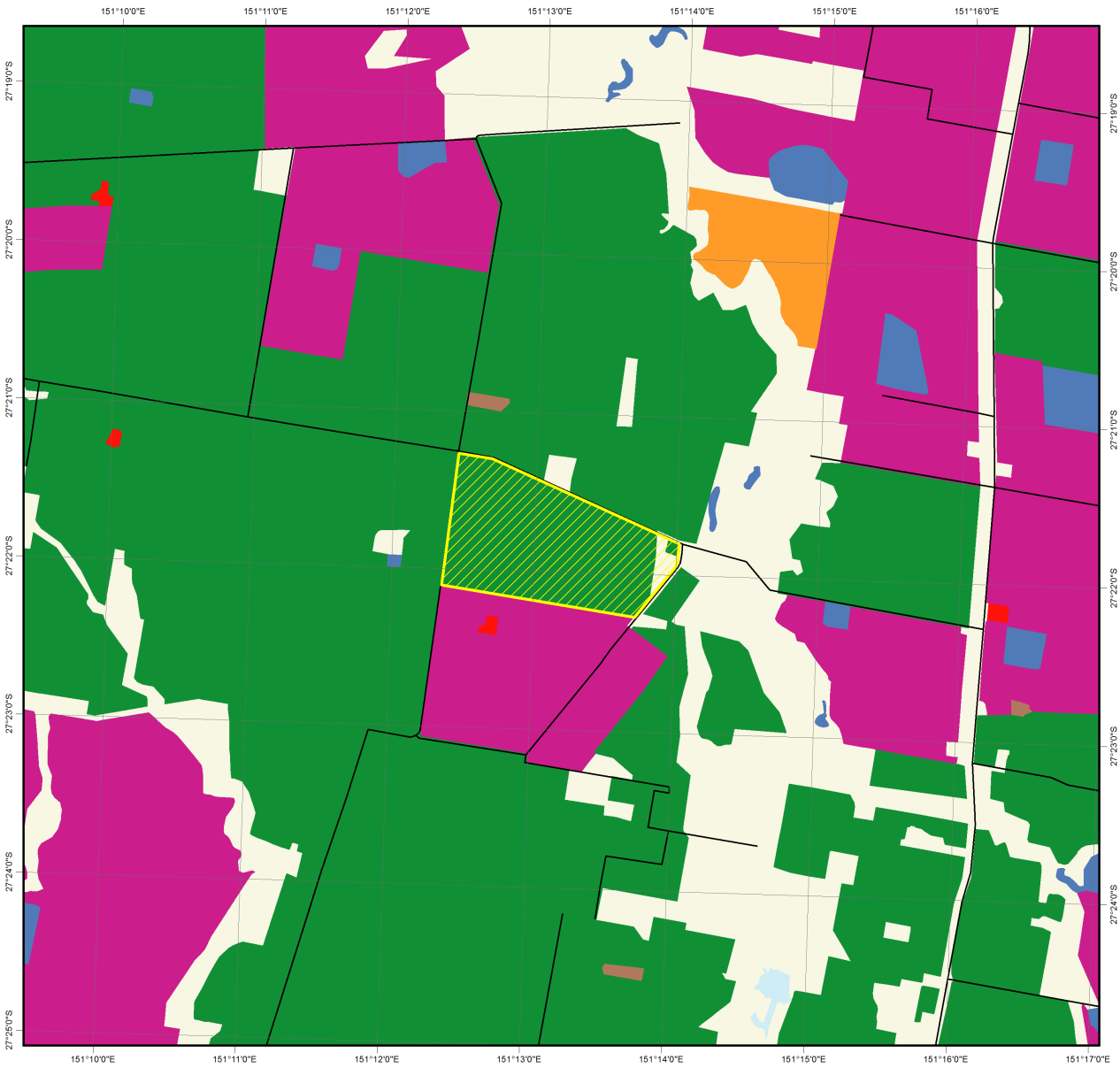
# Land Use

## Queensland Land Use Mapping Program

**1RP78475**

**Uncontrolled (0)**

Document: V:\Products\Australia\Queensland\Surat_Basin\General\220420_RITM0402111_RIDALandUseMaps_AH\LandUseMaps_64DY972_0.mxd **NOT FOR CONSTRUCTION** Print Date: 21/04/2022



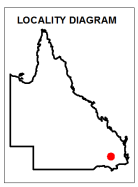

# Land Use

## Queensland Land Use Mapping Program

### Legend

**ALUM v8 Secondary level**

- Selected Lot and Plan
- Other minimal use
- Grazing native vegetation
- Cropping
- Irrigated cropping
- Residential and farm infrastructure
- Services
- Lake
- Reservoir/dam
- Freeways / motorways; Highways
- Secondary roads; Streets




N

0 680 1360 2040 2720 3400 m

This product is projected into GDA 1994 Queensland Albers

The land use dataset is a product of the Queensland Land use Mapping Program (QLUMP), at a nominal scale of 1:50,000. The layer is a polygon dataset with each feature having attributes describing land use . It presents the most current land use information available in Queensland.

Land use is classified according to the Australian Land Use and Management Classification (ALUMC) Version 8, October 2016. Primary and secondary levels relate to land use (i.e. the principal use of the land in terms of the objectives of the land manager), the tertiary level further discriminate land use, eg. commodity/intensity. Where required and possible, attribution is performed to tertiary level. QLUMP maps the land use classes of sugar and cotton consistently to tertiary level. The minimum attribution level for land use mapping in Queensland is secondary land use, as presented in this map.

Refer to the contact position for additional information regarding source data. Further information relating to land use mapping can be found at http://www.qld.gov.au/environment/land/vegetation/mapping/qlump/ and http://www.agriculture.gov.au/abares/aclump/land-use/

While every care is taken to ensure the accuracy of this information, the Department of Environment and Science makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which might be incurred as a result of the information being inaccurate or incomplete in any way and for any reason.

# Appendix 5: Forage Crop Frequency Data for the years 2012 – 2021

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# FORAGE REPORT: CROP FREQUENCY

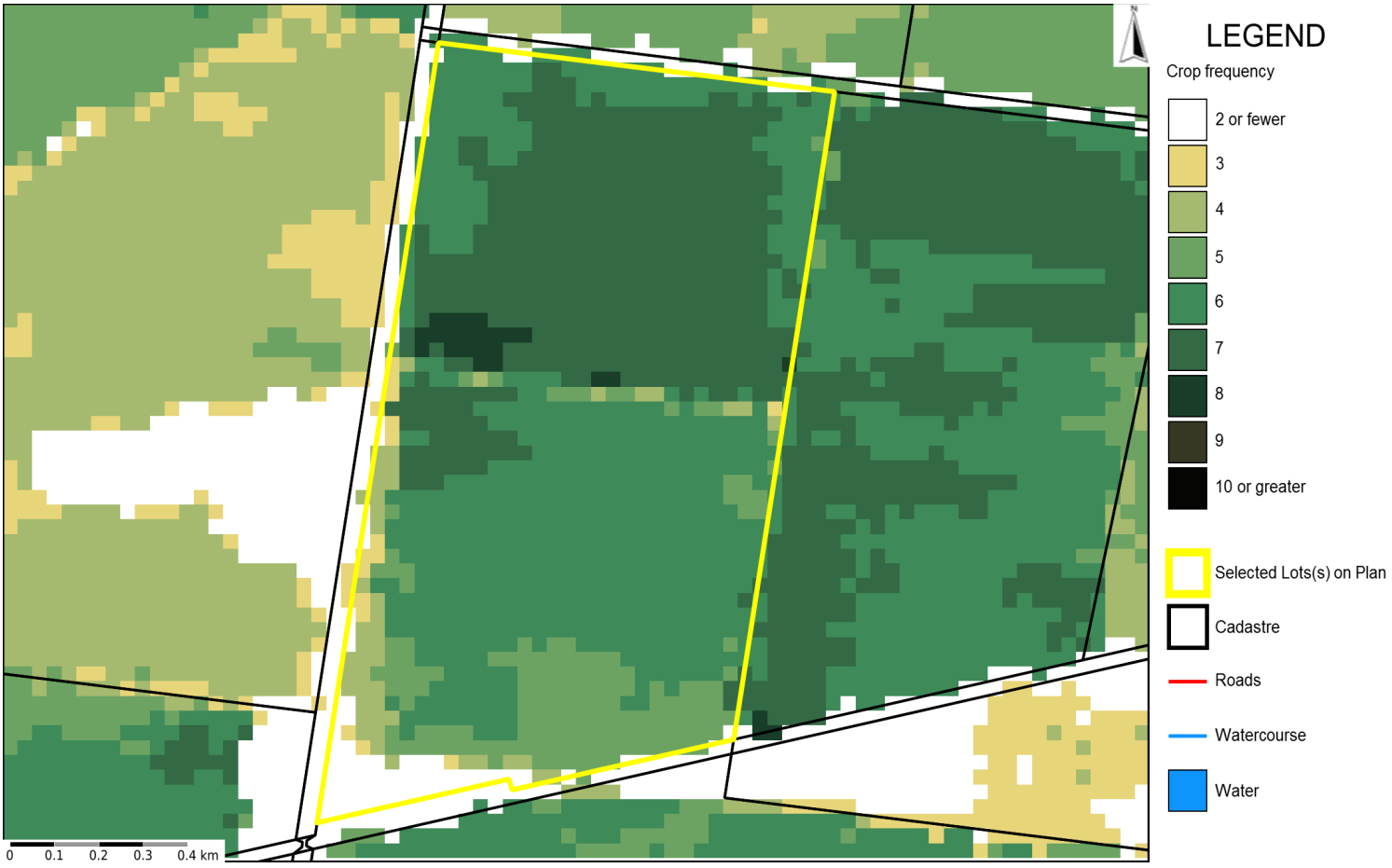


Queensland Government

## Introduction

This report presents maps of crop frequency for your chosen area, and chosen time period. Maps are based on time-series analysis of satellite imagery (30-m spatial resolution), for both the summer and winter growing seasons, aimed at detecting cycles of greenness in vegetation. Composite satellite images that display the maximum greenness within a summer or winter growing season for each year are also provided, as a visual reference. For further information refer to the FORAGE User Guide (https://data.longpaddock.qld.gov.au/static/forage_user_guide.pdf ) .

## Estimated total crop frequency map (2012 - 2021)




## How to interpret the information

**Crop-frequency mapping**: Coloured areas on the maps indicate locations where active crops have been detected three or more times in the summer or winter growing seasons, for the time period specified. The map on this page shows "Total Frequency" which is a count of the number of times that an active crop was detected. The maps on the following page show the summer and winter crop frequency, respectively. Analysis of satellite imagery can result in some misclassification, so it is recommended to view the composite imagery (see below) to help confirm the presence of a crop in a given season.

**Mapping of broad groups of crops**: Crop frequency is also separated into estimates of the broad crop groups within the area. This estimation is based on an automated classification approach (see https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/crops for more detail).

In the winter season the classification differentiates between the groups:

- Cereal crops (e.g. wheat, barley, oats);
- Pulse crops (e.g. chickpea).

In the summer season the classification differentiates between the groups:

- Coarse-grain and pulse (e.g. sorghum, maize, mungbean);
- Cotton crop.

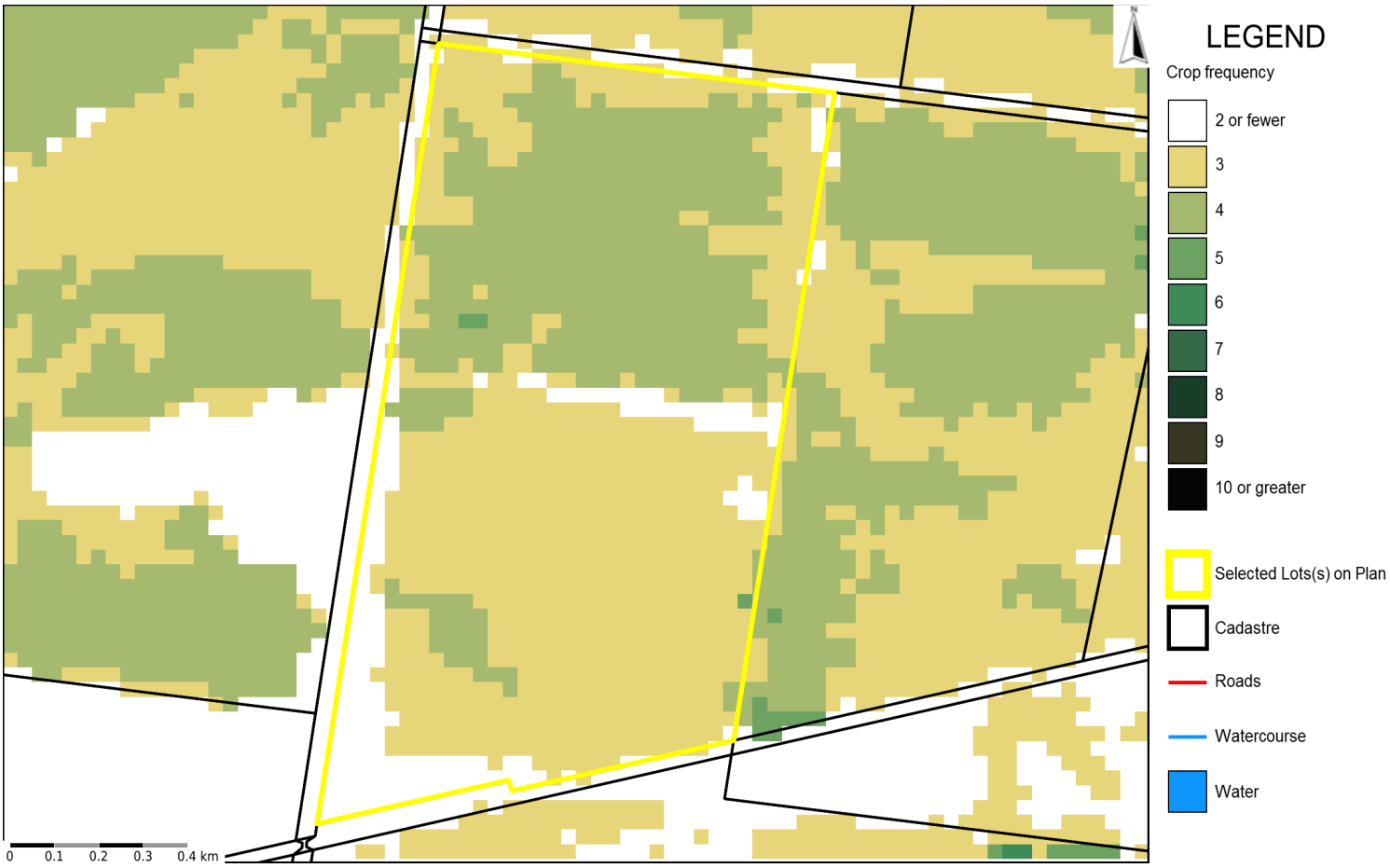
**Composite satellite imagery**: Due to the limitations of the automated method used to detect active cropping, it is recommended to view the seasonal composite images (pages 5 onward), compiled to represent the maximum greenness (per pixel) within a growing season. Cropped areas will generally appear bright green in the imagery compared with the surrounding landscape. Even if the crop-frequency mapping does not indicate cropping in an area, it is important to check each composite image to confirm that cropping has not been undertaken. Sometimes it will not be possible to clearly identify cropped areas in the imagery, e.g in some wetter seasons the entire landscape might appear green. In this case, it is recommended to undertake further investigation using other information sources. Note: the composite images are only used to confirm the presence or absence of cropping activity; it is not possible to visually differentiate between the crop groups.

# FORAGE REPORT: CROP FREQUENCY

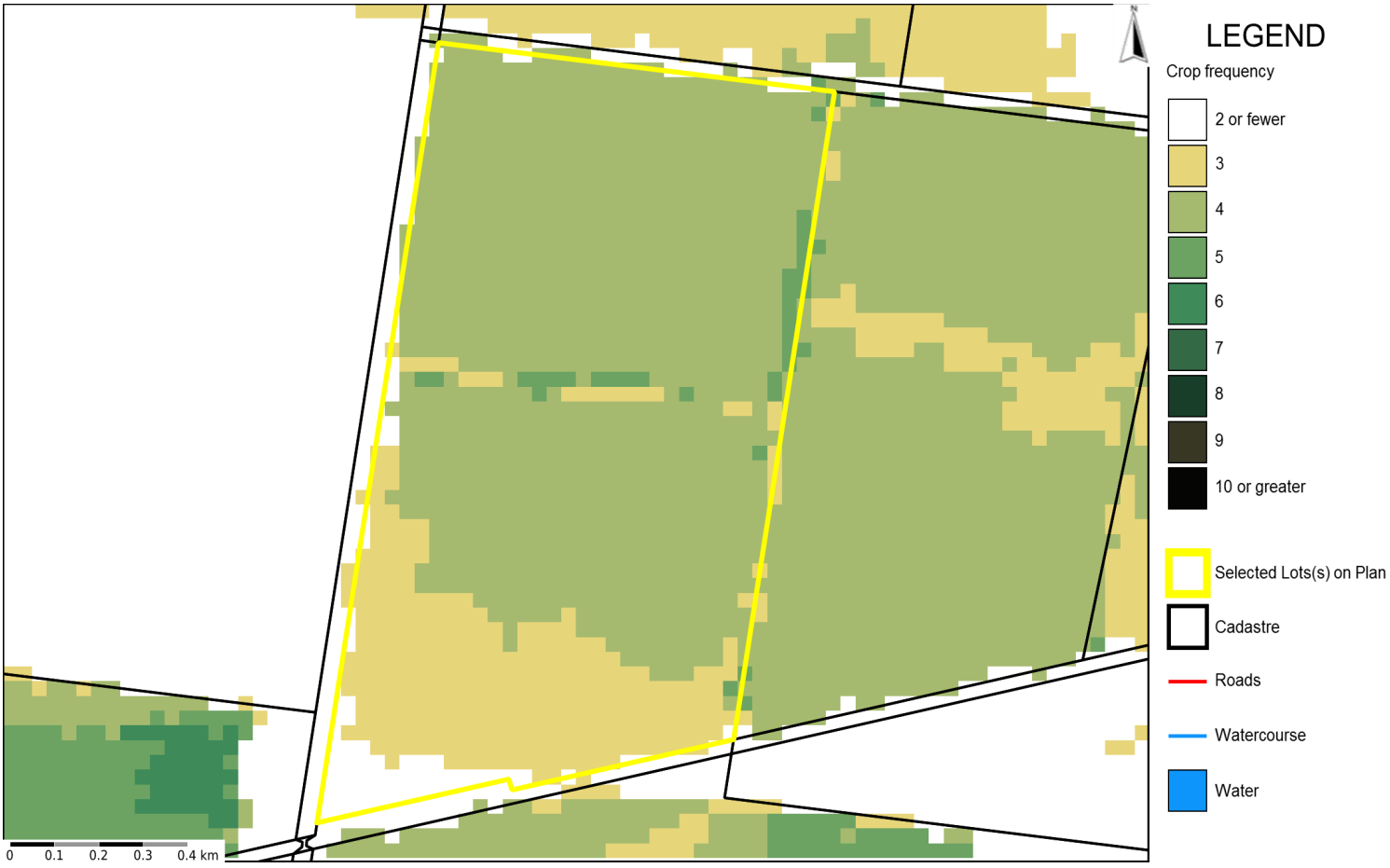
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP83755* *Label: p9*

Queensland Government

## Estimated frequency map for summer (February) crops (2012 - 2021)




## Estimated frequency map for winter (September) crops (2012 - 2021)

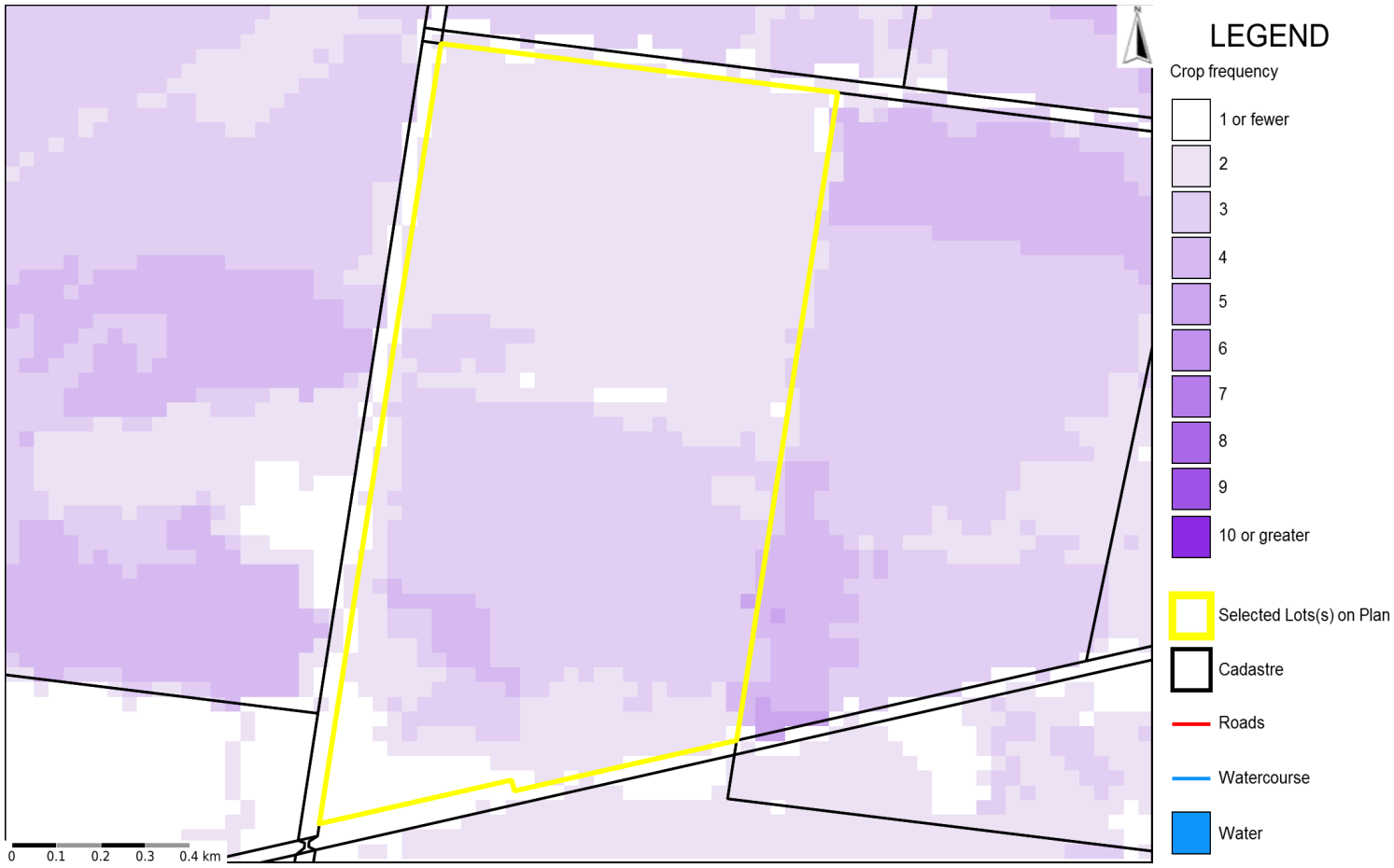


# FORAGE REPORT: CROP FREQUENCY

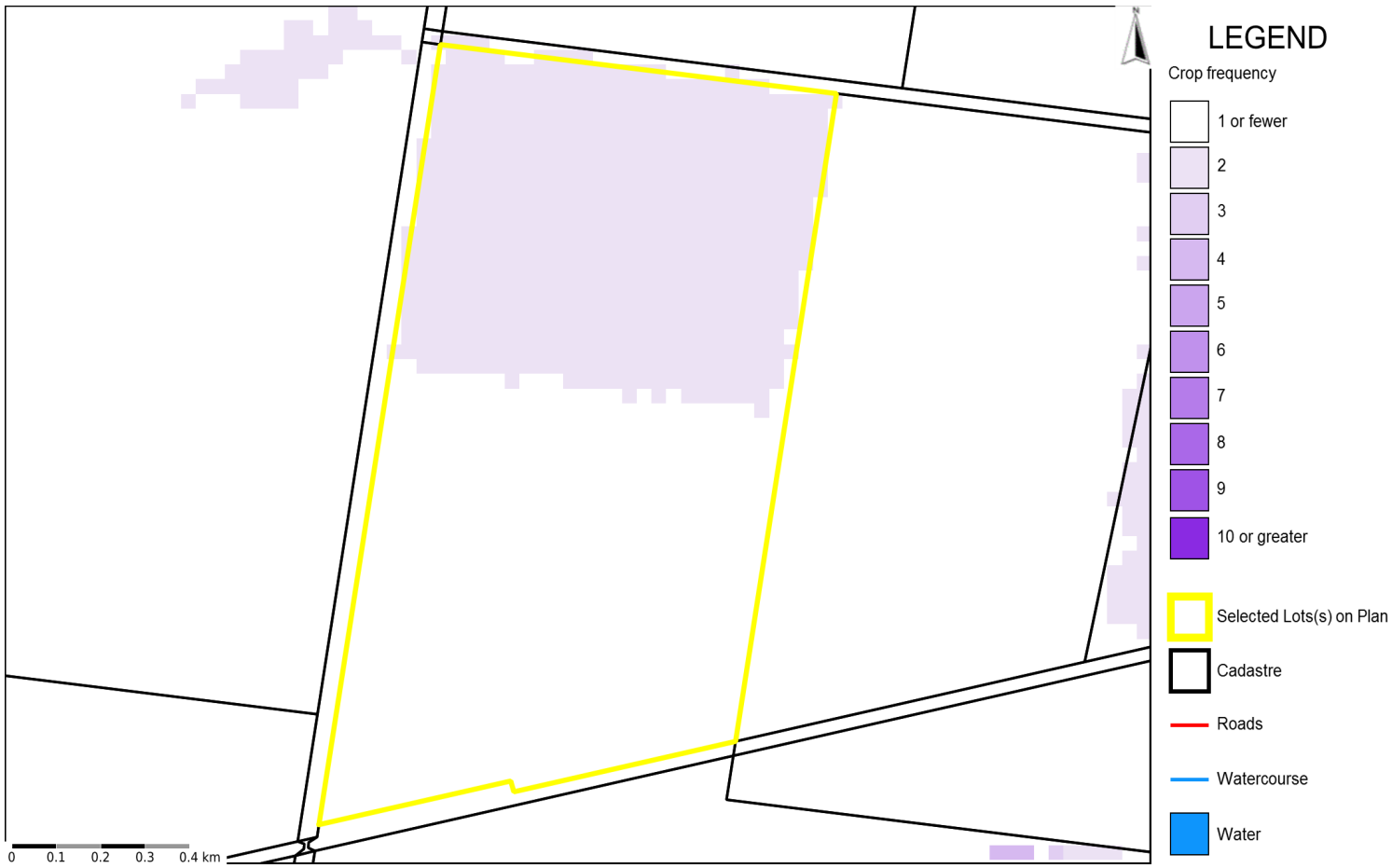
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP83755* *Label: p9*

Queensland Government

## Estimated frequency map for summer (February) coarse grain and pulse crops (2012 - 2021)




## Estimated frequency map for summer (February) cotton crops (2012 - 2021)

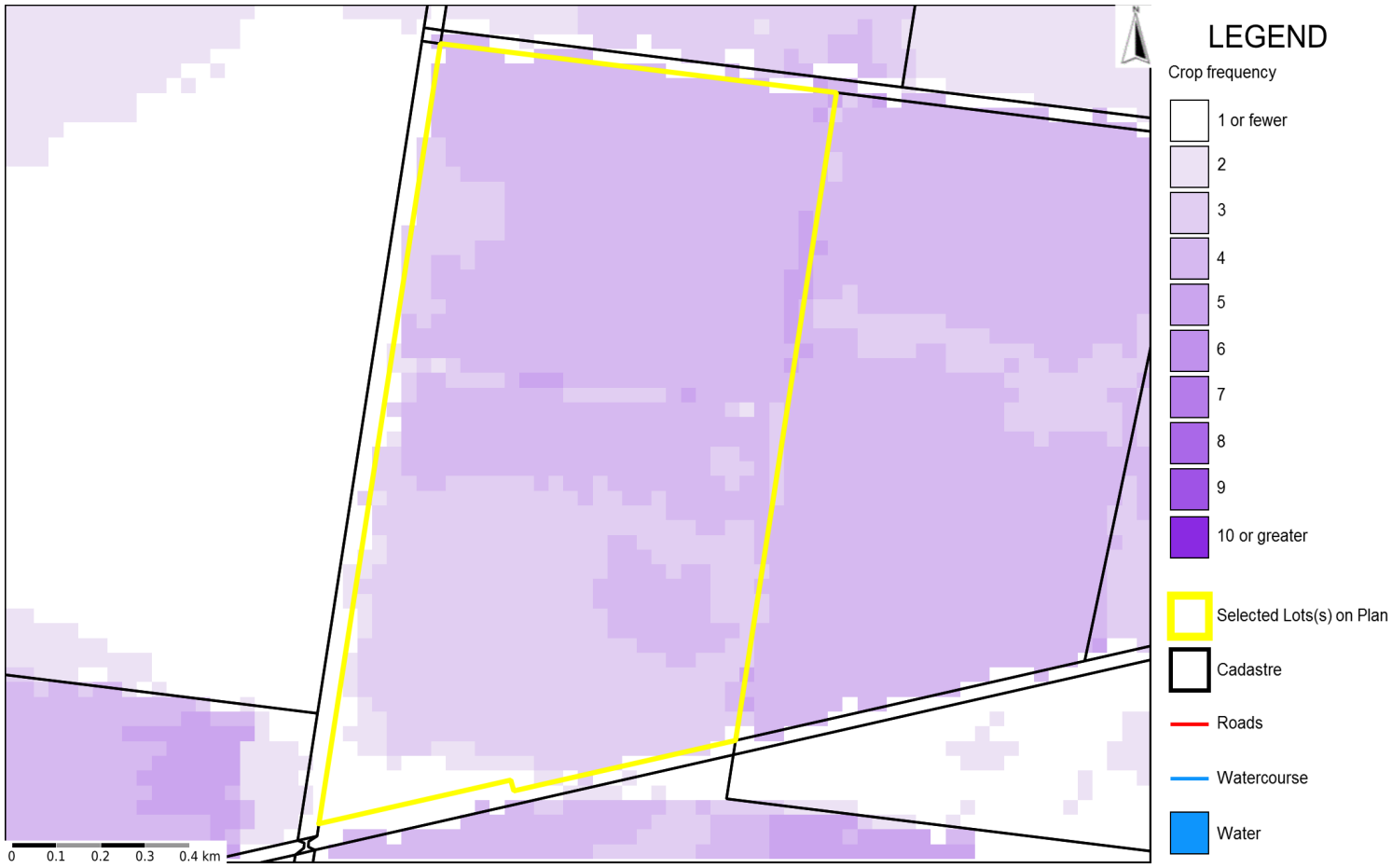


# FORAGE REPORT: CROP FREQUENCY

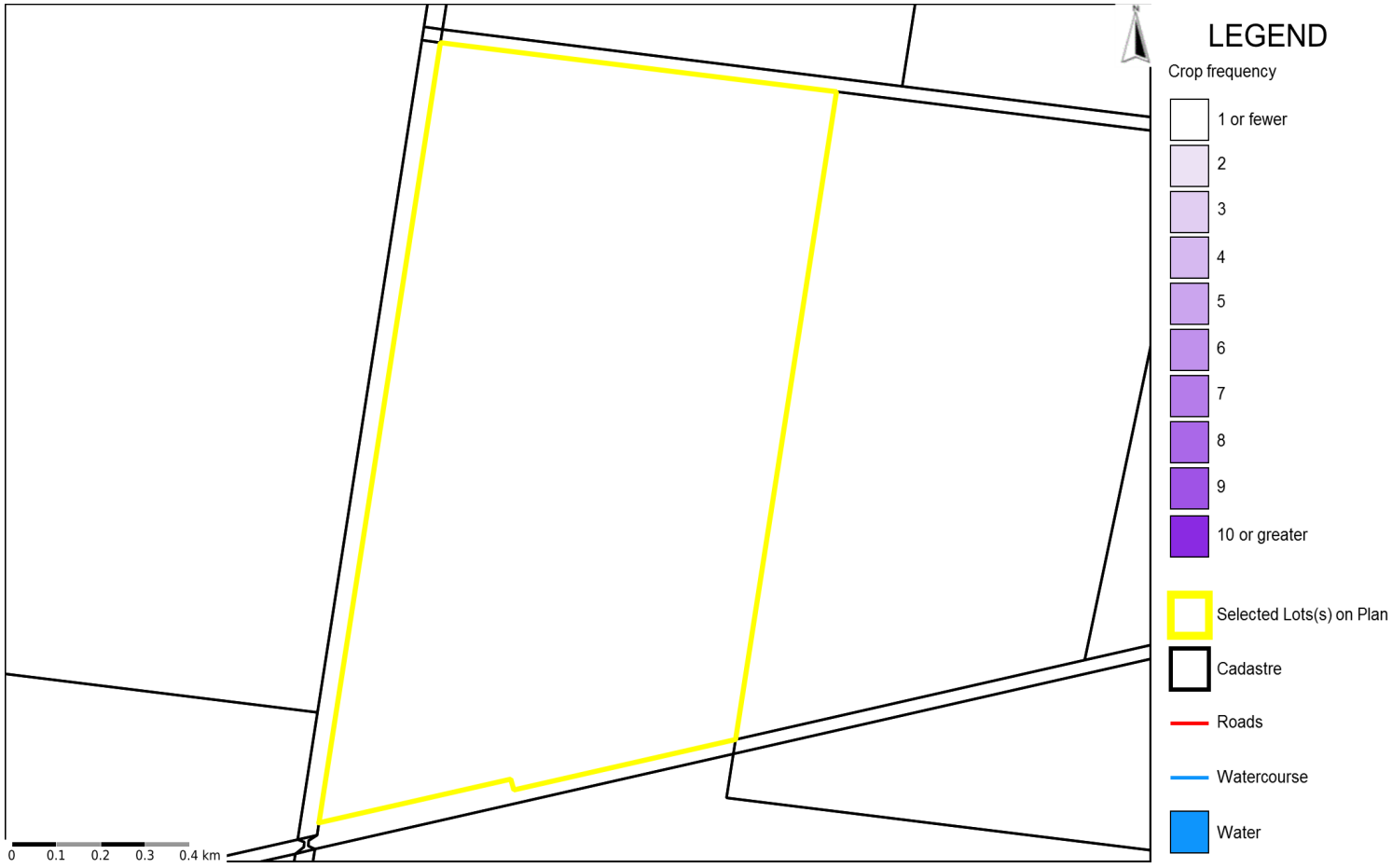
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP83755* *Label: p9*

Queensland Government

## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)

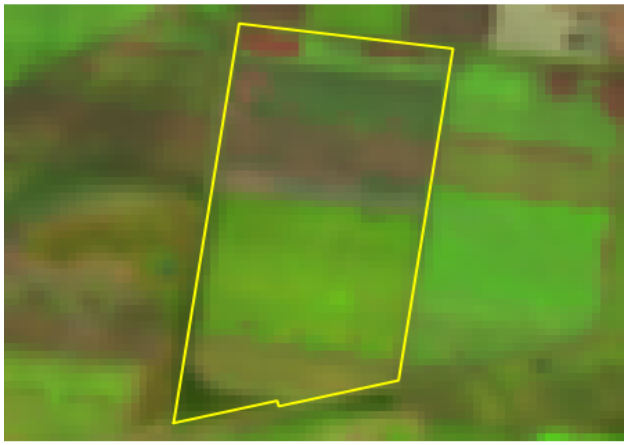


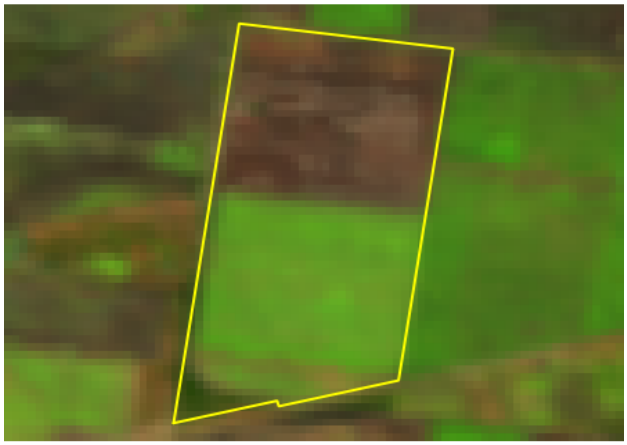
# FORAGE REPORT: CROP FREQUENCY



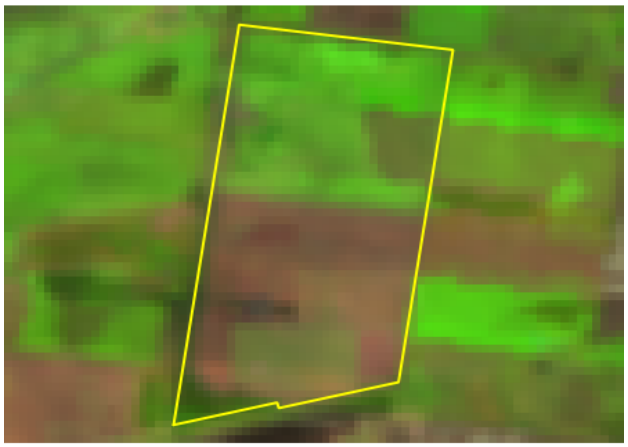
Queensland Government

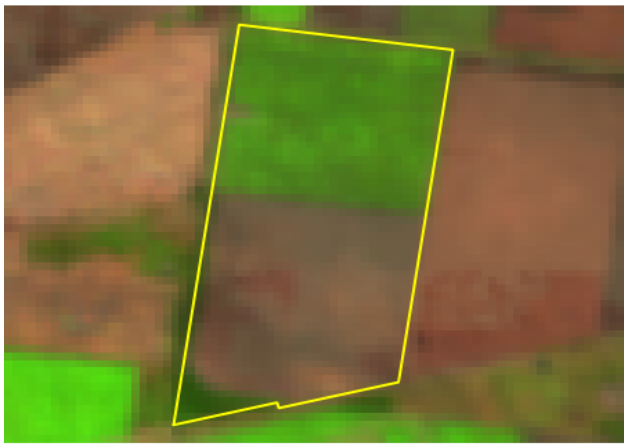
## February (left) and September (right) images for 2012



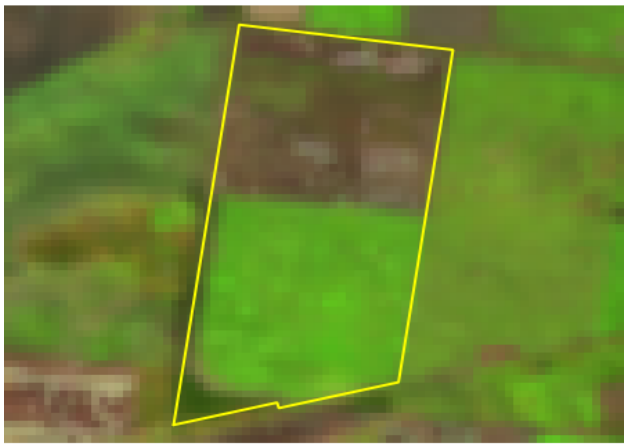


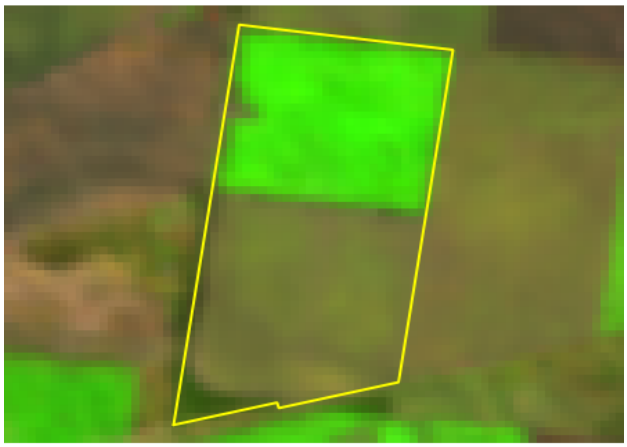
## February (left) and September (right) images for 2013





## February (left) and September (right) images for 2014



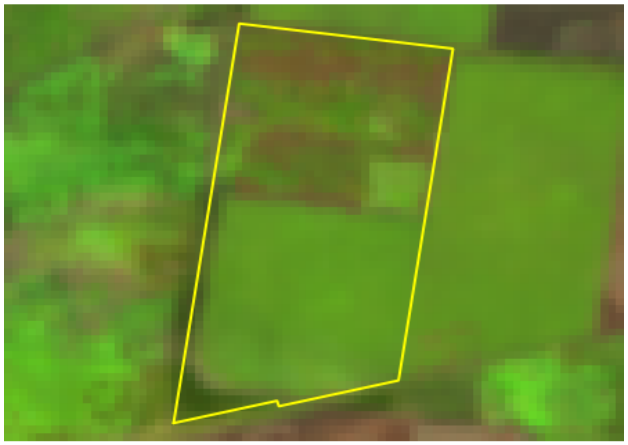


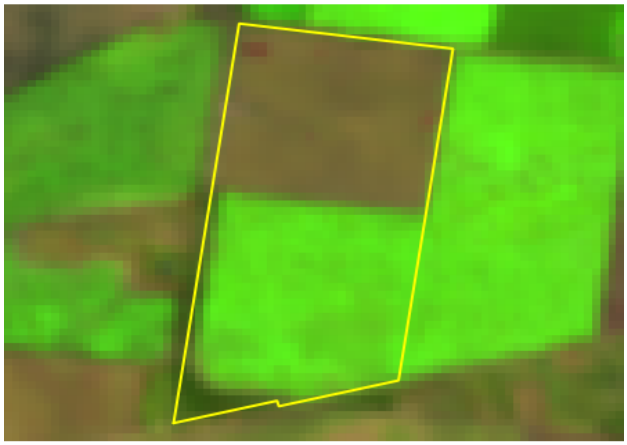
# FORAGE REPORT: CROP FREQUENCY



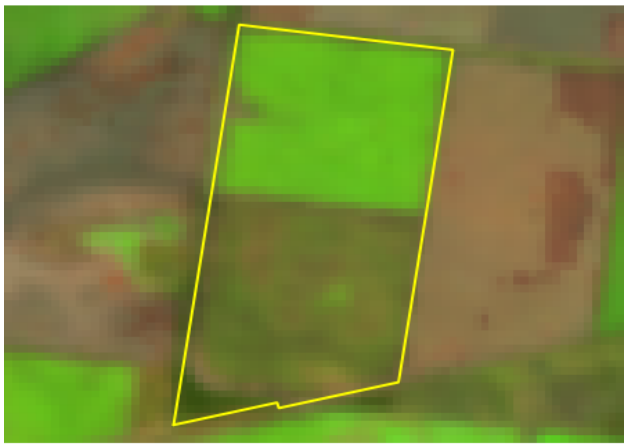
Queensland Government

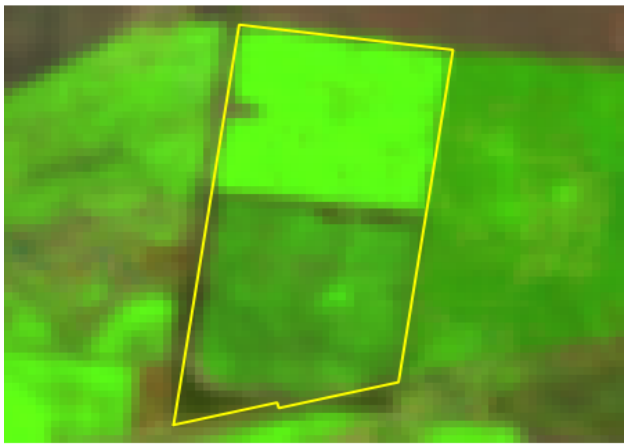
## February (left) and September (right) images for 2015



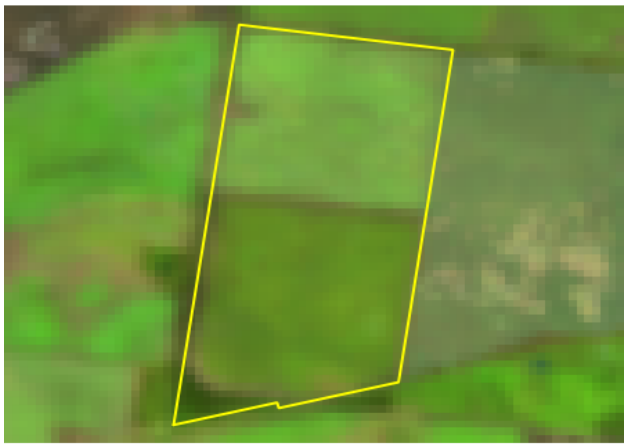


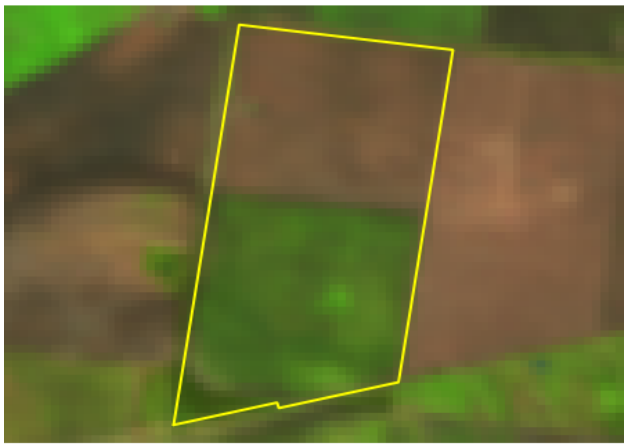
## February (left) and September (right) images for 2016





## February (left) and September (right) images for 2017



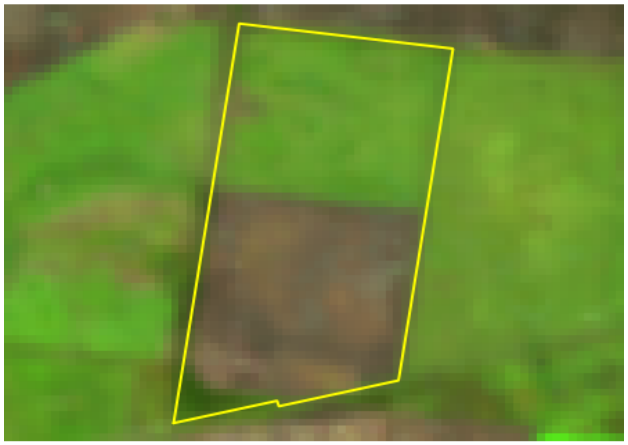


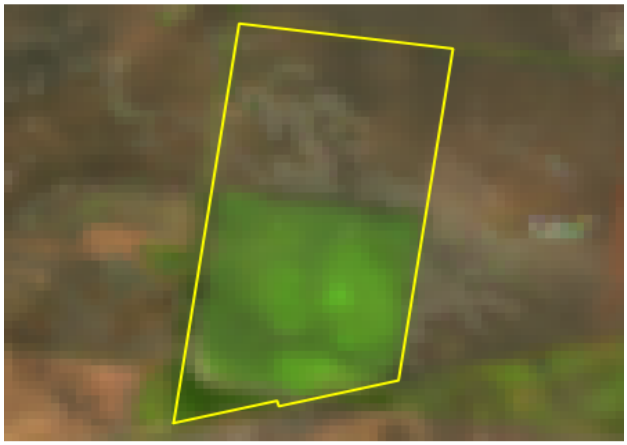
# FORAGE REPORT: CROP FREQUENCY



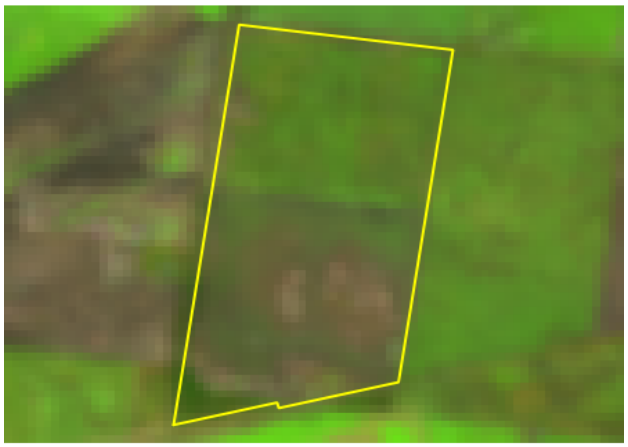
Queensland Government

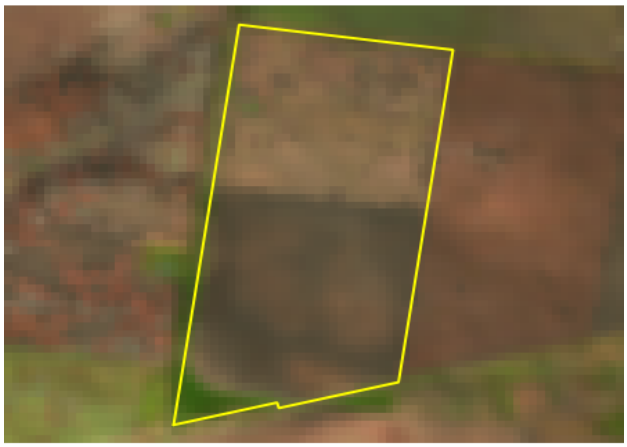
## February (left) and September (right) images for 2018



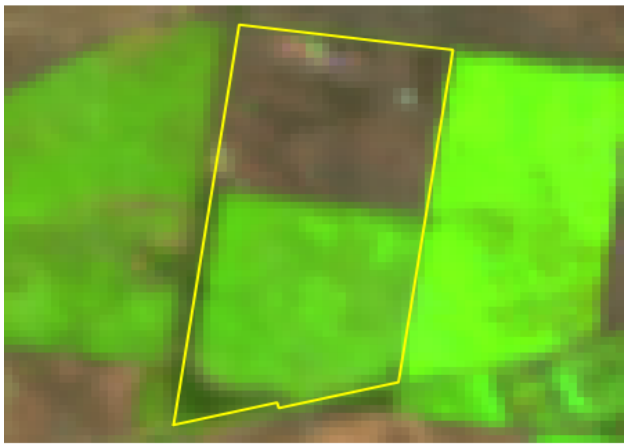


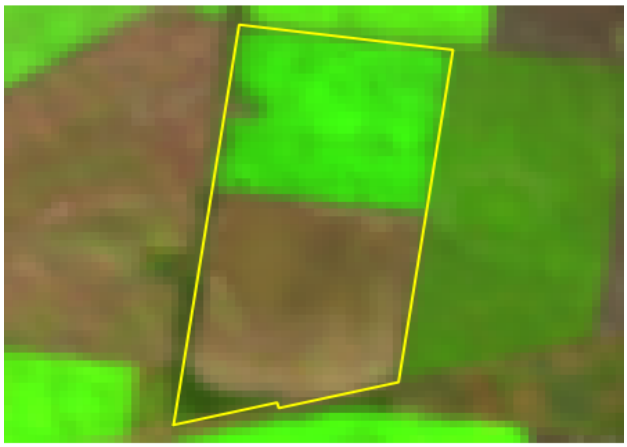
## February (left) and September (right) images for 2019





## February (left) and September (right) images for 2020



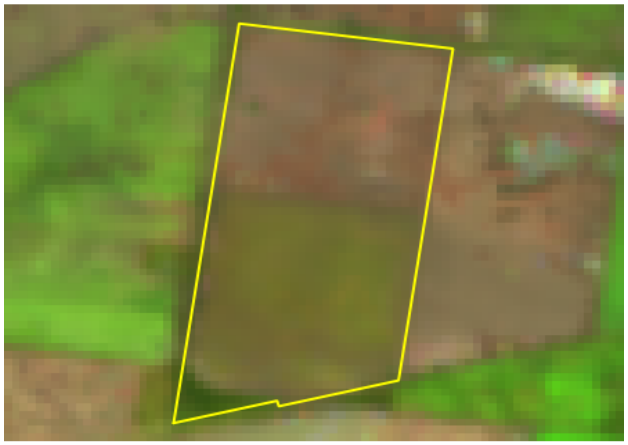


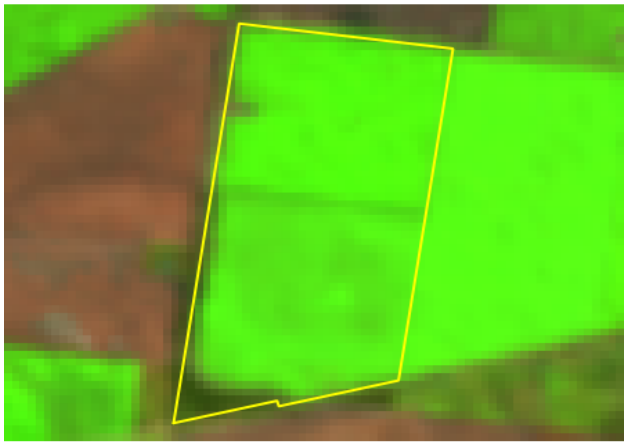
# FORAGE REPORT: CROP FREQUENCY



Queensland Government

## February (left) and September (right) images for 2021





## Disclaimer

# FORAGE REPORT: CROP FREQUENCY

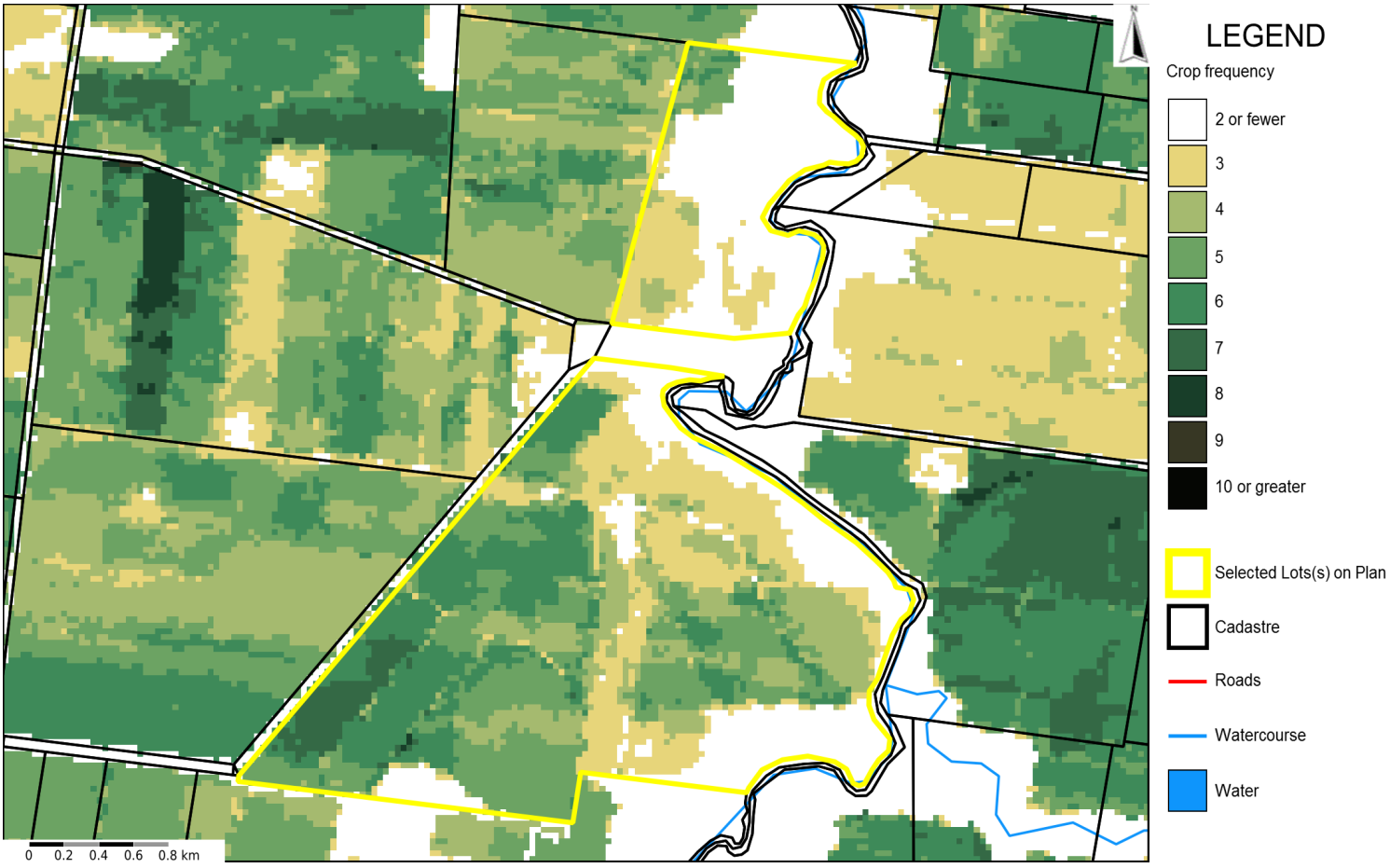


Queensland Government

## Introduction

This report presents maps of crop frequency for your chosen area, and chosen time period. Maps are based on time-series analysis of satellite imagery (30-m spatial resolution), for both the summer and winter growing seasons, aimed at detecting cycles of greenness in vegetation. Composite satellite images that display the maximum greenness within a summer or winter growing season for each year are also provided, as a visual reference. For further information refer to the FORAGE User Guide (https://data.longpaddock.qld.gov.au/static/forage_user_guide.pdf ) .

## Estimated total crop frequency map (2012 - 2021)




## How to interpret the information

**Crop-frequency mapping**: Coloured areas on the maps indicate locations where active crops have been detected three or more times in the summer or winter growing seasons, for the time period specified. The map on this page shows "Total Frequency" which is a count of the number of times that an active crop was detected. The maps on the following page show the summer and winter crop frequency, respectively. Analysis of satellite imagery can result in some misclassification, so it is recommended to view the composite imagery (see below) to help confirm the presence of a crop in a given season.

**Mapping of broad groups of crops**: Crop frequency is also separated into estimates of the broad crop groups within the area. This estimation is based on an automated classification approach (see https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/crops for more detail).

In the winter season the classification differentiates between the groups:

- Cereal crops (e.g. wheat, barley, oats);
- Pulse crops (e.g. chickpea).

In the summer season the classification differentiates between the groups:

- Coarse-grain and pulse (e.g. sorghum, maize, mungbean);
- Cotton crop.

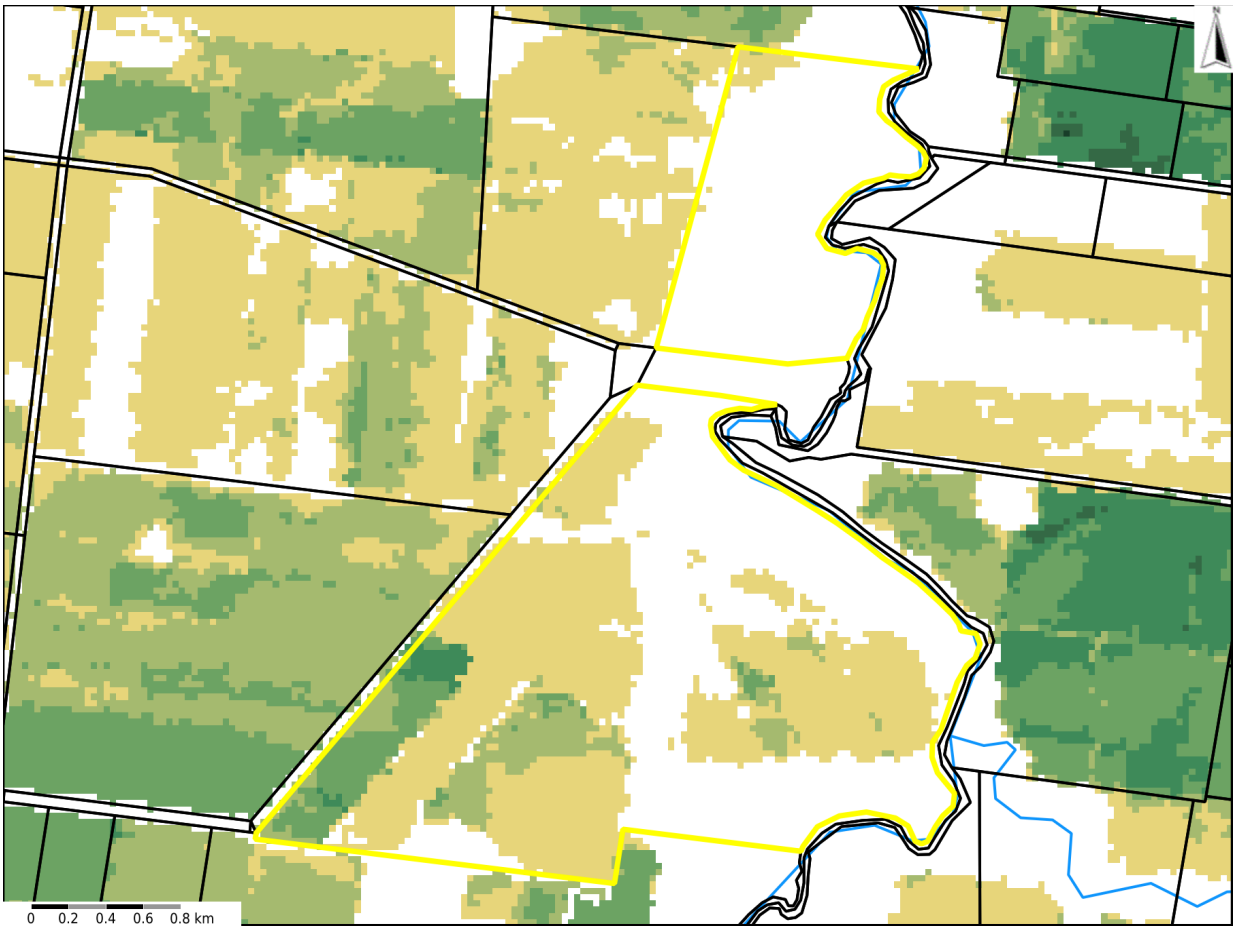
**Composite satellite imagery**: Due to the limitations of the automated method used to detect active cropping, it is recommended to view the seasonal composite images (pages 5 onward), compiled to represent the maximum greenness (per pixel) within a growing season. Cropped areas will generally appear bright green in the imagery compared with the surrounding landscape. Even if the crop-frequency mapping does not indicate cropping in an area, it is important to check each composite image to confirm that cropping has not been undertaken. Sometimes it will not be possible to clearly identify cropped areas in the imagery, e.g in some wetter seasons the entire landscape might appear green. In this case, it is recommended to undertake further investigation using other information sources. Note: the composite images are only used to confirm the presence or absence of cropping activity; it is not possible to visually differentiate between the crop groups.

# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 11SP191489,956DER3479* *Label: p13*

Queensland Government

## Estimated frequency map for summer (February) crops (2012 - 2021)



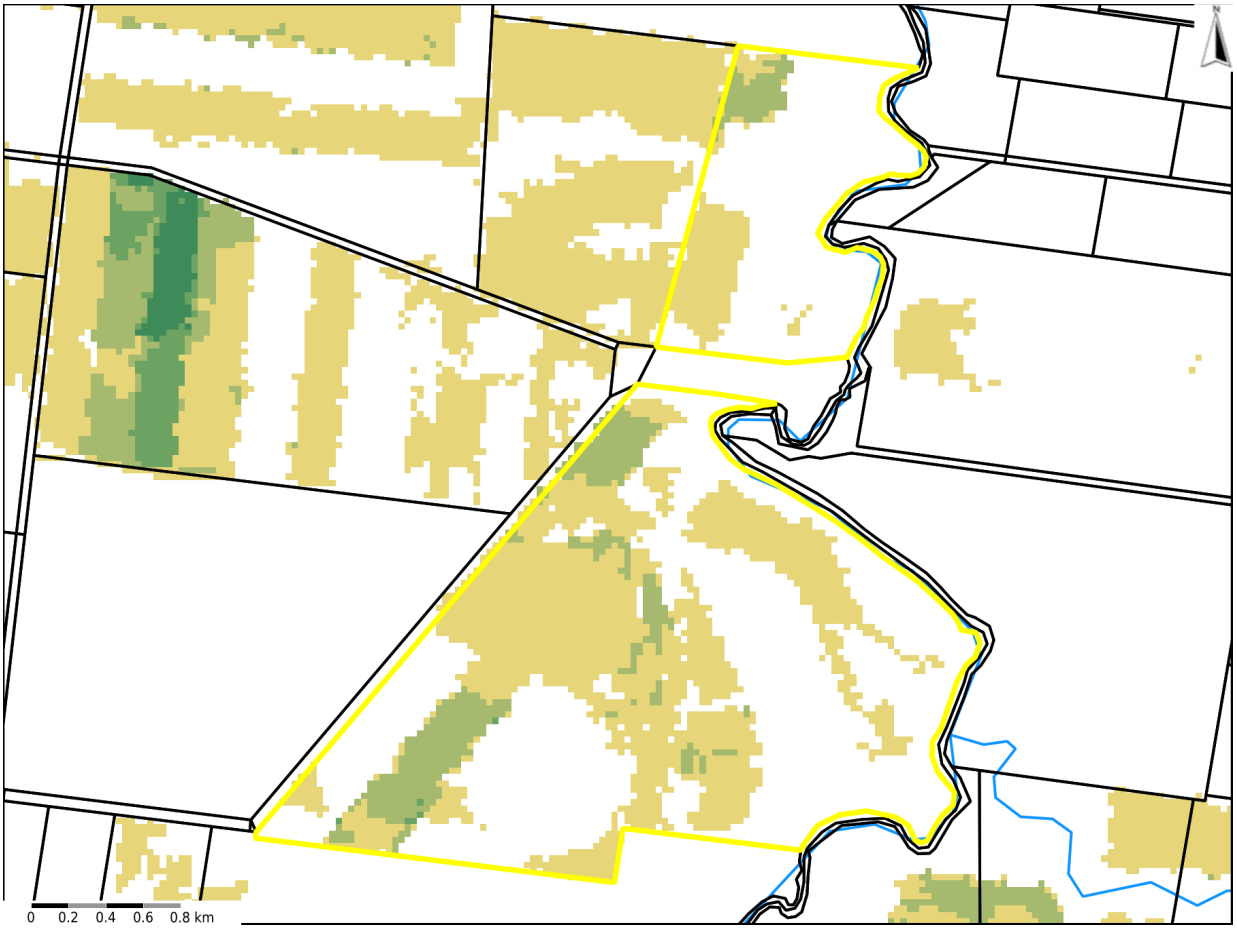

LEGEND

Crop frequency

- 2 or fewer
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 or greater

- Selected Lots(s) on Plan
- Cadastre
- Roads
- Watercourse
- Water

## Estimated frequency map for winter (September) crops (2012 - 2021)

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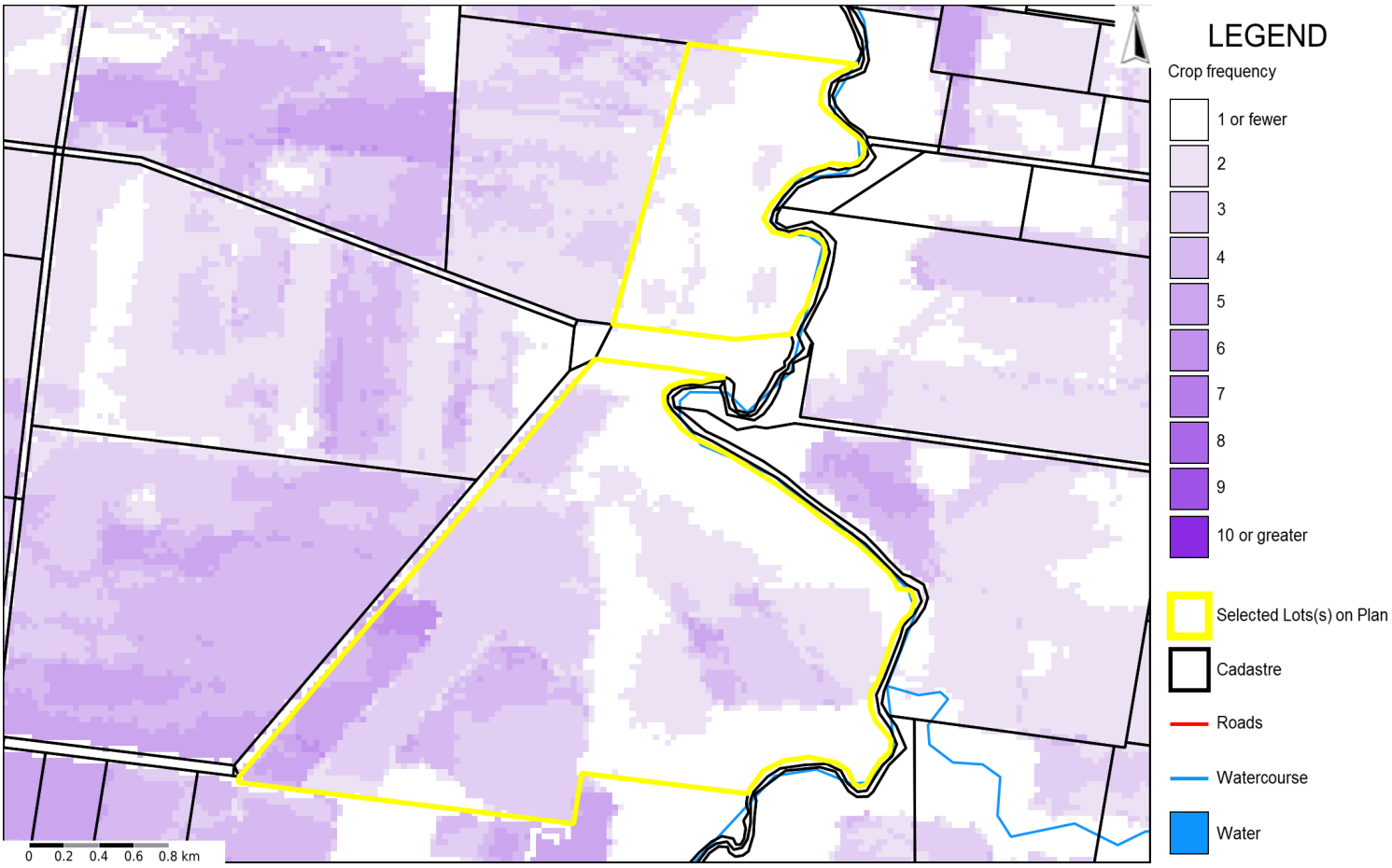
- Watercourse
- Water

# FORAGE REPORT: CROP FREQUENCY

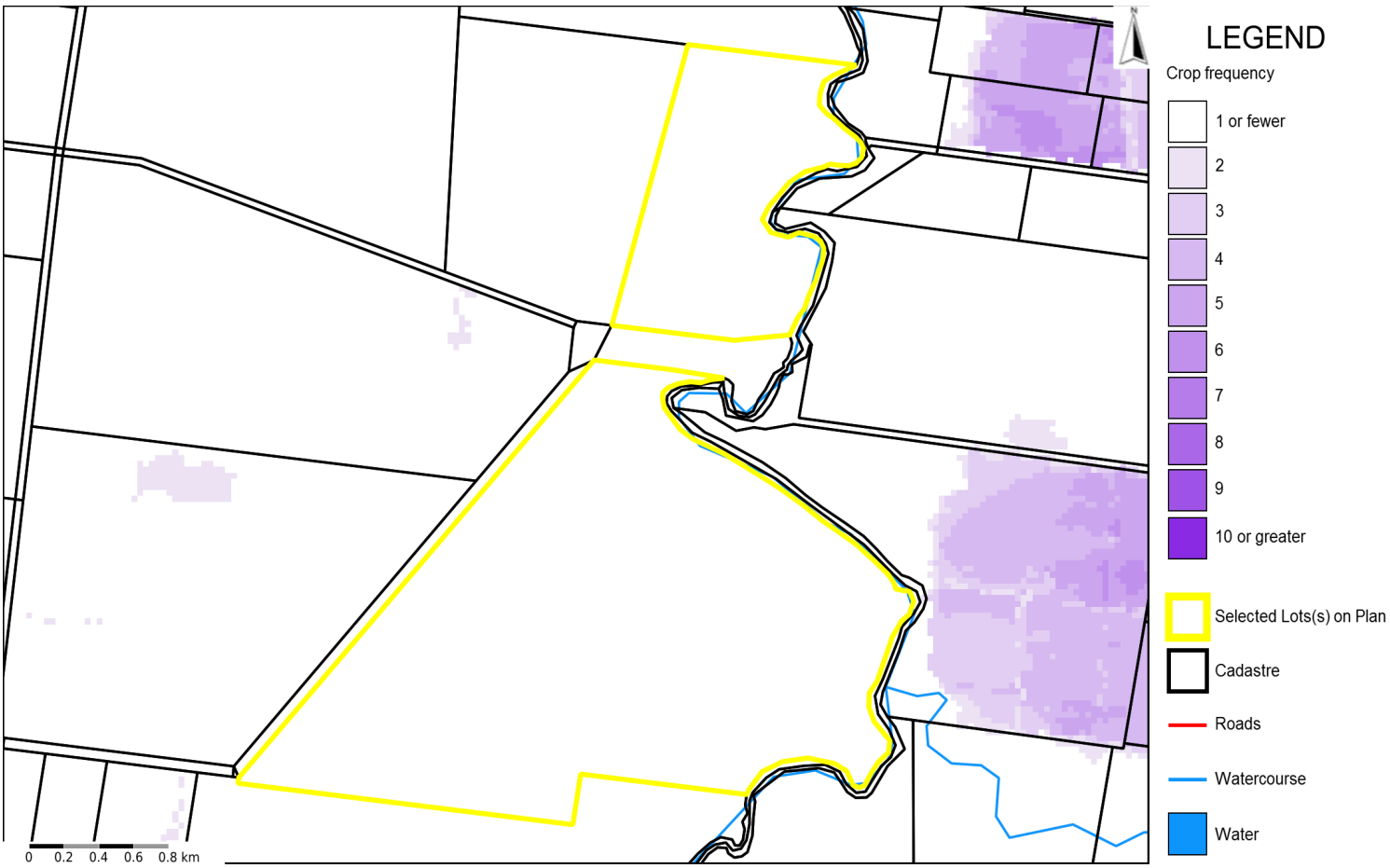
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 11SP191489,956DER3479* *Label: p13*

Queensland Government

## Estimated frequency map for summer (February) coarse grain and pulse crops (2012 - 2021)




## Estimated frequency map for summer (February) cotton crops (2012 - 2021)

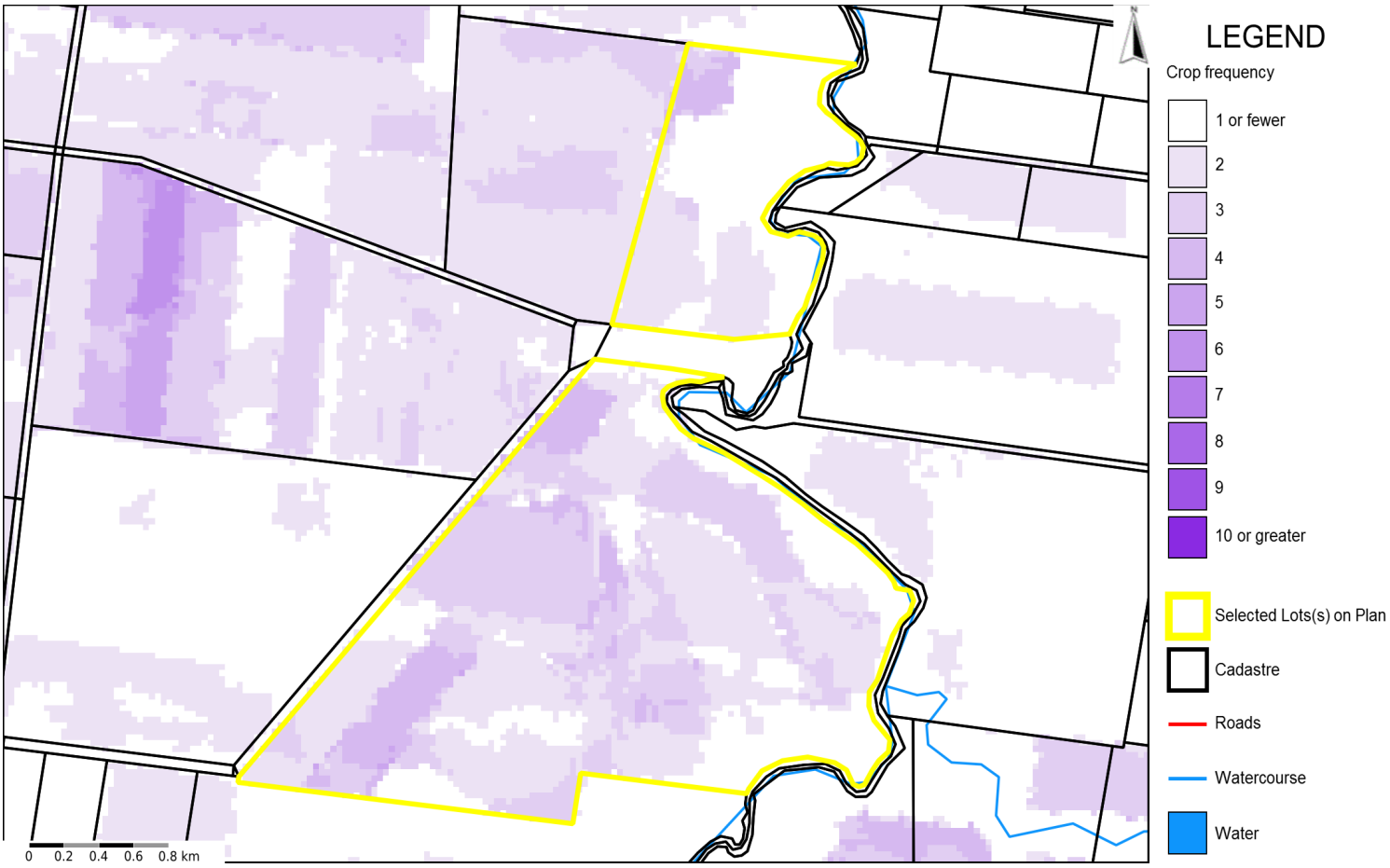


# FORAGE REPORT: CROP FREQUENCY

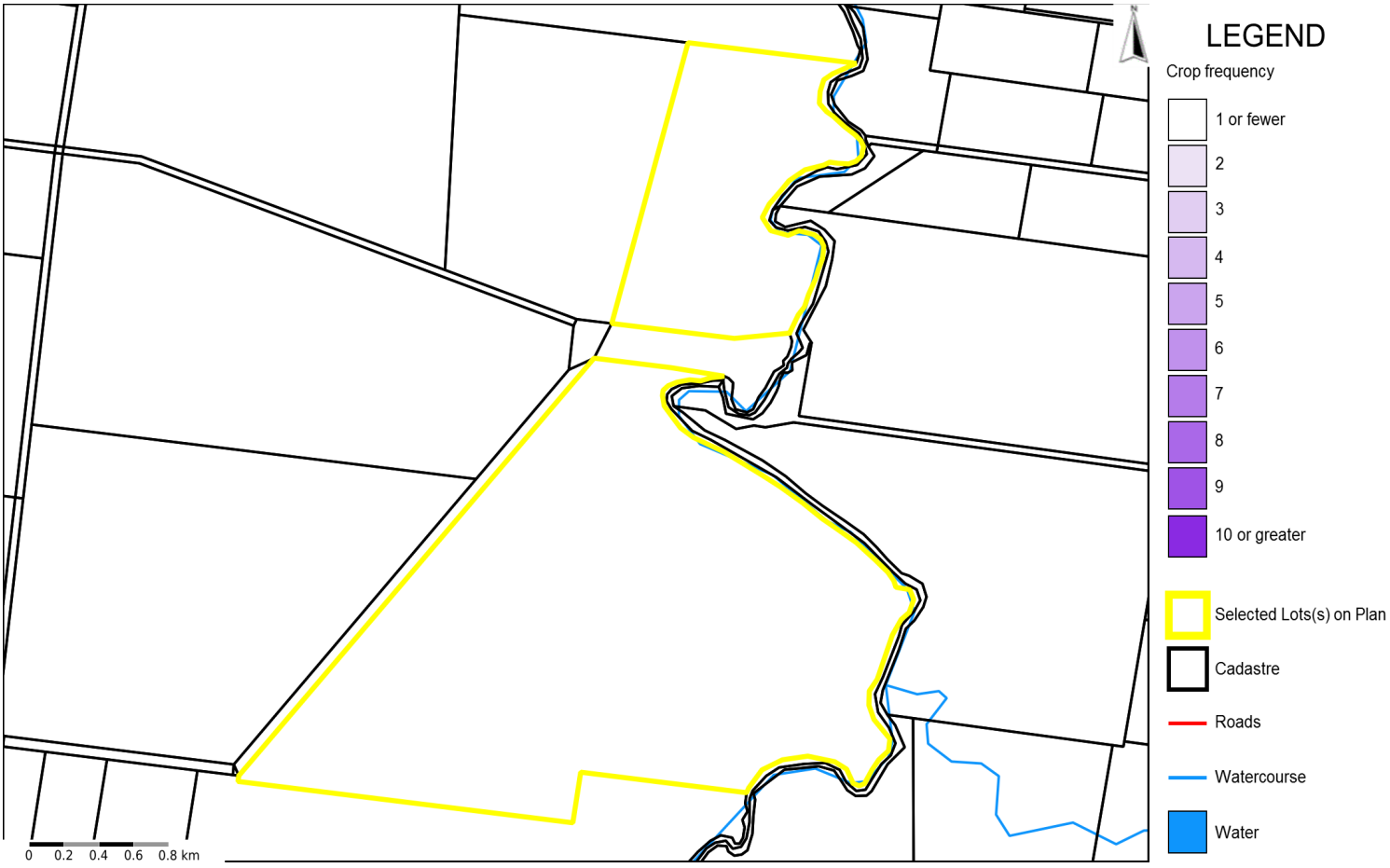


Queensland Government

## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)

