Senex

Louisiana EA Amendment Supporting Information Report

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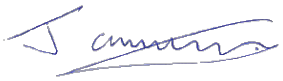
Approved by	J. Cumpstay Environment Manager	**Signed**		**Date:** 03/06/24
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Executive Summary

Senex Assets 2 Pty Ltd (ACN 650 731 918), a wholly owned subsidiary of Senex Energy Pty Ltd (ACN 008 942 827) seeks to authorise the construction and operation of the following regulated and low consequence structures (dams to manage produced water from the development of PL 209 and PL 445).

Authorised Petroleum Activity	Scale	Intensity
Regulated Structures	3	75 ha
Low Consequence Structures	5	25 ha

Petroleum activities are currently authorised on PL 209 and PL 445 by Environmental Authority (EA) P-EA-100112777 (the existing EA). The existing EA contains a Schedule of conditions (Schedule J) specific to the design, construction and operation of regulated and low consequence dams as a result of the previous tenure holder (APLNG) envisaging that such infrastructure would be required. However, the associated Environmentally Relevant Activity is not listed on the EA, and regulated and low consequence structures are not included in the schedule of disturbance (Schedule A - Table 1).

Senex commits to undertaking the proposed activities in strict compliance with the existing Schedule J conditions in P-EA-100112777. This is in accordance with the principles of outcome focused conditioning.

The specific location/s of the proposed infrastructure is not yet known. However, Senex has completed the following works to identify potential dam locations, associated Environmental Values (EVs) and risks:

1. Conceptual Dam Location Assessment
2. Environmental Values (EV) assessment for conceptual locations
3. Preliminary Consequence Category Assessment (CCA)
4. Preliminary Basis of Design (BoD)

Further, with the implementation of Senex planning and management controls (Sections 4 and 5) identified EVs ('constraints' for the purposes of Senex's Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development' (Appendix D)) will in order of preference be avoided, minimised or mitigated.

Specifically:

1. No Environmentally Sensitive Areas (ESAs) will be cleared.
2. As non-essential petroleum activities, the proposed regulated and low-consequence structures will not be located within the primary protection zones of ESAs.
3. No remnant or regrowth vegetation with habitat value for NC Act threatened species (CE, E, V and NT) will be cleared.
4. Proposed activities will result in disturbance within areas of Koala and Southern Squatter Pigeon dispersal and Echidna habitat. However, as per assessment against the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (December 2014) no significant residual impact will result.
5. The Senex Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development will be implemented to ensure impacts to other environmental constraints are first avoided, then minimised, then mitigated.
6. Structures will be constructed above the 1:100 Annual Exceedance Probability flood level for stream order 2 or higher watercourses.
7. All Structures will be designed, constructed and operated in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933), the guideline Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/2016/1934)* and the conditions of Schedule J of the existing EA.
8. Structures are designed to be no-release and design controls as per the relevant guidelines and manuals will be implemented to ensure ongoing safe operation.
9. The CCAs (Appendix G) and preliminary dam basis of design (Appendix H) demonstrate compliance with relevant guidelines and manuals. They also demonstrate that controls implemented during dam

design, construction and operation are a function of the consequence category assessment and independent of location.

10. Environmental risk is managed by preventative controls required by the dam planning and design conditions of the existing EA.
11. Under existing EA conditions (J1) – (J5) a CCA must be completed and certified by a suitably qualified and experienced person and in accordance with the requirements of the dam manual.
12. Dam design requirements are set by the outcome of a CCA and:
    a) mitigate known risks; and
    b) are sufficiently comprehensive to also account for any site-specific geotechnical data.

    As a result, risk of environmental harm occurring operates independently of location.
13. EVs in the vicinity of each identified conceptual dam location have been identified and are described in section 8.
14. Air emissions will be limited to vehicular emissions from up to 20 vehicles and dust and particulate emissions generated by short-term construction activities. Dust generation will be managed through the standard process of dust suppression.
15. Acoustic emissions will be limited to construction activities and relate to operation of construction plant and equipment. There are a limited number of sensitive receptors in and around PL 209 and PL 445 (Figure 7-1) and where construction activities may occur within identified noise buffer zones (1,200m[1]) of a sensitive receptor Senex will (in order of preference):
    a) negotiate an alternate arrangement;
    b) implement noise mitigation controls; or
    c) amend the planned location.

Based on the above, the proposed amendment will not cause environmental nuisance or adverse impacts to identified EVs.

[1] Table 13-4 of this report.

1. Introduction

1.1. Overview

Senex Assets 2 Pty Ltd (ACN 650 731 918), a wholly owned subsidiary of Senex Energy Pty Ltd (ACN 008 942 827), has prepared this Supporting Information Report to accompany an application to amend Environmental Authority (EA) P-EA-100112777 for Petroleum Leases (PLs) 209 and 445 under Section 224 of the *Environmental Protection Act 1994* (EP Act). PL 209 and PL 445 are located approximately 20 kilometres (km) southwest of Wandoan in southwestern Queensland (Figure 1-1).

PL 209 and PL 445 form part of a larger development area with the immediately adjacent Senex tenures PL 1037 and Authority to Prospect (ATP) 2059 (PLA 1127). Parts of this larger group of tenures form Senex's Atlas Stage 3 Gas Project for which a separate referral under the *Environment Protection and Biodiversity Conservation Act 1999* has been submitted to the Commonwealth Department of Climate Change, Energy, Environment and Water (DCCEEW)[2], and subsequent assessment via preliminary documentation is ongoing.

The boundary for the proposed Atlas Stage 3 Gas Project over PL 209 and PL 445 is shown in Figure 1-1 and serves as the spatial extent for development considered within this proposed Environmental Authority (EA) amendment. Proposed infrastructure the subject of this amendment will not be located to the south of the Atlas Stage 3 Gas Project referral area boundary on PL 209. For clarity, terms associated with the various tenures and development footprints in this application are detailed in Table 1-1.

Table 1-1: Application Terminology

Term	Definition
Atlas	PL 1037 (EA0001207)
Atlas Stage 3 Gas Project Area	Those parts of ATP 2059, PL209, PL 445 and PL 1037 within the EPBC referral area shown in red on Figure 1-1.
Atlas Stage 3 Gas Project Field Development Area	The area used to demarcate the various impact assessment studies associated with the Atlas Stage 3 Gas Project (9,772 ha) and excludes the area of PL 1037 to the west of Woleebee Creek because activities within this area are already authorised under the PL 1037 EA. This area is shown in yellow hatching on Figure 1-1 and on all maps within Section 8.1.
Development Footprint	The on-ground disturbance required to construct the infrastructure proposed in this amendment application.
Existing EA	The authorised EA for PL 209 and PL 445 – P-EA-100112777.
Project Area	Those parts of PL 209 and PL 445 within the EPBC referral area shown in red on Figure 1-1.
Tetris	ATP 2059 (PLA 1127) (EA0002524 / P-EA-100511582)

PL 209 and PL 445 were acquired by Senex from APLNG in 2019, and the EA transferred to Senex with a full suite of conditions covering the design, construction and operation of regulated and low consequence structures (Schedule J of P-EA-100112777). However, the Environmentally Relevant Activity (ERA) for regulated structures was not included on the EA and regulated structures were not included in the table of disturbance (Schedule A: Table 1 – Authorised Petroleum Activities*)*. Following email advice from the then Department of Environment and Science (DES) (now Department of Environment, Science and Innovation (DESI)) this amendment application seeks to authorise the construction and operation of water management infrastructure (dams) and involves the addition of the following ERA to the existing EA:

[2] EPBC 2022/09410

- Schedule 3, item 6: a petroleum activity carried out on a site that contains a high consequence dam or a significant consequence dam if the dam forms part of the activity.

This EA application comprises the following documents:

- A completed application form;
- Supporting Information Report; and
- Appendices.

As the dams are still in the planning phase within Senex, their exact location is not yet known and cannot be finalised until after detailed negotiations with landholders and subject to the approval of this application. However:

- Areas where regulated or low consequence structures could be constructed have been identified (Figure 4-2 and Appendix A);
- EVs for these locations have been identified (Section 8);
- Two Consequence Category Assessments (CCAs) – one for produced water and one for brine – covering all identified potential locations and required failure scenarios are presented in Section 0; and
- A preliminary Dam Design Plan has been prepared and attached which addresses construction requirements for all potential locations.

Bow-tie risk assessments (a best practice approach to build a complete picture of risk to understand the causes, controls and effects) have also been undertaken for each of the three CCA scenarios (seepage, overtopping, and breach). These are provided with this report (Appendix I), to demonstrate that:

- the overwhelming majority of controls are preventative and operate in isolation from location and proximity to Environmental Values (EVs); and
- construction requirements and controls remain the same regardless of location.

Senex notes that:

- Regulated and low consequence structures are designed to be **no-release structures**.
- The requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*' (ESR/2016/1933) (the 'dam manual') mean that dam design is driven by the outcome of the CCA rather than site-specific environmental values.
- The nature of regulated structures and the requirements of the dam manual means that almost all management controls and mitigations are preventative.
- Regulated structures must be operated in accordance with a Dam Operating Plan, with a heavy focus on monitoring and maintenance to ensure structural integrity and that risks are managed to ALARP.

1.2. Purpose

Senex's existing gas supply commitments to domestic Australian users requires ongoing development of its production tenures. For Coal Seam Gas (CSG) developments, increased gas production, is generally also linked to increased water production as coal seams are required to be depressurised to allow gas to desorb and flow to the surface. This 'produced' water is required to be safely and appropriately stored and managed via treatment or beneficial re-use.

Senex originally planned to use existing water storage facilities on the Senex owned and operated PL 1037 for produced water from PL 445 and PL 209. However, revisions to the water balance model have identified the need for additional CSG water or brine storage dams associated with PL 445 and PL 209 (Appendix B).

This amendment application seeks to authorise the construction and operation of regulated and low consequence structures (dams) in the area of P-EA-100112777 to manage produced water from the development of PL 209 and PL 445.

Because the existing EA already includes the necessary and relevant conditions relating to regulated structures (Schedule J), this amendment application specifically seeks to add Schedule 3, Item 6 ERA to the existing EA and update the schedule of disturbance.

1.3. Associated Document References

This Supporting Information Report is an attachment to the EA application which has been made on the approved form (Queensland Department of Science (DES) *Application to amend an environmental authority – Application Form* (ESR/2015/1733 V21.02)). In support of this application, the following associated Senex documents are appended:

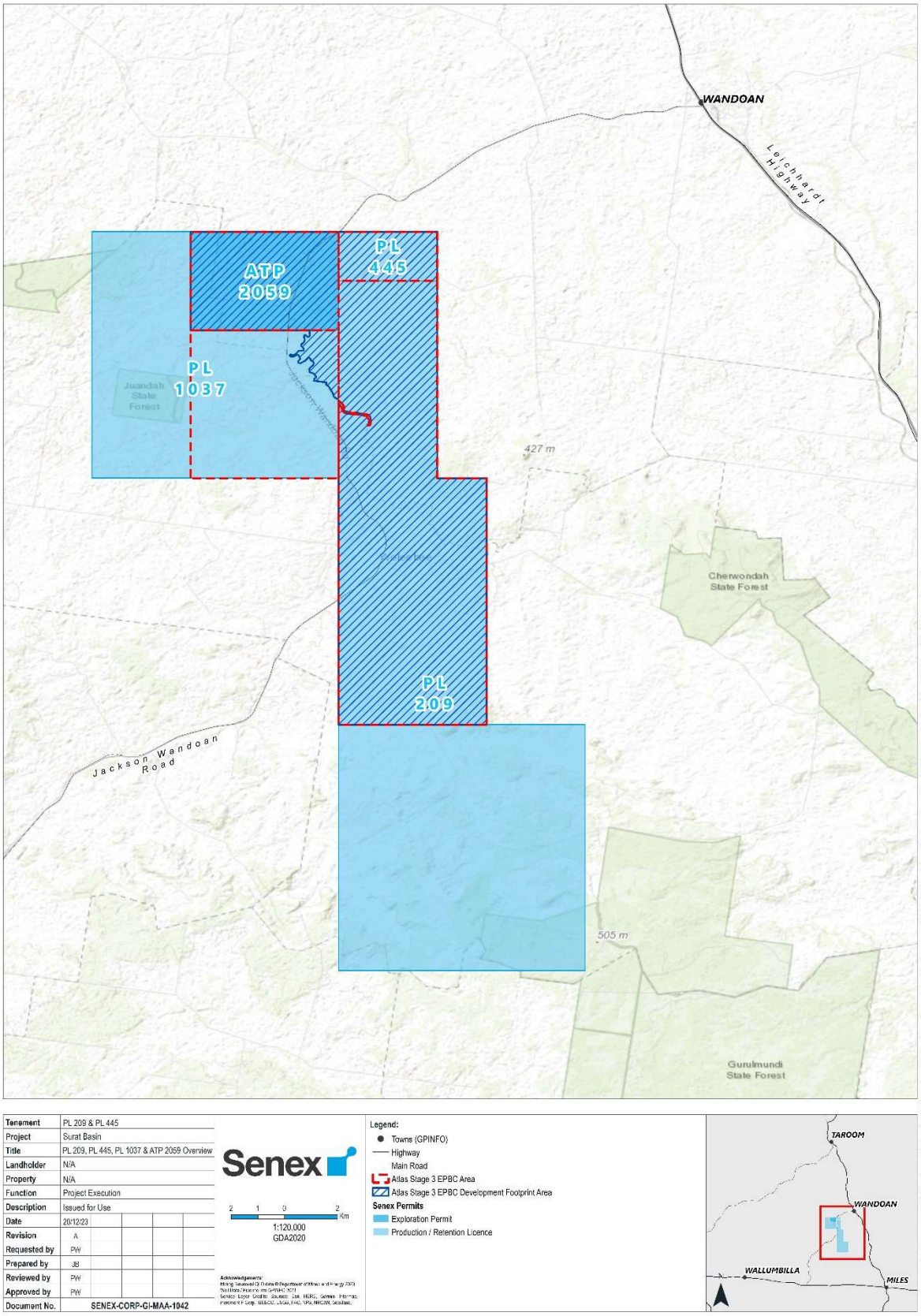
- Atlas Stage 3 Coal Seam Gas Water Management Plan (CSG WMP) (Appendix B)
- Environmental Management Plan Atlas Stage 3 Gas Project [SENEX-ATLS-EN-PLN-015] (Appendix C)
- Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development [OPS-ATLS-EN-PLN-001] (Appendix D)
- Waste Management Procedure (Appendix E)
- Senex Rehabilitation Plan (Appendix F)

1.4. Terms and Abbreviations

Table 1-2: Glossary

Term	Definition
AEP	Annual Exceedance Probability
ALARP	As Low As Reasonably Practicable
ATW	Access to Work
BoD	Basis of Design
CCA	Consequence Category Assessment
CSG	Coal Seam Gas
CSG WMP	Coal Seam Gas Water Management Plan
DDP	Dam Design Plan
DESI	Department of Environment, Science and Innovation
DCCEEW	Department of Climate Change, Energy, the Environment, and Water (Cwlth)
DSA	Design Storage Allowance
EA	Environmental Authority
EP Act	*Environmental Protection Act 1994*
EPP Air	Environmental Protection (Air) Policy 2019
EPP Noise	Environmental Protection (Noise) Policy 2019
EPP Waters and Wetland Biodiversity	Environmental Protection (Waters and Wetland Biodiversity) Policy 2019
ERA	Environmentally Relevant Activity

ESA	Environmentally Sensitive Area
ESCP	Erosion and Sediment Control Plan
ESS	Extreme Storm Storage
EV	Environmental Value
GCF	Gas Compression Facility
GDE	Groundwater dependent ecosystems
IAQM	Institute of Air Quality Management
km	kilometre
mm	millimetre
MNES	Matter of National Environmental Significance
MOL	Maximum Operating Level
MRL	Mandatory Reporting Level
MSES	Matter of State Environmental Significance. Also known as PEM.
NC Act	*Nature Conservation Act 1992*
PEM	Prescribed Environmental Matters as defined in Schedule 2 of the Environmental Offsets Regulation 2014. Also known as MSES.
PFL	Petroleum Facility Licence
PL	Petroleum Lease
PM2.5 / PM10	Particulate Matter (2.5 or 10 microns in size)
PMST	Protected Matters Search Tool
RE	Regional Ecosystem
RPEQ	Registered Professional Engineer Queensland
SMC	Streamlined Model Conditions for Petroleum Activities (ESR/2016/1989)
TEC	Threatened Ecological Community/ies
WCM	Walloon Coal Measures
WO	Wildlife Online



N.B. the hatched blue area shown on this map is the same area that is shown in the ecological mapping in Section 8 of this report.

Figure 1-1: Location Overview including PL 209, PL445 and Atlas Stage 3 Gas Project

2. Application Requirements

2.1. Mandatory Application Requirements

Chapter 5, Part 7, Division 2 of the *Environmental Protection Act 1994* (EP Act) prescribes the requirements for a properly made amendment application for an EA. Each requirement is outlined below with specific references to where the requirements are addressed in the application.

Table 2-1: Mandatory EA Amendment Requirements

EP Act Section	Requirement	Reference
224	EA may be amended by the holder	Senex is the holder of P-EA-100112777
225	Application cannot be made in certain circumstances	n/a
226(1)(a)	Application must be made to the administering authority	Application has been made to Department of Environment, Science and Innovation (DESI)
226(1)(b)	Application must be made in the approved form	Application made on form ESR/2015/1733 V21.01
226(1)(c)	Application must be accompanied by the prescribed fee	Senex will pay the prescribed fee on provision of relevant BPoint details by PaLM
226(1)(d)	Application must describe the proposed amendment	Section 3
226(1)(e)	Application must describe the land affected by the proposed amendment	Section 7
226(1)(f)	Application must include any other document relating to the application prescribed by regulation.	n/a
226(2)	Subsection (1)(d) and (e) do not apply to an application for a condition conversion	n/a
226AA	Requirement for amendment application to ensure consistency between EA and PRCP schedule	n/a
226A(1)(a)	Application must describe any development permits in effect under the Planning Act for carrying out the relevant activity for the authority	n/a
226A(1)(b)	Application must state whether each relevant activity will, if the amendment is made, comply with the eligibility criteria for the activity	n/a – application is to amend a site-specific EA.
226A(1)(c)	If the application states that each relevant activity will, if the amendment is made, comply with the eligibility criteria for the activity–include a declaration that the statement is correct	n/a
226A(1)(d)	Application must state whether the application seeks to change a condition identified in the authority as a standard condition	n/a
226A(1)(e)	If the application relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit–state whether the applicant seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit	n/a
226A(1)(f)	Application must include an assessment of the likely impact of the proposed amendment on the environmental values, including–	

EP Act Section	Requirement	Reference
226A(1)(f)(i)	A description of the environmental values likely to be affected	Section Sections 8 to 13
226A(1)(f)(ii)	Details of emissions or releases likely to be generated	
226A(1)(f)(iii)	A description of the risk and likely magnitude of impacts on the environmental values	
226A(1)(f)(iv)	Details of the management practices proposed to be implemented to prevent or minimise adverse impacts	Section 4 and Section 5
226A(1)(f)(v)	If a PRCP schedule does not apply for each relevant activity—details of how the land the subject of the application will be rehabilitated after each relevant activity ends	Section 5.6
226A(1)(g)	Application must include a description of the proposed measures for minimising and managing waste generated by amendments to the relevant activity	Section 5.7
226A(1)(h)	Application must include details of any site management plan or environmental protection order that relates to the land the subject of the application.	n/a
226A(2)	Subsection (1)(f) does not apply if an EIS process has been completed or the Coordinator-General has evaluated an EIS and there are Coordinator-General's conditions that relate to the proposed amendment	n/a
226A(3)	Certain subsections do not apply for a condition conversion	n/a
226A(4)	Despite subsections (1)(f), (g) and (h), certain subsections do not apply for an application for a prescribed Environmentally Relevant Activity (ERA) mentioned in the Environmental Protection Regulation 2019, Schedule 2, section 13A (commercial cropping and horticulture in Great Barrier Reef catchment)	n/a
226A(1)(h)	Application must include details of any site management plan or environmental protection order that relates to the land the subject of the application	n/a
226B	Requirements for amendment applications for PRCP schedules	n/a
227	Requirements for amendment applications–CSG activities	Section 227 applies to the proposed amendment, so the requirements of s126(1) and s126(2) of the EP Act need to be addressed (Table 2-2).
227AA	Requirements for amendment application–underground water rights	n/a

Table 2-2: Requirements for amendment applications—CSG activities

EP Act Section	Requirement	Reference
126(1)	A site-specific application for a CSG activity must also state the following—	
126(1)(a)	the quantity of CSG water the applicant reasonably expects will be generated in connection with carrying out each relevant CSG activity	Refer to Section 6.1
126(1)(a)	the flow rate at which the applicant reasonably expects the water will be generated;	Refer to Section 6.1.
126(1)(a)	the quality of the water, including changes in the water quality the applicant reasonably expects will happen while each relevant CSG activity is carried out;	Refer to Section 6.2.
126(1)(a)	the proposed management of the water including, for example, the use, treatment, storage or disposal of the water;	Refer to Section **Error! Reference source not found.**.
126(1)(a)	the measurable criteria (the management criteria) against which the applicant will monitor and assess the effectiveness of the management of the water, including, for example, criteria for each of the following— (i) the quantity and quality of the water used, treated, stored or disposed of; (ii) protection of the environmental values affected by each relevant CSG activity; (iii) the disposal of waste, including, for example, salt, generated from the management of the water;	Refer to Section 6.4
126(1)(a)	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 complied with in the future.	Refer to Section 6.4.
126(2)	The proposed management of the water can not provide for using a CSG evaporation dam in connection with carrying out a relevant CSG activity unless—	The proposed amendment does not include a CSG evaporation dam.
126(2)(a)	the application includes an evaluation of— (i) best practice environmental management for managing the CSG water; and (ii) alternative ways for managing the water; and (iii) the evaluation shows there is no feasible alternative to a CSG evaporation dam for managing the water.	n/a
126(3)	N/A	n/a

2.2. Environmentally Relevant Activities (ERA)

This amendment application seeks to add the following ERA to P-EA-100112777. Further details are provided in Section 3.1:

- Schedule 3 - 06 - a petroleum activity carried out on a site that contains a high consequence dam or a significant consequence dam if the dam forms part of the activity.

2.3. Assessment Level Decision

Section 223 of the EP Act defines the requirements that must be satisfied for an assessment level decision for an amendment application under section 228, to be decided as a minor amendment. Amendment

applications exceeding the thresholds are considered major amendments. Senex considers this EA amendment application to be a Major amendment, as outlined below.

Table 2-3 Minor Amendment Threshold

s.223 EP Act	Minor Amendment Threshold	Justification
(a)	Amendment is not a change to a condition identified in the authority as a standard condition	n/a
(b)	Amendment does not significantly increase the level of environmental harm caused by the relevant activity	Amendment seeks to add a new ERA and authorisation to construct up to 3 regulated structures with a maximum disturbance footprint of 75 ha; and up to 5 low consequence structures with a maximum disturbance footprint of 25 ha
(c)	Amendment does not change any rehabilitation objectives stated in the authority in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the authority	No
(d)	Amendment does not significantly increase the scale or intensity of the relevant activity	Amendment seeks to add a new ERA and authorisation to construct up to 3 regulated structures with a maximum disturbance footprint of 75 ha; and up to 5 low consequence structures with a maximum disturbance footprint of 25 ha
(e)	Amendment does not relate to a new relevant resource tenure for the authority that is (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the Geothermal Energy Act; or (iv) a new Greenhouse Gas (GHG) injection and storage lease under the GHG storage Act	No
(f)	Amendment involves an addition to the surface area for the relevant activity of no more than 10% of the existing area	No
(g)	For an environmental authority for a petroleum activity— (i) if the amendment involves constructing a new pipeline—the new pipeline does not exceed 150 km; and (ii) if the amendment involves extending an existing pipeline—the extension does not exceed 10% of the existing length of the pipeline	No
(h)	If the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—the amendment application under section 224 seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit.	No

3. Proposed Amendments

In order to support the construction and operation of regulated structures to appropriately manage produced water from the development of PL 209 and PL 445, Senex is seeking authorisation for the following amendments to P-EA-100112777:

- Amend the table on page 1 of P-EA-100112777, titled 'Environmentally Relevant Activity and Location Details' to add the ERA for high consequence or significant consequence dams; and
- Amend 'Schedule A: Table 1: Authorised Petroleum Activities' to include three regulated structures and five low consequence structures.

Because the justification and potential impacts to environmental values are the same for the abovementioned amendments, they are addressed holistically in the following subsections. Please note that proposed amendments / additions to P-EA-100112777 are in red text.

Importantly, it should be noted, that while this EA amendment application includes brine storage as an option, it does not propose any amendments to construct or operate water treatment plants (WTPs) or associated pipelines. Should these activities be required, then they will be subject to the outcome of a separate and future EA amendment application.

3.1. Amending the Environmentally Relevant Activity and Location Details table

Senex proposes to include the relevant ERA for high consequence or significant consequence dams as shown in Table 3-1.

Table 3-1: Environmentally Relevant Activity and Location Details

Environmentally Relevant Activity	Location(s)
Schedule 3 - 06 - a petroleum activity carried out on a site that contains a high consequence dam or a significant consequence dam if the dam forms part of the activity	PL 209
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	PL 209
Ancillary 15 - Fuel burning - Using fuel burning equipment that is capable of burning at least 500kg of fuel in an hour	PL 209
Ancillary 60 - Waste disposal - 2(b) - Operating a facility for disposing of, in a year, the following quantity of waste mentioned in subsection (1)(b) - 2,000t to 5,000t	PL 209
Schedule 3 - 06 - a petroleum activity carried out on a site that contains a high consequence dam or a significant consequence dam if the dam forms part of the activity	PL445
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	PL445
Ancillary 15 - Fuel burning - Using fuel burning equipment that is capable of burning at least 500kg of fuel in an hour	PL445
Ancillary 60 - Waste disposal - 2(b) - Operating a facility for disposing of, in a year, the following quantity of waste mentioned in subsection (1)(b) - 2,000t to 5,000t	PL445

3.2. Amending Schedule A, Table 1 – Authorised Petroleum Activities

Senex proposes to amend the schedule of disturbance as shown in Table 3-2.

Table 3-2: Proposed amendment to Schedule A Table 1 - Authorised Petroleum Activities

Authorised Petroleum Activity	Scale		Intensity
	Maximum Size	Location	
Petroleum Activities			
Coal Seam Gas Production and exploration wells	270 wells	Within Project Area	270 wells
Specified relevant activities			
Stimulation activities	-	Within Project Area	270 wells
Regulated Structures	3	Within Project Area	75 ha
Low Consequence Structures	5	Within Project Area	25 ha

3.3. Justification

PL 209 and 445 were acquired by Senex from APLNG in 2019, and while some historic exploration and appraisal activities have been undertaken in the area, development for commercial production has not yet occurred.