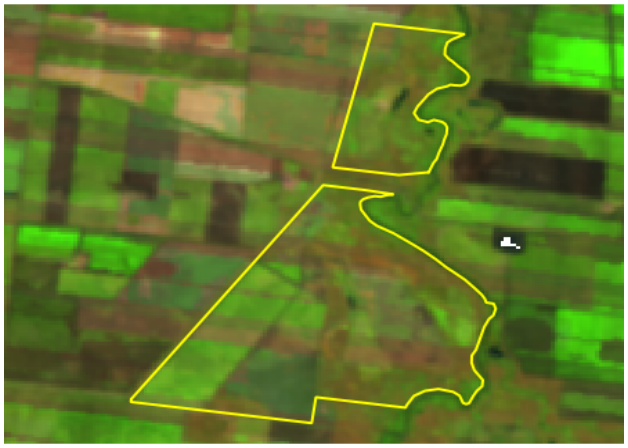


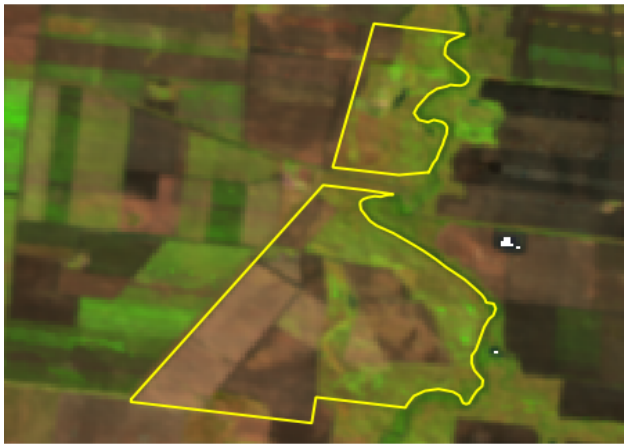
# FORAGE REPORT: CROP FREQUENCY



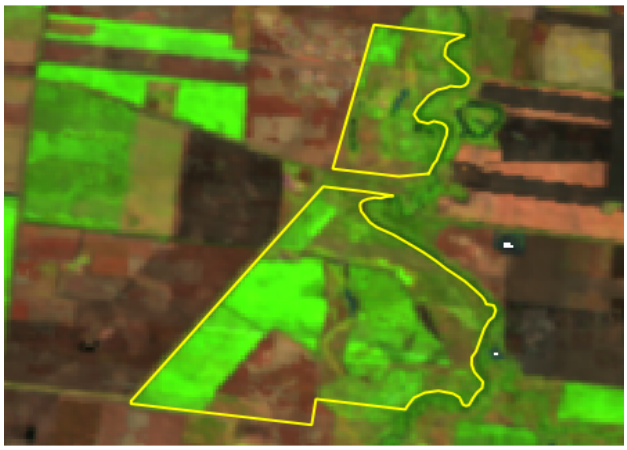
Queensland Government

## February (left) and September (right) images for 2012

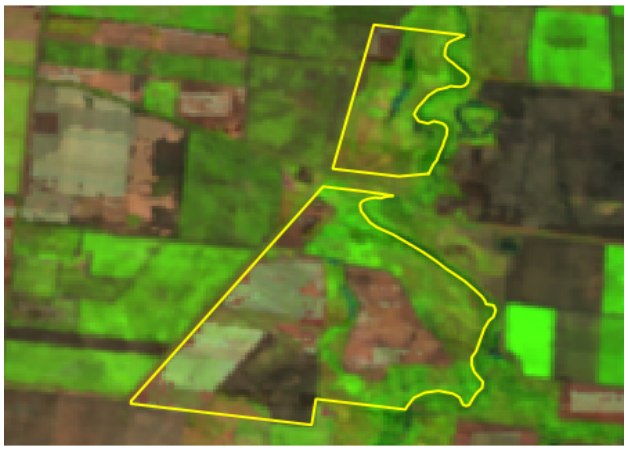


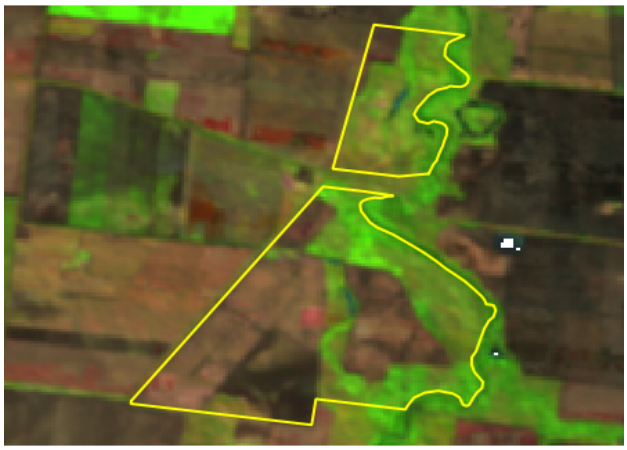


## February (left) and September (right) images for 2013



## February (left) and September (right) images for 2014



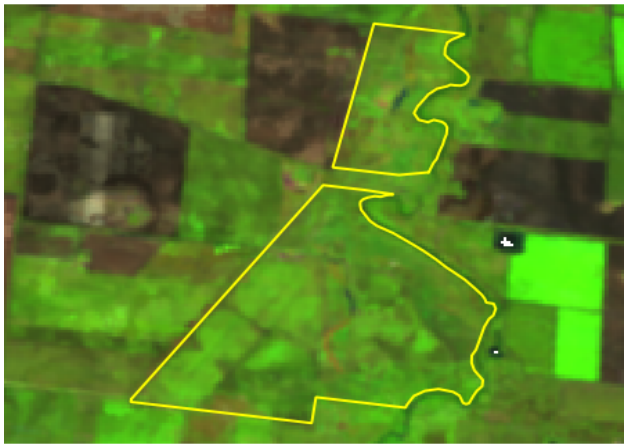


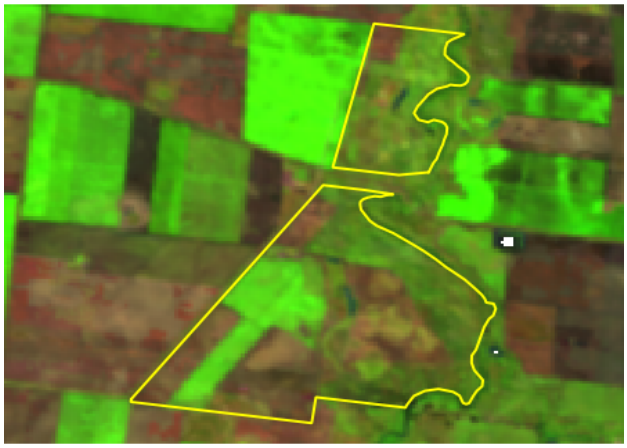
# FORAGE REPORT: CROP FREQUENCY



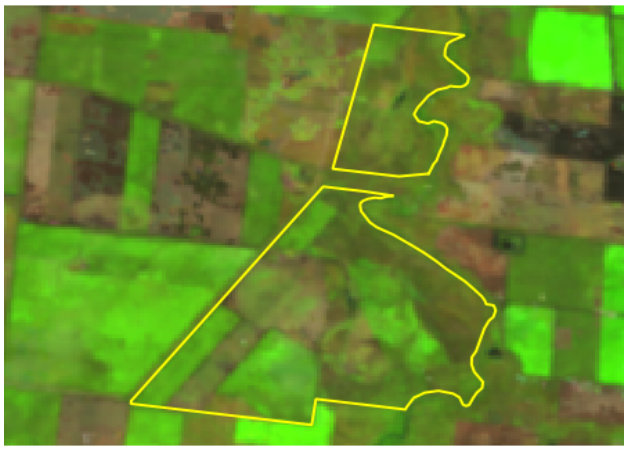
Queensland Government

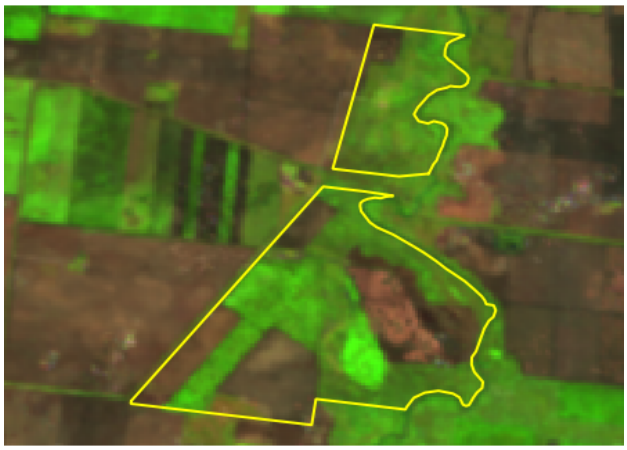
## February (left) and September (right) images for 2015



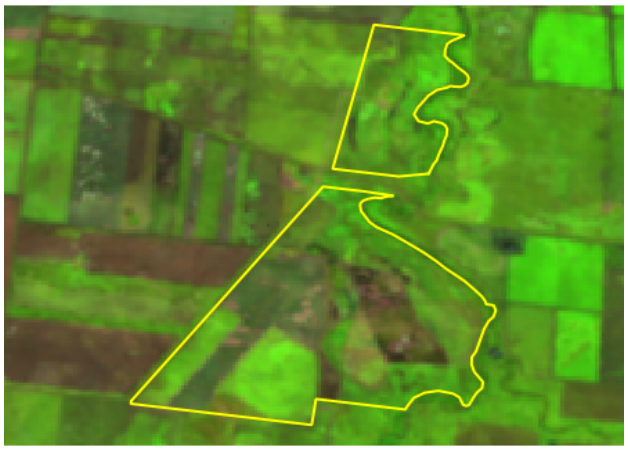


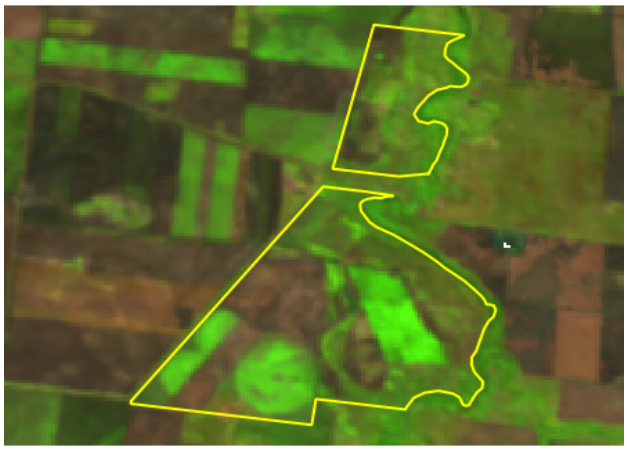
## February (left) and September (right) images for 2016





## February (left) and September (right) images for 2017



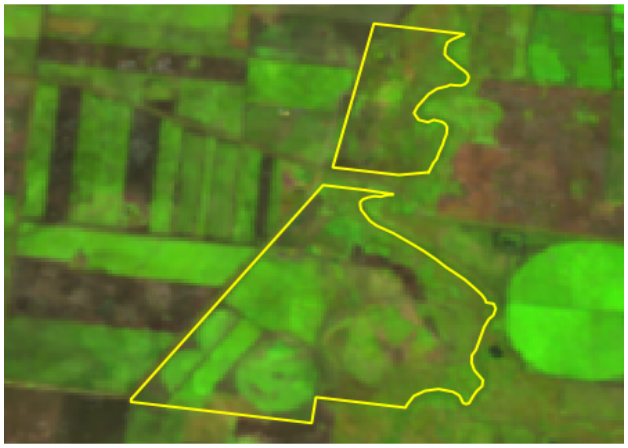


# FORAGE REPORT: CROP FREQUENCY

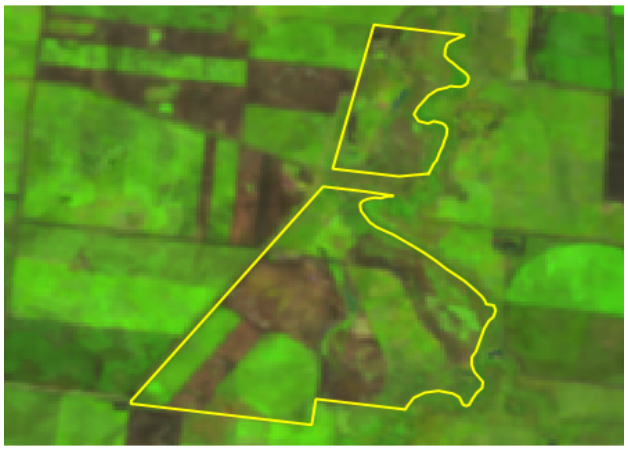


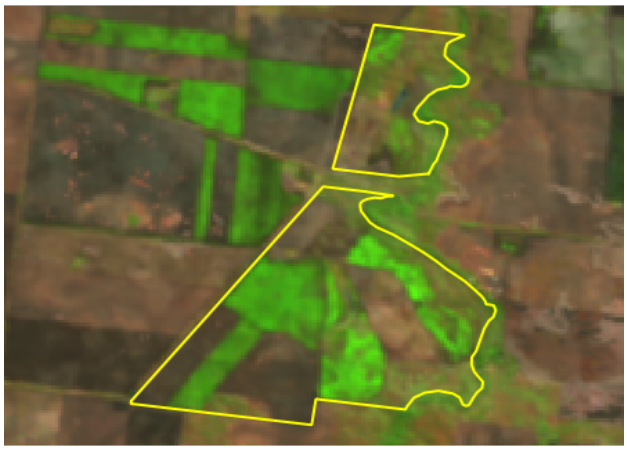
Queensland Government

## February (left) and September (right) images for 2018

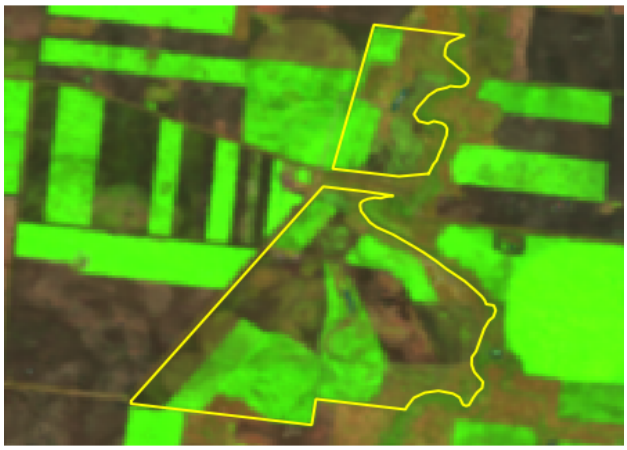


## February (left) and September (right) images for 2019





## February (left) and September (right) images for 2020

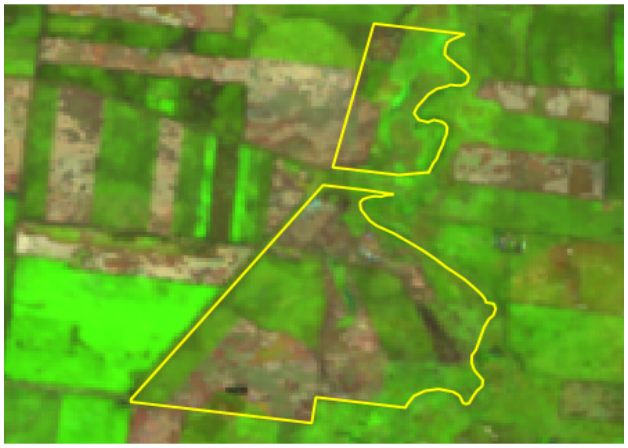


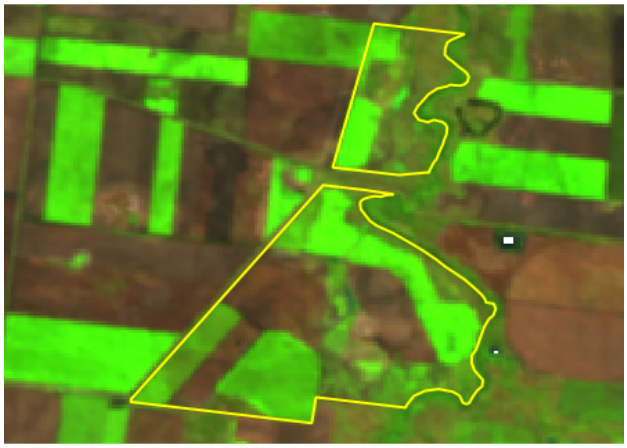
# FORAGE REPORT: CROP FREQUENCY



Queensland Government

## February (left) and September (right) images for 2021





## Disclaimer

# FORAGE REPORT: CROP FREQUENCY

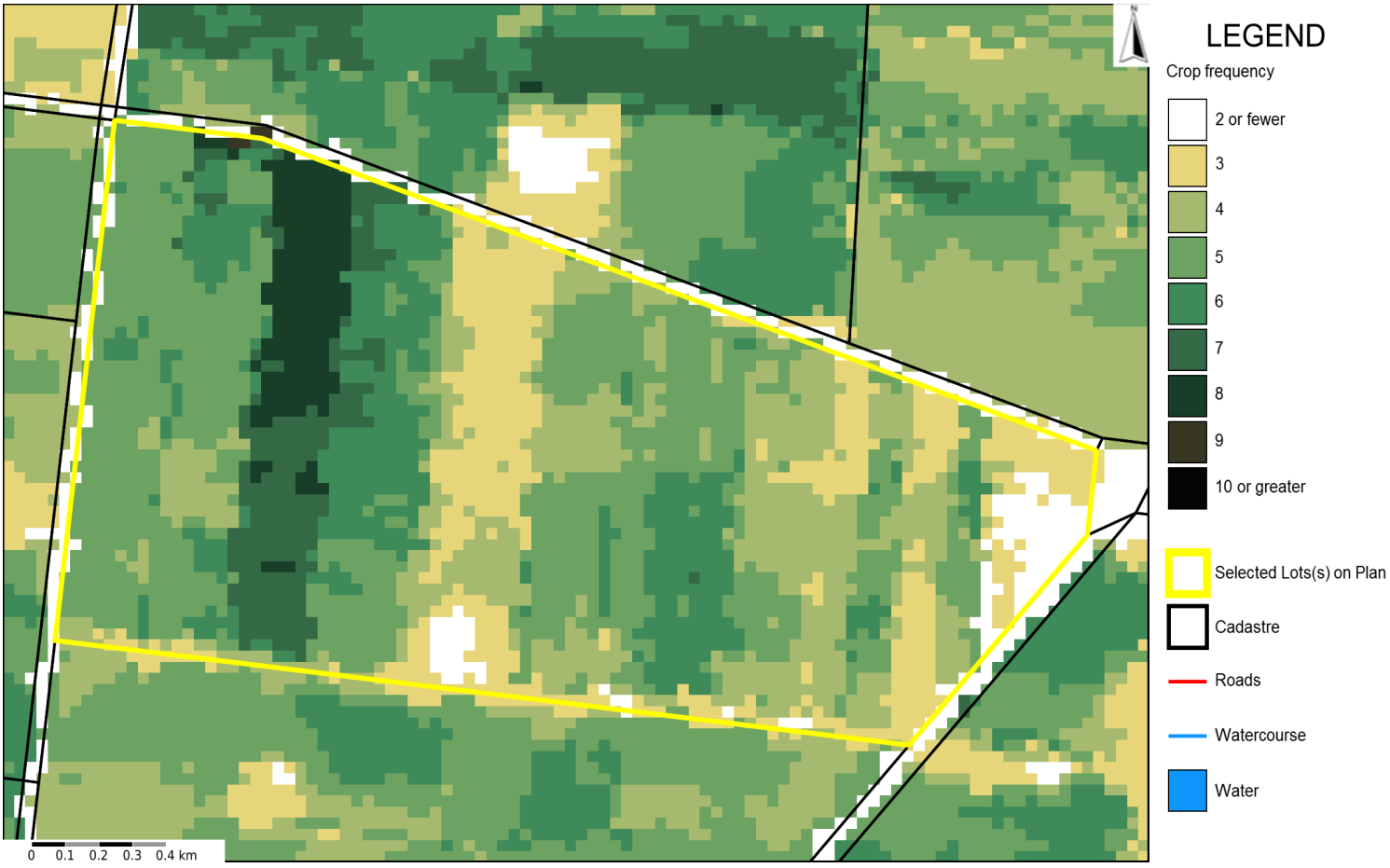
*http://www.longpaddock.qld.gov.au/forage 22/06/2022 Lot on Plan: 56DY592 Label: noLabel*

Queensland Government

## Introduction

This report presents maps of crop frequency for your chosen area, and chosen time period. Maps are based on time-series analysis of satellite imagery (30-m spatial resolution), for both the summer and winter growing seasons, aimed at detecting cycles of greenness in vegetation. Composite satellite images that display the maximum greenness within a summer or winter growing season for each year are also provided, as a visual reference. For further information refer to the FORAGE User Guide (https://data.longpaddock.qld.gov.au/static/forage_user_guide.pdf ) .

## Estimated total crop frequency map (2012 - 2021)




## How to interpret the information

**Crop-frequency mapping**: Coloured areas on the maps indicate locations where active crops have been detected three or more times in the summer or winter growing seasons, for the time period specified. The map on this page shows "Total Frequency" which is a count of the number of times that an active crop was detected. The maps on the following page show the summer and winter crop frequency, respectively. Analysis of satellite imagery can result in some misclassification, so it is recommended to view the composite imagery (see below) to help confirm the presence of a crop in a given season.

**Mapping of broad groups of crops**: Crop frequency is also separated into estimates of the broad crop groups within the area. This estimation is based on an automated classification approach (see https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/crops for more detail).

In the winter season the classification differentiates between the groups:

- Cereal crops (e.g. wheat, barley, oats);
- Pulse crops (e.g. chickpea).

In the summer season the classification differentiates between the groups:

- Coarse-grain and pulse (e.g. sorghum, maize, mungbean);
- Cotton crop.

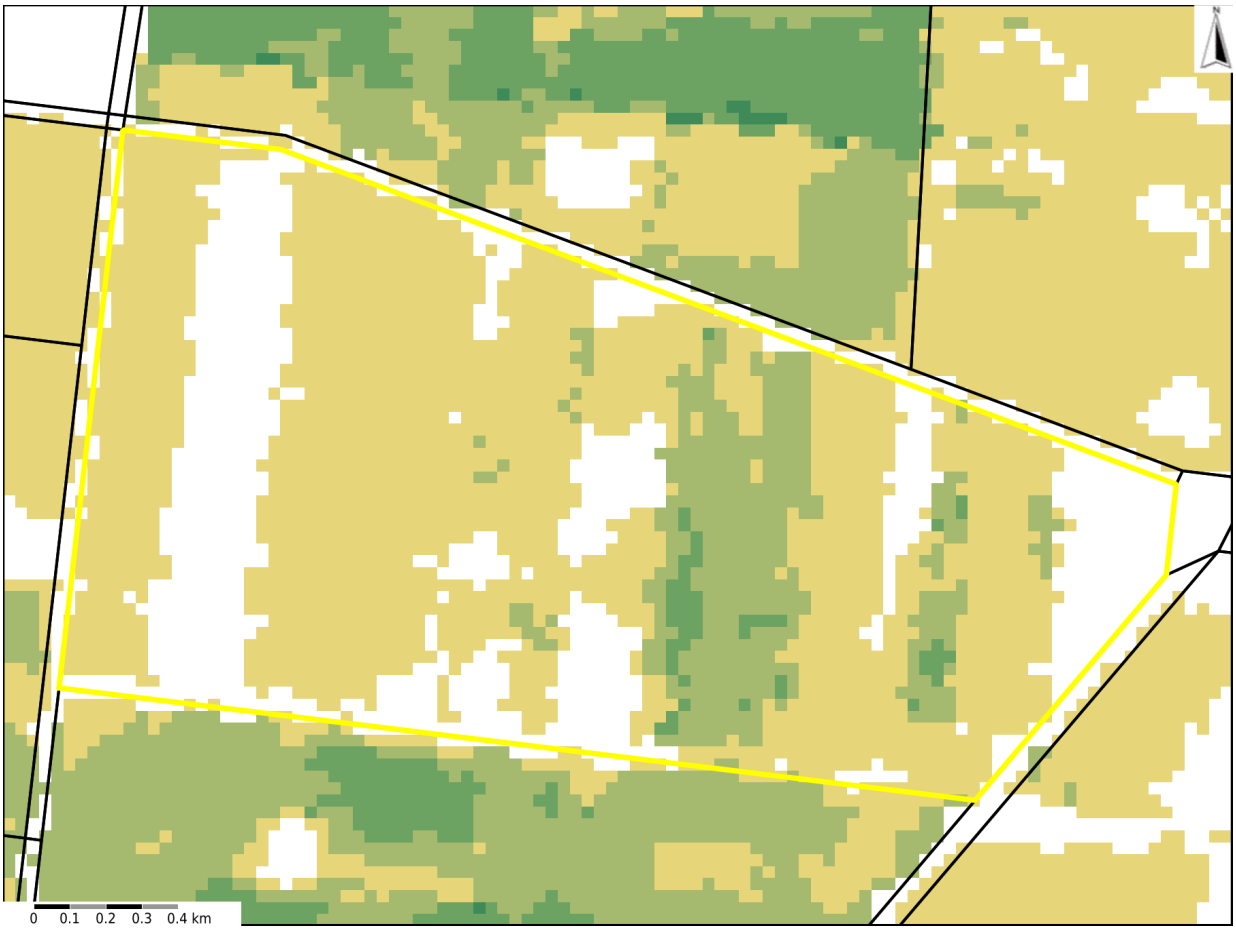
**Composite satellite imagery**: Due to the limitations of the automated method used to detect active cropping, it is recommended to view the seasonal composite images (pages 5 onward), compiled to represent the maximum greenness (per pixel) within a growing season. Cropped areas will generally appear bright green in the imagery compared with the surrounding landscape. Even if the crop-frequency mapping does not indicate cropping in an area, it is important to check each composite image to confirm that cropping has not been undertaken. Sometimes it will not be possible to clearly identify cropped areas in the imagery, e.g in some wetter seasons the entire landscape might appear green. In this case, it is recommended to undertake further investigation using other information sources. Note: the composite images are only used to confirm the presence or absence of cropping activity; it is not possible to visually differentiate between the crop groups.

# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage 22/06/2022 Lot on Plan: 56DY592 Label: noLabel*

Queensland Government

## Estimated frequency map for summer (February) crops (2012 - 2021)



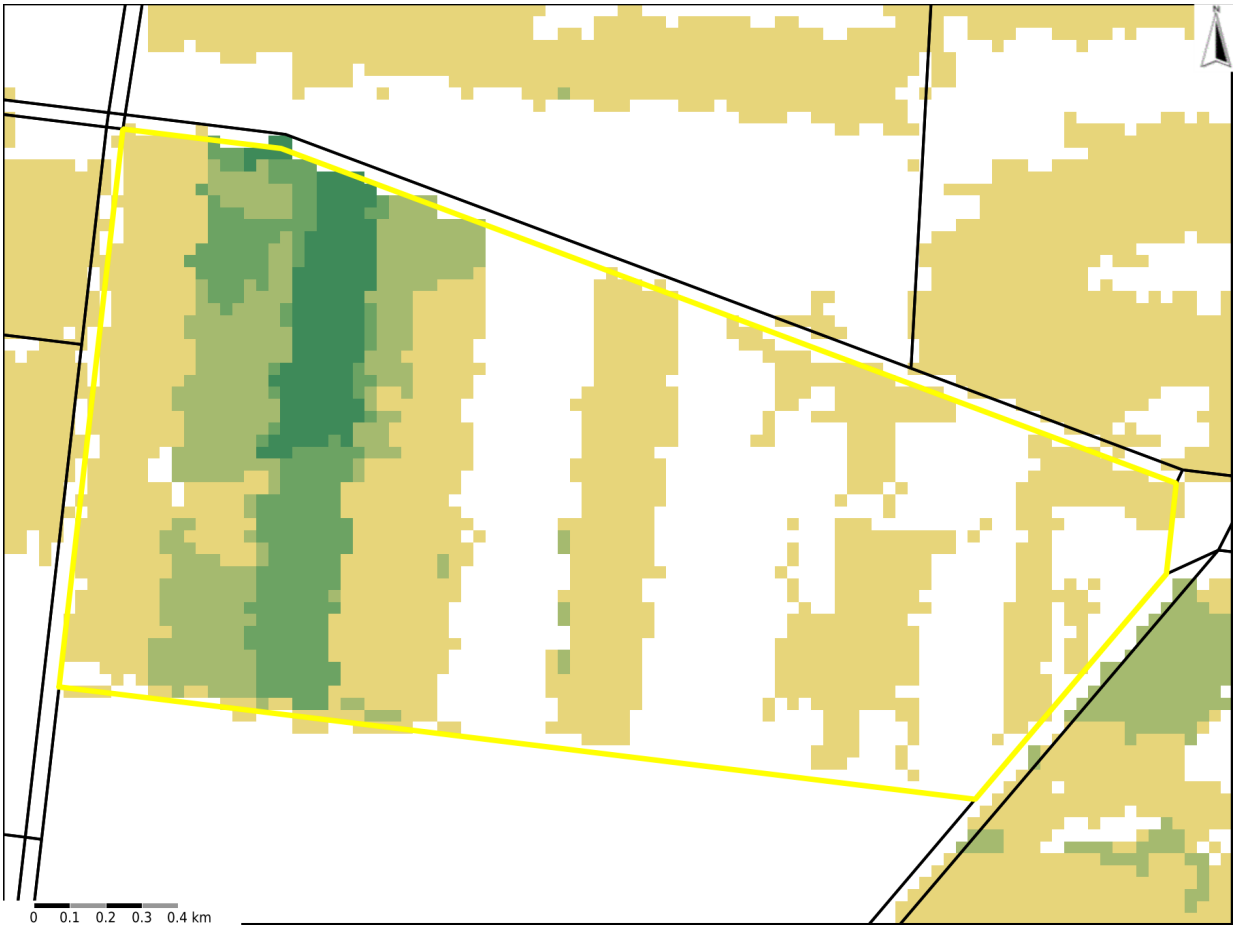

LEGEND

Crop frequency

- 2 or fewer
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 or greater

- Selected Lots(s) on Plan
- Cadastre
- Roads
- Watercourse
- Water

## Estimated frequency map for winter (September) crops (2012 - 2021)




LEGEND

Crop frequency

- 2 or fewer
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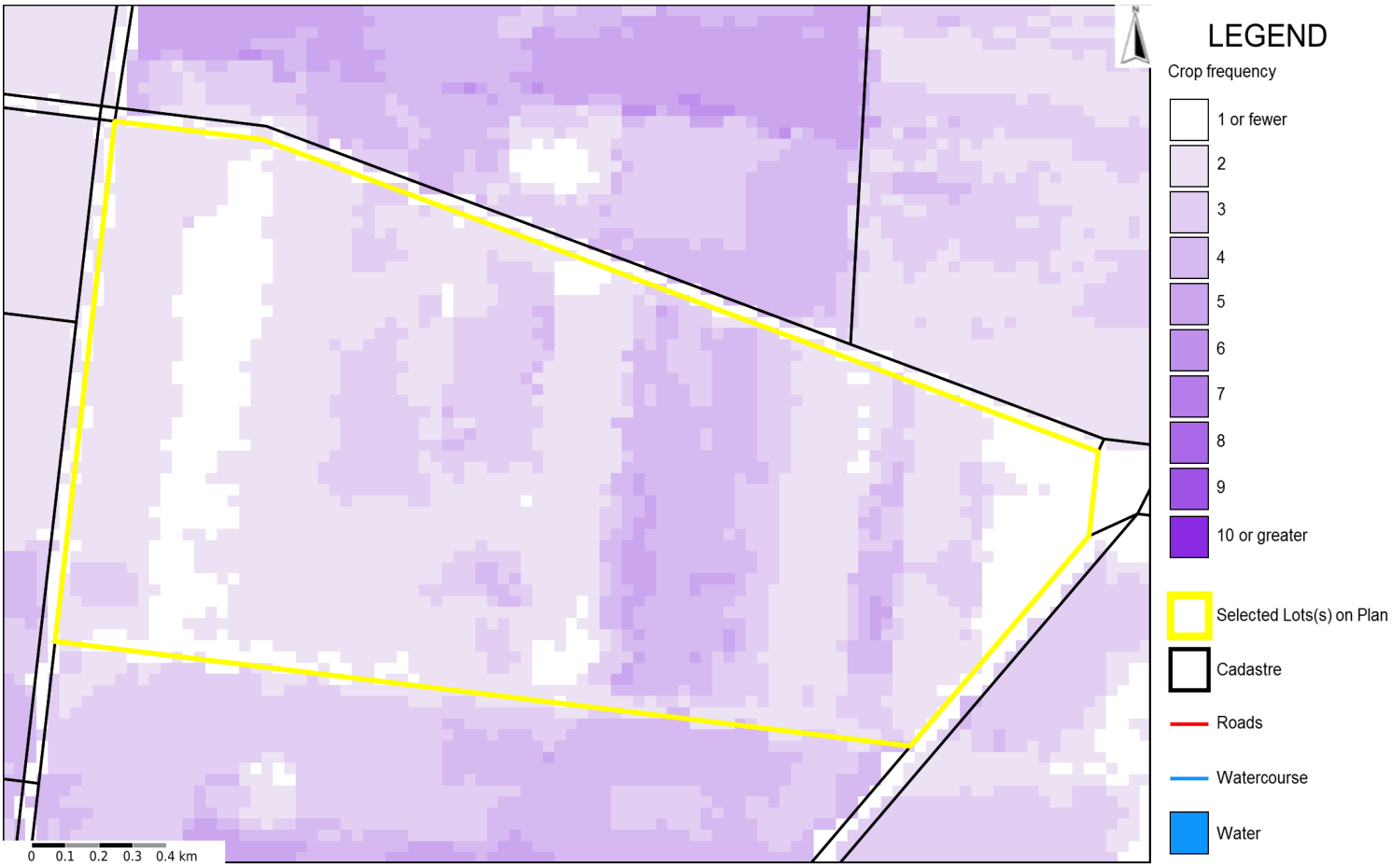
- Selected Lots(s) on Plan
- Cadastre
- Roads
- Watercourse
- Water

# FORAGE REPORT: CROP FREQUENCY

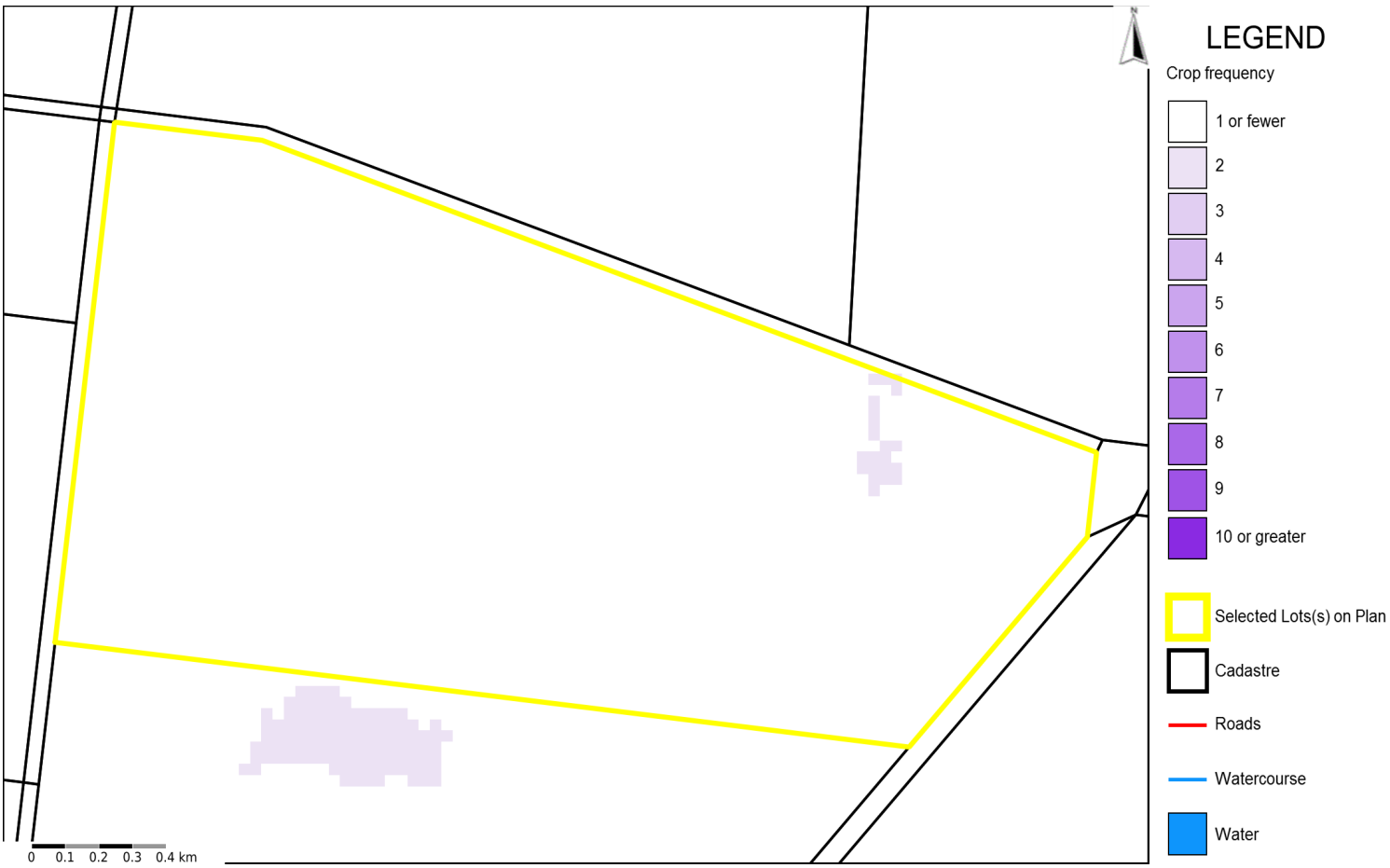
*http://www.longpaddock.qld.gov.au/forage 22/06/2022 Lot on Plan: 56DY592 Label: noLabel*

Queensland Government

## Estimated frequency map for summer (February) coarse grain and pulse crops (2012 - 2021)




## Estimated frequency map for summer (February) cotton crops (2012 - 2021)

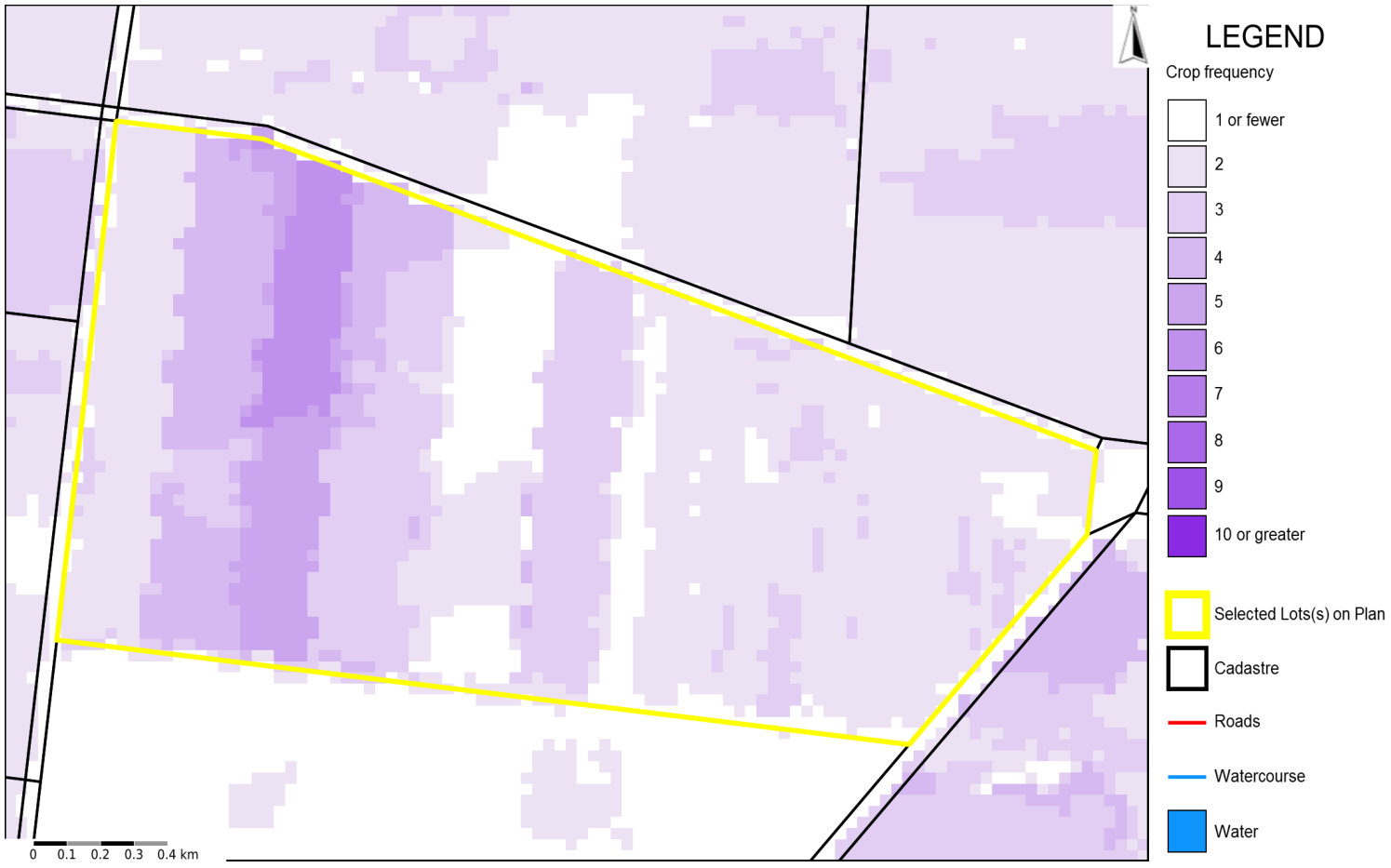


# FORAGE REPORT: CROP FREQUENCY

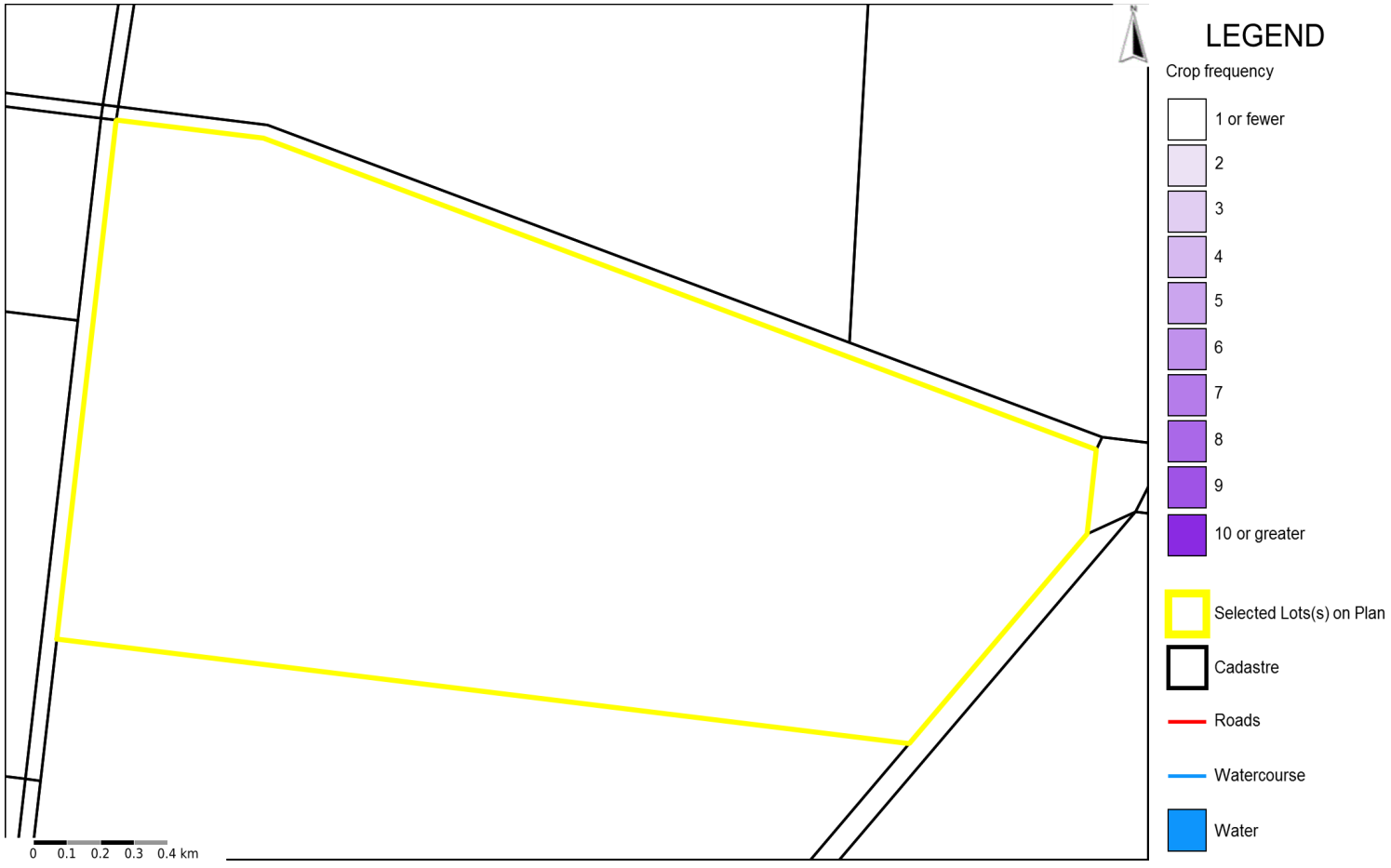
*http://www.longpaddock.qld.gov.au/forage 22/06/2022 Lot on Plan: 56DY592 Label: noLabel*

Queensland Government

## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)

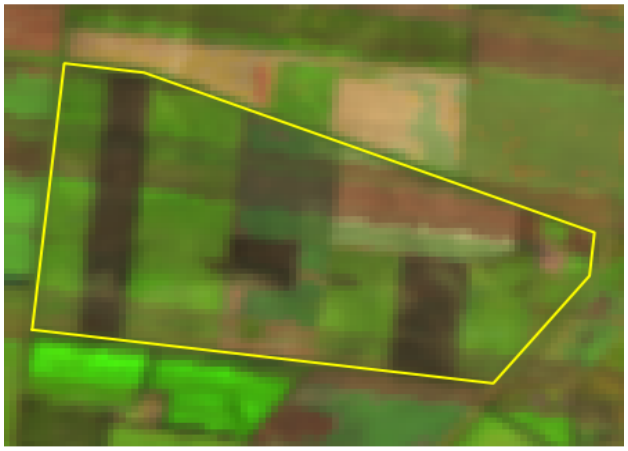


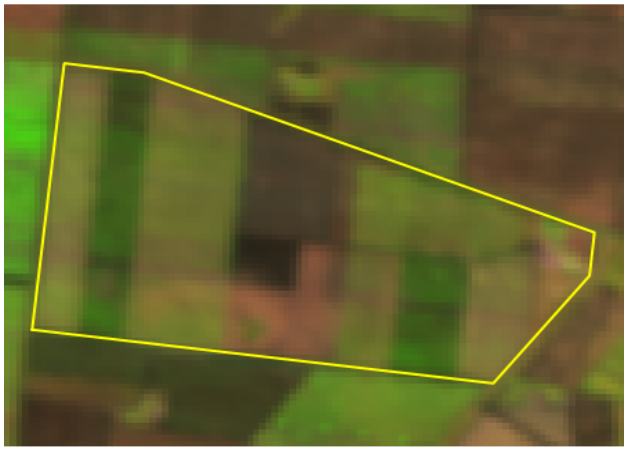
# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *22/06/2022* *Lot on Plan: 56DY592* *Label: noLabel*

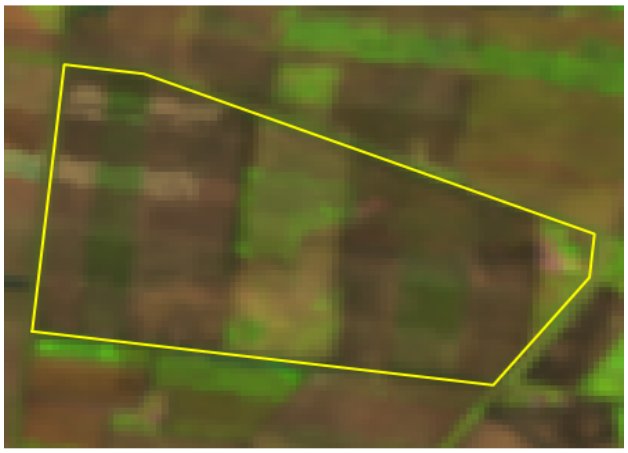
Queensland Government

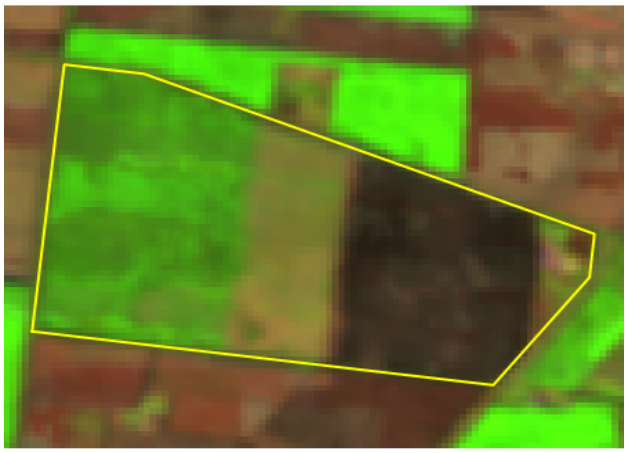
## February (left) and September (right) images for 2012



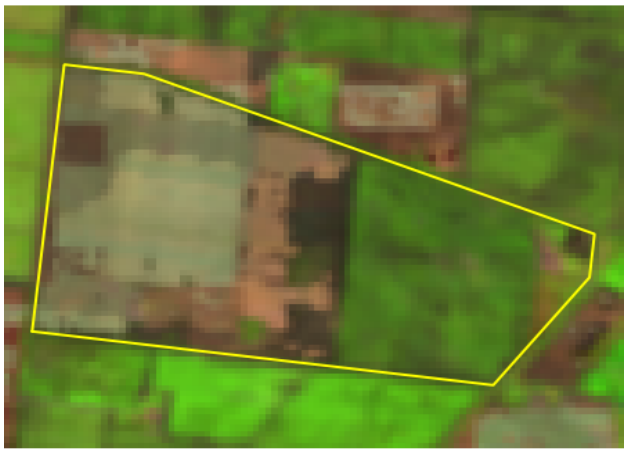


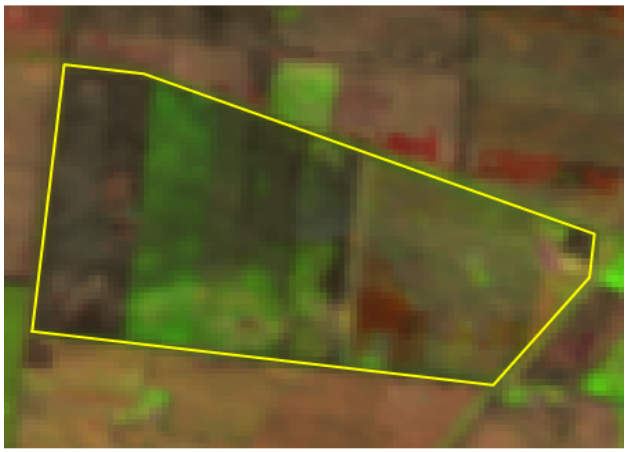
## February (left) and September (right) images for 2013





## February (left) and September (right) images for 2014



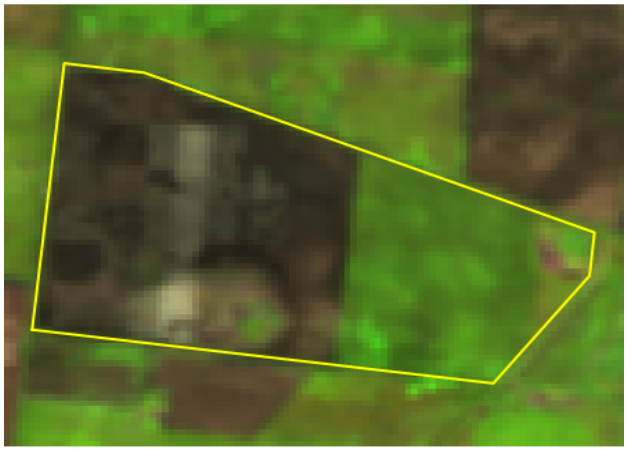


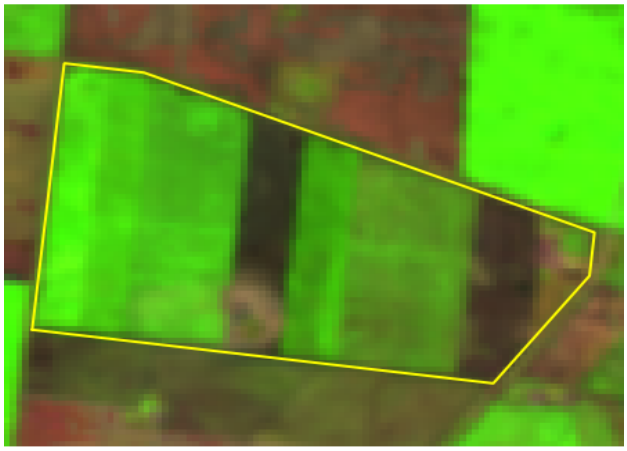
# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *22/06/2022* *Lot on Plan: 56DY592* *Label: noLabel*

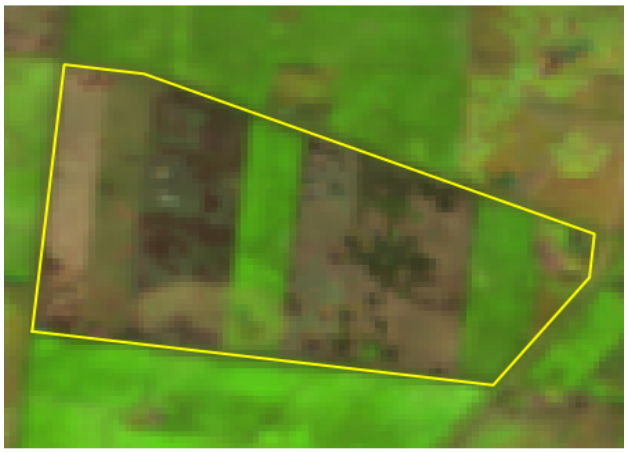
Queensland Government

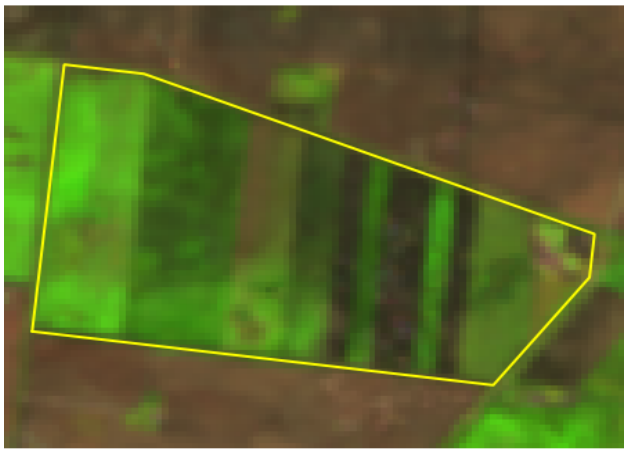
## February (left) and September (right) images for 2015



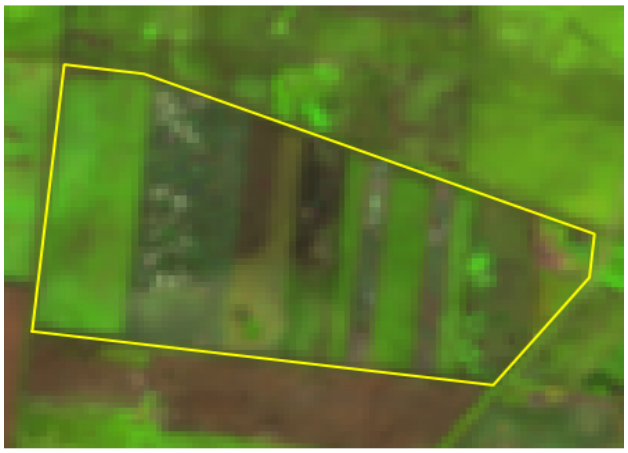


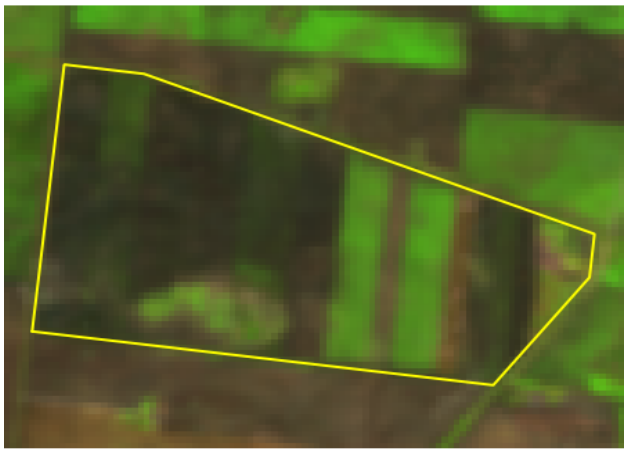
## February (left) and September (right) images for 2016





## February (left) and September (right) images for 2017



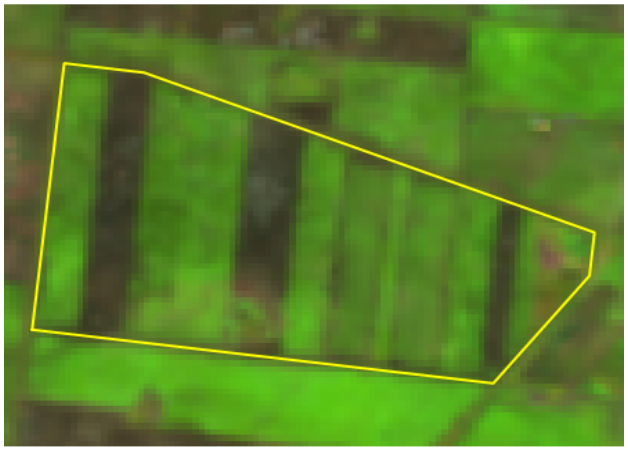


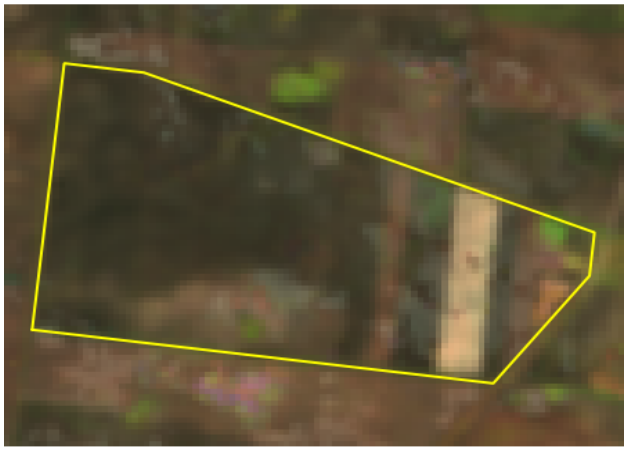
# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *22/06/2022* *Lot on Plan: 56DY592* *Label: noLabel*

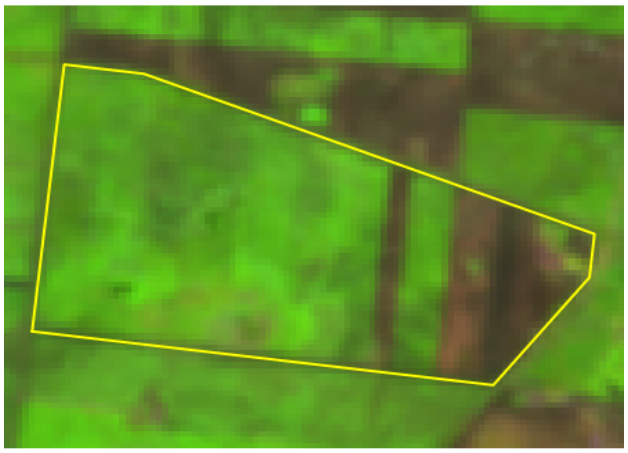
Queensland Government

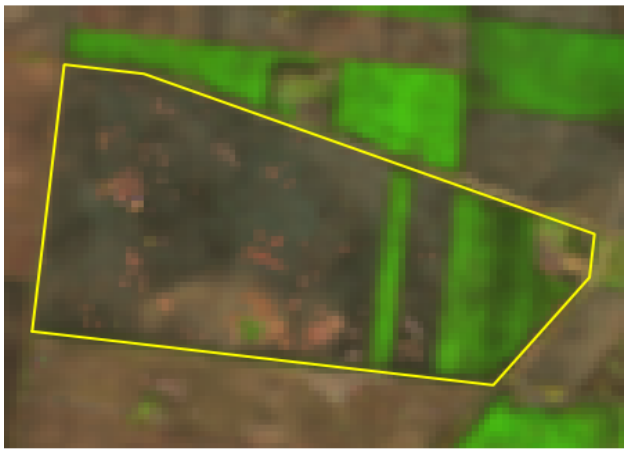
## February (left) and September (right) images for 2018



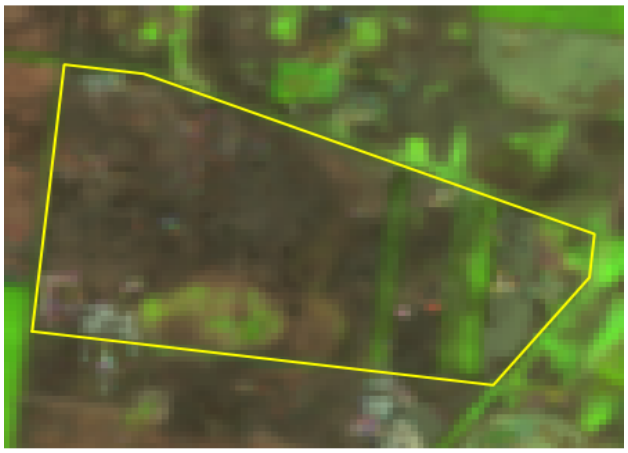


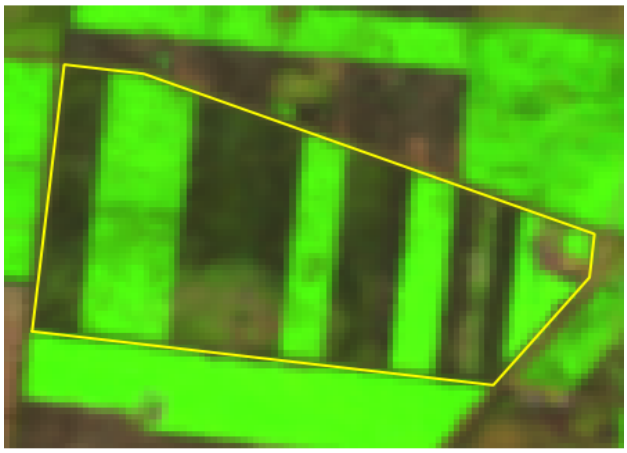
## February (left) and September (right) images for 2019





## February (left) and September (right) images for 2020



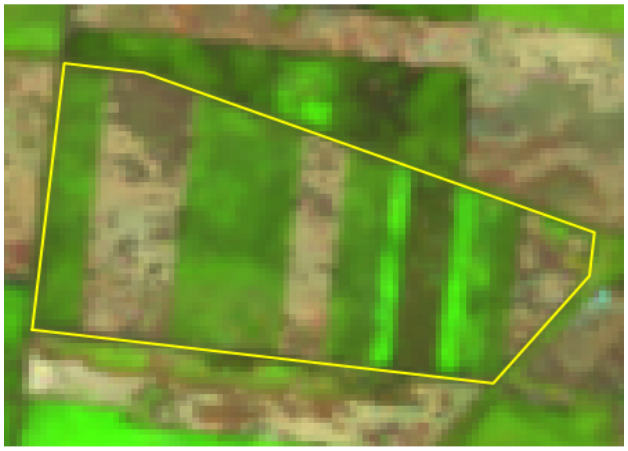


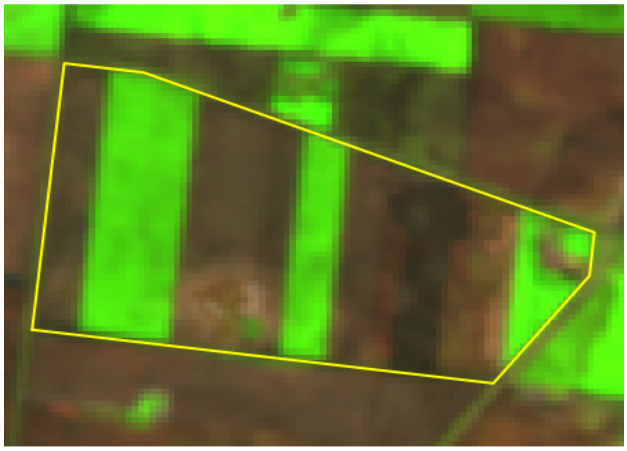
# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *22/06/2022* *Lot on Plan: 56DY592* *Label: noLabel*

Queensland Government

## February (left) and September (right) images for 2021





## Disclaimer

# FORAGE REPORT: CROP FREQUENCY

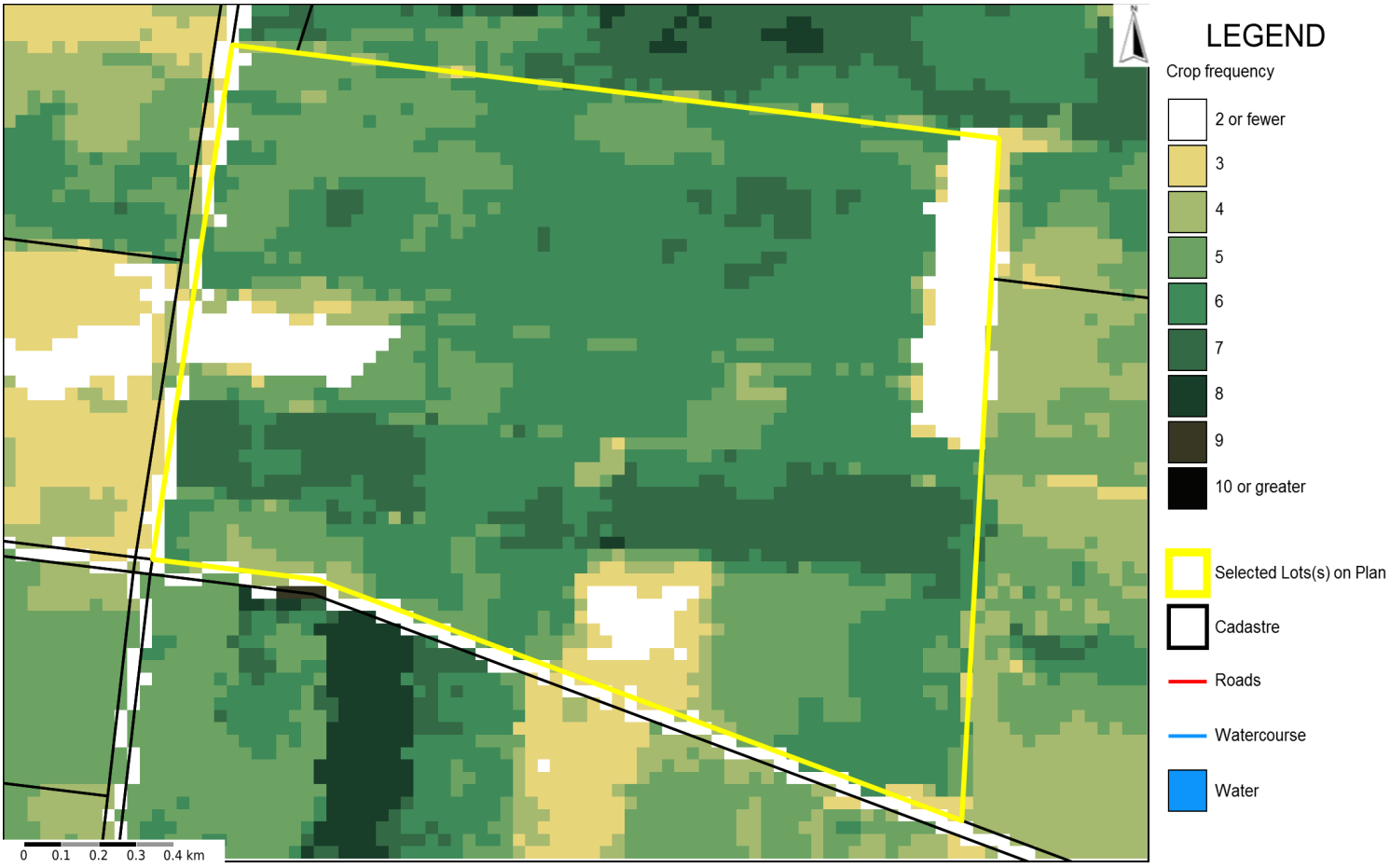


Queensland Government

## Introduction

This report presents maps of crop frequency for your chosen area, and chosen time period. Maps are based on time-series analysis of satellite imagery (30-m spatial resolution), for both the summer and winter growing seasons, aimed at detecting cycles of greenness in vegetation. Composite satellite images that display the maximum greenness within a summer or winter growing season for each year are also provided, as a visual reference. For further information refer to the FORAGE User Guide (https://data.longpaddock.qld.gov.au/static/forage_user_guide.pdf ) .

## Estimated total crop frequency map (2012 - 2021)




## How to interpret the information

**Crop-frequency mapping**: Coloured areas on the maps indicate locations where active crops have been detected three or more times in the summer or winter growing seasons, for the time period specified. The map on this page shows "Total Frequency" which is a count of the number of times that an active crop was detected. The maps on the following page show the summer and winter crop frequency, respectively. Analysis of satellite imagery can result in some misclassification, so it is recommended to view the composite imagery (see below) to help confirm the presence of a crop in a given season.

**Mapping of broad groups of crops**: Crop frequency is also separated into estimates of the broad crop groups within the area. This estimation is based on an automated classification approach (see https://www.qld.gov.au/environment/land/management/mapping/statewide-monitoring/crops for more detail).

In the winter season the classification differentiates between the groups:

- Cereal crops (e.g. wheat, barley, oats);
- Pulse crops (e.g. chickpea).

In the summer season the classification differentiates between the groups:

- Coarse-grain and pulse (e.g. sorghum, maize, mungbean);
- Cotton crop.

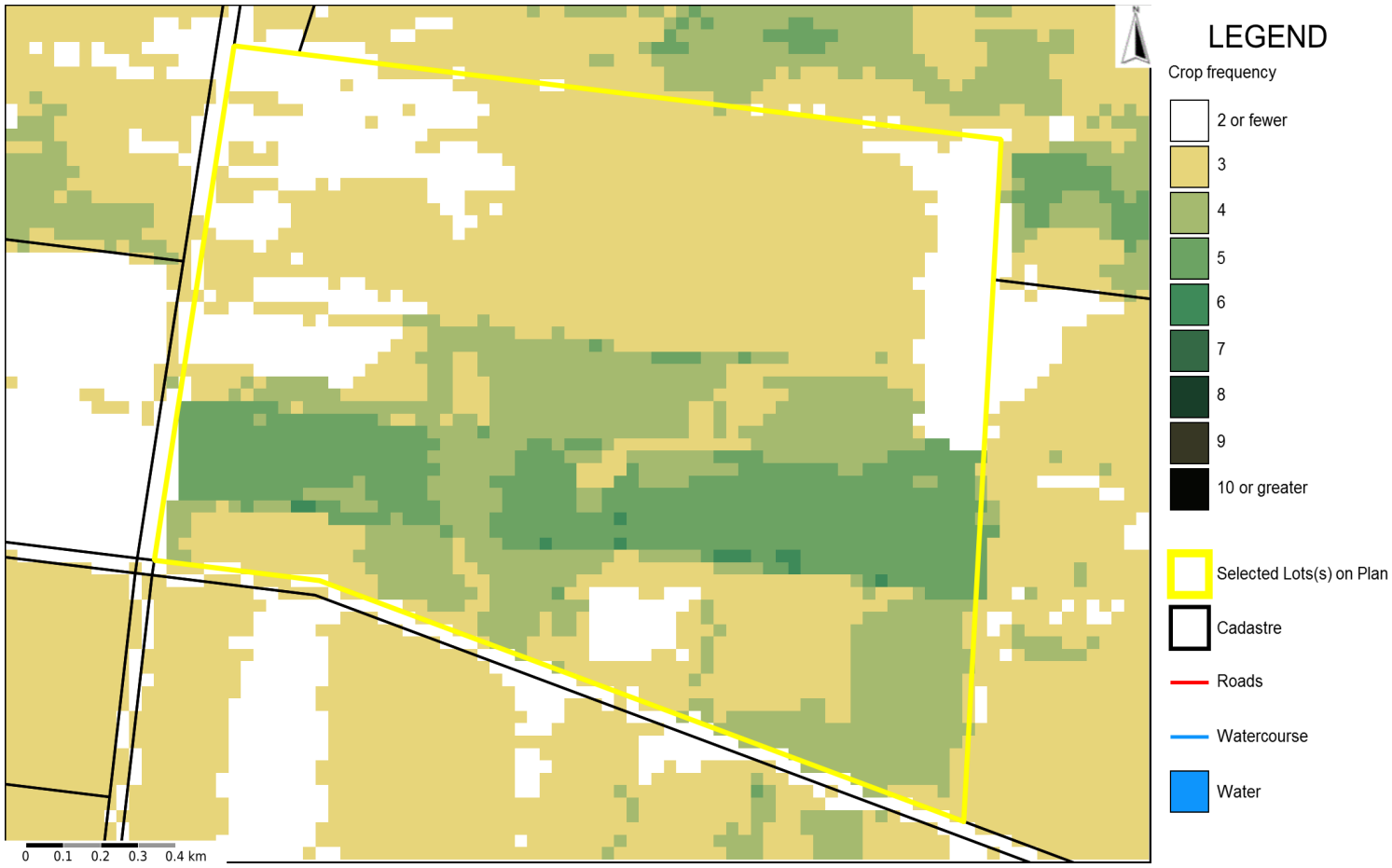
**Composite satellite imagery**: Due to the limitations of the automated method used to detect active cropping, it is recommended to view the seasonal composite images (pages 5 onward), compiled to represent the maximum greenness (per pixel) within a growing season. Cropped areas will generally appear bright green in the imagery compared with the surrounding landscape. Even if the crop-frequency mapping does not indicate cropping in an area, it is important to check each composite image to confirm that cropping has not been undertaken. Sometimes it will not be possible to clearly identify cropped areas in the imagery, e.g in some wetter seasons the entire landscape might appear green. In this case, it is recommended to undertake further investigation using other information sources. Note: the composite images are only used to confirm the presence or absence of cropping activity; it is not possible to visually differentiate between the crop groups.

# FORAGE REPORT: CROP FREQUENCY

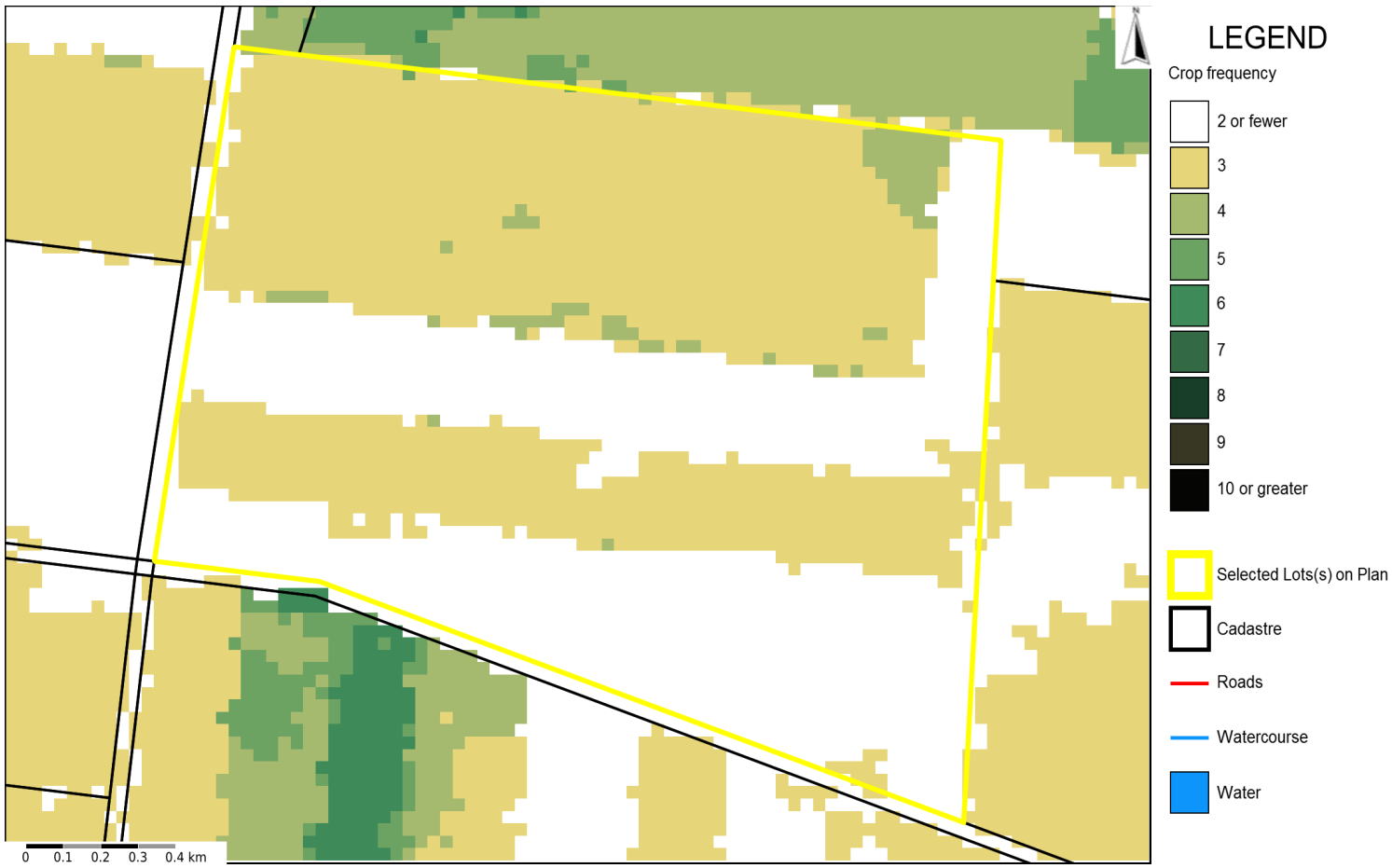
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 55DY592* *Label: p16*

Queensland Government

## Estimated frequency map for summer (February) crops (2012 - 2021)




## Estimated frequency map for winter (September) crops (2012 - 2021)

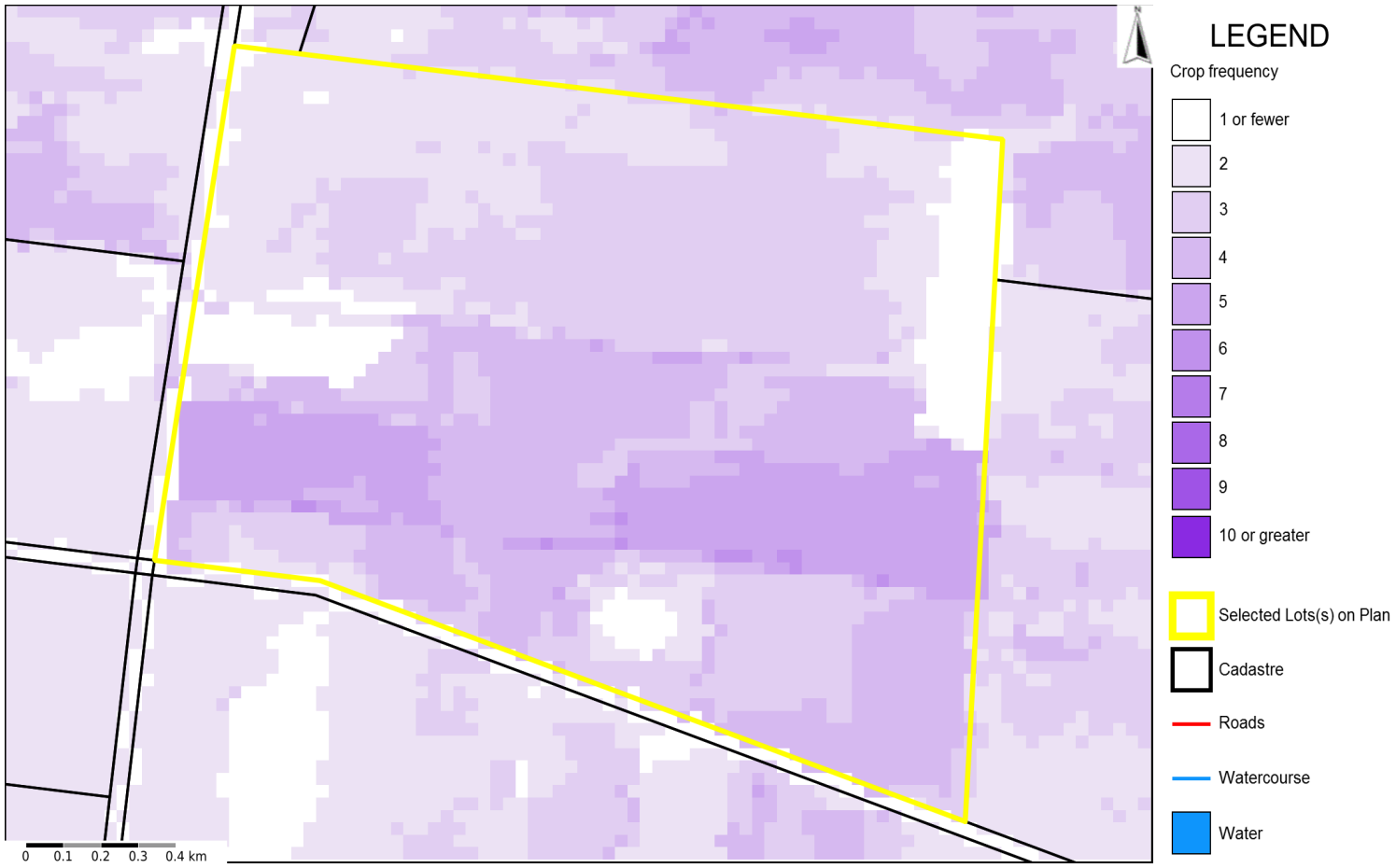


# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 55DY592* *Label: p16*

Queensland Government

## Estimated frequency map for summer (February) coarse grain and pulse crops (2012 - 2021)



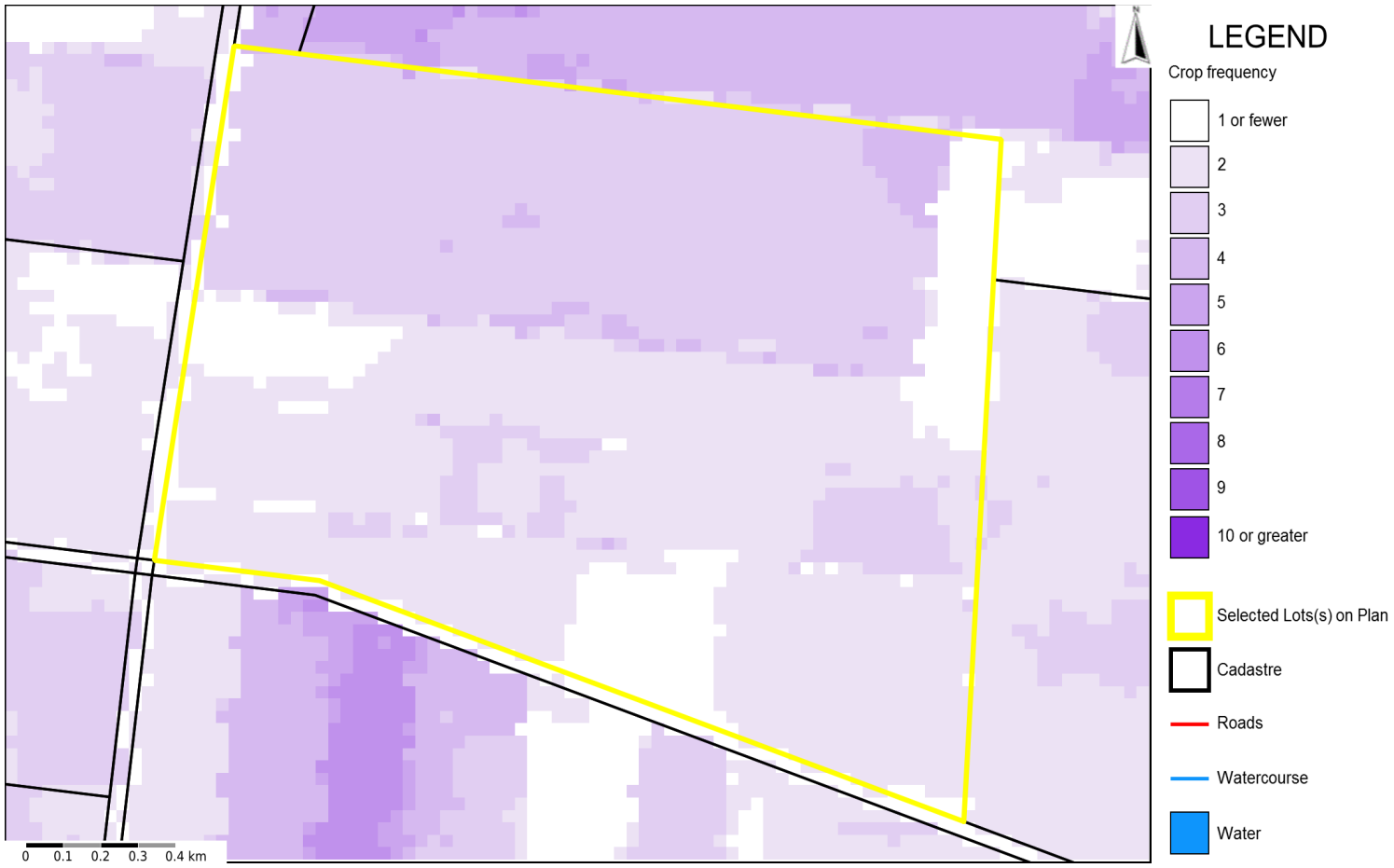

## Estimated frequency map for summer (February) cotton crops (2012 - 2021)

# FORAGE REPORT: CROP FREQUENCY

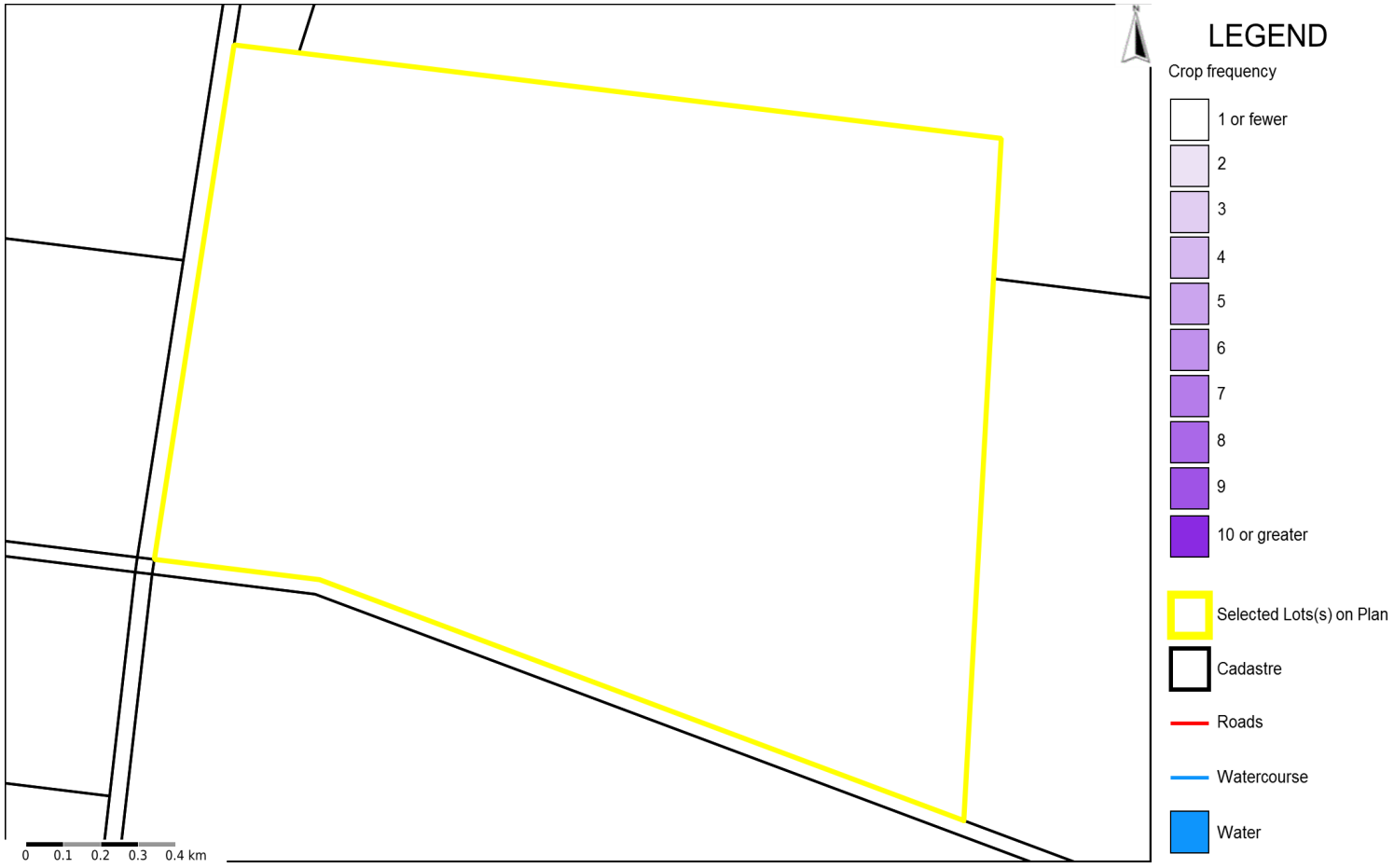
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 55DY592* *Label: p16*

Queensland Government

## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)

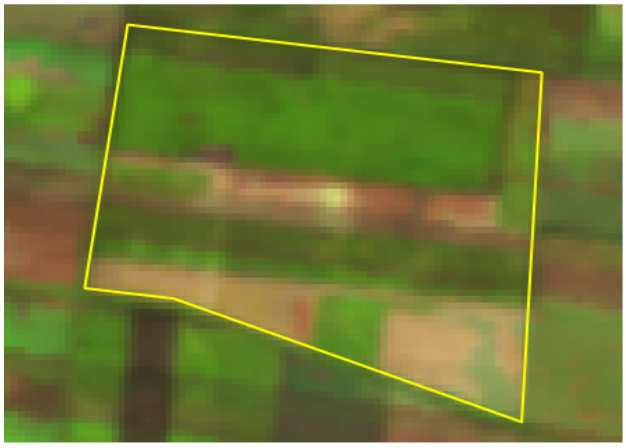


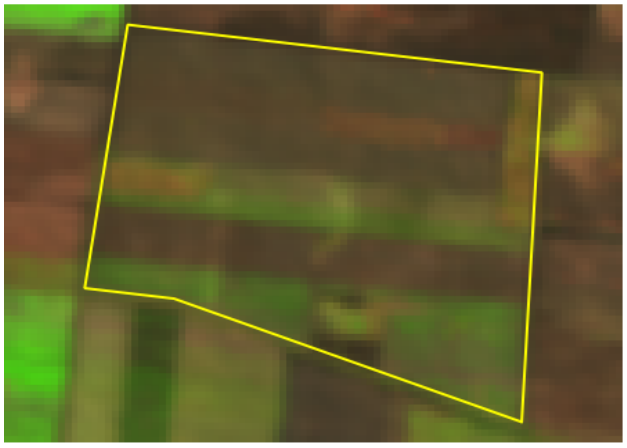
# FORAGE REPORT: CROP FREQUENCY



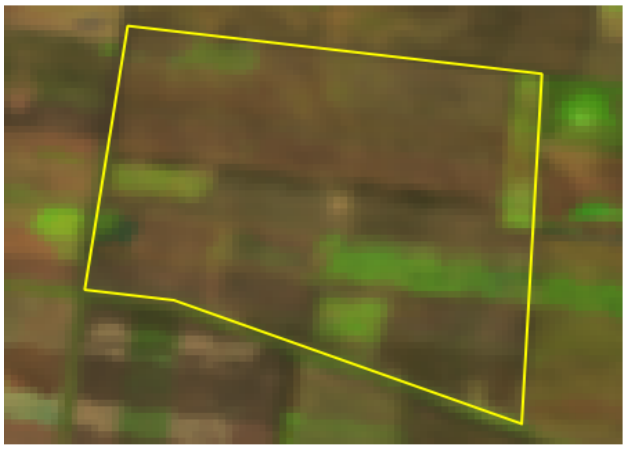
Queensland Government

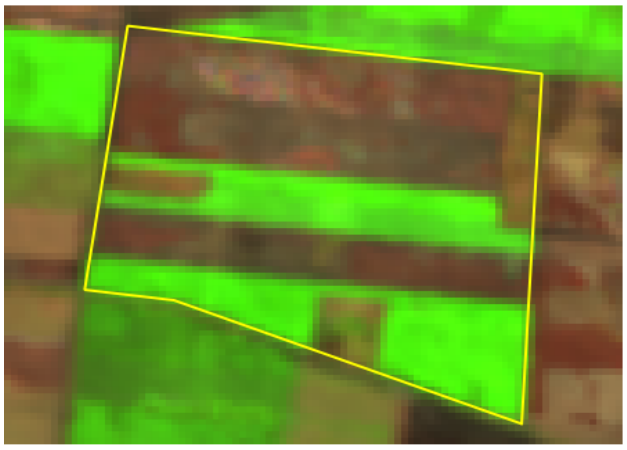
## February (left) and September (right) images for 2012



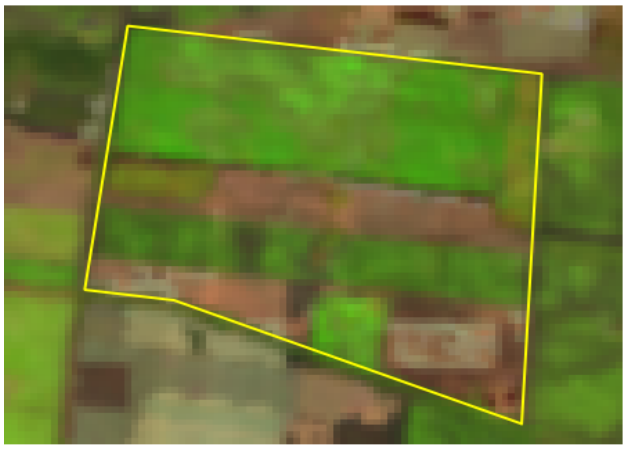


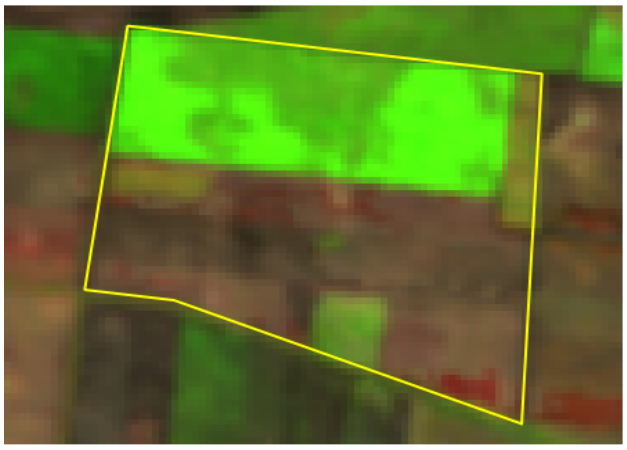
## February (left) and September (right) images for 2013





## February (left) and September (right) images for 2014



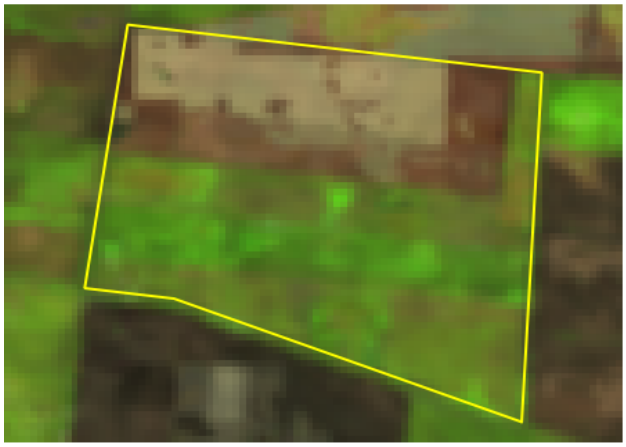


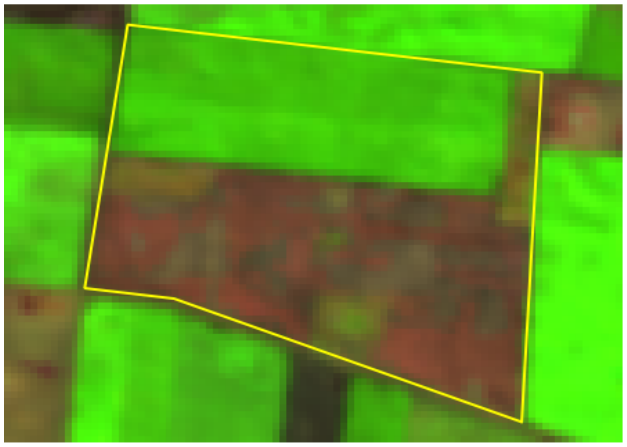
# FORAGE REPORT: CROP FREQUENCY



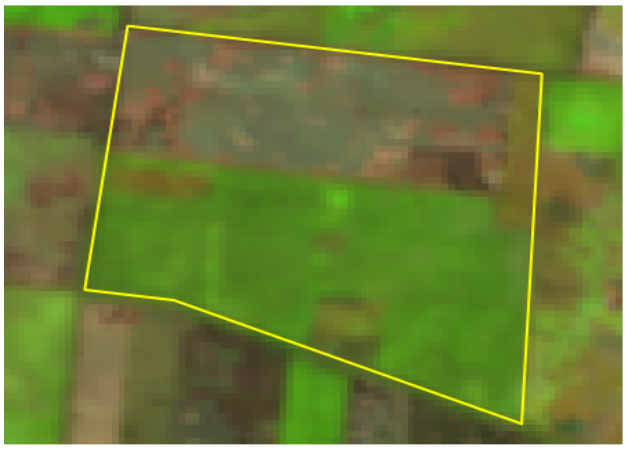
Queensland Government

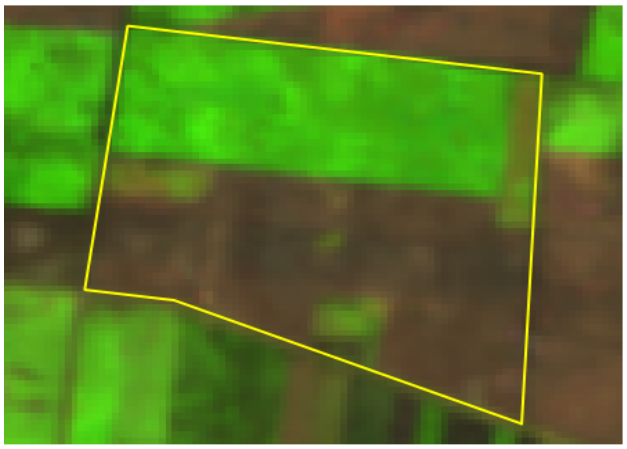
## February (left) and September (right) images for 2015





## February (left) and September (right) images for 2016





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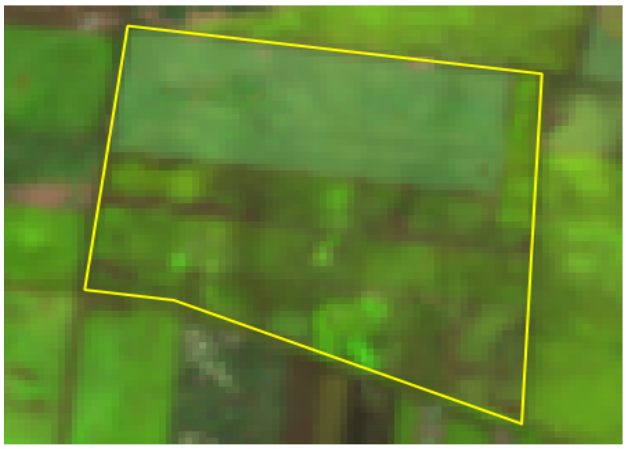

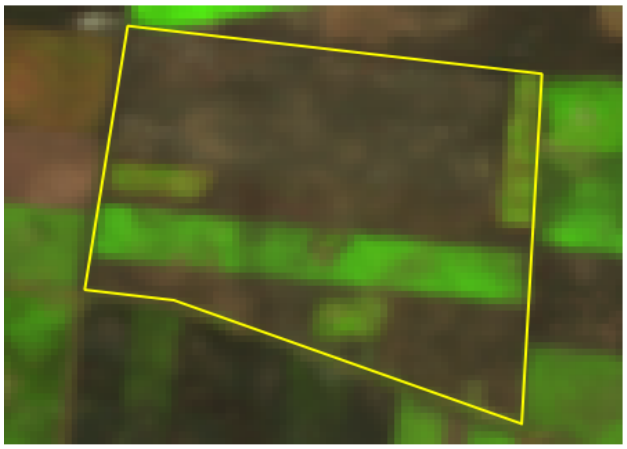

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Queensland Government

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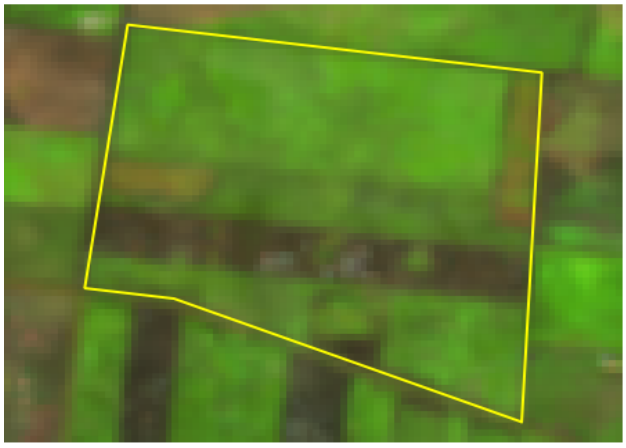

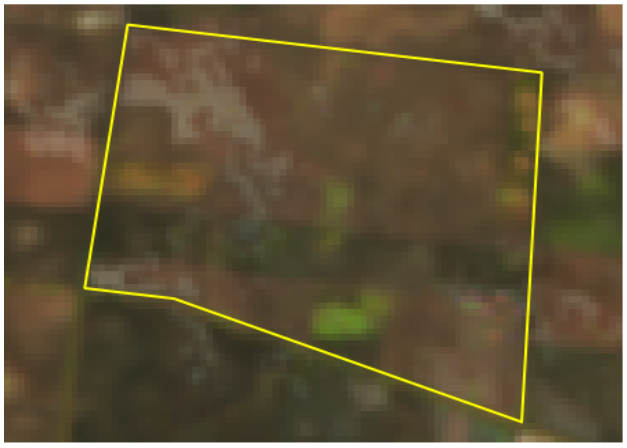

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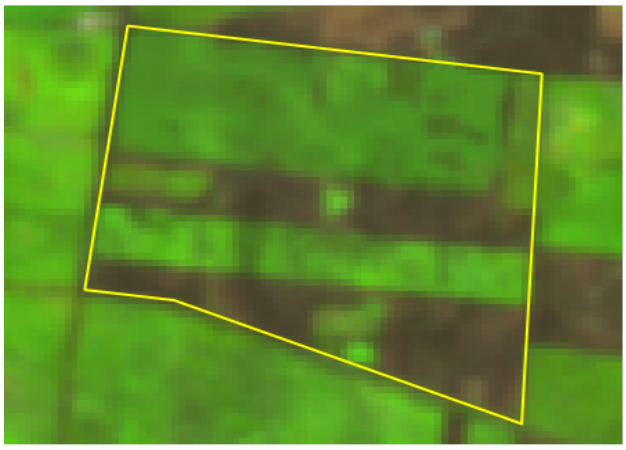
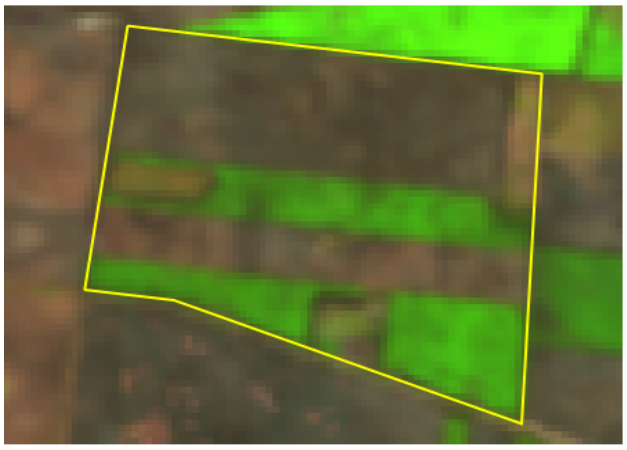
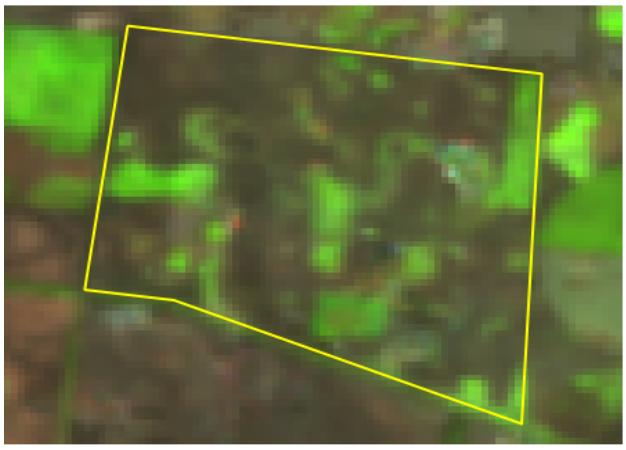
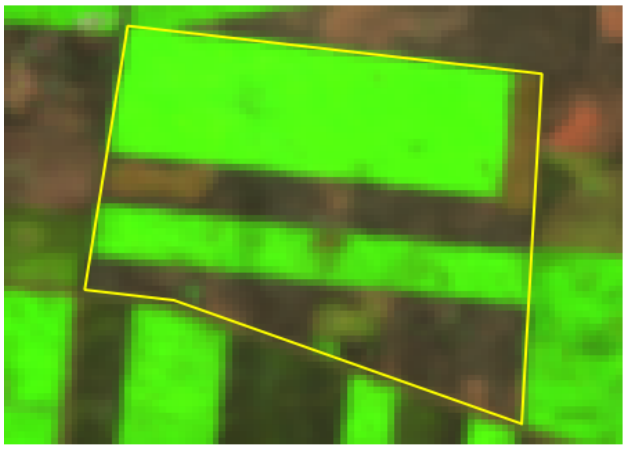




## February (left) and September (right) images for 2020



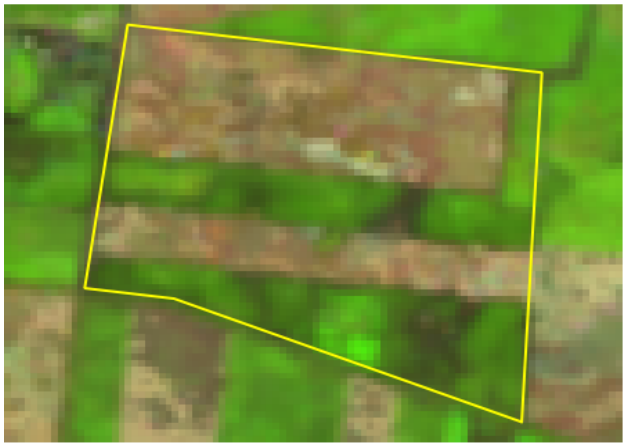


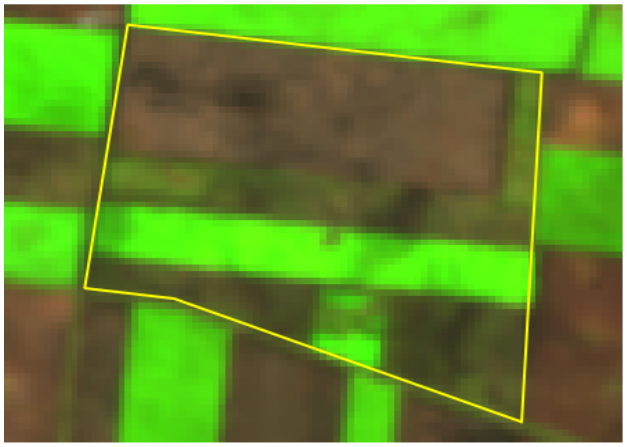
# FORAGE REPORT: CROP FREQUENCY



Queensland Government

## February (left) and September (right) images for 2021





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# FORAGE REPORT: CROP FREQUENCY



Queensland Government

## Introduction

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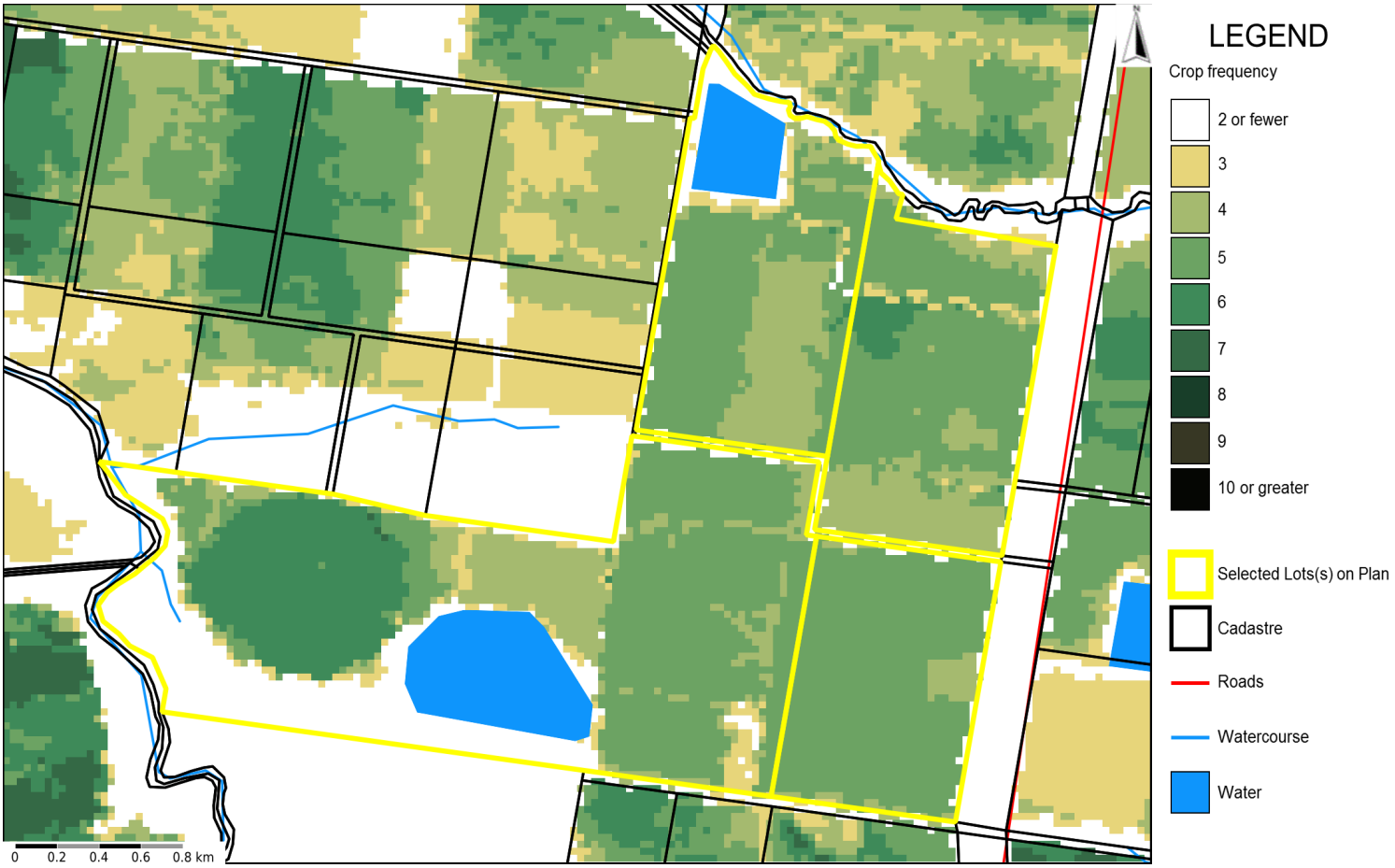


## How to interpret the information

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- Cotton crop.

**Composite satellite imagery**: Due to the limitations of the automated method used to detect active cropping, it is recommended to view the seasonal composite images (pages 5 onward), compiled to represent the maximum greenness (per pixel) within a growing season. Cropped areas will generally appear bright green in the imagery compared with the surrounding landscape. Even if the crop-frequency mapping does not indicate cropping in an area, it is important to check each composite image to confirm that cropping has not been undertaken. Sometimes it will not be possible to clearly identify cropped areas in the imagery, e.g in some wetter seasons the entire landscape might appear green. In this case, it is recommended to undertake further investigation using other information sources. Note: the composite images are only used to confirm the presence or absence of cropping activity; it is not possible to visually differentiate between the crop groups.

# FORAGE REPORT: CROP FREQUENCY



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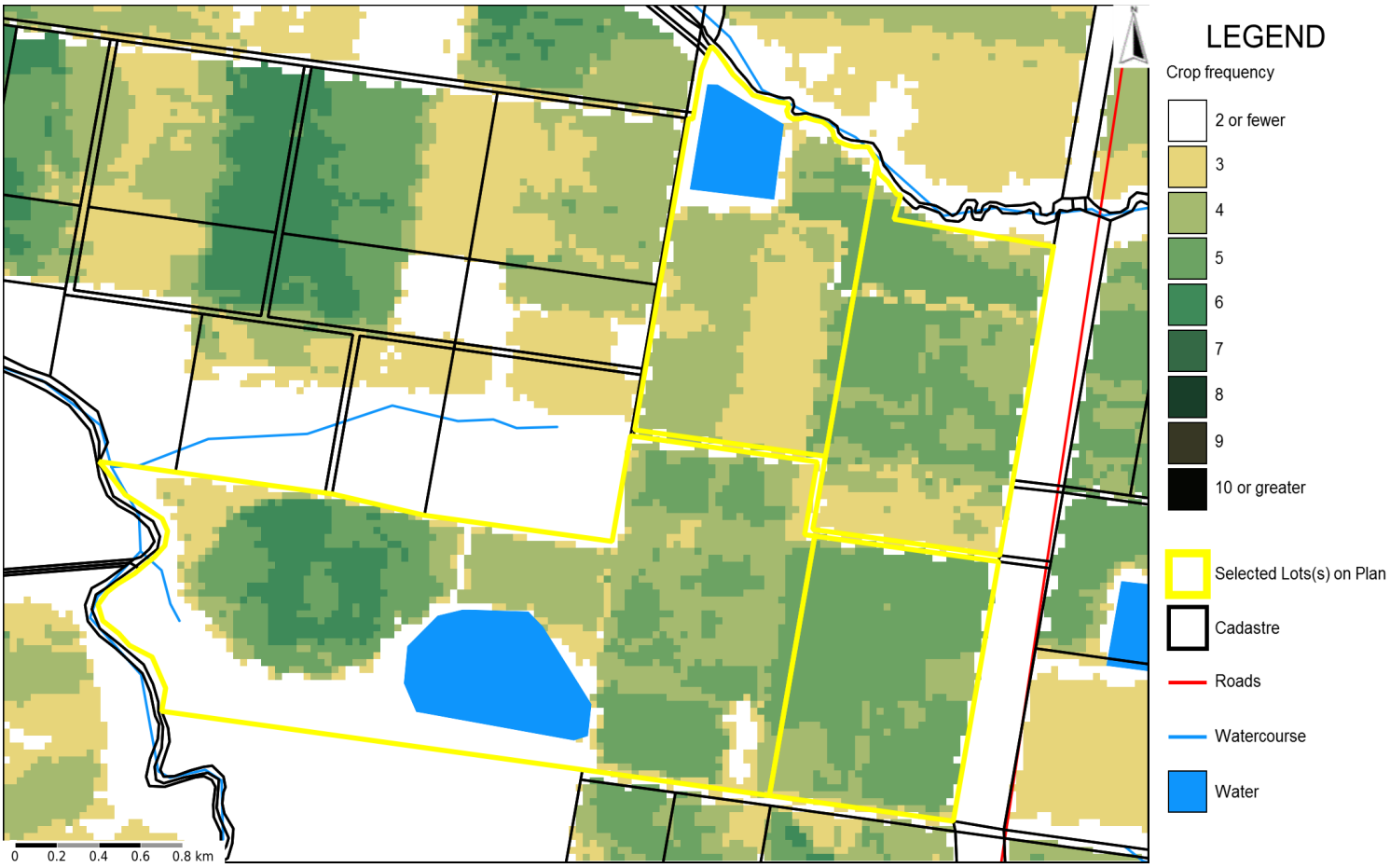
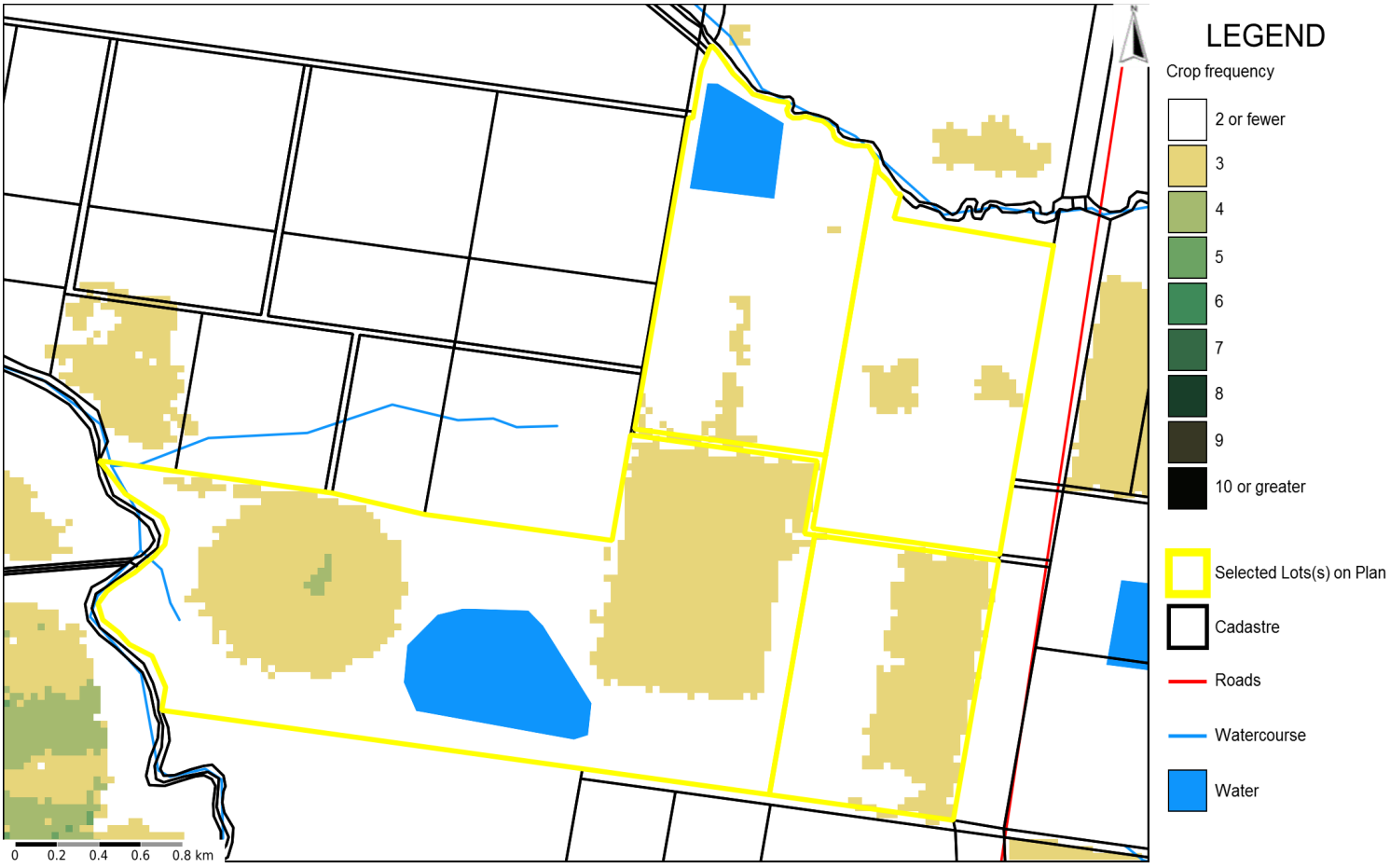
## Estimated frequency map for summer (February) crops (2012 - 2021)




## Estimated frequency map for winter (September) crops (2012 - 2021)



# FORAGE REPORT: CROP FREQUENCY



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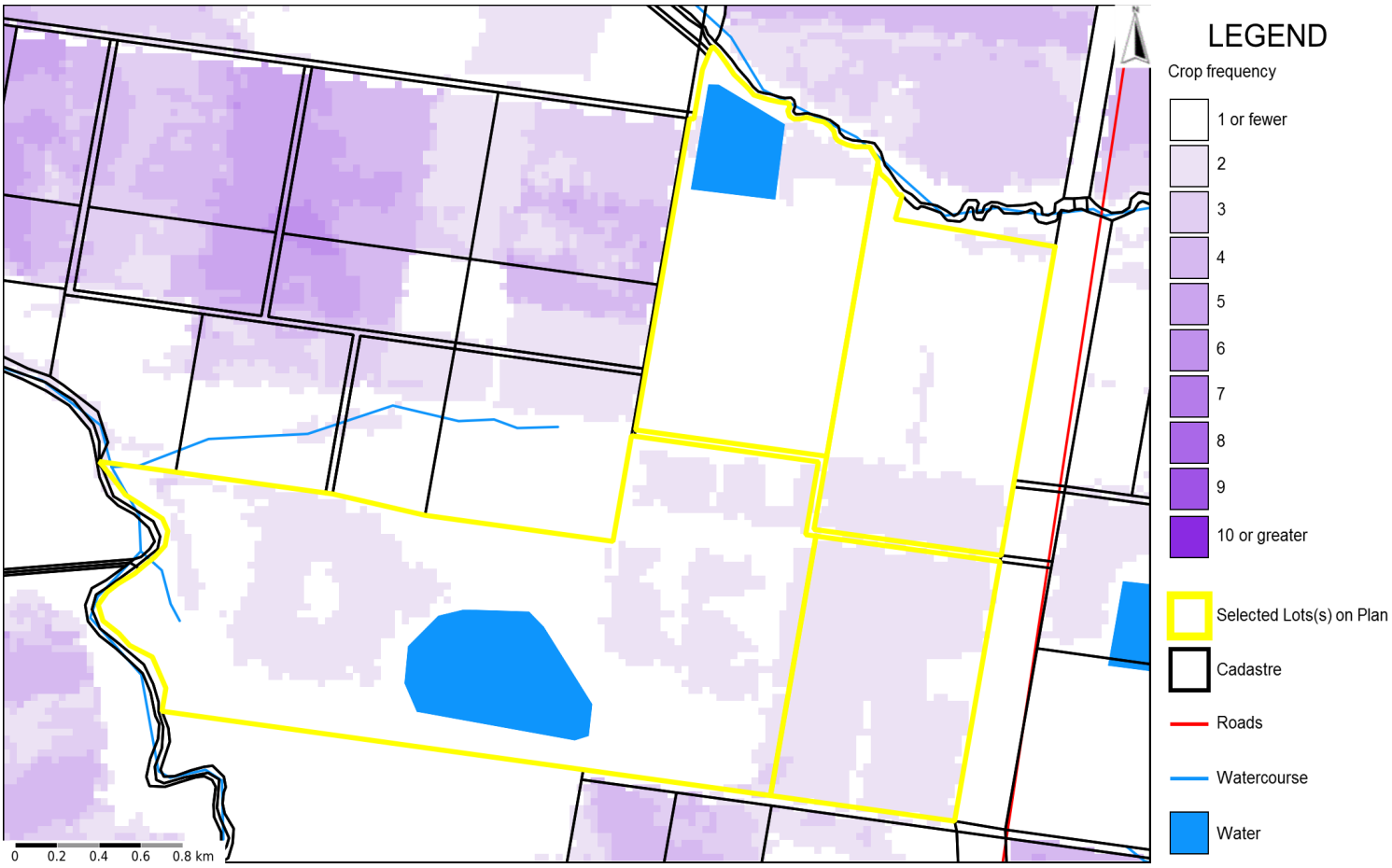
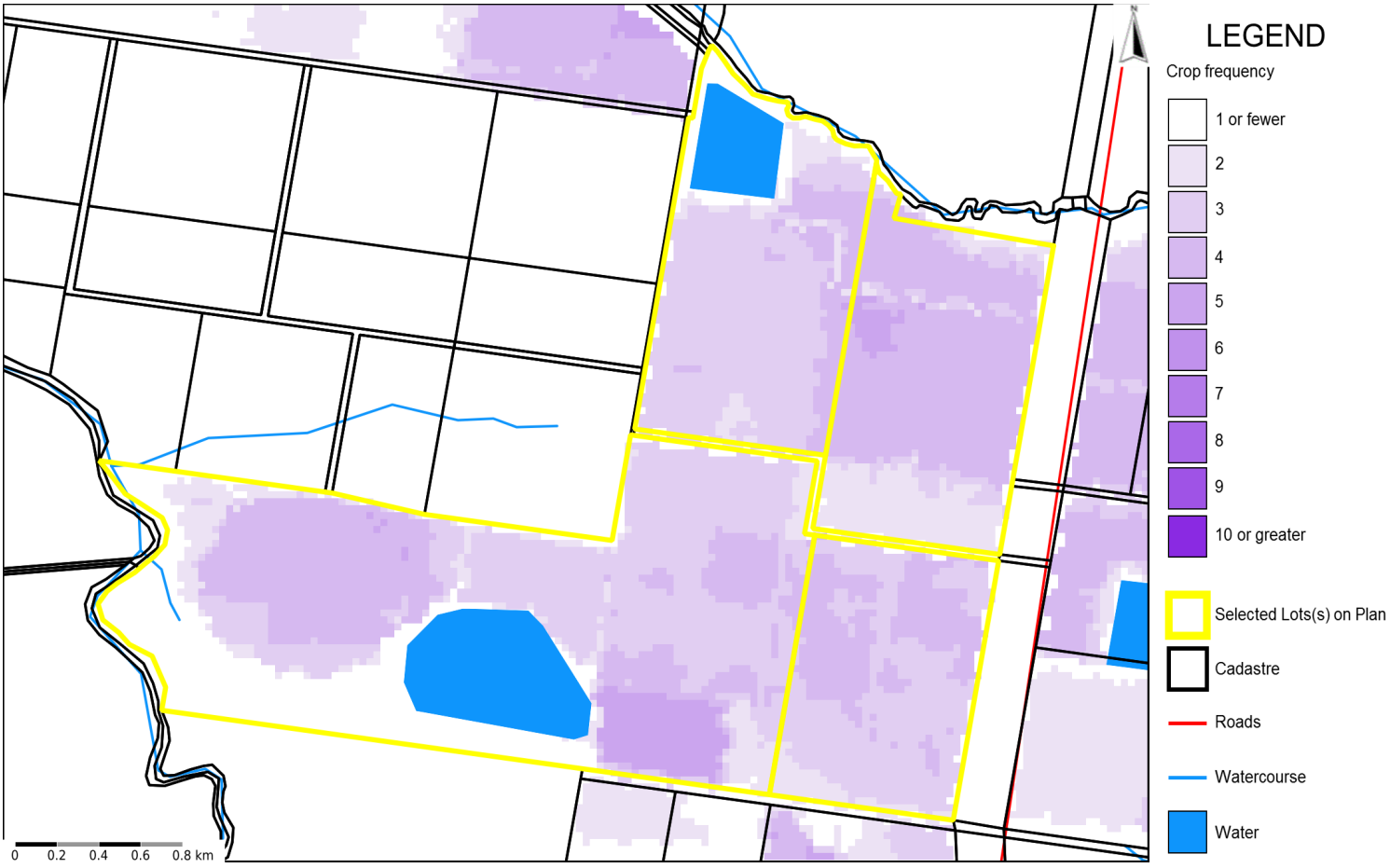
## Estimated frequency map for summer (February) coarse grain and pulse crops (2012 - 2021)




## Estimated frequency map for summer (February) cotton crops (2012 - 2021)



# FORAGE REPORT: CROP FREQUENCY



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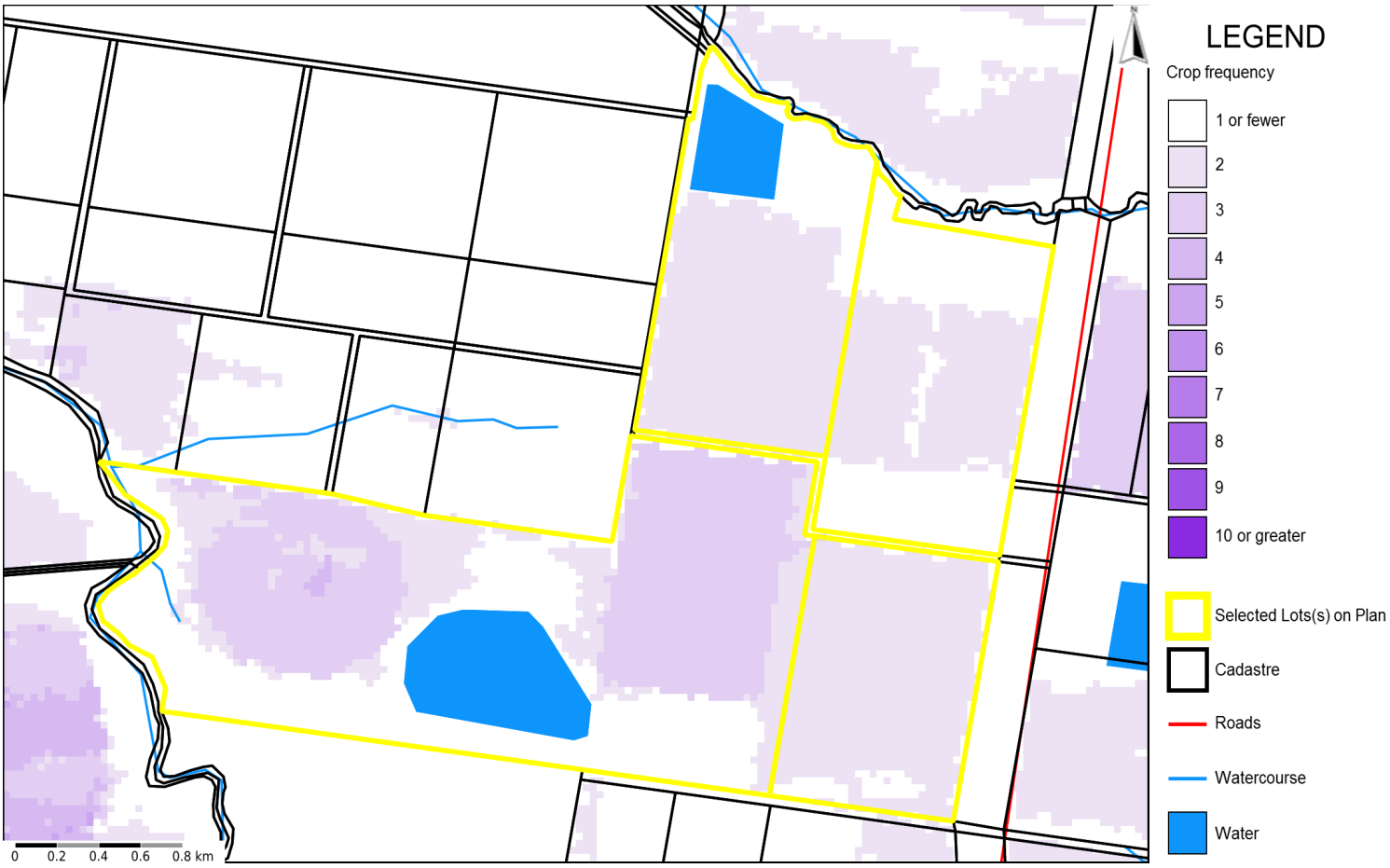
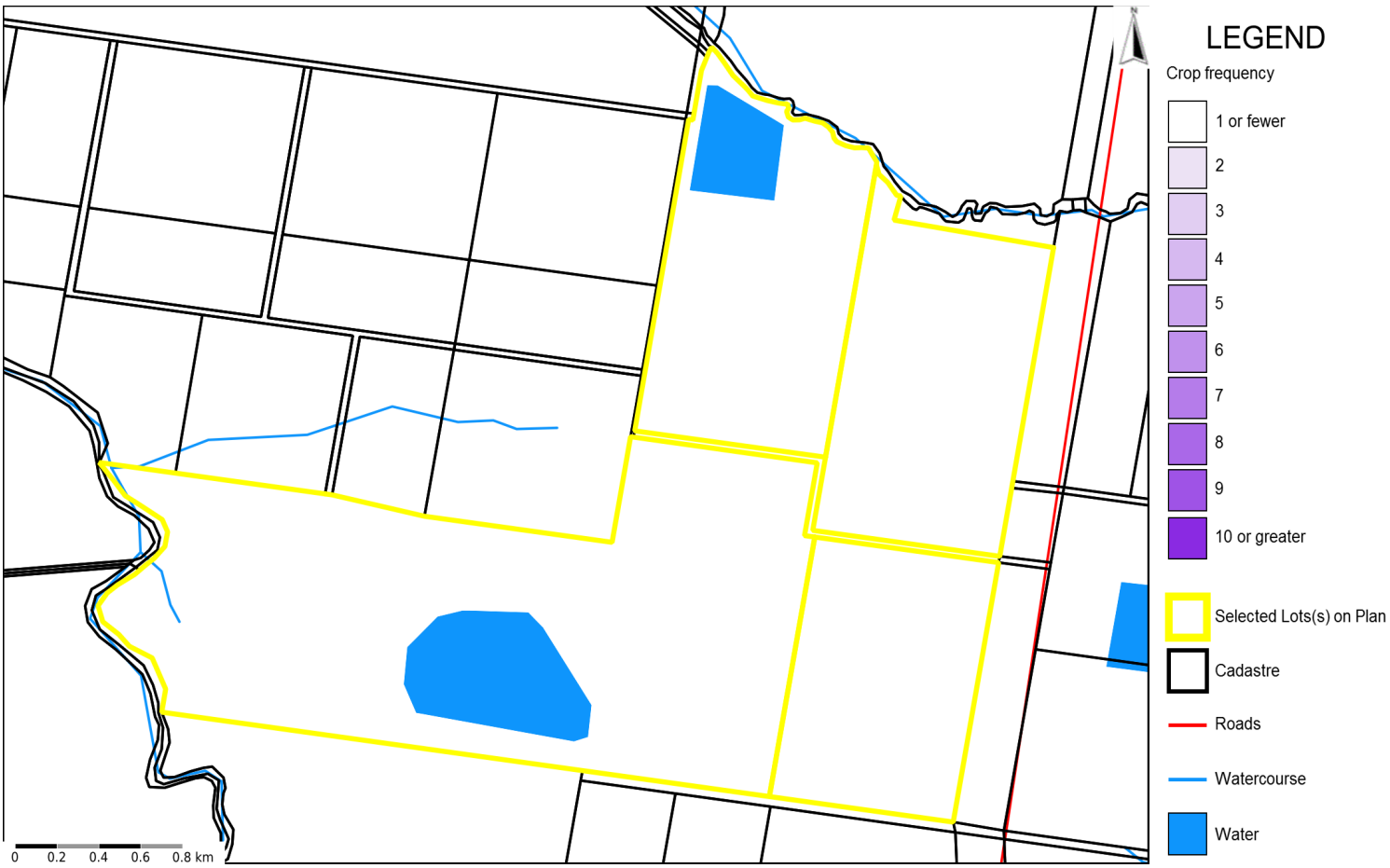
## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)

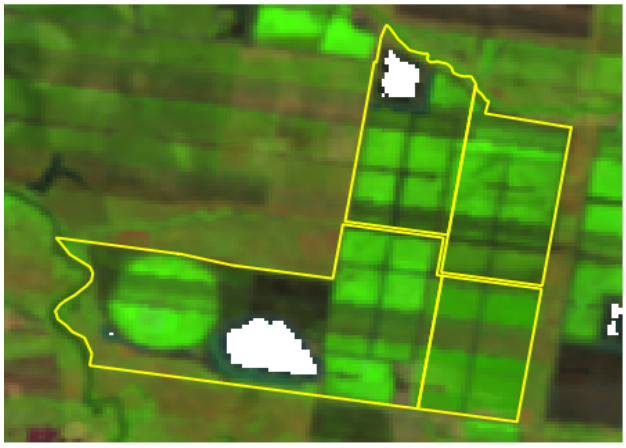


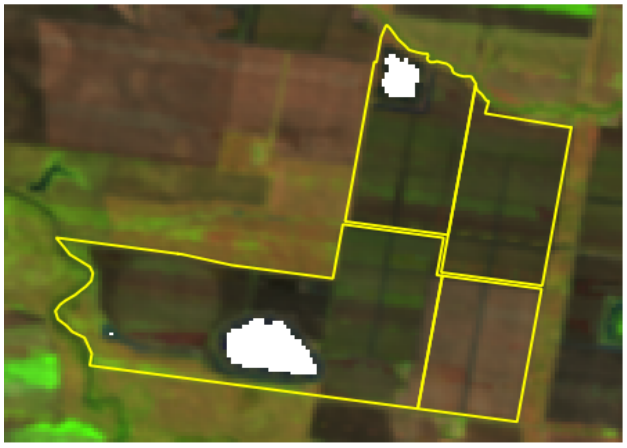
# FORAGE REPORT: CROP FREQUENCY



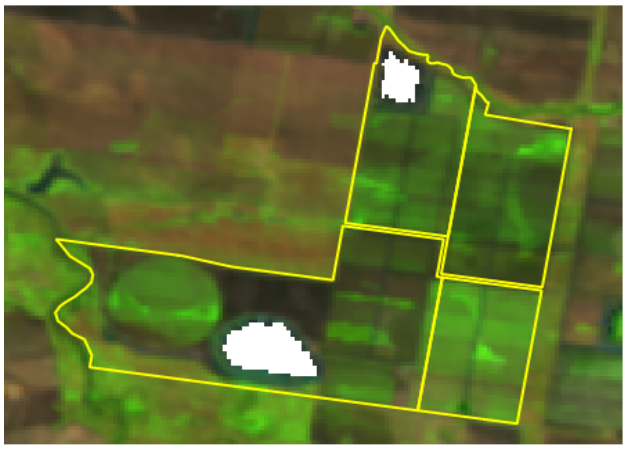
Queensland Government

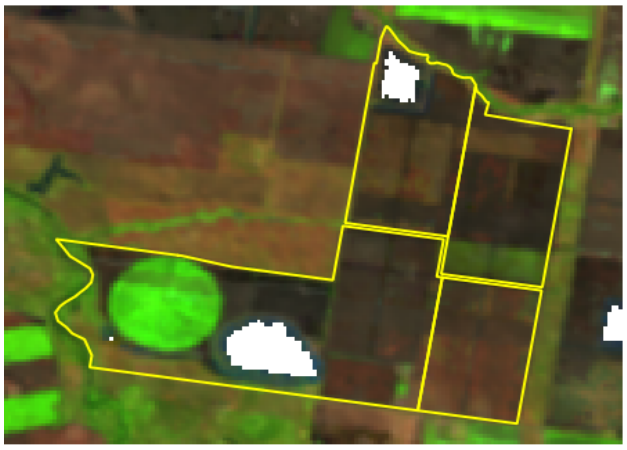
## February (left) and September (right) images for 2012



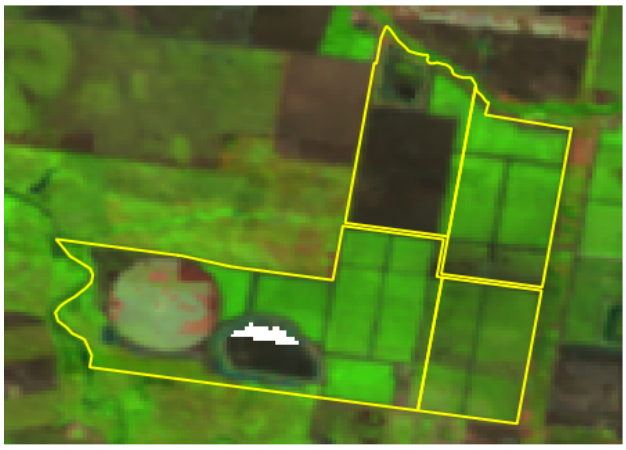


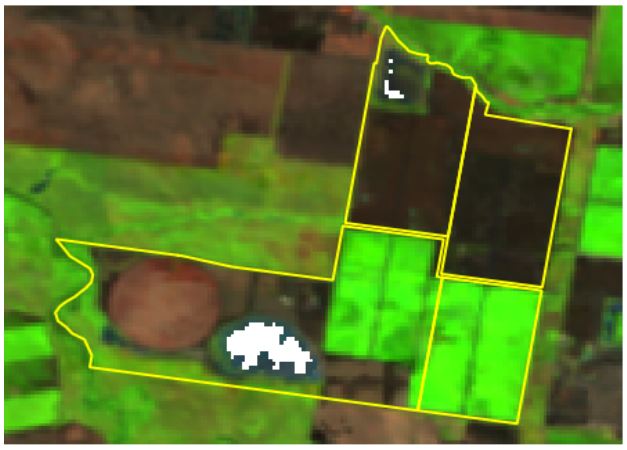
## February (left) and September (right) images for 2013





## February (left) and September (right) images for 2014



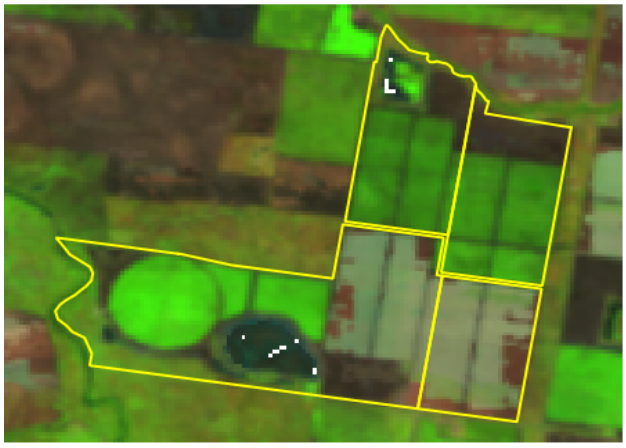


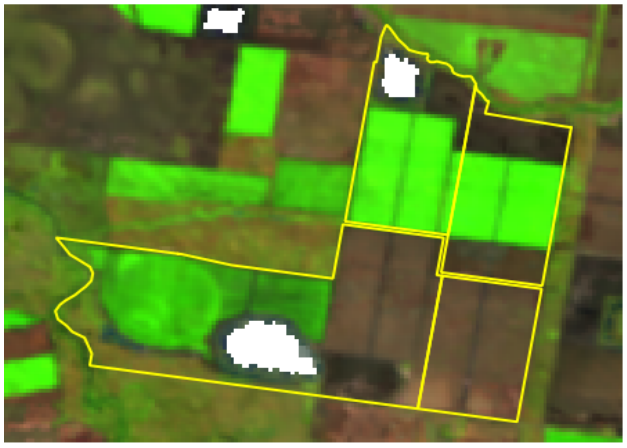
# FORAGE REPORT: CROP FREQUENCY



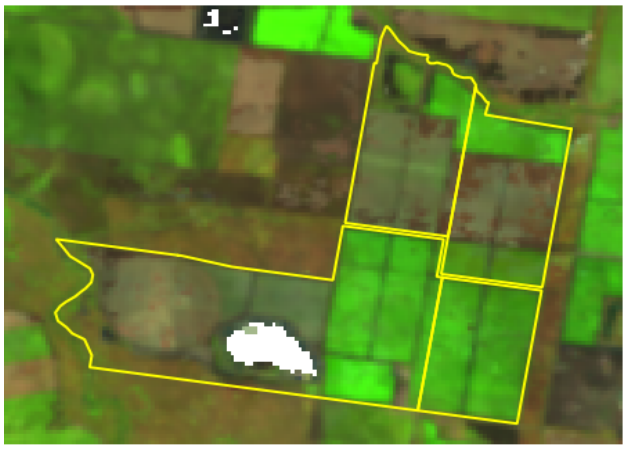
Queensland Government

## February (left) and September (right) images for 2015

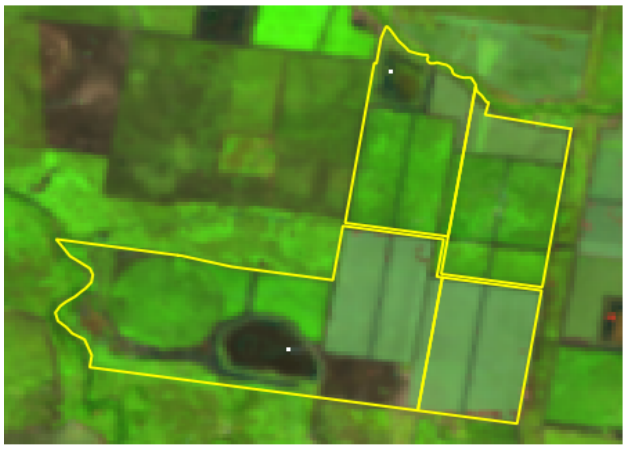


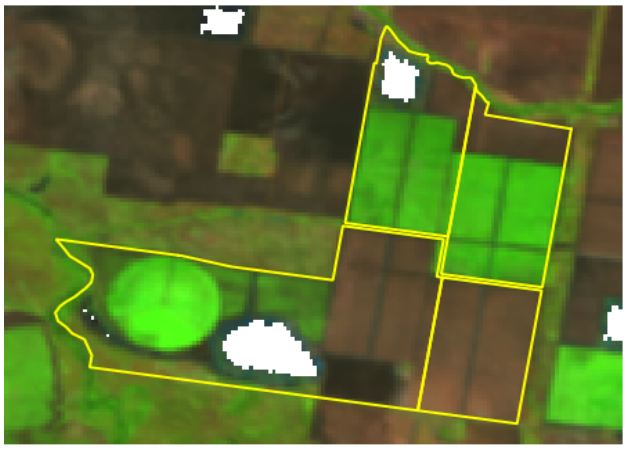


## February (left) and September (right) images for 2016



## February (left) and September (right) images for 2017





# FORAGE REPORT: CROP FREQUENCY



Queensland Government

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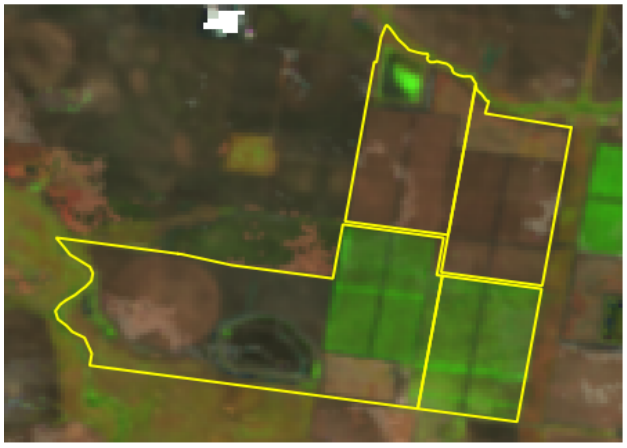
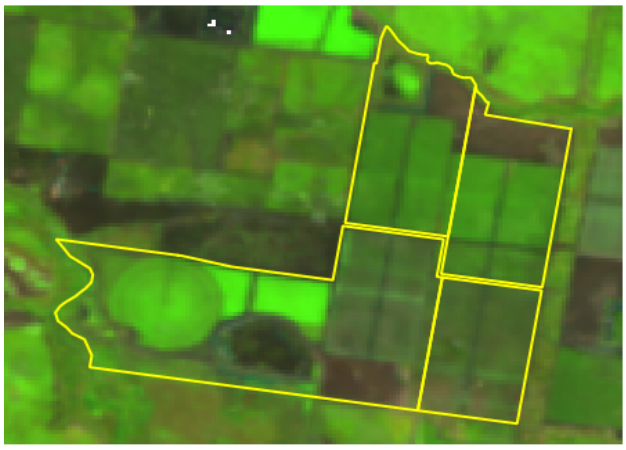
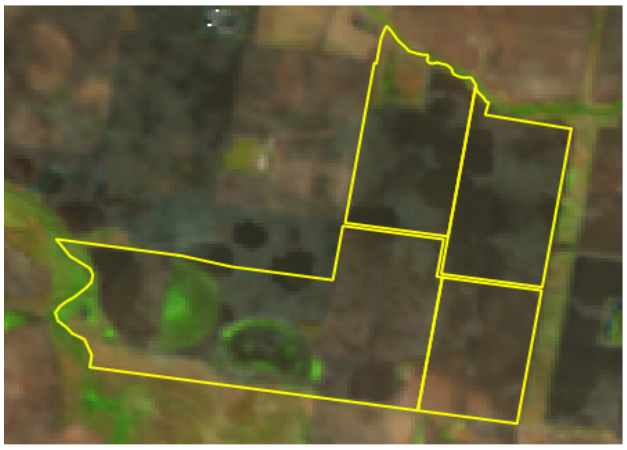


## February (left) and September (right) images for 2019





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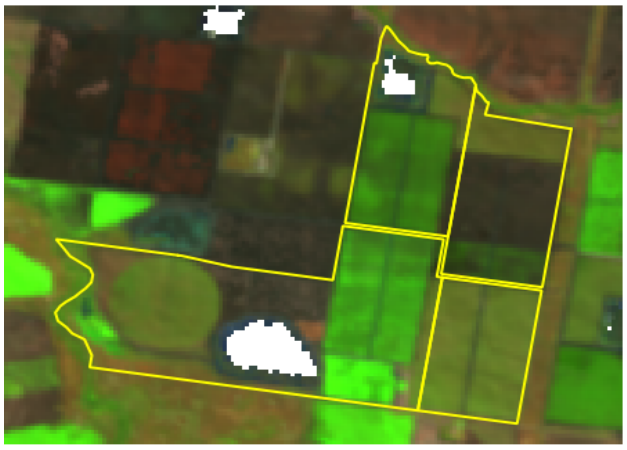

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Queensland Government

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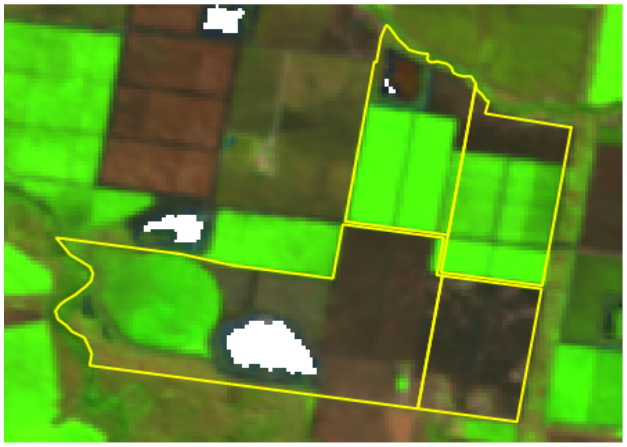

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Queensland Government

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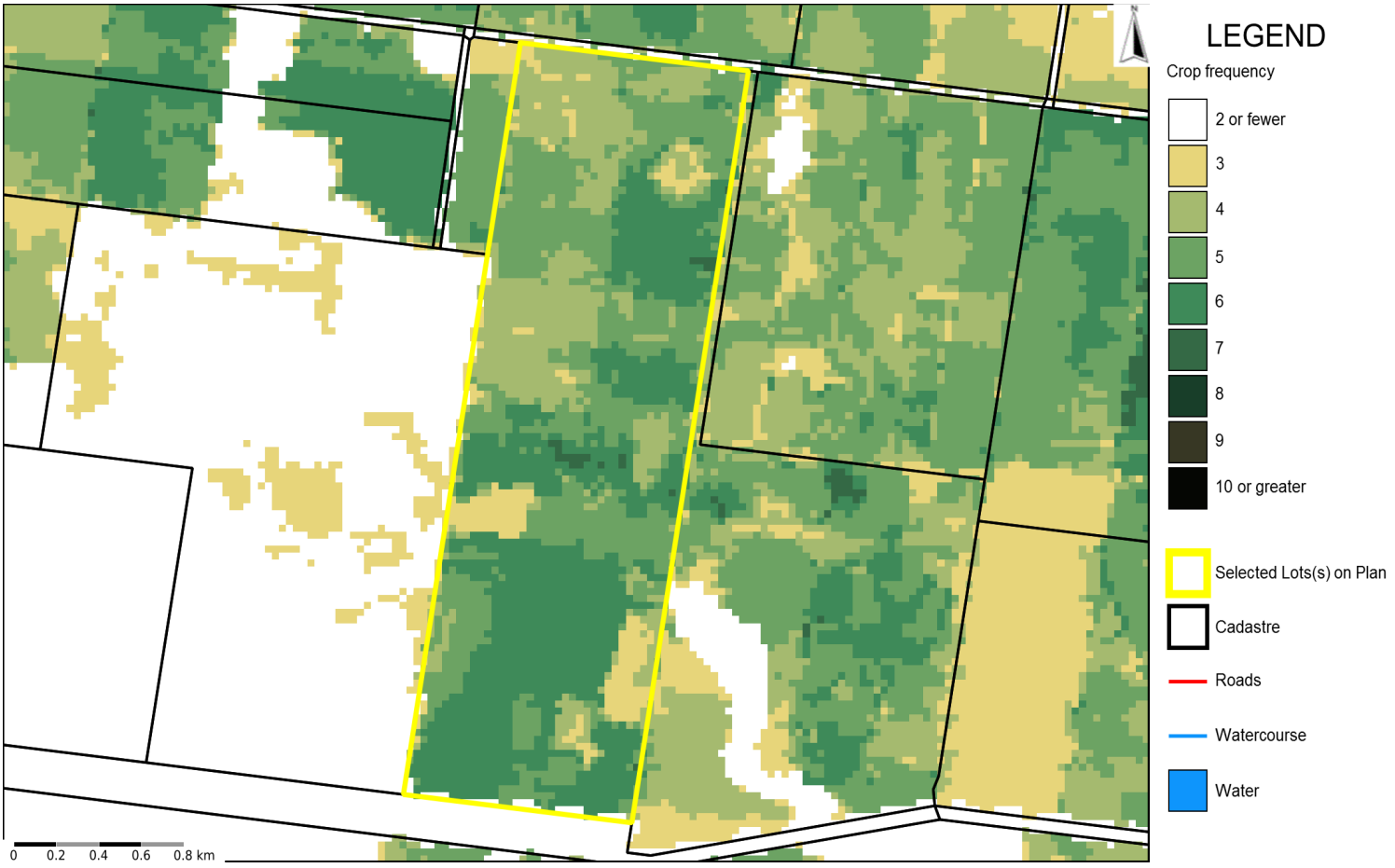


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# FORAGE REPORT: CROP FREQUENCY

*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP78475* *Label: p18*

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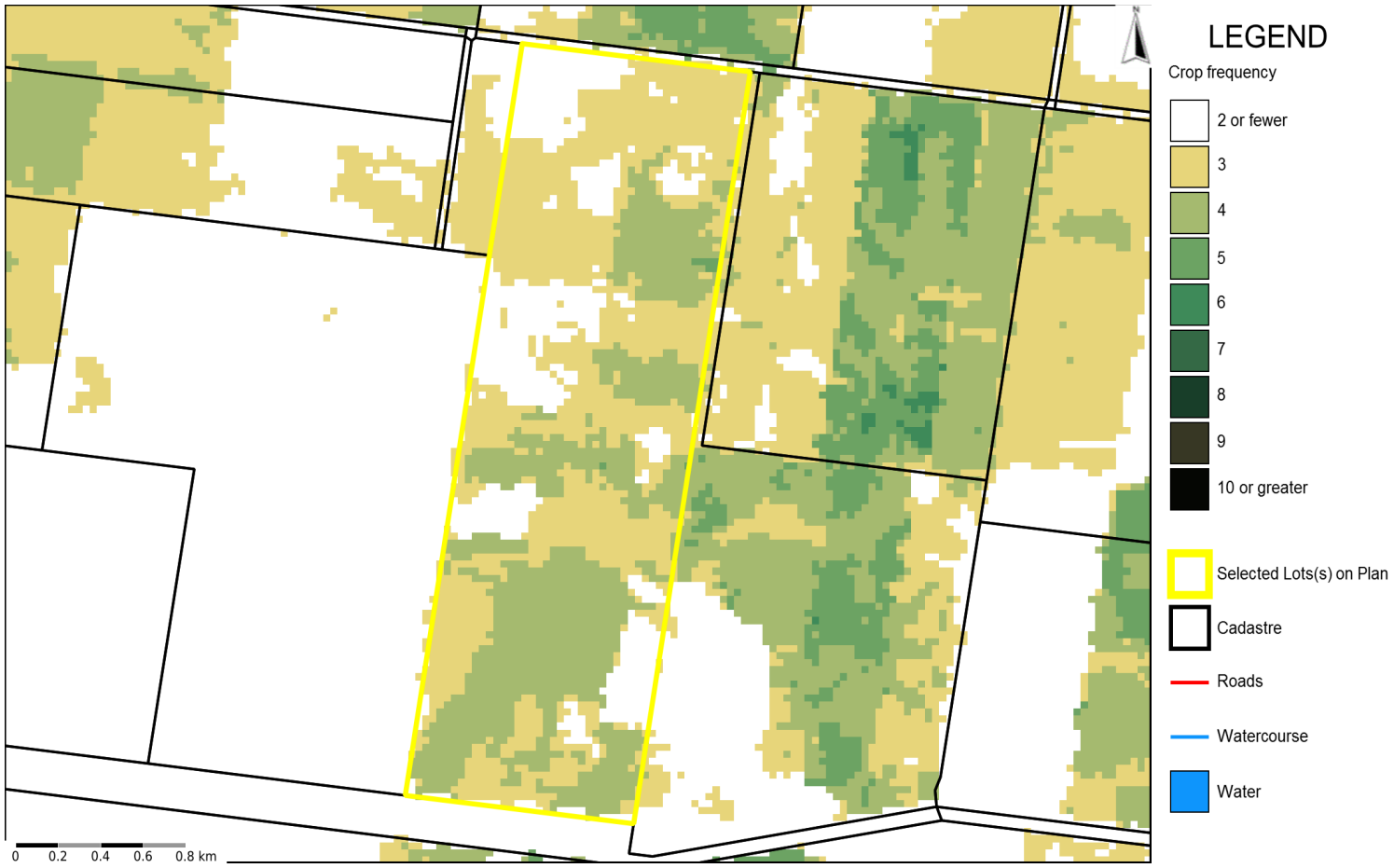
## Estimated frequency map for summer (February) crops (2012 - 2021)

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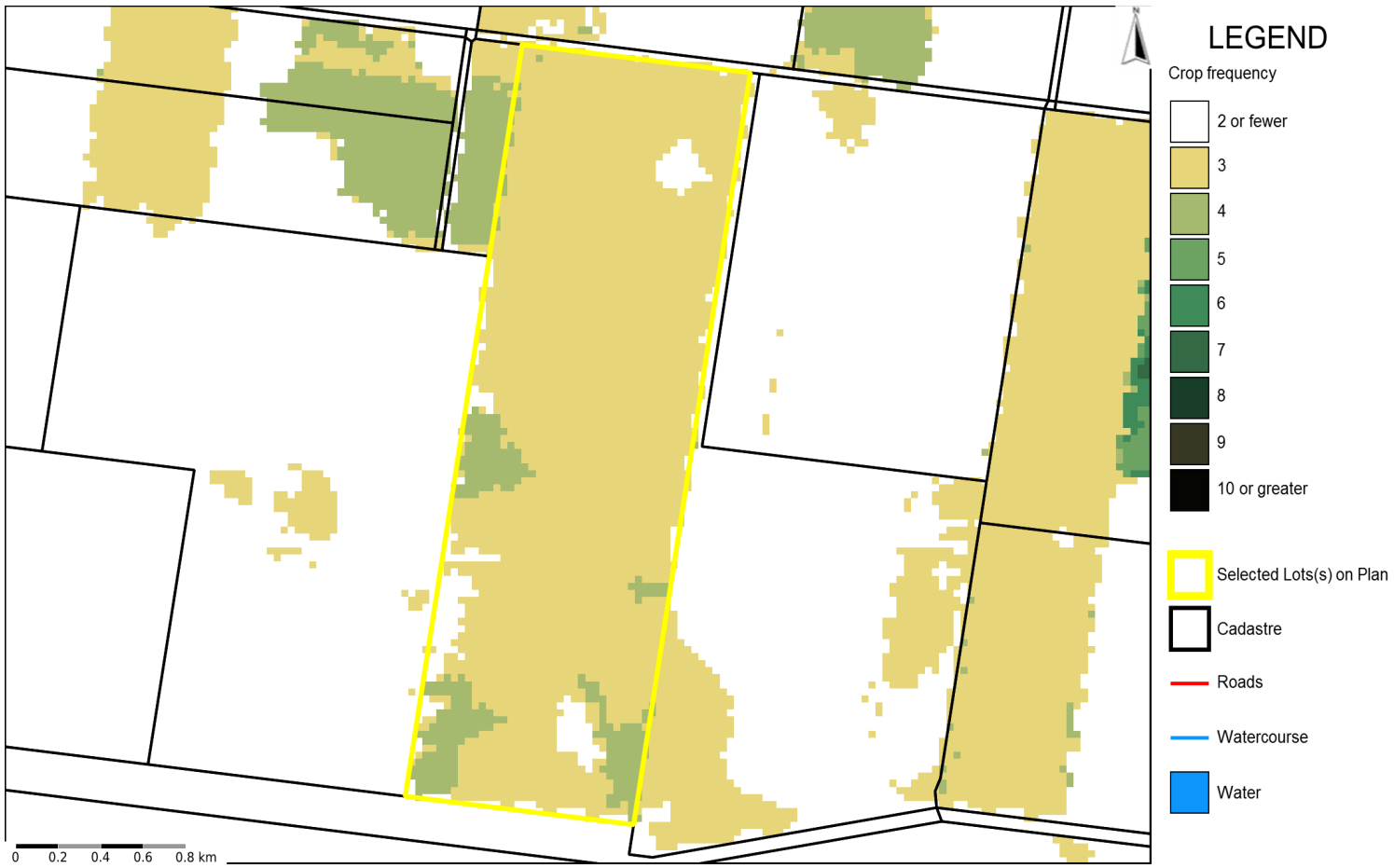

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*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP78475* *Label: p18*

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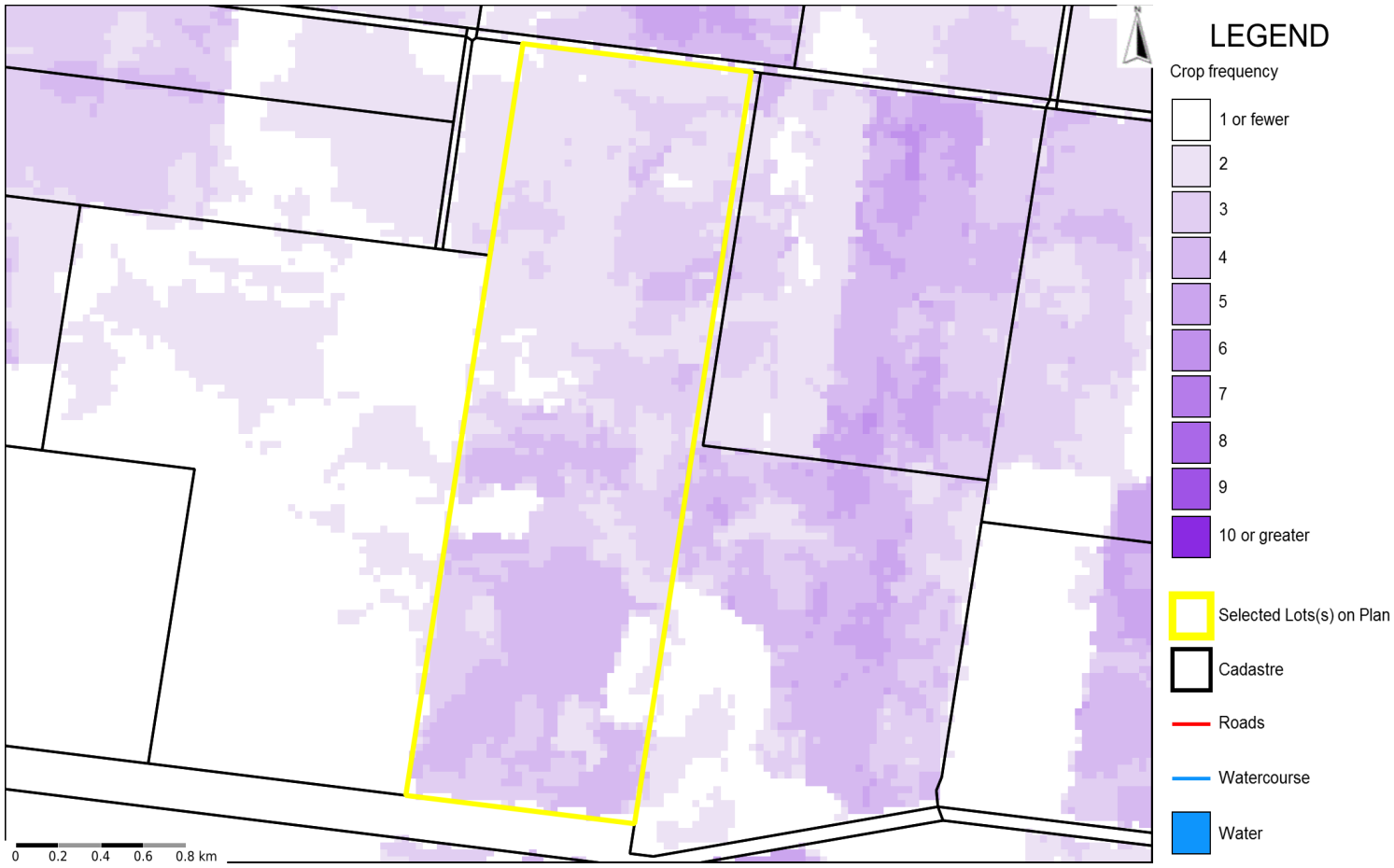
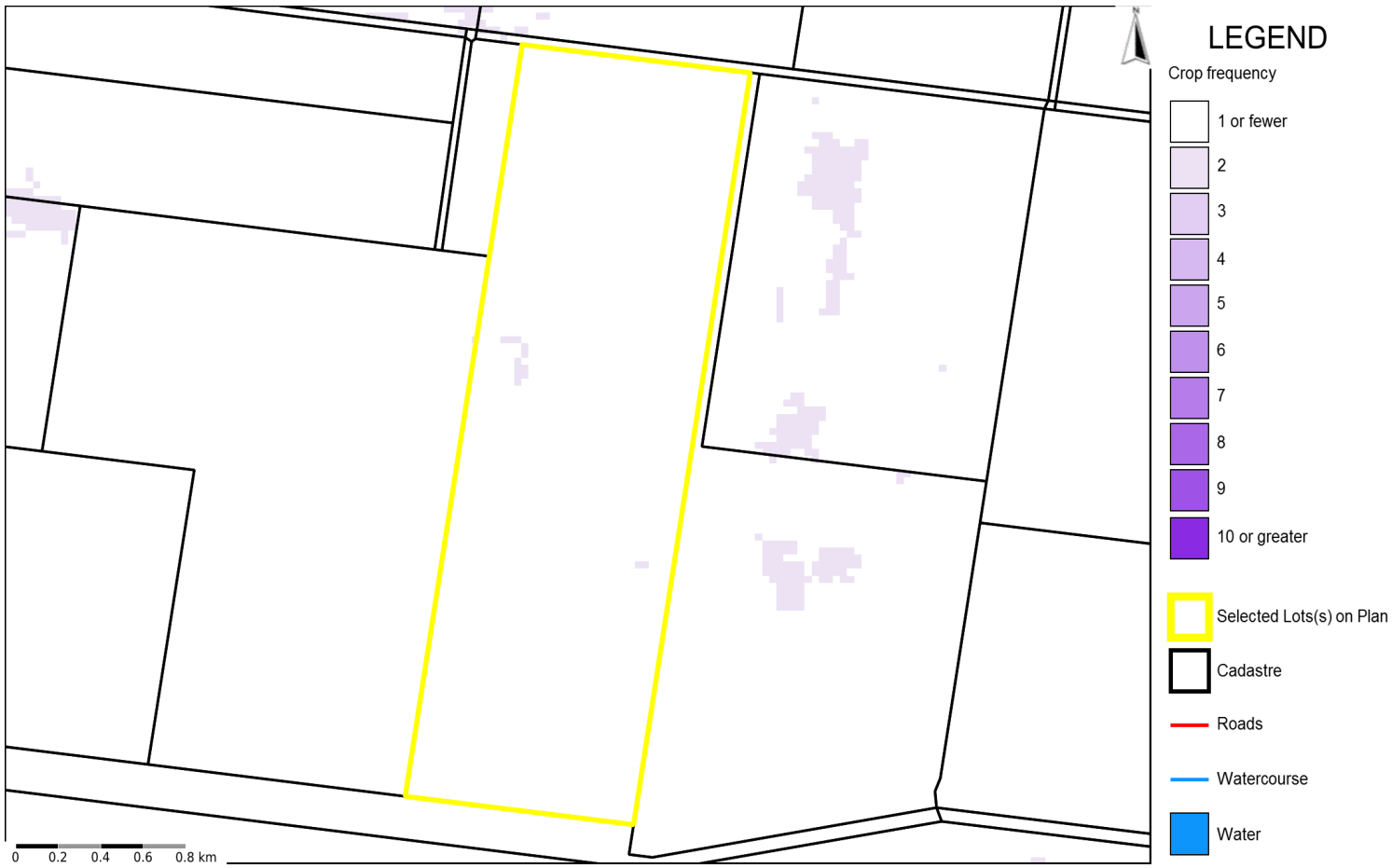