Commercial production from these tenures is required to allow Senex to meet its existing gas supply commitments to Australian domestic users (including CSR, BlueScope and Visy) and the conditions of its granted tenure under the *Petroleum and Gas (Production and Safety) Act 2004*.

CSG production, is generally also linked to water production as coal seams are required to be depressurised (through de-watering) to allow gas to desorb and flow to the surface. As a responsible tenure holder, and in compliance with its existing EA conditions, Senex is required to safely and appropriately, store and manage this water. The authorisation of water management infrastructure as detailed in Table 3-2 will allow this to happen.

4. Dam Siting, Design and Construction

In its original application (dated January 2024), Senex committed to implementing its Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development' (the constraints protocol) (Appendix D). The constraints protocol is an adaptive environmental framework based on constraints planning, to inform the siting of project infrastructure and to develop specific controls and procedures to be applied to project activities at specific sites. The constraints protocol aims to address uncertainties surrounding the final location of project infrastructure and activities by ensuring controls and procedures are in place that recognise the environmental and social values of the location. The framework is a decision-making tool and is an essential part of the planning and development process undertaken by Senex.

The constraints protocol formalises the assessment and evaluation of potential layout options and the development of a best fit development plan which minimises impacts to identified EVs as far as reasonably practicable.

Known constraints are assigned a constraints category and then mapped. Atlas Stage 3 constraint categories and mapping are provided in Table 4-1, Table 4-2 and Figure 4-1.

Table 4-1: Constraint Categories

Constraint category	Access permitted	Constraints[3]
No-go area	No petroleum activities	Threatened Ecological Communities MNES and MSES species habitat (apart from Koala and Southern Squatter Pigeon dispersal habitat and Echidna habitat), including all areas of remnant vegetation and regrowth areas that meet species habitat definitions Category A, B and C ESAs[4] Ooline plants (10 m buffer) in addition to mapped Ooline habitat If any are found to be present in the Project Area: • Slender Tylophora plants and a 10 m buffer; and • Populations[5] of the Dulacca Woodland Snail
High constraint area	Low impact petroleum activities, and Linear infrastructure	Buffer zone (10 m buffer around all 'No-go areas') Protected plants under the NC Act (if any are found)
Low constraint area	All petroleum activities[6]	Koala and Southern Squatter Pigeon dispersal habitat Echidna (NC Act - Special least concern) habitat Previously cleared areas that have been assessed as not containing MNES or MSES or its habitat

3 Disturbance of MNES and MSES will not exceed identified upper disturbance limits.

4 Category A and category B environmentally sensitive areas (ESAs) as defined under Schedule 19 of the Environmental Protection Regulations 2019 (EP Regulation) and category C ESAs where defined in the relevant EA.

5 Avoids field verified population (evidence of any individuals) of the threatened Dulacca Woodland snail (*Adclarkia dulacca*) if it is found to occur within proposed disturbance areas in the Atlas tenements.

6 All petroleum activities will be permitted within the low constraints area. However, Koala juvenile and non-juvenile trees and seedlings will be avoided unless avoidable due to other constraints (e.g. environmental features and values, cultural heritage values, geological features, landholder/livestock/ agricultural requirements and existing or planned landholder, utility or community infrastructure).

Table 4-2: Summary of activities permitted in each constraint category for the Atlas 3 Gas Project

Constraint category	Low impact petroleum activities	Linear infrastructure	Well pads	All petroleum activities
No-go area	No	No	No	No
High constraint area	Yes	Yes	No	No
Low constraint area	Yes	Yes	Yes	Yes

At this point, the conceptual design would usually be refined multiple times following additional field surveys, ecological pre-clearance surveys and initial landholder negotiations to arrive at a development footprint that firstly avoids, then minimises impacts to environmental values. The application of the protocol for all Senex developments and infrastructure locations, means that these principles are enshrined in Senex's business practices.

This process (or variations thereof) has operated successfully across industry and the broader Surat Gas Fields in recognition of the difficulty in pinpointing exact locations prior to approval and the commencement of Landholder negotiations. The rolling back of the Queensland Government green tape reduction reforms and a simultaneous move away from outcome focused conditions has required that Senex think differently about the application of the protocol to the potential location of regulated structures the subject of this application.

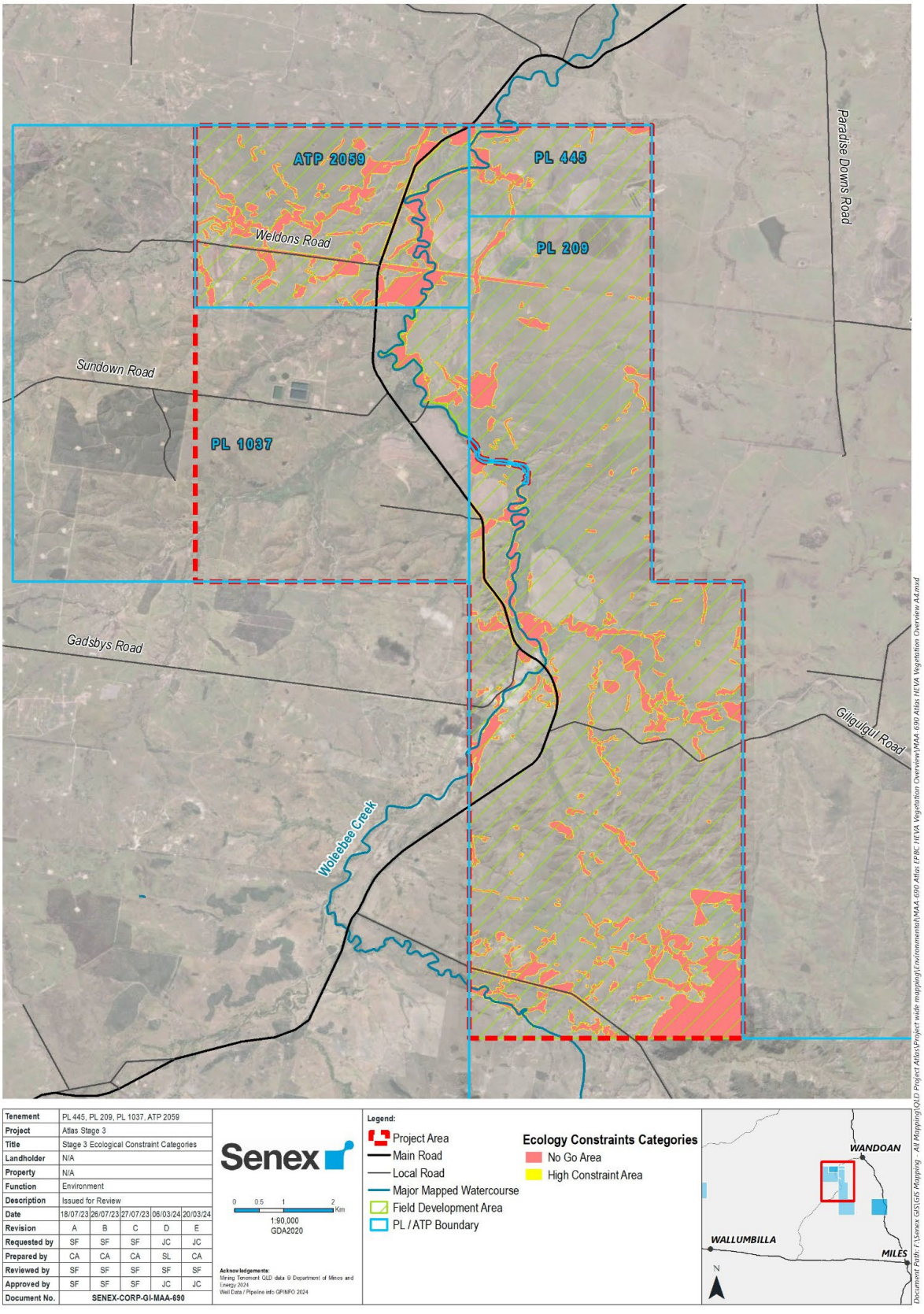
With the emphasis on provision of site-specific information in circumstances where locations cannot be finalised until post approvals, Senex commissioned a study (Engeny, 2024) to identify potential locations for dams across the area of PL 209 and PL 445 using the following criteria:

1. Minimum area of 10ha to allow for construction of a dam with relatively standard dam geometry that meet constraints 2 and 3 below.
2. Construction and operation of a dam at a potential location must be in accordance with any relevant conditions of Schedule J of the existing EA.
3. Construction and operation of a dam at a potential location must implement the following controls committed to in this application:
    a. No ESAs will be cleared.
    b. Potential locations will not be located within the primary protection zones of ESAs
    c. Potential locations will not encroach on No-go areas identified in the Atlas Stage 3 Environmental Constraints Protocol for Planning and Field development (the Constraints Protocol) (Figure 4-1).
    d. Potential Locations will be above the 1:100 Annual Exceedance Probability (AEP) flood level for stream order 2 or higher watercourses.
    e. Potential locations must not be on land with slope greater than 7%.

Engeny (2024) identified a total of 25 potential sites meeting the above criteria. An overview of these locations is provided in Figure 4-2, with higher resolution mapping provided in Appendix A. Each of these locations avoids known environmental constraints and provides:

- A potential construction envelope within which there may be some room for minor adjustments to accommodate Landholder concerns.
- Multiple options for regulated structure locations should a preferred location/s be rejected by a Landholder.

For the purposes of this application, these 25 potential dam sites are used to provide site-specific information in relation to the proposed amendment.



Note: ESA buffers to be applied separately, but condition (F7) of the existing EA will be strictly complied with.

Figure 4-1: Constraints Protocol Overlay

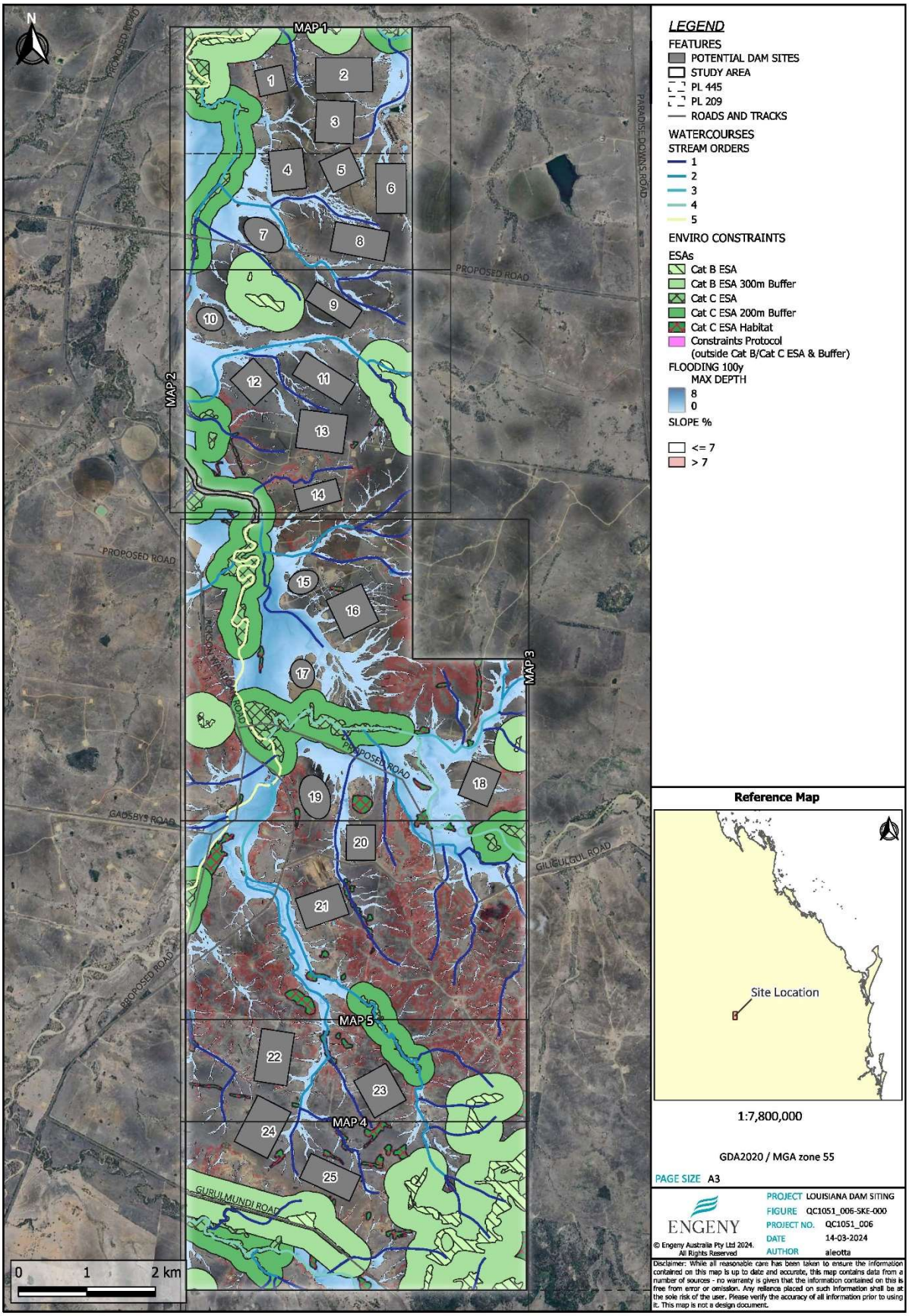


Figure 4-2: Conceptual Dam Locations

Additionally, as part of the EPBC conditions for the Atlas Stage 3 project, further on ground surveys are required for all areas of proposed disturbance within PL445 and PL209 prior to disturbance. The requirements for these surveys are a detailed within the Constraints Protocol (Appendix D). The surveys are required to be completed by suitably qualified ecologists and are to be undertaken to confirm the suitability of the location and identify any additional constraints not originally known during the desktop constraints analysis phase. A scouting area will extend a minimum of 30 m beyond finalised dam infrastructure footprint/s will ground-truth mapped constraints including, but not limited to:

- protected vegetation,
- threatened flora / fauna habitat, and likelihood of occurrence
- prescribed environmental matters
- watercourses,
- invasive weeds,
- confirm the likelihood of habitat for threatened fauna, the likelihood of occurrence of threatened flora and fauna, regional ecosystems and ecological communities, prescribed environmental matters, and validation of mapped watercourses

The pre-clearance survey will be undertaken not more than 12 months prior to clearing activities commence and results are documented in a scope specific ecology report.

Should site surveys identify constraints or constraint boundaries different from the desktop environmental constraints analysis, infrastructure locations will be modified or revised.

4.1. Consequence Category Assessments

In accordance with the *Manual for assessing consequence categories and hydraulic performance of structures* (ESR/2016/1933, version 5.03) (the Dam Manual), all structure which are dams or levees associated with the operation of an ERA must…*have their consequence category assessed based on the potential environmental harm* (Table 4-4) that would result from the following failure event scenarios:

a) ‘Failure to contain – seepage’ – spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure;

b) ‘Failure to contain – overtopping’ – spills or releases from the structure that result from loss of containment due to overtopping of the structure; and

c) ‘Dam break’ – collapse of the structure due to any possible cause.

Engeny (2024) completed a preliminary CCA covering all 25 potential 300 – 1000ML dam locations across the Louisiana area in accordance with the Dam Manual (Appendix G). This CCA is based on the parameters identified in Table 4-3.

Table 4-3: Details of Proposed Structures

Structure	Maximum Storage Capacity	Purpose of Structure	Overflow / Dam Break Destination
Produced Water Dam	700 ML	Storage of untreated CSG Water	Lower order tributaries, Woleebee Creek, Juandah Creek, Dawson River
Brine Storage Dam	300 ML	Storage of reverse osmosis concentrate / brine	Lower order tributaries, Woleebee Creek, Juandah Creek, Dawson River
Low Consequence Dam	<100ML	Storage of untreated CSG Water	Lower order tributaries, Woleebee Creek, Juandah Creek, Dawson River

The dam manual requires the assessment of the consequences of the following failure event scenarios:

- ‘Failure to contain – seepage’ – spills or releases to ground and/or groundwater via seepage from the floor and/or sides of the structure.

- ‘Failure to contain – overtopping’ – spills or releases from the structure that result from loss of containment due to overtopping of the
- structure.
- ‘Dam break’ – collapse of the structure due to any possible cause.

For each failure event scenario, the consequences need to be assessed for the following categories of harm:

- Harm to humans.
- General environmental harm.
- General economic loss or property damage.

The consequence category for each type of harm is assigned based on the severity of harm as defined in Table 4-4, and the CCA for each of the required scenarios are presented in Table 4-5, Table 4-6 and Table 4-7. Dams containing <100ML and holding only produced water have been assessed against the criteria in Table 4-4 and meet those for Low Consequence. These Low consequence dams will be constructed and operated as per conditions (J5), (J6) and (J9) of the existing EA and have not been included in the following CCAs.

Table 4-4: Consequence Category Assessment

Environmental Harm	Consequence Category		
	High	**Significant**	**Low**
Harm to Humans	Location such that people are routinely present in the failure path and if present loss of life to greater than 10 people is expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are routinely present in the failure path and if present loss of life to 1 person or greater but less than 10 people is expected[8]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.	Location such that people are not routinely present in the failure path and loss of life is not expected[7]. Note: The requirement to consider the location of people in the failure path is only relevant to the 'dam break' scenario.
	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 20 or more people being affected10[10].	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of 10 or more people but less than 20 people being affected[9].	Location such that contamination of waters (surface and/or groundwater[9]) used for human consumption could result in the health of less than 10 people being affected[9].
General Environmental Harm	Location such that: a) Contaminants may be released to areas of MNES, MSES or HEV waters that are not already authorised to be disturbed to at least the same extent under other conditions of this authority subject to any applicable offset commitment (Significant Values); and	Location such that contaminants may be released so that adverse effects (that are not already authorised to be disturbed to at least the same extent under other conditions of the authority subject to any applicable offset commitment) either: a) Would be likely to be caused to Significant Values but those adverse effects[10] would not be likely to meet the thresholds for the High consequence category and instead would be likely to cause at least one of the following:	Location such that either: a) Contaminants are unlikely to be released to areas of Significant Values or Moderate Values; or

[7] To be used for all failure event scenarios

[8] 'People routinely present in the failure path' could be considered to be people who occupy buildings or other places of occupation that lie within the failure impact zone. For the purposes of this Manual, this should refer to people other than site personnel engaged by the resource operation and located on the tenements and tenure associated with the resource operation; for other ERAs, it would be the 'premises referred to in the authority'. It should be noted that while this is appropriate for the assessment of consequence categories in accordance with this Manual, adherence to the requirements of this Manual does not limit, amend or change in any way, any other requirements to be complied with under relevant health and safety acts or legislation that requires the safety of site personnel to be considered.

[9] When considering potential impacts on groundwater, it is not envisaged that a full hydrogeological assessment will be required in all cases. Any consideration of potential impacts on groundwater systems should consider the water quality of the potential receiving aquifer as well as the quality of fluid stored in the regulated dam. Existing groundwater drawdown in areas surrounding resource operations (e.g. drawdown as a result of mine pit or underground mine dewatering) can also be considered when assessing the consequence of dam seepage on groundwater systems.

[10] 'An adverse effect on human health means a physiological effect on human health and does not include an impact on the quality of downstream water that merely negatively affects taste and which is unlikely to cause persons to become physically ill.

	b) Adverse effects[11] on Significant Values are likely; and c) The adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $50,000,000; or ii) remediation of damage is likely to take 3 years or more; or iii) permanent alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 5km^2.	i) loss or damage or remedial costs greater than $10,000,000 but less than $50,000,000; or ii) remediation of damage is likely to take more than 6 months but less than 3 years; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 1km2 but less than 5km2. or b) Would be likely to be caused to environmental values classed as slightly or moderately disturbed waters[12], wetland of general ecological significance[13], riverine areas, springs or lakes and associated flora and fauna (Moderate Values), and the adverse effects[10] are likely to cause at least one of the following: i) loss or damage or remedial costs greater than $20,000,000; or ii) remediation of damage is likely to take more than 1 year; or iii) significant alteration to existing ecosystems; or iv) the area of damage (including downstream effects) is likely to be at least 2 km2	b) Contaminants are likely to be released to those areas, but would be unlikely to meet any of the minimum thresholds specified for the Significant Consequence Category for adverse effects[10]
General economic loss or property damage	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $10 million or greater in rehabilitation, compensation, repair or rectification costs[14].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require $1 million and greater but less than $10 million in rehabilitation, compensation, repair or rectification costs[13].	Location such that harm (other than a different category of harm as specified above) to third party assets in the failure path would be expected to require less than $1 million in rehabilitation, compensation, repair or rectification costs[13].

[11] Adverse effects includes chronic and acute effects where an acute effect is on living organism/s which results in severe symptoms that develop rapidly, and a chronic effect is an adverse effect on a living organism/s which develops slowly. In some instances, it may be necessary to carry out or reference existing ecological/toxicological studies to assess the impacts of contaminants on living organisms.

[12] See Environmental Protection (Water and Wetland Biodiversity) Policy 2019for definitions

[13] Wetland of general ecological significance' means a wetland shown on a map of referable wetland as a 'general ecologically significant wetland' or 'wetland of other environmental value'.

[14] This does not include the holder's own mine or gas production, on-site industrial or commercial assets, the holder's workers' accommodation, agricultural facilities on the holder's land such as a farm shed or farm dam or infrastructure solely for servicing the holder.

Table 4-5: CCA Failure to Contain - Seepage

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
Harm to Humans	Groundwater in the vicinity of the project area is not utilised for human consumption. It is considered unlikely that health of more than ten people would be affected.	Low	Low
General Environmental Harm	It is considered that seepage from the dam may impact on endangered and of-concern regional ecosystems, regulated vegetation and GDEs if expressed within Woleebee Creek. Seepage to groundwater and surface water will be slow moving and of relatively small magnitude. For the produced water dam, the severity of the adverse effects on endangered and of-concern regional ecosystems, regulated vegetation and GDEs are not expected to exceed the range of effects defined for the Significant consequence category in Table 1 of the Manual. For the brine storage dam, the severity of the adverse effects on endangered and of-concern regional ecosystems, regulated vegetation and GDEs are expected to be in the range of effects defined for the Significant consequence category in Table 1 of the Manual.	Low	Significant

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
General Economic Loss or Property Damage	The predominant land use and downstream of the project area is cattle grazing with some areas of dryland and irrigated cropping. The water within the dam is expected to exceed stock watering and cropping irrigation limits. It is considered likely that seepage from the dam will impact third party farming operations if it contaminates groundwater or is expressed in Woleebee Creek. For the produced water dam, it is considered unlikely that seepage from the dam will cause significant economic loss or property damage greater than $1 million. For the brine storage dam, it is considered unlikely that seepage from the dam will cause significant economic loss or property damage greater than $1 million.	Low	Low
'Failure to Contain – Seepage' Consequence Category		Low	Significant

Table 4-6: CCA Failure to Contain - Overtopping

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
Harm to Humans	The Glebe Weir is located along the Dawson River more than 90 km downstream of the project area which supplies drinking water for urban communities in Central Queensland. Due to the expected small catchment area of the dams relative to the receiving waterways, overflows are likely to be of small magnitude and short duration and will only occur during periods of significant stream flow in the receiving waterways, resulting in dilution of overflows from the structures. Due to the expected downstream dilution effects and the large distance to downstream water storages used to supply drinking water it is considered unlikely that the health of more than ten people would be affected in the event of a dam overflow.	Low	Low

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
General Environmental Harm	Endangered and of-concern regional ecosystems and regulated vegetation are present within the project area and along Woleebee Creek. Due to the small catchment area of the dams relative to the receiving waterways, overflows are likely to be of small magnitude and short duration and will only occur during periods of significant stream flow, resulting in dilution of the high salinity overflows from the structures. For the produced water dam, overflows may cause adverse effects on the ecosystems within the receiving waterways, and these effects are considered unlikely to meet the minimum thresholds of environmental harm defined for the Significant consequence category in Table 1 of the Manual. For the brine storage dam, overflows are expected to cause adverse effects on the ecosystems within the receiving waterways, and these effects are considered likely to meet the thresholds of environmental harm defined for the Significant consequence category in Table 1 of the Manual.	Low	Significant
General Economic Loss or Property Damage	The predominant land use and downstream of the project area includes irrigation of crops, farm use and stock watering. Due to the small catchment area of the dams relative to the receiving waterways, overflows are likely to be of small magnitude and short duration and will only occur during periods of significant stream flow, resulting in dilution of the high salinity overflows from the structures. There may be some adverse effects to cropping and livestock that drink water from the receiving waterways following an overflow event, however any economic loss or property damage are expected to be lower than $1 million.	Low	Low
'Failure to Contain – Overtopping' Consequence Category		Low	Significant

Table 4-7: CCA Failure to Contain - Dam Break

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
Harm to Humans	There are several agricultural farming properties and associated habitable dwellings located downstream of the project area along Woleebee Creek. These buildings are not considered at risk of inundation as dam break flows are expected to be generally confined within the primary channel and flood plain of Woleebee Creek. Given the size of the structures, the failure impact zone of the dams are anticipated to propagate approximately 10 to 15 km downstream based on Table 5 of *the Guideline for failure impact assessment of water dams* (DNMRE, 2018). Contamination of surface water used for human consumption may occur if the dams fail, however it is not expected that more than 10 people would be affected due to the small number of dwellings located along the receiving waterways downstream of the project area and the minimal use of these waterways as a drinking water source. Glebe Weir is too far downstream from the project area to be affected.	Low	Low
General Environmental Harm	Endangered and of-concern regional ecosystems and regulated vegetation are present within the project area and along Woleebee Creek. Significant adverse effects on these ecosystems are considered likely in the event of a sunny day failure of the dam due to the high salinity of the water in the dams and the lack of downstream dilution capacity if the dam failure occurs under sunny day conditions. For the produced water dam, the severity of the adverse effects on the ecosystems within the receiving waterways are difficult to quantify but are expected to be in the range of effects defined for the Significant consequence category in Table 1 of the Manual. For the brine storage dam, the severity of the adverse effects on the ecosystems within the receiving waterways are difficult to quantify but are expected to be in the range of effects defined for the High consequence category in Table 1 of the Manual.	Low	High

Environmental harm	Consequence of Seepage	Produced Water Dam Consequence Category	Brine Dam Consequence Category
General Economic Loss or Property Damage	Potential economic loss and property damage in the event of a dam failure includes the potential damage to Jackson Wandoan Road, Sundown Road, and private access roads, and the disruption and damage to grazing and cropping irrigation activities caused by the contamination of the receiving waterways. The potential magnitude of rehabilitation, compensation, repair or rectification costs is estimated to be greater than $1 million but less than $10 million.	Low	Low
'Failure to Contain – Dam Break' Consequence Category		Low	High

4.2. Dam Design Plan / Basis of Design

The dam manual notes that 'The detailed design of a regulated structure is to be undertaken by a suitably qualified and experienced person with relevant professional experience and requires appropriate documentation and certification'.