## Estimated frequency map for summer (February) cotton crops (2012 - 2021)



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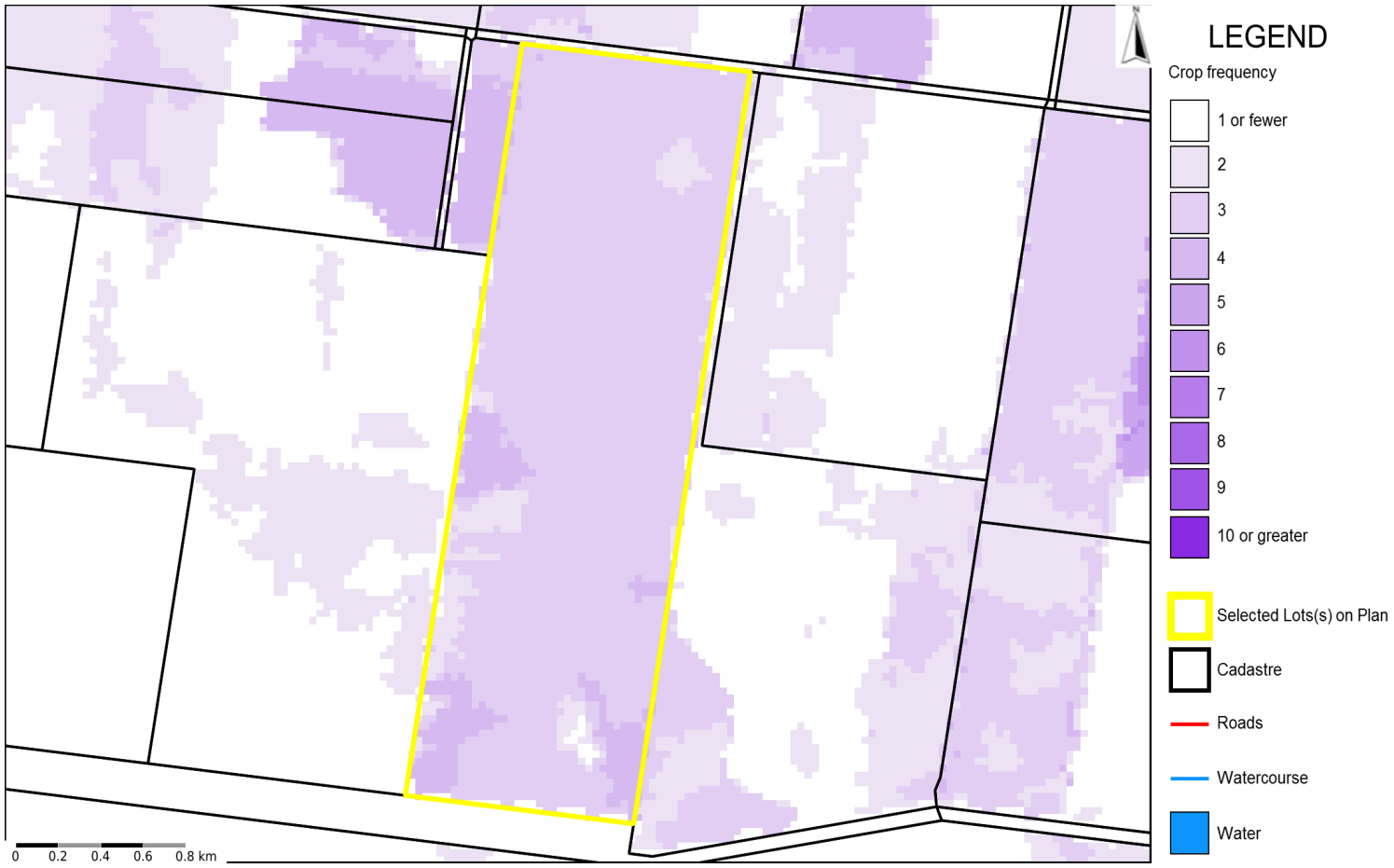
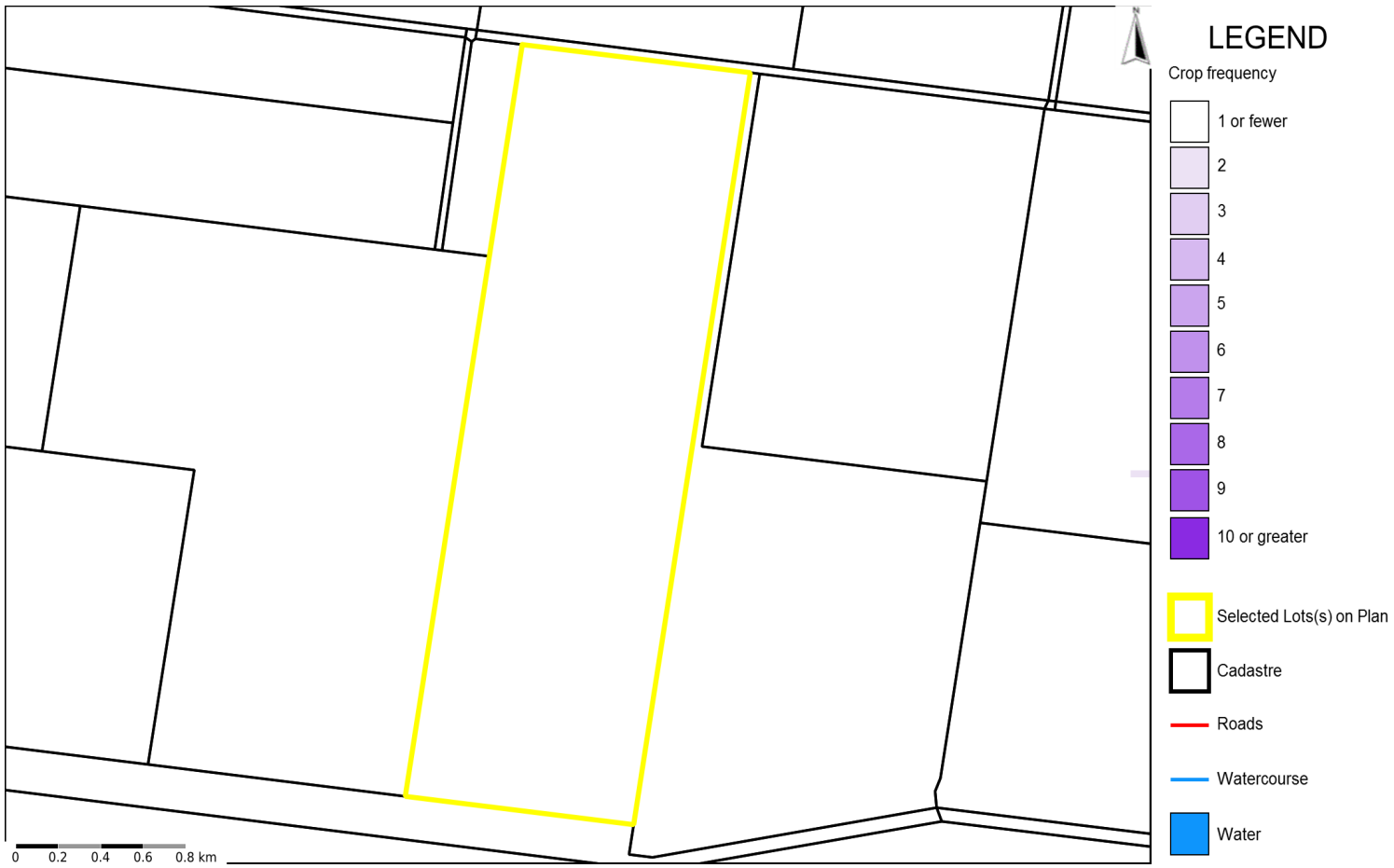
*http://www.longpaddock.qld.gov.au/forage* *January 26, 2022* *Lot on Plan: 1RP78475* *Label: p18*

Queensland Government

## Estimated frequency map for winter (September) cereal crops (2012 - 2021)




## Estimated frequency map for winter (September) pulse crops (2012 - 2021)



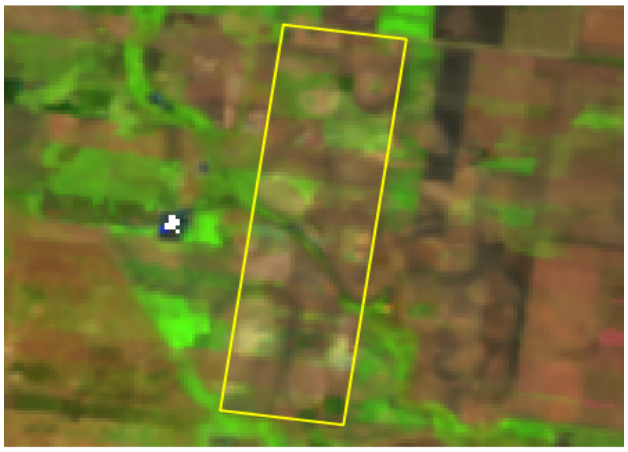
# FORAGE REPORT: CROP FREQUENCY



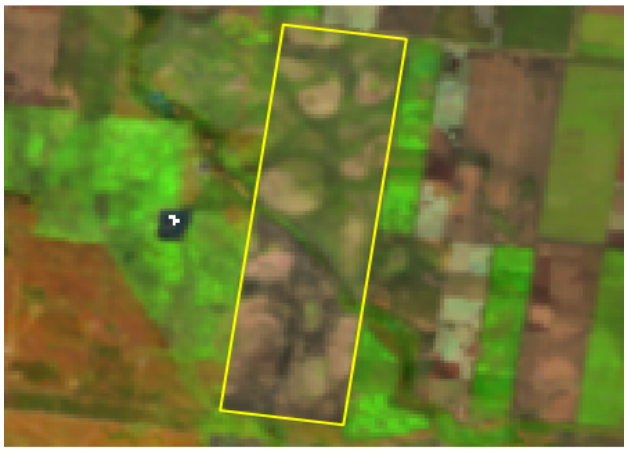
Queensland Government

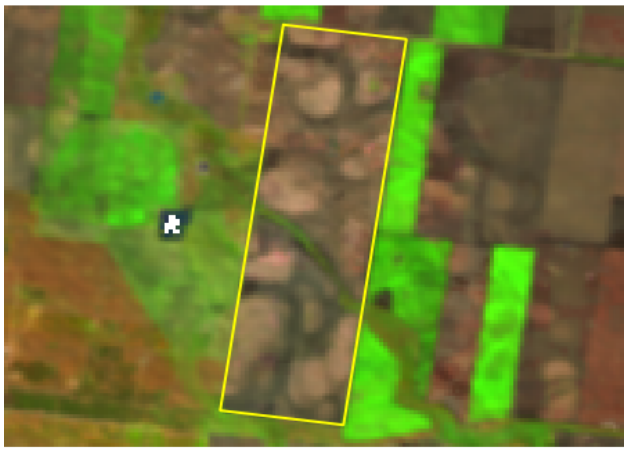
## February (left) and September (right) images for 2012

## February (left) and September (right) images for 2013



## February (left) and September (right) images for 2014



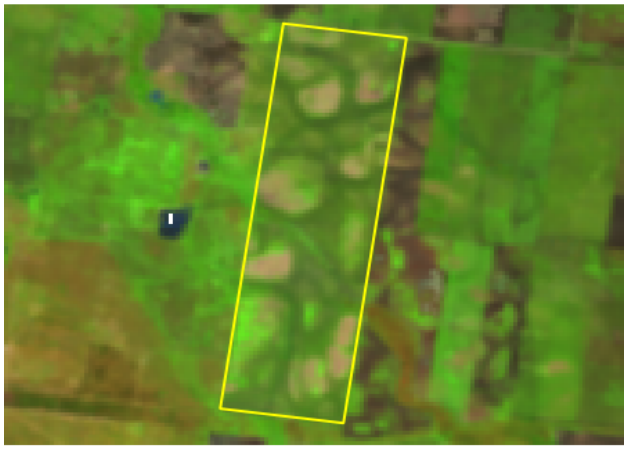


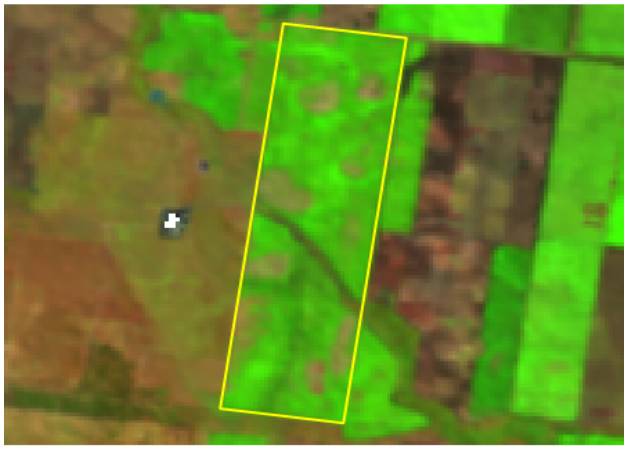
# FORAGE REPORT: CROP FREQUENCY



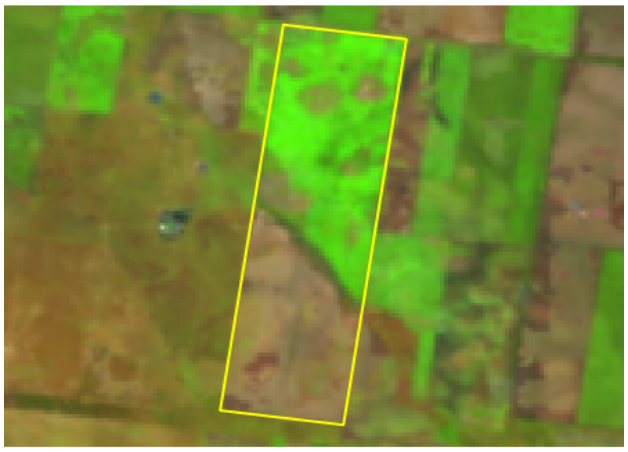
Queensland Government

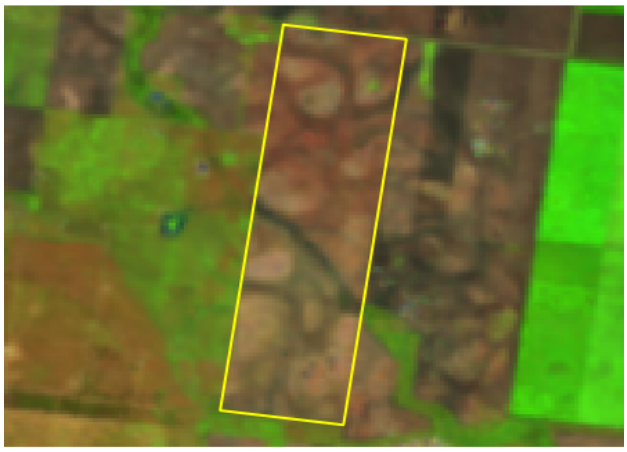
## February (left) and September (right) images for 2015



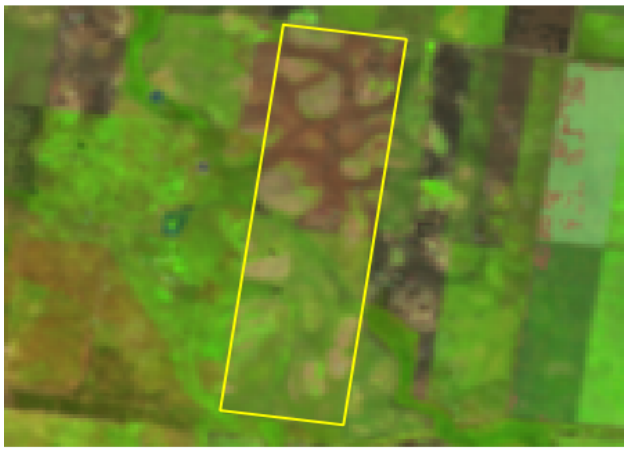


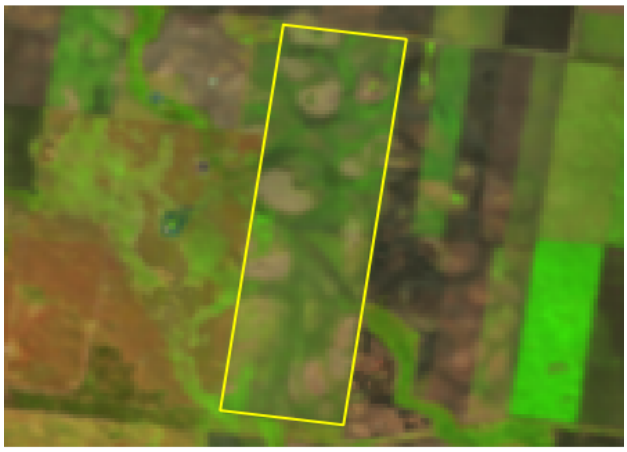
## February (left) and September (right) images for 2016





## February (left) and September (right) images for 2017



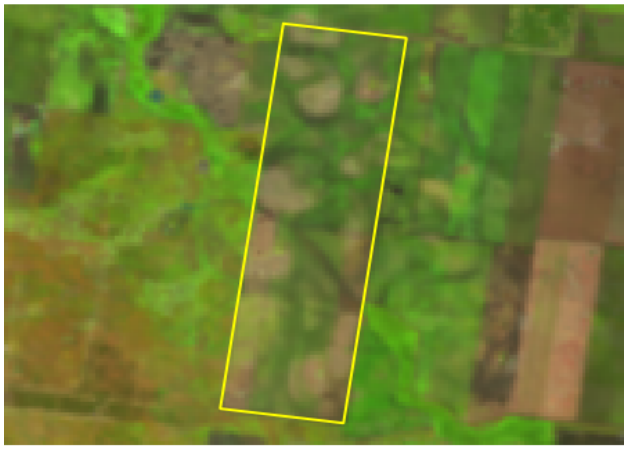


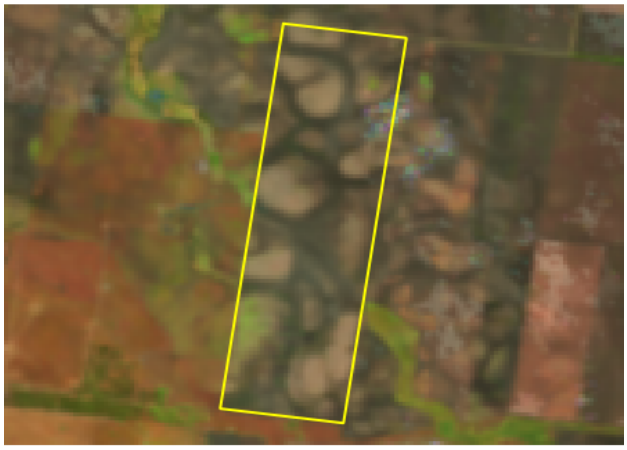
# FORAGE REPORT: CROP FREQUENCY



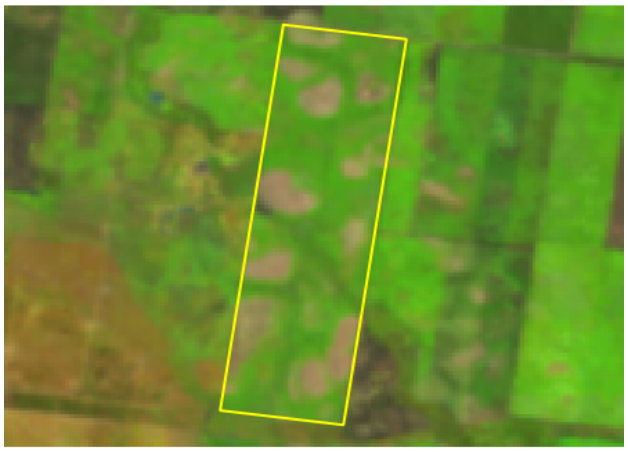
Queensland Government

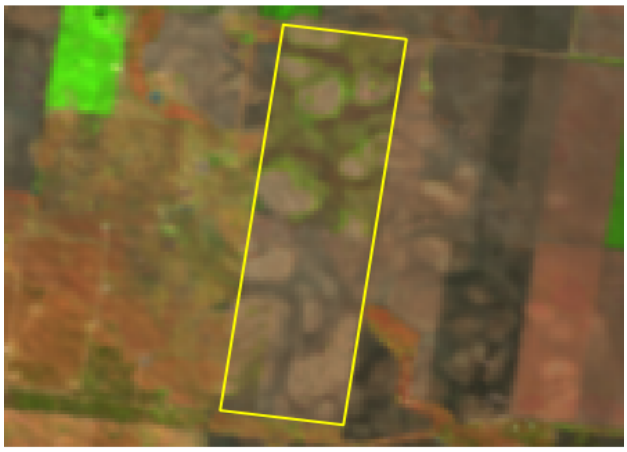
## February (left) and September (right) images for 2018



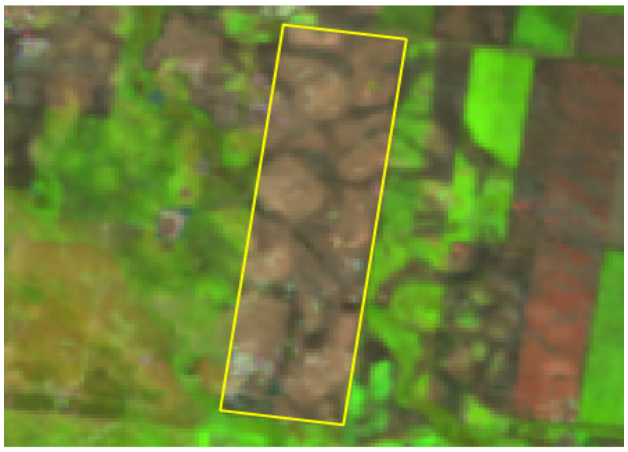


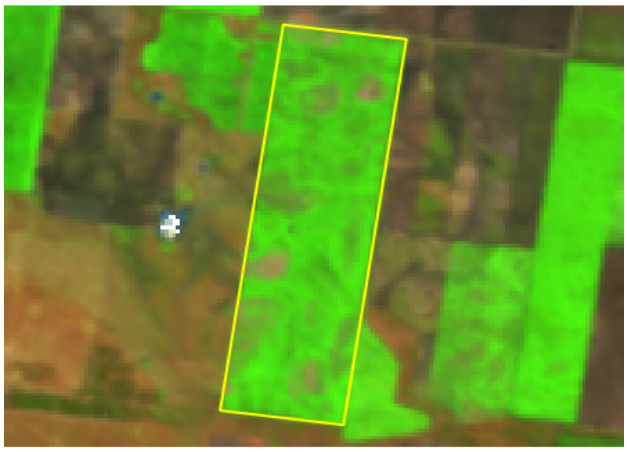
## February (left) and September (right) images for 2019





## February (left) and September (right) images for 2020



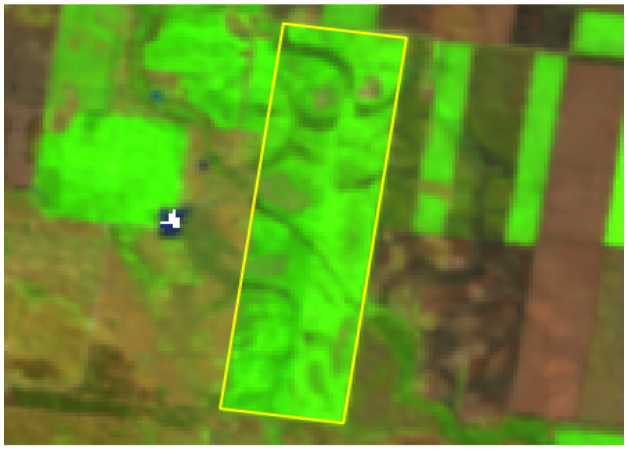


# FORAGE REPORT: CROP FREQUENCY



Queensland Government

## February (left) and September (right) images for 2021



## Disclaimer

# Appendix 6: Baseline Reports for Subject Land

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Report

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# Baseline Report

## Surface Elevation Data – 1RP78475

| | |
|---|---|
| **Version** | 1 |
| **Released** | 17/12/2021 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lot on plan 1RP78475:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

The InSAR data is provided to Arrow as persistent and distributed scatter points by the InSAR provider, processed using their proprietary SqueeSAR technology. The InSAR data provided commenced in 2015 with the Sentinel satellite system, and provides continual information on regional ground movement using industry leading experts.

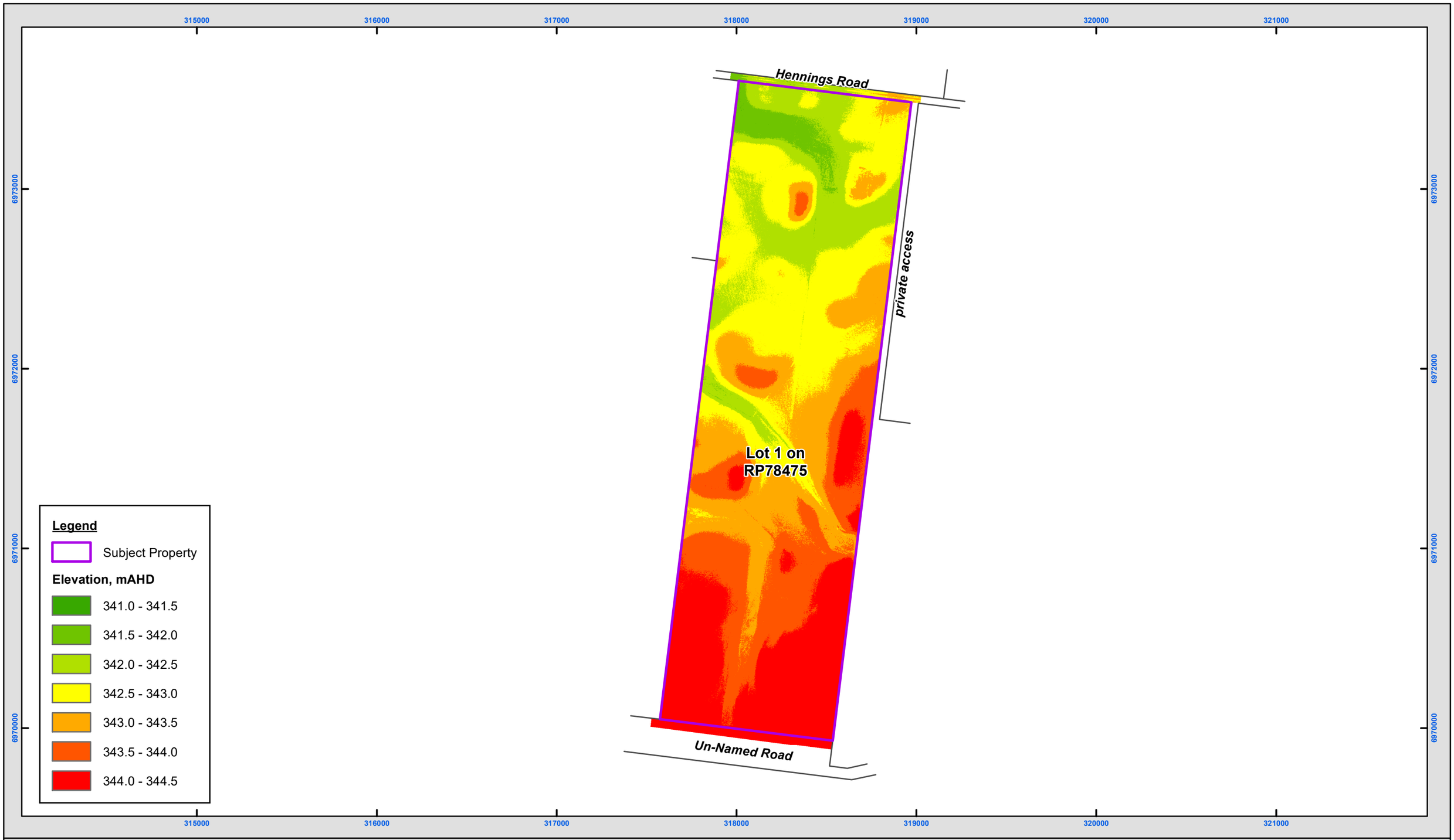
**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2




# Figure 1 : 2012 DEM, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 28/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

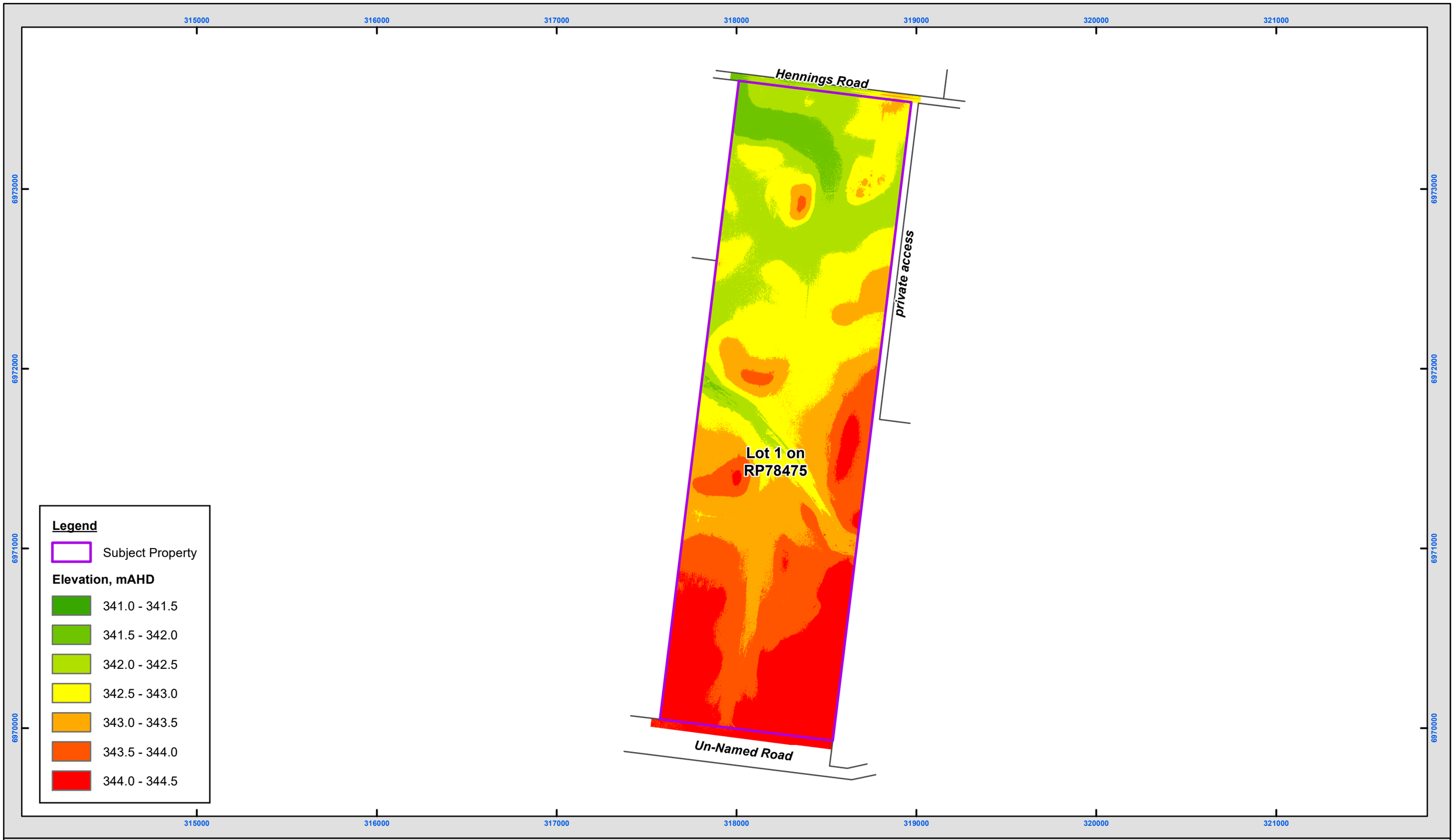
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 2 : 2014 DEM, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 28/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

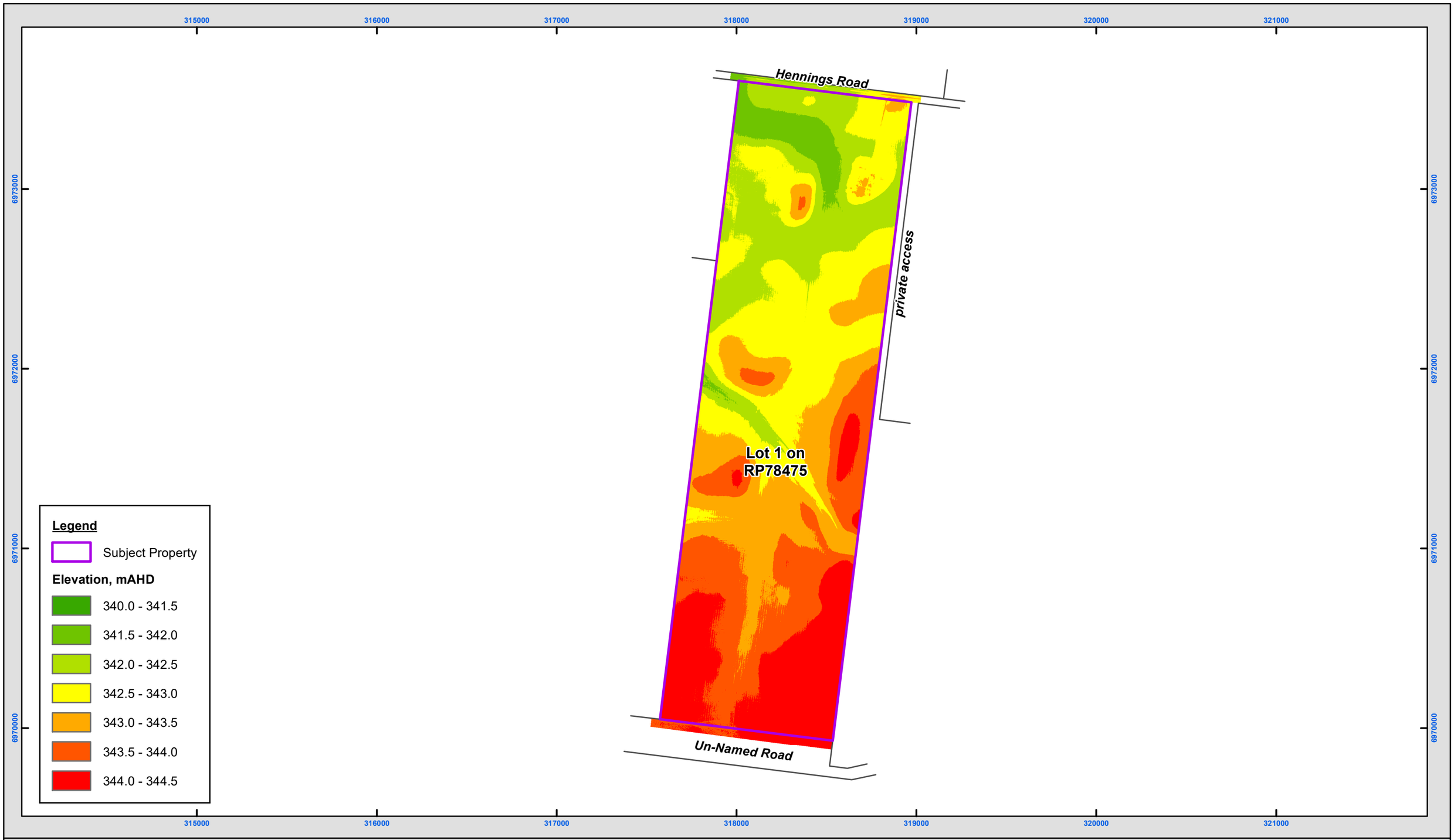
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 3 : 2020 DEM, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 28/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

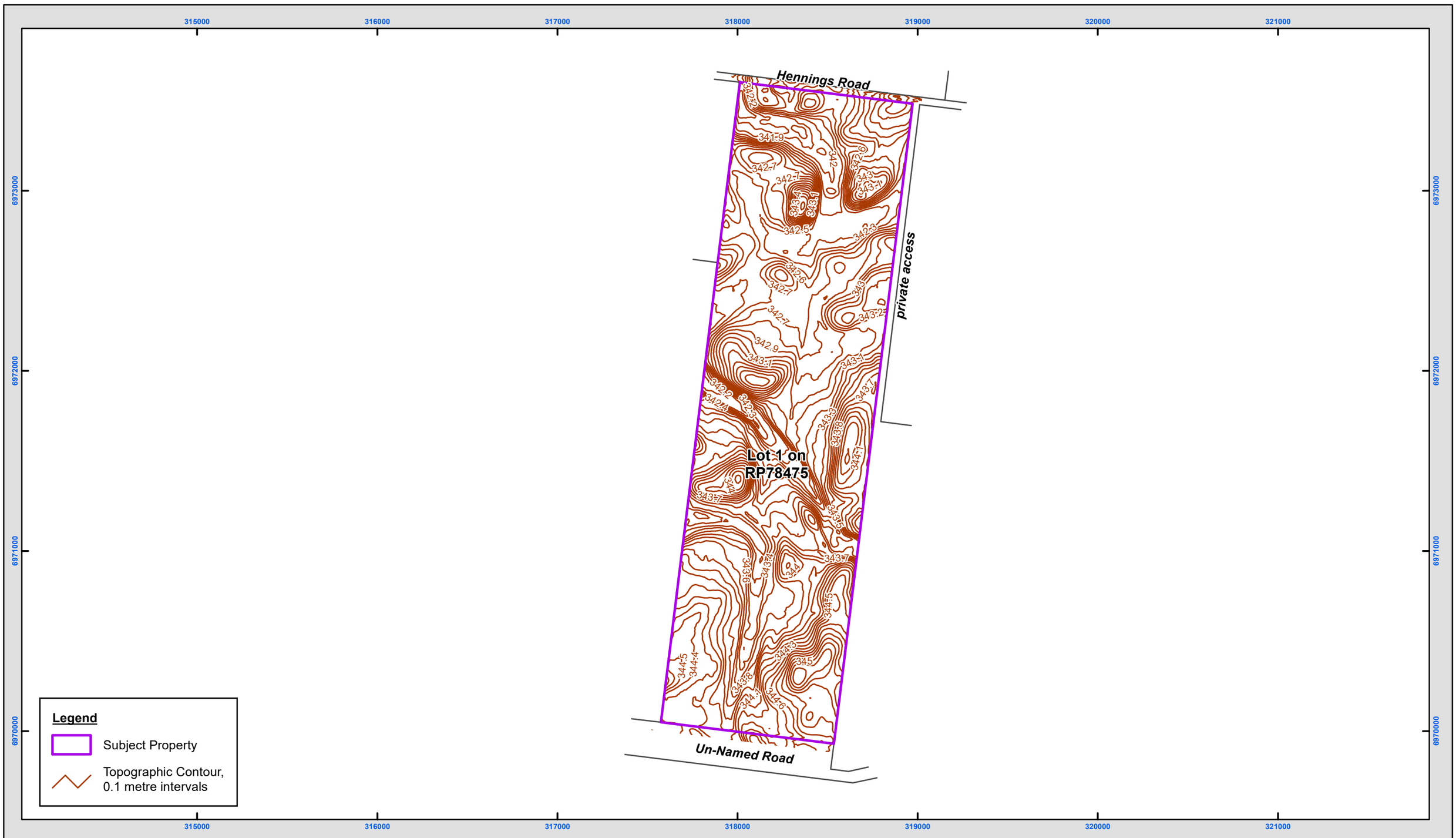



**Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lot on Plan : 1RP78475**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

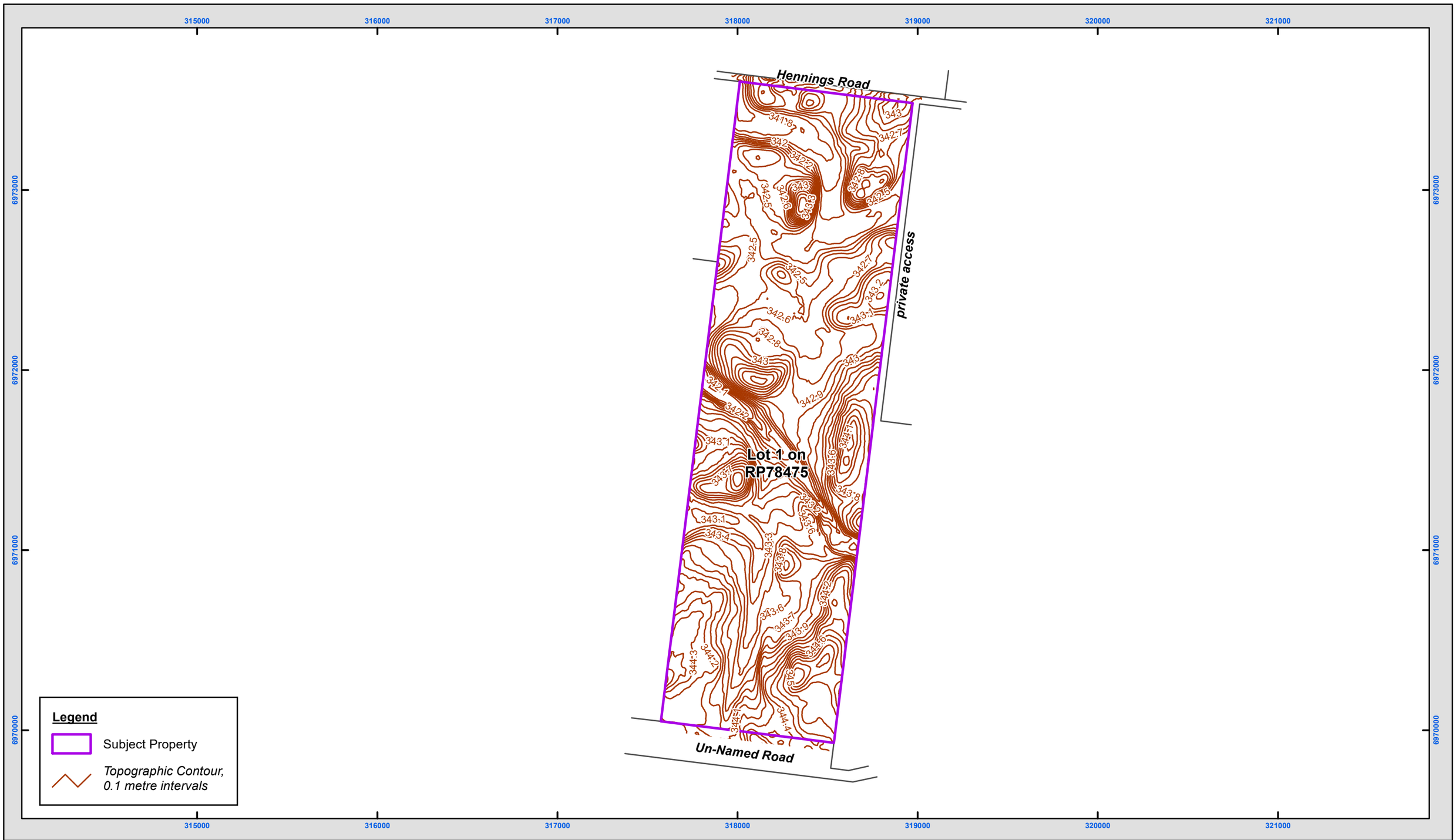
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

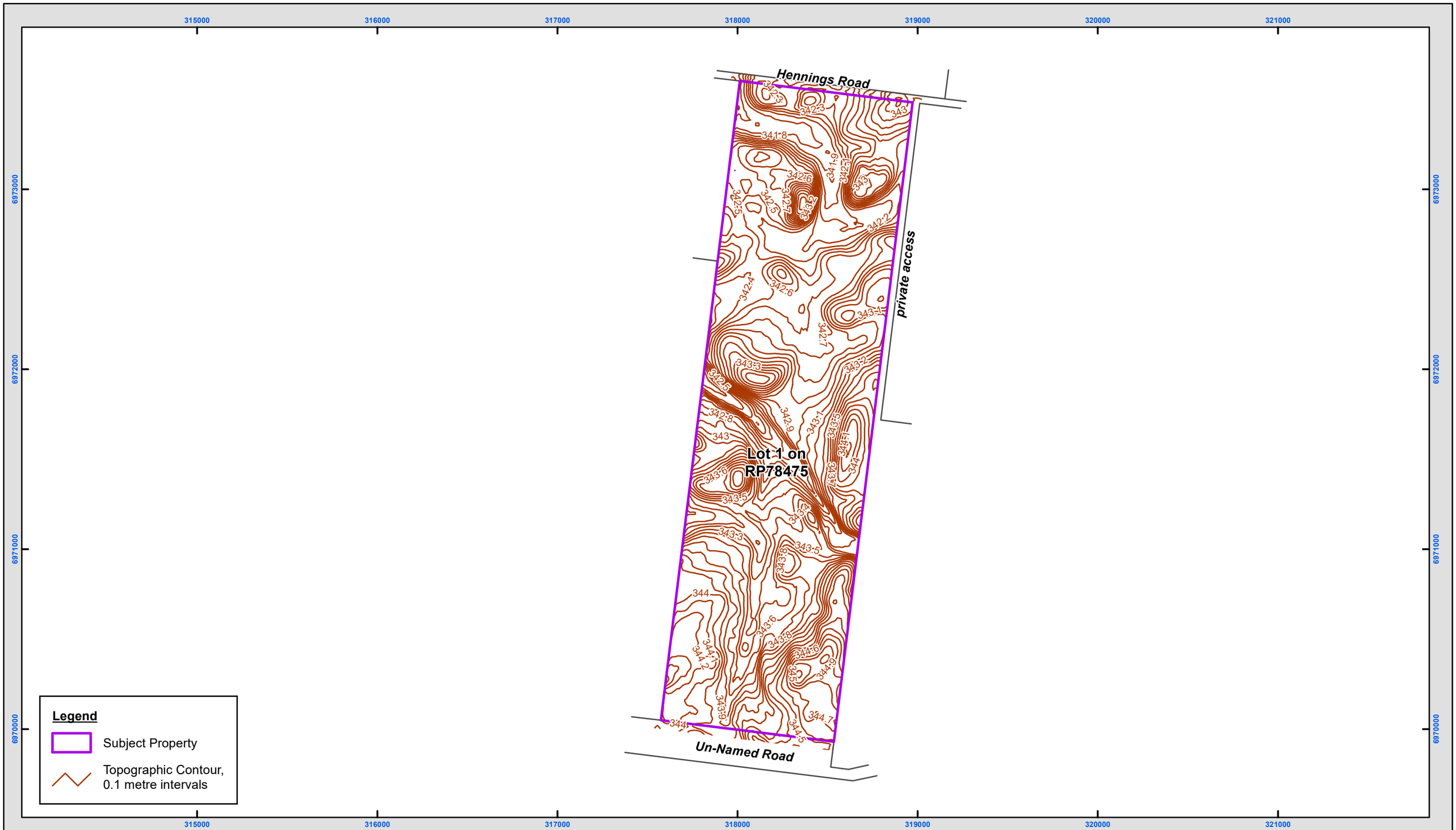
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

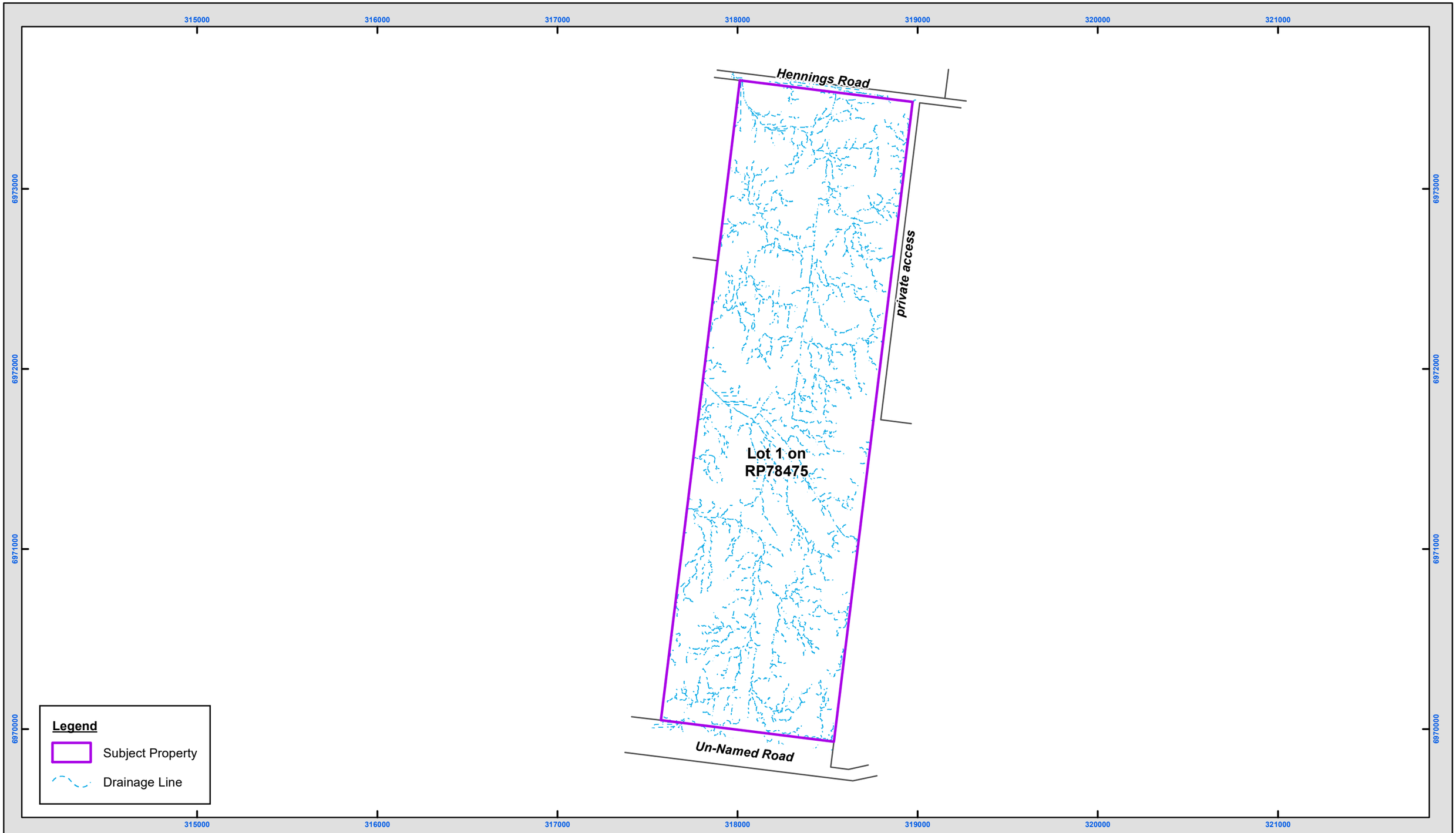
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 7 : 2012 DEM, Drainage Lines, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

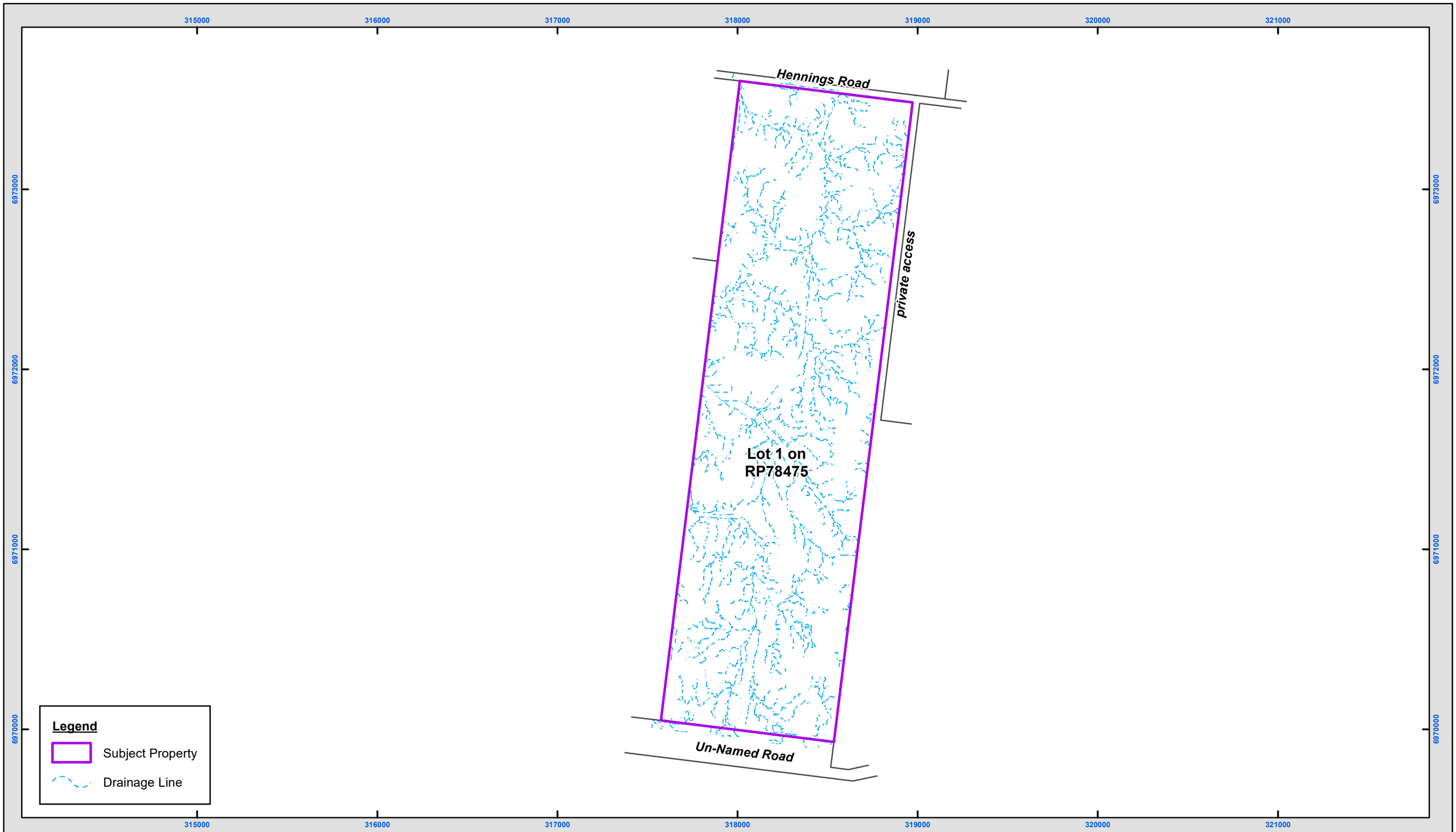
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 8 : 2014 DEM, Drainage Lines, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

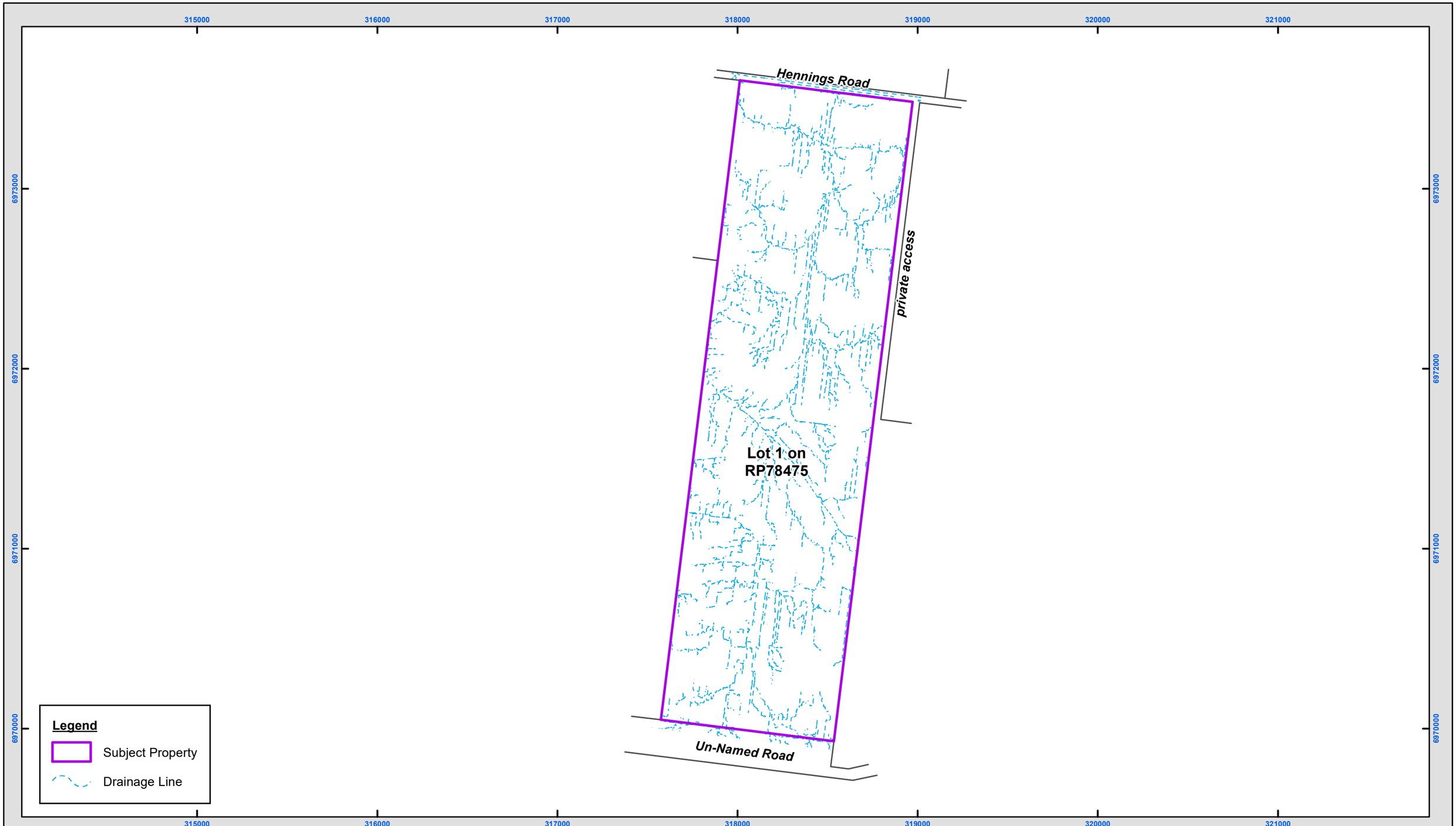
0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



**NOT FOR CONSTRUCTION**




## Figure 9 : 2020 DEM, Drainage Lines, Lot on Plan : 1RP78475

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 24/11/2021

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

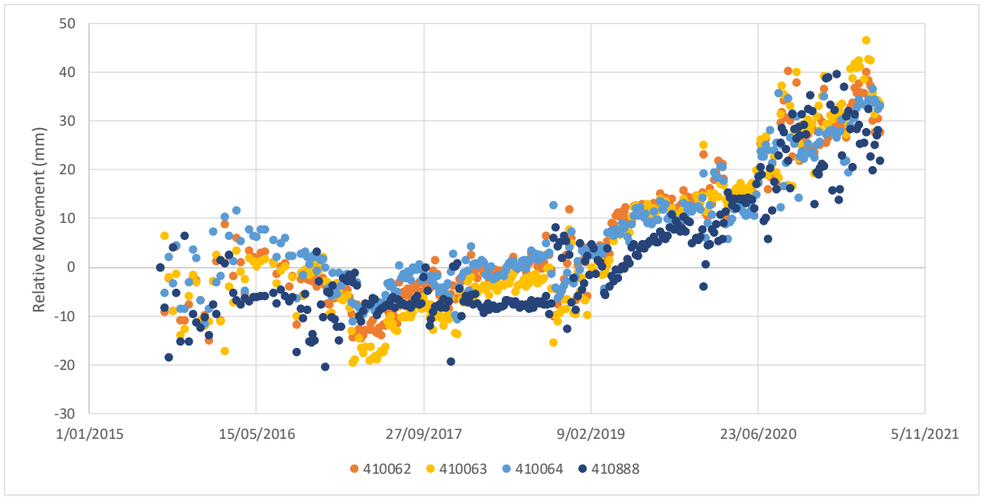
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**







**Legend**

- Subject Property
- InSAR distrubuted scatter points
- InSAR persistent scatter points

## Figure 10 : InSAR persistent and distributed scatter points on Lot on Plan : 1RP78475 and time series plot.

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 10/02/2022

Author: Arrow Energy

0.55 0.275 0 0.55 Kilometres

Scale: 1:20,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



**NOT FOR CONSTRUCTION**

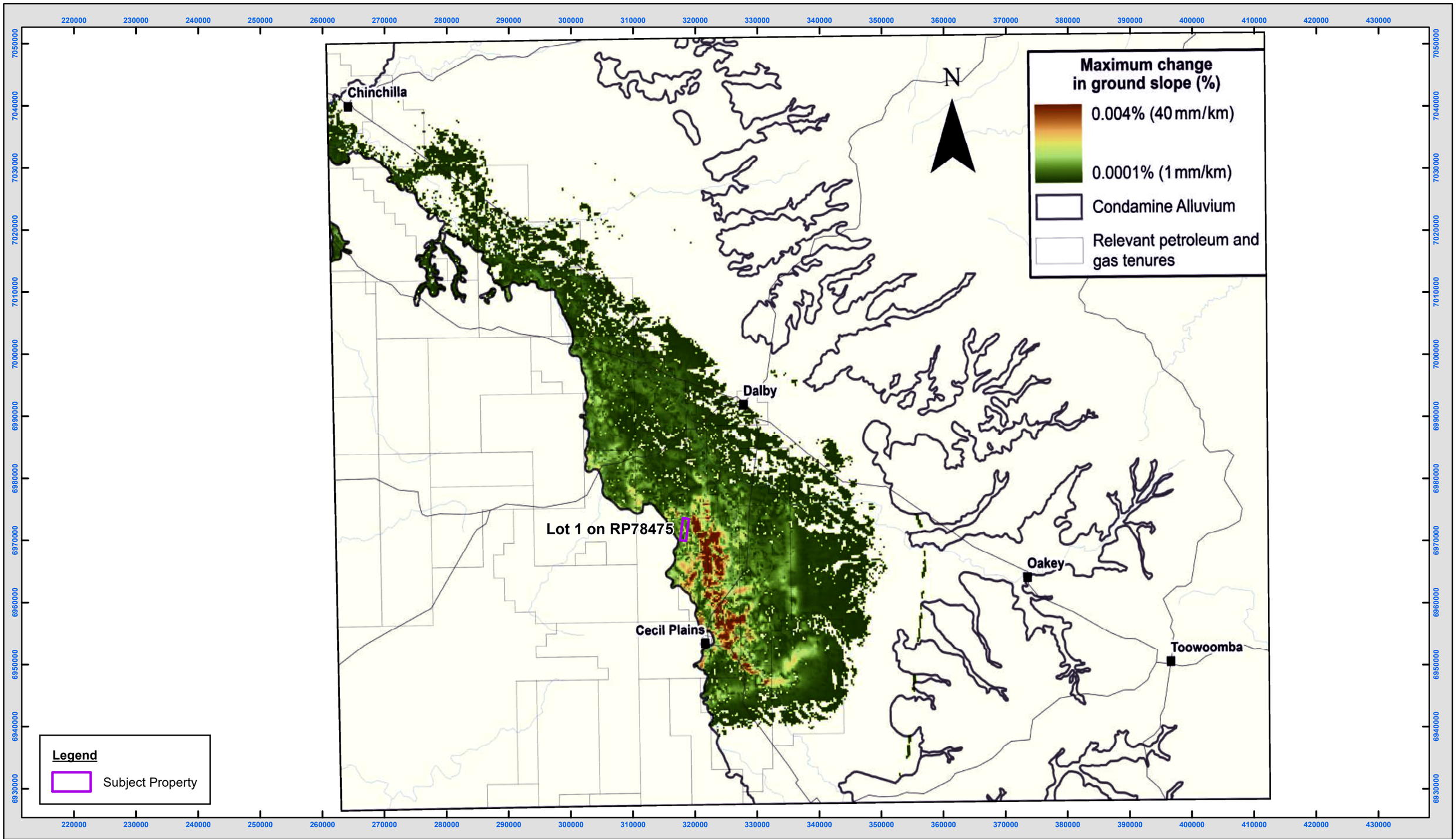



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lot on Plan : 1RP78475.**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/12/2021

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



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# Baseline Report

## Surface Elevation Data – 1RP83755

| | |
|---|---|
| **Version** | 1 |
| **Released** | 04/01/2022 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lot on plan 1RP83755:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

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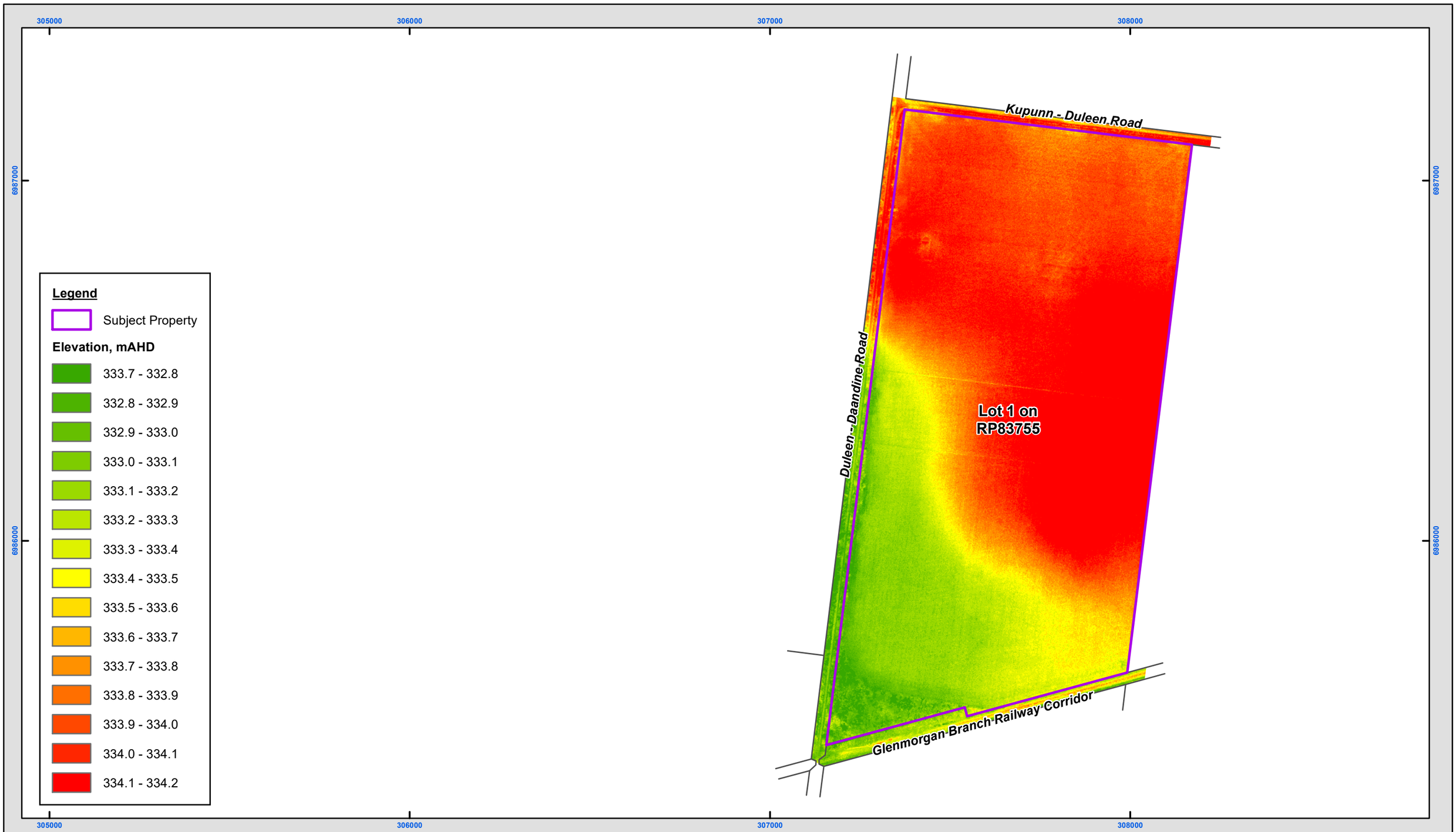
**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2




## Figure 1 : 2012 DEM, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

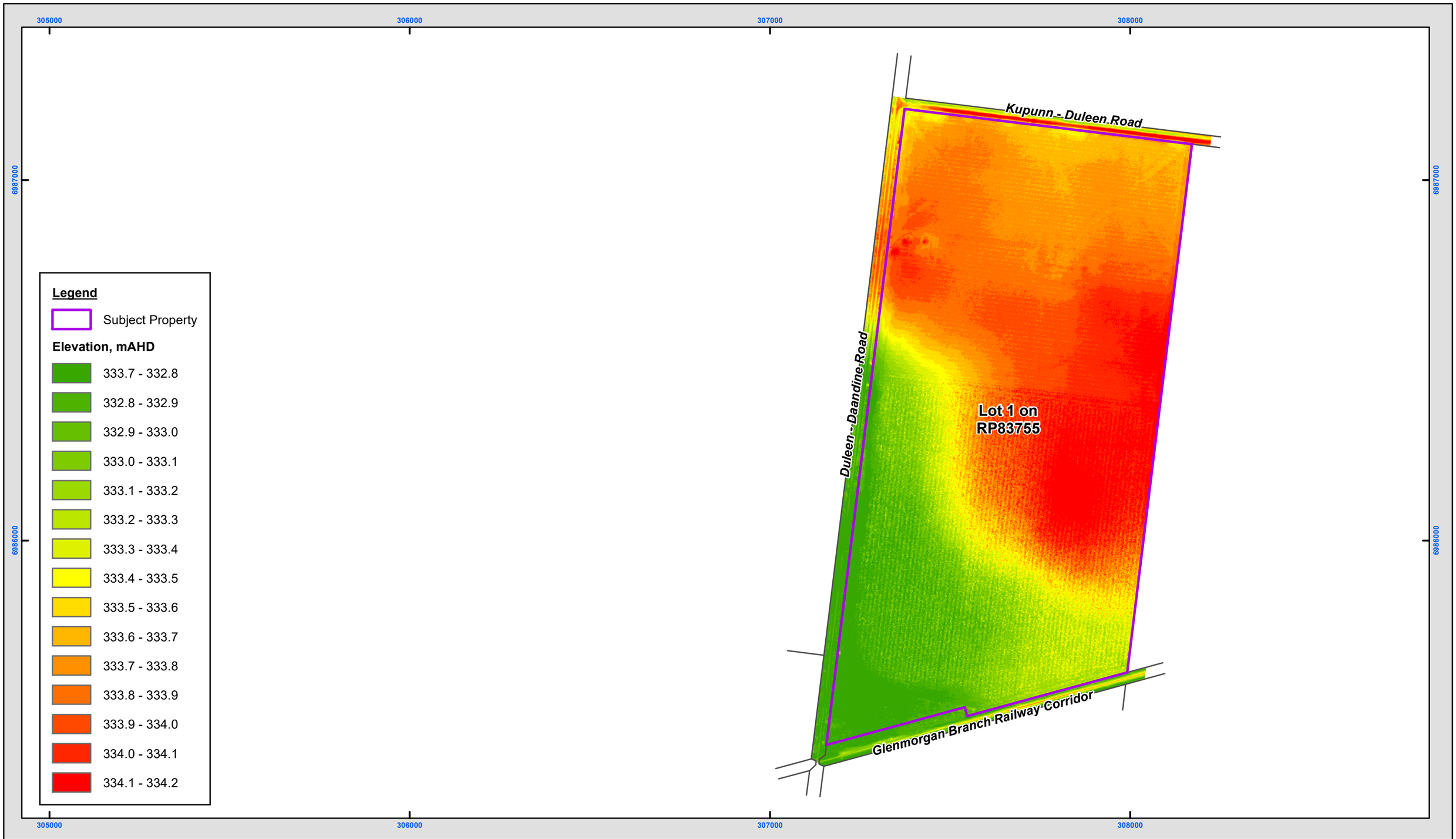
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 2 : 2014 DEM, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

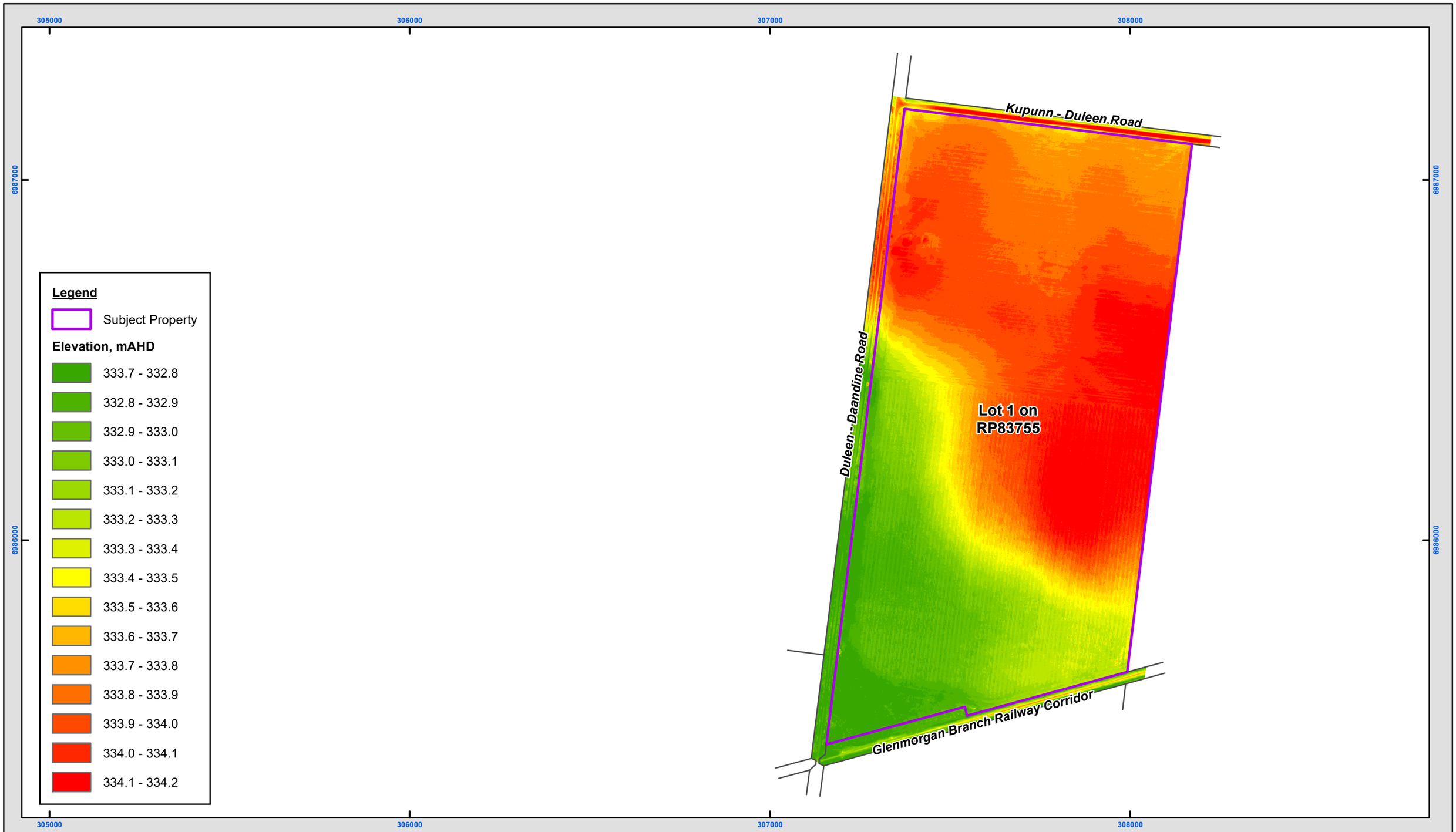
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 3 : 2020 DEM, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 31/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

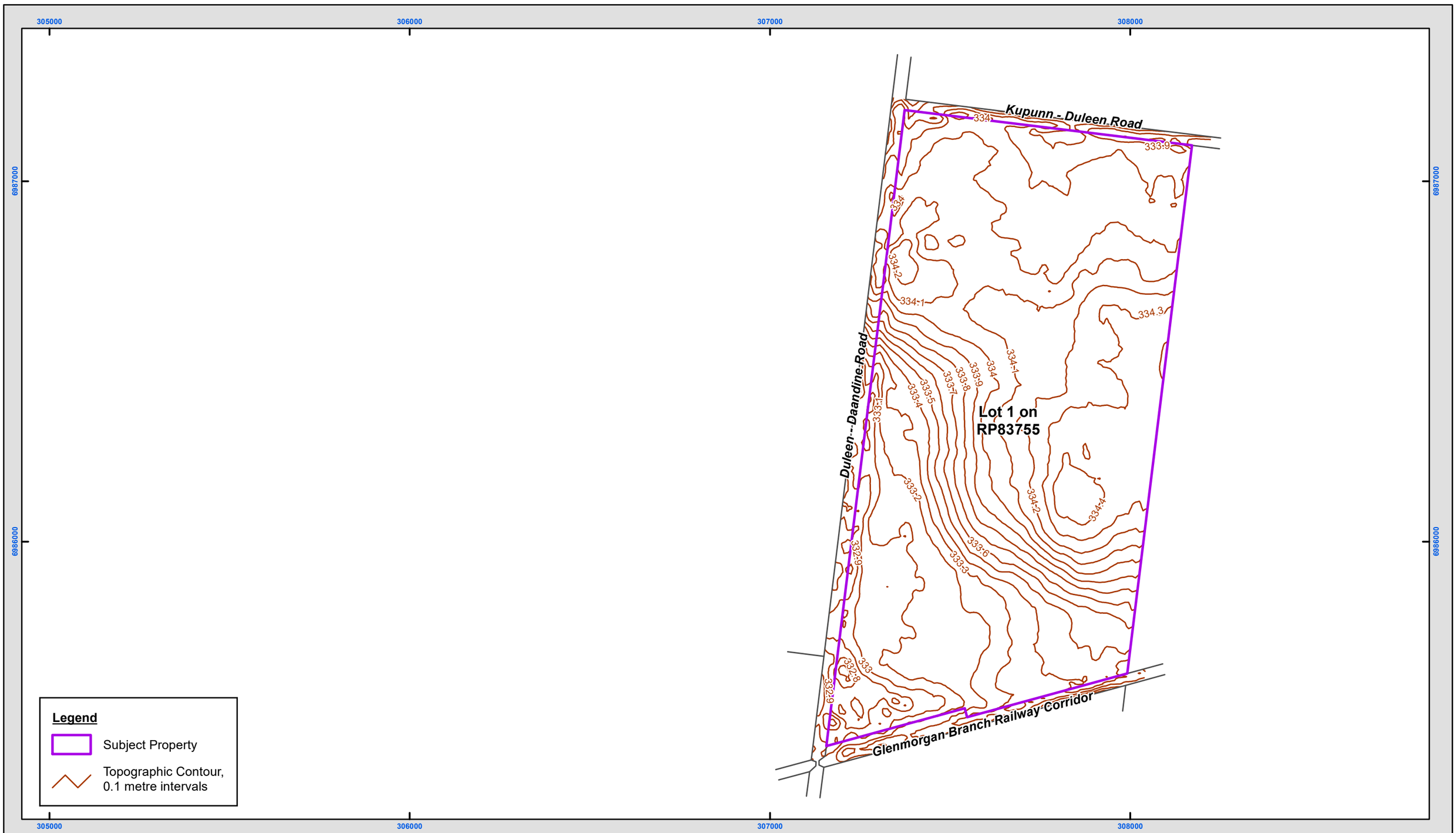



**Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lots on Plans : 1RP83755**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