Subsequent to identifying conceptual locations and undertaking a CCA appropriate to all identified dam locations, Senex also engaged Engeny (who hold the relevant professional experience and certifications) to prepare a preliminary Basis of Design (BoD) (Appendix H) to identify indicative required dam design elements and demonstrate the effective management of risks associated with proposed regulated structures. This will be finalised post approval and on selection of final dam location/s.

As described in section 4.1, selected dam design criteria (Table 4-8 to Table 4-10) are based on the outcome of the CCA, and contribute to the development of civil design criteria for any given dam. (Table 4-11).

Table 4-8: Applicable design criteria for 'Failure to Contain - Seepage' Scenario

Design Criteria	Produced Water Dam	Brine Storage Dam
Consequence Classification for Failure to contain – Seepage	Low	Significant
Containment	N/A	Dam to be lined to contain the wetting front and any entrained contaminants within the bounds of the containment system. Dam to incorporate a system for the collection and proper disposal of any contaminants that move beyond the bounds of the containment system.
Leak Detection / Monitoring	N/A	Requires a system that will detect any passage of the wetting front or entrained contaminants through the floor or sides of the dam.
Rectification	N/A	N/A

Table 4-9: Applicable Design Criteria for 'Failure to Contain - Overtopping' Scenario

Design Criteria	Produced Water Dam	Brine Storage Dam
Consequence Classification for Failure to contain – Overtopping	Low	Significant
Containment – Extreme Storm Storage / Mandatory Reporting Level	N/A	Larger of the 1:10 AEP 72-hour duration storm or wave run-up for 1:10 AEP wind
Containment – Design Storage Allowance	N/A	1:20 AEP

Table 4-10: Applicable design criteria for 'Failure to Contain - Dam Break' Scenario

Design Criteria	Produced Water Dam	Brine Storage Dam
Consequence Classification for Failure to contain – Dam Break	Significant	High
Spillway Capacity	1:100 AEP to 1:1,000 AEP	1:1,000 AEP to 1:10,000 AEP
Flood level for Embankment Crest levels	Spillway design flood peak level + wave run-up for 1:10 AEP wind	Spillway design flood peak level + wave run-up for 1:10 AEP wind

Table 4-11: Basis of Design - Regulated Structures

Item	Value	Basis
Design life	25 years	Nominated
Dam embankment crest width	6.0 m minimum	Trafficable crest
Dam embankment crossfall	3% toward downstream batter	Prevent ponding on crest
Dam embankment batters	Downstream batter: 1V:4H Upstream batter: 1V:3H	Safety during construction, stability
Dam embankment crest surfacing	Gravel Capping	Trafficability for inspections and monitoring
Dam embankment upstream batter surfacing	HDPE geomembrane liner system	Nominated
Dam embankment downstream batter surfacing	Topsoil and grass seed (additional erosion minimization controls to be determined during design)	Minimise erosion
Impoundment excavation surfacing (batters and floor)	HDPE geomembrane liner system	Nominated
External catchments*	Diverted around dams via diversion drains and bunds to prevent ponding or flow against dam embankments	Nominated
Embankment zoning	Homogenous earth fill embankment	Dams incorporate a liner system
Embankment fill material	General fill	Dams incorporate a liner system
Fill material borrow area	Impoundment excavation	Achieve cut/fill balance
Liner system	Processed water dam – Single HDPE geomembrane liner Brine storage dam – Double HDPE geomembrane liner	Consequence classification of low and significant for seepage
Leakage collection and extraction system	Produced water dam: Present below the primary liner to detect, collect and remove leakage resulting from holes and defects in the primary liner and return it to the dam storage. Brine storage dam: Present below the primary liner to detect, collect and remove leakage resulting from holes and defects in the primary liner and return it to the dam storage	Nominated Consequence category of low for seepage
Seepage collection and extraction system	Produced water dam: N/A Brine storage dam: present below the primary liner to detect, collect and remove leakage resulting from holes and defects in the secondary liner and return to dam storage	Consequence category of low for seepage Consequence category of significant for seepage
Seepage monitoring	Produced water dam: Shallow groundwater monitoring bores around dam. Brine storage dam: Seepage collection system and shallow groundwater monitoring bores around dam.	Consequence category of low for seepage Consequence category of significant for seepage
Emergency egress	Liner to be textured to allow for emergency egress. Life rings to be located at multiple locations along the crest.	Safety in for operation / maintenance personnel

Design storage allowance (DSA)	Produced water dam: Maximum Allowable Operating Level (MAOL) to be specified to achieve 1:20 AEP wet season containment to reduce likelihood of spillway overflows. Brine storage dam: 1:20 AEP wet season containment.	Consequence category of low for overtopping Consequence classification of significant for Overtopping
Mandatory reporting level (MRL)	Produced water dam: N/A Brine storage dam:	Consequence category of low for overtopping Consequence classification of significant for Overtopping
Design earthquake loading	Operating Basis Earthquake (OBE): 1:100 AEP Maximum Design Earthquake (MDE): 1:1,000 AEP	ANCOLD Guidelines
Acceptable factors of safety (FoS) against embankment instability	Long term drained: FoS ≥ 1.5. Short term undrained (potential loss of containment): FoS ≥ 1.5. Short term undrained (no potential loss of containment): FoS ≥ 1.3. Post Seismic: FoS ≥ 1.1.	ANCOLD Guidelines

* Predominantly for management of overland flow during rain events

4.3. Risk Assessments

Bow-Tie risk assessments are a recognised way of presenting risks in the context of causes, effects and controls. Senex has completed Bow-Tie risk assessments for produced water and brine dams for each CCA failure scenario (Appendix G) and a summary of the outputs is provided in Table 4-12.

For the purposes of the proposed regulated structures, these Bow-Tie risk assessments illustrate the heavy (and necessary) reliance on preventative controls.

The exiting regulatory framework set by Schedule J of the existing EA, first requires the preparation and submission of a certified CCA, followed by the preparation and submission of a certified dam design plan.

For the purposes of controlling risk, the CCA investigates possible failure scenarios, and the resulting consequence category is then used to determine the appropriate level and type of control required by the dam design plan in accordance with the requirements of the dam manual.

The likelihood of controls already required by the dam manual needing to be amended to account for site-specific considerations is considered to be negligible as the same control would be applied regardless of location. For example, the dam manual requires geotechnical data used to assess requirements for storage and strength of all structures. This would be gathered and interpreted at any location, regardless of soil type / sub-grade conditions.

It is a given that impacts to EVs will occur as a result of a failure scenario. However, the intent of appropriate design in accordance with the dam manual is that regulated structures do not fail, and while knowledge of a specific location may increase the scale of a potential impact, the preventative control (as required by the dam manual) remains the same and is intended to mitigate the risk to As Low as Reasonably Practicable (ALARP). The design and installation of a spillway is an emergency measure to save the integrity of the dam where events conspire to produce circumstances where dam capacity would be exceeded. As such, a controlled release significantly reduces the scale of impact compared to a dam break scenario.

Further, design and construction of a regulated structure needs to be overseen and certified by a Registered Professional Engineer (QLD) (RPEQ), who stakes their professional reputation on the controls stipulated in the design plan and that construction has been to a standard required to deliver the necessary level of control, and safe long-term operation.

It should be noted that regulated structures are by design, no release structures (including via seepage), with all design controls being intended to achieve this. Critical controls (highlighted green in Appendix G) designed to avoid CCA failure scenarios, and which will be implemented by Senex include (but are not limited to):

1. Activation of a well turn-down plan to reduce inflows to a dam.
2. Stop brine inflows.
3. Development of a Basis of Design which which informs DSA / MRL based on conservative modelling based on probabilistic water production rates and climate data.
4. Construction in accordance with Dam Design and Operating Plan, approved and certified by SQP and RPEQ – inclusive of detailed geotechnical investigations and on-site construction supervisions by RPEQ.
5. Inspection and testing of materials by Level 2 earthworks testing (AS 3798 – 2007).
6. Leak Collection System to capture inflow between liners and designed for modelled flow rates – inclusive of remote telemetry.
7. Installation of dual liner system.

Table 4-12: Summary of Bow-Tie risk assessments

Scenario	Dam type	Risk type	Likelihood	Consequence	Risk
Failure to contain – overtopping	Produced water	Inherent (without controls)	Possible	Moderate	Intermediate (C3)
		Target (with controls)	Unlikely	Minor	Negligible (D2)
	Brine	Inherent (without controls)	Possible	Moderate	Intermediate (C3)
		Target (with controls)	Unlikely	Moderate	Low (D3)
Failure to contain - seepage	Produced Water	Inherent (without controls)	Possible	Moderate	Intermediate (B3)
		Target (with controls)	Unlikely	Minor	Low (C2)
	Brine	Inherent (without controls)	Possible	Moderate	Intermediate (B3)
		Target (with controls)	Unlikely	Minor	Low (C2)
Failure to contain – dam break	Produced Water	Inherent (without controls)	Possible	Major	Intermediate (C4)
		Target (with controls)	Unlikely	Major	Intermediate (D4)
	Brine	Inherent (without controls)	Possible	Catastrophic	High (C5)
		Target (with controls)	Unlikely	Catastrophic	Intermediate (D5)

5. Dam Operation and Existing Management Practices

The risk of potential impacts from the proposed amendments will be further minimised through the application of Senex's internal management plans and procedures which are designed to ensure compliance with its EA conditions of approval.

Those directly relevant to the amendments proposed are summarised in the following sub-sections.

5.1. EA conditions

Despite not having the relevant ERA listed, the existing EA already contains a full schedule of conditions covering the design, construction and operation of regulated structures (Schedule J). While Schedule J conditions are not word for word the same as the model dam conditions (taken from Department of Environment and Science Guideline: *Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/2016/1934 • Version 9.02, April 2022)* their intent and purpose are commensurate, and all key requirements of the 'model dam conditions' are addressed.

Schedule J also includes conditions (J6, J8 and J9) which are specific to low consequence structures.

Compliance with these conditions will ensure that Senex constructs and operates regulated and low consequence structures in accordance with current regulatory practice and expectations. This extends to the seepage monitoring requirements.

Specifically, the requirement for a Dam Design Plan to be prepared and certified by an RPEQ (existing conditions J10 and J11) together with the requirements for ESCP (existing condition J12) mean that bulk earthworks associated with the construction of a regulated structure will:

- be subject to stringent engineering requirements;
- be managed in accordance with appropriate controls to protect and conserve soil resources; and
- avoid potential sedimentation impacts to surrounding vegetation and water features.

5.2. Erosion and Sediment Control

As per condition (A15) of the existing EA, Senex is required to prepare an Erosion and Sediment Control Plan (ESCP). Specifically:

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).

Noting that the construction of regulated structures often involves large-scale earthworks, Senex will ensure that any site-specific ESCP developed for the purposes of constructing a regulated structure will

not only comply with existing condition (B2) but will also be developed in accordance with the International Erosion Control Association Guidelines[15] in place at the time of plan development.

5.3. Dam Operating Plan

As required by the existing EA, Senex will implement a dam operating plan for each constructed regulated structure.

5.3.1. Inspections and Monitoring

As per existing EA condition (J13)(e), the design plan for a regulated structure must include, but not necessarily be limited to:

e) an operational plan that includes;

i. normal operating procedures and rules;

ii. emergency and contingency plans including operating procedures designed to avoid and / or minimise environmental impacts including threats to human life resulting from any overtopping or loss of structural integrity of the structure;

As a matter of course, and in addition to compliance with the above EA requirements, Senex will also include comprehensive commissioning, routine and surveillance inspections to:

- Assess the performance of a regulated structure during commissioning.
- Assess the condition and performance of a regulated structure under normal operating conditions.
- Identify the need for routine maintenance and/or defect remediation.
- Collect monitoring data in accordance with legislative and risk mitigation requirements.
- Assess the condition of a regulated structure following an emergency event.
- Comply with risk mitigations measures identified in the regulated structure design risk assessment.

The above inspections are generally conducted as per the frequencies in Table 5-1.

Table 5-1: Recommended Inspection and Monitoring Frequencies

Inspection	Recommended Frequency
Commissioning Inspection	Fortnightly for the first 3 months of filling
Routine Inspection	Quarterly (i.e. every 3 months)
Annual Inspection	Annually
Special Inspection	When a performance trigger is identified (refer Table 5-2).
Weather	Daily
Water Level	Minimum hourly recording
Water Chemistry	Quarterly
Leakage Detection	Hourly recording (level) Daily volume (flow totaliser)
Seepage Detection	Quarterly

[15] Publications - International Erosion Control Association (austieca.com.au)

Table 5-2: Performance Triggers

Trigger Event	Performance Trigger	Type of Inspection
Flood Event	Rainfall event greater than an AEP 0.1	Visual inspection as per Annual Inspection but with specific focus on developing responses required for performance triggers or identification of Emergency Triggers requiring implementation of Emergency Response Plan.
Earthquake Event	Earthquake event greater than 5 (Richter Scale) within 200km of the regulated structure	
Operation Trigger Condition	Storage below the minimum operating level Exceedance of operating level Exceedance of design leakage rate Embankment cracks, erosion, sink holes, tunnelling, washouts and vegetation establishment Other abnormal issues identified during routine inspections	

5.3.2. Performance Inspections

Performance Investigations are to be considered based on findings from regulated structure inspections. Performance Investigations focus on assessment of Performance Triggers or Emergency Triggers and can provide data to support the decision to undertake routine maintenance, undertake defect remediation and/or initiate the Emergency Response Plan. Typical Performance Investigation can include:

- Embankment Survey to assess embankment movement.
- Liner Integrity Surveys to identify damage and holes in a liner.
- Liner Degradation Testing to assess degradation of material properties of a liner.
- Geophysical Surveys to assess potential seepage from a regulated structure storage area.
- Groundwater and Soil Chemistry Assessment to assess potential seepage from a regulated structure storage area.

5.3.3. Surveillance Requirements

5.3.3.1. Exceedance of MOL

The discharge and extraction of water into/from each regulated structure is to be managed to maintain a level below the MOL. Exceedances in volume above this level present an increased risk of overtopping of the dam or not having the DSA volume available on November 1st (see Section 2.8) (i.e. exceeding the Mandatory Reporting Level (MRL)).

Compromising the availability of the DSA on November 1st (required to comply with condition (A10) of the existing EA) is not considered acceptable in the operation of the storages under any circumstances. To remove any doubt, the target maximum water level in the base case scenario of water balance projections is to always remain under 100% of the MOL (i.e., planning to exceed MOL is not considered acceptable for base case operations). Mitigative actions are to be taken if exceedance of the MOL is projected to return the projected level back under 100%. These actions may include:

- Field turndown/well shut in.
- Implementation of new offtakes (such as water carting or use for construction).
- Transfer of water to alternate storages.

The addition of any process water into the dams above the MOL is only to be considered following risk assessment with and final authorisation of the Operations Manager (or higher). Factors to be considered as part of the risk assessment include (but are not limited to):

- Forecast weather (evaporation and rainfall).
- Plan to return the storage to below MOL (processing capacity upgrades, transfer to other storages, etc.).
- Projected produced water production.
- If availability of the DSA on November 1st is projected to be compromised.

In the event that the MOL is exceeded, all reasonable and practical measures are to be taken to manage the level within this structure to prevent overtopping of the structure. These measures may include:

- Isolating/diverting the produced water supply to other storages suitable to contain water.
- Extraction to relocate or temporarily store the water.
- Installation of additional water offtakes.
- Well turndown and/or shutoff.

Exceedance of the MOL is considered a “Performance Trigger” which requires a response (refer to Table 5-2Section 5.3.2).

5.3.3.2. Exceedance of MRL

The MRL is a level above the MOL, but below the spillway level. The MRL is the level required to provide Extreme Storm Storage (ESS), defined as the storage volume to prevent spill from the regulated structure for an extreme storm event. The pond should not reach the MRL under normal operating conditions.

In the event that the MRL is exceeded, all reasonable and practical measures are to be taken to prevent any further increase in the water level within the regulated structure. All inflows to the regulated structure shall be isolated. These measures may also include:

- Isolating/diverting the water supply feed to other storages suitable to contain water.
- Extraction to relocate or temporarily store the water.
- Installation of additional water offtakes.
- Changes in operation to reduce inflows.

Exceedance of the MRL is considered a Performance Trigger which requires a response (refer to Section 5.3.2).

Exceedance of the MRL must, as soon as practical and within forty-eight (48) hours, be reported to the administering authority.

5.3.4. Emergency Response Plan

As per the dam manual, an emergency response plan forms part of the operational plan held by the holder or a nominated responsible officer and identifies emergency conditions that sets out procedures and actions that will be followed and taken by the regulated structure owner and operating personnel in the event of an emergency. The actions are to minimise the risk and consequences of failure and ensure timely warning to affected persons and the implementation of protection measures.

The primary objectives for an Emergency Response Plan are:

- To define events which constitute a regulated structure emergency.
- To identify conditions or triggers for regulated structure emergency events.
- To define procedures to be adopted during a regulated structure emergency to minimise the economic, environmental and public safety risks associated with a dam/tank.
- To provide emergency contacts for regulated structure emergency events.

An example of what an Emergency Response Procedure may look like for the proposed dams is presented in Table 5-3.

Table 5-3: Indicative Emergency Response Procedures

Emergency Event	Emergency Response Procedure	Responsibility
Significant loss of regulated structure liner integrity	All inflows to the regulated structure shall be isolated/redirected.	Senex operations
	Reduce Produced Water level in the regulated structure (if possible).	Senex operations
	Undertake Special Inspection (refer to Section 5.5).	Designer
	Specify liner system remediation requirements.	Designer
	Undertake liner system remediation as required.	Senex Maintenance Team or Civil Contractor

Emergency Event	Emergency Response Procedure	Responsibility
	Perform investigation of environmental harm.	Environmental Advisor
	Provide report to relevant local authority on environmental harm, if required.	Environmental Advisor
	Close-out emergency trigger response.	Emergency Response Coordinator
Imminent or actual dam overtopping	All inflows to the dam/tank shall be isolated/redirected.	Senex operations
	Reduce Produced Water level in the regulated structure (if possible).	Senex operations
	Undertake Special Inspection (refer to Section 5.5).	Designer
	Perform investigation of environmental harm.	Environmental Advisor
	Provide report to relevant local authority on environmental harm, if required.	Environmental Advisor
	Undertake design of permanent remediation measures.	Designer
	Construct permanent remediation measures.	Senex Maintenance Team or Civil Contractor
	Close-out emergency trigger response.	Emergency Response Coordinator
Imminent or actual regulated structure failure (breach)	Notify downstream landholders and perform evacuations if required.	Emergency Response Coordinator and SES
	All inflows to the regulated structure shall be isolated/redirected.	Senex operations
	Reduce level in the regulated structure (if possible).	Senex operations
	Undertake Special Inspection (refer to Section 5.5).	Designer
	Identify temporary stabilization measures.	Designer
	Construct temporary stabilization measures.	Civil Contractor
	Perform investigation of environmental harm.	Environmental Advisor

5.4. Seepage Monitoring

As per existing EA condition (GG1) *'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 prior to the commissioning of any containment facility.'*

The required content for the seepage monitoring program is specified in EA condition (GG2) and includes:

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 background and seepage monitoring bores for the trigger parameters identified in condition (GG2)(b) at a frequency, determined by a suitably qualified person and:
i. at least once every two years where baseline data has been established; or
ii. at least quarterly for two years to establish baseline data for any impact to groundwaters, after which time monitoring may continue at the frequency according to condition (GG2)(f)(i),

g) seepage trigger action response procedures for when trigger parameters and trigger levels identified in conditions (GG2(b)) and (GG2(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.*

On selection of a final location of a dam, work to define and implement the seepage monitoring program will also commence. Where monitoring results identify any significant changes in groundwater quality caused by petroleum activities, these must be investigated and reported on to DESI and include details of appropriate remedial action undertaken.

While the nature of the sub-surface lithology will ultimately determine the number, depth and location of seepage monitoring bores, the requirement to implement a seepage monitoring plan operates entirely independently of the location of the dam and the proximity of any EVs.

5.5. Decommissioning

Decommissioning of Project infrastructure will be undertaken in accordance with Senex's Atlas Stage 3 Gas Project Rehabilitation Plan (SENEX-ATLS-EN-PLN-018; Appendix F) and the relevant provisions of the *Petroleum and Gas (Production and Safety) Act 2014*, EP Act and EA conditions.

The timing and works undertaken as part of rehabilitation activities will be dependent on the activity type and operational stage of the project and governed by EA requirements. Given the nature of the activities that are the subject of this EA application, and the fact that the activities involve the construction and operation of infrastructure, much of the disturbance is longer-term requiring decommissioning and rehabilitation at the end of project life.

Infrastructure constructed by Senex will be removed from site except where it is to remain with the written agreement of the landholder.

Rehabilitation will be undertaken when the area for infrastructure, laydowns, hardstands or stockpile areas is no longer required for operational activities. Rehabilitation is further discussed in Section 5.6.

5.6. Rehabilitation

Senex's existing EA conditions include the full suite of Streamlined Model Conditions (ESR/2016/1989) for rehabilitation (Schedule H), though again, not in exactly the same order as the SMCs. To ensure compliance with these conditions, rehabilitation of regulated structures will be undertaken in accordance with the Rehabilitation Plan (Appendix F).

The objectives of rehabilitation are to achieve agreed final land uses that are:

- Safe to humans and wildlife.

- Stable and non-polluting.
- Re-profiled to contours consistent with the surrounding landform.

Proposed rehabilitation measures are summarised in the following sections.

5.6.1. Transitional Rehabilitation

Transitional rehabilitation (also known as reinstatement or partial rehabilitation) will be undertaken on disturbance associated with ongoing operational activities where part of the disturbed area is no longer required.

The aim of transitional rehabilitation is to stabilise disturbed land during the operational phase, thereby minimising potential impacts on surrounding EVs (e.g. minimising erosion and potential for weed establishment). Transitional rehabilitation will generally involve re-contouring the land surface if required, replacing topsoil, and direct seeding groundcover species (pasture or native grasses depending on the final post-disturbance land use) or allowing natural recruitment of plant species, with ongoing maintenance where corrective actions are identified during monitoring.

5.6.2. Final Rehabilitation

Final rehabilitation will be undertaken once the site is no longer required for operational activities and may involve:

- Remediating any contamination;
- Re-contouring the landform;
- Replacing subsoil and topsoil;
- Ripping as required; and
- Direct seeding pasture grass or native grass or allowing natural recruitment of plant species.

5.7. Waste Management

5.7.1. Environmental Values

Within the project area and surrounds, solid and liquid wastes are generated from domestic and commercial premises as well as agricultural, industrial and resource activities. These wastes comprise general, recyclable and regulated wastes.

Although there are currently no prescribed EVs for waste management, those previously prescribed under the *Environmental Protection (Waste Management) Policy 2000 (repealed)* provide some guidance on the matter. The former EVs for waste were:

- the life, health and wellbeing of people;
- soil, air, and surface and groundwater quality; and
- land use capability, having regard to economic considerations.

5.7.2. Emissions and Releases

Wastes generated from construction and operational activities comprise:

- General waste - those not defined as regulated waste under legislation. General wastes comprise putrescible wastes (easily decomposed, recyclable by composting) and non-putrescible wastes (not easily decomposed, may be recyclable);
- Recyclable waste – this waste type is able to be reconditioned, reprocessed or reused; and
- Regulated waste - regulated wastes are those that require specific controls or actions as defined by legislation. Listed, hazardous, regulated, controlled or trackable wastes typically have unique handling and disposal requirements in order to manage specific associated hazards.

The Senex Waste Management Procedure (Appendix E) details the relevant waste streams and management practices. However, wastes likely to be generated are presented in Table 5-4 along with the activity likely to generate that waste and the proposed waste minimisation/management measures to be implemented where practicable. Expected volumes of waste will be determined further into the engineering design process associated with construction and operational activities.

Table 5-4: Waste Streams and Management

Waste Name	Description	Activity	Minimisation / Management Measures
General Wastes			
Green waste	Whole or parts of trees, bushes, grass or similar produced from vegetation clearing activities	Construction activities	Stockpiled on site or mulched to be spread for rehabilitation and erosion control or placed in surrounding area to provide fauna habitat.
Domestic wastes	Food scraps, tea bags, coffee grounds etc. Food wrappers and packaging Textile materials Plastic wrapping films, plastic bags Facial tissues, ear plugs Pens and pencils Polystyrene Aluminium foil, waxed paper or cardboard Non-recyclable plastics No recyclables, hazardous wastes, liquids, chemicals or batteries.	All activities	Disposal to licensed landfill.
Pipeline tape wrap	Pipeline tape wrap protects pipelines against corrosion.	Construction and operational activities	Disposal to landfill.
Timber	Untreated timber derived from packaging and uses that cannot be reused or recycled.	All activities	In order of preference: reuse or recycle or licenced landfill.
Uncontaminated scrap metals and wiring	Uncontaminated scrap metals and wiring. No pressurised cylinders or drums with chemical or oily residue.	All activities	Recycled where practical otherwise disposed to landfill.
Recyclable wastes			
General Recycling	Plastic bottles and clean food containers Glass bottles and jars, milk cartons, aluminium bottles and cans, metal lids from jars, tin cans, plastic and paper cups. Cardboard and paper packaging Folders, phone books, envelopes, office paper, magazines, cereal boxes, clean paper towels. Scrap metals (uncontaminated) No plastic food wrap or general waste.	All activities	Recycled at local facility wherever practicable.
Intermediate bulk containers	Containers used for transport of fluids and bulk materials.	All activities	Returned to supplier once no longer required.
Plastic (HDPE)	Waste HDPE includes dam liner material, flowlines and drip tubes from irrigation activities.	Construction and operational activities	Recycle
Scrap Metals	Uncontaminated scrap metals and wiring	All activities	Recycled at scrap metal recycler.

	No pressurised cylinders or drums with chemical or oily residue.		
Regulated Wastes			
Asbestos and Synthetic Mineral Fibre Insulation (SMF)	Asbestos can be found in materials such as lagging, insulation, gaskets and brake pads. Examples of SMF include waste insulation and rock wool.	All activities	Transported by appropriately licensed transporter to an appropriately licensed disposal / recycling facility.
Batteries	Lead, gel, nickel-cadmium and alkaline type batteries generated from equipment, vehicles, generators and electronics.	All activities	Recycling facility
Chemical waste and chemical containers (including plastic fuel, and lubricant containers)	Chemical wastes may include herbicides, pesticides, water treatment chemicals (biocides), paint and solvents. Regulated chemical containers are those containing any volume of free chemical that is regulated. These may include waste oil containers, and aerosol cans containing solvent or paint.	All activities	Recycle
Contaminated soil	Contaminated soils are generated where local spills of hydrocarbons and other contaminants may occur.	All activities	Regulated – Treated or regulated landfill. General – re-use
Medical and clinical waste	Sharps and biohazard wastes are generated at camps during routine medical care and treatment.	Incidental activities	Treated at licensed facility
Oily filters, rags, absorbents	Oily filters, rags and absorbents are generated from routine equipment and vehicle servicing, repair and filter changes.	All activities	Recycle
Triethylene Glycol / Glycol / coolant	Waste Triethylene Glycol / Glycol / coolant are generated from vehicle and equipment fluid changes, and as part of the gas dehydration process.	Construction and operational activities	Treated at licensed facility
Tyres	Tyres and tubes are generated from tyre changes on work vehicles and equipment.	All activities	Licensed facility - recycle
Used spill kits	Used spill kits are generated from spill clean-up of chemicals and hydrocarbons.	All activities	Regulated landfill
Waste oil (clean waste oil)	Small quantities of waste oil are generated routinely from vehicle and equipment oil changes.	All activities	Recycle

6. CSG Water Management

The proposed amendment relates to the management of CSG water, and the requirements of section 126(1) and section 126(2) of the EP Act are addressed in the following sub-sections.

6.1. CSG Water Production

As described in the CSG WMP (Appendix B), CSG water will be produced as a by-product of depressurisation of coal seams for the Project. The target coal seams are the Walloon Coal Measures (WCM). Produced water volumes and rates Figure 6-1 are based on reservoir modelling data which considered reservoir parameters (i.e., permeability, porosity, and net coal). Peak CSG water production is predicted to occur in 2026 at an average daily rate of ~4.6 ML/day. It is estimated that ~6,800 ML of groundwater will be produced during the Project life.

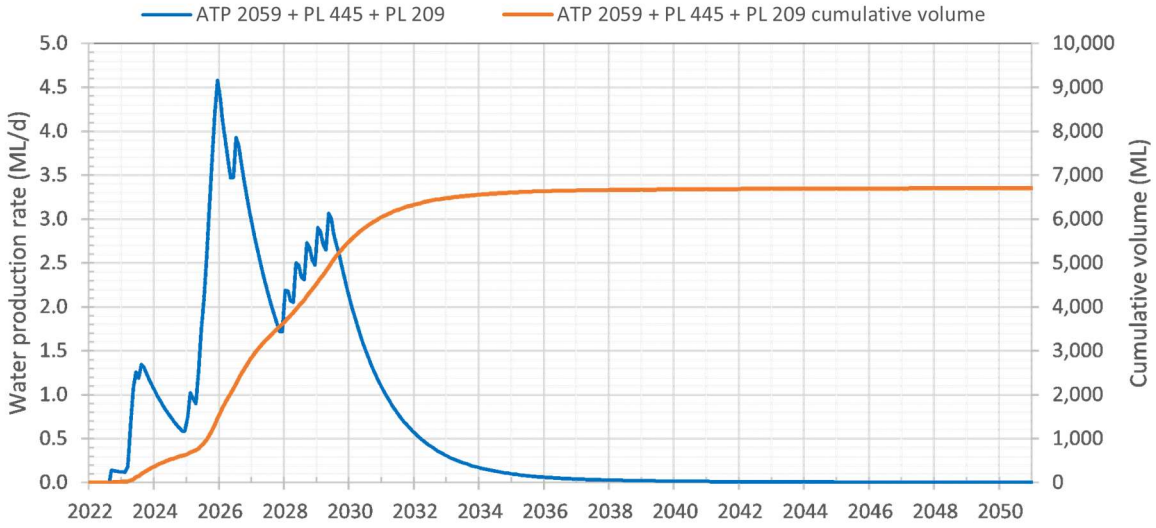


Figure 6-1: PL 445 and PL 209 Forecast Water Production

6.2. CSG Water Quality

Regional water quality characteristics associated with the WCM are provided since WCM-specific water quality data is not available. The produced water quality from the WCM varies from fresh to saline. In general, the total dissolved solids (TDS) of the WCM within the Surat Cumulative Management Area (CMA) ranges from 30 to 18,000 mg/L, with a mean TDS of 3,000 mg/L (OGIA, 2016a). In addition, available samples from existing CSG bores in the Surat CMA at significant depth show distinct characteristics with negligible concentrations of calcium, magnesium and sulfate, and higher concentrations of sodium and fluoride, compared with the other formations.

Analytical results of twenty-four WCM samples (Table 6-1) located within 25 km of the Project were extracted from the groundwater database (GWDB). The majority of the samples came from third-party groundwater bores located to the north of the Project. In addition, groundwater analysis results from the adjacent PL 1037 are provided in Table 6-2.

Table 6-1: Summary of WCM Water Quality from Available GWDB Samples within 25 km of the Project

Parameter	Unit	Count	Min	Max	Median	Average
EC	µS/cm	12	1,900	13,400	8,010	7,310
pH	-	15	5.5	8.8	7.7	7.7
Sodium Adsorption Ratio (SAR)	-	24	7.6	171	81	81
TDS	mg/L	18	883	17,733	5,176	5,645
Sodium	mg/L	24	262	6,860	2,024	2,651
Potassium	mg/L	4	4.3	16.3	5.9	8.1
Calcium	mg/L	24	7.9	344.3	33.5	81.1
Magnesium	mg/L	24	2.9	162.9	10.7	31.4
Bicarbonate (HCO_3)	mg/L	16	30	862	512.0	512.3
Carbonate (CO_3)	mg/L	12	15	343.2	198.8	168.1
Chloride	mg/L	24	375	11,454	2,904	4,014
Fluoride	mg/L	15	0.2	2.2	0.8	0.9
Sulfate	mg/L	16	1.0	57	4.0	8.7

Table 6-2: Summary of WCM Water Quality from PL 1037, PL 209 and PL 445

Parameter	Unit	percent.25	percent.50	percent.75	percent.95	mean
Bicarbonate Alkalinity as CaCO3	mg/L	527.25	578.00	588.50	598.45	559.88
Carbonate Alkalinity as CaCO3	mg/L	129.75	139.50	157.50	188.30	144.63
Chloride	mg/L	3482.50	3515.00	3567.50	3799.50	3523.75
Electrical Conductivity @ 25°C	µS/cm	10325.00	10700.00	11300.00	11765.00	10753.00
Fluoride	mg/L	1.40	1.45	1.50	1.50	1.44
Magnesium	mg/L	7.00	8.00	8.00	8.65	7.63
pH Value	pH Unit	8.92	8.96	8.98	9.05	8.95
Potassium	mg/L	21.75	23.00	25.75	29.30	23.88
Sodium	mg/L	2300.00	2340.00	2382.50	2533.00	2343.75
Sodium Adsorption Ratio		134.00	136.00	139.50	142.30	136.88
Sulfate as SO4 2-	mg/L	1.00	1.00	1.00	1.00	1.00
Total Dissolved Solids (Calc.)	mg/L	6745.00	6960.00	7247.50	7670.00	6976.25
Bicarbonate Alkalinity as CaCO3	mg/L	548.00	639.00	664.00	739.00	617.94
Carbonate Alkalinity as CaCO3	mg/L	50.50	62.00	68.00	82.30	59.94
Chloride	mg/L	2730.00	2800.00	2860.00	3003.00	2809.71
Fluoride	mg/L	1.15	1.20	1.30	1.66	1.25
Magnesium	mg/L	5.00	6.00	7.00	8.00	6.06
Potassium	mg/L	9.00	11.00	12.00	18.80	11.66

Sodium	mg/L	1770.00	1890.00	1960.00	2019.00	1883.71

Table 6-3: PL 1037 Brine Analysis

Chemical Name	Unit	percent.25	percent.50	percent.75	percent.95	mean
Bicarbonate Alkalinity as CaCO3	mg/L	3260.00	3520.00	3735.00	4102.50	3415.00
Carbonate Alkalinity as CaCO3	mg/L	1725.00	2035.00	2577.50	2857.50	2165.00
Chloride	mg/L	24900.00	27400.00	30800.00	32700.00	27033.33
Electrical Conductivity @ 25°C	µS/cm	64700.00	75950.00	84200.00	89200.00	72950.00
Fluoride	mg/L	9.20	10.15	12.22	12.78	10.30
Magnesium	mg/L	48.50	53.00	58.25	67.25	52.50
pH Value	pH Unit	9.00	9.02	9.08	9.14	9.04
Potassium	mg/L	311.50	352.50	388.25	399.50	351.33
Sodium	mg/L	18025.00	20150.00	23475.00	25950.00	20466.67
Sodium Adsorption Ratio	SAR Unit	483.75	527.50	635.00	676.75	557.50
Sulfate as SO4 2-	mg/L	10.50	11.00	11.50	11.90	11.00
Total Dissolved Solids (Calc.)	mg/L	42075.00	49400.00	54700.00	57950.00	47416.67

6.2.1. Water Balance

The timing for the long-term water management strategy for the Project area was determined by utilising a water balance model. The model simulates the operation of the existing Atlas (PL 1037) water management system (as detailed in Figure 6-2) with the ability to add in additional water management infrastructure as/if required due to the increased water production forecasts (i.e., Atlas Stage 3 water production forecast). Parameters used in the model are discussed in detail in Section 4.4 (Water Balance) of the CSG WMP.

The water balance model uses a methodical mass balance process which stipulates variable inflows and outflows into a Net storage calculation. More specifically, the climate data uses monthly averages extracted from Bureau of Meteorology (BoM) for the region from circa 1980 to present, providing options for distinct solutions within the simulation period, with statistics used to present the results in terms of percentiles.

Results from water balance modelling conclude that to provide sufficient containment under the P50 and P90 climate scenario, augmentation of the existing holistic water management infrastructure is recommended as follows:

- Atlas (PL 1037) water production forecast:
  - Additional brine storage (online 2024 and required because the current PL 1037 water production forecast is larger than originally modelled):
  - Two additional brine tanks each with a Full Supply Volume of 57 ml, Maximum Operating Level of 44 ml
- Atlas Stage 3 water production forecast:
  - PL 1037 WTF: increase capacity up to 4.5 ML/d from mid-2024 to around 2030 when the water production rate is highest.
  - Add storage (online 2024).

- Irrigation area (online 2024).
- Increase irrigation area for Lara Dam from 105 ha up to ~200 ha which includes the additional 15 ha associated with the existing pivot end guns.
- Additional irrigation dam with an irrigation area of 115 ha.
- Additional produced water storage (online 2025).
- Accommodation of an additional produced water storage dam/s located PL445 and/or PL 209.

Understanding of well performance will improve as the Project progresses and more production data becomes available. Because of this, the water balance modelling will be updated as further production data becomes available and if the water production rates change.

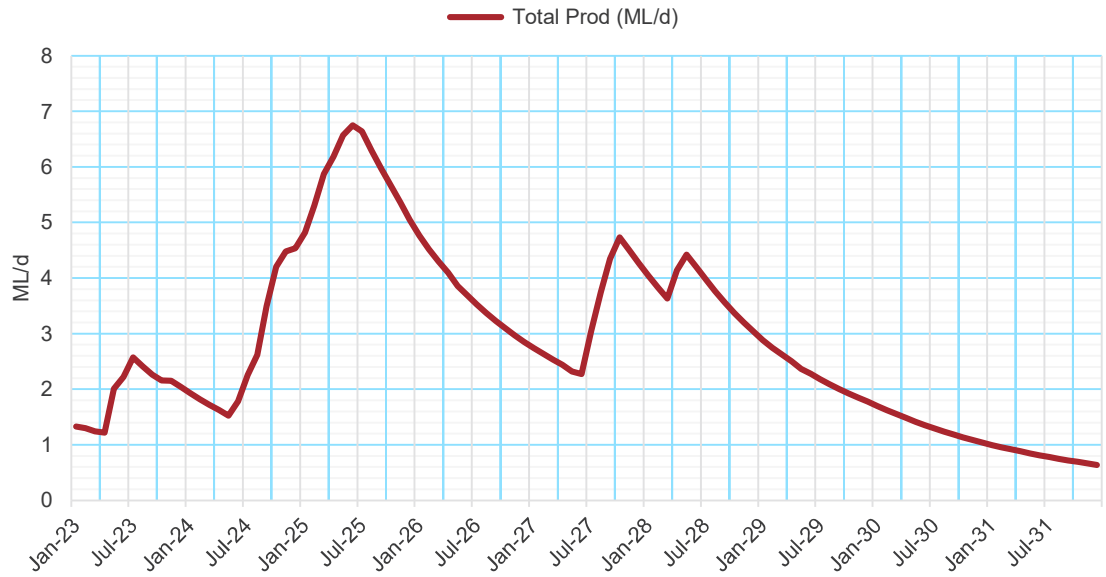
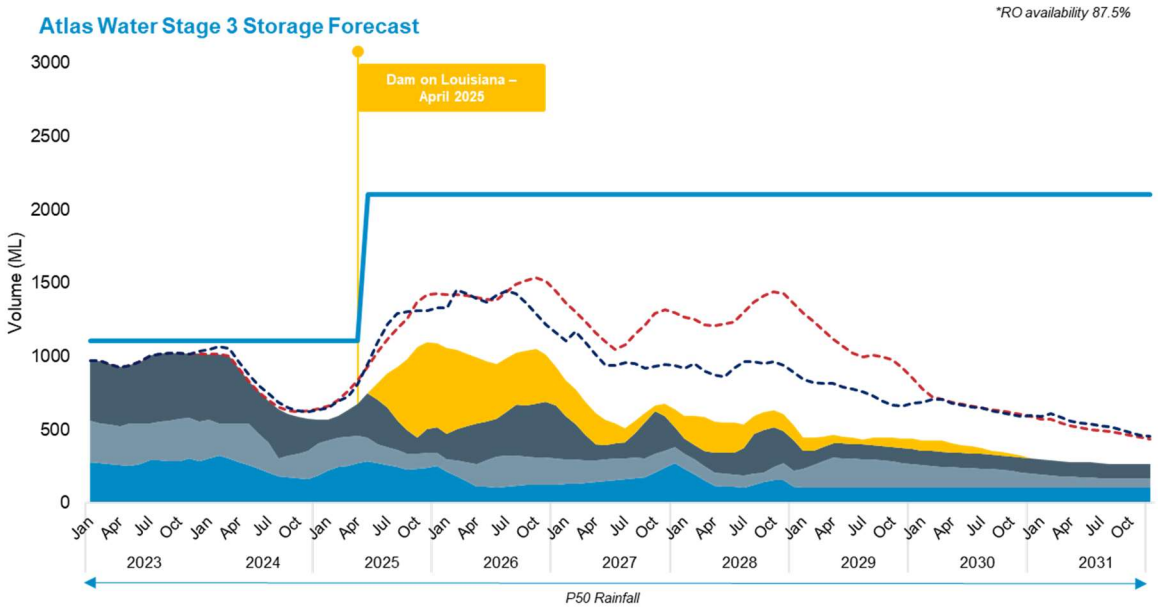


Figure 6-2: Atlas Stage 3 Water Production Rates and Cumulative Volume



Description	Climate	RO Upgrade	Production Rate
Atlas Dam 1 (300 ML)	P50	4.5 ML/d 24th March 2024	Forecast base rate
Atlas Dam 2 – Cell 1 (300 ML)	P50	4.5 ML/d 24th March 2024	Forecast base rate
Atlas Dam 2 – Cell 2 (500 ML)	P50	4.5 ML/d 24th March 2024	Forecast base rate
Louisiana Dam (1000 ML)	P50	4.5 ML/d 24th March 2024	Forecast base rate
High Water Rate (Totalized)	P50	4.5 ML/d 24th March 2024	Forecast high case +15%
High Rainfall (Totalized)	P90	4.5 ML/d 24th March 2024	Forecast base rate

Figure 6-3: Atlas Stage 3 Water Balance Model Results

6.3. CSG Water Management

Proposed CSG water management options for Atlas Stage 3 Gas Project have been developed based on the Department of Environment and Heritage Protection (DEHP) (now the Department of Environment Science and Innovation (DESI)) prioritisation hierarchy:

Priority 1 – CSG water is used for a purpose that is beneficial to one or more of the following:

- The environment;
- Existing or new water users; or
- Existing or new water-dependent industries.

Priority 2 – After feasible beneficial use options have been considered, treating, and disposing of CSG water in a way that firstly avoids, and then minimises and mitigates, impacts on EVs.

6.3.1. Water Management Infrastructure

CSG produced water for the Project will be collected via water gathering systems. Where practicable, and to the extent authorised by current and future approvals, the proposed action will integrate with infrastructure constructed on PL 1037. Such integration will maximise operational efficiency and reduce the impacts of the proposed action.

The water management process for the produced water will involve:

- Initial storage of Atlas Stage 3 Gas Project produced water in existing water management infrastructure on PL 1037.

- New aggregation dams that will be established on PL 1037 (already authorised under EA0001207) and/or PL 209 (the subject of this application) to service produced water from Atlas Stage 3 Gas Project.
- Additional aggregation storage infrastructure will range from pre-engineered above ground tanks to purpose built earthen dams with impervious liners and leakage detection/collection systems.
- The existing water treatment facility on PL 1037 will treat water from Atlas Stage 3.
- Subject to water production rates and other field development characteristics, an additional water treatment facility may also be constructed on PL 209. This potential water processing facility does not form part of this application.
- Treated water will be transferred to existing and new third-party irrigation dam(s) (approximately 50-200 ML each) on PL 1037 and/or PL 209.
- Brine from the water treatment process will be stored in a new brine storage dam which will be developed on PL 1037 (already authorised under EA0001207). Additional brine storage may also be required on PL 209.
- The infrastructure and flow process associated with water management is provided in Figure 6-4. Senex's strategy for CSG water management for the Project has been developed based on the Department of Environment and Science (DES) *Prioritisation Hierarchy* (DEHP 2012). The water management options have been developed to maximise beneficial use of water.

It was originally planned to use existing water storage facilities on PL 1037 for produced water from PL 445 and PL 209 (Figure 6-4). However, as discussed above, the need for additional CSG water or brine storage dams associated with PL 445 and PL 209 has been identified in Section 6.2.1, and as per the existing EA conditions these will be designed and assessed using the 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures' (ESR/2016/1933).

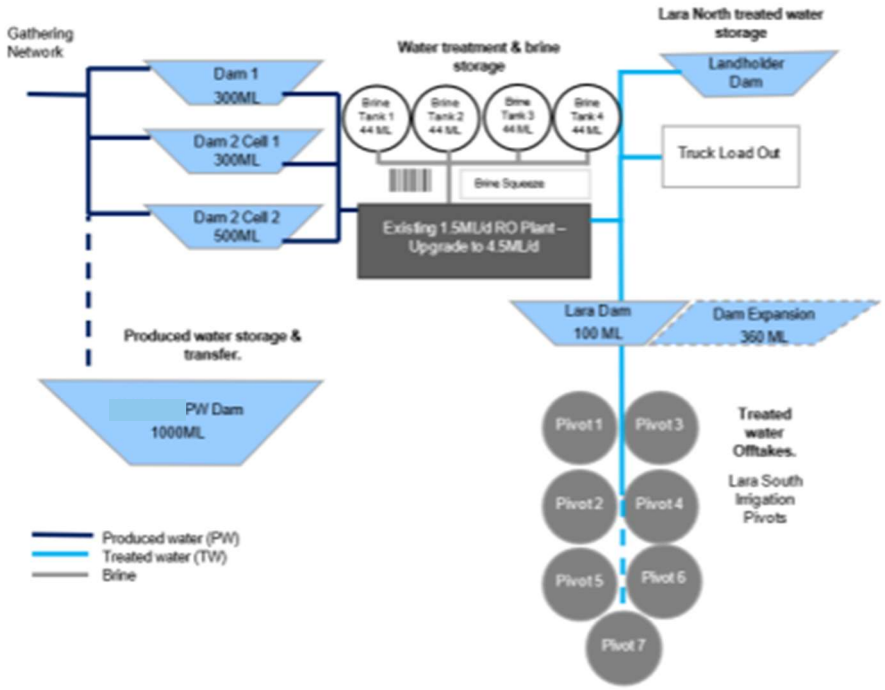


Figure 6-4: Existing Atlas Stage 3 Gas Project Water Management Infrastructure Schematic

Any low consequence dams required for CSG water storage will be designed in accordance with accepted engineering standards. The dams will be designed with a floor and sides comprising material capable of containing the water for the life of the project.

6.3.2. Water Management Options

The water management strategy has been developed to beneficially use water. This includes providing produced water for the following activities:

- Project activities - where practical, Senex will use untreated produced water to support ongoing development/construction activities such as: dust suppression; drilling; well completions and workovers; facilities construction; and hydro-testing gathering networks. Untreated produced water from the Project is expected to be used for dust suppression.
- Landowner Water Supply Agreements (WSA) including water for irrigation and stock watering.

6.3.3. Brine and Salt Management

The prioritisation hierarchy for managing saline waste is comprised of:

- Priority 1 – Brine or salt residues are treated to create useable products wherever feasible.
- Priority 2 – After assessing the feasibility of treating the brine or solid salt residues to create useable and saleable products, disposing of the brine and salt residues in accordance with strict standards that protect the environment.

Senex's brine management will be consistent with existing EA conditions in Schedule J which also addresses spills and leaks and Schedule GG which addresses seepage monitoring and management.

Brine will be transferred from the PL 1037 WTF to the brine storages. Based on a median salt concentration of 5,176 mg/L TDS (Table 6-3), it is anticipated that approximately five tonnes of salt per mega litre (ML) of produced water will be generated.

Brine will be stored in engineered storages that will contain all brine produced from the Project. Solar evaporation of the stored brine will yield a highly concentrated slurry or solid salt, which will be transferred to a Regulated Waste Facility for disposal when necessary. As outlined in Schedule H (Rehabilitation) of the EA, Senex will be responsible for the rehabilitation of any dams or infrastructure under the approval or, where appropriate, transferring dams to landholders in accordance with approved EA conditions and ensuring no legacy issues develop following the cessation of Project production.

6.4. Measurable Criteria

The EP Act requires that a site-specific application for a CSG activity must include measurable criteria (termed 'management criteria' in Appendix B), against which the applicant will monitor and assess the effectiveness of the management of all produced water and saline waste associated with the activity. Senex has developed criteria that addresses this requirement (the criteria have been developed following guidance outlined in the DES factsheet 'CSG water management: Measurable criteria' (ESR/2016/1902, version 1.02).

The management criteria (Table 6-4) address the requirements of section 126(1)(e) of the EP Act, namely:

- The quantity and quality of the water:
    - Used;
    - Treated;
    - Stored; or
    - Disposed of.
- Protection of EVs affected by each relevant CSG activity; and
- The disposal of waste generated from the management of water.

Senex is committed to maintaining compliance with management criteria. However, should any incidents or non-compliance of the management criteria occur, Senex will investigate and report on the non-compliance. Findings and recommendations will be adopted to assist with future compliance and enable continual improvement in water management and environmental performance.

Potential actions that may be implemented by Senex as a result of an investigation into a non-compliance with management criteria are listed in Table 6-5, other actions that may be taken are listed in Table 5-3.

Table 6-4: CSG Water Management Criteria

Objective	Environmental Values	Tasks	Performance Indicator
No unauthorised disturbance of ESAs due to CSG water management activities	Land Surface water	Secure disturbance approvals by implementing the 'Environmental Management Plan' (SENEX-ATLAS-EN-PLN-015) and Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development (OPS-ATLS-EN-PLN-001). Finalise infrastructure locations to identify area and location of disturbances. Comply with EA conditions related to disturbance, biodiversity values and ESAs.	• Site-specific Ecology Assessment Reports • Site-specific Desktop Constraints Reports • Compliance with extent of approved disturbance.
No unauthorised releases to the environment from the gathering network	Groundwater Surface water	Select gathering routes by implementing the 'Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development' (OPS-ATLS-EN-PLN-001). Implement the Environmental Management Plan' (SENEX-ATLAS-EN-PLN-015) Develop and implement operation and maintenance plans for gathering networks. Ensure plans includes: Operational procedures for infrastructure associated with isolation, leakage detection and venting / draining for the CSG production wellhead and gathering network; and Monitoring procedure for wellhead and gathering network infrastructure. Implement Senex Incident Reporting and Investigation Procedures.	• Recorded volume of unauthorised leaks / spills • Recorded number of incidents and associated investigations that have been completed.

No unauthorised releases to the environment from non-regulated structures storing CSG water.	Groundwater Surface water	Tanks – construction and maintenance in accordance with EA conditions; install remote monitoring equipment for water levels; and implement leak detection monitoring and site inspections. Ponds – implement site inspection / leak detection monitoring program in accordance with EA requirements (surface water and groundwater seepage). Implement Senex Incident Reporting and Investigation Procedures including but not limited to Atlas Stage 3 Water Monitoring and Management Plan (Senex 2024): Review monitoring data for identification of trigger exceedances. Assess and report impact(s), where appropriate, associated with trigger exceedance. Undertake remedial actions as required.	• Recorded volume of unauthorised leaks / spills • Recorded detection of unauthorised leaks (i.e., groundwater level rise, groundwater quality changes) • Recorded number of incidents and associated investigations.
No unauthorised releases to the environment from regulated structures storing CSG water.	Surface water Groundwater	Design, construct and operate all regulated structures in accordance with the requirements of the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES 2016a). Develop and maintain a regulated structure register. Implement a monitoring program to assess structure integrity and groundwater seepage in line with the *Atlas Stage 3 Water Monitoring and Management Plan* (Senex 2024). Develop and implement a rehabilitation plan for specific regulated structures, including, if required, a brine and salt management plan. Undertake assessment and reporting in accordance with EA requirements including: Review monitoring data for identification of trigger exceedances. Assess and report impact(s), where appropriate, associated with trigger exceedance. Undertake remedial actions as required.	• Recorded volume of unauthorised releases from regulated structure • Compliance with requirements of the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (DES 2016) • Recorded detection of unauthorised leaks (i.e., groundwater level rise, groundwater quality changes) • Recorded number of incidents and associated investigations.