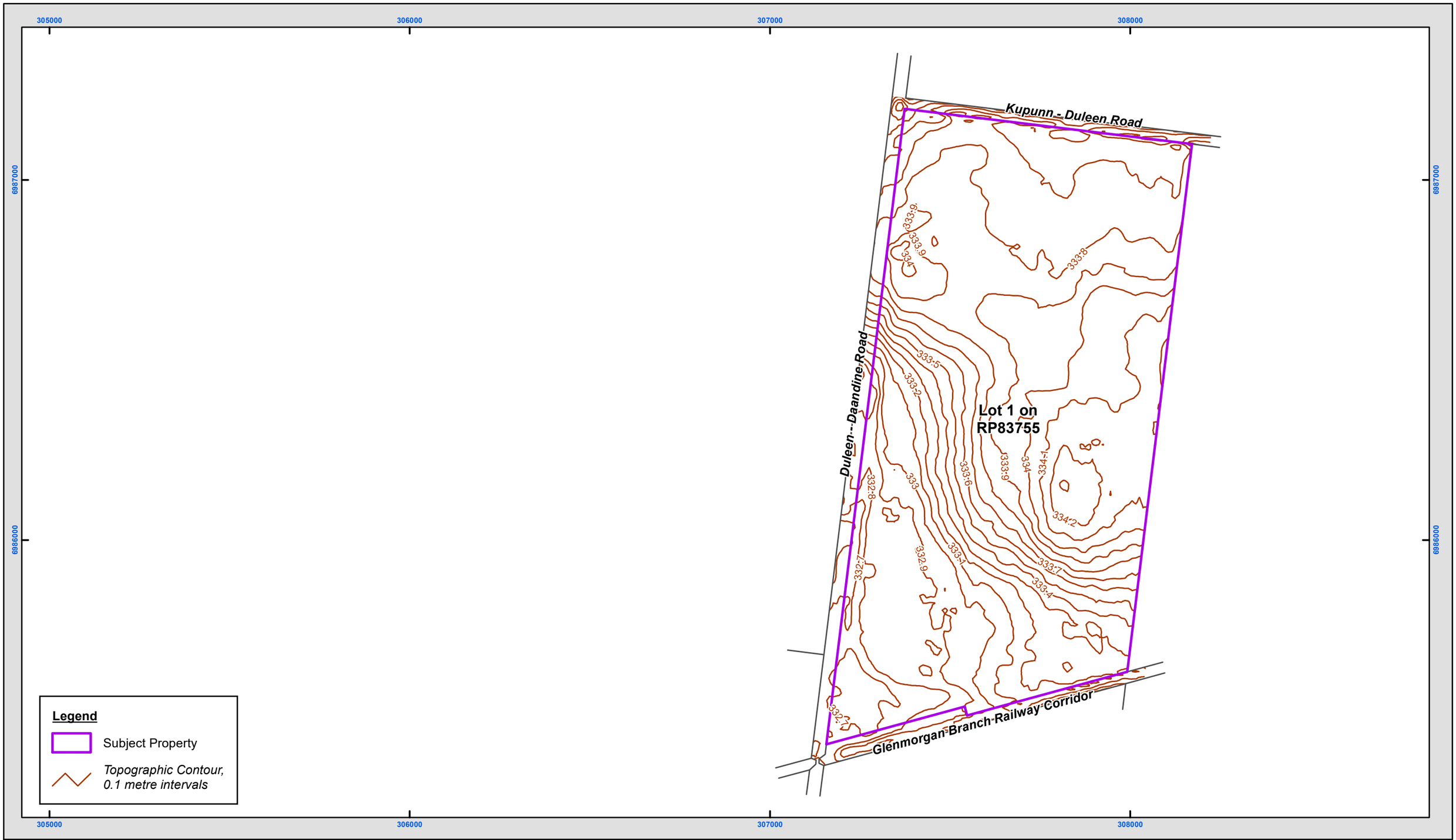



**Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lots on Plans : 1RP83755**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

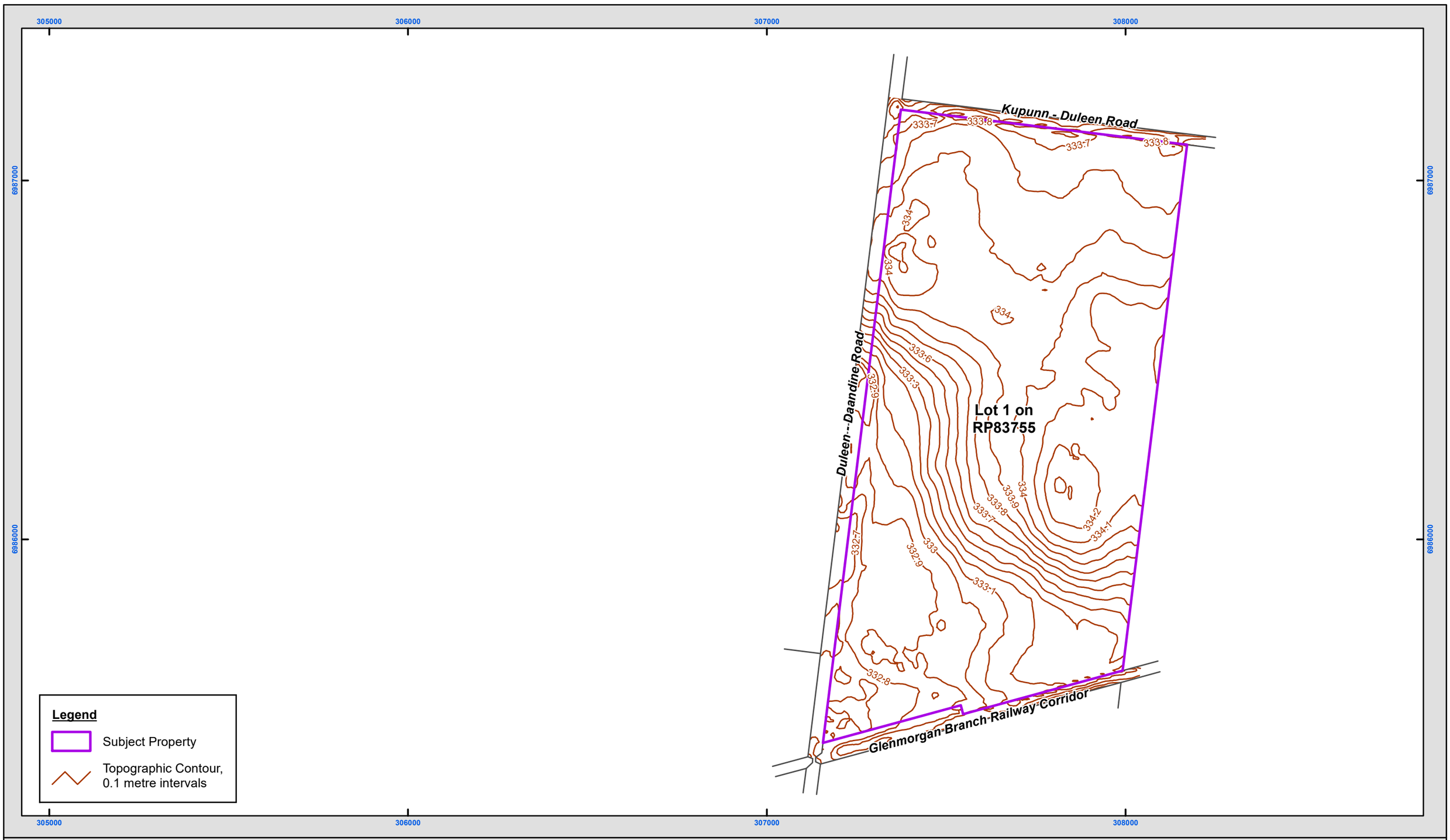
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

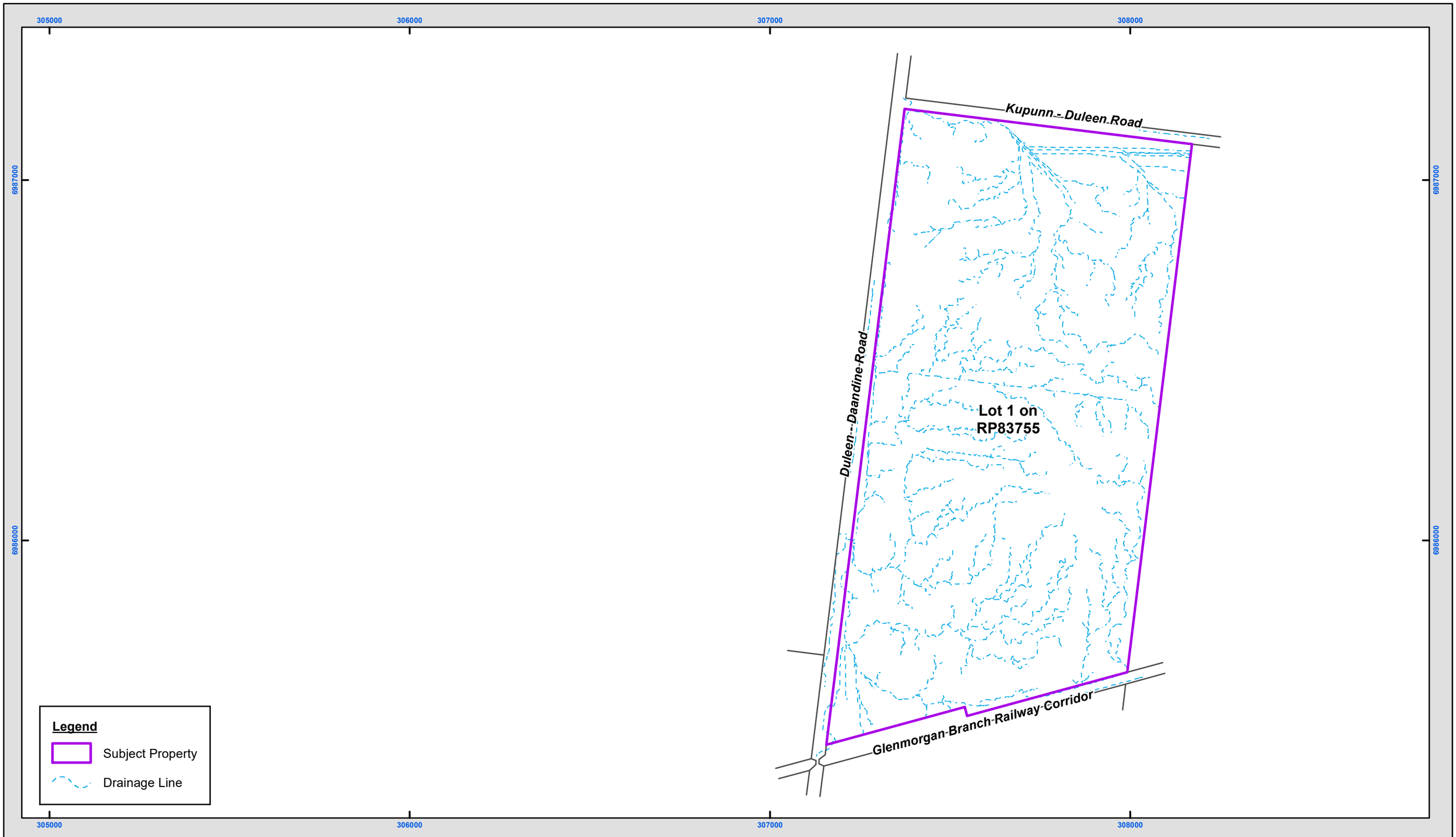
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 7 : 2012 DEM, Drainage Lines, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

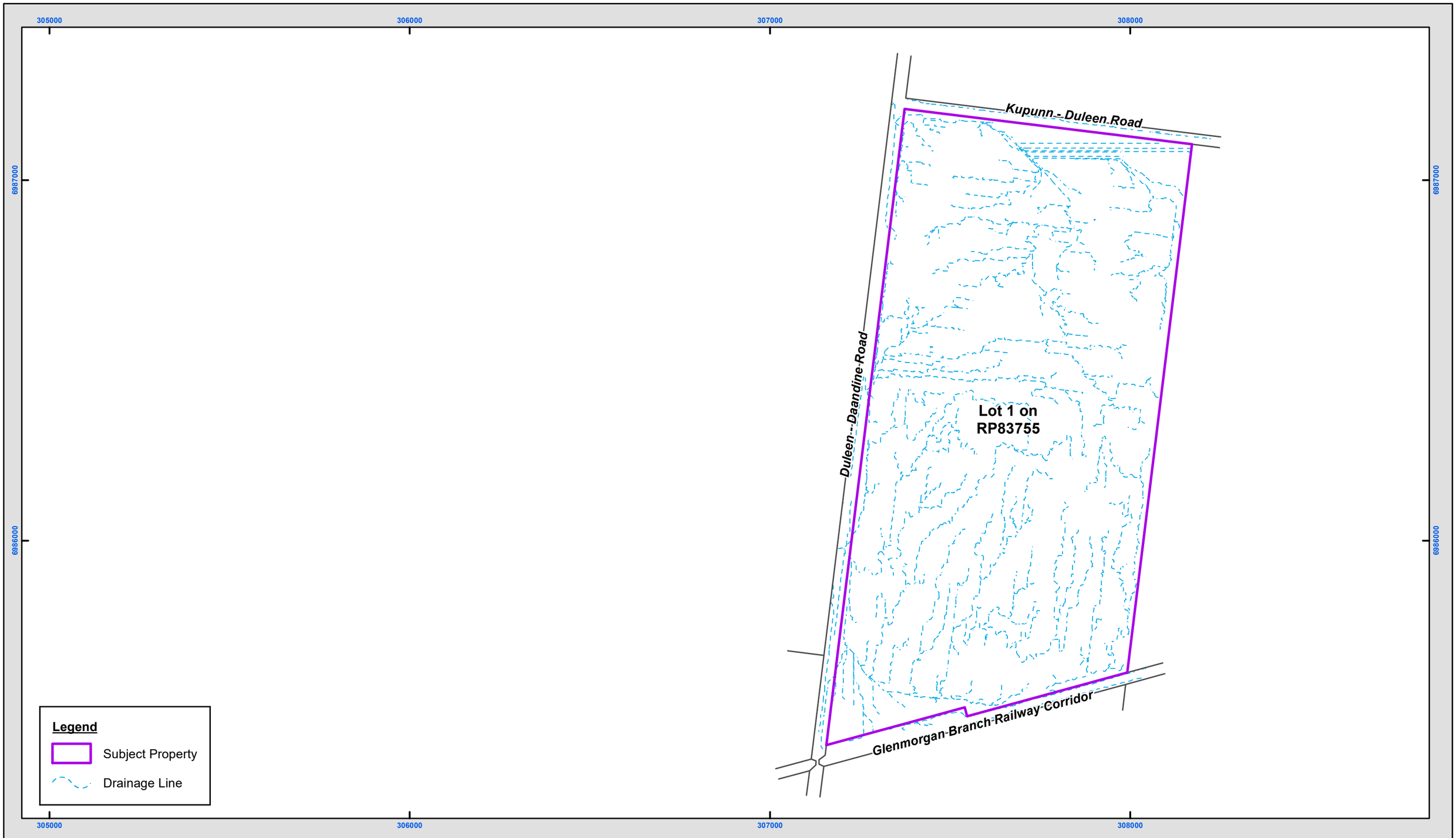
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 8 : 2014 DEM, Drainage Lines, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25
Kilometres

Scale: 1:10,000 @ A3

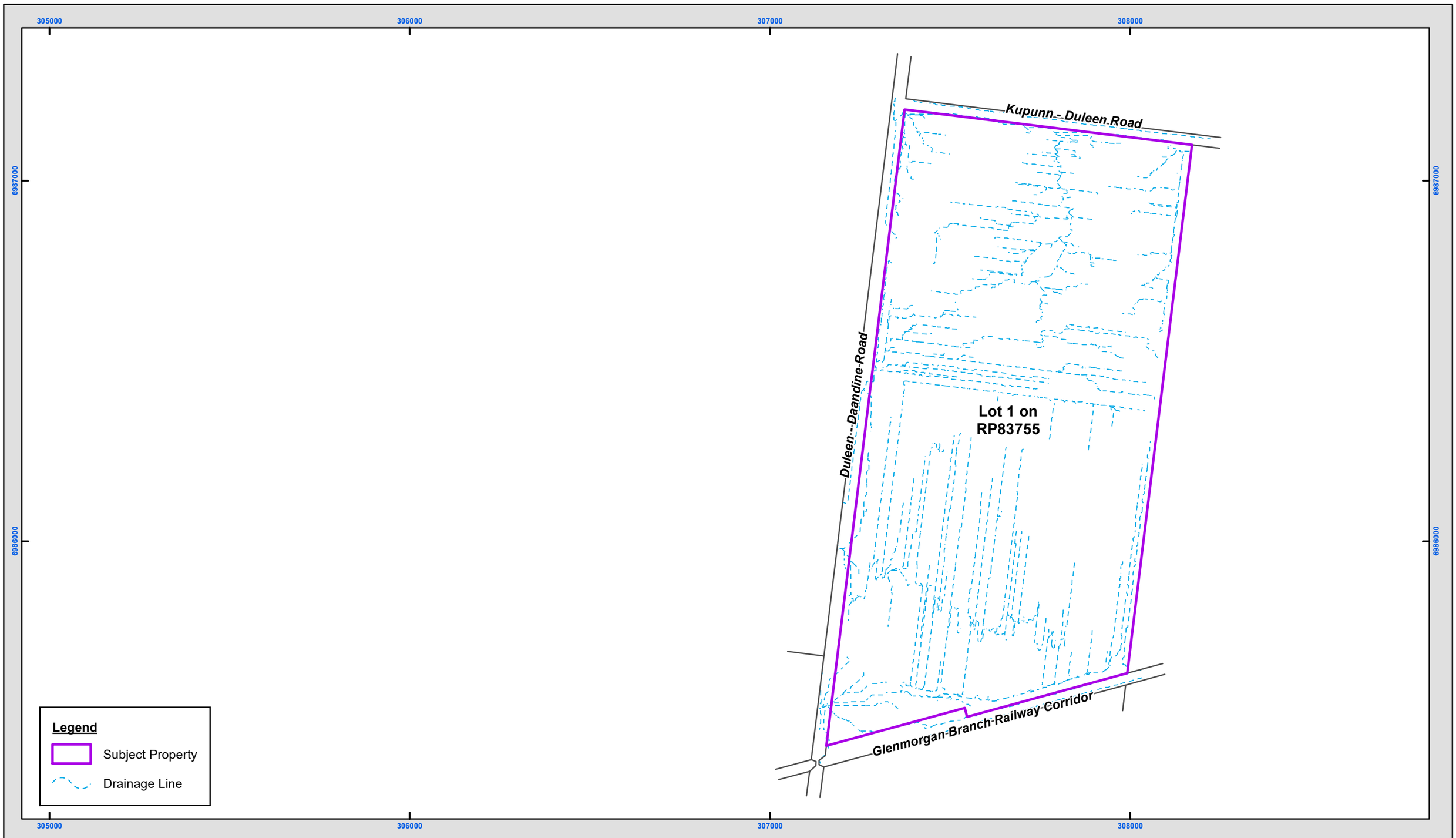
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 9 : 2020 DEM, Drainage Lines, Lots on Plans : 1RP83755

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:10,000 @ A3

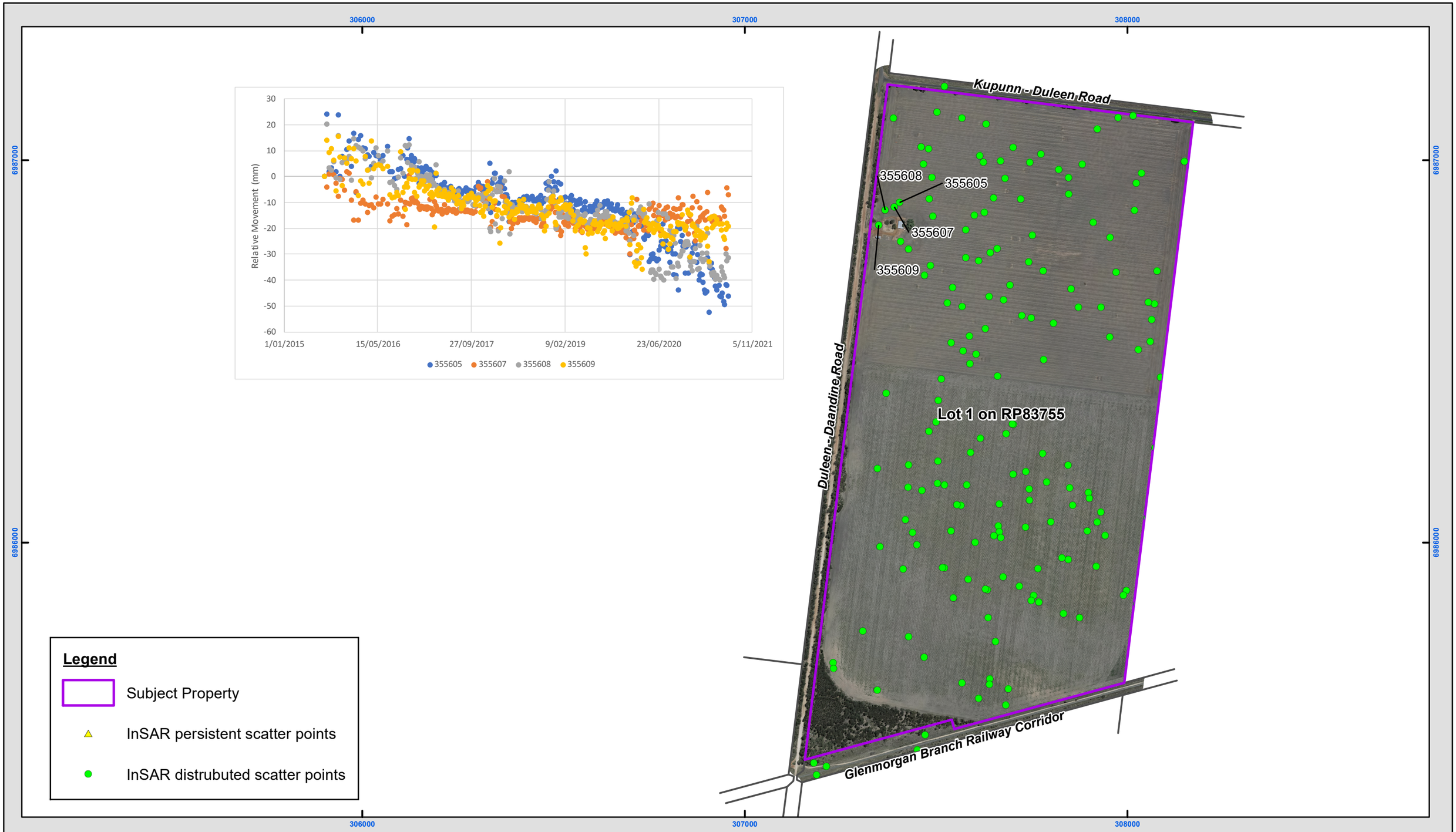
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 10 : InSAR persistent and distributed scatter points on Lot on Plan : 1RP83755, and time series plot

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,416 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

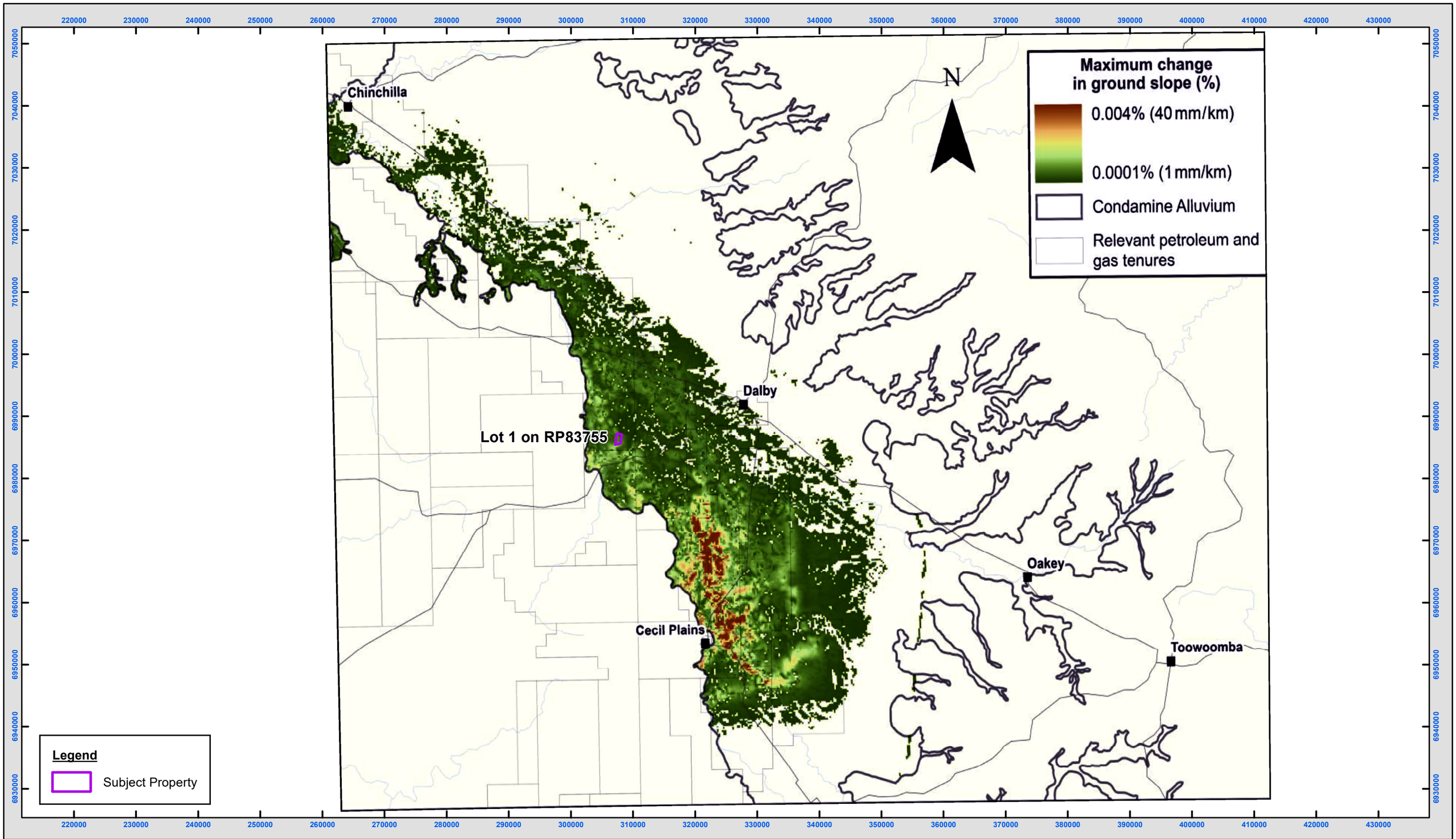



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lot on Plan : 1RP83755.**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 1/01/2022

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

Safe Work. Strong Business.

target zero

# Baseline Report

## Surface Elevation Data – 10SP191489 and 11SP191489

| | |
|---|---|
| **Version** | 1 |
| **Released** | 04/01/2022 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lots on plans 10SP191489 and 11SP191489:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

The InSAR data is provided to Arrow as persistent and distributed scatter points by the InSAR provider, processed using their proprietary SqueeSAR technology. The InSAR data provided commenced in 2015 with the Sentinel satellite system, and provides continual information on regional ground movement using industry leading experts.

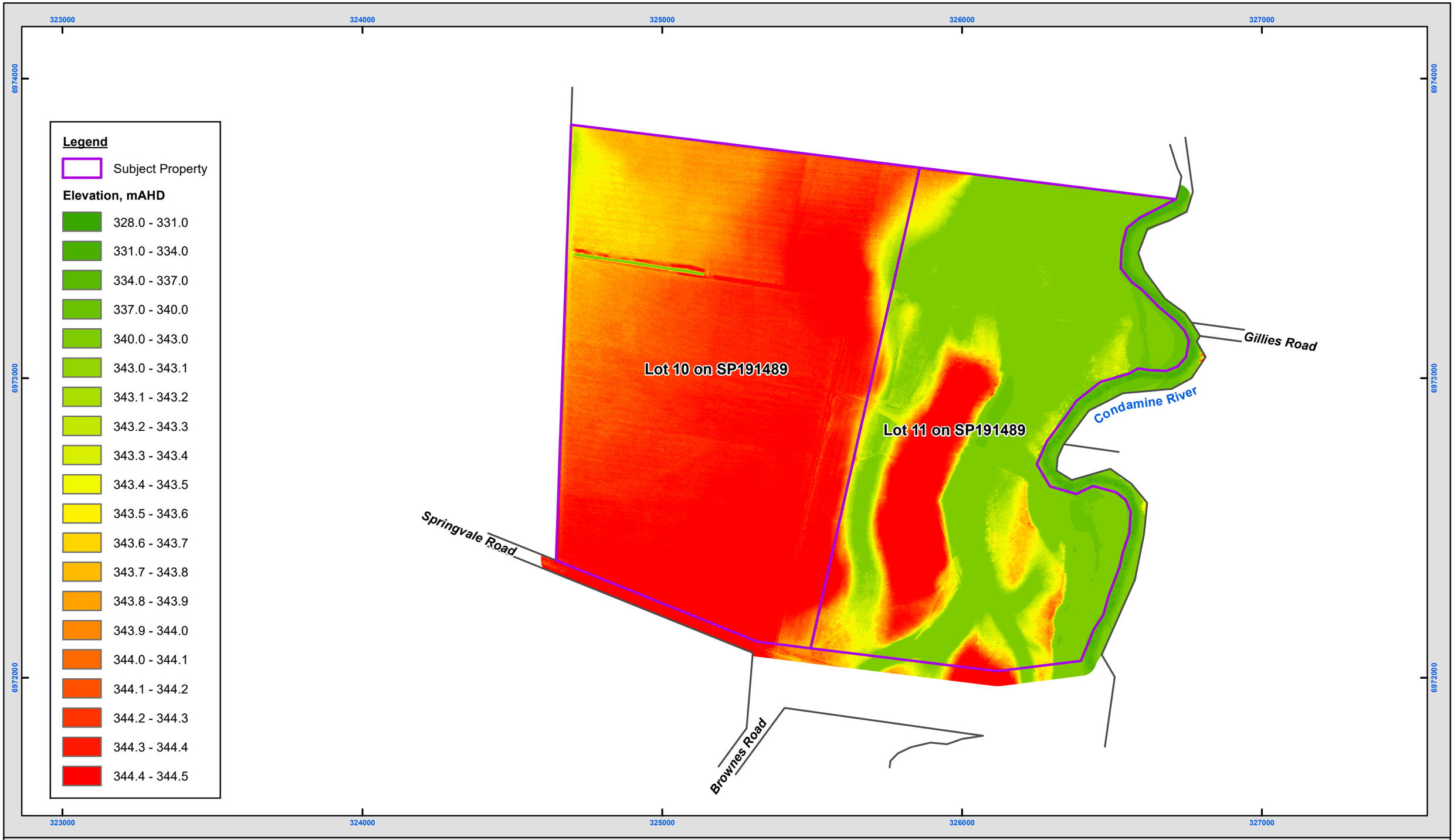
**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2




## Figure 1 : 2012 DEM, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

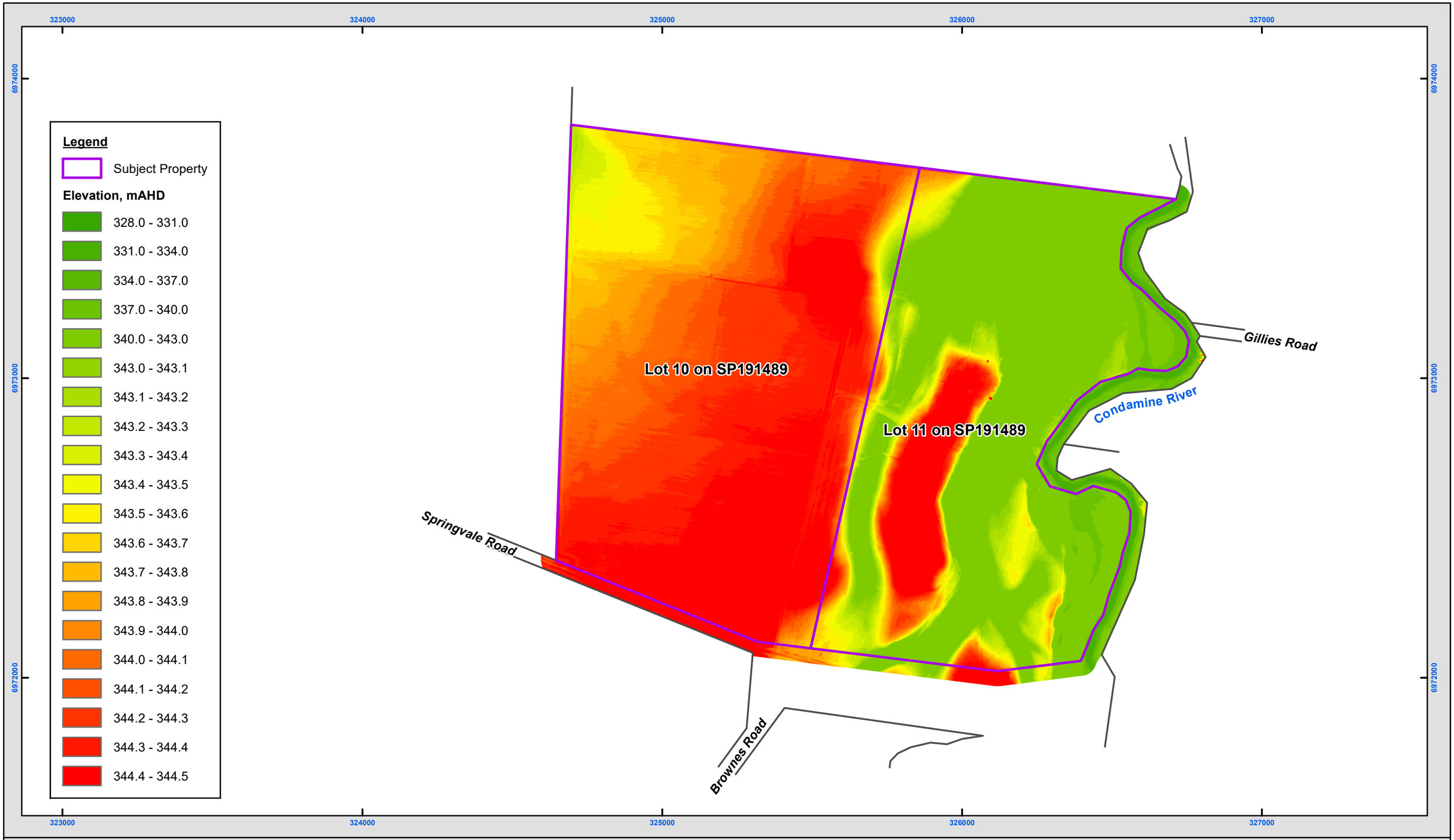
0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



**NOT FOR CONSTRUCTION**




## Figure 2 : 2014 DEM, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

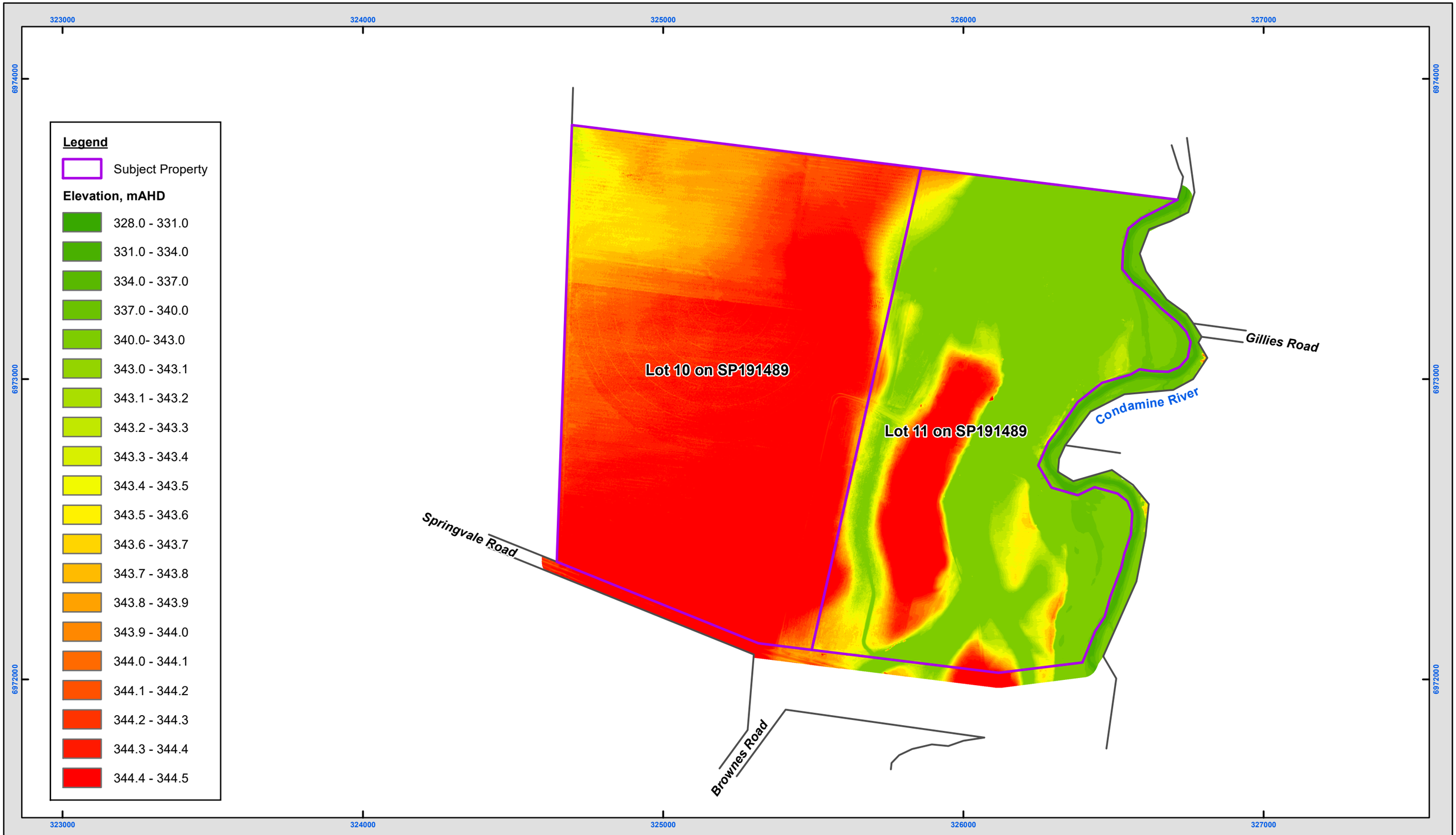
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 3 : 2020 DEM, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 9/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

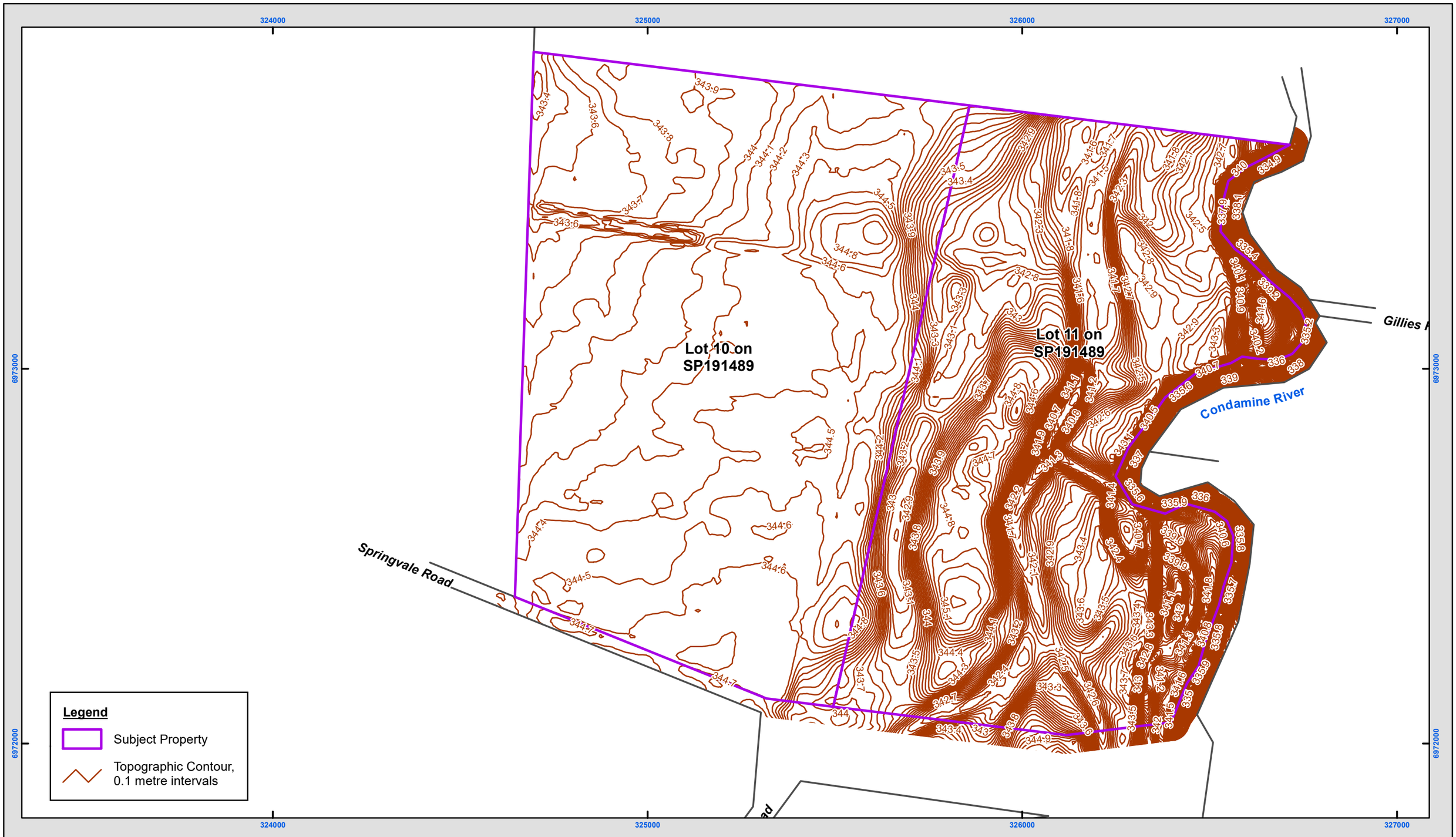



**Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lots on Plans : 10SP191489 & 11SP191489**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

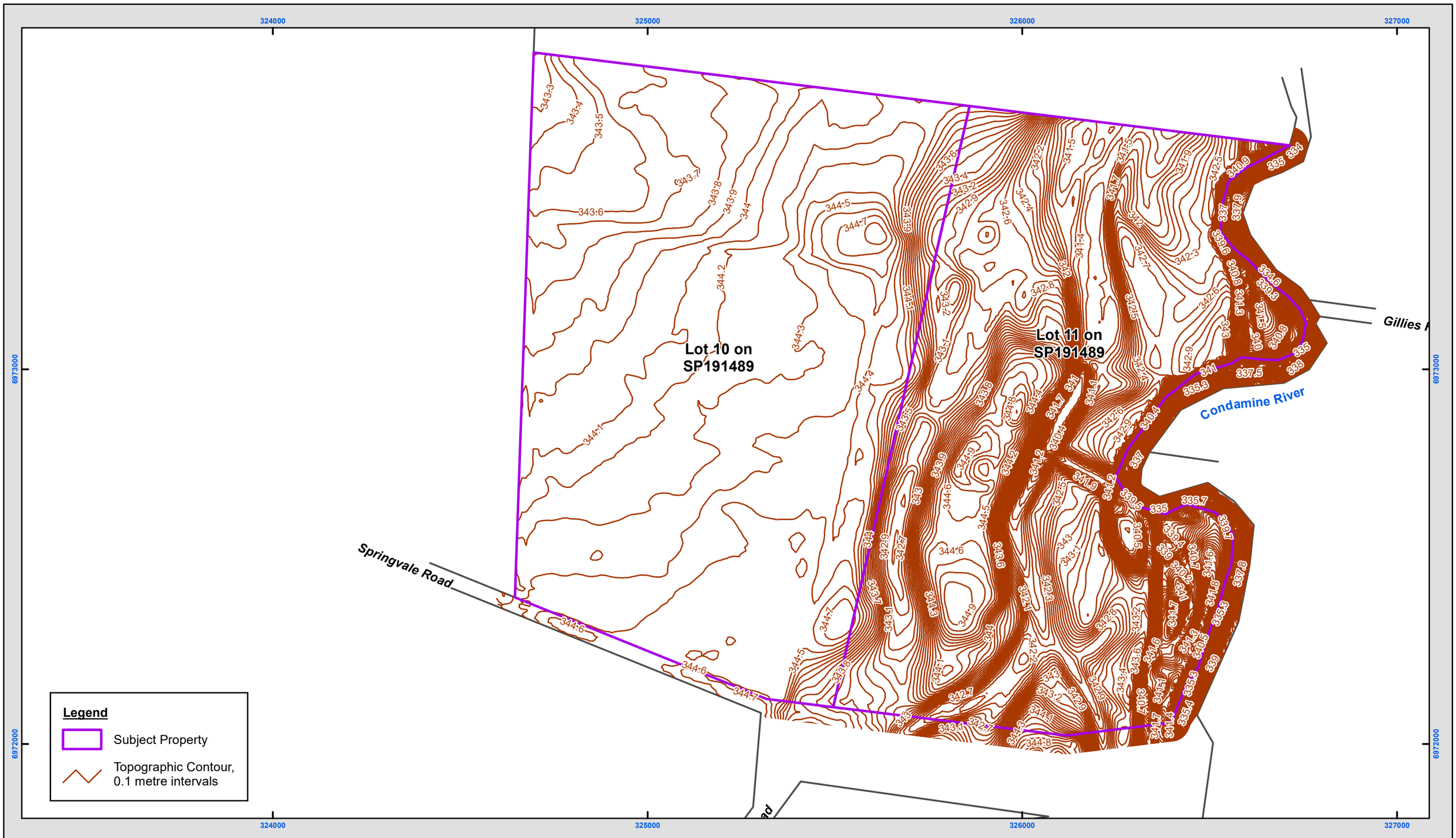
0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

Coordinate System: GDA 1994 MGA Zone 56



**NOT FOR CONSTRUCTION**




## Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

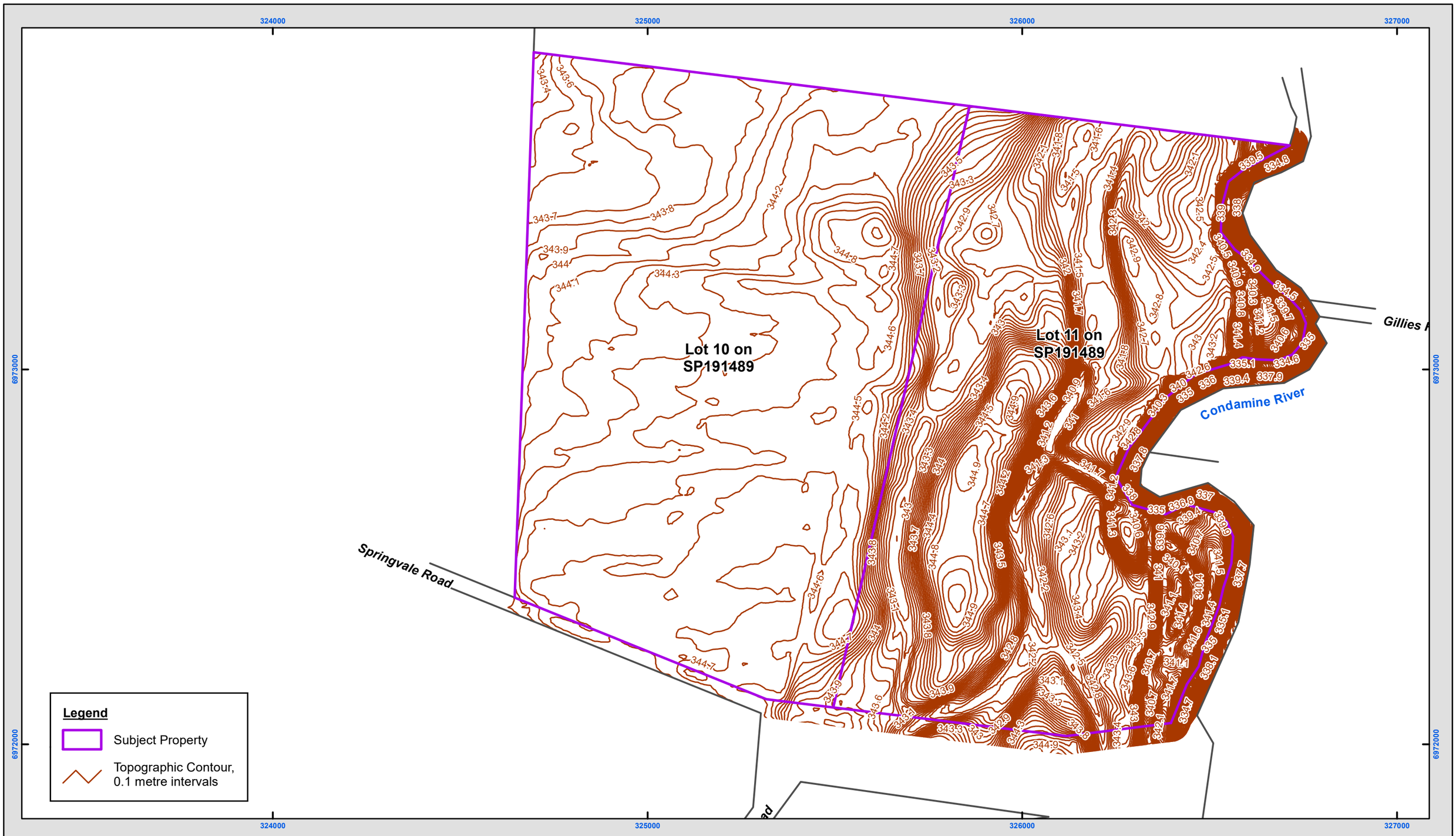
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

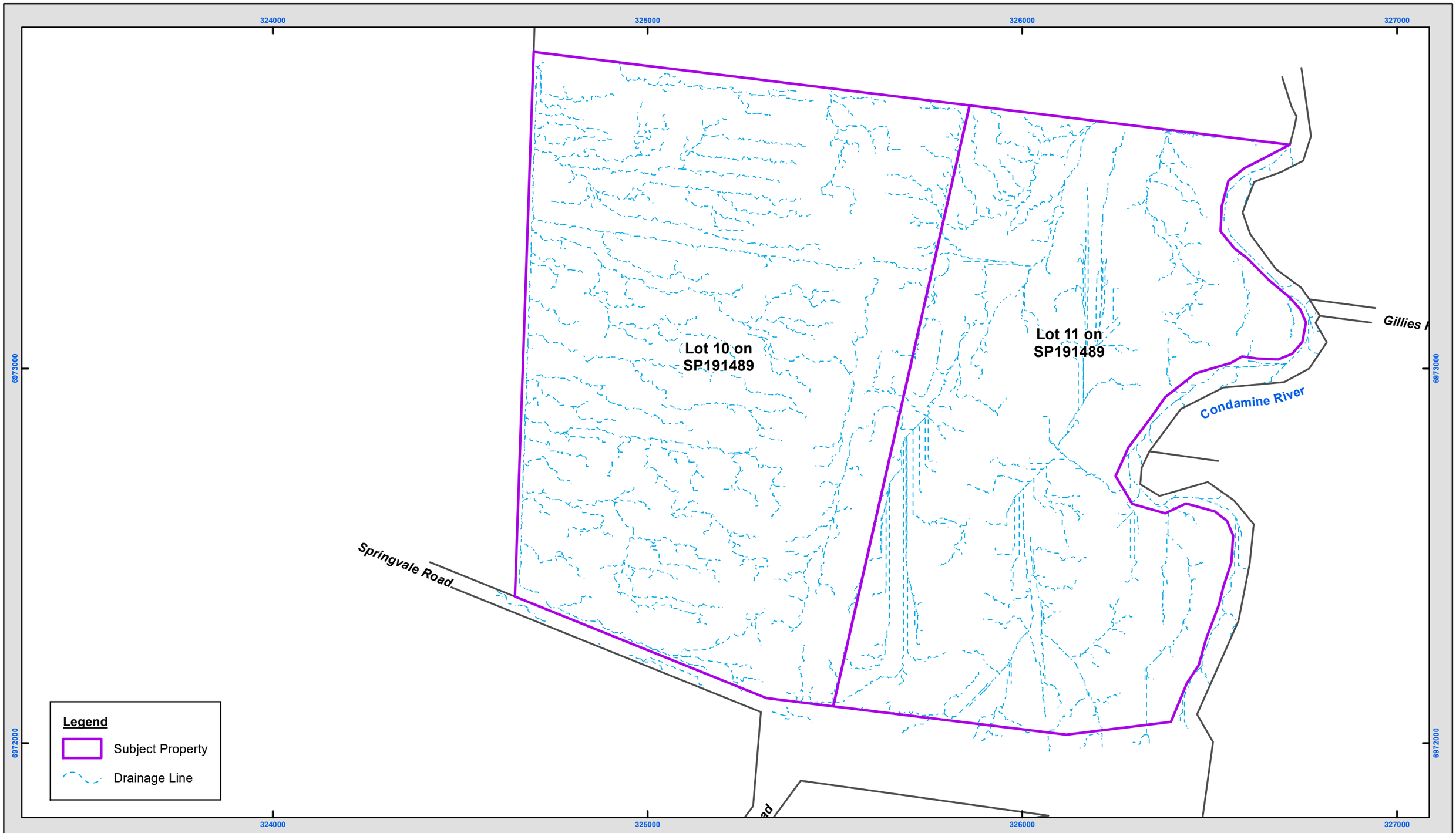
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 7 : 2012 DEM, Drainages Lines, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

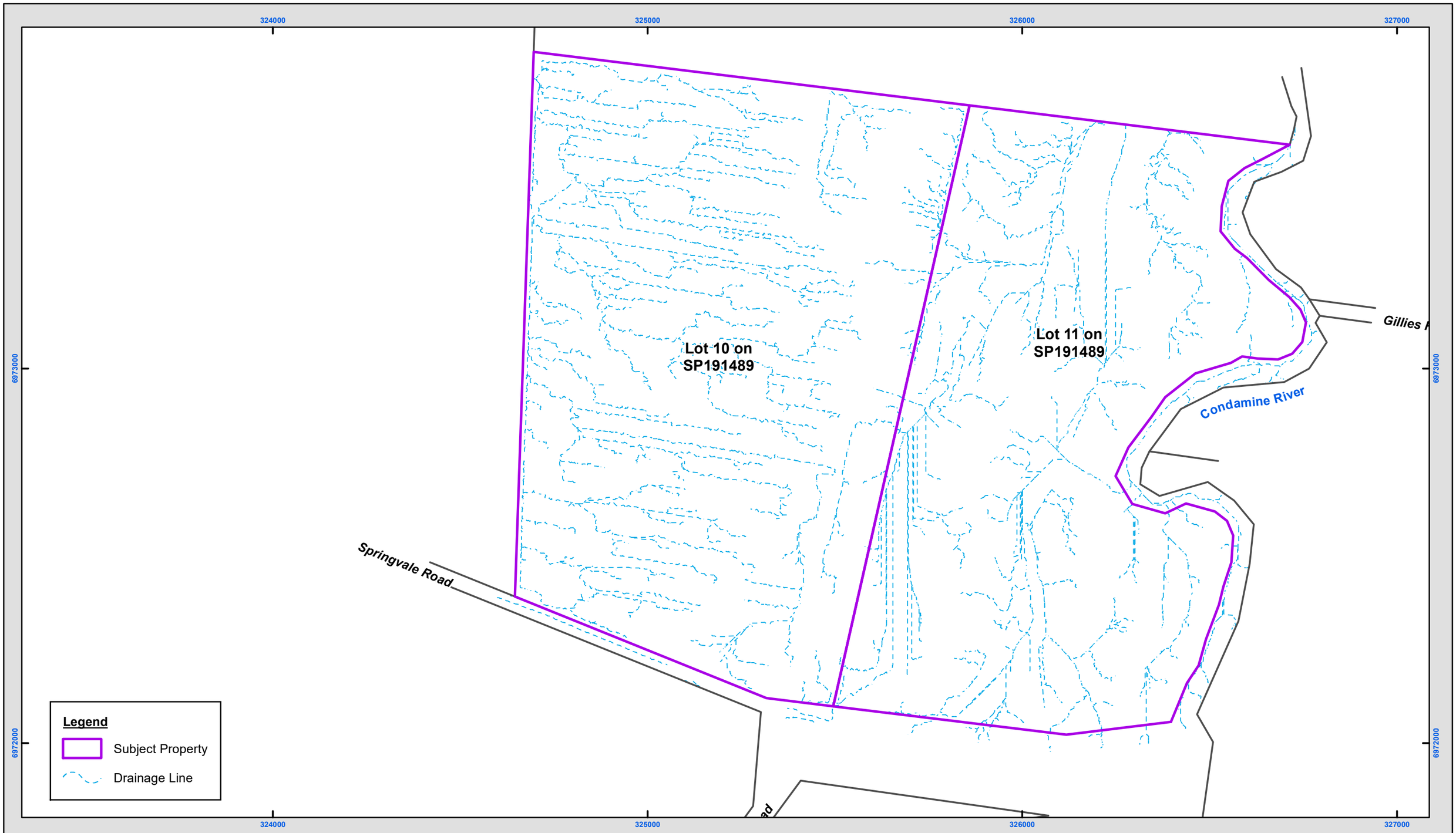
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 8 : 2014 DEM, Drainages Lines, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

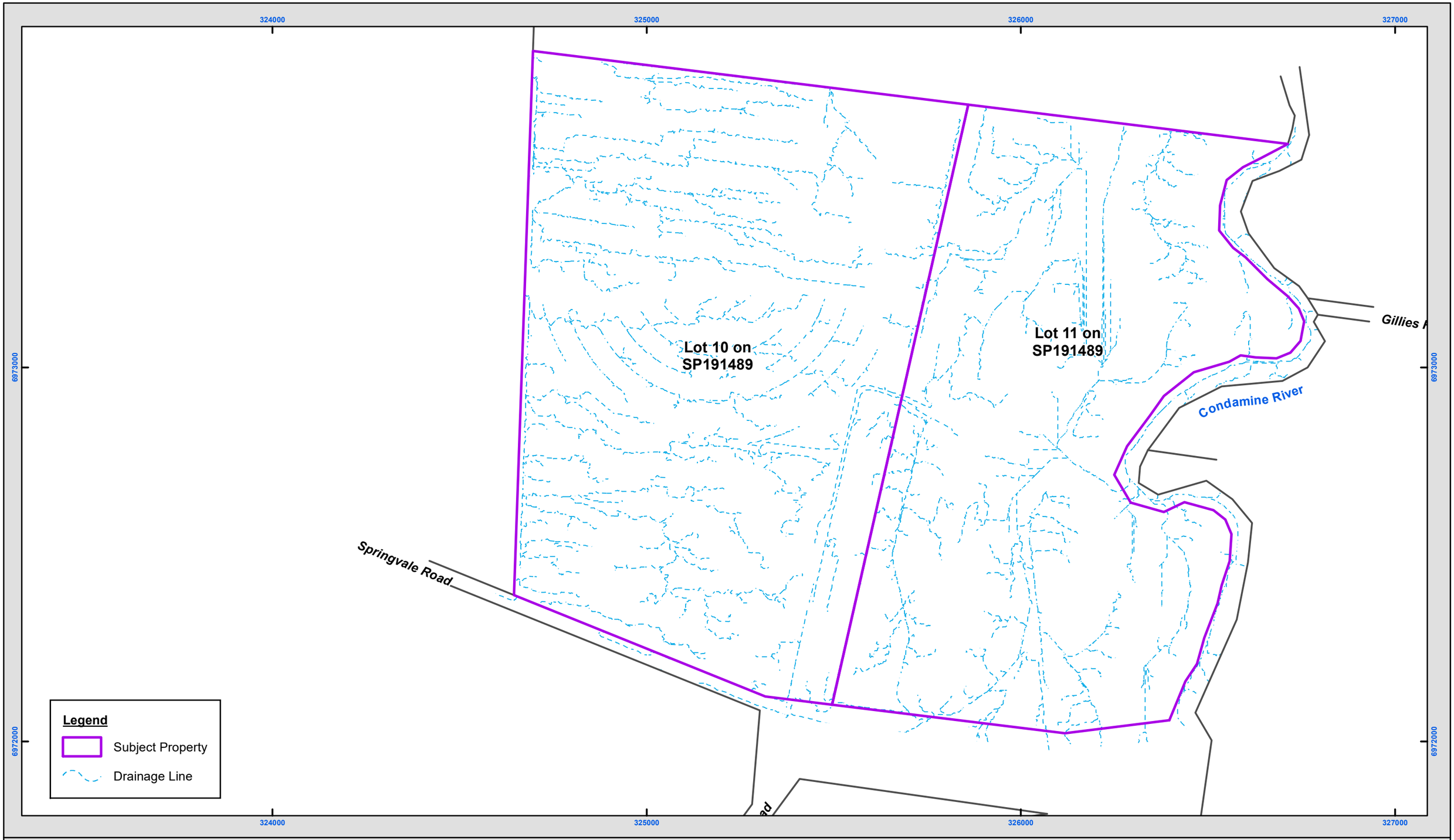
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 9 : 2020 DEM, Drainages Lines, Lots on Plans : 10SP191489 & 11SP191489

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 15/11/2021

Author: Arrow Energy

0.25 0.125 0 0.25 Kilometres

Scale: 1:9,615 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

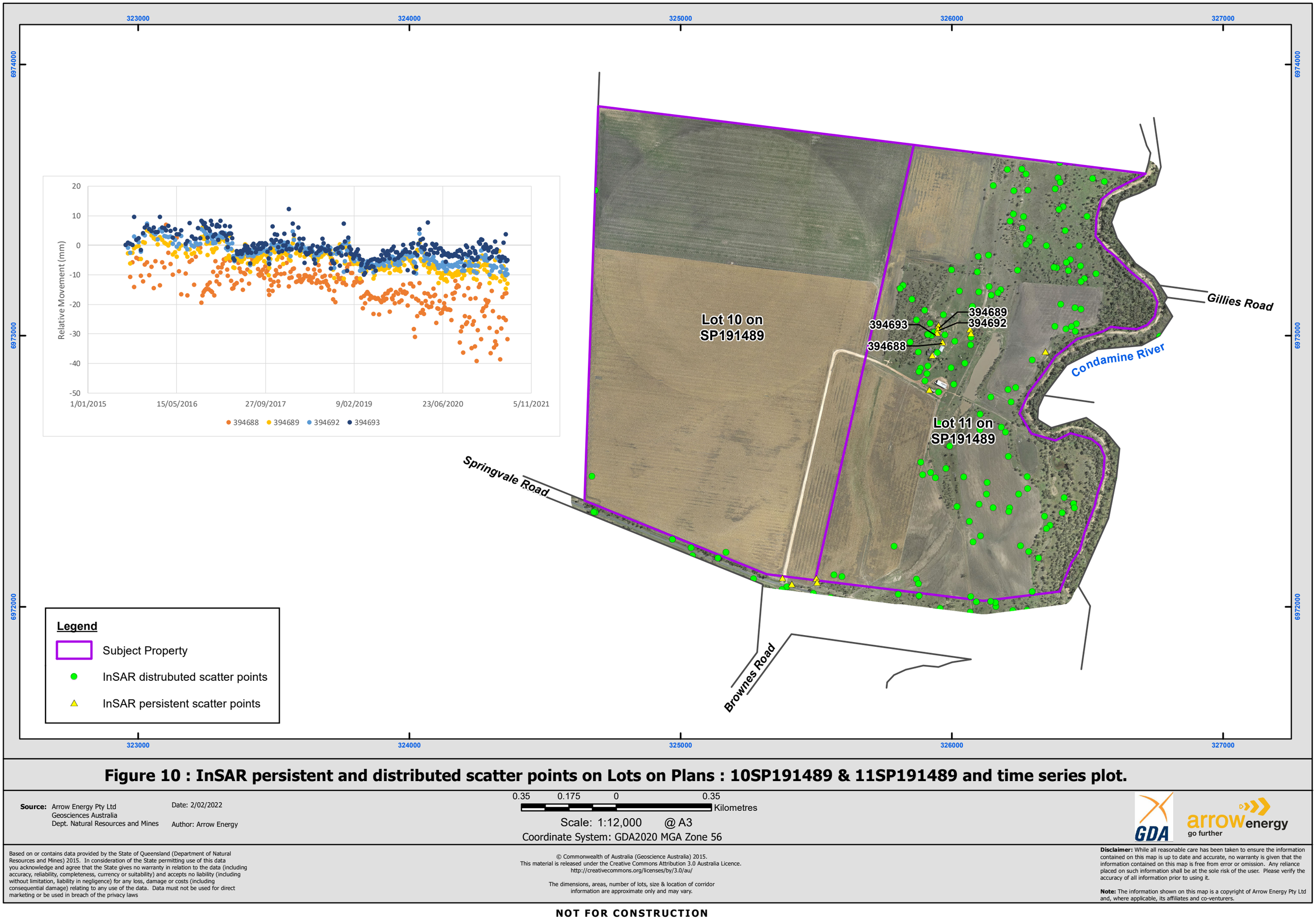



**Figure 10 : InSAR persistent and distributed scatter points on Lots on Plans : 10SP191489 & 11SP191489 and time series plot.**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 2/02/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

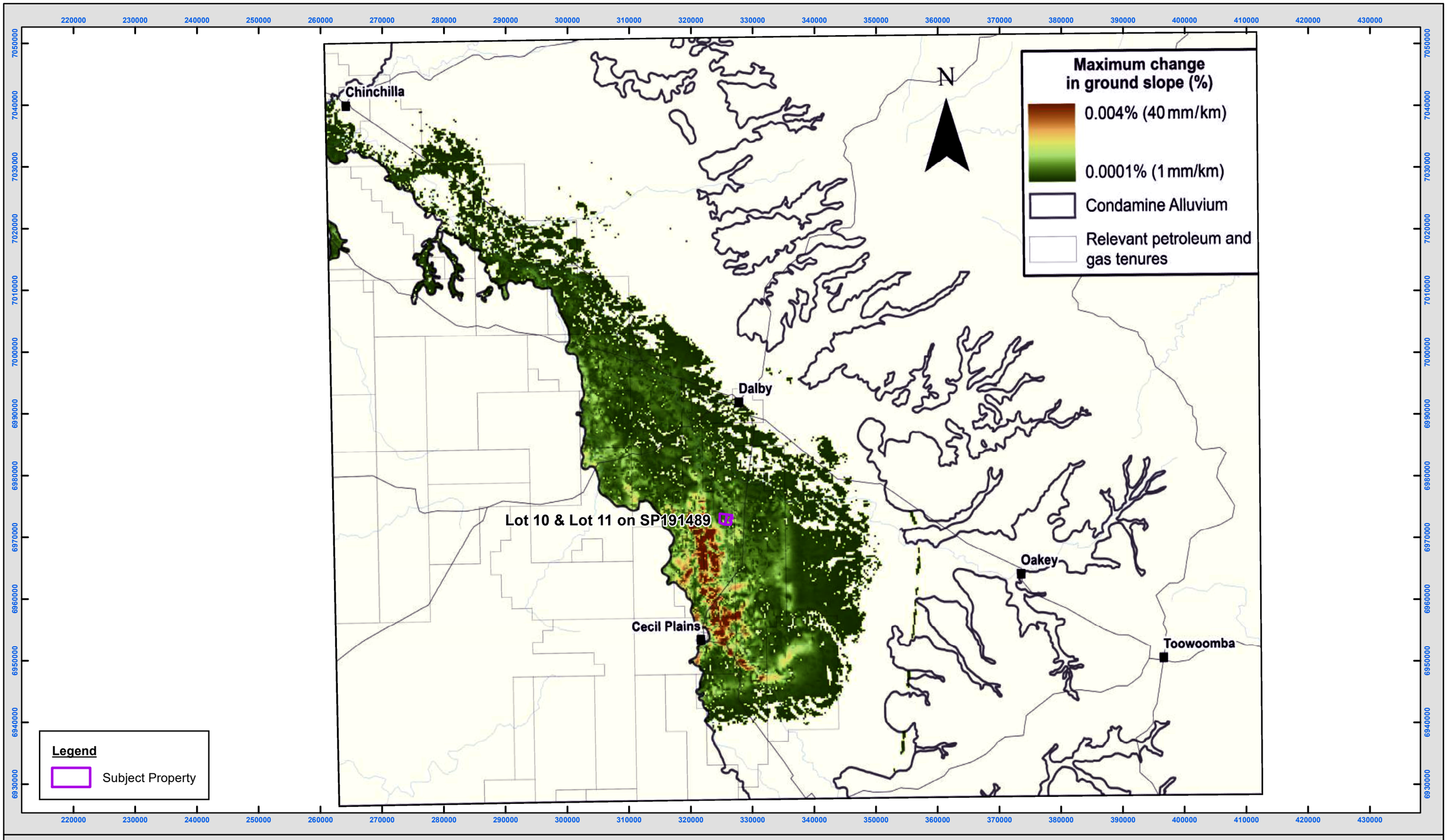



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lots on Plans : 10 & 11SP191489**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 11/12/2021

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



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Report

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# Baseline Report

## Surface Elevation Data – 55DY592

| | |
|---|---|
| **Version** | 1 |
| **Released** | 17/11/2021 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lot on plan 55DY592:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

The InSAR data is provided to Arrow as persistent and distributed scatter points by the InSAR provider, processed using their proprietary SqueeSAR technology. The InSAR data provided commenced in 2015 with the Sentinel satellite system, and provides continual information on regional ground movement using industry leading experts.

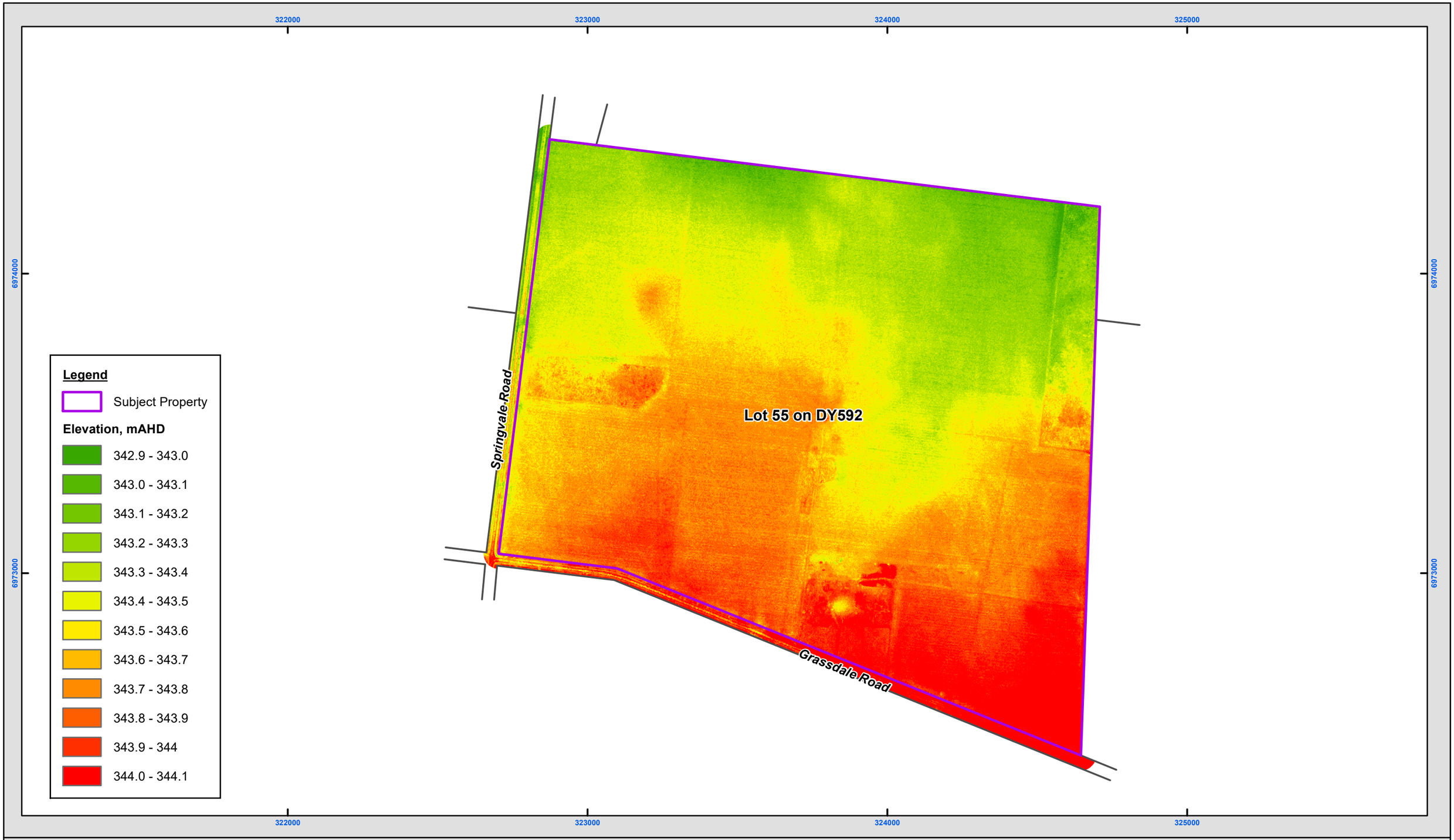
**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2




# Figure 1 : 2012 DEM, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

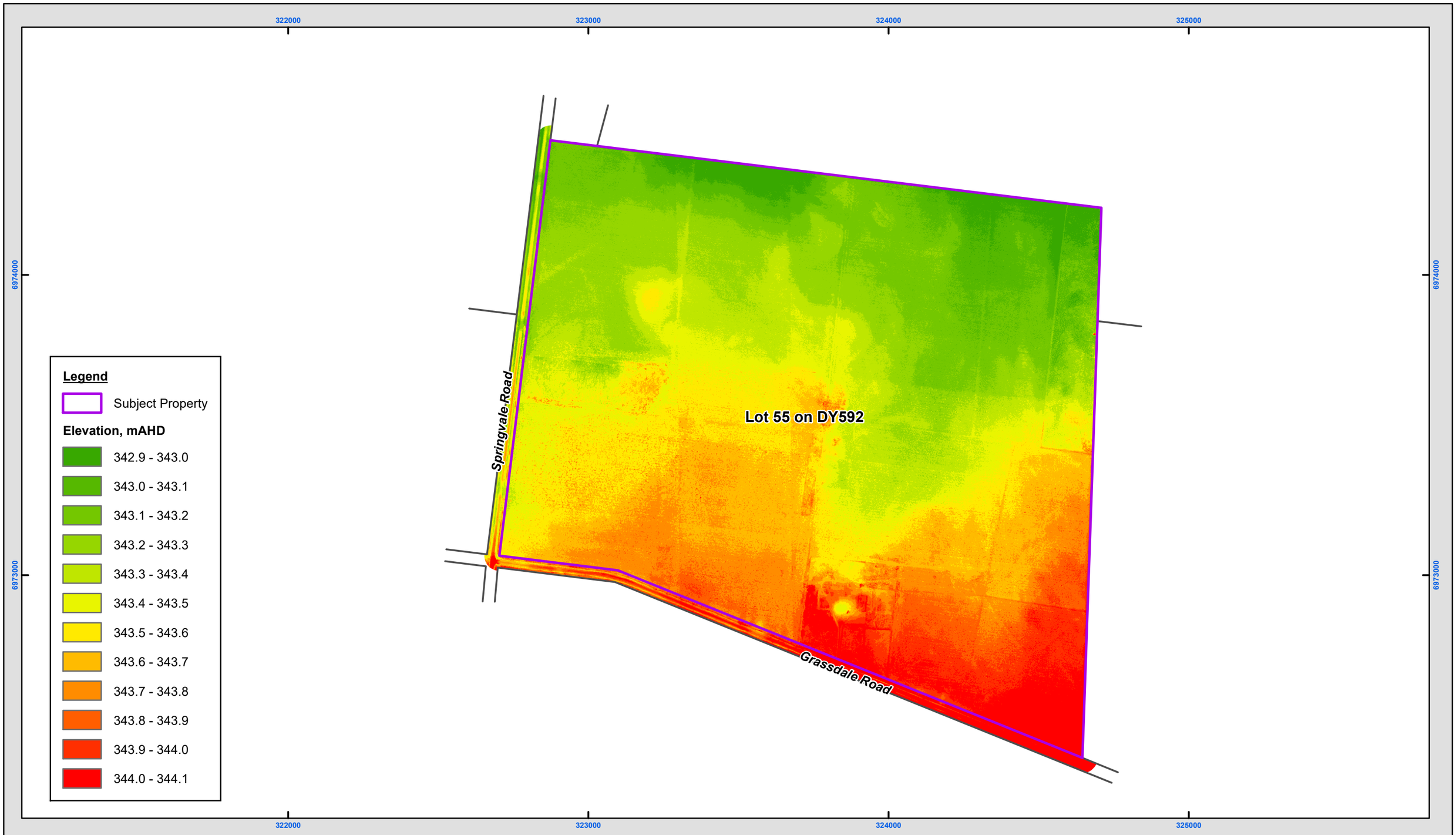
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 2 : 2014 DEM, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

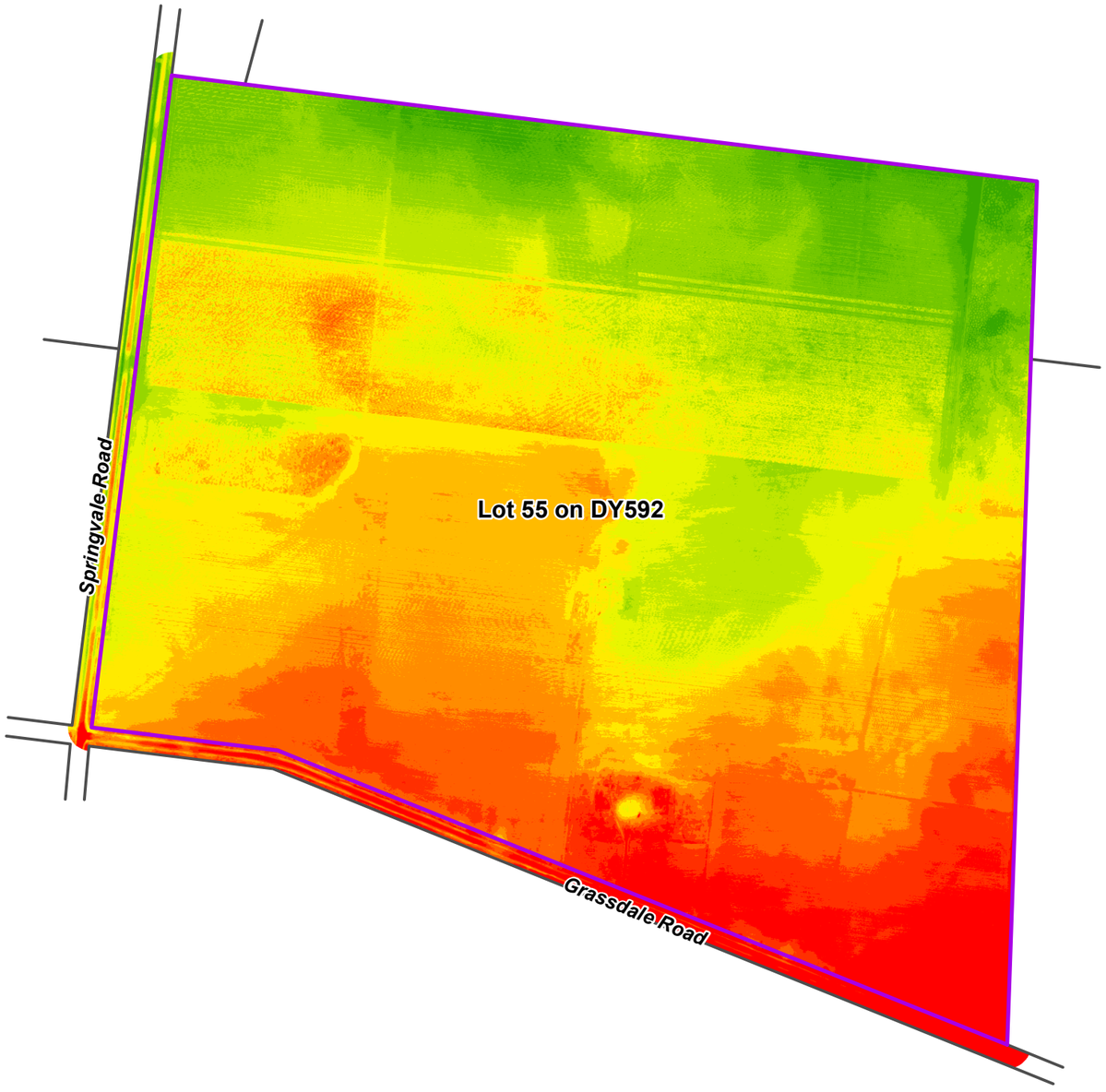


The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

322000
323000
324000
325000
6974000
6973000




**Legend**

Subject Property

**Elevation, mAHD**

- 342.9 - 343.0
- 343.0 - 343.1
- 343.1 - 343.2
- 343.2 - 343.3
- 343.3 - 343.4
- 343.4 - 343.5
- 343.5 - 343.6
- 343.6 - 343.7
- 343.7 - 343.8
- 343.8 - 343.9
- 343.9 - 344.0
- 344.0 - 344.1

# Figure 3 : 2020 DEM, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

322000 323000 324000 325000

6974000

6973000

Springvale Road

Grassdale Road

Lot 55
on DY592

343.1 343.2 343.3 343.4 343.5 343.6 343.7 343.8 343.9 344.0 344.1 344.2 344.3

**Legend**

Subject Property

Topographic Contour, 0.1 metre intervals

# Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 10/02/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

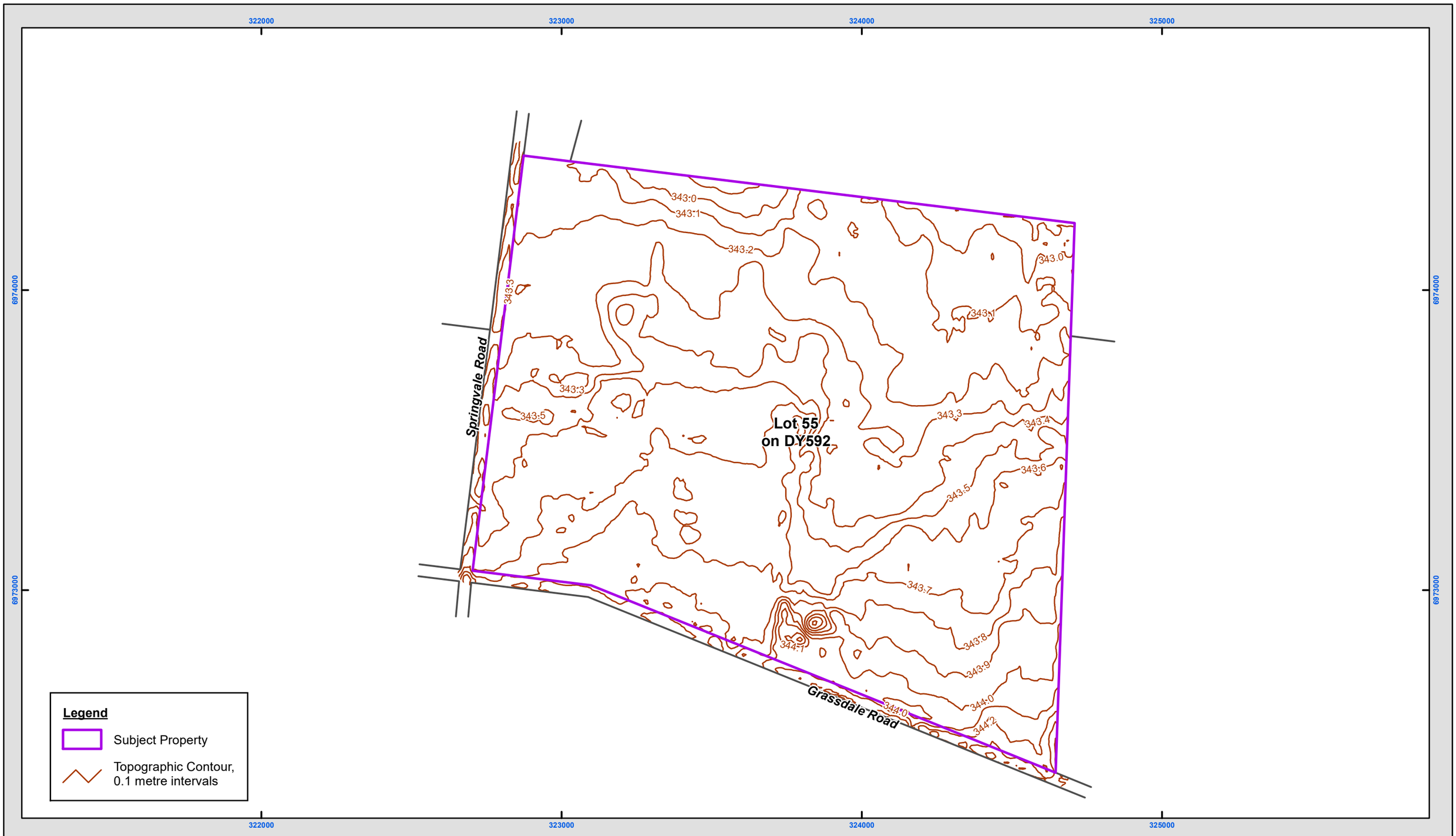
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 10/02/2022