Maximise the beneficial use of CSG water	Groundwater Surface water Land	Maintain the analytical reservoir model to predict the quantity and quality of water over the duration of the Project development. Develop and maintain a project water balance model to optimise the size of water management infrastructure and predict changes in water quality to support the water management strategy. Prioritise water use in accordance with the hierarchy defined in the *CSG Water Management Policy* (DEHP 2012). Develop and implement a Water Quality Monitoring Program to confirm if water is fit for beneficial use. Determine requirement for a WTF.	• Proportion of untreated CSG water beneficially used. • Proportion of treated CSG water beneficially used. • Monitoring data which are within the appropriate guidelines for relevant water quality objectives for the designated beneficial use.
Optimise CSG water and brine management	Groundwater Surface water	Maintain the analytical reservoir model to predict the quantity and quality of water over the duration of the Project development. Develop and maintain a project water balance model to optimise the size of water management infrastructure and predict changes in water quality to support the water management strategy. Continue to investigate opportunities for CSG water and brine management and prioritise these options in accordance with the *CSG Water Management Policy* (DEHP 2012). Undertake ongoing assessments of optimisation options for CSG water and brine management.	• Results from the project water balance identifying the preferred CSG water and brine management options.

Table 6-5: Potential Corrective Actions for exceedance of CSG Water Management Criteria

CSG Water Management Criteria	Potential Corrective Action
No unauthorised disturbance of ESAs due to CSG water management activities	Commitments made throughout this application state no disturbance to ESAs or their associated PPZs will occur as a result of the proposed amendment.
No unauthorised releases to the environment from the gathering network	Post-incident review Update of operational and/or incident response procedures Potential changes to gathering specifications, design and/or layout
No unauthorised releases to the environment from non-regulated structures storing CSG water.	In the unlikely scenario that preventative controls have not been effective, the following actions may be implemented: • Isolation of inlets to the dam / diversion of water to other produced water storages • Set up of temporary water transfer equipment to move water between storages (this is specific to Atlas where the dams are co-located) • Field production turndown • Post incident / performance trigger inspections as defined in our operating plans (checking integrity of spill ways etc. to ensure the structure isn't compromised)
No unauthorised releases to the environment from regulated structures storing CSG water	In the unlikely scenario that preventative controls have not been effective, the following actions may be implemented: • Isolation of inlets to the dam / diversion of water to other produced water storages • Set up of temporary water transfer equipment to move water between storages (this is specific to Atlas where the dams are co-located) • Field production turndown • Post incident / performance trigger inspections as defined in our operating plans (checking integrity of spill ways etc. to ensure the structure isn't compromised)
Maximise the beneficial use of CSG water	All Senex produced water is beneficially used or stored for future beneficial use and Senex plans to continue to use this approach.
Optimise CSG water and brine management	Implementation of operational measures to address recovery (e.g., chemical amendment at WTP to improve performance, membrane replacements, etc) Implementation of temporary arrangements to blend water (e.g., recycle a portion of permeate to feed ponds or blending of produced water from other dams if suitable)

7. Site Description

In overall terms, the character of the tenure area is rural, remote agricultural land with limited to no industrial activity and sparsely distributed dwellings. Due to the character of the location, ambient noise levels are low and typical of rural areas. Ambient air quality is typical of rural airsheds and exhibits no exceedances of the relevant EPP Air criteria.

7.1. Bioregion and Topography and soils

The tenure area is located within a landscape of rolling rises, with elevation varying from 280 metres to 340 metres above sea level. This site falls within the Southern Downs subregion of the Brigalow Belt bioregion and is drained by the Fitzroy River Basin. Soils from the proposed location primarily comprises brown clay-loams on hill slopes, with some areas of sandy-loams located predominantly along streamlines.

Acid-sulfate soils are not mapped within the project area.

7.2. Vegetation

PL 209 and 445 are located within the Queensland Brigalow Belt South bioregion. The tenure area has been extensively cleared for livestock grazing and agricultural purposes. Areas of remnant vegetation are restricted to small, isolated woodland fragments and narrow, discontinuous corridors of remnant and regrowth vegetation bordering watercourses and drainage lines.

Native vegetation of the bioregion is characterised by woodland and forest communities of *Acacia harpophylla* (Brigalow) with scattered ecosystems dominated by eucalypt species, cypress pine, acacia species and grassland. There are no mapped high-risk areas under the NC Act, and limited Regional Ecosystems (RE) listed under the VM Act have been validated as occurring within the area.

A significant portion of the tenure area comprises pasture dominated by Buffel Grass (*Cenchrus ciliaris*), but with sparse low shrubby regrowth of native species, and occasional paddock trees.

Detailed ecological information is provided in section 8.1.

7.3. Climate

The tenure area is subject to a humid subtropical climate with warm to hot summers and mild, dry winters. Monthly statistics from the closest Bureau of Meteorology monitoring station at Taroom Post Office (site number 035070) show that mean maximum temperatures range from 21.2°C in winter to 33.9°C in summer. Extremes of recorded temperatures have ranged from -5.6°C to 45.3.

Rainfall is relatively low throughout the year with the mean annual rainfall being 668mm. The highest rainfalls occur during the summer months and reduce over autumn into winter. The highest recorded monthly rainfall between 1870 and 2022 was approximately 421mm in February 1954.

7.4. Watercourses and Wetlands

Watercourses and wetlands within the project area are detailed in Section 10.1.1.

7.5. Sensitive Receptors

Sensitive receptors meeting the definition provided under the Department of Environment and Heritage Protection (EHP) guideline, *Application requirements for petroleum activities* and the Environmental Protection (Noise) Policy 2019 (EPP Noise) have been mapped across the Atlas Stage 3 Gas Project area (Figure 7-1). Notably, there are only two sensitive receptors identified within the development footprint of PL209 and PL 445.

Senex already has an alternative arrangement in place with one of these sensitive receptors and should air or noise emissions be likely to reach nuisance levels, will endeavour to negotiate alternate arrangements with other potentially impacted sensitive receptors. Additional information relating to potential air and noise emissions and impacts is presented in Section 12 and Section 13.

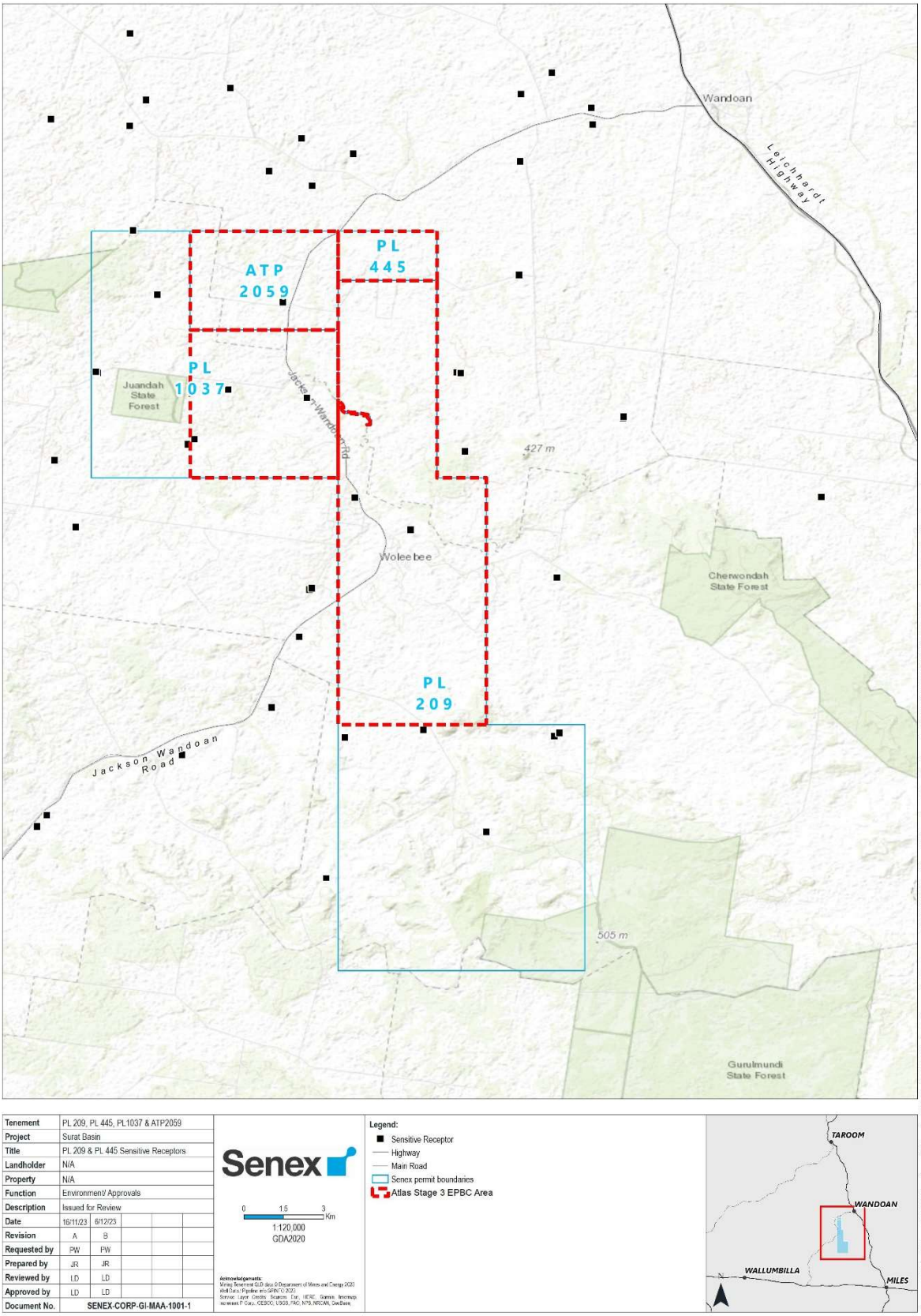


Figure 7-1: Sensitive Receptors

8. Environmental Values

Section 9 of the EP Act defines Environmental Value (EV) as:

(a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or
(b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

The following Environment Protection Policies (EPP) prescribe EVs as per section (9)(b) of the EP Act:

- *Environmental Protection (Air) Policy 2019*
- *Environmental Protection (Noise) Policy 2019*
- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*

An assessment of EVs relevant to each of the 25 conceptual locations is shown in Appendix J and summarised in Table 8-1, Figure 8-1 and Figure 8-1Figure 8-2. A detailed review of environmental values and potential impacts is provided in section 8.1 to section 13.

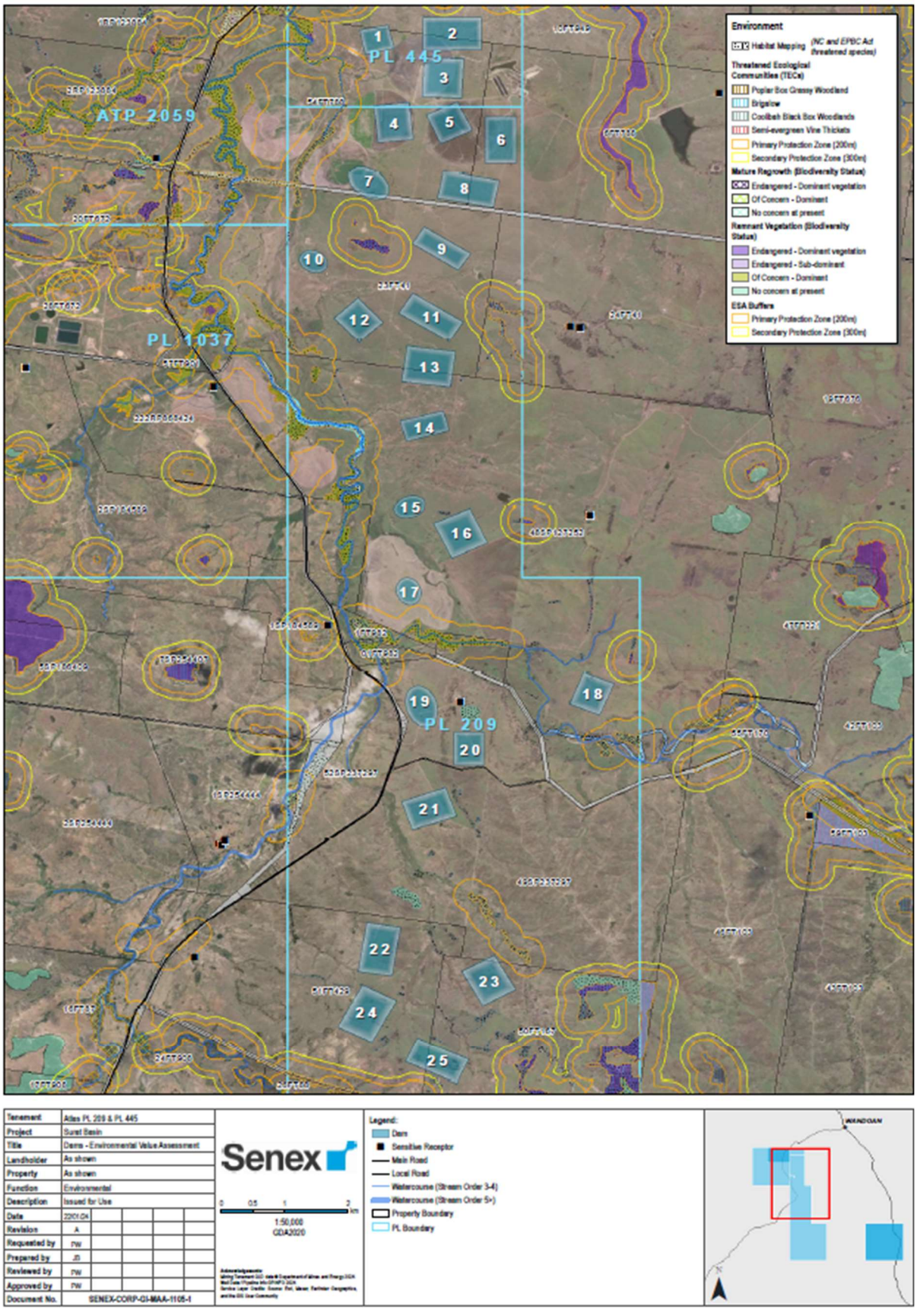
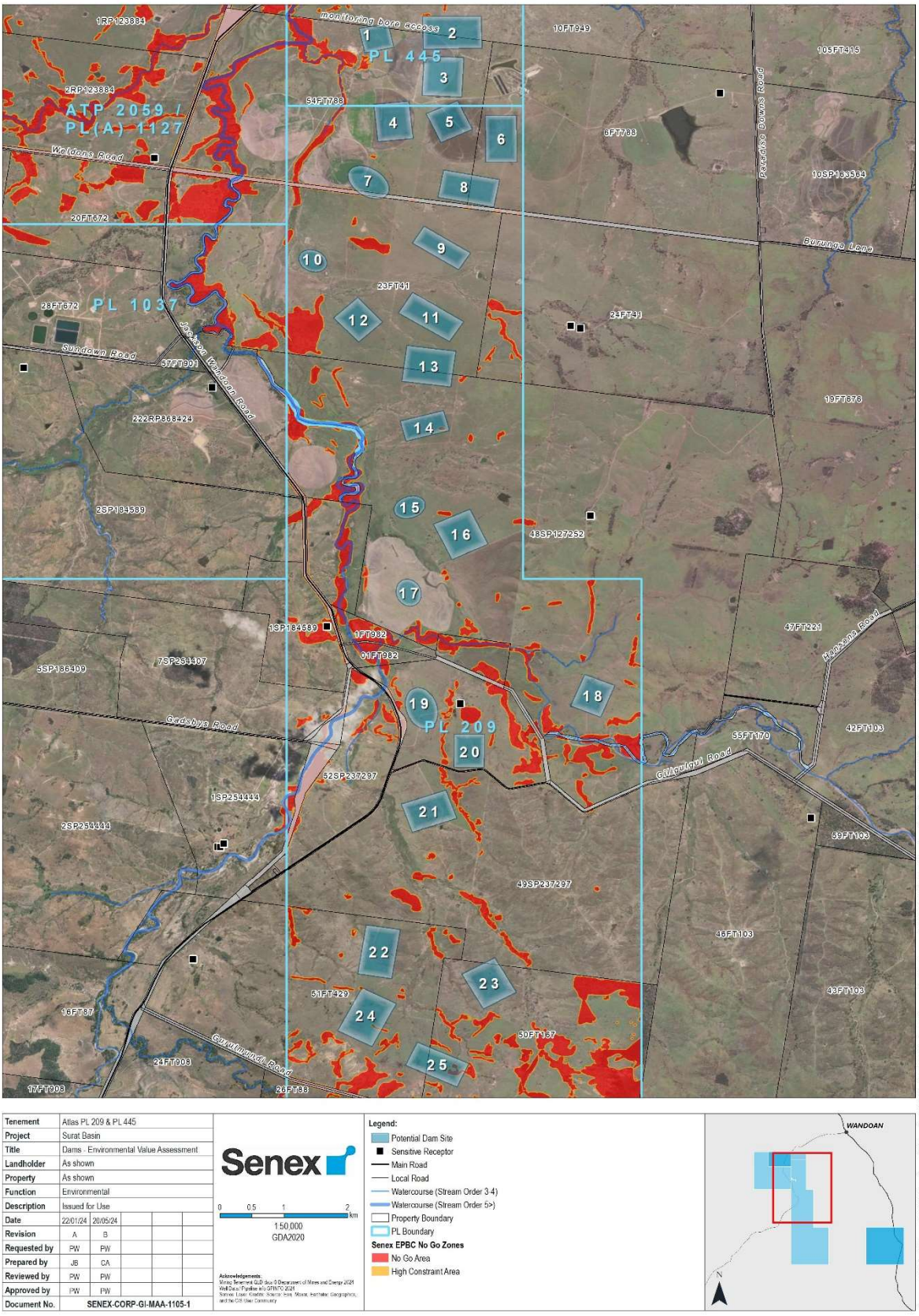


Figure 8-1: Environmental Values at Identified Dam Locations



Tenement	Atlas PL 209 & PL 445
Project	Surat Basin
Title	Dams - Environmental Value Assessment
Landholder	As shown
Property	As shown
Function	Environmental
Description	Issued for Use
Date	22/01/24 / 20/05/24
Revision	A / B
Requested by	PW / PW
Prepared by	JB / CA
Reviewed by	PW / PW
Approved by	PW / PW
Document No.	SENEX-CORP-GI-MAA-1105-1

Senex

0 0.5 1 2 km

1:50,000
GDA2020

Legend:
- Potential Dam Site
- Sensitive Receptor
- Main Road
- Local Road
- Watercourse (Stream Order 3-4)
- Watercourse (Stream Order 5>)
- Property Boundary
- PL Boundary

Senex EPBC No Go Zones
- No Go Area
- High Constraint Area

WANDOAN

Document Path: F:\Senex GIS\GIS Mapping - All Mapping\QLD Project Atlas\Project wide mapping\Environmental\MAA-1105 Atlas Dam Locations Environment Values Assessment\MAA-1105-1 Atlas Dam Locations EV Assessment.mxd

Figure 8-2: Indicative Dam Locations vs Constraints Protocol No-Go Areas

Table 8-1: Shortest distance to Identified Environmental Values at Conceptual Dam Locations

Dam Site	Distance to identified EV (km)									
	Sensitive Receptors	TEC	Mature Regrowth	Remnant Vegetation	Threatened Species Habitat (NC / EPBC Act)	ESA SPZ (300m)	ESA PPZ (200m)	Watercourse SO1	Watercourse SO2	Watercourse SO3
1	3.01	0.5	0.51	0.25	0.25		0.05	0.15		
2	3.43	0.35	0.34	0.35	0.34	0.04		0.22		
3	3.64	1.03	0.97	0.99	0.96	0.67		0.11		
4	3.16	0.39	0.39	0.66	0.39		0.19	0.12		
5	3.37	1.14	1.14	1.27	1.14		0.94	0.19		
6	2.67	1.97	1.97	1.18 (off-tenure)	1.81	0.88		0.15		
7	2.74	0.57	0.57	0.35	0.35	1.83			0.06	
8	2.15	1.01	1.44	1.01	1.01	0.71		0.07		
9	1.81	0.32	0.65	0.32	0.32	1.72		0.05		
10	2.27	0.45	0.71	0.45	0.24	0.15			0.27	
11	1.51	0.35	0.35	0.7	0.35	0.05			0.16	
12	2.03	0.46	0.69	0.49	0.46		0.29	0.03		
13	1.67	0.1	0.68	0.1	0.1	0.38		0.03		
14	2.23	1.13	1.2	0.54	0.51		0.34	0.05		
15	1.99	0.2	1.68	0.48	0.2		0.28		0.24	
16	1.51	0.02	1.5	0.58	0.02	0.28		0.34		
17	1.1	0.52	0.52	0.23	0.23		0.03	0.31		
18	1.55	0.2	0.35	0.37	0.2	0.07				0.19
19	0.33	0.88	0.4	0.32	0.07		0.2	0.15		
20	0.48	0.28	1.33	0.17	0.17	1.04		0.13		
21	1.36	0.04	1.2	0.9	0.04		1	0.07		
22	2.33	0.24	1.08	0.35	0.24		0.88		0.27	
23	2.71	0.09	0.24	0.82	0.09		0.04	0.09		
24	2.32	0.08	1.18	0.77	0.08	0.47		0.12		
25	1.57	0.05	0.65	0.37	0.05	0.07		0.02		

8.1. Potential Impacts

Potential Impacts of Proposed Amendment	Activity	Relevance to project area	Mitigation Measures
Clearing of native vegetation and habitat for listed Threatened species. Associated disturbance, displacement or injury of fauna species Fauna injury through associated vehicle movements	Construction Construction Construction and Operation	The project area is a predominantly cleared, agricultural landscape, with only 7% comprising remnant vegetation. Based on commitments made in this document and those made for the Atlas Stage 3 Gas Project EPBC referral direct impacts to the following environmental values will not occur: • Category B ESA or associated PPZ • Category C ESA or associated PPZ • TEC • Threatened species habitat	Refer to sections 4 and 9.
Degradation of existing environmental values due to inappropriate erosion and sedimentation control measures	Construction Operation Decommissioning	Senex will ensure that any site-specific ESCP developed for the purposes of constructing a regulated structure will not only comply with existing condition (B2) but will also be developed in accordance with the International Erosion Control Association Guidelines[16] in place at the time of plan development.	Refer to section 5.2
Dust and Acoustic emissions from construction plant causing environmental nuisance at sensitive receptors.	Construction Decommissioning	Sensitive receptors are scarce across the project area (Figure 7-1) and in accordance with existing EA conditions, where authorised emission limits may be exceeded Senex will seek to negotiate an alternate arrangement.	Refer to sections 12 and 13.
Introduction or spread of weed species	Construction Operations Decommissioning	The majority of the project area and surrounding areas is cleared, pastoral property and introduced flora are common. With the implementation of appropriate weed management and monitoring measures, the proposed amendment is unlikely to cause the introduction and/or spread of weed species within the Project Area.	Refer to section 9.3.6
Shallow groundwater contamination from seepage, overtopping or dam break scenarios. Flora and fauna mortality as a direct result of seepage, overtopping or dam break scenarios	Operations	Dams are designed as no release structures in accordance with relevant regulatory guidelines and existing EA conditions. Dam design (4.2) is governed by consequence category, which in turn is governed by the potential scale of impacts associated with three failure scenarios (section 0). Shallow groundwater may occur across the project area, most likely in conjunction with the alluvium surrounding higher order watercourses. Approximately 7% of the project area comprises remnant vegetation, with the remainder forming part of a cleared and modified agricultural landscape.	Refer to section 11

[16] Publications - International Erosion Control Association (austieca.com.au)

9. Ecology

An ecological assessment of the broader Atlas Stage 3 Gas Project area, including PL209 and PL445 has been completed for the Atlas Stage 3 Gas Project EPBC referral (2015/7469) by ERM (ERM, 2024) and is provided in Appendix K. This report covers the Atlas Stage 3 Gas Project Field Development Area and includes areas other than PL 209 and PL 445 (refer also Figure 1-1 and Table 1-2). Therefore, habitat areas shown in the maps are greater than those presented in the associated tables which are specific to PL 209 and PL 445. While the ERM (2024) report was developed for the EPBC referral, it also addresses MSES.

A key commitment made in the Atlas Stage 3 Gas Project EPBC referral, was that no remnant or regrowth vegetation with habitat values for MNES threatened species would be impacted by project activities. Given the scarcity of habitat within the development footprint on PL 209 and PL 445, this also means that impacts to Remnant and Regrowth REs and threatened species listed under the *Nature Conservation Act 1992* (NC Act) are also not expected.

Therefore, this section summarises the high-level findings of the ecological impact assessment to illustrate the general values present. As and when field development planning identifies potential locations for a proposed dam, Senex will apply its constraints protocol (Section 4 and Figure 4-1) and undertake site-specific ecological assessment as required.

As noted in Table 1-1, the term ‘Project Area’ is used to denote those parts of PL 209 and PL 445 within the Atlas Stage 3 Gas Project EPBC referral area shown in red on Figure 1-1 and is used throughout this section.

9.1. Existing Environment

The Project Area is entirely within the Brigalow Belt Bioregion and occurs across a boundary between the Taroom Downs subregion in the north and Southern Downs southern downs subregion in the south. The northern components of the Project Area feature watercourses on floodplains, surrounded by undulating hills. Towards the southern areas of the Project Area the landscape features steeper slopes and outcropping towards the south-eastern boundary. Several watercourses (stream orders 2 - 5) intersect the Project Area, with named watercourses including Woleebee Creek, Conloi Creek, Hellhole Creek and Wandoan Creek. It is noted that terrestrial and aquatic habitats demonstrated varying levels of degradation, including cattle grazing, clearing, erosion and invasive species and the majority of aquatic habitats surveyed are of limited ecological value.

The main land use within the Project Area is grazing of stock for beef production. Some floodplain areas have been developed for centre-pivot agriculture. The majority of the Project Area is cleared with 7.24% mapped as remnant vegetation and 92.76% of the Project Area classified as cleared areas with non-native pastures (Figure 9-1 and Table 9-4)).

9.2. Methodology

9.2.1. Desktop Assessment

A desktop assessment was performed prior to the field survey which included interrogation of the datasets listed in Table 9-1.

Table 9-1: Databases Reviewed for Desktop Analysis (Source: ERM, 2023).

Information Source	Name	Data Description
DCCEEW	Protected Matters Search Tool (PMST)	The search tool provides predictive results of MNES based on mapping of known and potential species distribution, habitat, ecological communities, and wetlands. The outputs are based on modelling results and do not necessarily reflect known records of species or communities. The features highlighted by the search are considered further through a likelihood of occurrence assessment (see Appendix B of Appendix K). The PMST results can be found in Appendix A of Appendix K. Search area: 10 km buffer around the Project Area.
DoR	Regional Ecosystem (RE) Version 12.2 mapping	This product maps remnant vegetation communities across Queensland and identifies communities listed as endangered, of concern or least concern status.
DoR	Property Maps of Assessable Vegetation mapping (published 16 September 2021)	This product provides certified property scale maps indicating where landholders can clear regrowth in 'Category X' areas without further approval and areas where approval is required for clearing regulated vegetation. The PMAV provides a property scale regulated vegetation map which replaces the statewide regulated vegetation map published by DoR.
Queensland Government	MSES mapping	This product maps areas of MSES as defined under the QLD State Planning Policy.
DoR	Queensland Globe	A Google Earth based product that allows viewing of spatial data and imagery covering Queensland.
DES	WO	A database that contains records of wildlife sightings including threatened flora and fauna species (protected under the NC Act) that have been provided to the agency by Government departments and external organisations.
ala.org.au	ALA	Australia national biodiversity database (supported by the National Collaborative Research Infrastructure Strategy, CSIRO). Database contains records accessed through an interactive spatial portal. Threatened species are searched to identify known records in proximity to the Project Area.
Darling Downs Regional Council	Darling Downs Regional Plan 2013	The *Darling Downs Regional Plan 2013* provides information relating to biodiversity, and wetland and waterway corridors.
DCCEEW	Species Profile and Threats Database (SPRAT)	The SPRAT profiles and associated conservation advice documents were consulted for the following reasons: They provide detailed information for the Likelihood of occurrence assessment on: • Species distribution; and • Habitat information including species-specific requirements. The conservation advice documents are particularly important for assessing Threatened Ecological Communities (TECs) found in field surveys, against the listed TEC guidelines.
BOOBOOK	Previous Ecological Surveys	Previous ecological surveys in the Senex Atlas gas field were also considered as part of the analysis for the Project Area (BOOBOOK 2014, 2020, 2021a, 2021b, 2022a; ERM 2018; all cited in ERM 2023).
Attexo	Previous Ecological Survey	Threatened flora surveys in the Senex Atlas gas field were also considered as part of the analysis for the Project Area (Attexo 2023, cited in ERM 2023).

9.2.2. Field Survey

Field surveys were conducted to identify and characterise the current presence, extent and condition of terrestrial and aquatic ecological values within the Project Area. Terrestrial ecological field surveys were undertaken in March (14-18th and 22-25th) and June (9-13th) of 2022, with Attexo Group undertaking targeted Ooline and threatened flora surveys via vehicle based and foot traverses of the Project Area, over the periods 31st January – 3rd February 2023. Aquatic ecological field surveys were undertaken in March (14-21st) 2022. As per section 4, ecological pre-clearance surveys will also be undertaken not more than 12 months prior to commencement of clearing activities.

The weather during the survey period was mild and wet with a total of 425.8 mm rainfall recorded from January to May (Bureau of Meteorology, 2022). This is significantly higher than the long term (1912 - 2021) median value of 204.2 mm (BOOBOOK, 2022, cited in ERM 2023). As such, wet weather caused impact to the field survey schedule and the soil remained moist with some areas waterlogged throughout the survey periods.

Details on field survey components, purpose and methodologies are provided in Table 9-2. An assessment of the adequacy of survey effort is provided in Table 3.5 of Appendix K.

Table 9-2: Field Survey Components, purpose and methodologies

Component	Purpose / Parameters	Methodology
Baseline vegetation surveys	describe dominant flora and vegetation community structure within the Project Area Ground-truthing of the RE vegetation communities was undertaken using the quaternary level of data collection Ground-Truthing of Environmentally Sensitive Areas	Neldner *et al.*
Biocondition Assessments	determine ecological functionality of major vegetation types in the Project Area	Eyre et al. (2015)
Flora Species Survey	Targeted threatened species for listed EPBC Act and NC Act threatened flora. Significant weed species, Weeds of National Significance (WoNS) and Biosecurity Act 2014 Restricted Matters, were also recorded	
Fauna Species Survey	Targeted threatened species searches were undertaken for listed EPBC Act and NC Act threatened and/or migratory fauna within the Project Area	Incidental and targeted searches in accordance with species specific survey guidelines, including more generally Eyre et al. (2018)
Fauna Habitat Assessment	Data were collected for fauna habitat features to inform the likelihood of occurrence and significant impact assessments for EPBC Act and NC Act listed fauna species. Data were collected within the same plots surveyed as part of the vegetation assessments	
Aquatic Habitat Assessment	Completed at nine sites	Australian River Assessment System (AusRivAS) protocols (DNRM 2001)
Surface Water Quality	Temperature, pH, DO, EC and Turbidity	*Monitoring and Sampling Manual: Environmental Protection (Water) Policy* (DES, 2018) and AS/NZ 5667.6:1998 Guidance on sampling of rivers and streams (AS/NZS 1998).
Aquatic Flora Sampling	Macrophytes	
Aquatic Invertebrate sampling	Macroinvertebrates	Stephens & Dowling (2002), Sainty & Jacobs (2003) and MacDonald & Haslam (2016).

Fish surveys	five locations sampled using backpack electrofishing. Sampling was carried out over a site reach spanning at least 100 m (where sufficient water was available).	Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES, 2018).
Turtle Surveys	Three had sufficient water to potentially support turtles. Two double winged two fyke nets (one large and one small) were set overnight. At one site, two cathedral traps were also deployed.	n/a
Platypus Habitat Assessment	Sites were assessed for the suitability for supporting platypus.	(Grant, 2007).
Frog Surveys	opportunistic visual encounter surveys and call surveys	n/a

9.2.3. Threatened Species and Communities Habitat Mapping

Habitat and vegetation community mapping was prepared to reflect as accurately as possible actual ground conditions (based on data collected from 2022 field surveys). This habitat mapping used Regional Ecosystem (RE) mapping to guide field investigations. However, the overall mapping results are defined by determining vegetation boundaries and floristic composition based on ground-truthed observations.

9.2.4. Likelihood of Occurrence Assessments

A likelihood of occurrence assessment was undertaken and informed by the field survey results and desktop sources. Desktop sources identified a number of flora and fauna species listed under the EPBC Act (i.e. Protected Matters Search Tool (PMST) search and NC Act Wildlife Online records) that have previously been recorded or predicted to occur within a 10 km buffer of the Project Area.

The assessment ranks the likelihood of the species occurring within the Project Area through analysis of species distribution information, nearest known records and the presence of specific habitat attributes as identified through the desktop analysis and field surveys. The criteria applied are outlined in Table 9-3.

Table 9-3: Likelihood of Occurrence Criteria

	Preferred habitat exists	General habitat exists[17]	Habitat does not exist[18]
Recent[19] records within the Project Area	Known	Known	Known
Recent records in the locality[20]	Likely	Potential	Unlikely
No records within the locality, but the Project Area is within known distribution	Potential	Unlikely	Unlikely
No records in the Locality, and the Project Area is outside of distribution	Unlikely	Unlikely	Unlikely

9.3. Survey Findings

9.3.1. Regional Ecosystems

Sixteen[21] REs covering a combined area of 567.87 ha (or 7.24% of the total Project Area) have been mapped within the Project Area. Seven of these REs are classed under the *Vegetation Management Act 1999* as Endangered or Of Concern. The dominant vegetation communities identified in desktop searches

17 Habitat may be considered general, but not preferred because: some desired habitat features may be present, but not all; habitat may have poor connectivity; or habitat may be known to be disturbed.

Based on sources review and/or field survey results.

18 Based on sources review and/or field survey results.

19 Recent records are those recorded in the last 20years.

20 ''Locality' refers to a 10km2 buffer around the Project Area.

21 11.9.5 and 11.9.5a represent variants of the same RE. Therefore, while Table 9-4 has 17 rows, there are only 16 REs.

and verified by field surveys were RE 11.3.25. *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines and RE 11.9.5. *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks (Table 9-4 and Figure 9-1).

9.3.2. Aquatic Habitat

The availability and quality of aquatic habitat is strongly influenced by water permanency. Twenty-three of the 32 sites held water during the survey while all other sites were dry. The habitat bioassessment only included twenty-four sites as the approach is not applicable to drainage features (five sites) and wetlands (three sites). Instream habitat was mostly found to be in 'fair' condition across all sites sampled (18 of the 24 sites). The remaining sites were determined to be in 'good' condition.

Across all sites, aquatic macrophyte diversity was relatively poor with the highest diversity recorded in a billabong adjacent to Wandoan Creek. Four floating attached macrophyte species and 15 emergent macrophyte species were recorded across all sites. Floating attached macrophytes were recorded at only five sites and no submerged or floating attached macrophyte species or species listed under state legislation as threatened was considered likely to occur.

Table 9-4: Ground-truthed Regional Ecosystems

RE Code	Description	Structure Category	VMA Class	Biodiversity Status	Area within Project Area (ha)	% of Project Area
11.3.1[22]	*Acacia harpophylla* and/or *Casuarina cristata open forest* on alluvial plains	Mid-dense	E	E	-	-
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Sparse	OC	OC	18	0.23
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains	Sparse	OC	OC	3.92	0.05
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Sparse	OC	E	7.1	0.09
11.3.19	*Callitris glaucophylla, Corymbia spp. and/or Eucalyptus melanophloia woodland on Cainozoic alluvial plains*	Sparse	LC	NC	14.16	0.05
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Sparse	LC	OC	151.54	1.97
11.3.27f	Freshwater wetlands: *Eucalyptus coolabah* and/or *E. tereticornis* open woodland to woodland fringing swamps	Other	LC	OC	40.99	0.53
11.3.39	Eucalyptus melanophloia +/- E. chloroclada open woodland on undulating plains and valleys with sandy soils	Sparse	LC	NC	4.63	0.06
11.5.1	*Eucalyptus crebra* and/or *E. populnea, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains and/or remnant surfaces	Sparse	LC	NC	7.27	0.09
11.5.5	*Eucalyptus melanophloia, Callitris glaucophylla woodland on Cainozoic sand plains and/or remnant surfaces. Deep red sands*	Sparse	LC	NC	7.25	0.09
11.9.2	*Eucalyptus melanophloia +/- E. orgadophila woodland to open woodland on fine-grained sedimentary rocks*	Sparse	LC	NC	25.28	0.33
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Mid-dense	E	E	139.09	1.81

[22] Included in table as is shown on Ecological mapping in Appendix I. However, it is not present within the project development footprint on PL 209 or PL 445

11.9.5a	*Acacia harpophylla and/or Casuarina cristata open forest on fine-grained sedimentary rocks: with Cadellia pentastylis and Brachychiton spp. as emergent or dominant in some places, a dense tall shrub layer and a more open low shrub layer of Semi-evergreen vine thicket species, occurring on undulating plains and rises.*	Mid-dense	E	E	11.4	0.15
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	Sparse	OC	OC	4.45	0.06
11.9.10	*Eucalyptus populnea* open forest with a secondary tree layer of *Acacia harpophylla* and sometimes *Casuarina cristata* on fine-grained sedimentary rocks	Mid-dense	OC	E	20.85	0.27
11.10.7	*Eucalyptus crebra woodland on coarse-grained sedimentary rocks*	Sparse	LC	NC	103.69	1.35
11.10.11	*Eucalyptus populnea, E. melanophloia +/- Callitris glaucophylla woodland on coarse-grained sedimentary rocks*	Sparse	LC	NC	8.25	0.11
Total					**567.87**	**7.24**

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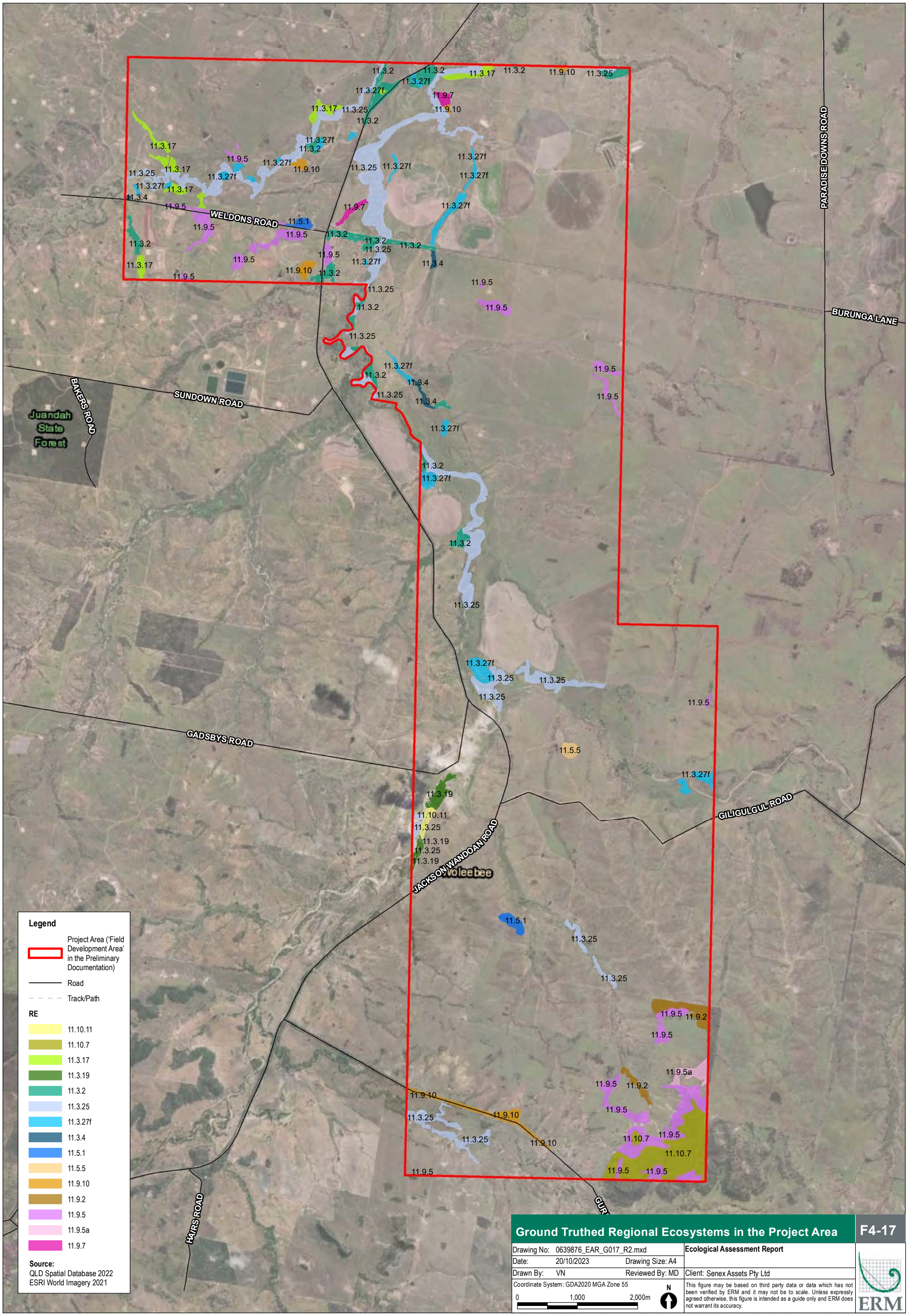


Figure 9-1: Ground-truthed Regional Ecosystems

9.3.3. Terrestrial Flora Species

The field surveys recorded 124 flora species, including one threatened flora species listed under the NC Act, Ooline. This species grows on undulating plains, valley slopes, hillsides and scarps, often in association with Brigalow and SEVT communities (DEWHA, 2008a). During field surveys, Ooline was recorded in isolated stands or clumps in the south-eastern part of the Project Area in Brigalow woodlands. There is 259.6 ha of Ooline habitat within the Project Area (Figure 9-2). During the 2022 field surveys, Ooline was observed in the south-eastern part of the Project Area in Brigalow woodland. In addition, the desktop searches showed four additional records within the Project Area. During the 2023 field surveys, 35 individuals were recorded within the eastern portion of the Hillandale property, adjacent to existing Ooline records. The individuals identified ranged from juveniles to mature plants from 1 - 18m high, occurring in mostly cleared agricultural land (Attexo, 2023). Ooline habitat in the Project Area consists of relatively narrow remnant and regrowth patches in the far south. It is inclusive of all broad habitat types excluding those Eucalypt and Callitris woodlands and Acacia woodlands dominated by Brigalow (*Acacia harpophylla*). As stated earlier, the proposed action will preferentially be located within previously cleared areas and the application of the constraints protocol (Section 4 and Figure 4-1) means that if individual plants are present they will be avoided where practicable.

Based on the likelihood of occurrence assessment, five additional NC Act listed Threatened and Near Threatened flora species, are considered as having potential to occur within the Project Area (Table 9-5, and Figure 9-3 and Figure 9-4).

Table 9-5: NC Act Threatened and Near Threatened Flora Species with the Potential to Occur

Scientific Name	Common Name	NC Act Status	Likelihood of Occurrence	Potential Habitat in the Project Area[23]
Homopholis belsonii	Belson's Panic	VU	Potential	Potential habitat for this species includes the broad habitat types of Eucalypt dominated woodlands mainly of *E. crebra, E. populnea* and *E. melophilia* and Acacia woodlands dominated by Brigalow (*Acacia harpophylla*). 199.4 ha of potential habitat has been mapped within the Project Area.
Rutidosis lanata	Red-soil Woolly Wrinklewort	NT	Potential	Potential habitat for this species is ecotonal transitions of the broad habitat types of Eucalypt dominated woodlands mainly of *E. crebra, E. populnea* and *E. melanophloia* and Acacia woodlands dominated by Brigalow (*Acacia harpophylla*). 202.51 ha of potential habitat has been mapped within the Project Area.
Vincetoxicum forsteri	Slender Tylophora	EN	Potential	Potential habitat for this species includes Eucalypt dominated woodlands mainly of *E. crebra, and E. melanophloia*. 118.3 ha of potential habitat has been mapped within the Project Area.
Acacia wardellii	Thomby Range Wattle	NT	Potential	Potential habitat is comprised of small amounts of the Eucalypt dominated woodlands mainly of *E. crebra, E. populnea* and *E. melanophloia* 14.53 ha of potential habitat has been mapped within the Project Area.
Solanum stenopterum	Winged Nightshade	VU	Potential	Potential habitat includes the broad habitat types of Eucalypt dominated woodlands mainly of *E. crebra, E. populnea and E. melanophloia* and Acacia woodlands dominated by Brigalow (*Acacia harpophylla*).

[23] Information on potential habitat sourced from BOOBOOK, 2022.

				213.3 ha of potential habitat has been mapped within the Project Area.
Status listing per the NC Act: EN = Endangered, VU = Vulnerable, NT = Near Threatened.				

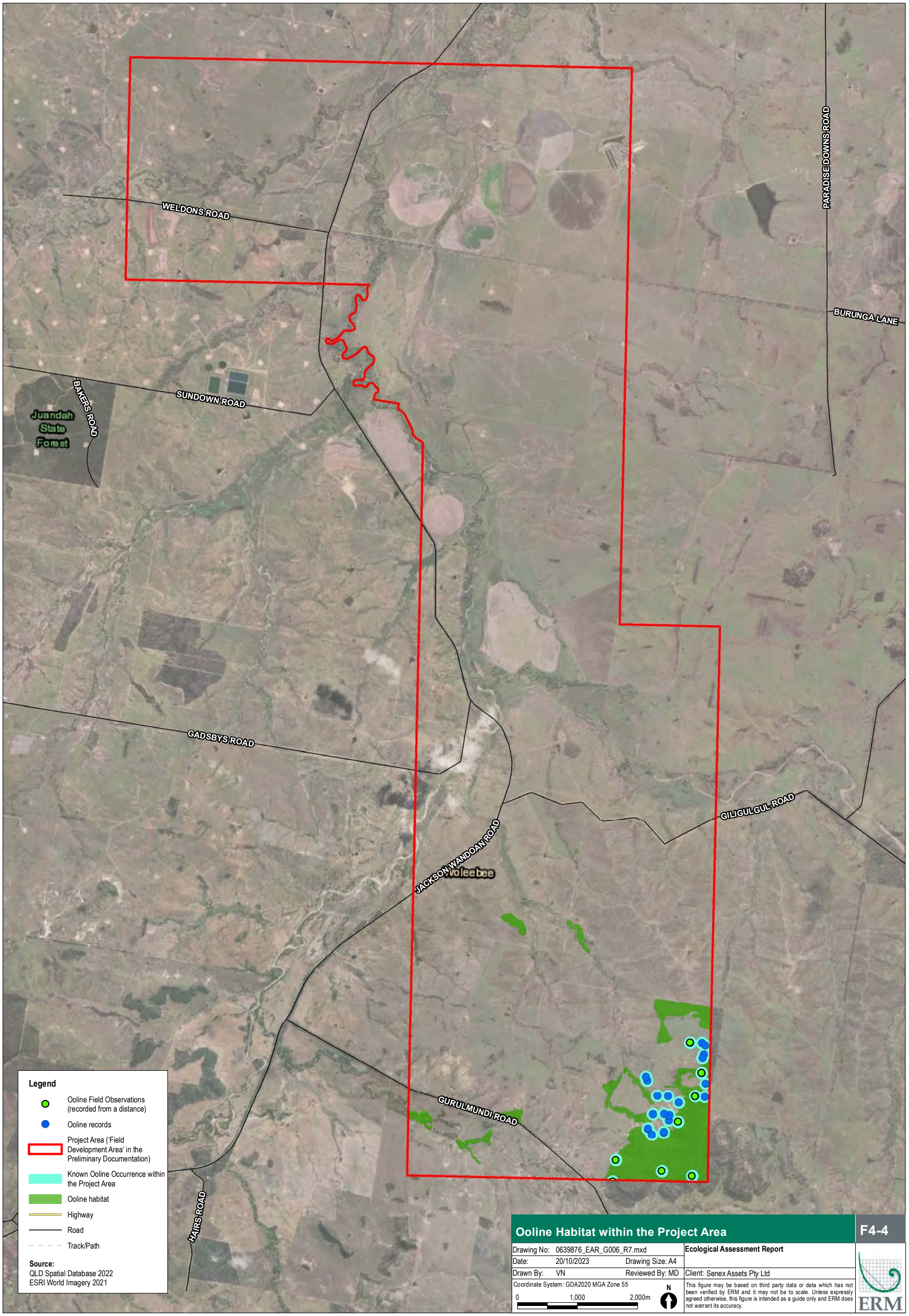


Figure 9-2: Ooline Habitat

JAMES ROAD
BUNDI ROAD
V ROAD
PARADISE DOWNS ROAD
WELDONS ROAD
BURUNGA LANE
SUNDOWN ROAD
BAKERS ROAD
Juandah State Forest
GADSBYS ROAD
JACKSON WANDOAN ROAD
GILIGULGUL ROAD
HANSENS ROAD
GURULMUNDI ROAD

Legend

- Belson's Panic Historical Record
- Project Area ('Field Development Area' in the Preliminary Documentation)
- *Homopholis_belsonii* Belson's panic Habitat
- *Vincetoxicum forsteri* Slender Tylophora
- Highway
- Road
- Track/Path

Source:
QLD Spatial Database 2022
ESRI World Imagery 2021

EPBC Act Listed Flora Species with Potential to Occur within the Project Area

F4-6

Drawing No:	0639876_EAR_G007_R3.mxd		**Ecological Assessment Report**
Date:	20/10/2023	Drawing Size: A4	
Drawn By:	VN	Reviewed By: MD	Client: Senex Assets Pty Ltd

Coordinate System: GDA2020 MGA Zone 55
0 1,000 2,000m
N

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

ERM

Figure 9-3: NC Act Threatened and Near Threatened Flora Species with Potential to Occur (Belson's Panic and Slender Tylophora)

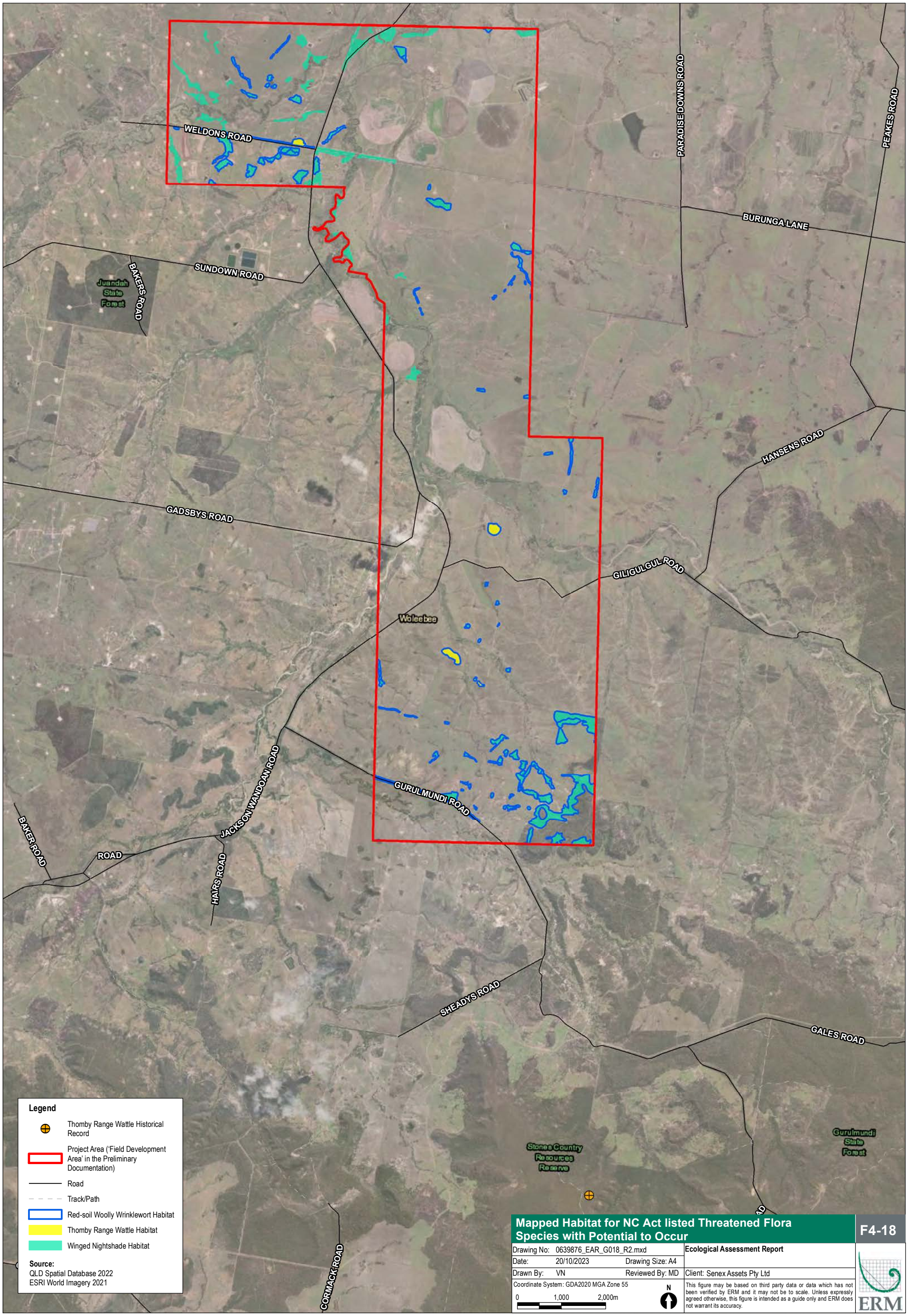


Figure 9-4: NC Act Threatened and Near Threatened Flora Species with Potential to Occur (Red-soil Wooly Wrinklewort, Thomby Range Wattle and Winged Nightshade)

9.3.4. Terrestrial Fauna Species

Four reptiles, 13 mammals, 123 birds and three butterfly non-NC Act listed Threatened species were recorded in the Project Area during field surveys. Seven NC Act listed threatened species are considered as known or likely to occur within the Project Area (Table 9-6).