Author: Arrow Energy

0.35 0.175 0 0.35
Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

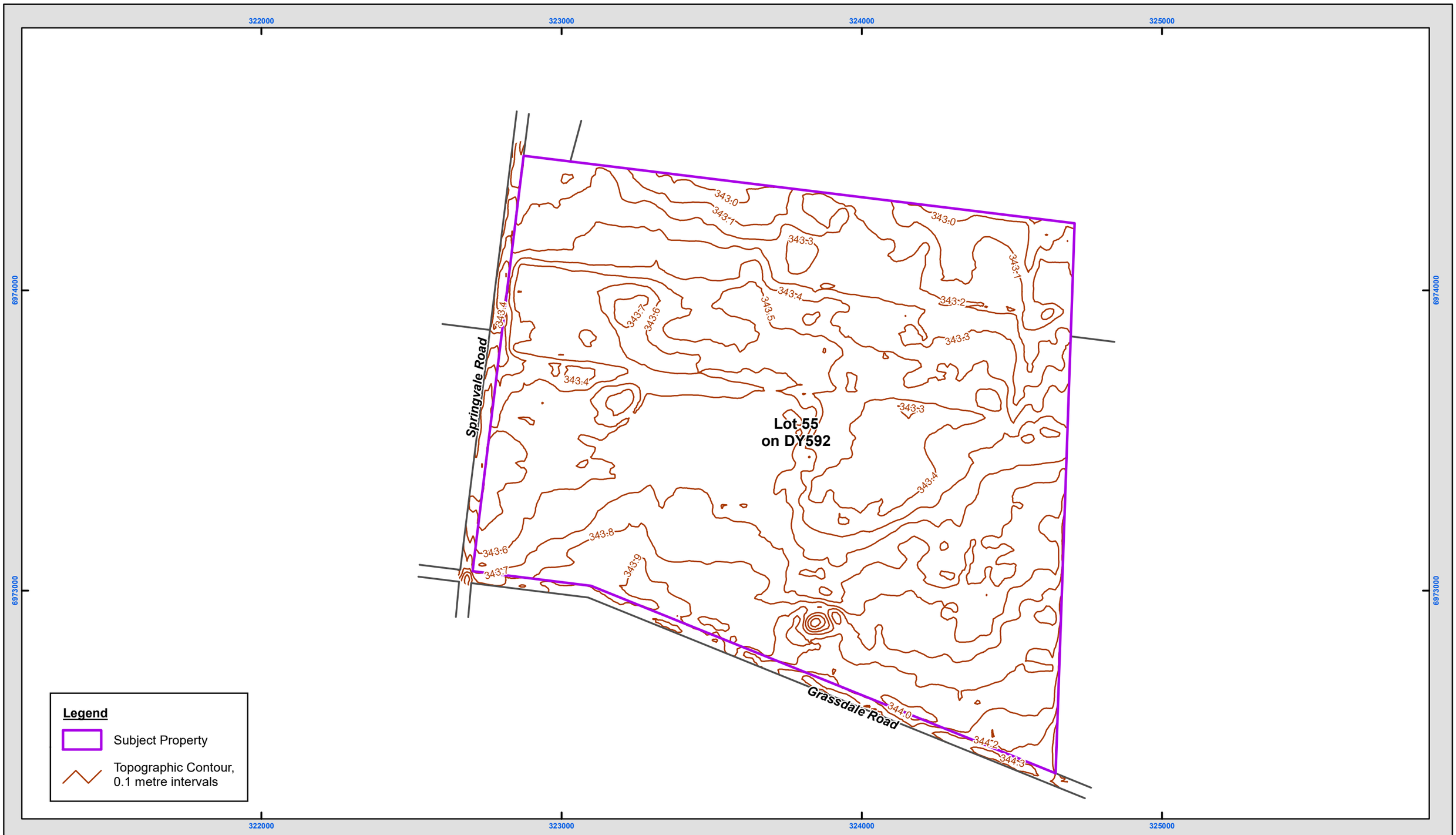



**Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lot on Plan : 55DY592**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

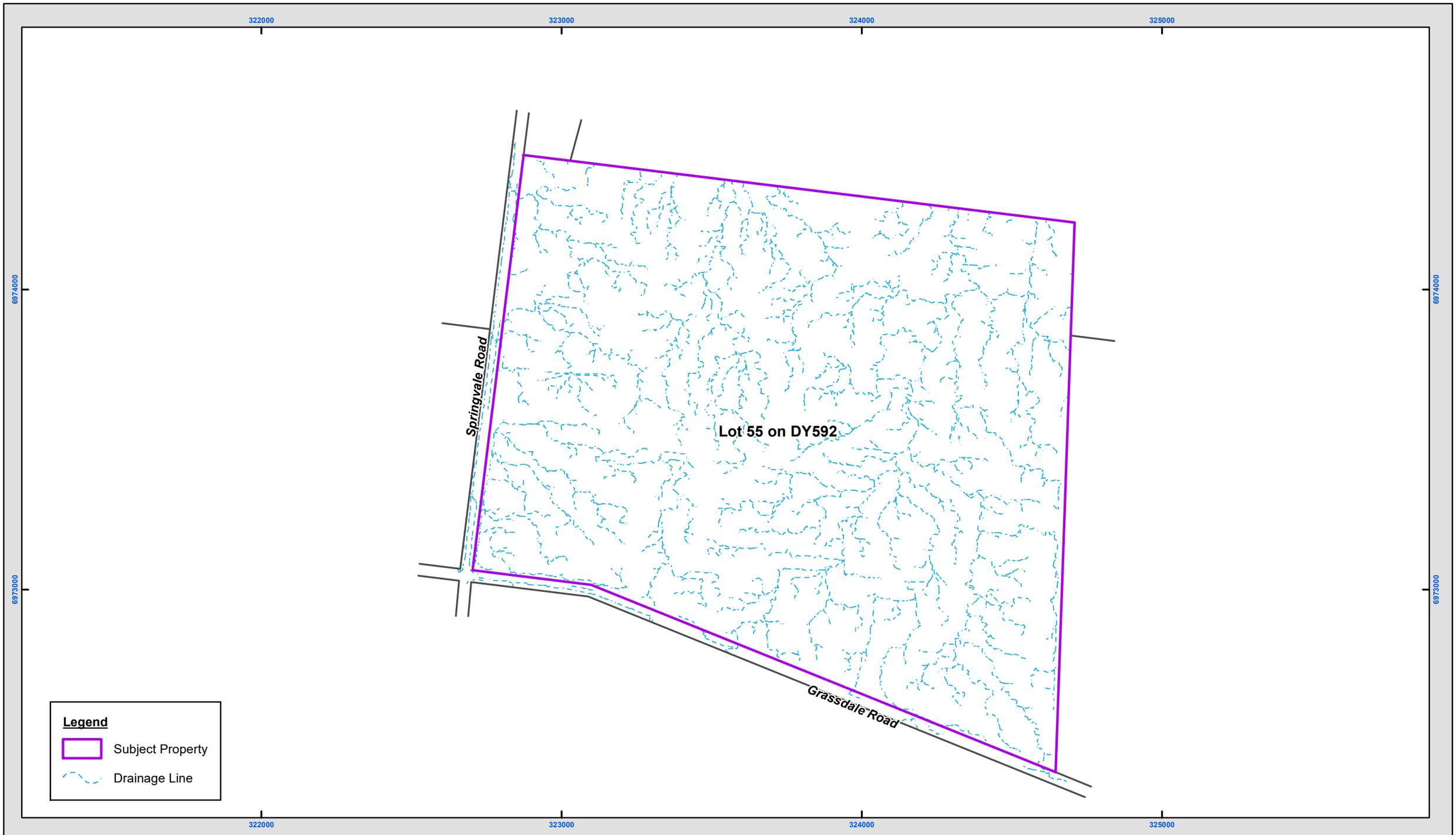
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 7 : 2012 DEM, Drainage Lines, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35
Kilometres

Scale: 1:12,000 @ A3

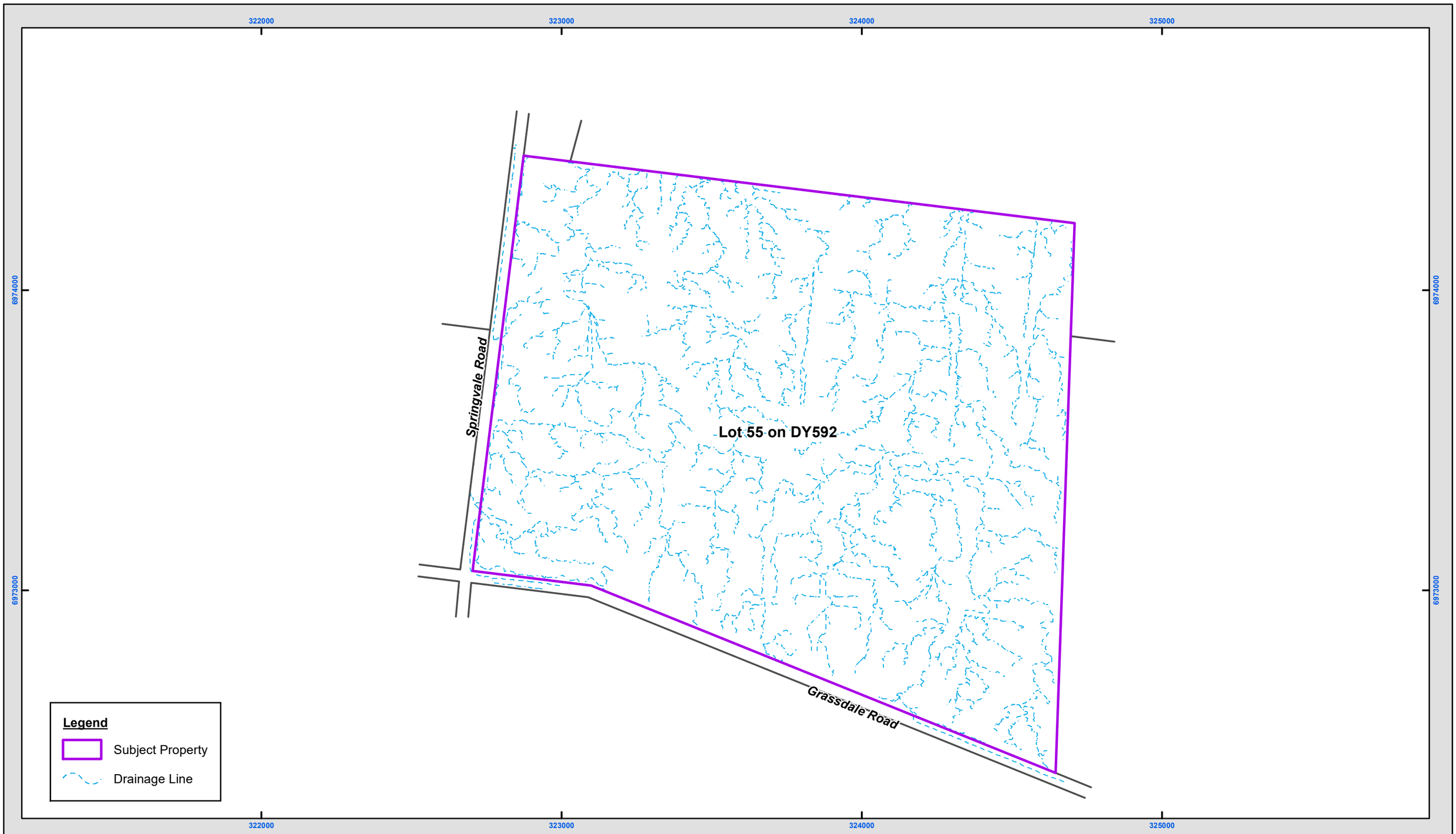
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 8 : 2014 DEM, Drainage Lines, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

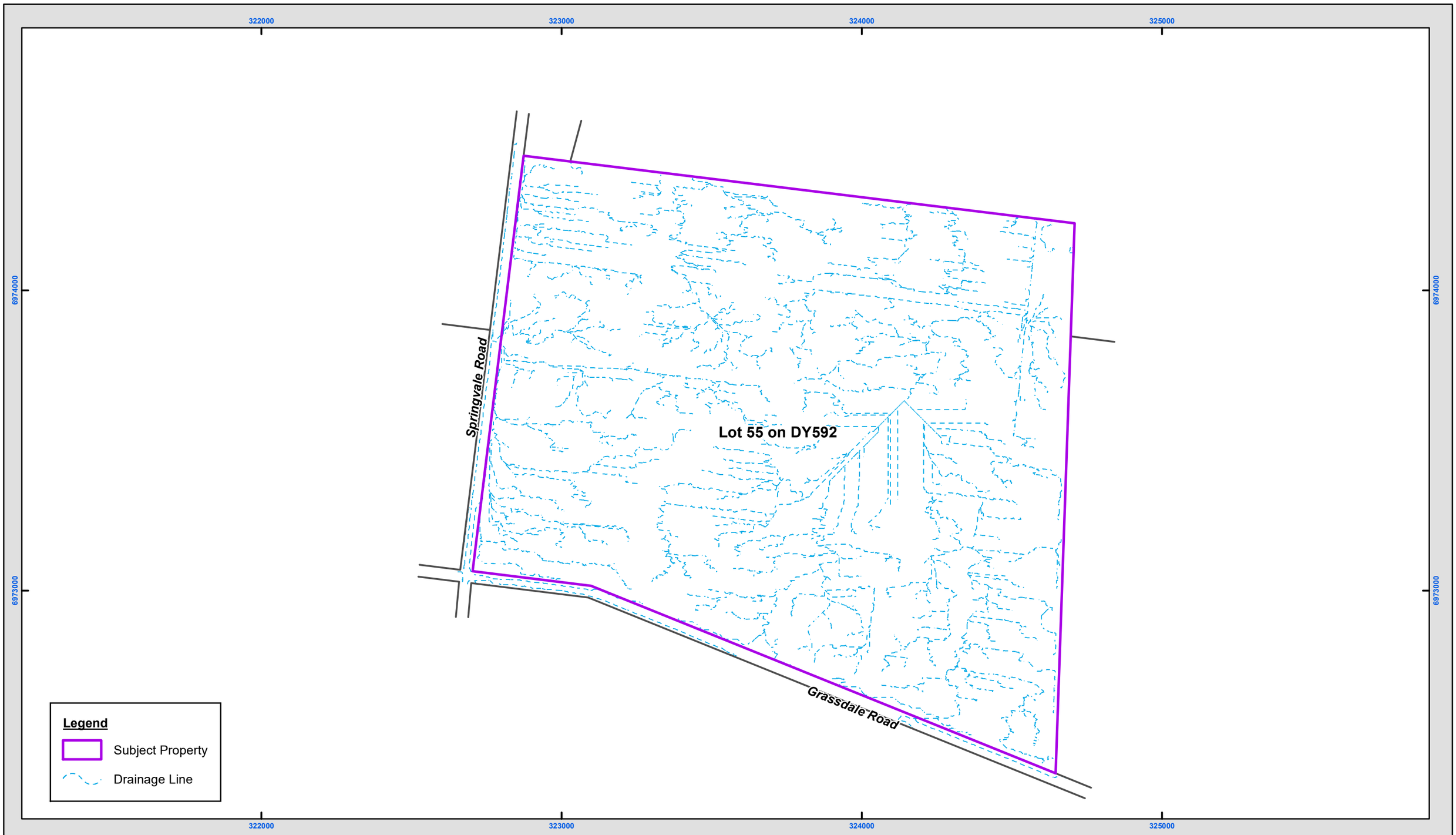
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 9 : 2020 DEM, Drainage Lines, Lot on Plan : 55DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

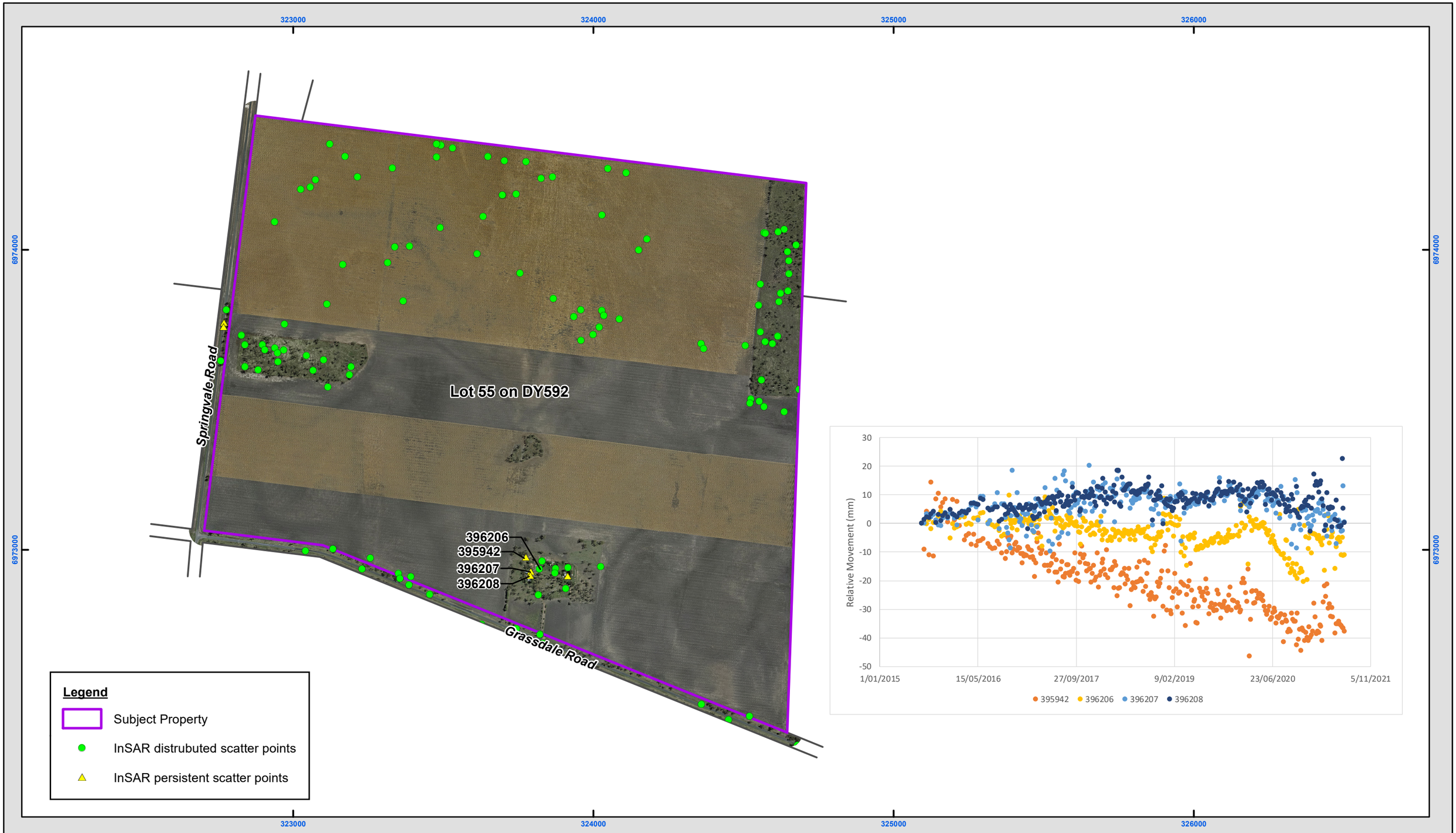
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 10 : InSAR persistent and distributed scatter points on Lot on Plan : 55DY592, and time series plot

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 9/02/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

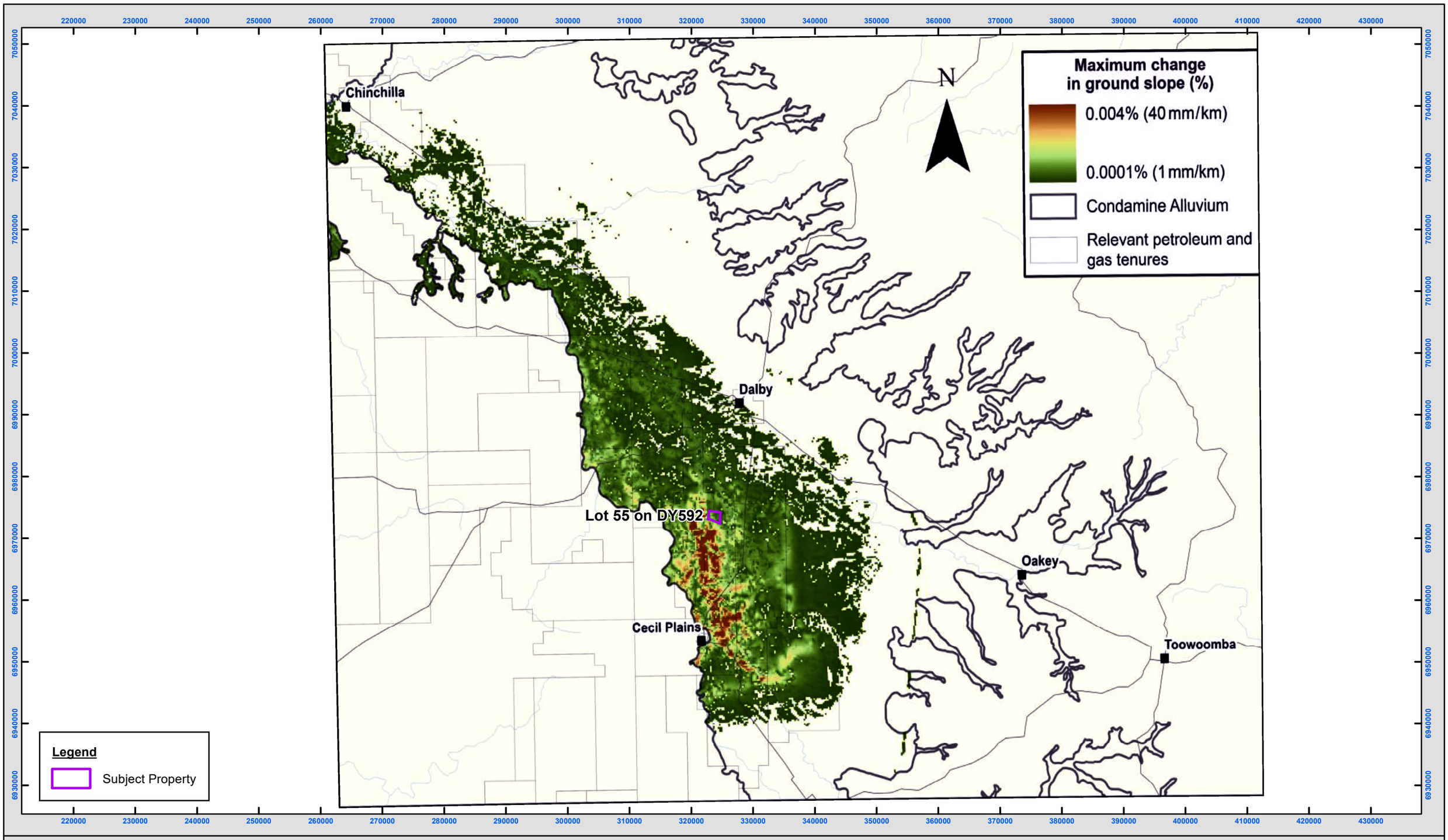



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lot on Plan : 55DY592**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 11/12/2021

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



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# Baseline Report

## Surface Elevation Data – 56DY592

| | |
|---|---|
| **Version** | 3 |
| **Released** | 04/01/2022 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lot on plan 56DY592:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

The InSAR data is provided to Arrow as persistent and distributed scatter points by the InSAR provider, processed using their proprietary SqueeSAR technology. The InSAR data provided commenced in 2015 with the Sentinel satellite system, and provides continual information on regional ground movement using industry leading experts.

**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

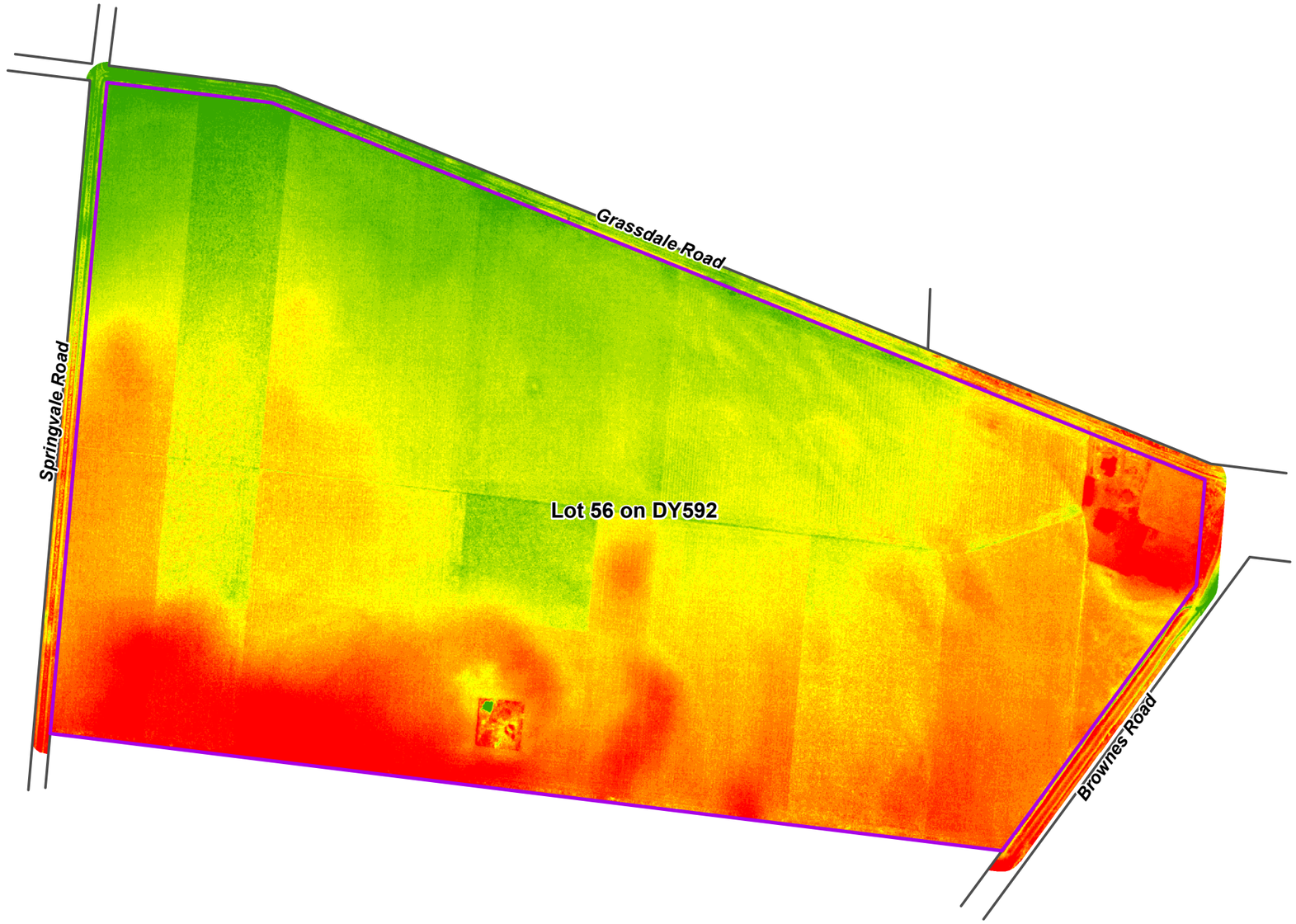
**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2

322000 323000 324000 325000

6973000 6972000 6971000




**Legend**

Subject Property

**Elevation, mAHD**

- 343.8 - 343.9
- 343.9 - 344.0
- 344.0 - 344.1
- 344.1 - 344.2
- 344.2 - 344.3
- 344.3 - 344.4
- 344.4 - 344.5
- 344.5 - 344.6
- 344.6 - 344.7
- 344.7 - 344.8
- 344.8 - 344.9
- 344.9 - 345.0
- 345.0 - 345.1

322000 323000 324000 325000

# Figure 1 : 2012 DEM, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

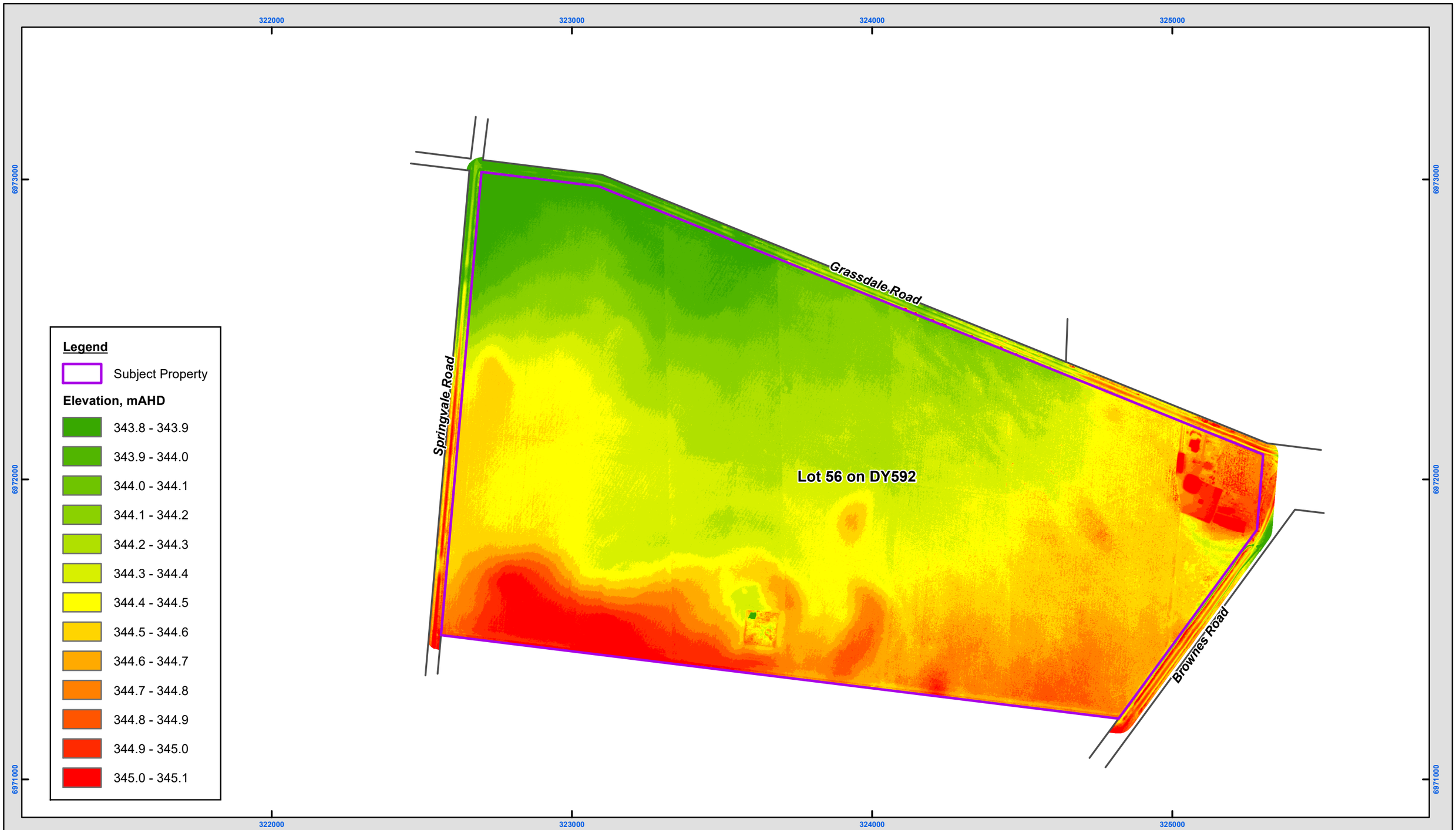
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 2 : 2014 DEM, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

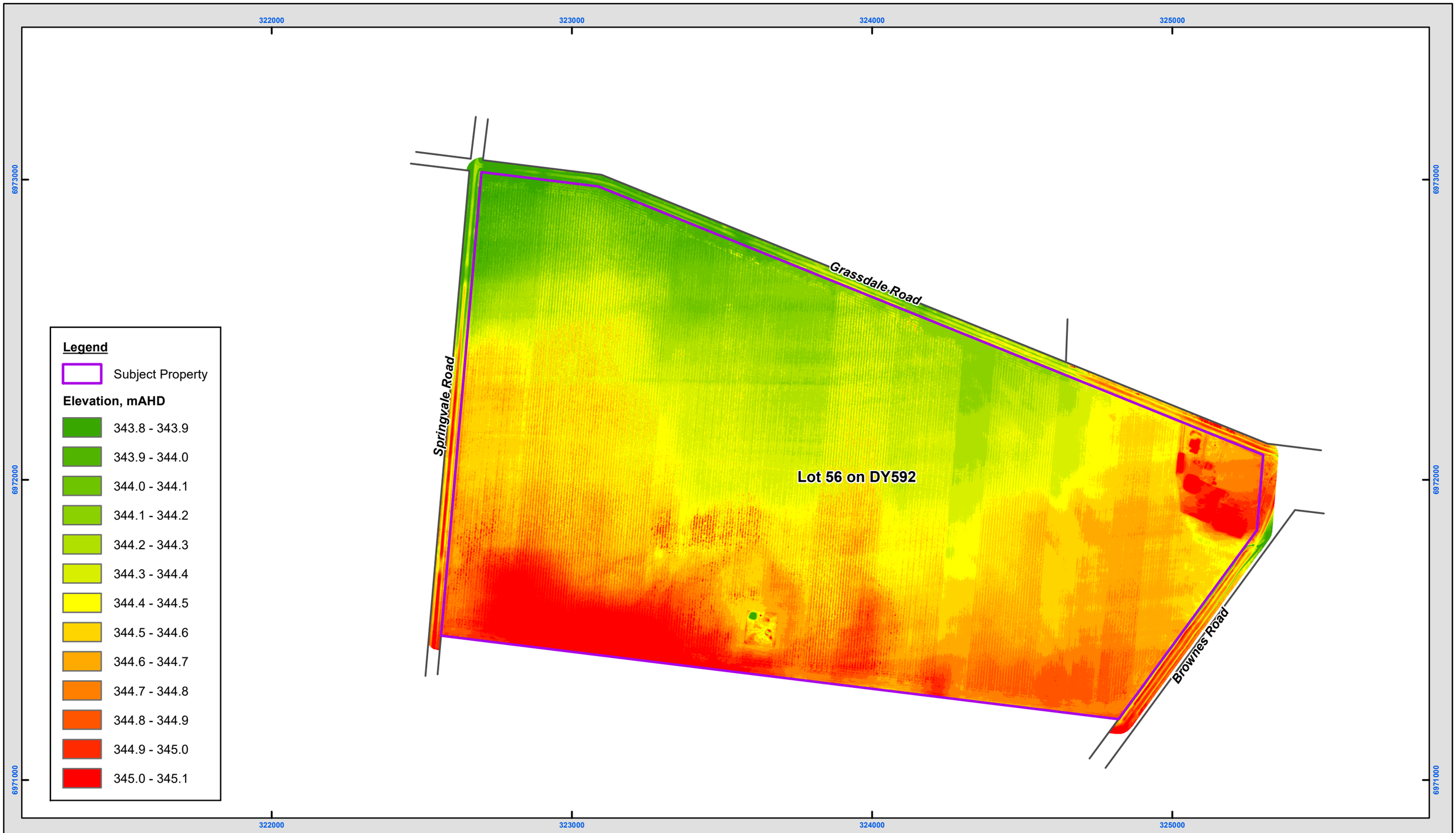
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 3 : 2020 DEM, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

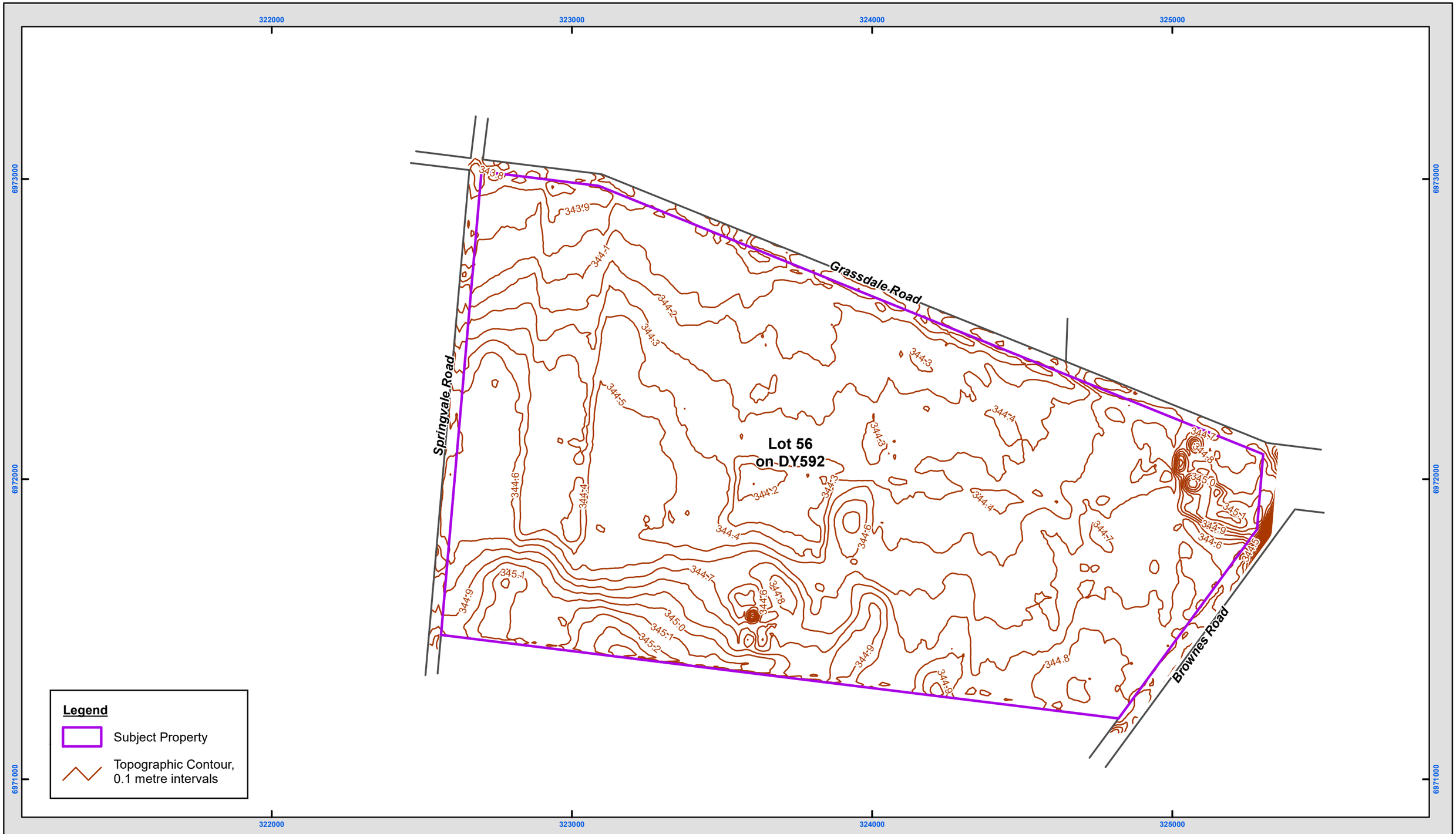



**Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lot on Plan : 56DY592**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

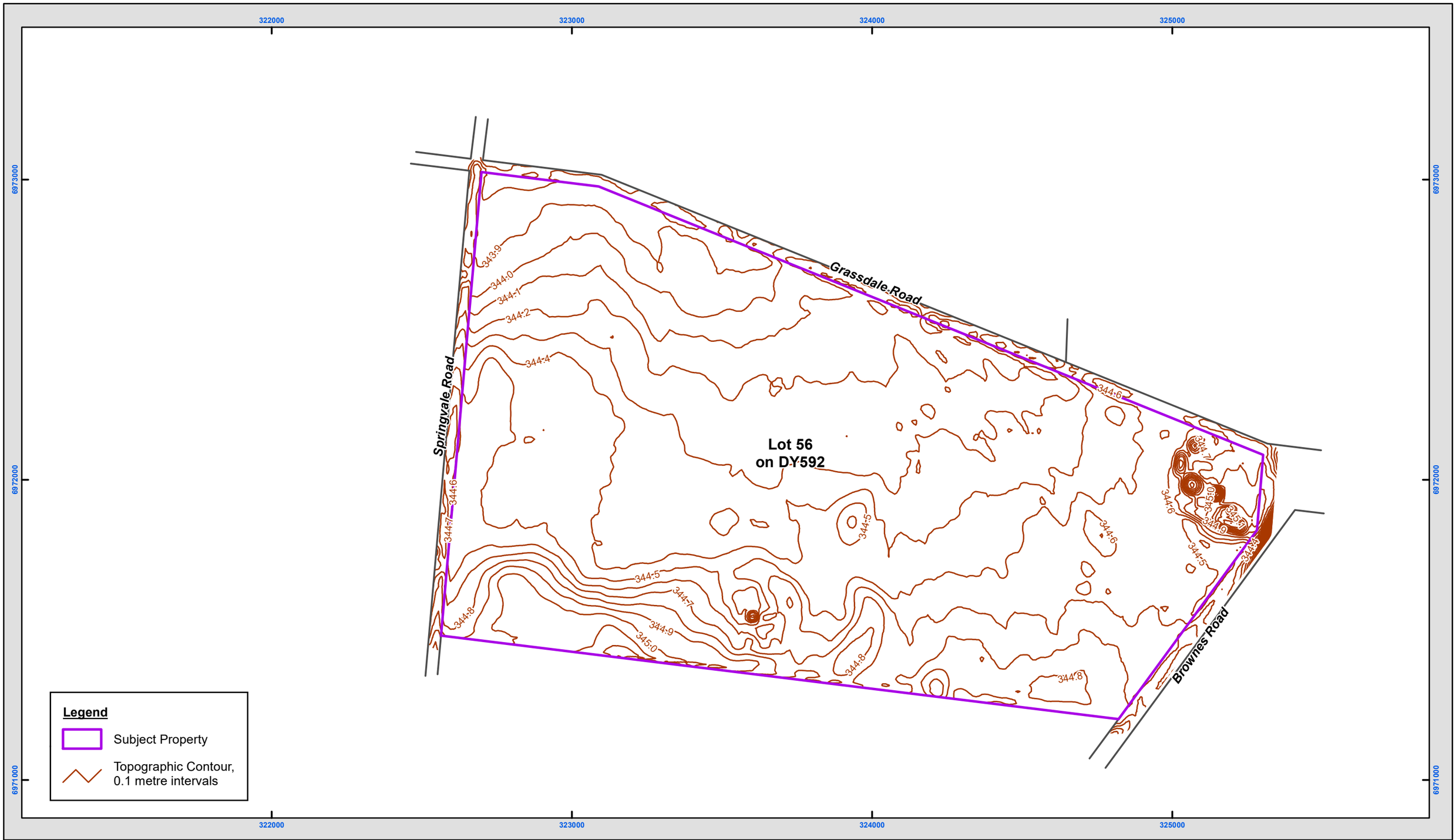
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

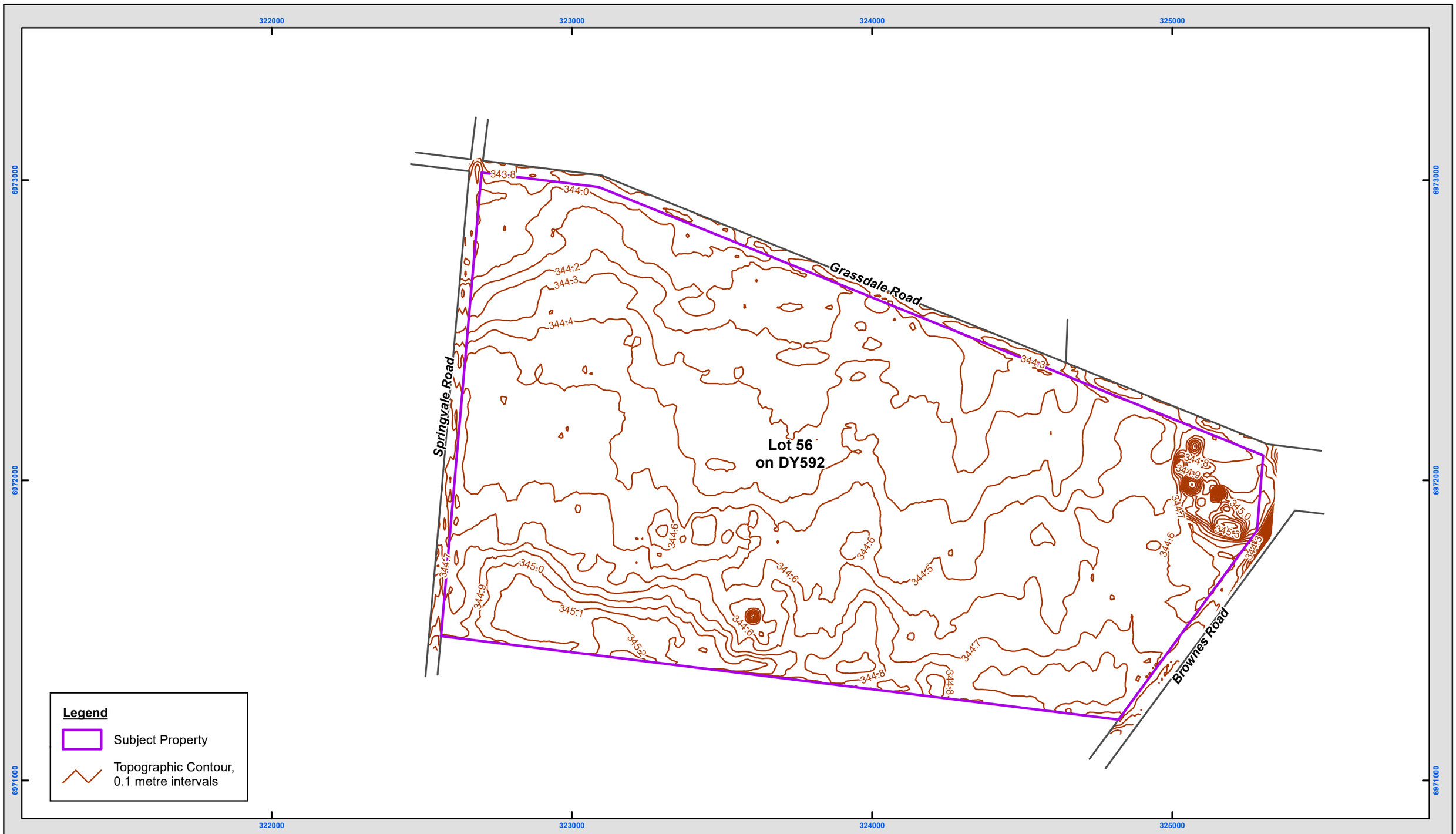
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

322000 323000 324000 325000

6973000 6972000 6971000

Springvale Road

Grassdale Road

Lot 56 on DY592

Browns Road

**Legend**

Subject Property

Drainage Line

# Figure 7 : 2012, Drainage Lines, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

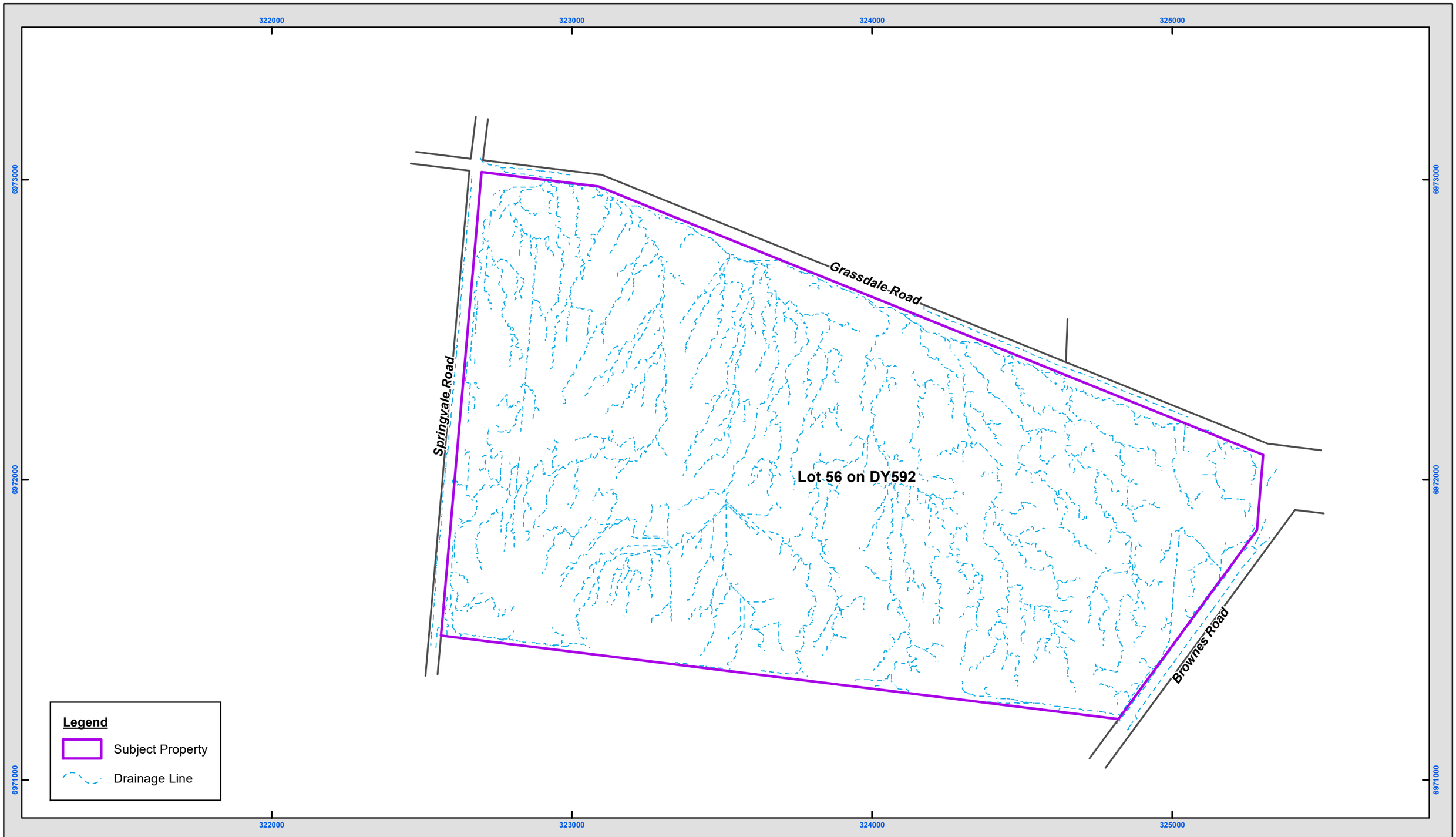
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 8 : 2014, Drainage Lines, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

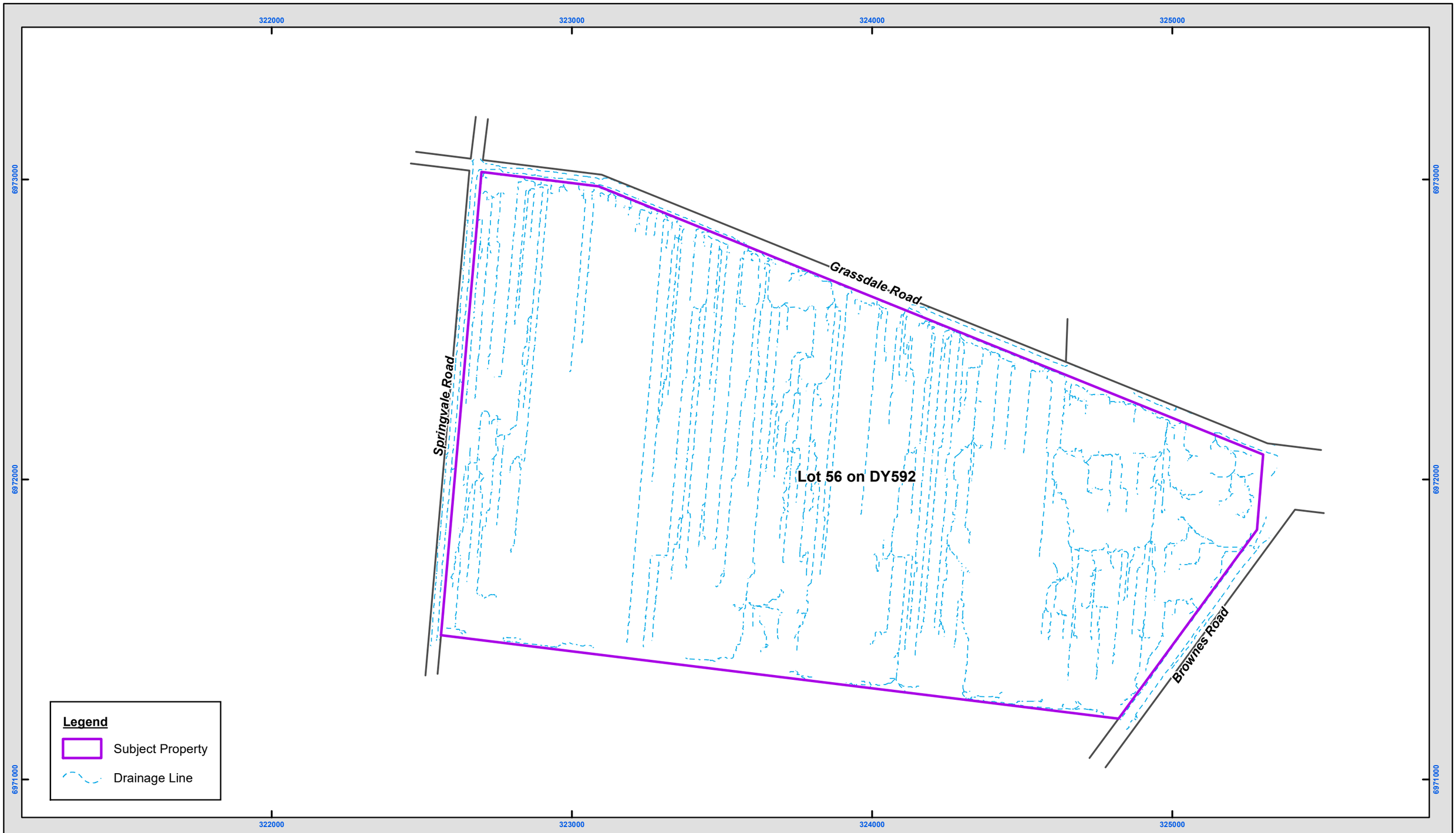
0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



**NOT FOR CONSTRUCTION**




# Figure 9 : 2020, Drainage Lines, Lot on Plan : 56DY592

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 14/11/2021

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

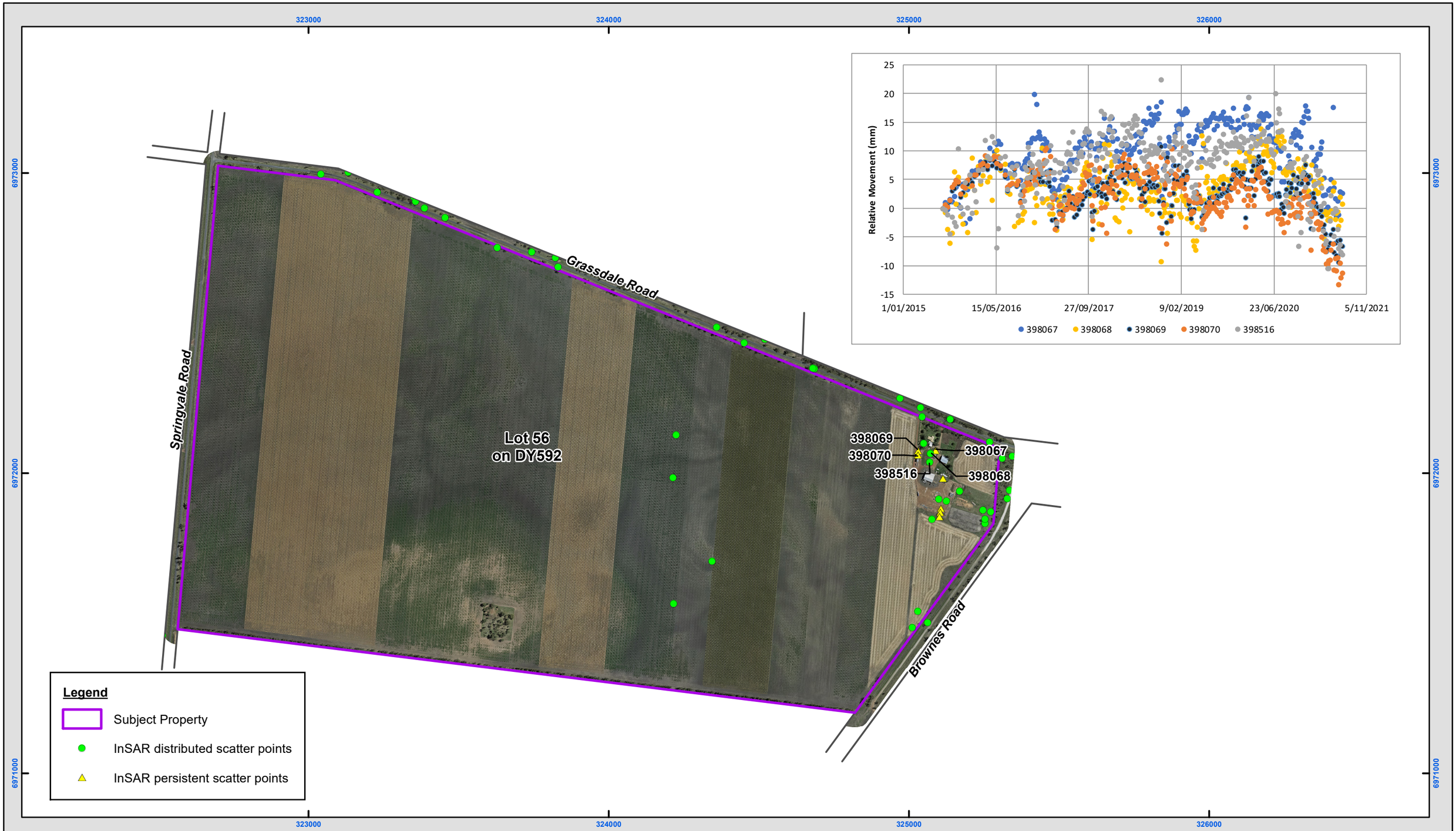
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 10 : InSAR persistent and distributed scatter points on Lot on Plan : 56DY592, and time series plot

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/03/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

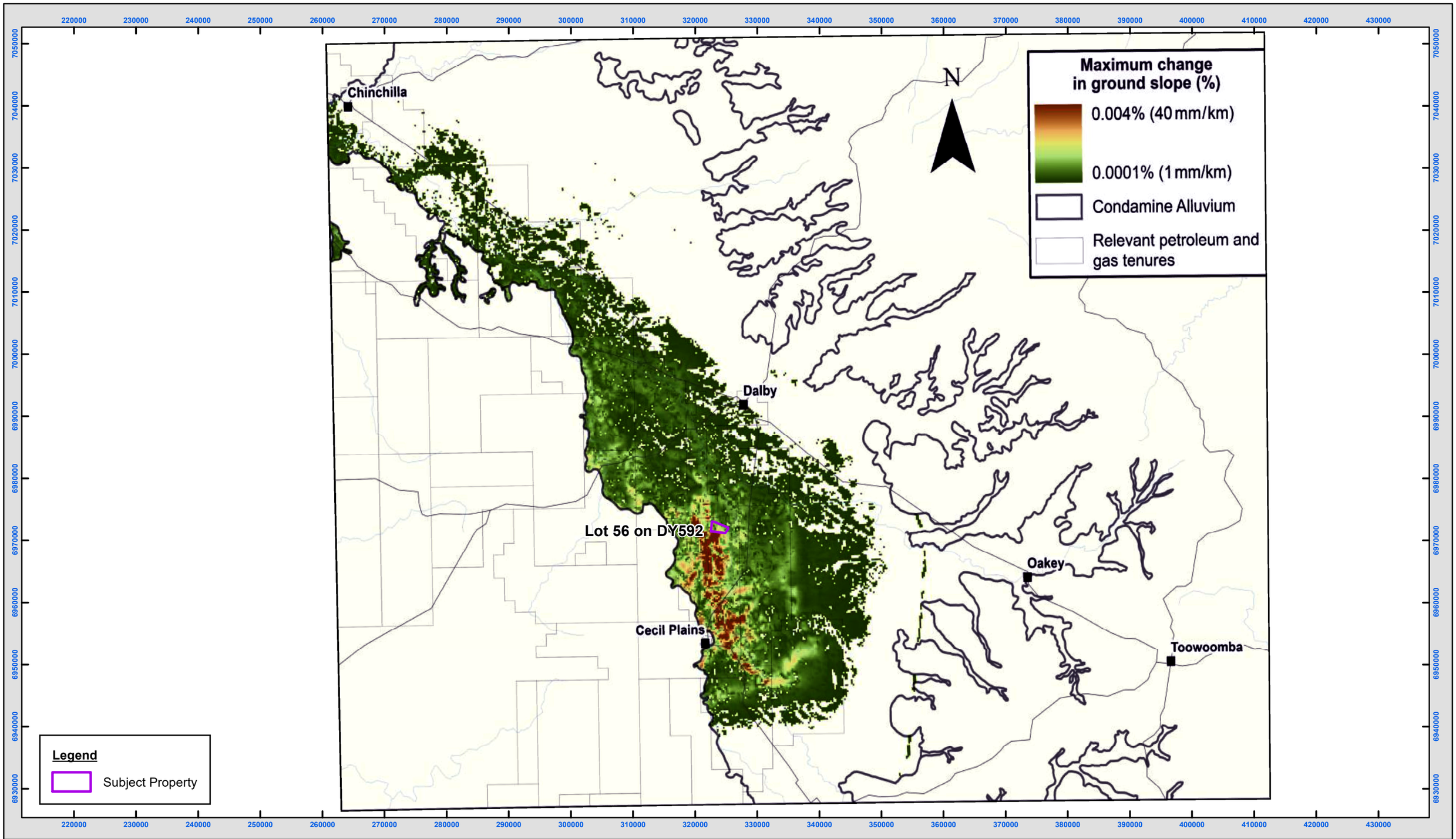



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lot on Plan : 56DY592**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 11/12/2021

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



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Report

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# Baseline Report

## Surface Elevation Data – 141AG4261

| | |
|---|---|
| **Version** | 1 |
| **Released** | 13/12/2021 |



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## Contents



## List of Figures

# 1. Purpose

This Report provides the following surface elevation datasets overlaid on lot on plan 141AG4261:

- 2012 Digitial Elevation Model (DEM) (Figure 1),
- 2014 DEM (Figure 2),
- 2020 DEM (Figure 3),
- 2012 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 4),
- 2014 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 5),
- 2020 DEM 0.1 m elevation contours (10m x 10m cells) (Figure 6),
- 2012 DEM drainage lines (Figure 7),
- 2014 DEM drainage lines (Figure 8),
- 2020 DEM drainage lines (Figure 9),
- InSAR persistent and distributed scatter points and time series plot (Figure 10), and
- OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) (Figure 11).

Electronic copies of the above datasets can be made available upon request.

The elevation related maps represented are based on light detection and ranging (LiDAR) elevation data acquired over 3 periods during Arrow Energy's operations (Table 1). The ground displacement map provides points based on interferometric synthetic aperture radar (InSAR), with time series graphs of selected persistent scatter points provided as an example of the data collected.

The LiDAR data is provided to Arrow as classified point clouds (with ground and non-ground points) and a Digital Elevation Model (DEM) generated from the ground classified points by the LiDAR providers. The LiDAR providers undertook surveying of a ground control network across the acquisition area to provide information on accuracy of the DEM. The DEM's derived from these LiDAR point clouds represent the most accurate regional scale datasets using industry leading experts available at the time of capture.

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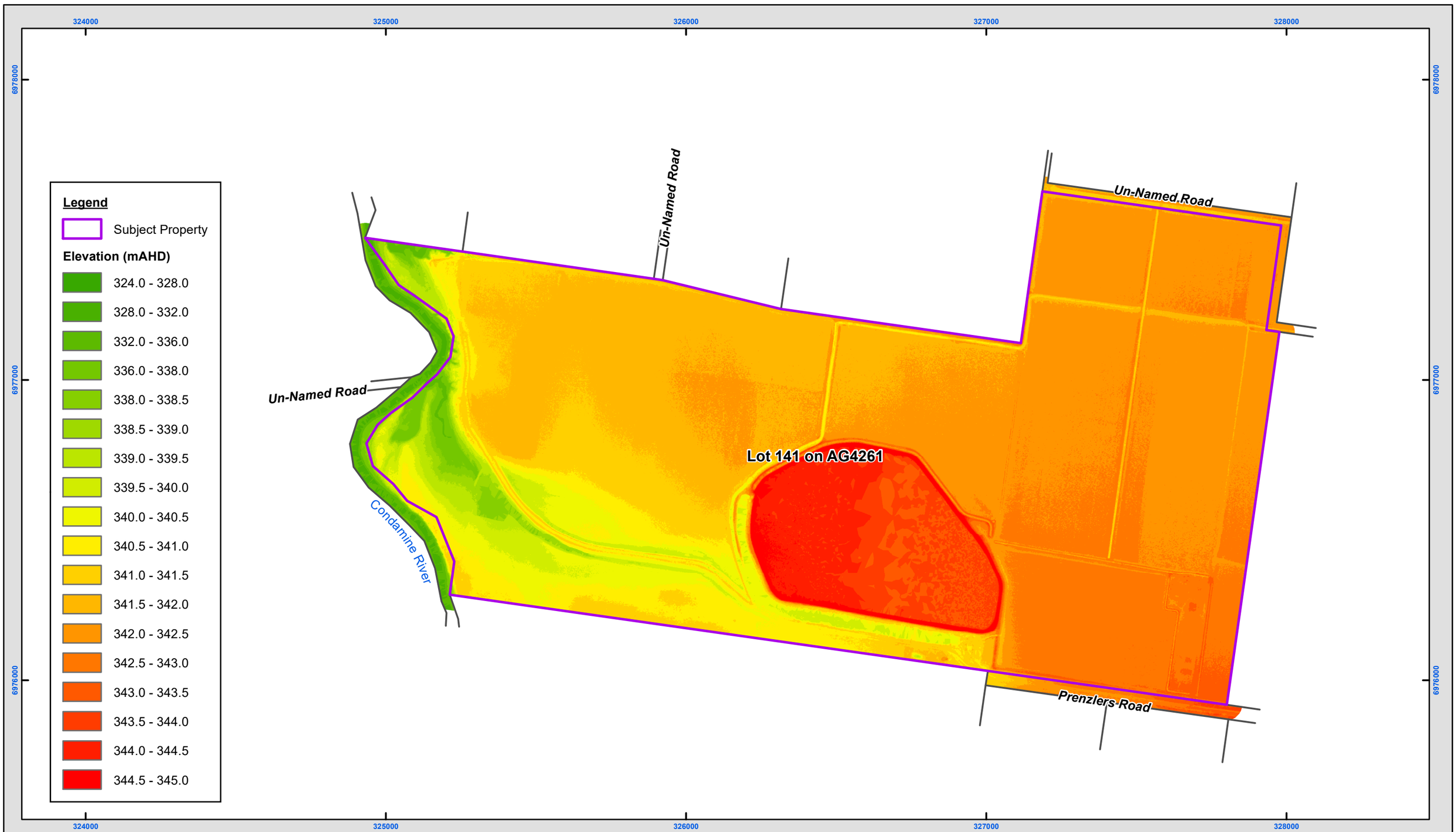
**Table 1: LiDAR Metadata**

| | 2012 LIDAR | 2014 LIDAR | 2020 LIDAR |
|---|---|---|---|
| **Company** | FUGRO | AAM | AAM |
| **Acquisition Start** | 16-Jun-12 | Nov-14 | 15-Oct-20 |
| **Acquisition End** | 29-Jul-12 | 12-Feb-15 | 6-Nov-20 |
| **Spatial Accuracy (Hz)** | 0.29m @ 67% CI | 0.15m @ 68% CI | 0.20m @ 68% CI |
| **Spatial Accuracy (Vt)** | 0.12m @ 67% CI | 0.07m @ 68% CI | 0.05m @ 68% CI |
| **Device Name** | Leica ALS50-2 | Riegl Q1560 | Galaxy Prime 424 |
| **Half Scan Angle** | not reported | 29 degrees | 25 degrees |
| **Laser Pulse Rate** | up to 150 kHz[1] | 400 kHz | 450 kHz |
| **Laser Scan Frequency** | up to 90 Hz[1] | 32 Hz | 40 Hz |
| **Horizontal Datum** | GDA94 | GDA94 | GDA2020 |
| **Map Projection** | MGA Zone 56 | MGA Zone 56 | MGA Zone 56 |
| **Vertical Datum** | AHD | AHD | AHD |
| **Geoid Model** | AusGeoid09 | AusGeoid09 | Ausgeoid2020 |

**Table 2: InSAR Metadata**

| | InSAR |
|---|---|
| **Satellite** | Sentinel Constellation |
| **Satellite Track** | 45 |
| **Satellite Track Geometry** | Descending |
| **Satellite Image Resolution** | 20m in range and 5m in azimuth |
| **Acquisition Start** | 4 August 2015 |
| **Acquisition End** | Ongoing |
| **Acquisitions** | 320 at date of dataset presented (27 June 2021) |
| **Processing** | TreAltamira SqueeSAR |
| **Horizontal Datum** | GDA94 |
| **Map Projection** | MGA Zone 56 |

[1] These values are based on the range of Leica ALS50-2




# Figure 1 : 2012 DEM, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

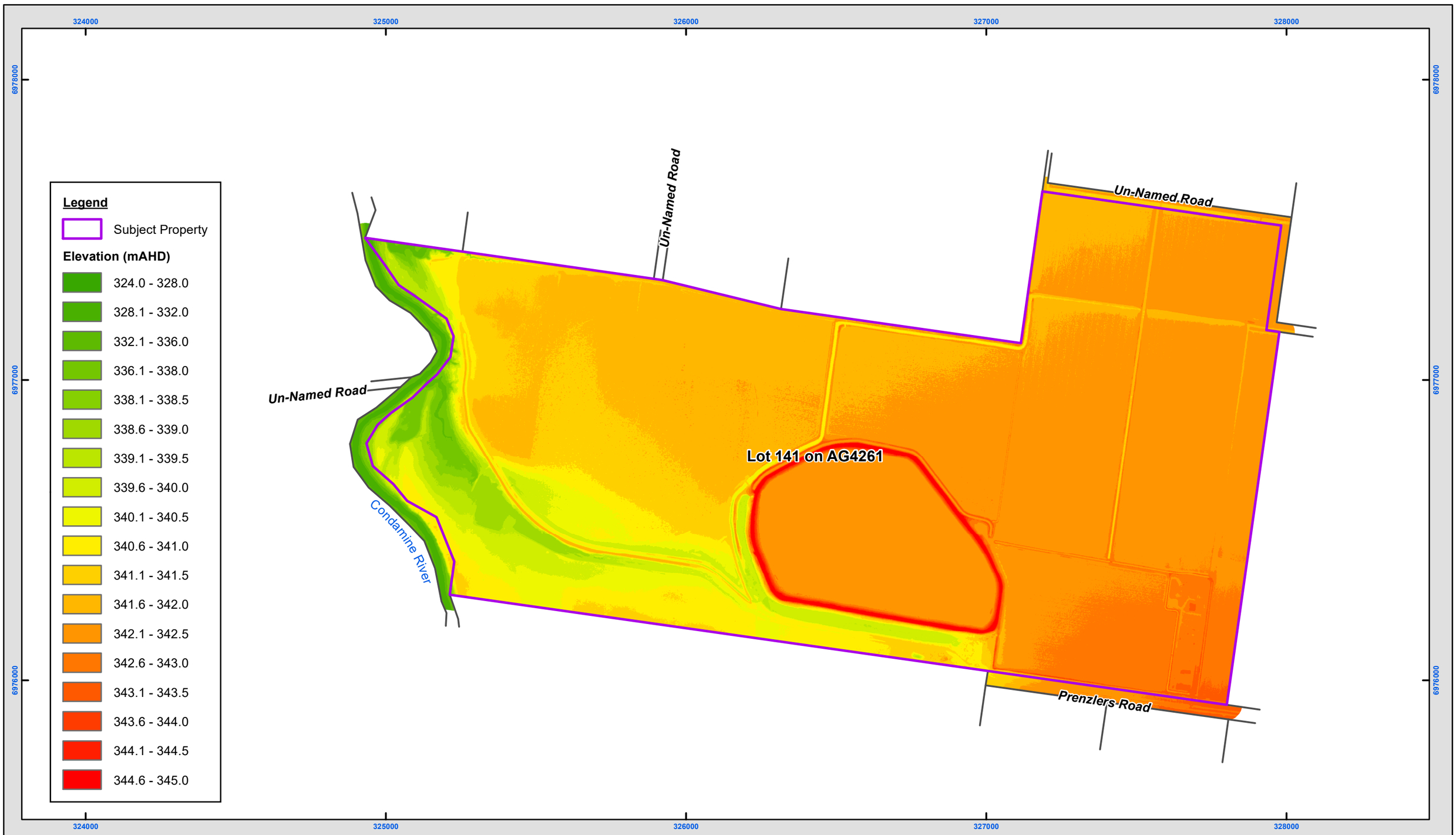
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 2 : 2014 DEM, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

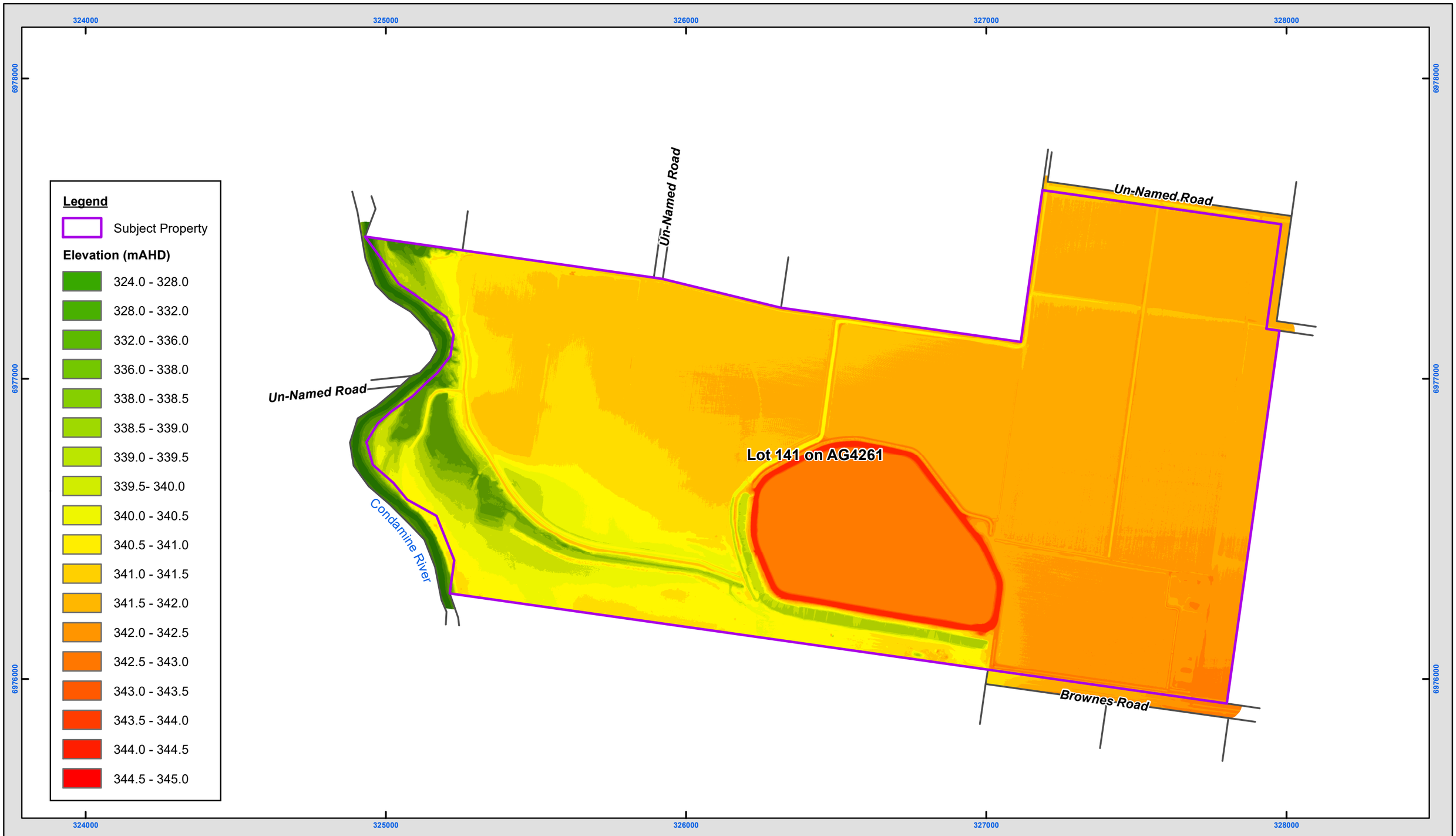
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 3 : 2020 DEM, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

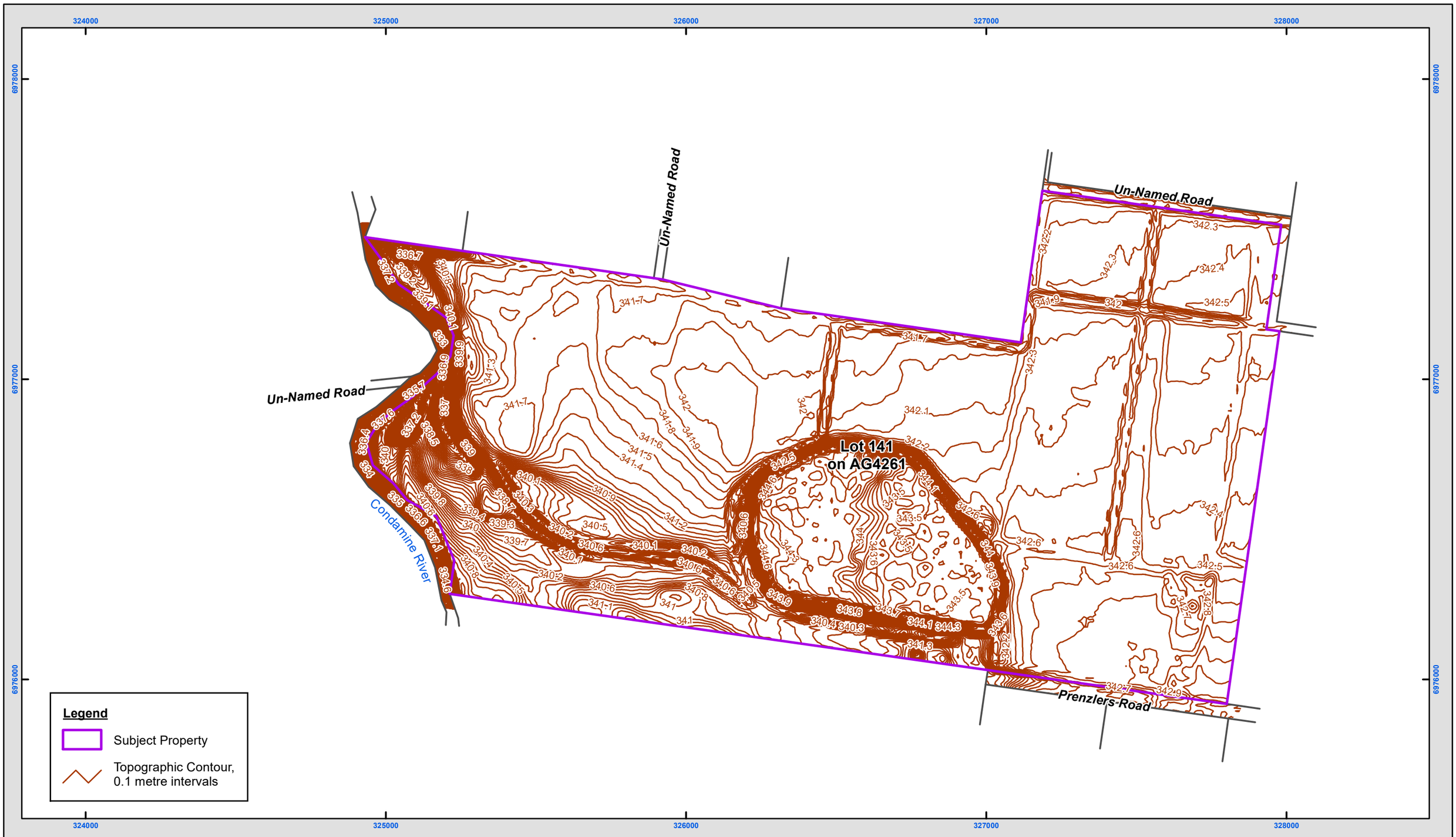
0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