- Dulacca Woodland Snail
- Koala
- Greater Glider
- Glossy Black-cockatoo
- Golden-tailed Gecko
- Pale Imperial Hairstreak
- White-throated Needletail

One species of special concern (Short-beaked Echidna) is also known to occur in the Project Area.

Based the likelihood of occurrence, a further fifteen NC Act Threatened and Near Threatened fauna species are considered to have the potential to occur within the Project Area (Table 9-7). Mapping for species with the potential to occur is provided in sections 4.4.7, 4.4.8 and 5.1 of Appendix K. However, given the extensive cleared areas within the Project Area, habitat for potentially occurring species is illustrated by the 'No-go' areas in the Senex Constraints Protocol, shown in Figure 4.1.

9.3.4.1. Koala

Koala habitat meeting the definition of Category C ESA is mapped across much of the extant vegetation within the tenure area. As per commitments made for the Atlas Stage 3 EPBC referral no clearing of these areas will occur. This is supported by their being defined as 'No go' areas in the Senex Constraints Protocol. These areas also conform with the definition of Protected Wildlife Habitat under the Environmental Offsets Regulation 2014 (EO Reg).

In addition to the use of vegetated areas for foraging and breeding, Koala's are able to traverse cleared areas of up to 2km from foraging and breeding habitat, and this is generally termed dispersal habitat. However, dispersal habitat is not 'habitat' per se, rather cleared areas through which the species transits. As it is generally cleared, it is usually mapped as Category X in the RVM mapping and is not captured by the definition of Category C ESA.

Potential impacts to Koala populations from disturbance within dispersal habitat generally occur where activities result in broad scale clearing leaving areas greater than 2km in width devoid of trees which may provide temporary refuge; or in the creation of a linear barrier to movement.

9.3.4.2. Echidna

Echidna habitat is mapped across the entirety of PL 209 and PL 445 given the prevalence of its food resource (ants and termites). It does not rely specifically on vegetated areas for habitat and as a result much of the habitat for Echidna does not meet the definition of Category C ESA.

Given that the Echidna is a habitat generalist, the activities the subject of this amendment are highly unlikely to impact the prevalence of available food resources, or significantly reduce available foraging area.

Table 9-6: NC Act Threatened and Near Threatened Fauna Species Known or Likely to Occur

Scientific Name	Common Name	Status	Likelihood of Occurrence	Habitat Definition, Records and Regional Importance of the Species
		NC Act		
Adclarkia dulacca	Dulacca Woodland Snail	EN	Likely	The Dulacca Woodland Snail has been recorded within the adjoined areas to the Project Area (a 10 km buffer) in Brigalow woodland areas (ALA, 2022). Suitable habitat of woodland consisting of Brigalow woodlands dominated by *Acacia harpophylla* is present within the Project Area. It has therefore been concluded as likely to occur within the Project area. The total amount of habitat for this species within the Project Area is 537.16 ha.
Calyptorhynchus lathami lathami	Glossy Black-cockatoo	VU	Likely	The Glossy Black-cockatoo has previously been recorded within the Project Area (BOOBOOK 2021a, DES 2022a), and two recent sightings (2009) have been reported within the adjoined areas of the Project Area). This is a specialised feeder dependent on seeds of Casuarinaceae (She-oak) trees. Breeding pairs nest in large hollows generally high up in large eucalypt trees or stags near water and food sources (Pavey et al. 2016). The species is capable of moving among isolated trees and small habitat patches within fragmented landscapes (Pavey et al. 2016, Holmes 2012). Casuarinaceae food trees are abundant within the Project Area including Belah (Casuarina cristata), which occurs throughout the Project Area and Bull Oak (*Allocasuarina luehmannii*), which occurs in scattered woodland patches on sandy soils, however no evidence of feeding (chewed cones) was observed during field surveys. Potential nest trees also occur in remnant Eucalypt woodland and forest and in well-developed riparian corridors across the Project Area (BOOBOOK, 2022). The total amount of preferred habitat for this species within the Project Area is 656.73 ha.
Strophurus taenicauda	Golden-tailed Gecko	NT	Likely	The Golden-tailed Gecko has been recorded within the adjoined areas to the Project Area (a 10 km buffer) in woodland and regrowth areas. (ALA, 2022). Suitable habitat of woodland consisting of Acacia spp. are present within the Project Area. The total amount of preferred habitat for this species within the Project Area is 222.82 ha.
Petauroides armillatus (Petauroides volans)	Greater Glider	EN	Known	The species was detected in Queensland Blue Gum woodland in the north of the Project Area, in the remnant riparian corridors along Wandoan Creek and Woleebee Creek. The species is likely to occur wherever large trees with hollows occur in woodland connected with these corridors and also in the extensively wooded in the south of the Project Area. The total amount habitat for this species within the Project Area is 306.42 ha.

Phascolarctos cinereus	Koala	EN	Likely	The field investigations conducted throughout 2022 did not directly record an individual Koala but did find evidence of the Koala through indirect signs of scratch marks on riparian Queensland Blue Gum (*Eucalyptus tereticornis*) trees in several locations along Wandoan Creek. The Koala is generally found in a range of temperate to tropical forests as well as woodlands and semi-arid communities dominated by Eucalyptus spp. (Martin & Handasyde, 1999). Koalas are also known to inhabit regrowth habitat. Due to the indirect method of recording Koala presence from scratch marks, there is a level of uncertainty that the scratches were from Koalas. No Koala faecal pellets were observed. No records or evidence of Koalas occurs elsewhere in the Project Area, despite targeted searches. From this information, it is considered that koala occurrence in the Project is very rare however applying the precautionary principle it's likelihood of occurrence has been assessed as likely. The total amount of foraging and breeding habitat for this species within the Project Area is 417.28 ha, and general habitat (dispersal habitat) for the species exists over the remainder of the tenure area (7,267.80). It is noted that Koala habitat that is mapped as foraging and breeding is preferred habitat, and the dispersal habitat is regarded as general habitat, per the SRI Guidelines.
Jalmenus eubulus	Pale Imperial Hairstreak (Butterfly)	VU	Likely	The Pale Imperial Hairstreak has been recently recorded in the nearby Gurulmundi State Forest. Occurs in Poplar box and Casuarina woodland, as well as grassland in clay and loam soils. Distributed across the Darling Downs region. The species has been recorded from the Condamine floodplain around Dalby, Chinchilla and Condamine and also from two localities along Channing Creek (ALA 2022). The total amount of preferred habitat for this species within the Project Area is 131.71 ha.
Tachyglossus aculeatus	Short-beaked Echidna	SLC	Likely	Recent records are present for this species in the adjoining areas. This species can be found across a wide range of habitats, including open woodland, semi-arid and arid areas as well as in agricultural areas (Aplin *et al*., 2016). Their foraging requirements include ant nests and termite mounds (Nicol *et al*., 2011). The whole of the tenure area represents potential habitat for this species. For this reason, this habitat has not been mapped.
Hirundapus caudacutus	White-throated Needletail	VU	Known	The White-throated Needletail was recorded flying over the Project Area in late 2022. Species likely only to fly aerially over the Project Area (through September to April on its migration), which contains no rainforest vegetation. The Project Area does not contain habitat in the form of elevated Eucalypt forests or wooded ridges to act as foraging and roosting habitat for the species. Habitat mapping has therefore not been undertaken for this species as it is only likely to fly aerially over the Project Area.
Status listing per the NC Act: EN= Endangered, VU = Vulnerable; NT = Near Threatened; and SLC = Special Least Concern				

Table 9-7: NC Act Listed Fauna Species with Potential to Occur

Species Name	Common Name	NC Act Status	Potential Habitat Mapped within the Project Area[24]
Birds			
Rostratula australis	Australian Painted Snipe	EN	52.17 ha of potential habitat is present within the Project Area. Potential habitat includes small areas of ephemeral wetland habitat within the Project Area; however, these may only periodically provide temporary refuges for this species. These areas correspond with riparian with riparian woodlands. This aligns with the broad habitat type of Riparian and wetland Eucalypt woodlands dominated by E. tereticornis.
Climacteris picumnus victoriae	Brown Treecreeper (south-eastern)	VU	224.45 ha of potential habitat is present within the Project Area. Potential habitat includes dry open eucalypt forests and woodlands with an open, grassy understorey and fallen timber. These areas should be subjected to a form of ongoing disturbance (i.e., historically Indigenous burning practices) to be favourable for the species.
Stagonopleura guttata	Diamond Firetail	VU	850.73 ha of potential habitat is present within the Project Area. Potential habitat includes grassy understoreys of open woodlands dominated by *Eucalypt* spp., *Acacia* spp., and/or *Casuarina* spp. *Eucalyptus* and Acacia woodlands and forests, occurs across the Project Area.
Aphelocephala leucopsis	Southern Whiteface	VU	565.95 ha of potential habitat is present within the Project Area. Potential habitat includes a wide range of open woodlands and shrubland environments dominated by *Acacia* spp. and *Eucalyptus* spp., particularly where understorey of grasses and/or shrubs are present. Almost all woodland habitats present within the Project Area are considered suitable habitat for the Southern Whiteface.
Grantiella picta	Painted Honeyeater	VU	176.63 ha of potential habitat is present within the Project Area. Potential habitat comprises remnant and regrowth communities with abundant Acacia and Casuarina hosts of Mistletoes. Potential habitat comprises larger contiguous areas of remnant and regrowth woodland and open forest, more specifically with a multi-layered shrubby understorey which the species prefers. This is made up of broad habitat type Eucalypt dominated woodlands mainly of E. crebra, E. populnea and E. melanophloia.
Geophaps scripta scripta	Southern Squatter Pidgeon	VU	164.23 ha of potential habitat is present within the Project Area. Potential habitat remains in the southern part of the Project Area (south of Giligulgul road) in grassy woodland with open areas for foraging and is made up of all broad habitat types excluding Acacia woodlands and cleared exotic pasture north of Giligulgul Road.
Mammals			
Nyctophilus corbeni	Corben's Long-eared Bat	VU	259.61 ha of potential habitat is present within the Project Area. Potential habitat is made up of all broad habitat types excluding the cleared exotic pasture and small isolated fragments, narrow corridors and the largely cleared landscape north of Giligulgul Road

[24] Information on potential habitat sourced from BOOBOOK, 2022.

Petaurus australis australis	Yellow-bellied Glider (south-eastern subspecies)	VU	145.67 ha of potential habitat is present within the Project Area. Potential habitat is comprised of large contiguous areas of remnant only Eucalypt woodland and open forests, including some riparian dominated woodlands. This is because the species requires large hollow-bearing trees for dens and preferred feed tree species (selected Eucalypts).
Reptiles			
Delma torquata	Collared Delma	VU	259.61 ha of potential habitat is present within the Project Area. Potential habitat comprises large logs, rocky outcrops and abundant woody debris occurs in the large contiguous area of forest and woodland associated with the escarpment and plateau in the south-eastern corner of the Project Area. This includes all broad habitat types except for the cleared exotic pasture as well as small, isolated fragments, narrow corridors and the largely cleared landscape north of Giligulgul Road.
Acanthophis antarcticus	Common Death Adder	VU	259.37 ha of potential habitat is present within the Project Area. Potential habitat comprises large logs, rocky outcrops and abundant woody debris occurs in the large contiguous area of forest and woodland associated with the escarpment and plateau in the south-eastern corner of the Project Area. This includes all broad habitat types except for the cleared exotic pasture as well as small, isolated fragments, narrow corridors and the largely cleared landscape north of Giligulgul Road.
Furina dunmalli	Dunmall's Snake	VU	259.61 ha of potential habitat is present within the Project Area. Potential habitat comprises large logs, rocky outcrops and abundant woody debris occurs in the large contiguous area of forest and woodland associated with the escarpment and plateau in the south-eastern corner of the Project Area. This includes all broad habitat types except for the cleared exotic pasture as well as small, isolated fragments, narrow corridors and the largely cleared landscape north of Giligulgul Road
Hemiaspis damelii	Grey Snake	EN	331.60 ha of potential habitat is present within the Project Area. Potential habitat includes Brigalow (*Acacia harpophylla*) and Belah (*Casuarina cristata*) woodlands on heavy, dark brown to black cracking clay soils, particularly in association with water bodies. Both woodlands were observed within the Project Area, along with suitable ephemeral wetlands.
Egernia rugosa	Yakka Skink	VU	227.77 ha of potential general habitat is present within the Project Area. Potential habitat is comprised of larger contiguous areas of remnant and regrowth woodland and open forest. The species requires loamy soils with large logs, accumulations of woody debris and/or rocky outcrops. This includes all broad habitat types with the above microhabitat features, excluding cleared exotic pasture and riparian Eucalypt woodlands
Anomalopus mackayi	Five-clawed Wormskink	EN	148.69 ha of potential habitat is present within the Project Area. Potential habitat includes woodlands generally supported by clay-loam soils, including grassy White Box woodlands, open woodlands and River Red Gum–Coolibah-Bimble Box woodlands. Limited areas of potential Five-clawed Worm-skink habitat are present within the Project Area.
Status listing per the NC Act: EN = Endangered; VU = Vulnerable. For the full reasoning for the potential outcomes for such species, refer to Appendix B of ERM 2023 (Appendix I to this report).			

9.3.5. Environmentally Sensitive Areas

There are no Category A ESA within the Project Area. Category B ESA within the Project Area are ground-truthed Endangered RE (Biodiversity Status), which consists of patches of the following REs: 11.3.17, 11.9.5, 11.9.5a and 11.9.10.

P-EA-100112777 defines Category C ESAs as:

…any of the following areas:

- *Nature Refuges as defined in the conservation agreement for that refuge under the Nature Conservation Act 1992;*
- *Koala Habitat Areas as defined under the Nature Conservation (Koala) Conservation Plan 2006;*
- *State Forests or Timber Reserves as defined under the Forestry Act 1959;*
- *Declared catchment areas under the Water Act 2000;*
- *Resources reserves under the Nature Conservation Act 1992;*
- *An area identified as "Essential Habitat" or "Essential Regrowth Habitat" under the Vegetation Management Act 1999 for a species of wildlife listed as endangered, vulnerable, rare or near threatened under the Nature Conservation Act 1992; or*
- *Of Concern Regional Ecosystems' that are remnant vegetation and identified in the database called 'RE description database' containing regional ecosystem numbers and descriptions.*

Based on the above definition, category C ESA within the Project Area includes:

- An area identified as "Essential Habitat" or "Essential Regrowth Habitat" under the Vegetation Management Act 1999 for a species of wildlife listed as endangered, vulnerable, rare or near threatened under the Nature Conservation Act 1992; and
- Of Concern RE (Biodiversity Status), which comprises the following RE: 11.3.2, 11.3.4, 11.3.25, 11.3.27f and 11.9.7.

Because ESAs identified within the project area correspond to Regional Ecosystems and/or Threatened species habitat additional ESA mapping is not provided. However:

- Mapping showing threatened fauna habitat is provided in section 4.4.7, 4.4.8 and 5.1.6 of Appendix K.
- Figure 9-2 and Figure 9-3 (A and B) show Threatened flora species habitat
- ; and
- Ground-truthed RE mapping is also provided in Figure 9.1.

Based on commitments made in this document and those made for the Atlas Stage 3 Gas Project EPBC referral impacts to Category B and Category C ESAs will not occur.

In addition, the application of condition (F7) and *Schedule F: Table 1 – Petroleum Activities in Environmentally Sensitive Areas* of the existing EA mean that the proposed regulated and low consequence structures (the subject of this amendment) will not be located within the Primary Protection Zones of Category B or Category C ESAs.

9.3.6. Weeds

Weeds of National Environmental Significance (WoNS) identified by desktop assessment as occurring within 10KM of the project area, and those WoNS identified during the field survey are shown in Table 9-8 and Figure 4-7 of Appendix K.

Table 9-8: WoNS

Scientific Name	Common Name	WoNS / Biosecurity Act Status	Comments
Parthenium hysterophorus	Parthenium Weed	WoNS, Cat. 3 Restricted Matter	Potentially occurring within the project area. Previously recorded within the 10 km buffer
Senecio madagascariensis	Fireweed	WoNS, Cat. 3 Restricted Matter	Potentially occurring within the project area. Previously recorded within the adjoining areas (DES, 2022a)
Anredera cordifolia	Madeira Vine	WoNS, Cat. 3 Restricted Matter	Potentially occurring within the project area. Previously recorded within the adjoining areas (DES, 2022a)
Opuntia aurantiaca	Tiger Pear	WoNS, Cat. 3 Restricted Matter	Detected during field surveys at moderate densities in Brigalow woodland. The closest records in ALA (2022) are over 45 km away, around Yuleba North, Barakula and Taroom. No previous records in WildNet from the project area (DES, 2022a).
Opuntia stricta	Common Pest Pear	WoNS, Cat. 3 Restricted Matter	Previously recorded within the adjoining areas (DES, 2022a). Detected in field surveys throughout the Project Area at low densities.
Opuntia tomentosa	Velvety Tree Pear	WoNS, Cat. 3 Restricted Matter	Previously recorded within the adjoining areas (DES, 2022a). Detected in field surveys throughout the Project Area at low densities

9.4. Impact Assessment

A Significant Residual Impact assessment undertaken in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (December 2014) has been completed for species known or likely to occur within the Project Area (Appendix G of Appendix K) and concluded that no Significant Residual Impact to any species would occur.

Species identified as potentially occurring were not considered for an SRI assessment. Potential habitat for these species is also habitat for known or likely to occur species, and previously stated management controls and mitigation measures will also be effective in preventing any SRI to potentially occurring species.

The outcome of the SRI was based on the management controls and mitigation measures detailed in this report (and the associated Atlas Stage 3 Gas Project EPBC referral and Preliminary Documentation), which include, but are not limited to the following:

- No remnant or regrowth vegetation holding habitat value for a threatened species listed under the NC Act will be cleared;
- No ESA will be cleared;
- Development would be undertaken in accordance with Condition (F7) of the existing EA, meaning the proposed infrastructure cannot be constructed within the Primary Protection Zone of a Category B or Category C ESA. Where other environmental constraints mean disturbance within these areas may be unavoidable, Senex would submit a separate amendment application.
- The only Prescribed Environmental Matters (PEMs) which may be impacted are Koala and Southern Squatter Pigeon dispersal habitat and Echidna habitat which are both mapped across the whole of the project area.

- Potential impacts to Koala populations from disturbance within dispersal habitat generally occur where activities result in broad scale clearing leaving areas greater than 2km in width devoid of trees which may form refugia, or in the creation of a linear barrier to movement. The proposed activities the subject of this application will be localized, undertaken in existing cleared areas, and will not result in the creation of any barriers to koala movement within the Project Area. As a result, project activities will not result in a Significant Residual Impact to Koala (section 4.4.7 and Appendix G of Appendix K).
- Potential impacts to Southern Greater Glider populations from disturbance within dispersal habitat are not expected to occur as disturbance will predominantly be located in previously cleared areas. As a result, project activities will not result in a Significant Residual Impact to Southern Greater Glider (section 4.4.8 and Appendix F of Appendix K).
- Given that the Echidna is a habitat generalist, the activities the subject of this amendment are highly unlikely to impact the prevalence of available food resources, or significantly reduce available foraging area. As a result, project activities will not result in a significant residual impact to Echidna (section 5.1 and Appendix G of Appendix K).

10. Surface Water

10.1. EPP (Water and Wetlands Biodiversity)

Environmental values for surface waters in the project area are defined in:

- The Dawson River sub-basin (State of Queensland 2011); and
- The WQ1308 plan (State of Queensland 2013) that accompanies the policy indicates that the

Project area is located on the southern tributaries of the Upper Dawson. Relevant EVs for surface water are presented in Table 10-1.

Table 10-1: EVs for the Dawson River Sub-Basin and Maranoa-Balonne Rivers Basin within the Vicinity of the Project (State of Queensland 2011)

	Environmental Values											
Water	Aquatic Ecosystem	Irrigation	Farm Supply / Use	Stock Water	Aquaculture	Human Consumer	Primary Recreation	Secondary Recreation	Visual Recreation	Drinking Water	Industrial use	Cultural and Spiritual Values
Dawson River Sub-Basin												
Upper Dawson Southern tributaries	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Undeveloped Areas	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓

✓ denotes the EVs selected for protection. Blank indicates the EV is not chosen for protection.

Under the EPP (Water and Wetland Biodiversity), Environmental Values are also defined as:

(a) for high ecological value waters—the biological integrity of an aquatic ecosystem that is effectively unmodified or highly valued; or

(b) for slightly disturbed waters—the biological integrity of an aquatic ecosystem that has effectively unmodified biological indicators, but slightly modified physical, chemical or other indicators; or

(c) for moderately disturbed waters—the biological integrity of an aquatic ecosystem that is adversely affected by human activity to a relatively small but measurable degree; or

(d) for highly disturbed waters—the biological integrity of an aquatic ecosystem that is measurably degraded and of lower ecological value than waters mentioned in paragraphs (a) to (c); or

(e) for waters that may be used to produce, or from which may be taken, aquatic foods for human consumption—the suitability of the water for—

(i) producing aquatic foods that are safe and suitable for human consumption; and

(ii) having aquatic foods that are safe and suitable for human consumption taken from the water; or

(f) for waters that may be used for aquaculture—the suitability of the water for aquacultural use; or

(g) for waters that may be used for agricultural purposes—the suitability of the water for agricultural purposes; or

(h) for waters that may be used for recreation or aesthetic purposes—the suitability of the water for—

(i) primary recreational use; or

(ii) secondary recreational use; or (iii) visual recreational use; or

(i) for waters that may be used for drinking water—the suitability of the water for supply as drinking water having regard to the level of treatment of the water; or

(j) for waters that may be used for industrial purposes—the suitability of the water for industrial use; or

(k) the cultural and spiritual values of the water.

10.1.1. Watercourses and wetlands

The Project Area is located within the upper Dawson River catchment in the Fitzroy River Basin. The largest watercourse that passes through the Project Area is Woleebee Creek which drains into Juandah Creek approximately 15 kilometres to the north of the Project Area, before entering the Dawson River approximately 55 kilometres north of the Project Area. Watercourses present within the Project Area are ephemeral, flowing after rainfall periods. (Freshwater Ecology, 2022). Several watercourses (stream orders 2 - 5) intersect the Project Area (Figure 10-1). Named watercourses include:

- Woleebee Creek runs south – north through the Project Area on the western boundary of PL445 and PL209;
- Conloi Creek feeds into Woleebee creek from the eastern boundary of the Project Area;
- Hellhole creek runs from the south through the south western boundary of the Project Area south of Gurulmundi Road, feeding into Woleebee creek; and

There are no Wetland Protection Areas, High Ecological Value (HEV) Wetlands or HEV Waterways that occur in the Project Area.

10.1.1.1. Floodplains and Annual Exceedance Probabilities

The undulating topography of the Atlas Stage 3 means that numerous drainage features and low stream order watercourses are present, together with a limited number of higher stream order (SO ≥4) watercourses e.g. Wandoan and Woleebee Creeks. The government 1% AEP flood mapping over the project area is relatively granular, especially for low order watercourses (SO 1) and may not be relied upon for finer scale field development planning (Figure 10-2).

Where necessitated by location constraints, diversion drains may be constructed around regulated structures (dams) to re-establish drainage lines and stream order 1 watercourses away from the dam. For higher order watercourses (SO ≥2), Senex will avoid locating regulated structures (as defined under the EP Act) within the mapped 1% AEP zone (or as subsequently calculated by SQPs). The conceptual dam locations identified by Engeny specifically avoid any overlap with mapped watercourses, and specifically avoid the 1:100 AEP flood zone for stream order 2 and above watercourses. However, 1:100 AEP flood modelling for stream order 1 watercourses does encroach into all identified conceptual dam locations (Figure 4-2 and Appendix A). Despite this, the location of dams is high in the catchment, with these areas mapped in the flood modelling being highly ephemeral, shallow drainage channels which only flow in periods of intense rainfall and have limited ecological and environmental value. With the construction of a dam, the site would be re-profiled and drains installed to divert stormwater away from the toe of the embankments and into more defined watercourses via any appropriate ESCP measures. Environmental impacts as a result of the installation of diversion drains are expected to have negligible impact to EVs and would function as a key safety measure in maintaining the integrity of dam embankments.

At a State level, the design of a dam is stringently regulated through the imposition of conditions of approval, generally following the form used in the DES guideline: *Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/ 2016/1934)*. Dam design is required to be in accordance with a Dam Design Plan prepared and certified by a Registered Professional Engineer of Queensland (RPEQ). An RPEQ must also oversee the construction of the proposed dam.

Of particular relevance, existing condition J12 covers design and construction in relation to dam integrity:

> ***(J12) Regulated dams must be designed and constructed to prevent**:*
>
> *a) floodwaters from entering the regulated structure from a watercourse or drainage line to the annual exceedance probability specified for determining spillway capacity in the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures, as amended from time to time; and*
>
> *b) wall failure due to erosion by floodwaters arising from the watercourse or drainage line to the annual exceedance probability specified for determining spillway capacity in the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures, as amended from time to time; and*
>
> *c) overtopping as a result of a flood event of the annual exceedance probability specified for determining spillway capacity in the Manual for Assessing Consequence Categories and Hydraulic Performance of Structures, as amended from time to time.*

In addition, the capacity of a regulated structure classified as high or significant consequence under the DES guideline: *Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933)* must include a:

- Design Storage Allowance (DSA) – a volume that must be available on 1 November every year to allow for wet season rainfall without overtopping;
- Mandatory Reporting Limit (MRL) – the level at which the operator must report to the regulator, and at which point measures may be required to reduce or manage water levels; and
- Extreme Storm Storage (ESS) – a storm storage allowance to allow for waves within the dam and brief heavy rainfall without overtopping.

Senex will line proposed water stores with an appropriate geo-synthetic liner and install relevant seepage detection (monitoring bores) in accordance with the likely State conditions of approval (*ESR/ 2016/1934)* (Table 4-11 and Section 4.2).

10.1.2. Impact Assessment

The proposed amendment to authorise the construction of regulated structures has the potential to impact surface waters. However, compliance with existing Schedule J conditions together with the application of mandated design and construction requirements and the implementation of ongoing operational controls identified in Section 4 to Section 6 of this report means that the risk of impacts to identified surface water EVs from the proposed inclusion of regulated and low consequence structures is As Low As Reasonably Practicable (ALARP) and design, construction and operational controls are commensurate with industry best practice.