**NOT FOR CONSTRUCTION**




# Figure 4 : 0.1m contours (10m x 10m cells) of the 2012 DEM, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

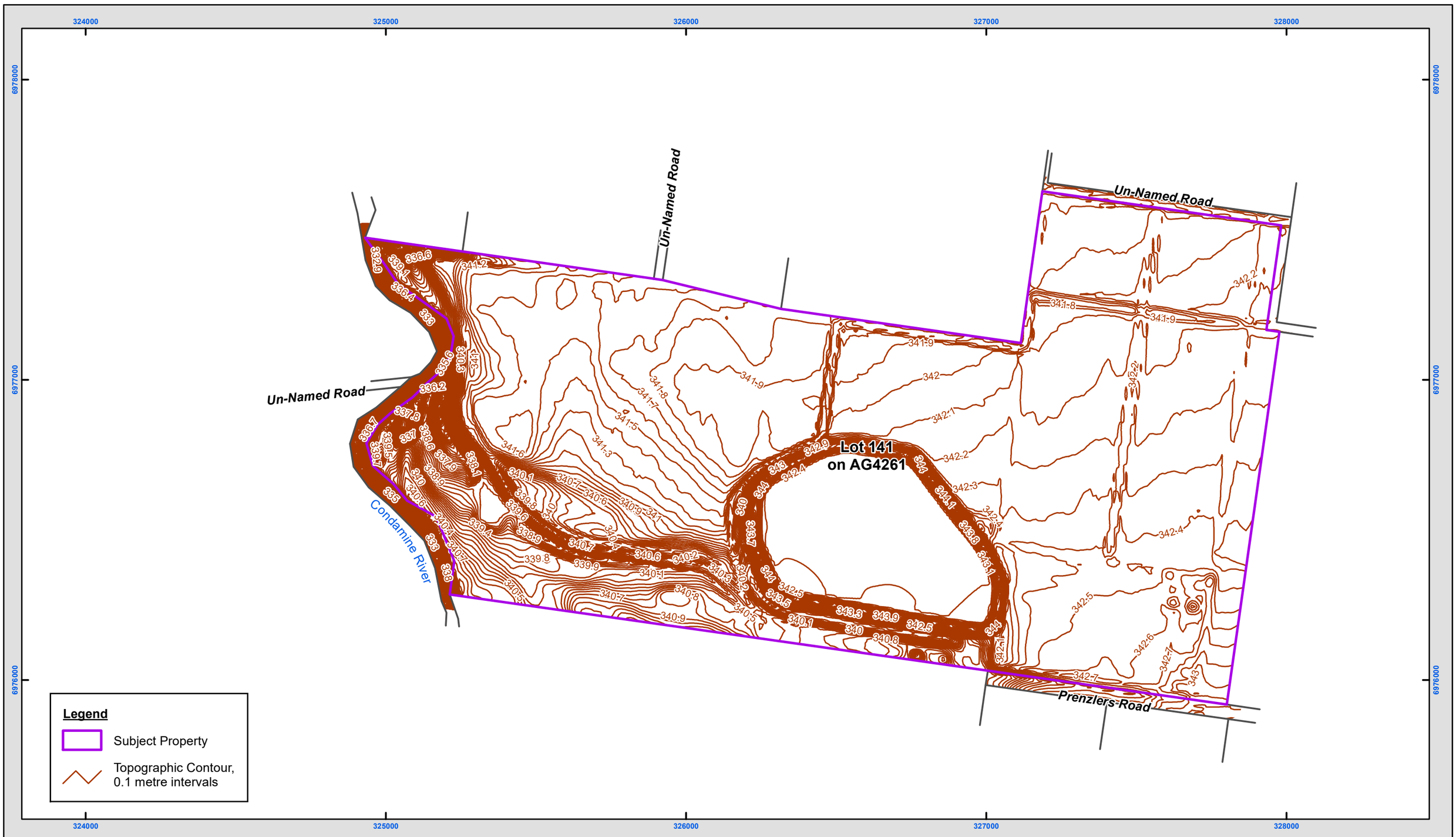
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




# Figure 5 : 0.1m contours (10m x 10m cells) of the 2014 DEM, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

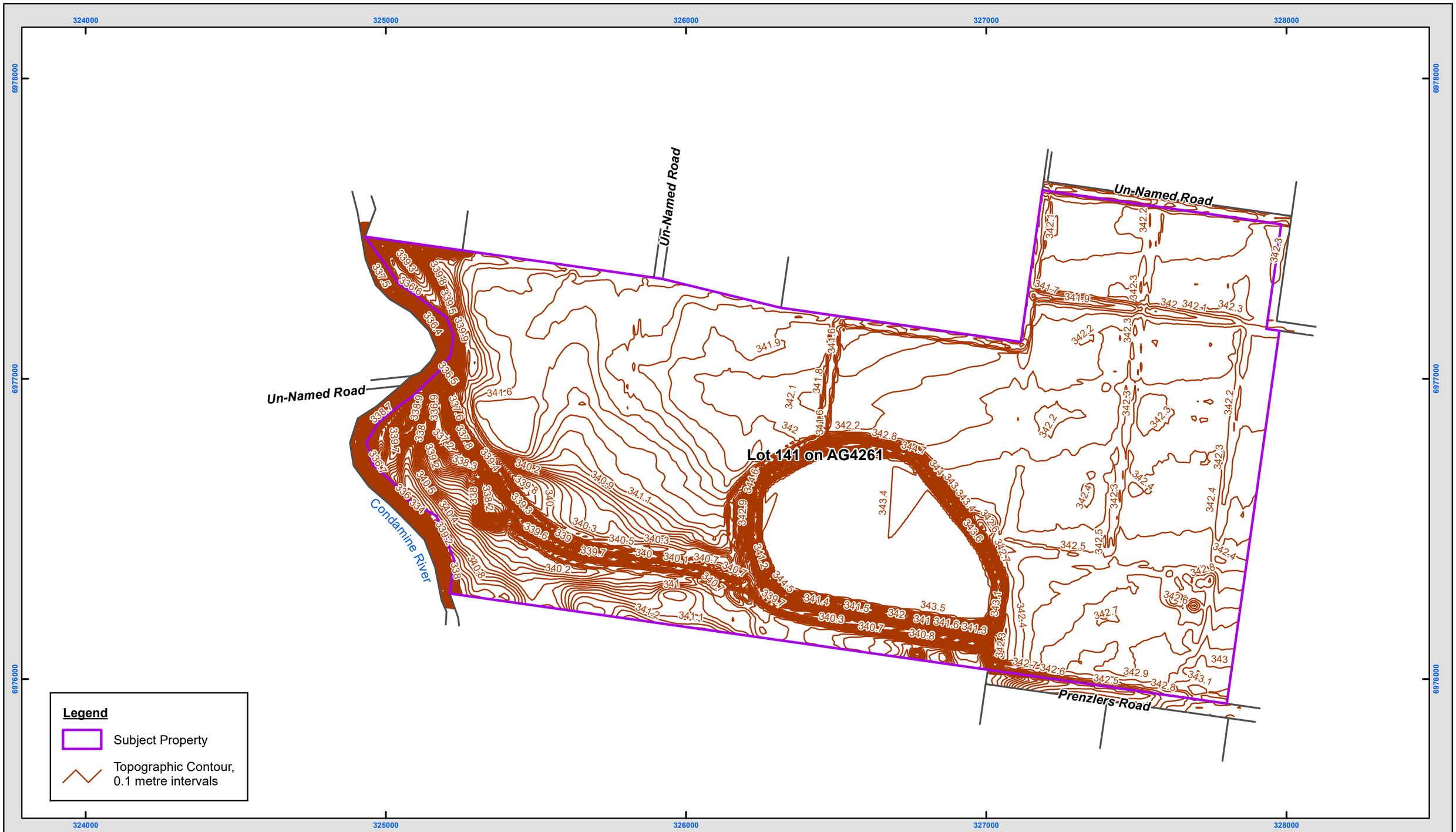



**Figure 6 : 0.1m contours (10m x 10m cells) of the 2020 DEM, Lot on Plan : 141AG4261**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 31/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

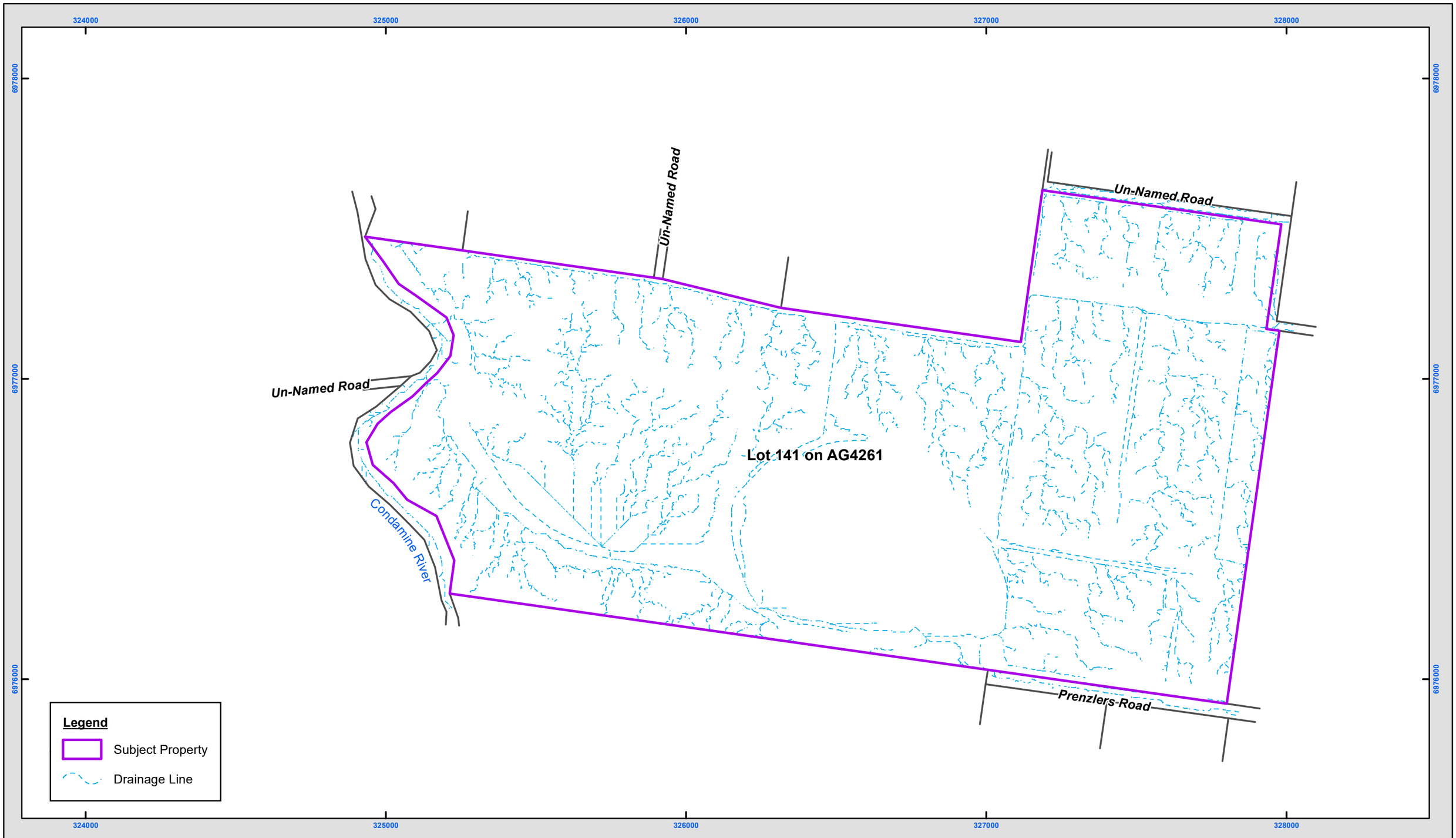
Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 7 : 2012 DEM, Drainage Lines, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

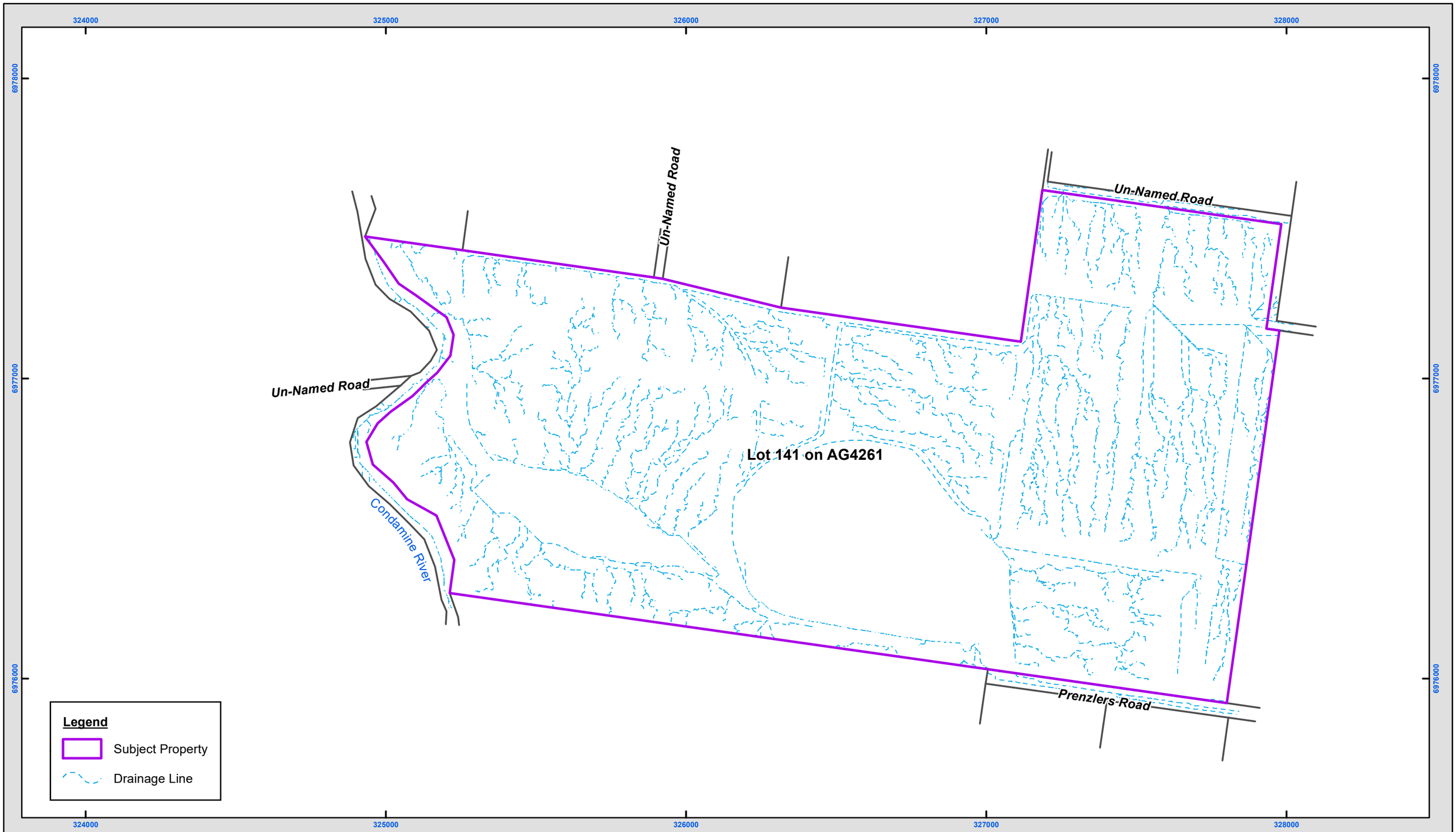
0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56



**NOT FOR CONSTRUCTION**




# Figure 8 : 2014 DEM, Drainage Lines, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

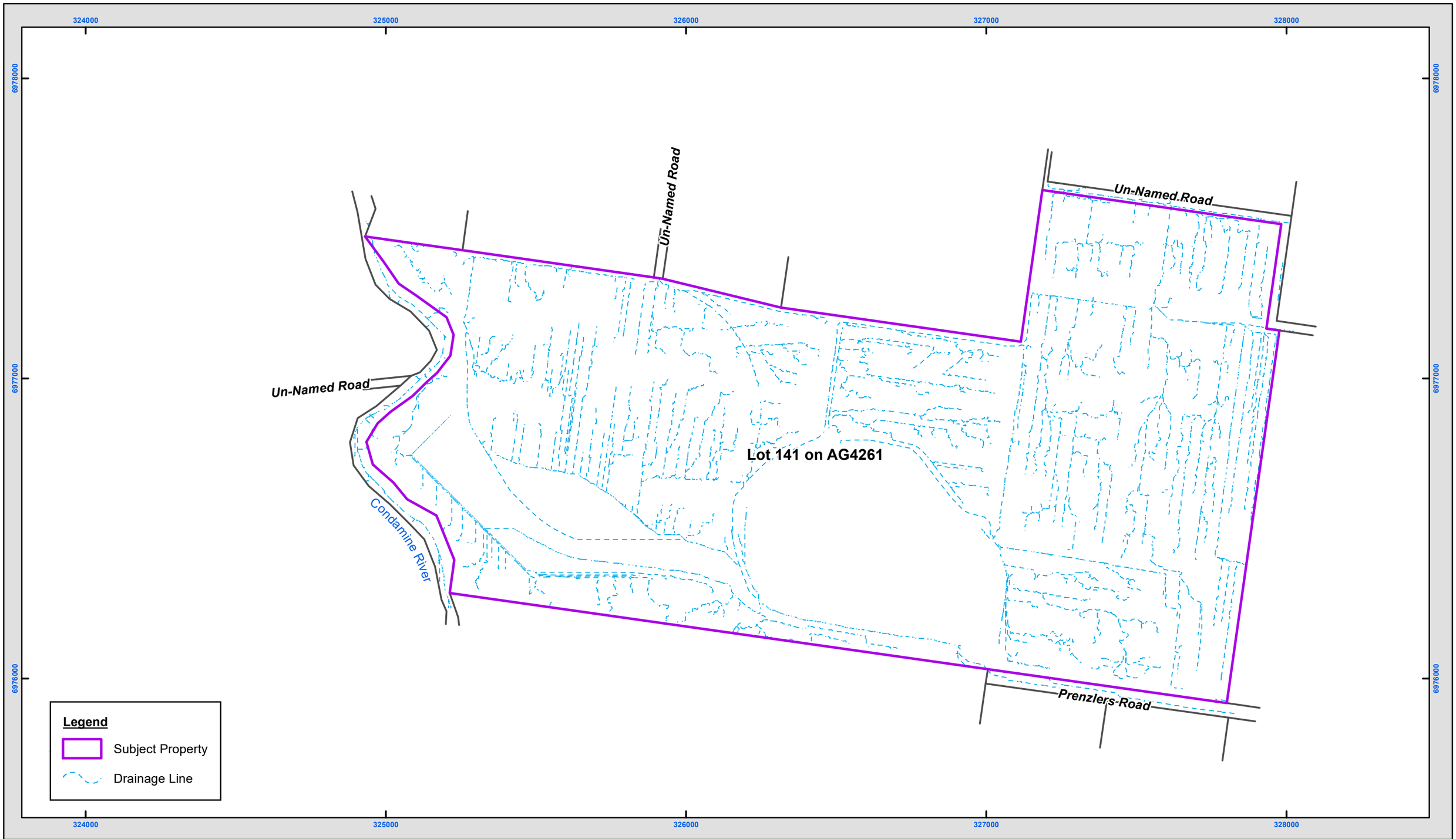
Coordinate System: GDA 1994 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**




## Figure 9 : 2020 DEM, Drainage Lines, Lot on Plan : 141AG4261

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 3/01/2022

Author: Arrow Energy

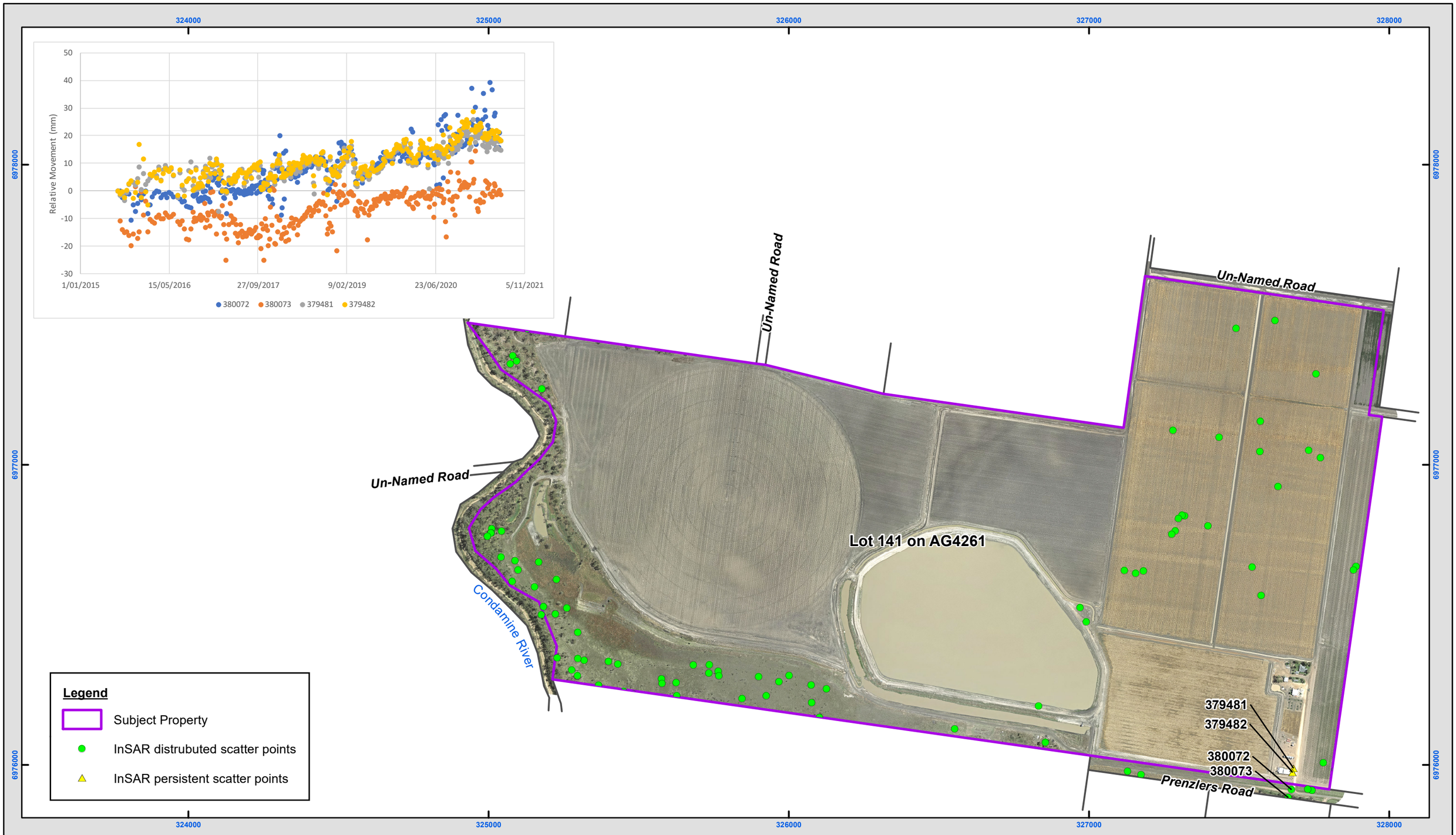
0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



**NOT FOR CONSTRUCTION**




## Figure 10 : InSAR persistent and distributed scatter points on Lot on Plan : 141AG4261, and time series plot

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 31/01/2022

Author: Arrow Energy

0.35 0.175 0 0.35 Kilometres

Scale: 1:12,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

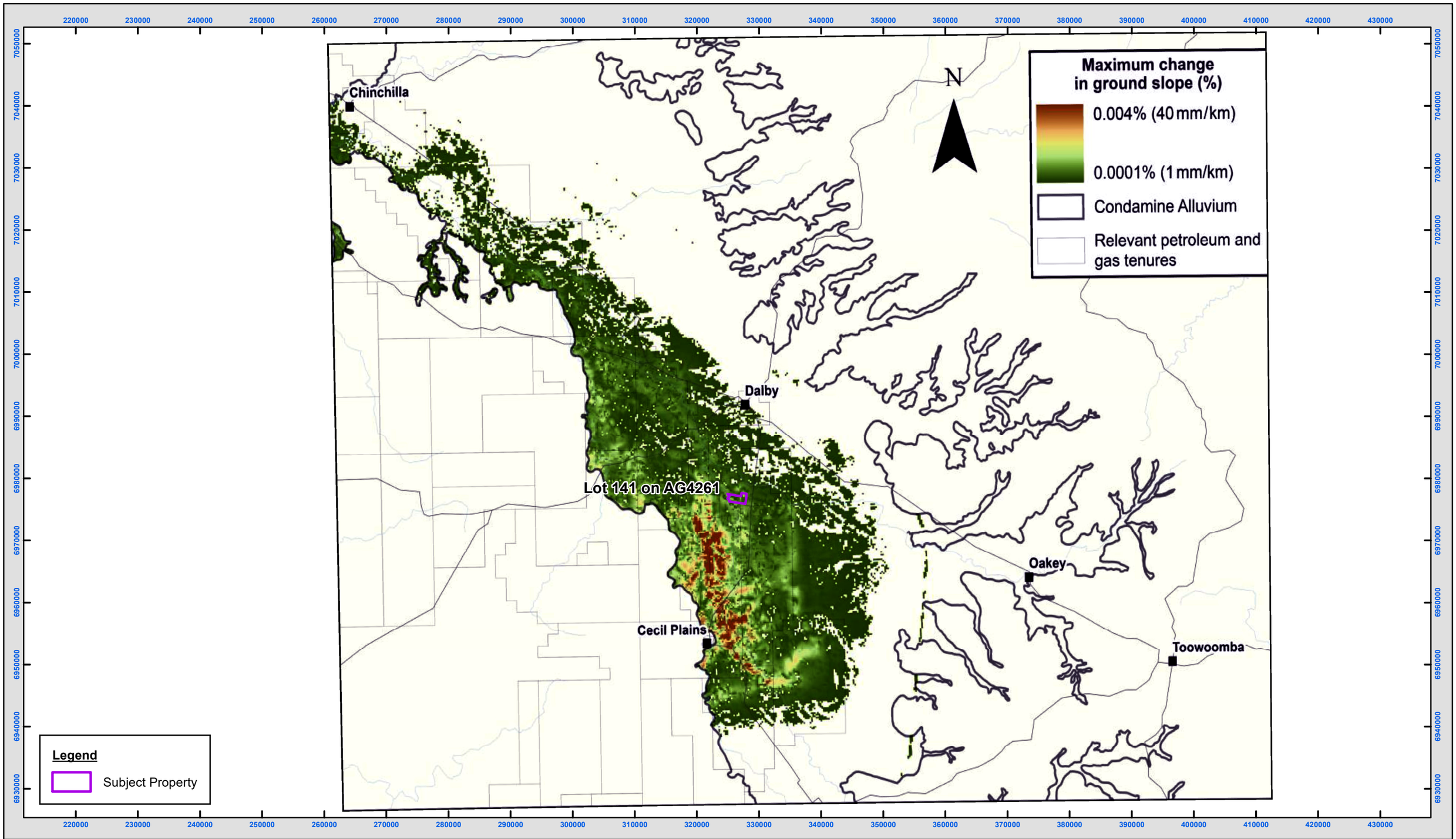



**Figure 11 : OGIA predicted maximum change in ground slope from CSG-induced subsidence (source: draft 2021 UWIR for the Surat CMA, OGIA 2021) and Lot on Plan : 141AG4261.**

**Source:** Arrow Energy Pty Ltd
Geosciences Australia
Dept. Natural Resources and Mines

Date: 8/12/2021

Author: Arrow Energy

10 5 0 10 Kilometres

Scale: 1:580,000 @ A3

Coordinate System: GDA2020 MGA Zone 56



The dimensions, areas, number of lots, size & location of corridor information are approximate only and may vary.



**NOT FOR CONSTRUCTION**

# Appendix 7: Arrow CSG Water Management Plan

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**Appendix 10 - CSG Water Management Plan**

# Surat Gas Project

## CSG Water Management Plan



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**Contents**

## Tables



## Figures

# 1. Introduction

## 1.1 Location and Project Description

This Coal Seam Gas Water Management Plan (CWMP) is for Arrow Energy Pty Ltd.'s (Arrow) Surat Gas Project (SGP). The project development area is located approximately 160 km west of Brisbane in Queensland's Surat Basin and extends from the township of Wandoan in the north towards Millmerran in the south, in an arc through Dalby (Figure 1-1). The towns of Wandoan, Chinchilla, Kogan, Dalby, Cecil Plains, Millmerran, and Miles are located in or adjacent to the project development area.

The SGP will be a phased development over the approximate 40 year life of the project. Within the Surat Basin Arrow operates existing domestic gas facilities referred to as the Dalby Expansion Project (DXP). The SGP will utilise existing DXP water assets (e.g. dams and water treatment plants), and will also provide water to existing QGC operated assets. Over the life of the project, new assets will be developed by drilling wells and constructing associated infrastructure to transport both gas and water.

The project development area comprises Petroleum leases (PLs) 194, 198, 230, 238, 252, 258, 260, 185, 253, 304, 305, 491, 492, 493, 494, 1039, 1040, 1041, 1042, 1043, 1044 and ATP 676.

## 1.2 Purpose

The purpose of this CWMP is to:

- Address the requirements of section 126 of the EP Act as required for a site specific EA application (in this instance a site specific amendment application) ;[1]
- Address Arrow's commitment under the Surat Gas Project Environmental Impact Statement (EIS) to produce a CWMP; and
- Describe how SGP's CSG water will be managed in a way that protects and maintains environmental values whilst balancing social and economic considerations.

This CWMP has been prepared in accordance with the following Queensland Government regulatory guidance documents:

- The *Environmental Protection Act 1994* (Qld) (EP Act) – specifically Section 126 (1) and 126 (2); and
- The Department of Environment and Heritage Protection *Coal Seam Gas Water Management Policy*[2] – specifically its prioritisation hierarchy for managing and using CSG water and for managing saline waste.

**Figure 1-1 Surat Gas Project Development Area**

[1] Section 126 requirements for each project EA are provided as part of each site specific EA application.

[2] Queensland Department of Environment and Heritage Protection (2012*), Coal Seam Gas Water Management Policy*.

# Plan

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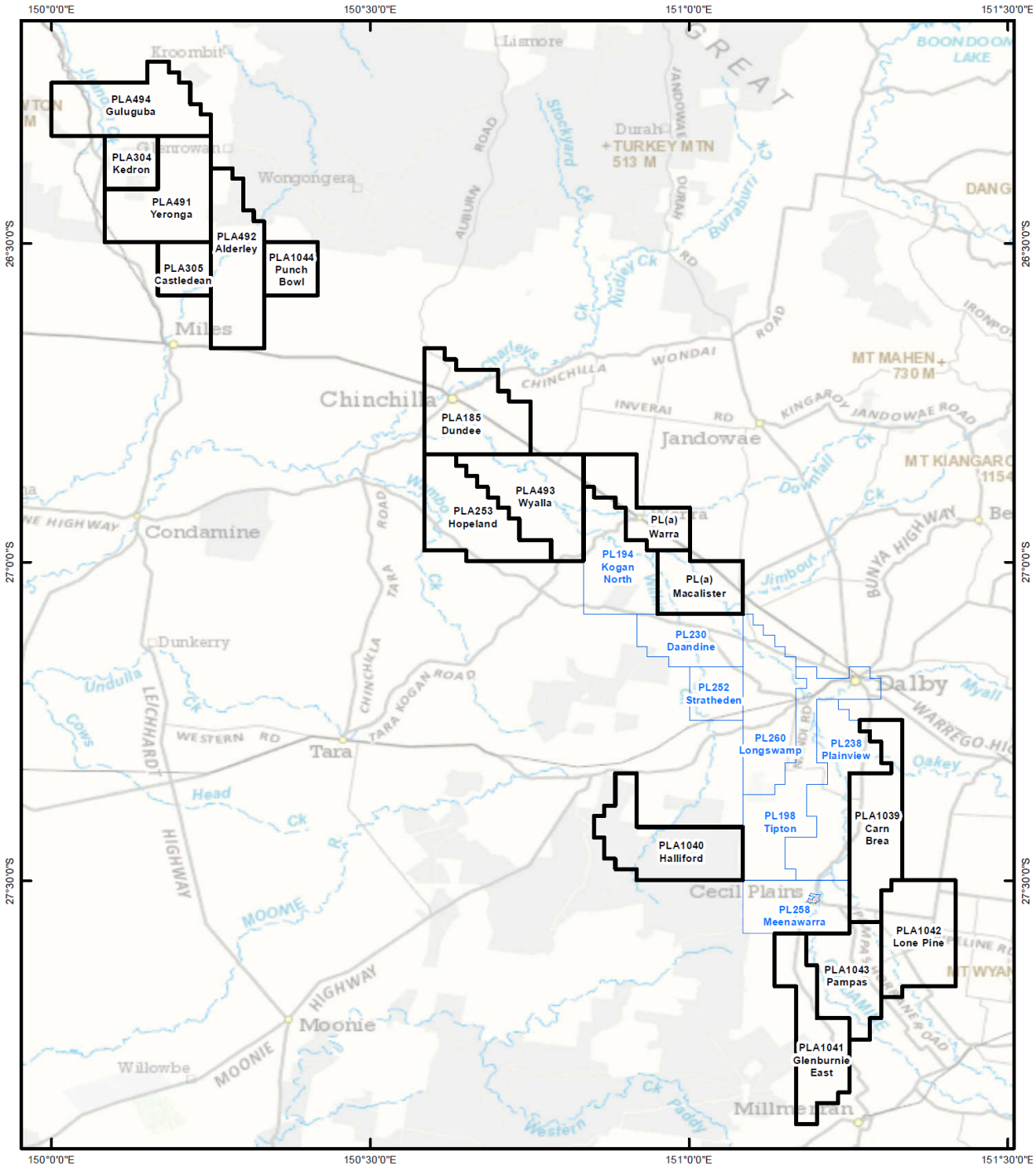




N

**Coordinate System:** GCS GDA 1994

0 5 10 20
km

Surat Gas Project Tenures

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Date: 9/04/2018



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## 1.3 Scope

The scope of this CWMP includes:

- Characterisation of CSG water and the existing environment;
- Description of current and proposed CSG water management including the use, treatment, storage and beneficial use of water; and
- Description of procedures, controls and monitoring programs that minimise risk of CSG water management causing environmental harm.

The strategies for managing CSG water described in this CWMP align with Arrow Energy's broader vision for CSG water management in the Surat basin, as outlined in its Surat Gas Project CSG Water Management Strategy[3].

## 1.4 Conformance Table

Table 1-1 lists specific CWMP regulatory requirements specified under Section 126 of the EP Act, and identifies the relevant sections of the CWMP which address each specific requirement.

**Table 1-1 EP Act Conformance Table**

| Requirement Under Section 126 of the EP Act | Relevant Section of CWMP |
|---|---|
| The quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant activity. | Section 3.1 |
| The flow rate at which the applicant reasonable expects CSG water will be generated. | Section 3.1 |
| The quality of the water, including changes in the water quality that the applicant reasonably expects will happen while each relevant activity is carried out. | Section 3.2 |
| The proposed management of CSG water including use, treatment, storage or disposal. | Section 4 and 5 |
| The measurable criteria (the management criteria) against which the applicant will monitor and assess the effectiveness of water management including:<br>• The quantity and quality of the water used, treated, stored or disposed of;<br>• Protection of environmental values affected by each relevant activity; and the disposal of waste, including, for example, salt. | Section 6 |
| The action proposed to be taken if any of the management criteria are not complied with, to ensure the criteria will be able to be satisfied in the future. | Section 6 |

[3] Arrow Energy (2017), *Surat Gas Project CSG Water Management Strategy*, Rev: 0, Doc No: ORG-ARW-ENV-STR-00001.

## 1.5 Project Approvals

Table 1-2 lists the status of Arrow Energy's CSG water management approvals applicable to the scope of this CWMP.

**Table 1-2 Arrow Energy's CSG Water Management Approvals in the Surat Basin**

| Responsible Department | Area of Regulation | Requirement of Regulation | Status |
|---|---|---|---|
| Department of Environment and Science | CSG activities including CSG water management | Environmental Authorities (EAs) | Approved - Dalby Expansion Project EA (EPPG00972513) for PLs194, 198, 230, 238, 252, 258 and 260. |
| | | | Approved - EA North for PLs 304, 305, 491, 492, 494, and 1044. |
| | | | Approved - EA South PLs 185, 253, 493, 1039, 1040, 1041, 1042, and 1043. |
| | | | Approved - EA Kogan – for PLs 1052 and 1053 |
| | | | Approved - EA Hopeland for PL 253. |
| | | | Approved – EA Kenya Pipelines and Brine Dams PPL 2034 |
| | | CWMP | Finalised May 2018 to support EA applications and updated June 2020 to support the Hopeland EA amendment application |

## 1.6 DES CSG Water Management Policy

The *CSG Water Management Policy* (DEHP, 2012) outlines the Queensland Government's position on the management of CSG water and guides CSG operators to consider the feasibility of using such water to meet the obligations of the EP Act as part of developing their CSG water management strategies and plans.

The policy aims to encourage the beneficial use of CSG water in a way that protects the environment and that maximises its productive use as a valuable resource. To achieve this, the policy outlines prioritisation hierarchies for managing and using CSG water, and for managing saline waste.

The policy focuses on the management and use of CSG water under the EP Act, and does not change obligations the *Water Act 2000* (Water Act), including 'making good' any relevant impacts that may result from a CSG operation on water bores. Such measures executed under the Water Act may require the provision of water to mitigate impacts.

Arrow has adopted the DES prioritisation hierarchy as its starting point for determining the options for management of CSG water and brine. DES's prioritisation hierarchies for

CSG water and brine are presented in Figure 1-2. In accordance with the Policy, Arrow evaluates potential management options for water and brine against the prioritisation hierarchy, and implements Priority 1 options wherever feasible. Where Priority 1 options are not feasible, Priority 2 options are implemented. In determining the feasibility of options, factors that may be considered include technical and economic aspects in assessing identified options.

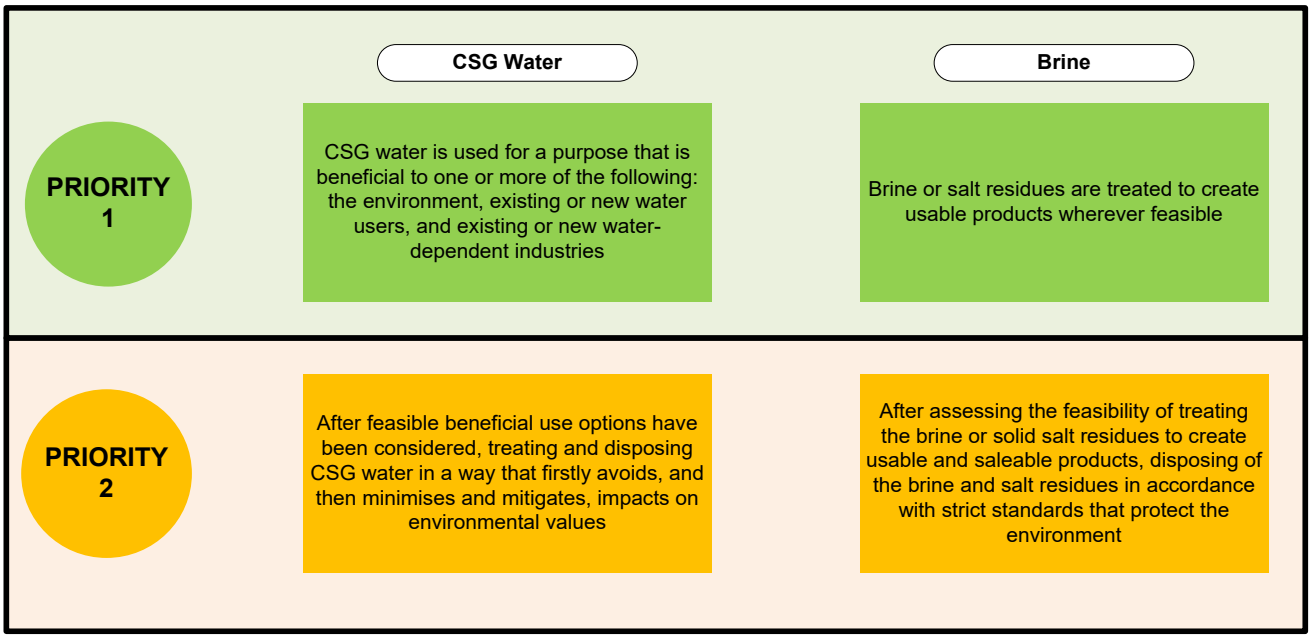



**Figure 1-2 DES Prioritisation Hierarchies for CSG Water and Brine Management**

# 2. Existing Environment

## 2.1 Climate

The Darling Downs has a warm climate typical of subtropical regions with mean temperatures in the project development area ranging from a mean monthly minimum of 3.6 in winter months (June to August) to a mean monthly maximum of 35°C in summer months (December to February).

The majority of rain falls between November and February. The average annual rainfall varies across the region and ranges from an average of 20 to 40 mm a month in winter, to 70 to 100 mm a month in summer. Around 20 thunderstorm days per year occur in the region, often involving strong winds, heavy rainfall and flooding.

## 2.2 Surface Water

The regional surface water environment is represented by four drainage basins, all of which intersect the SGP development area: Condamine-Culgoa Basin (Condamine River and Balonne River), Fitzroy Basin (Dawson River), Border Rivers Basin (Weir and Macintyre rivers and Macintyre Brook), and Moonie Basin (Moonie River). The Condamine-Culgoa, Border Rivers, and Moonie basins form part of the Murray-Darling drainage division, while the Fitzroy Basin is part of the North-East Coast drainage division.

Basins can be divided into sub-basins, with six sub-basins in the project development area: Balonne River, Condamine River, Macintyre Brook, Macintyre and Weir rivers, Moonie River and Dawson River. The Condamine is the predominant sub-basin within the project development area, accounting for over 50% of the total area.

The location or origin of each drainage basin is as follows:

- The Condamine-Culgoa Basin forms the northern headwaters of the Murray-Darling river system;
- The Border Rivers Basin, comprising the Weir and Macintyre rivers, lies mostly within Queensland. Macintyre Brook is a major tributary of the Macintyre River, which eventually joins the Weir River near Talwood, Queensland;
- The Moonie Basin contains the Moonie River, a tributary of the Barwon River forming part of the Murray-Darling Basin; and
- The Fitzroy Basin is located in central eastern Queensland and contains the Dawson River sub-basin. The Fitzroy River is formed by the confluence of the Dawson and MacKenzie rivers and then flows into the Coral Sea north of Rockhampton.

The project area is characterised by an extensive network of watercourses that are largely ephemeral, with varying geomorphic stream types that provide geomorphic diversity and contribute to habitat diversity. Rivers and creeks are generally intermittent, with surface waters in many streams receding to disconnected pools and dry beds during the dry season.

Potential water uses within catchments that include the SGP are:

- Agricultural (crop production and stock watering)
- Pastoral;
- Urban;
- Power generation;
- Mining; and
- Recreation.

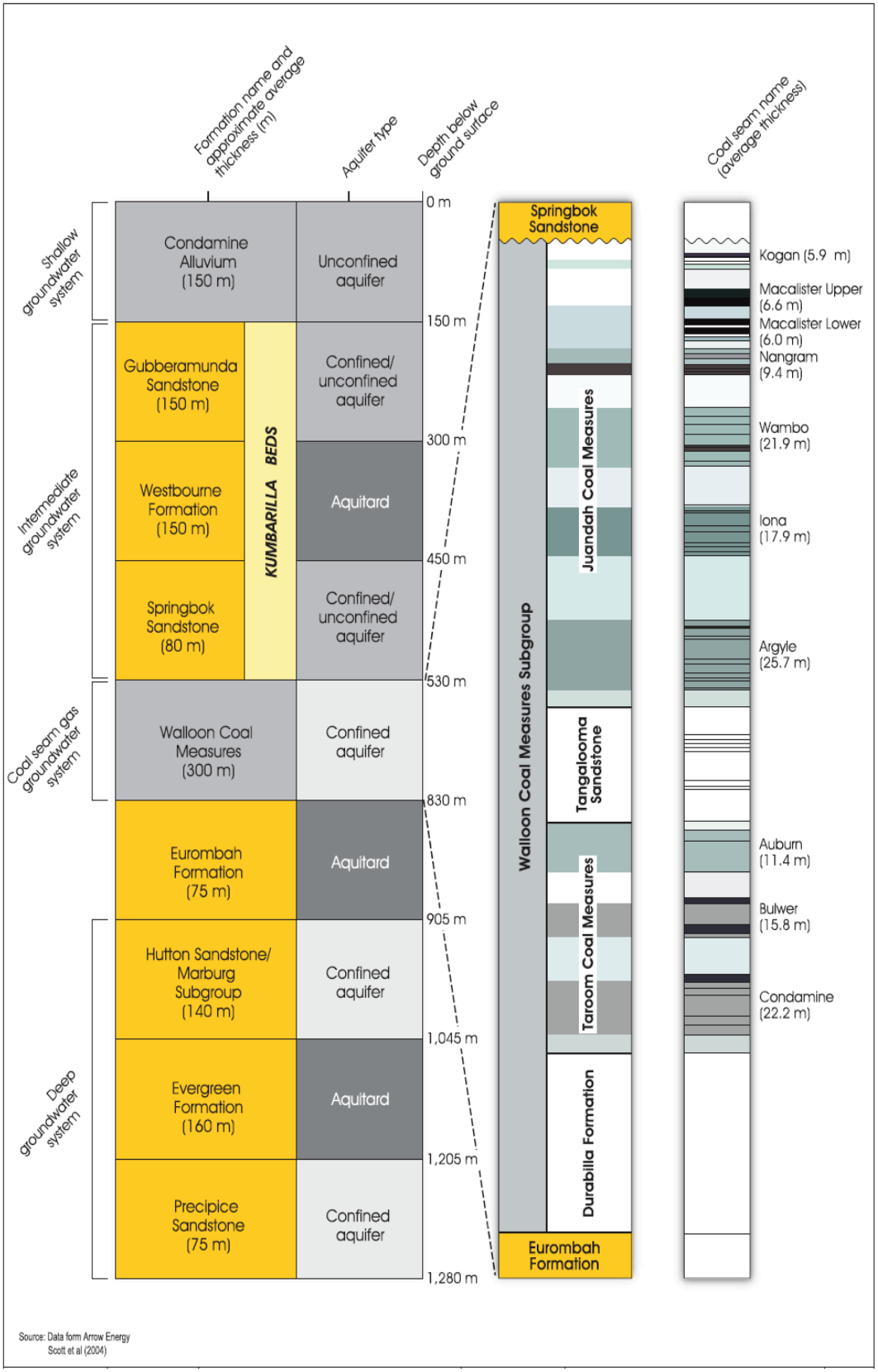
## 2.3 Groundwater

The geology of the Surat Basin is presented in Figure 2-1, and reflects approximately 200 million years of sedimentation producing a sedimentary sequence with up to a 2,500 m maximum depth. Geology underlying the project area consists of a sequence of interbedded aquifers and aquitards and is situated on the eastern section of the Great Artesian Basin (GAB) and the western margin of the Clarence-Moreton Basin.

The following groundwater systems have been identified in the vicinity of the project area (listed in order of increasing depth):

- Shallow groundwater system – Condamine Alluvium;
- Intermediate groundwater system – Gubberamunda Sandstone, Westbourne Formation and Springbok Sandstone;
- Coal seam gas groundwater system – Walloon Coal Measures; and
- Deep groundwater system – Hutton Sandstone, Evergreen Formation and Precipice Sandstone.

**Figure 2-1 SGP Groundwater Geology**



## 2.4 Terrain, Geology and Soils

### 2.4.1 Terrain

Topography of the SGP area is characterised by gently undulating land formed by fluvial deposition and erosion processes. Rock outcrops are present where resistance to erosion and channel scour has occurred. The underlying geology and geomorphic conditions have influenced the landscape and the area is characterised by the Great Dividing Range highlands, the Kumbarilla Ridge uplands and four drainage basins, the Condamine-Culgoa, Fitzroy, Border Rivers and Moonie.

### 2.4.2 Geology

Gas reserves within the SGP project area are primarily contained within the Walloon Coal Measures. The Walloon Coal Measures were formed during the Middle Jurassic period and are characterised by carbonaceous mudstone, siltstone, minor sandstone and coal. The geology of the Walloon Coal Measures is presented above in Figure 2-1 and comprises the following formations:

- Juandah Formation;
- Tangalooma Sandstone;
- Taroom Coal Measures; and
- Euromah Formation.

Only the Juandah Formation and Taroom Coal Measures are targeted for CSG production for the SGP.

### 2.4.3 Soils

Soil types across the SGP area have been classified under the Australian Soil Classification System and divided into seven broad types:

- Gilgai Clays - Occurring on flat to gently undulating terrain.
- Cracking Clays - Widespread across the Project area.
- Uniform Non-cracking Clays - Occurring on gently undulating plains and rises, and upper slopes of hills.
- Texture Contrast Soils - Sharp textural contrast between surface and subsoil horizons of low agricultural value.
- Uniform Loams and Clays - Loams found along upper slopes whereas clay occur on lower slopes.
- Sands and Sandy Loams - Consists of alluvial and residual sands found on plains.
- Skeletal, Rocky or Gravelly Soils - Occur adjacent to rocky outcrops.

### 2.4.4 Land Use

The SGP is located within the Darling Downs, which is an important agricultural area. The land use in the area is strongly related to the different soil types and topography. Soils within the project development area are dominated by heavy clays, which form rich agricultural soil around the Condamine River. These soils are characterised by self-mulching, cracking clays with a deep profile. At higher elevations, shallow, gravelly soils are present.

Soil erosion is evident in areas where brigalow woodland has been extensively cleared. Agricultural land use within the project development area ranges from concentrated agriculture on the Condamine River floodplain, where many paddocks have been laser-levelled to achieve effective flood irrigation, through to cattle grazing in more marginal areas located to the north and west. Limited agricultural activity exists in areas of higher elevation and within state forests.

Current agricultural activities in the greater Darling Downs region include:

- Dryland broadacre farming;
- Irrigated broadacre farming;
- Horticulture;
- Fruit;
- Vineyards;
- Livestock industries; and
- Timber production.

# 3. CSG Water Characteristics

This section presents forecast CSG water production data and expected water quality.

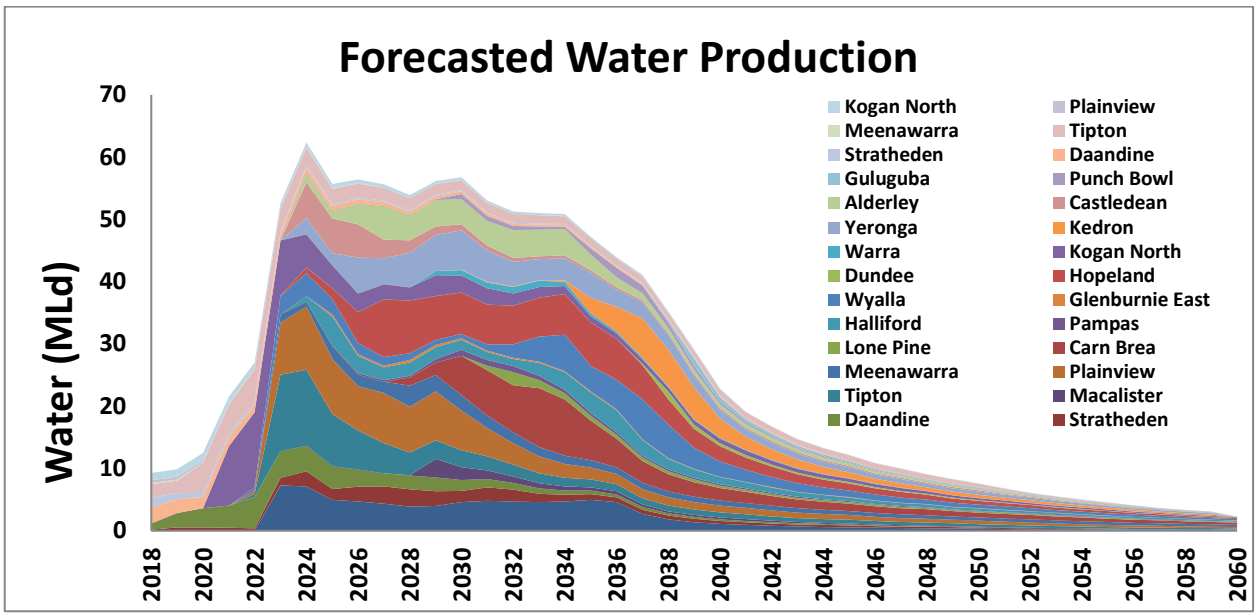
## 3.1 CSG Water Quantity

CSG is the name given to naturally occurring gas trapped in underground coal seams by water and ground pressure. The gas lines the open fractures between the coal (called cleats) and the inside of the pores within the coal (the matrix). Coal seams store both gas and water. When the water pressure is reduced, the gas is released. In the production process, the water pressure is reduced when a well is drilled into a coal seam and the water is gradually pumped out of the seam. This allows the gas to flow to the surface via the well. CSG water production volumes and qualities vary considerably with location, well-spacing and coal seam depth. Water production forecasts fluctuate over time as a product of progressively commissioning and decommissioning wells to meet Gas Sale Agreements. For these reasons, forecasts for the timing, volumes and quality of CSG water production are updated on a monthly basis. Production forecasting involves the following steps:

1. Developing key assumptions such as expansion areas, gas sales targets and gas usage for production activities;
2. Simulating the required production rates using a reservoir engineering model;
3. Developing and maintaining well program based on forecast timing; and
4. Reviewing model performance against actual production data and history matching.

Figure 3-1 presents the CSG water production forecast for the SGP. The forecast indicates that approximately 400 GL of water will be produced over the life of the project. Water production starting in 2018 was the continuation of production in the existing DXP EA development areas, with production from new areas commencing in 2021. Water production peaks at a flow rate of approximately 62 ML/day achieved in 2024. Water production will diminish from the peak until project completion in approximately 2060.

Figure 3-1 SGP Forecasted Water Production




## 3.2 CSG Water Quality Characteristics

### 3.2.1 CSG Water at the Well

The SGP targets the Walloon Coal Measures. CSG water quality in these formations varies from slightly brackish to brackish. The water typically has the following characteristics:

- pH of approximately 8 to 9;
- Salinity in the range of 5,000 to 13,000 µS/cm (i.e. brackish);
- Suspended solids that will usually settle out over time;
- Trace metals and low levels of nutrients.

Table 3-1 presents a summary of expected water quality for wells across the SGP development area.

Table 3-1 SGP Expected Water Quality[4]

| Parameter | LOR | Units | 10% | Median | 90% |
|---|---|---|---|---|---|
| **Alkalinity** | | | | | |
| Bicarbonate Alkalinity as CaCO3 | 1 | mg/L | 389.8 | 815.5 | 1387.0 |
| Carbonate Alkalinity as CaCO3 | 1 | mg/L | < 1 | 27.5 | 119.7 |
| Hydroxide Alkalinity as CaCO3 | 1 | mg/L | < 1 | < 1 | < 1 |
| Total Alkalinity as CaCO3 | 1 | mg/L | 392.6 | 872 | 1440.0 |
| **Major Anions** | | | | | |
| Bromide | 0.02 | mg/L | 3.6 | 4.99 | 10.6 |
| Chloride | 1 | mg/L | 1040.0 | 1705 | 4231.0 |
| Fluoride | 0.1 | mg/L | 1.0 | 1.8 | 2.6 |
| Silicon | 0.05 | mg/L | 7.5 | 8.2 | 9.5 |
| Sulfate as SO4 2- | 1 | mg/L | < 1 | < 1 | 2.0 |
| Sulfide as S2- | 0.1 | mg/L | < 0.1 | < 0.1 | < 0.1 |
| **Major Cations** | | | | | |
| Calcium | 1 | mg/L | 4.0 | 9 | 39.7 |
| Magnesium | 1 | mg/L | 2.0 | 3 | 13.0 |
| Potassium | 1 | mg/L | 5.0 | 7 | 13.0 |
| Sodium | 1 | mg/L | 1233.0 | 1630 | 2720.0 |
| **Major Ions** | | | | | |
| Ionic Balance | 0.01 | meq/L | 21.5 | 106.72 | 191.9 |
| Total Anions | 0.01 | meq/L | 85.9 | 171.1 | 256.3 |
| Total Cations | 0.01 | meq/L | 86.2 | 171.4 | 256.6 |
| **Metals (Dissolved)** | | | | | |
| Aluminium | 5 | µg/L | < 5 | < 5 | 12.8 |
| Arsenic | 0.2 | µg/L | < 0.2 | < 0.2 | 0.6 |
| Barium | 0.5 | µg/L | 603.4 | 1100 | 4212.0 |
| Beryllium | 0.1 | µg/L | < 0.1 | < 0.1 | < 0.1 |
| Boron | 5 | µg/L | 235.6 | 340 | 590.0 |
| Cadmium | 0.05 | µg/L | < 0.05 | < 0.05 | 0.1 |
| Chromium | 0.2 | µg/L | < 0.2 | < 0.2 | 2.4 |
| Cobalt | 0.1 | µg/L | < 0.1 | < 0.1 | < 0.1 |
| Copper | 0.5 | µg/L | < 0.5 | < 0.5 | 2.0 |
| Ferric Iron | 0.05 | mg/L | < 0.05 | < 0.05 | 0.2 |
| Ferrous Iron | 0.05 | mg/L | < 0.05 | < 0.05 | 0.5 |
| Hexavalent Chromium | 0.01 | mg/L | < 0.01 | < 0.01 | < 0.01 |
| Lead | 0.1 | µg/L | < 0.1 | < 0.1 | < 0.1 |
| Manganese | 0.5 | µg/L | 2.0 | 9 | 45.0 |
| Mercury | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 |
| Molybdenum | 0.1 | µg/L | < 0.1 | < 0.1 | 2.0 |

[4]The information presented in this table is aggregated data from production sampling at Arrow's Dalby Expansion Project and exploration sampling across ATP tenures proposed for conversion to PLs as part of the SGP. A < value indicates observations below the limit of reporting.

| | | | | | |
|---|---|---|---|---|---|
| Nickel | 0.5 | µg/L | < 0.5 | < 0.5 | 1.0 |
| Selenium | 0.2 | µg/L | < 0.2 | < 0.2 | 0.2 |
| Strontium | 1 | µg/L | 1036.0 | 1920 | 9234.0 |
| Trivalent Chromium | 0.01 | mg/L | < 0.01 | < 0.01 | < 0.01 |
| Vanadium | 0.2 | µg/L | < 0.2 | < 0.2 | 10.0 |
| Zinc | 1 | µg/L | < 1 | < 1 | 16.0 |
| **Metals (Total)** | | | | | |
| Aluminium | 5 | µg/L | 20.0 | 640 | 4244.0 |
| Arsenic | 0.2 | µg/L | < 0.2 | < 0.2 | 2.0 |
| Barium | 0.5 | µg/L | 717.2 | 1250 | 4510.0 |
| Beryllium | 0.1 | µg/L | < 0.1 | < 0.1 | < 0.1 |
| Boron | 5 | µg/L | 250.0 | 360 | 580.0 |
| Cadmium | 0.05 | µg/L | < 0.05 | < 0.05 | 0.2 |
| Chromium | 0.2 | µg/L | < 0.2 | 2 | 9.4 |
| Cobalt | 0.1 | µg/L | < 0.1 | < 0.1 | 3.0 |
| Copper | 0.5 | µg/L | 0.5 | 3 | 18.0 |
| Lead | 0.1 | µg/L | < 0.1 | 1.4 | 8.0 |
| Manganese | 0.5 | µg/L | 8.0 | 31 | 118.4 |
| Mercury | 0.0001 | mg/L | < 0.0001 | < 0.0001 | < 0.0001 |
| Molybdenum | 0.1 | µg/L | < 0.1 | < 0.1 | 0.4 |
| Nickel | 0.5 | µg/L | < 0.5 | 1 | 6.0 |
| Selenium | 0.2 | µg/L | < 0.2 | < 0.2 | 0.2 |
| Strontium | 1 | µg/L | 1136.0 | 2110 | 9496.0 |
| Vanadium | 0.2 | µg/L | < 0.2 | < 0.2 | 1.4 |
| Zinc | 1 | µg/L | < 1 | 13 | 65.4 |
| **Nutrients** | | | | | |
| Ammonia as N | 0.01 | mg/L | 0.8 | 1.13 | 1.7 |
| Nitrate as N | 0.01 | mg/L | < 0.01 | 0.01 | 0.1 |
| Nitrite + Nitrate as N | 0.01 | mg/L | < 0.01 | 0.01 | 0.1 |
| Nitrite as N | 0.01 | mg/L | < 0.01 | < 0.01 | < 0.01 |
| Reactive Phosphorus as P | 0.01 | mg/L | < 0.01 | 0.01 | 0.0 |
| Total Kjeldahl Nitrogen as N | 0.1 | mg/L | 0.9 | 1.3 | 1.8 |
| Total Nitrogen as N | 0.1 | mg/L | 0.9 | 1.3 | 1.8 |
| Total Phosphorus as P | 0.01 | mg/L | 0.0 | 0.06 | 0.2 |
| **Organic Carbon** | | | | | |
| Dissolved Organic Carbon | 1 | mg/L | < 1 | 6 | 14.1 |
| Total Organic Carbon | 1 | mg/L | < 1 | 13 | 35.1 |
| **Physico-Chemical** | | | | | |
| Electrical Conductivity @ 25°C | 1 | µS/cm | 5640.0 | 7070 | 13060.0 |
| pH Value | 0.01 | pH Unit | 8.1 | 8.385 | 8.6 |
| Suspended Solids (SS) | 5 | mg/L | 11.9 | 100.5 | 520.5 |
| Total Dissolved Solids @180°C | 5 | mg/L | 3190.0 | 4215 | 7546.0 |
| Turbidity | 0.1 | NTU | 6.1 | 50 | 401.8 |
| **Silica** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Reactive Silica | 0.1 | mg/L | 14.1 | 15.9 | 19.2 |
| Silica | 0.1 | mg/L | 15.7 | 17.4 | 20.4 |

## 3.3 Arrow Energy CSG Water and Salt Management Strategy

Arrow is committed to managing CSG water in a way that maximises beneficial use and that minimises environmental impact. To demonstrate this, Arrow has developed a Surat Gas Project Water Management Strategy[5] to ensure that the SGP manages water and salt consistently and within the Queensland Government regulatory framework. The strategy is supported by a series of plans and procedural documents to ensure that the following objectives are achieved:

- Communicate corporate policy and principles for the management of CSG water and salt;
- Align with the regulatory framework that applies to the:
  - Gathering, treatment, storage, distribution, beneficial use and disposal of CSG water and salt;
  - Monitoring and management of groundwater and predicted impacts to groundwater level changes in quality;
- Facilitate management of CSG water and salt in a way that maximises beneficial use and minimises the potential for environmental impacts; and
- Establish a framework for development of aquifer, surface water and infrastructure groundwater monitoring programs.

### 3.3.1 Water and Salt Management Options

Arrow CSG Water and Salt Management Strategy aligns with the DES CSG Water Management Policy as defined in Section 1.6.

To ensure that the most sustainable CSG water management portfolio is implemented, Arrow evaluates all strategy management options using a systematic and transparent multi-criteria assessment (MCA) process (refer Figure 3-2). The performance of each identified option is assessed against a set of weighted criteria and options selected as either “preferred”, “reserved” or “not preferred” based on the weighted score derived from the MCA[6].

Preferred options are prioritised for investment whilst reserved options continue to be evaluated through targeted feasibility studies. Non-preferred options are put on hold. To ensure that Arrow’s approach to CSG water utilisation remains reflective of the latest information, MCAs may be updated on a periodic basis.

[5] Arrow Energy (2017), *Surat Gas Project CSG Water Management Strategy*, Rev: 0, Doc No: ORG-ARW-ENV-STR-00001.
[6] Safety is a core value of Arrow Energy and all activities and processes require safety to be at the forefront of assessment. Therefore, safety is not incorporated into the MCA.

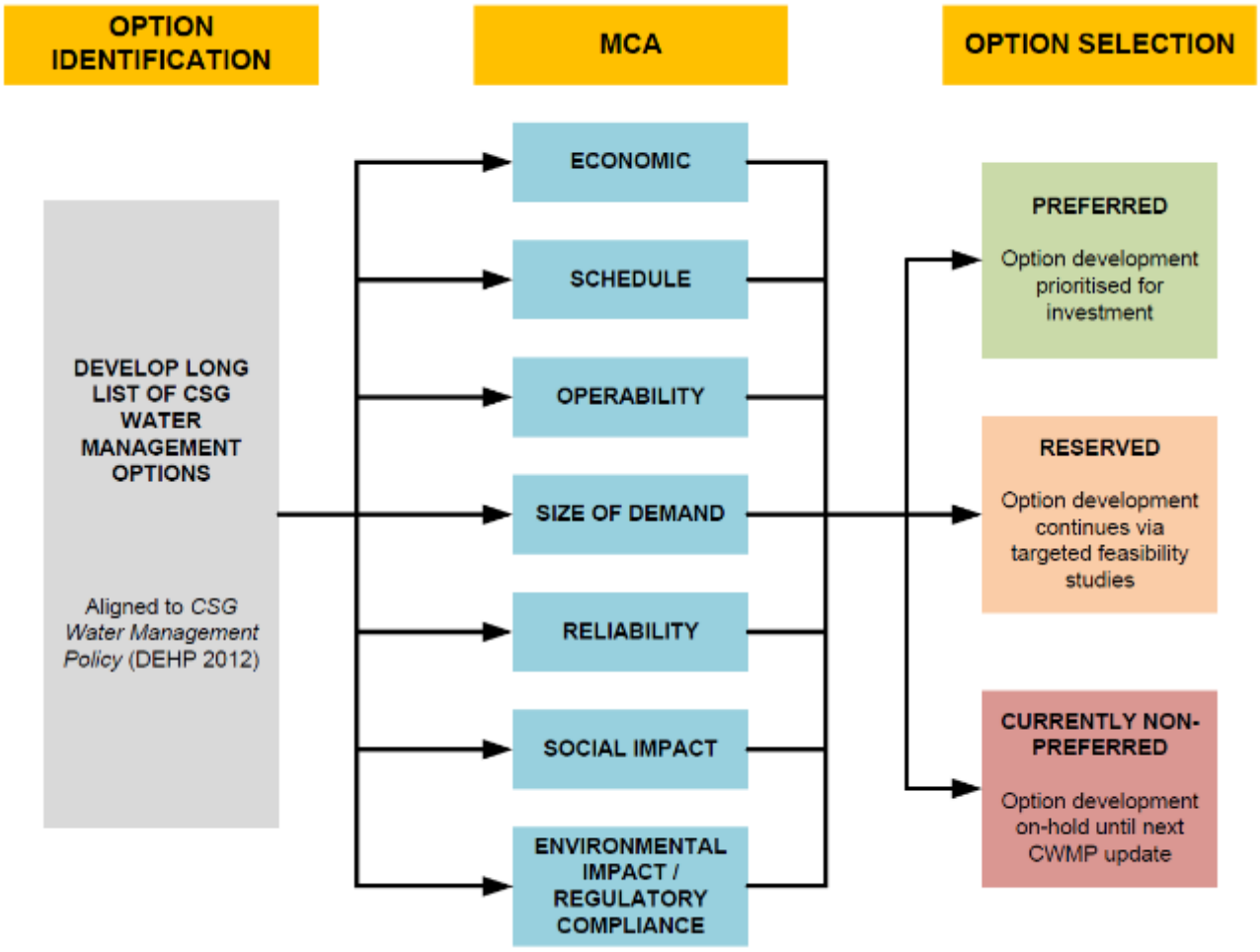



**Figure 3-2 Option Selection and MCA Framework**

## 3.4 Water management options

This section presents the water management options considered for the SGP. Saline waste management is discussed in Section 3.5.

Implementation of the preferred CSG water management options will result in the distribution of CSG water to a range of beneficial uses. Currently identified options are described below.

### 3.4.1 Agricultural uses

Irrigation is the predominant water use within the SGP development area. Options exist to provide water to existing irrigators, to replace other water sources used for irrigation (including through substitution of their existing groundwater allocations), or to supply water to new irrigation projects.

Key considerations for providing CSG water to end users for irrigation include:

- The ability of end users to take large volumes of water regularly and reliably;
- The location of end users in relation to the water treatment facility (due to the cost of transporting water over large distances);
- The approvals framework;

- The extent to which the user is going to become reliant on water supplied by Arrow; and
- The appropriateness of the supply given the short term nature of CSG water availability.

The water and implications of its use will be the responsibility of the end users. Arrow retains no control over how the water is used beyond the transfer point.

Where practical, Arrow's preferred management option for CSG water is beneficial use through substitution of existing groundwater allocations in the operating area. Substitution of allocations has the advantage that it constitutes both a beneficial means of managing produced CSG water, and a means of offsetting the potential impacts of Arrow's CSG production to bore owners with groundwater allocations.

Currently, there is no regulatory basis to facilitate substitution. Therefore, Arrow would develop a commercial scheme to support the supply of treated CSG water to groundwater users who hold allocations. Under this scheme end users would receive and utilise water supplied by Arrow in lieu of their groundwater allocations.

Arrow has committed to offsetting its component of modelled likely flux impacts to the Condamine Alluvium in the area of greatest predicted drawdown, as a result of CSG water extraction from the Walloon Coal Measures. This can be achieved through a beneficial use network that will distribute water to groundwater users within specified areas of the Condamine Alluvium to mitigate the modelled likely flux impact by substitution of their allocations. These users, or other existing users, could be offered excess water in addition to the substitution requirements to manage peaks in the water production profile.

### 3.4.2 Other agricultural uses

Other potential agricultural beneficial uses include provision of water for livestock watering purposes (including feedlots) or for aquaculture.

### 3.4.3 Discharge

Discharge of treated CSG water to watercourses is a reserved option in the event that other beneficial uses of CSG water are temporarily unavailable.

### 3.4.4 Urban uses

Urban supply remains a potential CSG water end use, but is subject to further negotiation and a suitable supply arrangement that economically satisfies regulatory requirements.

### 3.4.5 New uses

Over the course of the SGP, water demands across areas in which Arrow operates will vary and it is anticipated that new opportunities for use of treated and untreated water may emerge.

Whilst Arrow may choose to evaluate any such opportunities in accordance with the adopted selection methodology (refer Section 3.3.1), supply to new users is not a preferred water management option. This is because the CSG water supply will only be available for a reasonably short period of time, and the development of new water reliant uses may result in potential legacy issues when CSG water is no longer available.

### 3.4.6 Aquifer injection

Aquifer injection, either for re-pressurisation or as a means for CSG water management, is not currently proposed for the SGP due to the potential risks and the lack of an appropriate regulatory system.

### 3.4.7 Ocean outfall

Disposal of CSG water to the sea via an ocean outfall pipeline is recognised as a technically feasible option, but currently non-preferred due to environmental and community concerns, and potential schedule impact.

### 3.4.8 Alignment of Arrow and DES priorities

A summary of the CSG water management options is presented in Table 3-2 which aligns Arrows preferred and non-preferred options with the DES prioritisation hierarchy.

Table 3-2 CSG water management – alignment of Arrow and DES priorities

| Arrow priority | Option | Comments | DES Priority |
|---|---|---|---|
| Preferred | Arrow operational supply | Dust suppression, construction, potable, etc. | Priority 1 |
| | Substitution of allocations | Beneficial use to existing abstractors (virtual injection) | Priority 1 |
| | Industrial supply to existing users | Non-Arrow use, where established | Priority 1 |
| Reserved | Discharge to watercourse | Subject to Environmental Authority conditions | Priority 2 |
| | Urban water supply | Subject to negotiation and approvals | Priority 1 |
| Non-preferred | MAR | Managed aquifer recharge | Priority 1 |
| | Industrial supply to new users | Non-Arrow use, where established | Priority 1 |
| | Ocean outfall | Non-preferred due to environmental and community concerns, and potential schedule impact | Priority 2 |
| | Deep aquifer injection | Currently no identified target aquifer | Priority 2 |

## 3.5 Brine and salt management options

Water treatment processes that include desalination, such as reverse osmosis, produce a brine stream by-product.

Assuming an average salt concentration of 4,500 mg/L for CSG water in the Surat Basin, treatment of CSG water via reverse osmosis ( to ~500 mg/L TDS) will generate in the order of 4 tonnes of salt per megalitre of treated water. Raw water feed concentrations vary across tenements and may also change over time within a given CSG field. Brine stream concentrations will therefore change accordingly.

Specific measures are required to manage the storage and use (or disposal) of brine. A range of brine management options are identified, and described in the following sections.

### 3.5.1 Salt recovery

The concentrated brine by-product of desalinated water from the Surat Basin coal measures is comprised primarily of sodium chloride, sodium carbonate and sodium bicarbonate salts. A range of options for salt recovery are under consideration for the SGP.

#### i. Non-selective salt recovery and landfill

Non-selective recovery can be undertaken in purpose designed, lined solar evaporation ponds, through other thermal processes, or using mechanical crystallisers. The mixed salt product recovered has little or no commercial value, therefore landfill of the solid product is required, either in third-party landfills, or through encapsulation of the solid salts in purpose designed cells.

#### ii. Selective salt recovery

SSR requires the selective crystallisation of salts from RO brine to provide separate end product streams – typically sodium chloride, sodium carbonate and sodium bicarbonate, enabling commercial opportunity for sale of the product. A waste salt by-product is also produced that is dependent on the chemical characteristics of the brine processed at the salt recovery facility.

SSR is currently a reserved option because work to date has demonstrated that the recovered salt product has only modest value and the market is fully supplied by existing low cost producers. Furthermore, the process is energy intensive and substantial transport distances to market would present issues of safety and cost. The combined energy and transport requirements would also result in high emissions intensity for the final product.

### 3.5.2 Brine injection

Brine injection requires identification of a target formation with permeability and parameters sufficient to enable injection and storage, and where the water quality is such that injection of the brine will not impact the environmental values of the groundwater system.

To date, suitable aquifers have not been identified within Arrow's Surat tenements, and brine injection is a non-preferred management option.

### 3.5.3 Ocean outfall

As for water, disposal of brine to the sea via an ocean outfall pipeline is recognised as a technically feasible option, but is currently non-preferred.

### 3.5.4 Alignment of Arrow and DES Priorities

A summary of the brine and salt management options is presented in Table 3-3 which aligns Arrows preferred and non-preferred options with the DES prioritisation hierarchy.

Table 3-3 Saline waste management – alignment of Arrow and DES priorities

| Arrow priority | Option | Comments | DEHP Priority |
|---|---|---|---|
| Preferred | Non-selective salt recovery and landfill encapsulation | Solid product landfill in purpose designed regulated waste facilities | Priority 2 |
| Reserved | Selective salt recovery | Currently uneconomic, unable to demonstrate a commercial market, has high emissions intensity and greater safety risk. | Priority 1 |
| Non-preferred | Brine injection | Currently no identified target aquifer | Priority 2 |
| | Ocean outfall | Non-preferred due to community concerns, and potential schedule impact | Priority 2 |

# 4. SGP Coal Seam Water Management Network

## 4.1 SGP Water Management

As stated in Section 1, the SGP will utilise existing DXP gas and water assets (e.g. water treatment plants), but will also provide both gas and water to existing QGC assets. SGP water management will comprise six main process components:

1. CSG production wells and associated water gathering system;
2. Water transfer pipeline(s);
3. Aggregation dam(s);
4. Water Treatment Plants (WTP);
5. Treated water dam(s) and associated beneficial use offtakes; and
6. Brine dam(s).

Figure 4-1 provides a conceptual diagram of this process. Figure 4-2 provides an overview of the proposed SGP water management network.

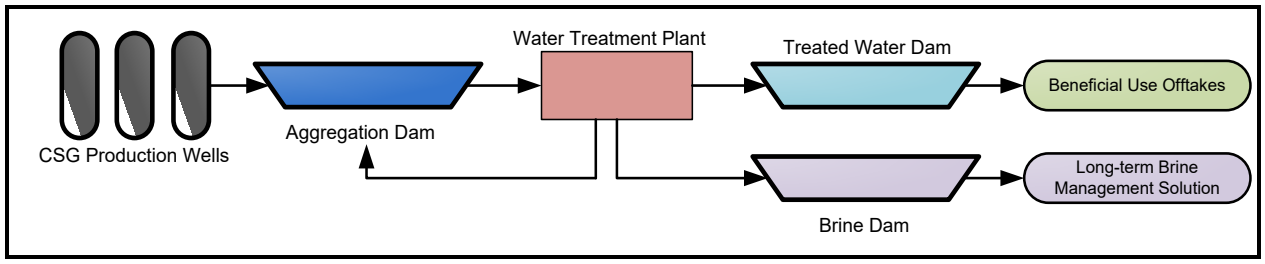
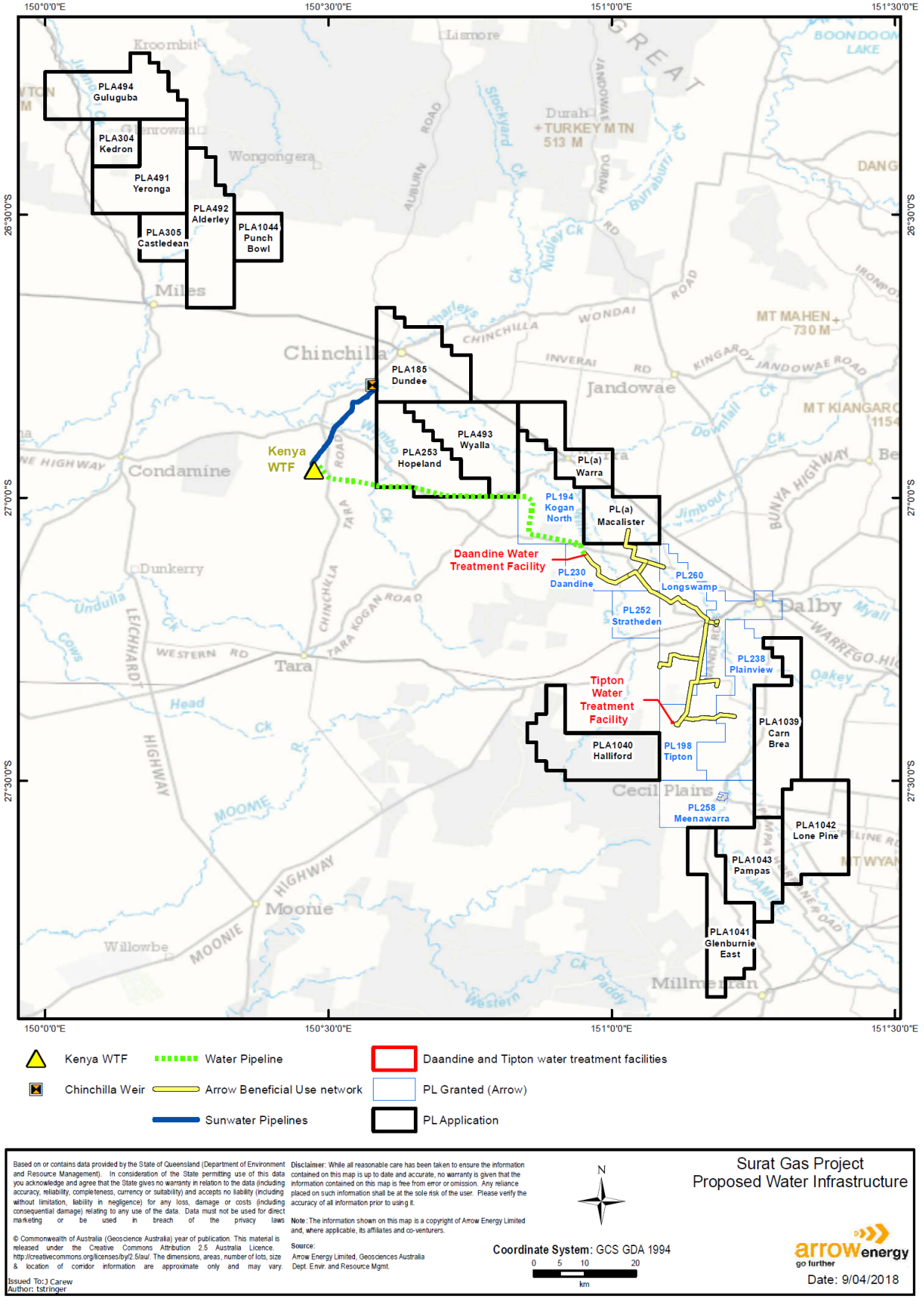



**Figure 4-1 Conceptual Diagram of CSG Water Management**

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Author: tstringer

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**Coordinate System:** GCS GDA 1994

0 5 10 20
km

Surat Gas Project
Proposed Water Infrastructure

arrow energy go further

Date: 9/04/2018

**Figure 4-2 Proposed SGP CSG Water Management Network**



arrow energy go further

### 4.1.1 Gathering System and Storage

CSG water is gathered via a network of buried HDPE low pressure pipes to a series of aggregation dams. Arrow Energy defines its dams as follows:

- **Aggregation Dams** – contain CSG water from gathering network. Aggregation dams provide a buffer to address variations in CSG water production and water treatment capacity.
- **Treated Water Dams** – contain treated CSG water. Treated water dams provide a buffer between treatment plant output and beneficial use demand.
- **Central Gas Processing Facility (CGPF) and WTP Utility Dams** – contain waste lubricants and chemicals used in treatment and compression systems.
- **Brine Dams** – contain brine produced from the reverse osmosis water treatment process.

DES requires that consequence categories of dams are assessed. The DEHP 2013 *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*[7] provides guidance on the assessment process. Arrow has implemented the assessment procedure outlined in the manual.

### 4.1.2 CSG Water Treatment

Arrow Energy currently treats CSG water through a process of MF and RO. QGC uses similar technologies at its Kenya water treatment facility. MF is a microporous membrane separation process with selectivity on the basis of the size of the particle. Most MF membranes are screen filters with the feed inlet pressure serving as the driving force for filtration. The membranes allow the removal of turbidity, bacteria, cysts and particulates from the water to sizes of 0.1 to 3 µm. Following MF, water is treated using RO to remove dissolved salts. RO is significantly more complex than MF and involves the separation of salts from solution through a semi–permeable, microporous membrane under elevated hydrostatic pressure creating a permeate stream of treated CSG water and a brine waste stream containing concentrated salts.

### 4.1.3 Brine Management

Water treatment processes that include desalination, such as reverse osmosis, produce a brine stream by-product. The resulting brine will be stored in purpose built brine storage dams until such time as Arrow selects a brine management solution. A range of brine management options have been identified and are described above in Section 3.4.

Both Arrow and QGC WTPs include (or have planned) technologies to minimise the brine stream and thereby reduce the number of required brine storage dams. The Kenya facility already has thermal brine concentrators to produce a highly concentrated brine stream whilst the Arrow facilities plan to utilise membrane concentration technology to further concentrate the brine stream.

[7] Queensland Department of Environment and Heritage Protection, *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures,* DEHP, Queensland, Australia (ESR/2016/1934).

### 4.1.4 Beneficial Use

As detailed above in section 3.4, the preferred DES CSG water management strategy is beneficial use. Across the SGP, the most substantial beneficial use option is irrigation. Other major beneficial use options include supply to industrial users (power stations or coal mines) and intensive livestock (feedlots, piggeries). Selection of beneficial use options requires careful consideration of the predicted water volumes, stakeholder requirements and Arrow's approval obligations.

Arrow's preferred management option for CSG water is beneficial use through substitution of existing Condamine Alluvium groundwater allocations. Under this scheme end users would receive and utilise water supplied by Arrow in lieu of their groundwater allocations. Arrow has committed to offsetting its component of modelled likely flux impacts to the Condamine Alluvium in the area of greatest predicted drawdown as a result of CSG water extraction from the Walloon Coal Measures and is conditioned to do so under its Federal environmental approval.

A beneficial use network (BUN) will be constructed to distribute treated water to groundwater users within specified areas of the Condamine Alluvium. Users connected to the network will receive water from the Tipton and Daandine facilities as well as a proportion of Arrow's water treated at the QGC Kenya facility. Water from the Kenya facility will be provided back to the Arrow BUN via pipeline. The proposed BUN and associated water pipelines are presented above in Figure 4-2. Any remaining treated water from Kenya will be supplied to the existing SunWater beneficial use scheme which connects Kenya to the Chinchilla weir.

It is expected that treated water distributed by Arrow will be supplied under conditions in the relevant EA or by using the relevant End of Waste Code. Treated water specifications from all of the water treatment facilities will meet the requirements of these approvals.

A small portion of produced water may selectively be used by Arrow for construction purposes or dust suppression, or may be supplied for industrial uses (e.g. coal mines or power stations) or stock watering.

## 4.2 Arrow Daandine Water Management Network

As discussed in section 4.1, the SGP will integrate with Arrow's existing facilities at both Daandine and Tipton. The Daandine water management network connects Daandine, Kogan North and Stratheden fields to a WTP at Daandine. Figure 4-3 schematically illustrates Daandine water management network infrastructure.

### 4.2.1 Dams

The Daandine water management network includes six (6) dams. Five dams are located within the Daandine field, and a sixth dam is located at Kogan North. The Kogan North dam enables aggregation and transfer of CSG water to the Daandine WTP for treatment. Table 4-1 lists dam storage characteristics.

**Table 4-1 Daandine Water Management Network Storages**

| Dam Description | Volume at Mandatory Reporting Level (ML) | Volume at Spillway (ML) | Volume at Design Storage Allowance (ML) |
|---|---|---|---|
| **Daandine Aggregation Dam** | 1,239 | 1,458 | 1,166 |
| **Daandine Feed Water** | 418 | 458 | 392 |
| **Daandine Treated Water** | 208 | 238 | 199 |
| **Daandine Brine** | 1,096 | 1,184 | 1,045 |
| **Daandine Utility** | 31 | 48 | 26 |
| **Kogan North** | 299 | 427 | 261 |

**Note**: DSA and MRL volumes have been updated to reflect the 2017 Annual Dam Inspections (AECOM, 2017).

### 4.2.2 Water Treatment Plant

In December 2009, Arrow Energy constructed and commissioned a 12 ML/d water treatment plant (WTP) at Daandine, to facilitate beneficial use and align Arrow's operation with the *CSG Water Management Policy* (DEHP, 2012).

For a description of the water treatment process refer to section 4.1.2. For characterisation of treated CSG water quality refer to section 3.

### 4.2.3 Beneficial Use

A number of beneficial use offtakes have been developed as part of the Daandine water management network. Table 4-2 identifies currently operating offtakes and peak daily usage. Additional offtakes will be added when the SGP enters the development phase. These offtakes will form part of the proposed Arrow BUN.

**Table 4-2 Current Daandine Third Party Water Off-takes**

| Beneficial Use Offtake | Peak daily usage (ML/day) | DEHP Hierarchy Priority |
|---|---|---|
| Irrigation | 8* | Priority 1 |
| Power Station | 1.5 | Priority 1 |
| Power Station | 1 | Priority 1 |
| Arrow Projects (construction and operational uses) | 1 | Priority 1 |
| Feedlot | 1 | Priority 1 |

**Note**: Irrigation offtake rate has no minimum or maximum under the existing agreement. Supply rates are limited to pumping and pipeline infrastructure at 8ML/day.

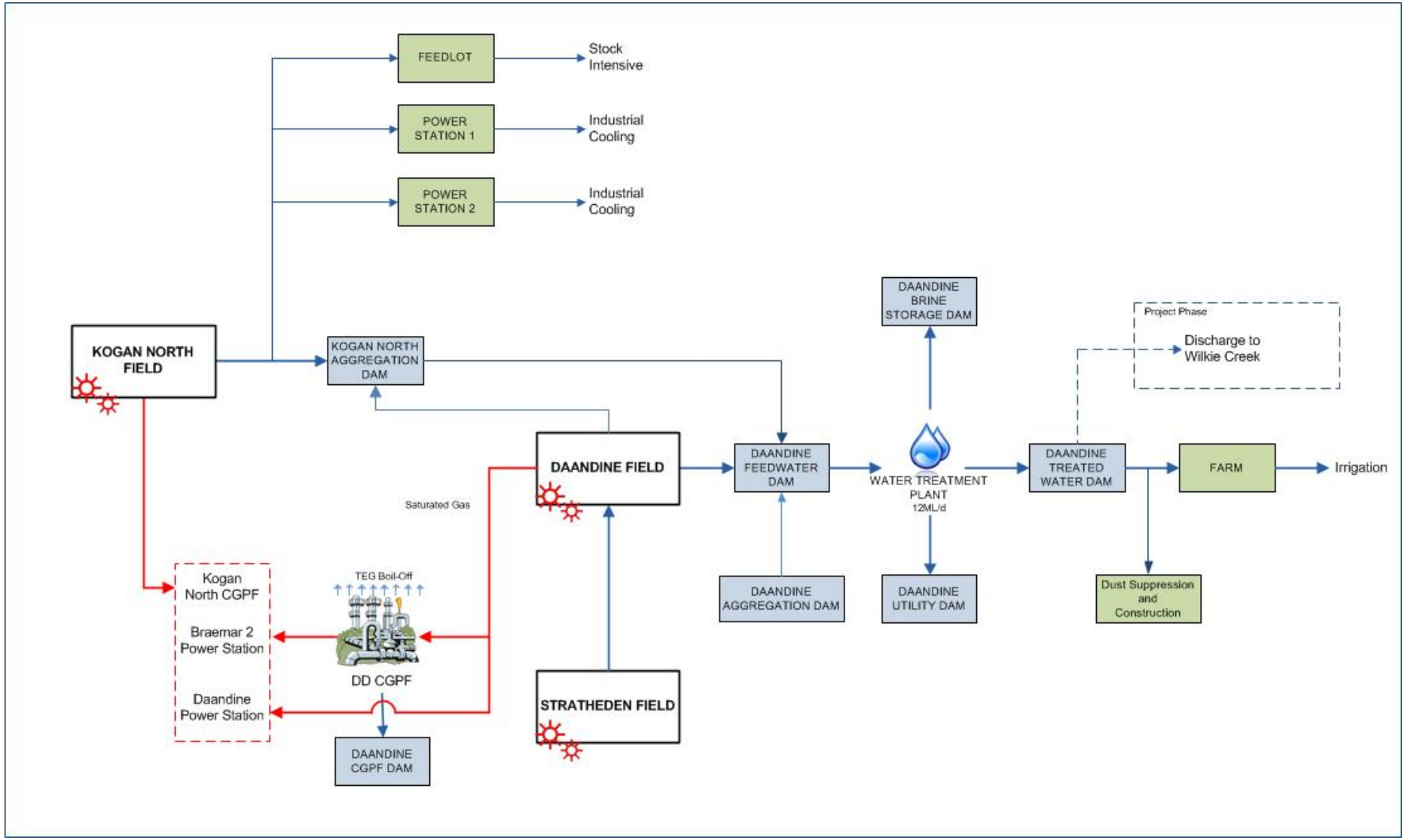


**Figure 4-3** **Schematic diagram of the Daandine Water Management Network**

### 4.2.4 Brine Management

Brine at Daandine is currently stored in a dam compliant with the DEHP 2013 *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*[8] and the DXP EA conditions. Arrow is currently pursuing brine management options in line with its Surat CSG Water and Salt Management Strategy (refer Section 3.5). A long term brine management solution has not been selected at this stage.

### 4.2.5 Contingency Discharge

Arrow is currently licensed under the DXP EA to release treated CSG water to Wilkie Creek. Arrow is committed to maximising beneficial use of its CSG water prior to disposal methods and thus discharge to Wilkie Creek is held as a contingency measure to adapt to seasonal fluctuation in irrigation demand or to preserve dam integrity during excessive rainfall. The infrastructure required to facilitate discharge to Wilkie Creek has not yet been constructed.

## 4.3 Arrow Tipton Water Management Network

Figure 4-4 illustrates the existing Tipton water management network.

### 4.3.1 Dams

Refer to Section 4.1.1 for a description of the gathering network and conditions pertaining to dams. Arrow operates six (6) dams at Tipton. Table 4-3 provides dam storage characteristics for Tipton.

**Table 4-3 Tipton Storage Characteristics**

| Dam Description | Volume at Spillway (ML) | Volume at Mandatory Reporting Level (ML) | Volume at Design Storage Allowance (ML) |
|---|---|---|---|
| **Tipton Aggregation Dam 1** | 1,443 | 1,240 | 1,096 |
| **Tipton Aggregation Dam 2** | 2,046 | 1,728 | 1,781 |
| **Feedwater Dam** | 422 | 388 | 357 |
| **Treated Water Dam** | 422 | 404 | 367 |
| **Brine Dam** | 1,141 | 989 | 879 |
| **Utility Dam** | 61 | 57 | 41 |

**Note**: DSA and MRL volumes have been updated to reflect the 2017 Annual Dam Inspections (AECOM, 2017).

### 4.3.2 Water Treatment Plant

In April 2013, Arrow Energy commissioned a 12 ML/d WTP at Tipton to facilitate beneficial use and align Arrow's operations with the updated CSG water management policy (DEHP, 2012). For a description of the water treatment process refer to Section 4.1.2. For characterisation of treated CSG water quality refer to Section 4.2.

[8] Queensland Department of Environment and Heritage Protection, *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures,* DEHP, Queensland, Australia (ESR/2016/1933).

### 4.3.3 Beneficial Use

Table 4-4 outlines the beneficial use offtakes from Tipton. The only current offtake is supply to a feedlot. Additional offtakes will be added when the SGP enters the development phase. These offtakes will form part of the proposed Arrow BUN.

**Table 4-4 Tipton Third Party Water Offtakes**

| Beneficial Use Offtake | Maximum Possible Volume (ML/day) | DEHP Hierarchy Priority |
|---|---|---|
| Feedlot | Min = 1.75, Max = 4 | Priority 1 |

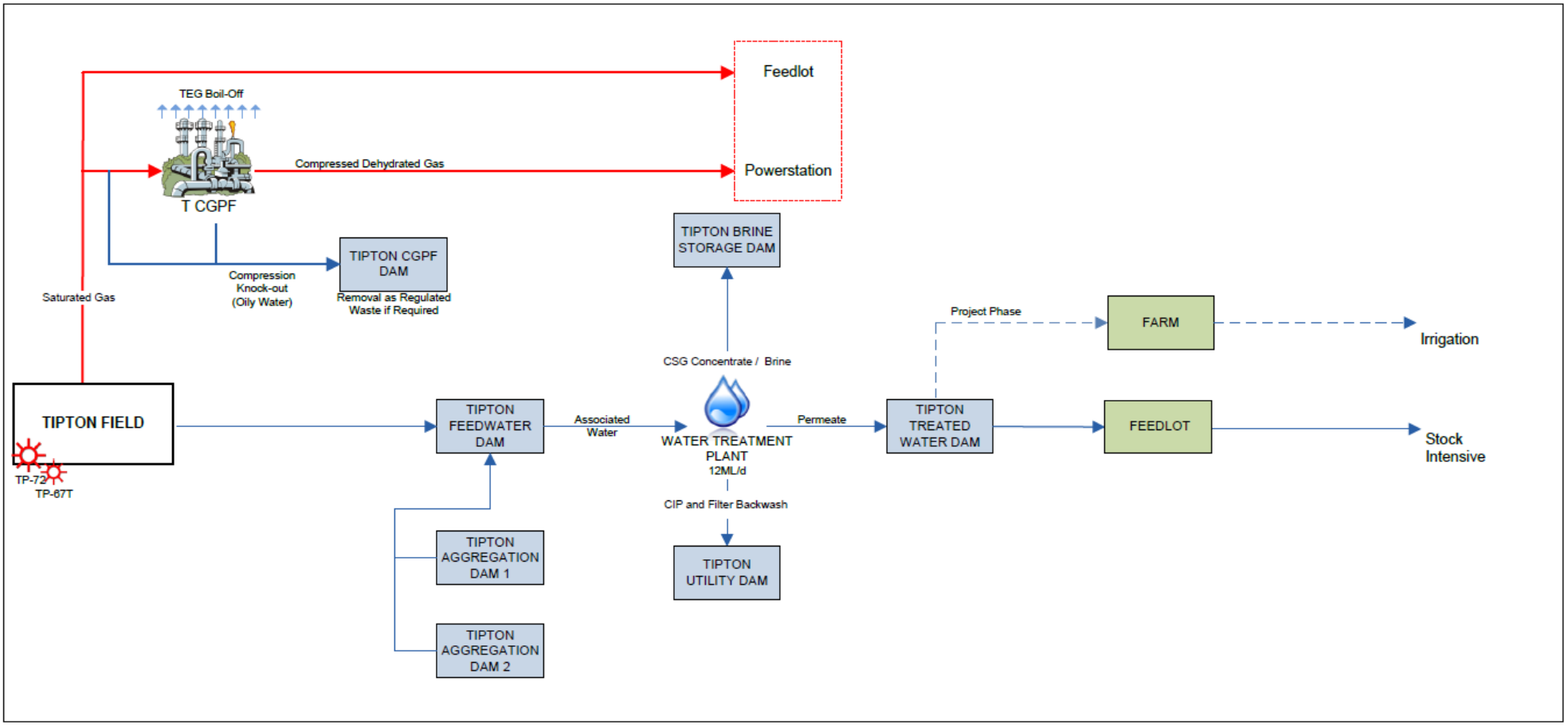


**Figure 4-4** **Schematic diagram of the Tipton Water Management Network**

### 4.3.4 Brine Management

Brine at Tipton is currently stored in a dam compliant with the DEHP 2013 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures and the DXP EA conditions. Arrow is currently pursuing brine management options in line with its Surat CSG Water and Salt Management Strategy (refer Section 3.5). A long term brine management solution has not been selected at this stage.

# 5. RISK MANAGEMENT

Arrow implements a standardised approach to risk management enabling risks to be ranked and prioritised across all operations. Arrow's approach to risk management seeks to:

- Identify and understand risks inherent to the business; and
- Apply adequate risk response by:
    - Decreasing the likelihood and consequence of adverse effects;
    - Increasing the likelihood and impact of positive effects;
    - Implementing effective controls;
    - Setting boundaries for risk acceptance;
    - Focusing assurance activities towards the highest areas of risk.

## 5.1 SGP Risk Assessment

An assessment of the risks related to CSG water management for the SGP was completed in March 2018. The risk assessment used the Arrow Energy framework[9]. Table 5-1 summarises the most pertinent CSG water management risks for the DXP, alongside mitigation measures that will control all risks to acceptable levels.

The risk assessment shows that:

- Most risks are ranked as Low considering existing management controls;
- Risks related to the failure of the WTP to achieve desired design water quality, the failure to secure off-take agreements and the failure to deliver a long term brine management solution ranked as Medium;
- For risks which ranked as Medium, the residual risk ranking is Low after consideration of risk response measures.

[9] Arrow Energy, 2018 *Arrow Energy Risk Management Procedure, Appendix 1 - Risk Assessment Matrix*, Version 5.0, Doc No: ORG-ARW-RMT-PRO-00001.

**Table 5-1 Summary of Risk Assessment**

| Hazard / Threat | Consequences | Existing Controls | Current Risk Ranking | Risk Response | Residual Risk Ranking |
|---|---|---|---|---|---|
| Dam Break – collapse of the structure due to any possible cause | Dam break has the potential to cause:<br>harm to humans;<br>harm to the environment;<br>general economic loss or property damage; and<br>non-compliance with EA conditions. | Dams are designed and operated in accordance with Queensland regulation.<br>Monitoring and maintenance is undertaken in accordance with Dam Operating Plans.<br>Annual dam inspections conducted.<br>Weekly operator inspections of dam levels. | LOW *Aggregation Dam*<br>LOW *Treated Water Dam*<br>LOW *Brine Dam* | Implementation of emergency procedures as defined in the Dam Operating Plans. | LOW *Aggregation Dam*<br>LOW *Treated Water Dam*<br>LOW *Brine Dam* |
| Failure to contain – seepage - significant changes to Groundwater from seepage | Seepage has the potential to cause:<br>harm to humans;<br>harm to the environment;<br>general economic loss or property damage; and<br>non-compliance with EA conditions. | Dams are designed and operated in accordance with Queensland regulation.<br>Regular monitoring of groundwater quality in the immediate vicinity of regulated dams as per the Groundwater Monitoring Program.<br>Seepage controls such as HDPE liners and collection systems are in place where required by Queensland regulation.<br>Brine management dams include capability to capture any seepage that may pass through HDPE lining.<br>Monitoring and maintenance undertaken in accordance with Dam Operating Plans. | LOW *Aggregation Dam*<br>LOW *Treated Water Dam*<br>LOW *Brine Dam* | Implementation of emergency procedures as defined in the Dam Operating Plans. | LOW *Aggregation Dam*<br>LOW *Treated Water Dam*<br>LOW *Brine Dam* |
| Failure to Contain – overtopping – releases due to overtopping of the structure | Overtopping has the potential to cause:<br>harm to humans;<br>harm to the environment;<br>general economic loss or property damage; and | Dams are designed and operated in accordance with Queensland regulation.<br>Operation of storages in accordance with dam operating plans and EA conditions.<br>Adherence to DSA and MRL operating rules. | LOW | Construct contingency release infrastructure.<br>Implementation of emergency procedures (including emergency discharge strategy) as defined in the Dam Operating Plans. | LOW |

| Hazard / Threat | Consequences | Existing Controls | Current Risk Ranking | Risk Response | Residual Risk Ranking |
|---|---|---|---|---|---|
| | non-compliance with EA conditions. | Water production forecasting and water balance modelling.<br>Emergency spillways on dams. | | | |
| Failure of water treatment plant to achieve required water quality | Plant failure has the potential to cause:<br>an inability to use treated CSG water for intended beneficial use options; and<br>non-compliance with EA conditions. | Upstream buffer storage to allow for temporary system shut down to resolve potential issues.<br>Automated monitoring within the WTP system to allow for early detection and mitigation of issues.<br>Automated water quality sampling in permeate dam prior to beneficial use.<br>Ability to retreat water from permeate dam if there are significant exceedances. | LOW | Further in-field blending to address potential exceedances.<br>Water treatment plant upgrades (including pre and post treatment systems) or replacements to achieve water quality objectives.<br>Option to turn down / shut in wells if upstream storage becomes limiting. | LOW |
| Failure to secure water off-takes | Insufficient off-takes have the potential to require disposal of CSG water instead of beneficial use. | CSG water utilisation portfolio to be maintained with sufficient capacity (above upper bound water production curves) to address this risk.<br>Market analysis and identification of off-take opportunities. | LOW | Ability to provide excess capacity into existing SunWater beneficial use pipeline to Chinchilla weir. | LOW |
| Failure to deliver long-term brine management solution. | No long-term brine management solution has the potential to:<br>require additional brine storage construction when existing capacity is exhausted; and increase operational footprint and create additional impact on environmental receptors. | Brine feasibility studies to identify a long term brine management solution (refer Section 3.5).<br>Construction of additional brine storage dams. | MODERATE[10] | Full evaluation of multiple options in order to ensure long term management approach will be in place. | LOW |

[10] Risk ranks as moderate due to costs associated with disposal at a third-party waste facility.

# 6. MANAGEMENT CRITERIA

## 6.1 Measurable Criteria

Arrow Energy has defined Measurable Criteria for the SGP in accordance with Section 126 (1) of the *EP Act 1994*. To ensure criteria are targeted towards those CSG water management activities and elements that require greatest control, they have been developed from the outcomes of the risk assessment described in Section 5. The Measurable Criteria will be used to monitor and assess the effectiveness of CSG water management across a range of indicators and will be reported in the annual return.

Table 6-1 presents the measurable criteria required to satisfy the requirements of the EP Act. The criteria will be re-evaluated if required as a result of changes in the way which Arrow manages CSG water.

**Table 6-1 Measurable Criteria**

| Management Component | Objectives | Environmental Value Protected | Controls | Measurable Criteria |
|---|---|---|---|---|
| Transmission of CSG water via pipelines | Effective containment of water throughout transmission activities from well to beneficial use / disposal. | Surface and groundwater quality.<br>Soil quality (including structural and chemical properties). | Regular monitoring and maintenance in accordance with asset integrity and maintenance plan.<br>Process safety in design and controls. | No reportable unplanned releases of CSG water. |
| Storage of CSG water in regulated dams | Effective containment of CSG water in dams.<br>Regulated dams operated and maintained in accordance with approvals. | Surface and groundwater quality.<br>Soil quality (including structural and chemical properties). | Annual dam integrity inspections.<br>Groundwater monitoring program.<br>Scheduled maintenance of infrastructure and facilities.<br>Dam operating plans.<br>Water balance modelling to develop operating philosophy and strategy. | Water level below DSA at Nov-1.[11]<br>No breaches of MRL.<br>Annual inspections completed.<br>No unplanned releases. |
| Beneficial Use | Maximise beneficial use of CSG water.<br>Ensure that supplied beneficial use water is in accordance with approvals. | Surface and groundwater quality.<br>Soil quality (including structural and chemical properties). | Regular monitoring of the qualities and quantities of water suppled for beneficial use.<br>Scheduled maintenance of infrastructure and facilities.<br>CSG Water and Salt Management Strategy. | Water supply agreements in place.<br>Water quality for beneficial use meets approval conditions. |
| Management of salt and brine | Management of salt in accordance with the regulatory framework. | Land use capability, having regard to economic considerations.<br>Surface and ground water quality.<br>Soil quality (including structural and chemical properties). | Continual assessment of feasible options for beneficial use and/or disposal of salt in accordance with the CSG Water Management Policy 2012.<br>Containment of salt and brine in fit for purpose storage infrastructure operated and maintained in accordance with approvals. | Water level below DSA at Nov 1.<br>No breaches of MRL.<br>Annual inspections completed.<br>No reportable unplanned releases. |

[11] If the dam is a regulated structure as per the failure to contain overtopping scenario in the *Queensland Department of Environment and Heritage Protection, Manual for Assessing Consequence Categories and Hydraulic Performance of Structures,* DEHP, Queensland, Australia (ESR/2016/1933).

## 6.2 Response Procedures

Should any of the Measurable Criteria in Table 6-1 not be met, the following response procedure will be implemented:

- Where relevant, reporting of incident in line with DES requirements;
- Evaluation (including root cause analysis) of the underlying cause of the criteria not being met;
- Review of relevant procedures, protocols and management plans and make changes where required;
- Implementation of corrective actions to address underlying cause. This, for example, could include:
    - Engineering solutions;
    - Amendments to operating procedures; and/or
    - Change to management process.

## 6.3 Arrow Operating Procedures

Arrow Energy commits its staff to the adoption of a series of procedures that control important elements of CSG water management. These procedures include:

- 99-H-PR-0010 (5) Incident Reporting Recording and Investigation Procedure;
- ORG-ARW-HSM-PRO-00016 (8) Chemical Management Procedure;
- ORG-ARW-HSM-PRO-00066 (4) Waste Management Procedure; and
- ORG-ARW-HSM-PRO-00073 (7) Land Rehabilitation Procedure.

Each of Arrow Energy's procedures is reviewed regularly in order to ensure that all operating factors are considered, and that procedures continue to reflect latest understanding.

# 7. MONITORING

## 7.1 Environmental Monitoring

### 7.1.1 Surface Water

Contingency discharge of treated CSG water to watercourses is a potential option in the event that other beneficial uses of CSG water are temporarily unavailable. Prior to the release of treated CSG water to a watercourse, Arrow will develop a Receiving Environment Monitoring Plan (REMP) to monitor, identify and describe any adverse impacts to surface water environmental values, water quality, and flows due to authorised releases. The REMP will be developed in accordance with granted EA conditions. Arrow does not currently have any installed watercourse release infrastructure.

### 7.1.2 Groundwater

The Groundwater Monitoring Program will provide for the early detection of significant risks and changes in groundwater quality and levels as a result of activities authorised under the SGP EAs.

The Groundwater Monitoring Program will be based on the current program at Arrow's DXP and may include:

- regular monitoring of groundwater quality in the immediate vicinity of regulated dams;
- monitoring of background sites;
- monitoring of dam water quality;
- establishment of site-specific environmental values for the shallow groundwater system;
- development of site-specific trigger values;
- ongoing monitoring of groundwater to identify environmental impacts; and
- implementation of management actions in the event of environmental impact.

Monitoring groundwater quality at dam sites requires installation of monitoring bores in close proximity to dams. The exact location of these bores is guided by geotechnical investigations to identify the direction in which in groundwater impact is likely to travel. Background sites are also installed at distances of 500m to 1,500m (where access allows) both up and down gradient of the dams.

Site-specific trigger levels are developed by considering the background groundwater quality, established trigger levels (such as ANZECC water quality criteria), and the potential impacts of seepage from regulated dams. Ongoing monitoring is then used to identify whether, and to what extent, environmental impacts, with reference to the aforementioned criteria, are occurring. Where unacceptable impacts have occurred, management actions are initiated to remedy these.

## 7.2 Monitoring of CSG Water Management Dams

In accordance with dam operating plans, Arrow Energy will conduct the following monitoring:

- Weekly monitoring:
    - Dam water levels monitored against MRL and DSA;
    - Visual inspections to consider integrity issues; and
    - Visual inspections for algae, surface slicks or fauna interaction.
- Monthly Monitoring:
    - Visual structural inspection for early identification of integrity issues; and
    - Identification of any changes to the dam service/contents.
- Biannual monitoring:
    - Groundwater impact monitoring for physico-chemical parameters.
- Annual monitoring:
    - Each regulated dam will be inspected by a suitably qualified and experienced person with an Annual Inspection Report prepared and certified; and
    - An assessment of the DSA will be undertaken on or before 1 November each year.

# 8. REPORTING

## 8.1 Annual Return

In accordance with the requirements of the SGP EAs, Arrow Energy will complete and submit an Annual Return which will include an evaluation of the effectiveness of the management of CSG water under the criteria described in Section 126(1)(e) of the EP Act.

## 8.2 Annual Inspection Report

Arrow Energy will provide to DES upon request a copy of the Annual Inspection Report for each of its regulated structures. This will be certified by a suitably qualified and experienced person and will include any recommended actions to ensure the integrity of inspected dam.

## 8.3 Annual Monitoring Report

An Annual Monitoring Report summarising monitoring results over the previous 12 month period will be prepared and made available to DES upon request. All monitoring results will be retained for no less than five years.

## 8.4 Incident Reporting

If any contaminant levels are identified as having caused, or have the potential to cause environmental harm, this will be reported to DES in accordance with EP Act and EA requirements.

# 9. REFERENCES

ANZECC & ARMCANZ 2000, Australian and New Zealand guidelines for fresh and marine water quality, ANZECC & AMCANZ, Australia.

Arrow Energy, 2018 *Arrow Energy Risk Management Procedure, Appendix 1 - Risk Assessment Matrix*, Version 5.0, Doc No: ORG-ARW-RMT-PRO-00001.

Arrow Energy, 2013 Coal Seam Gas Water Management Plan – Surat Basin, Rev: 0, Doc No: ENV11-133.

Arrow Energy 2017, *Surat Gas Project CSG Water Management Strategy*, Rev: 0, Doc No: ORG-ARW-ENV-STR-00001.

Arrow Energy, 2017 Dalby Expansion Project (DXP) – Dam Operating Plan, Rev: 2, Doc No: 19-W-PL-0001.

Arrow Energy, 2013 Daandine Expansion – Field Development Plan, Rev: 3, Doc No: 05-PE-PL-0002 (3).

Arrow Energy, 2017 Daandine and Kogan North Water Management Review, Rev: 0, Doc No: 05-W-REP-0012.

Arrow Energy, 2017 Monthly Daandine Water Operations Report, Rev: 0, Doc No: 05-W-REP-0015.

Arrow Energy, 2017 Monthly Tipton Water Operations Report, Rev: 0, Doc No: 00-W-REP-0008.

Arrow Energy, 2017 Tipton West Management Review, Rev: 0, Doc No: 00-W-REP-0007, Arrow Energy, Australia.

Department of Environment and Heritage Protection, 2017 Environmental Authority: Arrow Energy Dalby Expansion Project, Permit No: EPPG00972513, effective 21 September, Queensland, Australia.

Department of Environment and Heritage Protection, 2013 *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*, Queensland, Australia (ESR/2016/1934).

Department of Environment and Heritage Protection, 2012 Coal Seam Gas Water Management Policy, Queensland, Australia.

Sinclair Knight Merz, 2012 Daandine Gas Project Environmental Assessment of Wilkie Creek, SKM, Australia.

# Appendix 8: Slope Class and OGIA Predicted Slope Change for Subject Land

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<table>
<tr><th>Lot on Plan</th><th>Qld Land Use Mapping (Queensland Government, 2021)</th><th>2020 Imagery</th><th>2020 DEM 10m x 10m slope (%)</th><th>Draft 2021 UWIR maximum change in ground slope (%) (OGIA, 2021)</th></tr>
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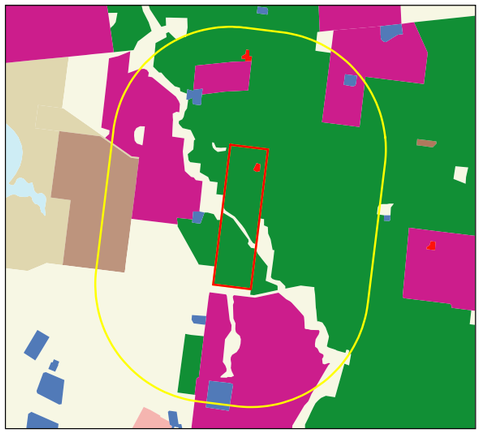
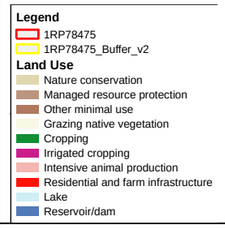
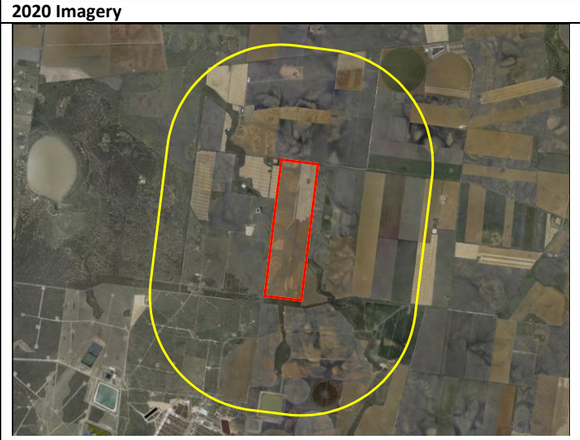
<td>Lot on plan mapped as cropping with grazing native vegetation and residential/farm infrastructure. Surrounding land use (within 3km buffer) includes cropping, irrigated cropping, dams, grazing native vegetation, residential/farm infrastructure and managed resource protection.<br>  <br>  </td>
<td>  </td>
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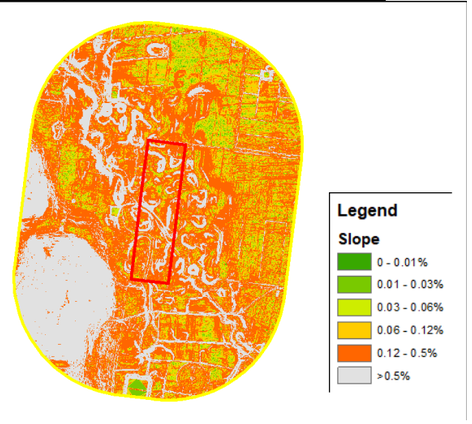 <br>
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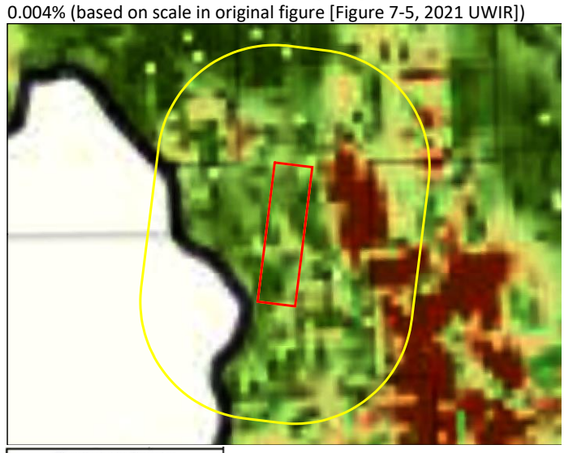
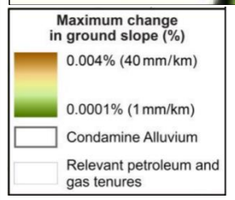
<td>Lot on plan approximate predicted maximum change in ground slope 0.0001% to 0.00205% (based on scale in original figure [Figure 7-5, Draft 2021 UWIR]). Surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.004% (based on scale in original figure [Figure 7-5, 2021 UWIR])<br>  <br>  </td>
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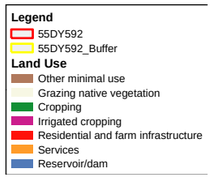
<td>Lot on plan mapped as cropping with grazing native vegetation and other minimal use. Surrounding land use (within 3km buffer) includes cropping, irrigated cropping, dams, grazing native vegetation, other minimal use, residential/farm infrastructure and services.<br>  <br>  </td>
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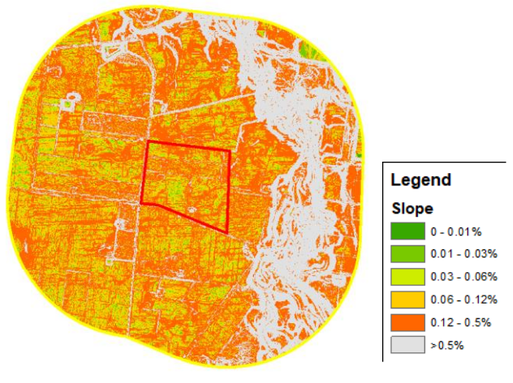 <br>
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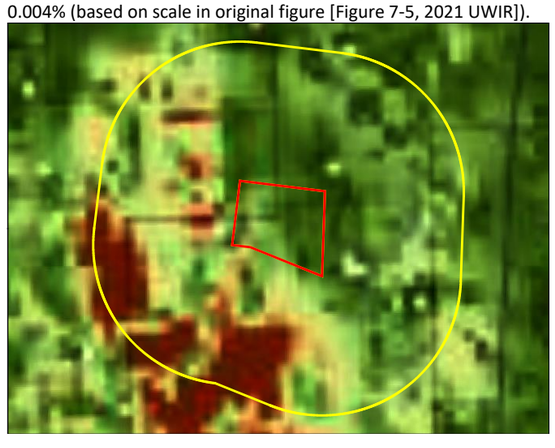
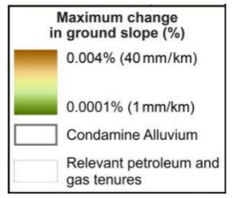
<td>Lot on plan approximate predicted maximum change in ground slope 0.0001% to 0.00205% (based on scale in original figure [Figure 7-5, Draft 2021 UWIR]). Surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.004% (based on scale in original figure [Figure 7-5, 2021 UWIR]).<br>  <br>  </td>
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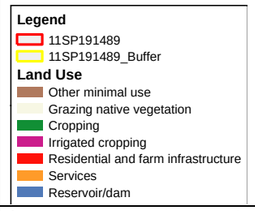
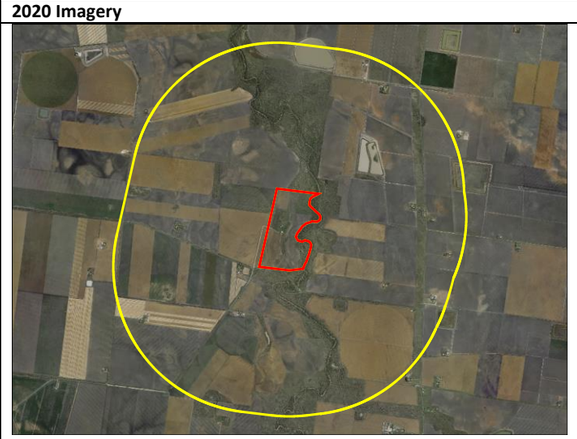
<td>Lot on plan mapped as cropping with grazing native vegetation and dams. Surrounding land use (within 3km buffer) includes cropping, irrigated cropping, dams, grazing native vegetation, other minimal use, residential/farm infrastructure and services.<br>  <br>  </td>
<td>  </td>
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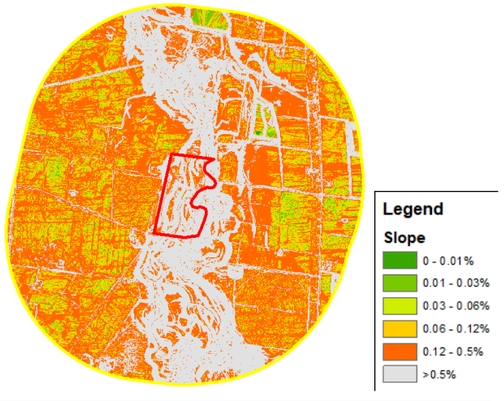

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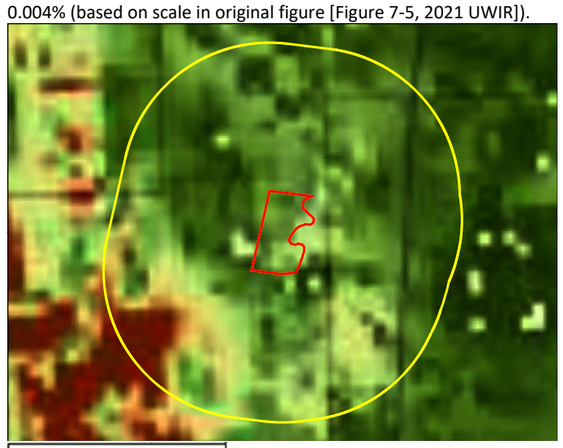
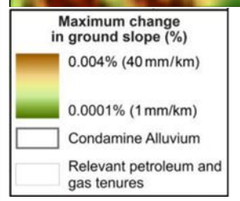
<td>Lot on plan approximate predicted maximum change in ground slope 0.0001% to 0.00205% (based on scale in original figure [Figure 7-5, Draft 2021 UWIR]). Surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.004% (based on scale in original figure [Figure 7-5, 2021 UWIR]).<br>  <br>  </td>
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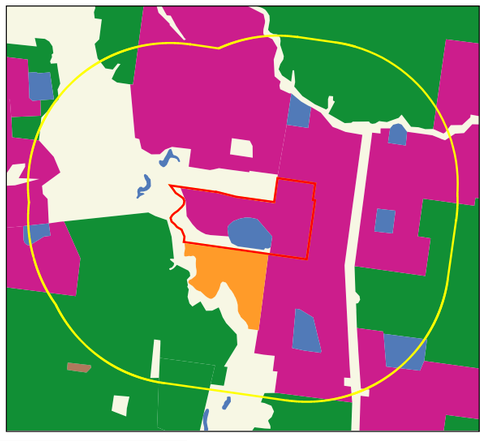
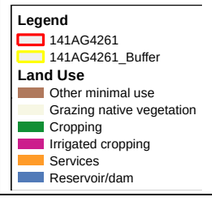
<td>Lot on plan mapped as irrigated cropping, grazing native vegetation and dams. Surrounding land use (within 3km buffer) includes cropping, irrigated cropping, dams, grazing native vegetation, other minimal use and services.<br>  <br>  </td>
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<td>
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<tr><th colspan="2">Within Lot on Plan</th><th colspan="2">Outside Lot on Plan but within 3km buffer</th></tr>
<tr><td>< 0.01</td><td>1.77</td><td>0.5%</td><td>18.48</td><td>0.3%</td></tr>
<tr><td>0.01 – 0.03</td><td>16.2</td><td>4.6%</td><td>134.35</td><td>2.5%</td></tr>
<tr><td>0.03 – 0.06</td><td>29</td><td>8.2%</td><td>356.3</td><td>6.6%</td></tr>
<tr><td>0.06 – 0.12</td><td>64.79</td><td>18.4%</td><td>898.73</td><td>16.7%</td></tr>
<tr><td>0.12 – 0.5</td><td>136.36</td><td>38.8%</td><td>2433.73</td><td>45.2%</td></tr>
<tr><td>> 0.5</td><td>103.72</td><td>29.5%</td><td>1548.71</td><td>28.7%</td></tr>
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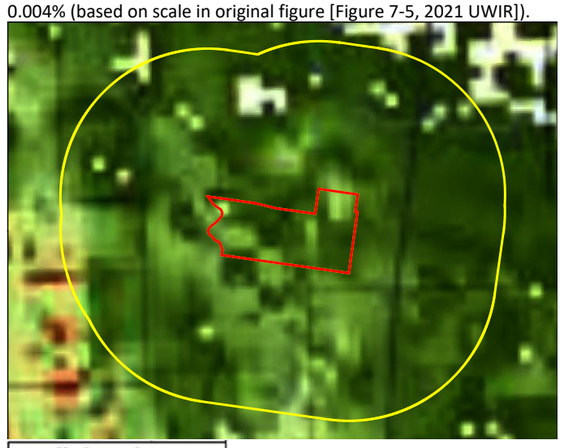
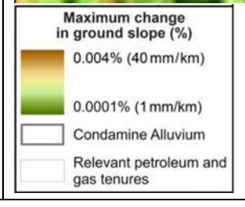
</td>
<td>Lot on plan approximate predicted maximum change in ground slope 0.0001% to 0.00205% (based on scale in original figure [Figure 7-5, Draft 2021 UWIR]). Surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.004% (based on scale in original figure [Figure 7-5, 2021 UWIR]).<br>  <br>  </td>
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<tr><th>Lot on Plan</th><th>Qld Land Use Mapping (Queensland Government, 2021)</th><th>2020 Imagery</th><th>2020 DEM 10m x 10m slope (%)</th><th>Draft 2021 UWIR maximum change in ground slope (%) (OGIA, 2021)</th></tr>
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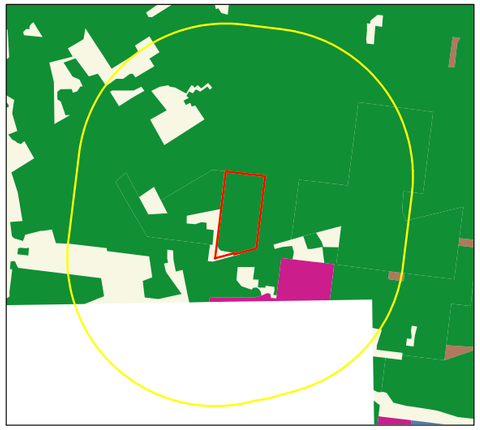
<td>1RP83755</td>
<td>Lot on plan mapped as cropping and grazing native vegetation. Surrounding land use (within 3km buffer) (within tenure) includes cropping, irrigated cropping, grazing native vegetation and other minimal use.<br> 
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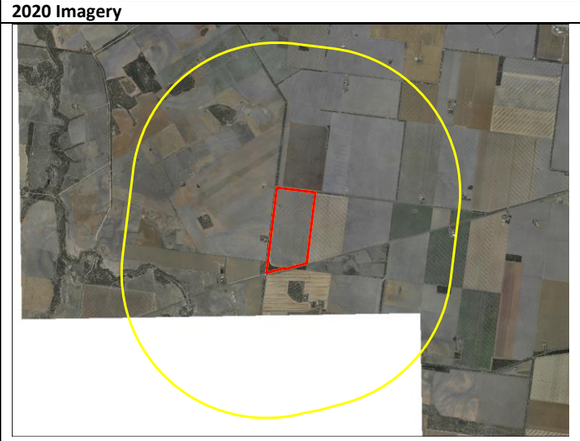
<td>  </td>
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<tr><td>0.03 – 0.06</td><td>11.51</td><td>8.8%</td><td>272.44</td><td>8.2%</td></tr>
<tr><td>0.06 – 0.12</td><td>33.23</td><td>25.4%</td><td>743.35</td><td>22.5%</td></tr>
<tr><td>0.12 – 0.5</td><td>74.4</td><td>56.8%</td><td>1769.06</td><td>53.5%</td></tr>
<tr><td>> 0.5</td><td>7.69</td><td>5.9%</td><td>419.27</td><td>12.7%</td></tr>
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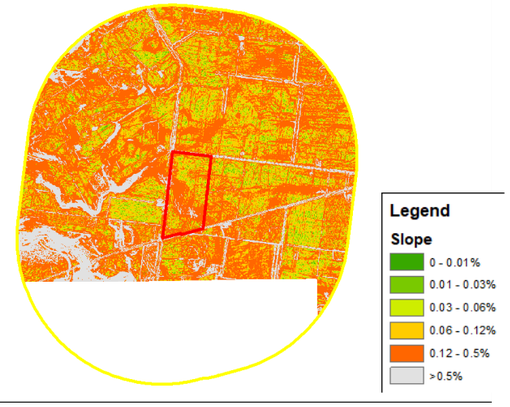
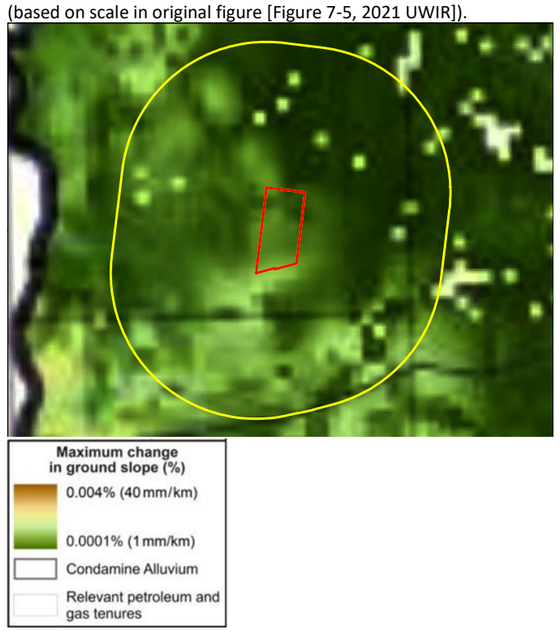


</td>
<td>Lot on plan and surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.00205% (based on scale in original figure [Figure 7-5, 2021 UWIR]).<br> 
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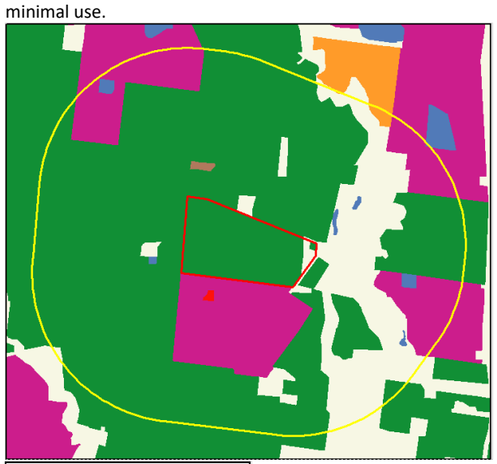
<td>Lot on plan mapped as cropping and grazing native vegetation. Surrounding land use (within 3km buffer) (within tenure) includes cropping, irrigated cropping, grazing native vegetation, farm infrastructure, dams, services and other minimal use.<br> 
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<table>
<tr><th rowspan="2">Slope Class</th><th>Hectares</th><th>%</th><th>Hectares</th><th>%</th></tr>
<tr><th colspan="2">Within Lot on Plan</th><th colspan="2">Outside Lot on Plan but within 3km buffer</th></tr>
<tr><td>< 0.01</td><td>1.49</td><td>0.5%</td><td>17.38</td><td>0.3%</td></tr>
<tr><td>0.01 – 0.03</td><td>11.36</td><td>3.4%</td><td>131.54</td><td>2.6%</td></tr>
<tr><td>0.03 – 0.06</td><td>34.54</td><td>10.4%</td><td>386.8</td><td>7.6%</td></tr>
<tr><td>0.06 – 0.12</td><td>90.74</td><td>27.5%</td><td>1020.51</td><td>19.9%</td></tr>
<tr><td>0.12 – 0.5</td><td>177.48</td><td>53.7%</td><td>2379.85</td><td>46.5%</td></tr>
<tr><td>> 0.5</td><td>14.95</td><td>4.5%</td><td>1180.77</td><td>23.1%</td></tr>
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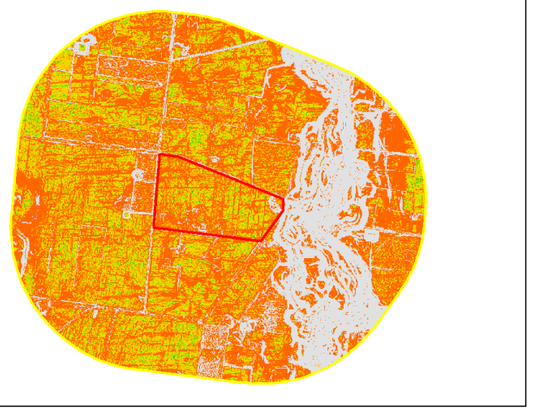
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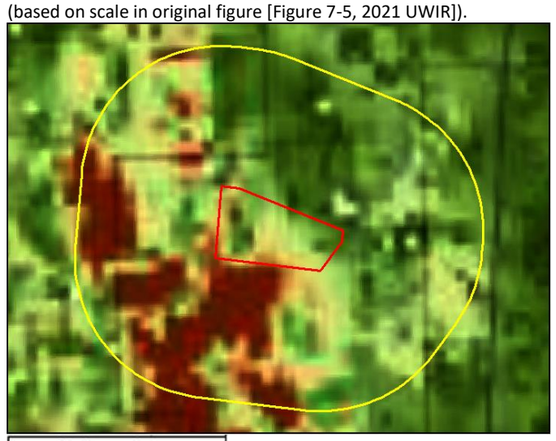
<td>Lot on plan and surrounding area (within 3km buffer) approximate predicted maximum change in ground slope 0.0001% to 0.004% (based on scale in original figure [Figure 7-5, 2021 UWIR]).<br> 
</td>
</tr>
</table>

# Appendix 9: Extract of WWMP - Section 7 Subsidence Assessment and Monitoring

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# 7. SUBSIDENCE ASSESSMENT AND MONITORING

A technical memorandum relating to subsidence was prepared to support development of the Stage 1 CSG WMMP and to address the requirements of condition 13(g) and is provided in Appendix K.

## 7.1 Baseline monitoring

Monitoring of subsidence was carried out by Altamira using satellite borne Interferometric Synthetic Aperture Radar technology (InSAR), a radar technique used in geodesy and remote sensing (Altamira, 2016). Data was obtained from Radarsat-2 satellite images covering 10,736 km$^2$ of Arrow SGP leases. InSAR makes use of the amplitude and the absolute phase of the return signal data to enable accurate determination of surface elevation. The change in phase difference between locations can be used to interpret changes in relative position, and indicate subsidence for different regions within areas potentially affected by CSG drawdown.

The InSAR data provides a baseline from which future data can be assessed to determine changes in vertical ground elevation, and also provides a snapshot of current vertical ground movement.

## 7.2 Assessment of subsidence

Predictions of drawdown resulting from the Action underpin the predictions of potential subsidence.

### 7.2.1 Predicted subsidence

The method for predicting subsidence is presented in detail in Appendix K.

When assessing subsidence impacts, consideration was given to both the absolute subsidence magnitude, as well as differential settlement.

Predicted subsidence effects on general farmland, small dams, and river hydrology, for movements of less than 100 mm over a distance of 1 km, are not considered likely to result in adverse impacts. Farmhouses, farm sheds and other small buildings can be assessed under the criteria for other buildings and structures.

Mines and mine infrastructure are typically subject to local ground movement associated with the mining operation and are also considered unlikely to be adversely affected by the anticipated magnitudes of CSG induced subsidence.

Assessed subsidence contours associated with predicted drawdown from Arrow operations only and cumulative cases for 2030 and 2050 for both the high and low settlement assumptions are presented in Figures 7.1 and 7.2 respectively.

Figures 7.3 and 7.4 present the predicted subsidence at 2030, for the high assessment, overlaid upon the Arrow SGP drainage areas for each scenario (Arrow only and cumulative cases respectively).

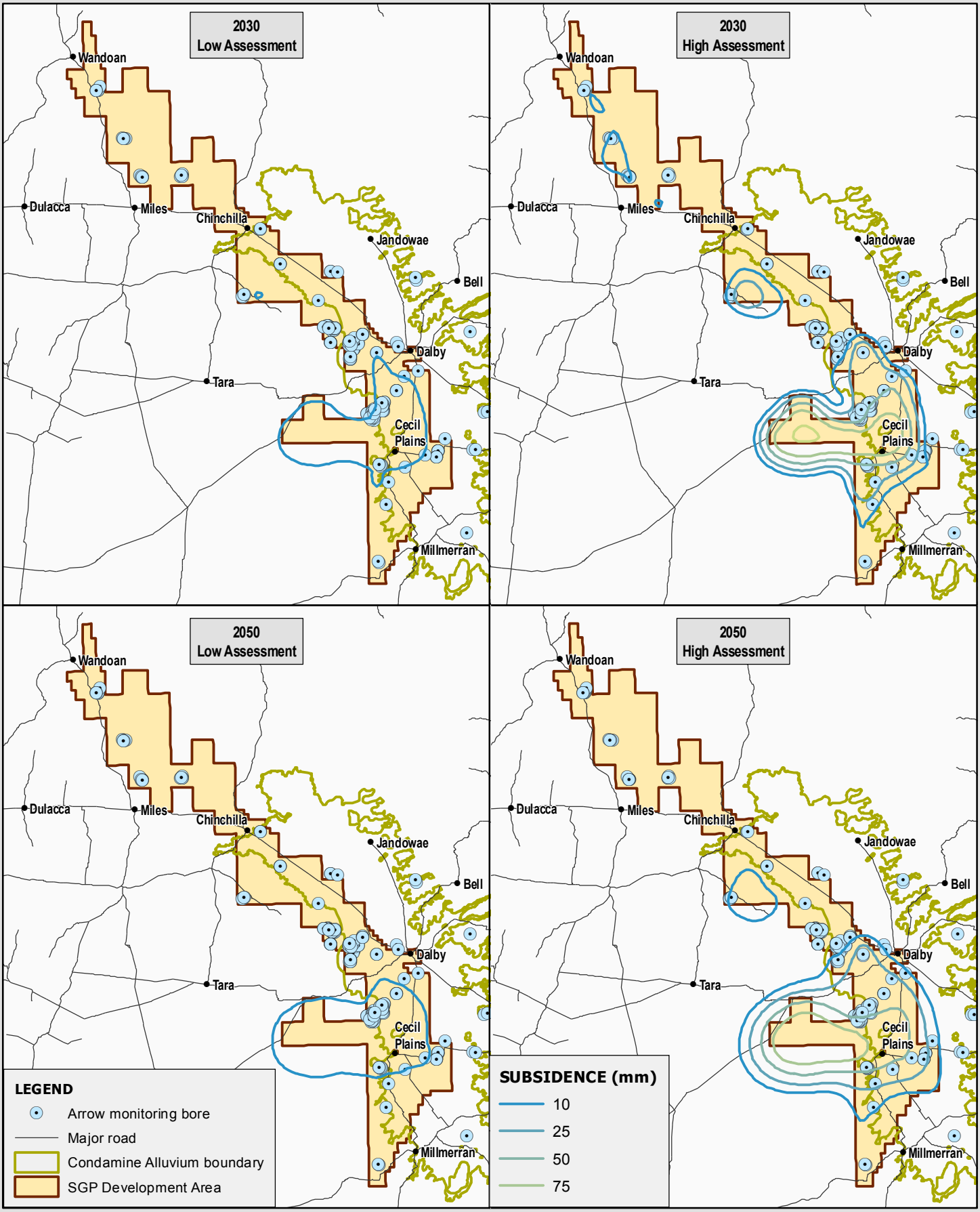


**Figure 7.1** **Subsidence assessment - Arrow only case**

**Source:**
Arrow Energy Pty Ltd
Coffey

Date: 14/07/2017
Issued To: Arrow Energy
Author: grant.young

0 10 20 40 60 80 100 120
Kilometres
Scale: 1:2,000,000 @ A4
Coordinate System: GDA 1994 MGA Zone 56

N

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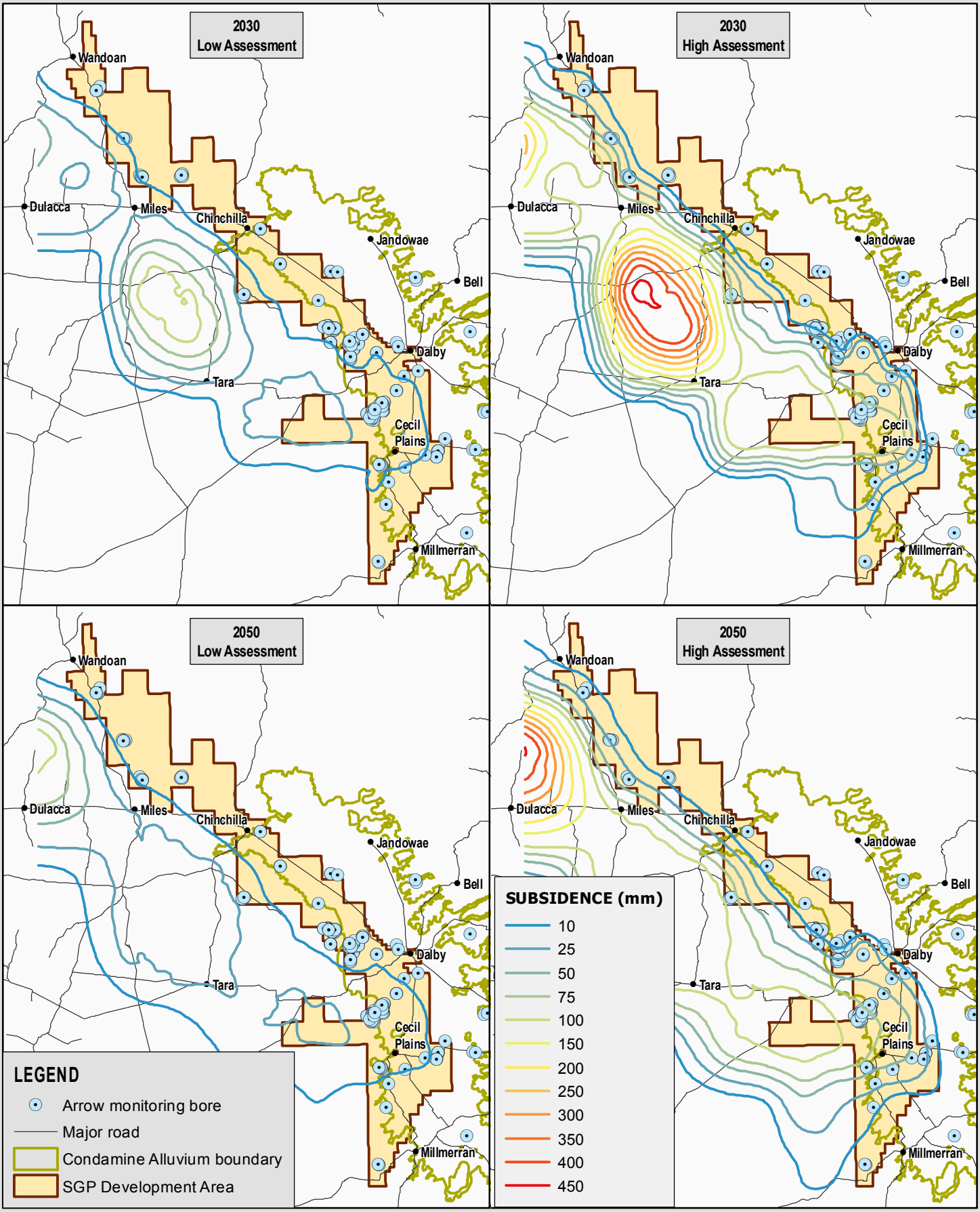


**Figure 7.2** **Subsidence assessment - cumulative case**

**Source:**
Arrow Energy Pty Ltd
Coffey

Date: 14/07/2017
Issued To: Arrow Energy
Author: grant.young

0 10 20 40 60 80 100 120
Kilometres
Scale: 1:2,000,000 @ A4
Coordinate System: GDA 1994 MGA Zone 56

N

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Document: \\Abifarcv01\data$\GIS\20484_ENAU\ABTF_Arrow_Surat\Arrow\SuratGIS\MXD\20484AA_R01\20484AA_R01_GIS040A_v0.mxd

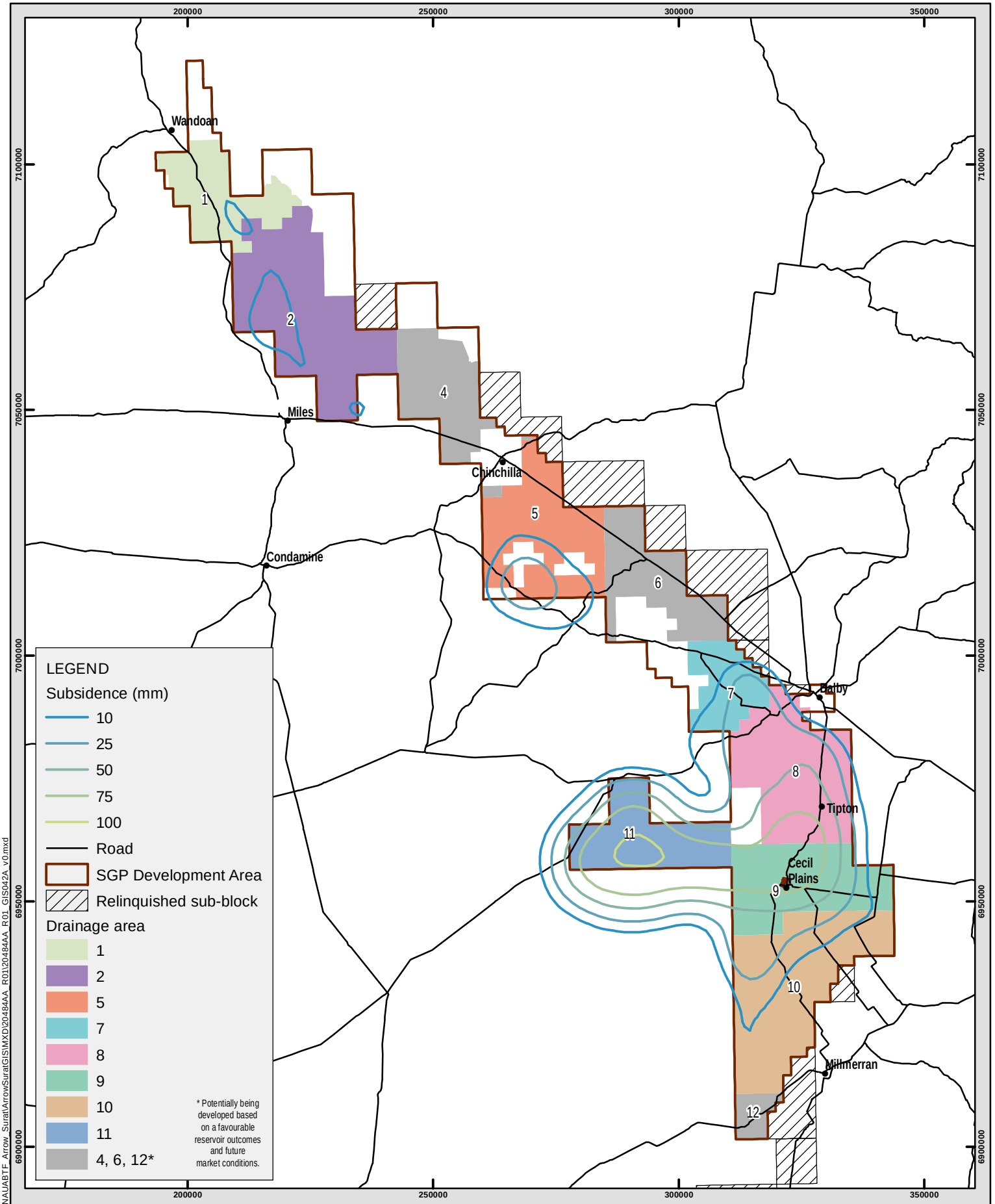


Figure 7.3 Predicted subsidence 2030 High assessment - Arrow only case

Source:
Arrow Energy Pty Ltd
Coffey

Date: 8/11/2017
Issued To: Arrow Energy
Author: Helen.Unkovich

0 5 10 20 30 40 50 60
Kilometres
Scale: 1:1,000,000 @ A4
Coordinate System: GDA 1994 MGA Zone 56

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Document: \\Abfarcv01\data$\GIS\20484_ENAUABTF_Arrow_Surat\ArrowSuratGIS\MXD\20484AA_R01\20484AA_R01_GIS042A_v0.mxd

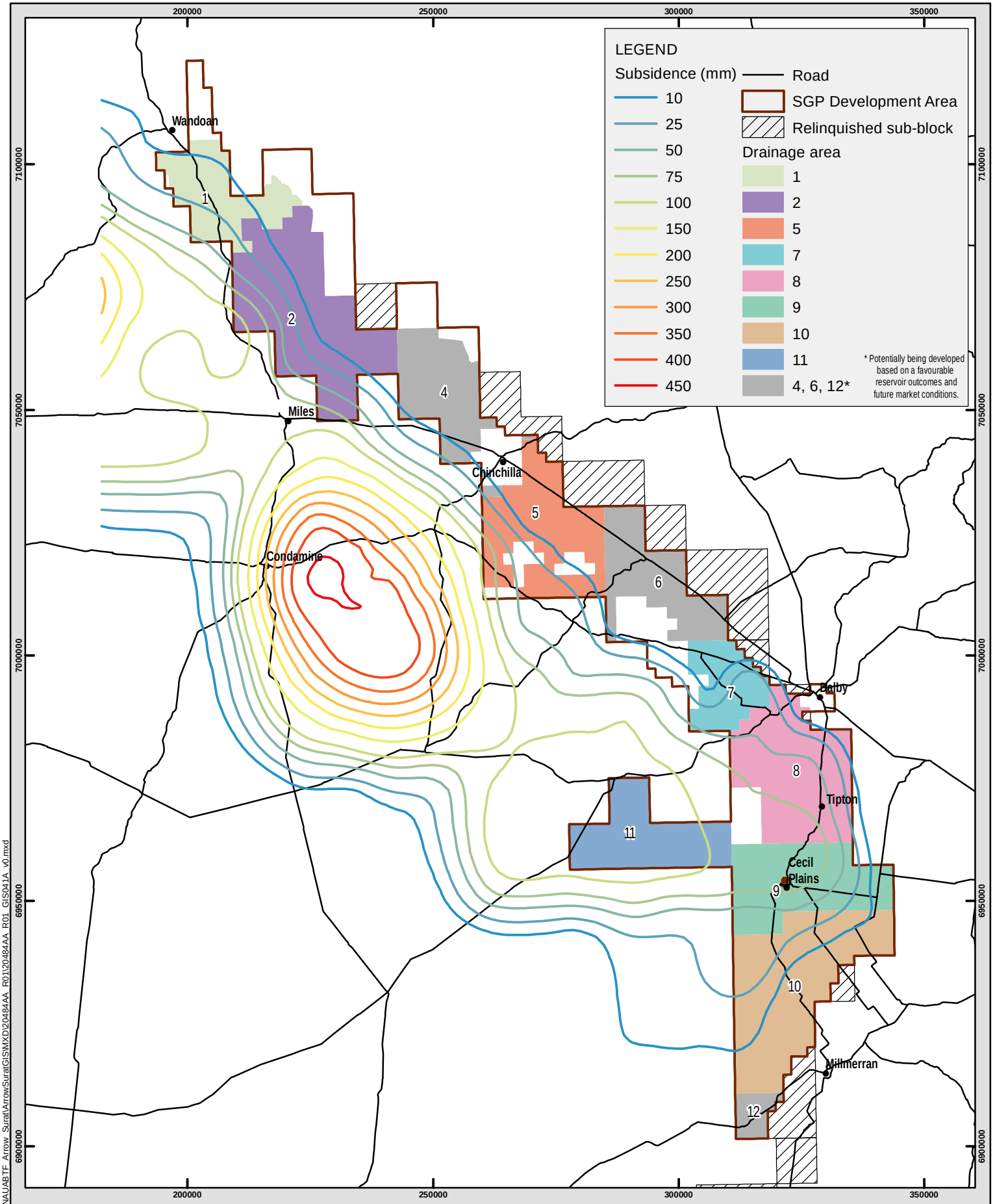


Figure 7.4 Predicted subsidence 2030 High assessment - Cumulative case

Source:
Arrow Energy Pty Ltd
Coffey

Date: 27/11/2017
Issued To: Arrow Energy
Author: Helen.Unkovich

0 5 10 20 30 40 50 60
Kilometres
Scale: 1:1,000,000 @ A4
Coordinate System: GDA 1994 MGA Zone 56

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## 7.3 Risk assessment

Risks associated with subsidence caused by CSG extraction were assessed using the approach set out in the Australian and New Zealand Standards Association Handbook SA/SNZ HB 89:2013. Under this approach, an 'event' is considered as CSG induced subsidence movement affecting an existing asset.

The likelihood of subsidence of a particular magnitude was assessed by reference to the subsidence measured to date, and the predictions for future subsidence. The consequence of an event of particular magnitude was assessed based on the nature of an asset and its sensitivity to movement.

## 7.4 Subsidence trigger thresholds

Trigger thresholds have been developed for CSG induced [22]subsidence as required by approval condition 13(g). They are derived from calculated risk assessments of potential subsidence, and taking into account the outcomes of the risk assessment process.

An initial screening level has been set to identify areas for targeted further assessment of settlement and evaluation of whether the trigger thresholds have been exceeded. The general assessment process that will be implemented is presented in Figure 7.5.

### 7.4.1 Screening level

Initial screening will involve identification of areas where significant subsidence is occurring based upon the annual rate of subsidence reported from InSAR monitoring results. This initial screening will involve identification of areas of 1 km by 1 km where more than 50% of the InSAR monitoring points indicate an annual subsidence rate of more than 8 mm/yr (a movement rate discernible using InSAR methods). In areas where this level of movement is recorded, further assessment will be carried out to assess whether the investigation levels as nominated in section 7.4.2 are exceeded.

### 7.4.2 Investigation Levels

In areas where the screening level is exceeded, further assessment of relevant data relating to subsidence will be undertaken. This will include an assessment of the CSG-related subsidence component of the reported InSAR measurements with consideration for the cumulative industry impact and reported subsidence since the commencement of the Action.

Investigation levels have been defined as set out in Table 7.1. Where the CSG-related subsidence exceeds the investigation levels set out in Table 7.1, further assessment will be carried out to assess the site-specific infrastructure that may be impacted and identify whether an impact has occurred as a result of the Action.

[22] Subsidence rates that have non-CSG influences (i.e. natural fluctuation and other anthropogenic influences) removed

### 7.4.3 Trigger threshold

Where the investigation levels nominated in Table 7.1 are breached additional investigation of the affected area will be carried out using conventional survey methods for a period of six months. The results of the survey will be tested against asset-specific thresholds (refer Appendix K for further detail). For example in the case of structures, assessment of damage categories as a result of ground movement would be based upon the guidance presented in Burland, 2012.

Where adverse impacts are identified to have occurred based on the results of the site-specific investigation, a trigger threshold is considered to have been exceeded and mitigation measures will be employed following the approach set out in Section 7.4.3.

### 7.4.4 Trigger threshold exceedance response actions

Approval condition 13(g) requires the development and implementation of an action plan to address identified subsidence impacts within 90 calendar days of a trigger threshold being exceeded.

Trigger threshold exceedance response actions are dependent on the evaluation of the cause of the exceedance, and if the potential for detrimental impacts is confirmed, a mitigation (action) plan will be developed and implemented within 90 days to minimise impact. The mitigation plan will:

- Identify potential mitigation measures and response actions.
- Select suitable response actions, tailored to site-specific conditions, impact cause, timing and magnitude.
- Evaluate time frames within which impacts would be expected to occur and within which mitigation actions would need to be successful.
- Schedule mitigation implementation, with consideration for the anticipated timing of the indicated impact.
- Contain procedures to evaluate the effectiveness of the mitigation measures.

Where an action plan is not developed and implemented within 90 calendar days of the identified trigger threshold exceedance this represents a non-compliance and the Minister will be notified.

| Item | Description | Criteria | Relevant assets | Basis for selection / comment |
|---|---|---|---|---|
| **Screening level** | Settlement rate | 8 mm/year (for >50% of sampling points in 1 km by 1 km block) | All natural features, man-made features and built infrastructure | Areas where this criterion is exceeded will be subject to investigation of subsidence (refer Appendix K). |
| **Investigation levels** | Gradient change | 0.03 % (300 mm per 1,000 m) | Irrigation system (laser levelled) | Based upon half the slope of minimum grades recommended by the Cotton Research and Development Corporation for furrow irrigation. Areas where this criterion is exceeded will be subject to investigation of subsidence (refer Appendix K), including review of laser levelling practices. |
| | Differential settlement (built infrastructure) | 0.001 m/m | Buildings, structures | • Selected for buildings as the most sensitive item in this group (refer Appendix K).<br>• Not relevant to linear infrastructure (roads, rail, transmission lines and pipelines) as predicted differential settlement is well within the tolerance of these facilities.<br>• Not relevant to bushland or farmland. |
| | Change in slope (natural features) | 25 mm/1,000 m | Flood flow in watercourses | • Taken as 5% of topographic gradient of the Condamine Plain.<br>• Applies only to the main channel of the Condamine River.<br>• Review of effects on flow and conventional survey would be carried out to assess the significance of the change. |
| **Trigger threshold** | Outcome of site specific monitoring using conventional survey and review of risk to asset. | Individual threshold based on the local conditions | Irrigation system, structure or watercourse | • Site specific assessment based upon conventional survey of identified asset. In the case of potential impacts on structures within populated areas the assessment will be based upon selected structures considered to be most vulnerable. |

**Table 7-1. Subsidence monitoring screening level, investigation levels and trigger threshold**

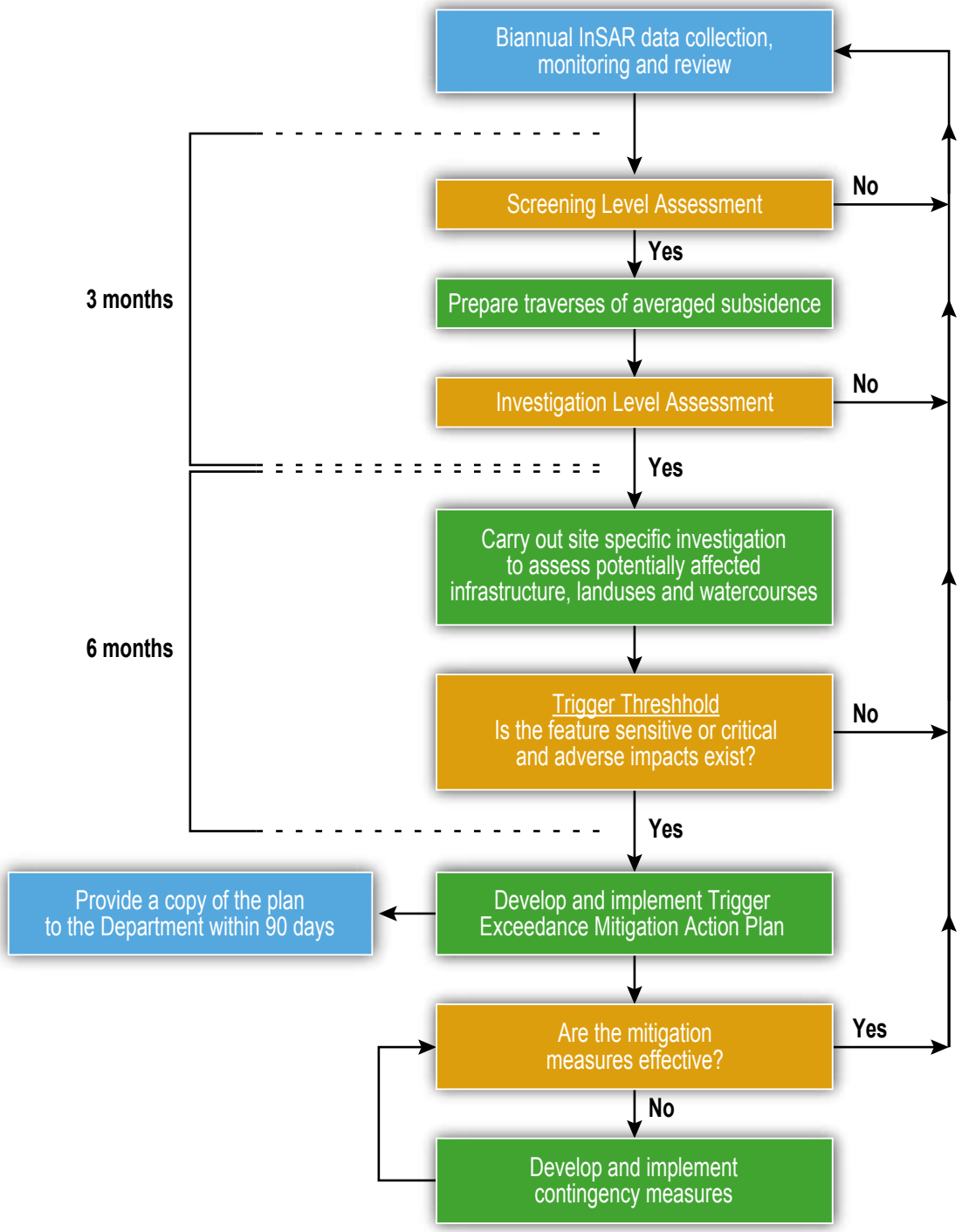


**Figure 7.5** **Subsidence monitoring assessment flow chart**

**Source:**
Coffey

Date: 19/09/2018
Issued To: Arrow Energy
Author: Helen.Unkovich / Richard.heath

## 7.5 Monitoring program

The current monitoring program provides groundwater level monitoring, and monitoring of subsidence using InSAR technology. InSAR technology provides high resolution and wide coverage, however separate geodetic measurement of ground movement will be taken at selected locations to provide a ground-truthing check and control on the InSAR results.

### 7.5.1 Measurement techniques and subsidence monitoring stations

Measurement techniques that can contribute to the assessment of subsidence impacts include:

- Tiltmeters, to measure small changes in ground slope.
- Survey using traditional or GPS methods.
- Extensometers in boreholes.
- Condition assessments of structures at risk.

Of these methods, the use of extensometers and survey to ground truth-the results of InSAR monitoring are considered most useful. Extensometers allow identification of the horizons in the ground profile contributing to surface settlement.

Locations for geotechnical ground movement monitoring will be co-located with groundwater monitoring bores where possible to provide coverage of the full ground profile potentially influenced by the SGP. Instrumented sites will be preferentially located at the centre of selected SGP well-fields, and will be installed to provide baseline information prior to the initiation of water production. The timing of monitoring location installation will reflect the FDP sequencing.

Figure 7.6 sets out locations recommended for establishment of subsidence monitoring stations that would comprise:

- Groundwater monitoring at multiple locations including within, above and below the WCM.
- Geodetic ground movement (vertical) monitoring monument (installed to avoid shrink swell movement of the upper soils).

In addition, at one station (SMS1 in Drainage Area 11, refer Figure 7.6) an extensometer array will be installed to separately record compression within the Juandah Coal Measures and the Taroom Coal Measures (member of the WCM subgroup).

### 7.5.2 Ongoing monitoring

Measurement of settlement and extensometers is proposed on an initially monthly frequency. Ongoing reviews of the baseline established will determine when changeover to monitoring commences on a quarterly basis (with associated continuous groundwater level measurement using data loggers).

A program for ongoing monitoring will be implemented to confirm that subsidence is within the predicted behaviour of the strata over time. Where deviation from predictions is observed, revised predictions will be prepared and assessment of the significance of the predictions made.

InSAR data updates will be received on a bi-annual basis. Review of the updated InSAR data will be undertaken within 3 months of the data being received.

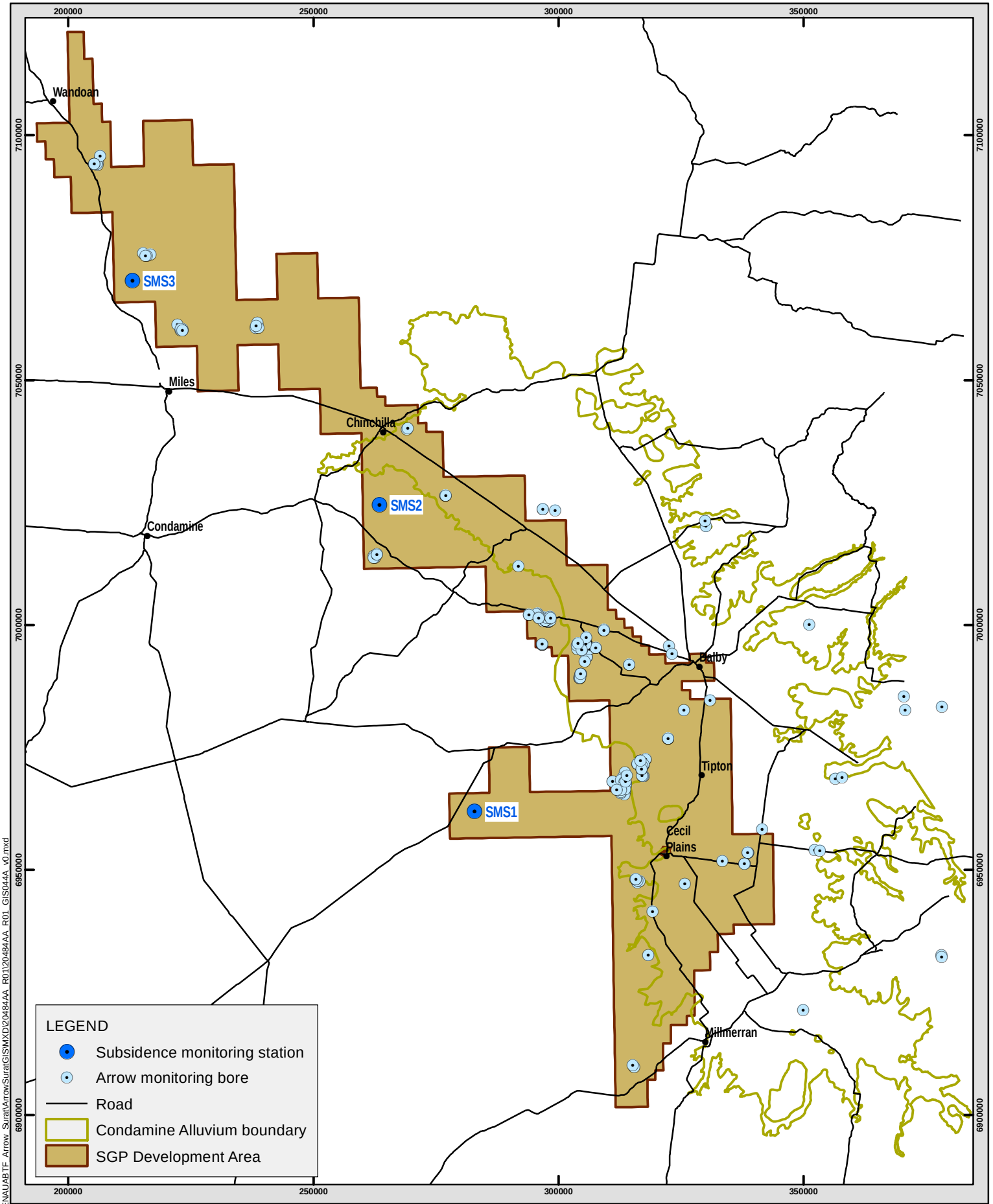


Figure 7.6 Subsidence monitoring stations

Source:
Arrow Energy Pty Ltd
Coffey

Date: 27/11/2017
Issued To: Arrow Energy
Author: Helen.Unkovich

0 5 10 20 30 40 50 60
Kilometres
Scale: 1:1,000,000 @ A4
Coordinate System: GDA 1994 MGA Zone 56

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# Appendix 10: Summary of Consultation (Confidential – Not for Public Release)

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