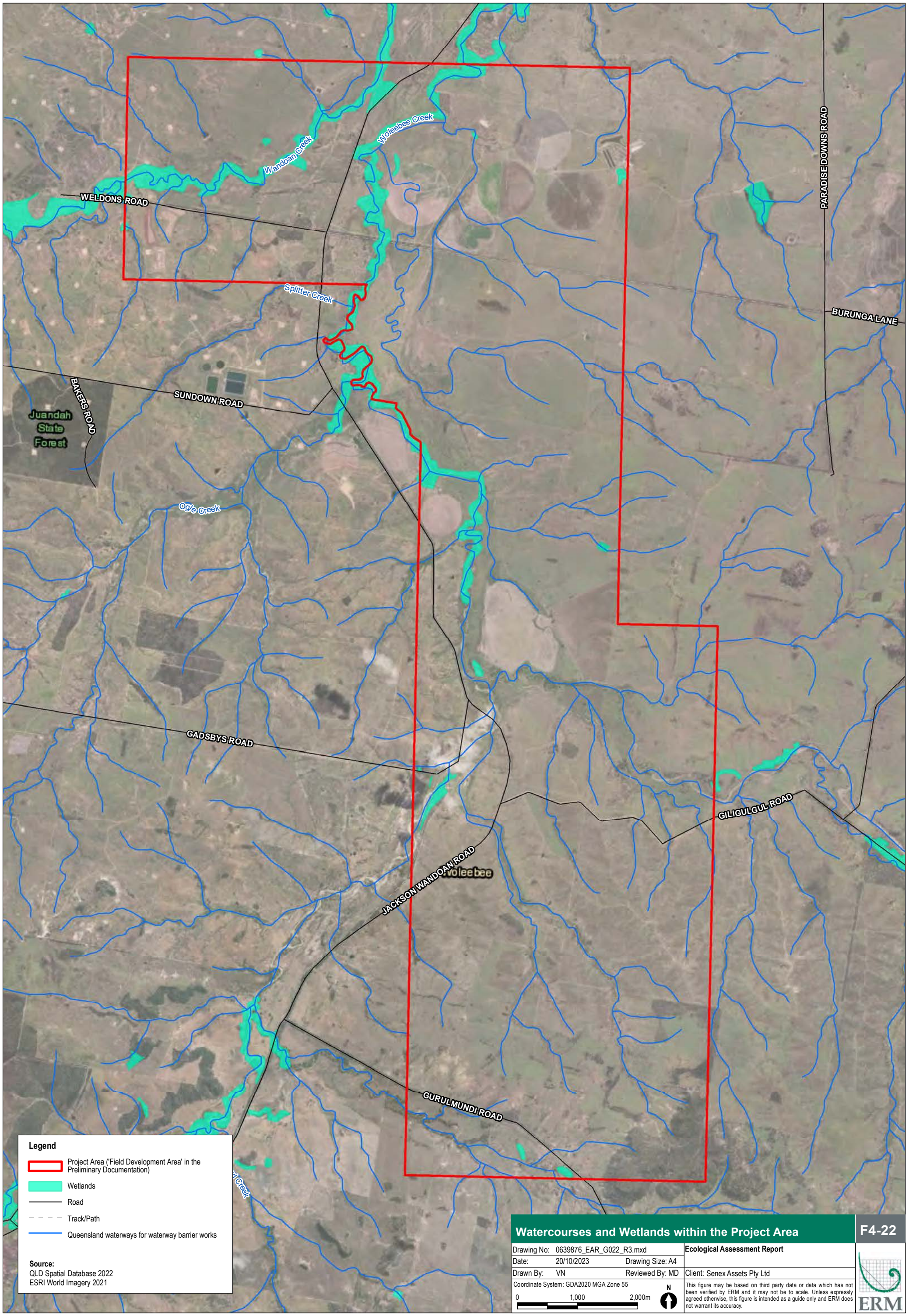


Figure 10-1: Mapped Watercourses

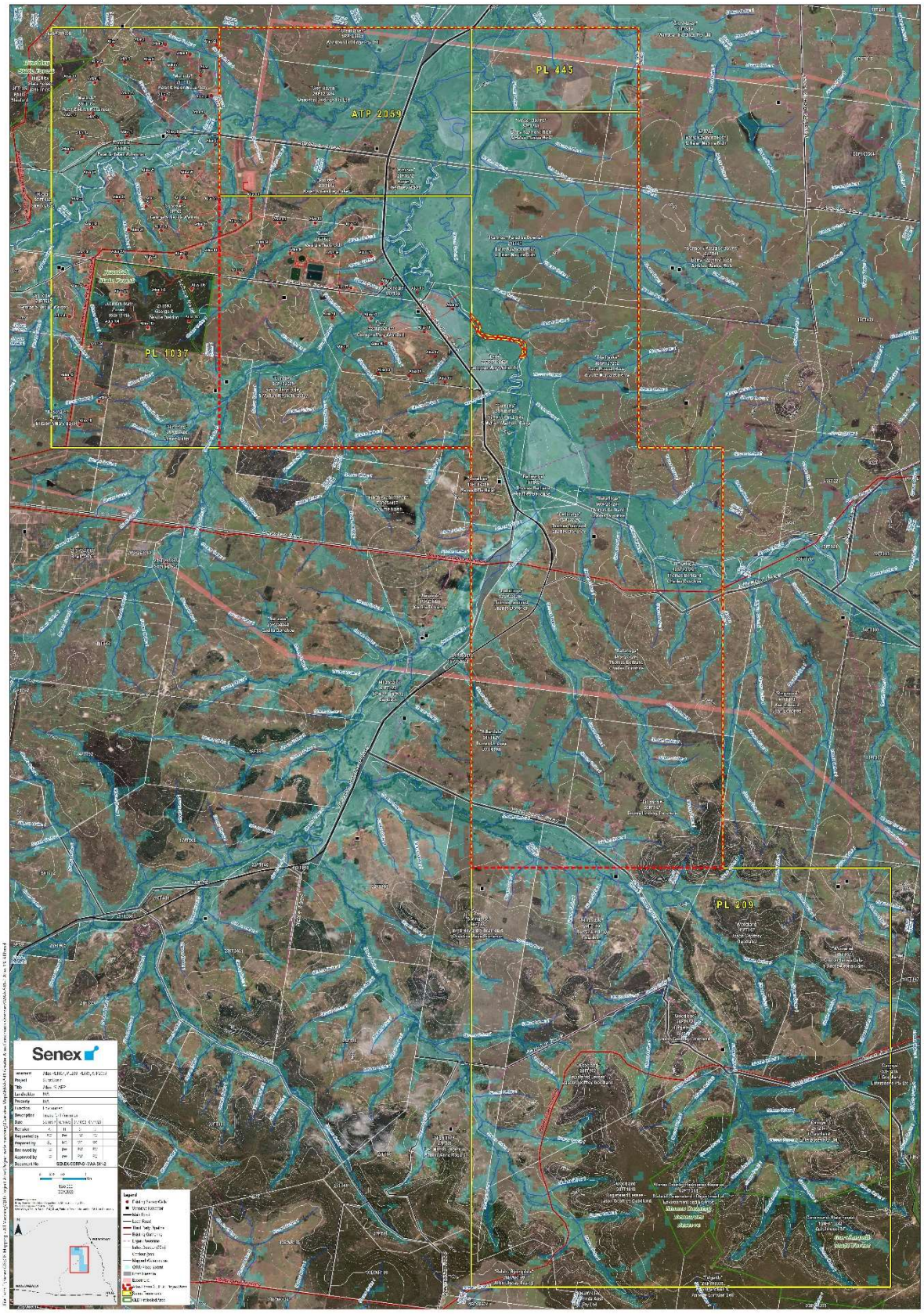


Figure 10-2: 1% AEP Mapping

11. Groundwater

11.1. Groundwater Environmental Values

Water Quality Objectives (WQOs) for groundwater are provided to protect EVs (State of Queensland 2013a). The project area is located within the Upper Dawson Catchment and WQOs for groundwater in the Upper Dawson are provided below:

Table 11-1: Summary of Applicable Upper Dawson WQOs for Groundwater

Environmental Value	WQO
Aquatic ecosystems applicable to groundwater where groundwater interacts with surface water	groundwater quality should not compromise identified EVs and WQOs for those waters
Drinking water	local WQOs exist which relate to before and after water treatment and are based on a number of guidelines / legislation including the Australian Drinking Water Guidelines (NHMRC 2021)
To protect or restore indigenous and non-indigenous cultural heritage	consistent with relevant policies and plans
Irrigation,	WQOs exist for metals, pathogens and other indicators in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018)
Stock watering	WQO exist for faecal coliforms, total dissolved solids, metals, and other objectives based on guidelines presented in ANZG (2018).
Farm use	As per the guidelines in ANZG (2018).

11.2. Hydrogeology

The Project is located within the Surat Basin, a basin of Jurassic-Cretaceous age, which is underlain by the Permo-Triassic Bowen Basin. Cenozoic-age formations are present overlying the Surat Basin formations. The surface geological map of the Project and surrounds is shown in Figure 3.2. Cenozoic-age formations cover much of the Surat Basin and generally comprise unconsolidated alluvial sediments, which have been deposited along pre-existing watercourses (OGIA 2016a).

The Surat Basin forms part of the Great Artesian Basin (GAB), which is comprised of several aquifers and confining aquitards. Aquifers of the Surat Basin are a significant source for water used for stock, public water, and domestic supply. OGIA (2016b) presents hydrostratigraphy of the Surat and Bowen Basin, included as Figure 3.3.

The main aquifers within the GAB, from the deepest to the shallowest, are the Precipice Sandstone, Hutton Sandstone, Springbok Sandstone, Gubberamunda Sandstone, Orallo Formation, Mooga Sandstone, and Bungil Formation. These aquifers are typically laterally continuous, have significant water storage, are permeable and are extensively developed for water supply. However, in some areas, they have more of the character of aquitards than aquifers (OGIA 2016b). The major aquitards are the Evergreen Formation, Durabilla Formation (formerly Eurombah Formation), Westbourne Formation, Surat

Siltstone and Griman Creek Formation (Figure 3.3). The WCM, target formation for CSG production, is described as an interbedded aquitard.

The Project is situated in an area where the Orallo Formation, Gubberamunda Sandstone, Westbourne Formation, and Springbok Sandstone outcrop. The WCM outcrop is mapped as occurring ~14 km north of the Project.

Key units related to the Project are the Upper Springbok Sandstone, the Westbourne Formation, and the Gubberamunda Sandstone which outcrop across the majority of the Project area. The Springbok

Sandstone consists mostly of feldspathic sandstones, commonly with calcareous cement (Green 1997). At the basin scale, the sandstones range from very fine to coarse-grained, although some very coarse grained, poorly sorted pebbly beds also occur within this unit. Minor interbedded siltstones, mudstones, and thin coal seams are also present, primarily in the upper part of the unit.

The Westbourne Formation comprises predominately siltstone layers with thick interbeds of fine to medium-grained sandstone and minor mudstone. Small coal fragments, lenses and lamina are common throughout the formation. The Westbourne Formation is a recognised aquitard (OGIA 2016a).

North-south and west-east oriented cross sections are presented in Figure 3.4 with the section locations provided on Figure 3.2. These sections show the hydrostratigraphic units dipping from the outcrop towards the south. Generally, all units are laterally extensive and continuous across the Project area.

Quaternary-age alluvium has been mapped as occurring within the Project area and is associated with Wandoan, Woleebee, Conloi, and Hellhole Creeks, as shown on Figure 3.2. The alluvium is mapped as relatively thin across the Project lease, with increased lateral extent towards the north as Wandoan Creek flows into Woleebee Creek.

Within the vicinity of the Project, groundwater recharge occurs as a result of direct rainfall on outcropping units, and localised recharge via discharge beneath watercourses and alluvial systems where sufficient saturation and hydraulic head allows water to infiltrate and migrate vertically into surficial aquifers and underlying units.

Shallow Groundwater Based on information gathered from the seepage monitoring bores location on PL 1037, the standing water levels in the Westbourne formation (which outcrops across much of the area) is between 2 and 35mbgl and have remained relatively stable across the monitoring period.

Groundwater within the Westbourne Formation at the Atlas produced water dams occur in shallow unconfined and deeper confined groundwater systems. In the deeper Westbourne Formation, flow direction is towards the east-southeast with a low horizontal hydraulic gradient across the area.

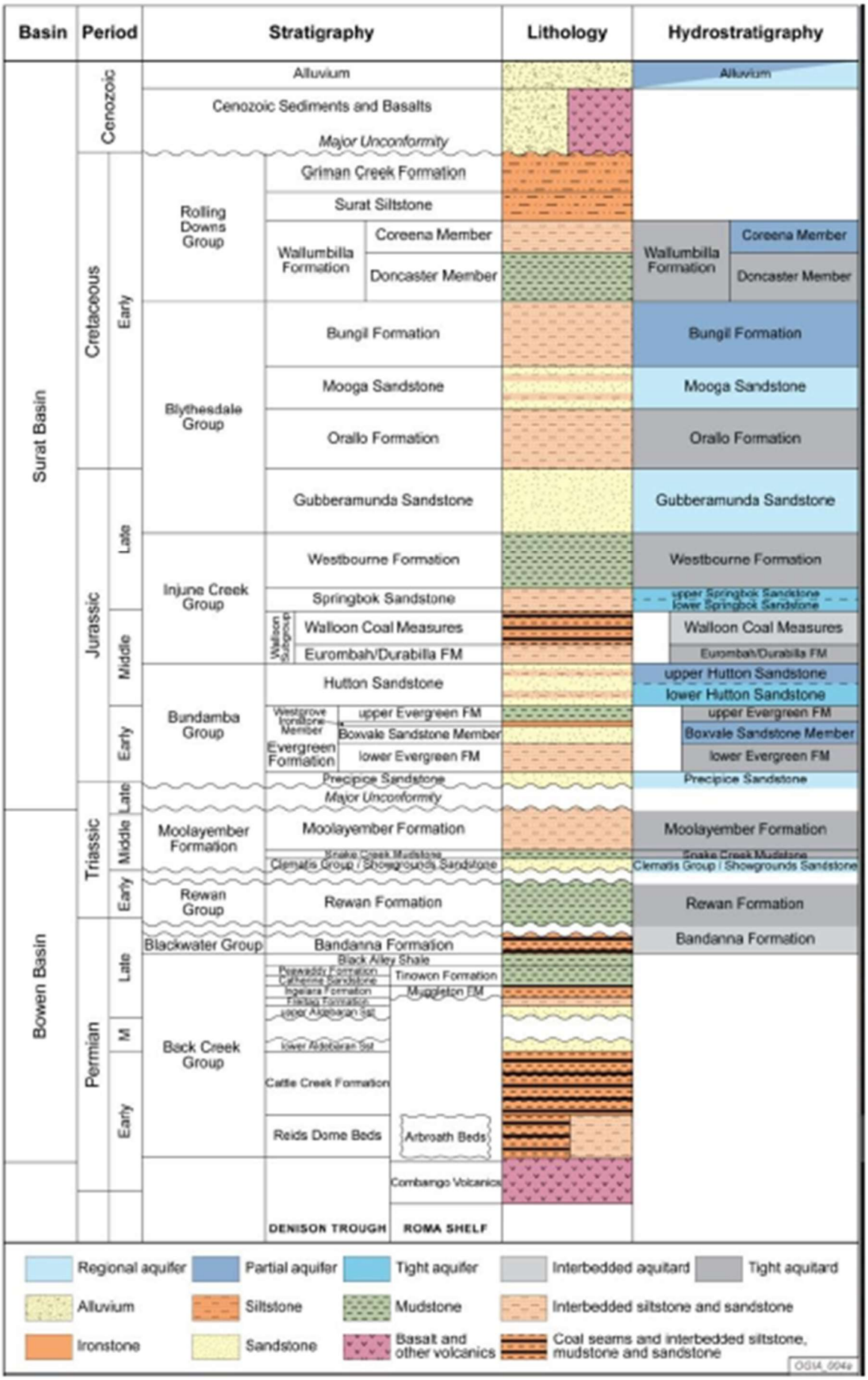


Figure 11-1: Regional Hydrostratigraphy (OGIA, 2021)

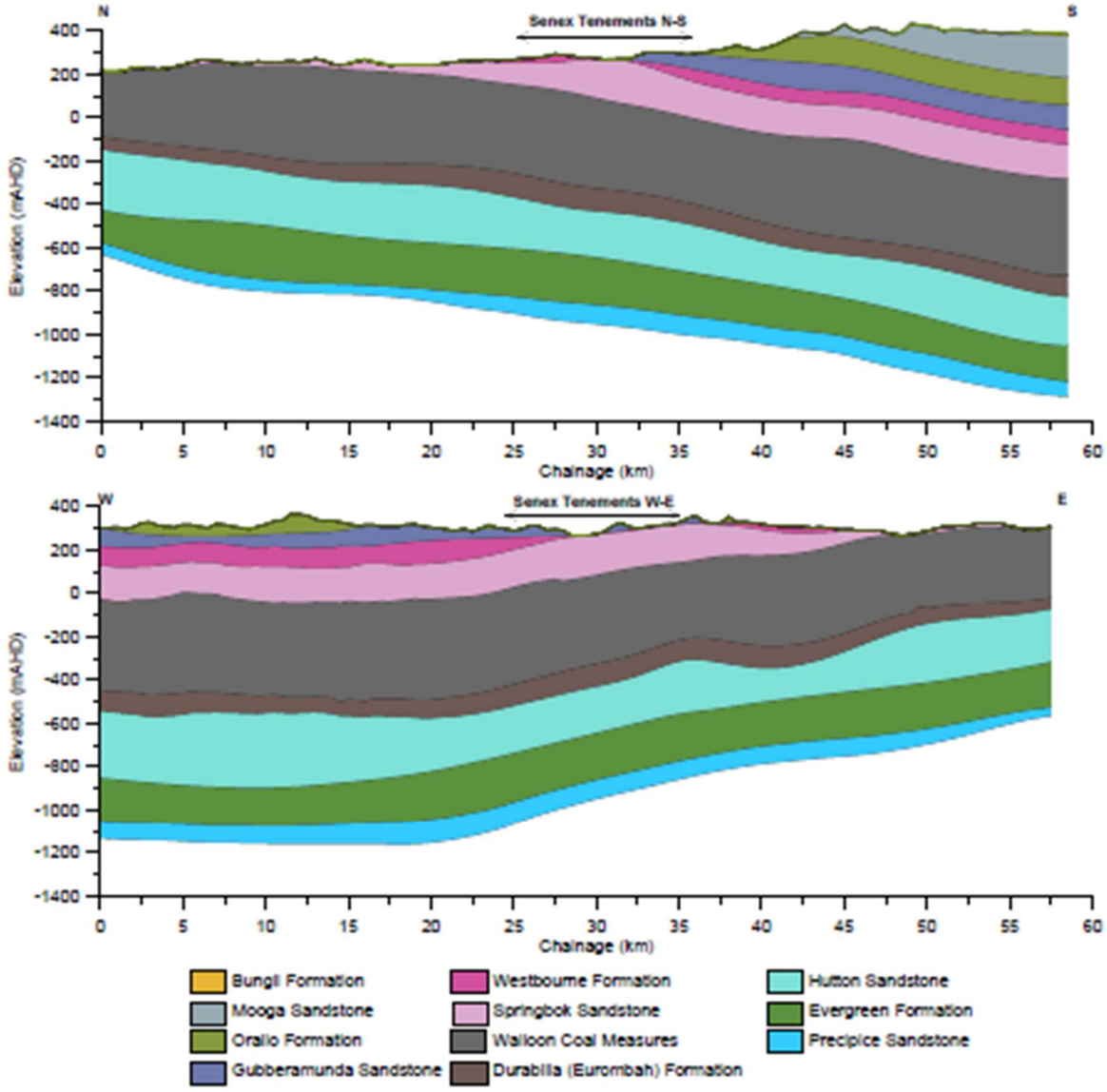


Figure 11-2: Geological cross section based on the OGIA model (OGIA, 2021)

11.3. Groundwater Quality

Table 11-2 presents a summary of the regional groundwater chemistry associated with each hydrostratigraphic unit occurring within the Project area from OGIA (2016c). Generally, total dissolved solids (TDS) are used as an indicator of salinity and displays a broad range across the Basin.

Table 11-2: Summary of Regional Groundwater Chemistry

Hydrostratigraphic unit	OGIA (2016) Description
Orallo Formation	Fresh to saline conditions with TDS ranging from 75 to 20,000 mg/L, with a mean of 1,700 mg/L.
Gubberamunda Formation	Fresh to brackish water. Mean TDS of 450 mg/L with a range of between 70 and 7,500 mg/L. Mean TDS ranges between 480 to 1,160 mg/L, depending on location category.
Westbourne Formation	Characterised by fresh to saline groundwater (TDS mean of 1,500 mg/L), ranging from 150 to 19,000 mg/L.
Springbok Sandstone	Fresh to brackish water quality, with a mean TDS of 1,000 mg/L (ranging between 200 and 7,000 mg/L).
WCM	Fresh to saline groundwater, TDS ranges from 30 to 18,000 mg/L, with a mean TDS of around 3,000 mg/L.
Hutton Sandstone	TDS ranges from 70 to 16,000 mg/L, with a mean TDS of around 1,600 mg/L, low salinity calcium and magnesium bicarbonate type water in the recharge areas, to a relatively high-salinity sodium-chloride type water in discharge areas.
Evergreen Formation	Low salinity (TDS) and concentrations of sodium and chloride, TDS ranges from 80 to 670 mg/L, with a mean TDS of around 260 mg/L.
Precipice Sandstone	Precipice Sandstone has the freshest groundwater in the Surat CMA, salinity ranges from 50 to 850 mg/L with a mean salinity (TDS) of 193 mg/L.

11.4. Groundwater Users

Within a 25 km buffer of the lease boundaries of the Project, there are 810 groundwater bores present with aquifer attributions provided by OGIA (OGIA 2022). Of these 810, 79 bores are not recorded in the registered groundwater bores database (GWDB) (State of Queensland 2022c). Of the 731 registered bores, 590 are existing, 12 are proposed and the remainder are abandoned but usable or decommissioned. A summary of registered bores is presented in Table 3-1, with their type and status, as derived from GWDB.

Of the 669 existing and unknown status bores (OGIA 2022):

- 410 bores have been identified as being used for water supply purposes (WS).
- 32 are potential water supply bores (PWS);219 are not used for water supply, they may be monitoring bores or not currently used for water supply (NWS); and eight are recent drills and the purpose is unknown.

The location of these bores is shown on Figure 11-3.

Groundwater abstraction for stock and domestic (S&D) use is the dominant water use purpose within the vicinity of the Project. There are five bores noted as town water supply and ten for intensive stock use.

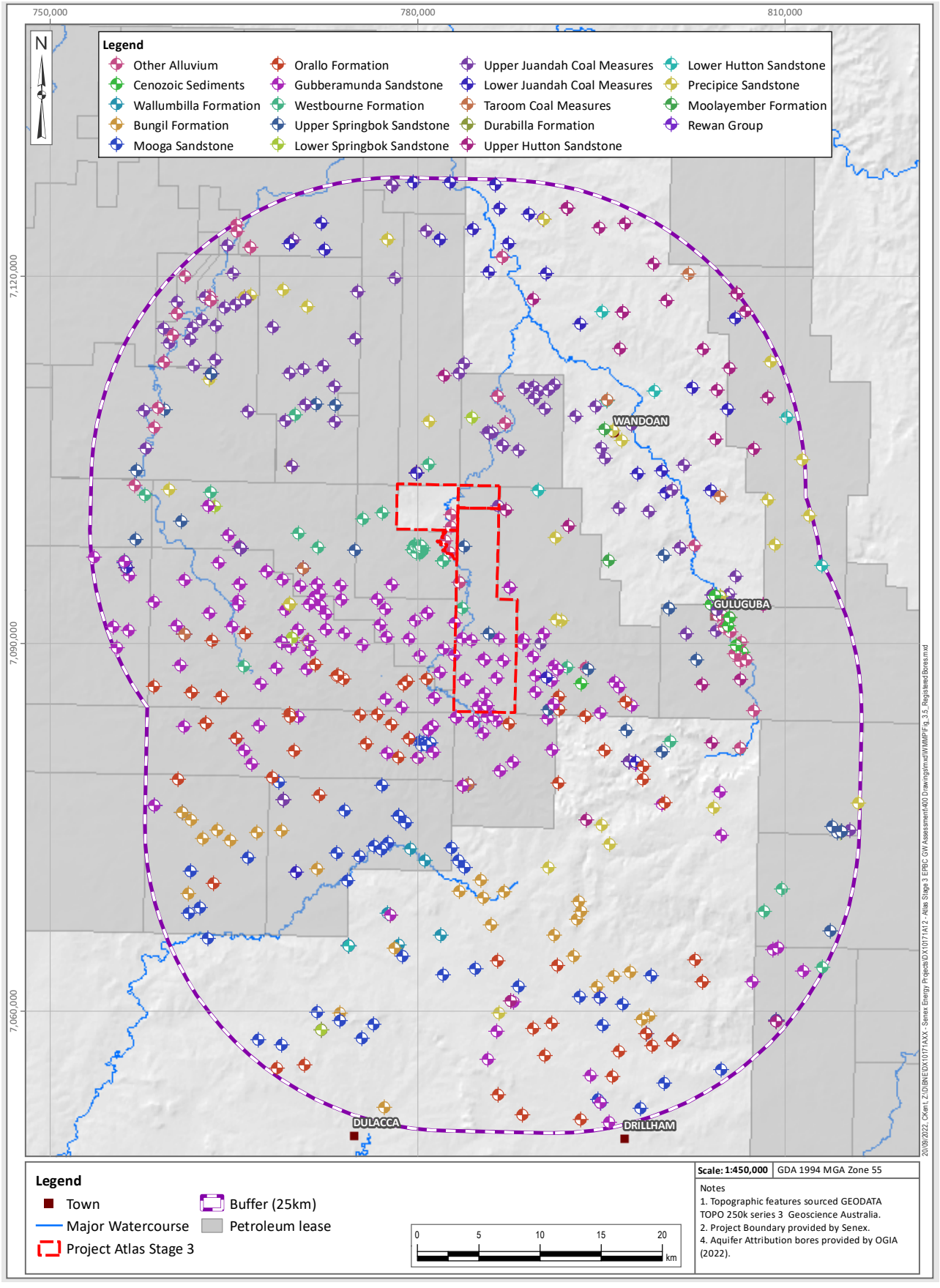


Figure 11-3: Location of Existing Registered Groundwater Bores in the Vicinity of the Project

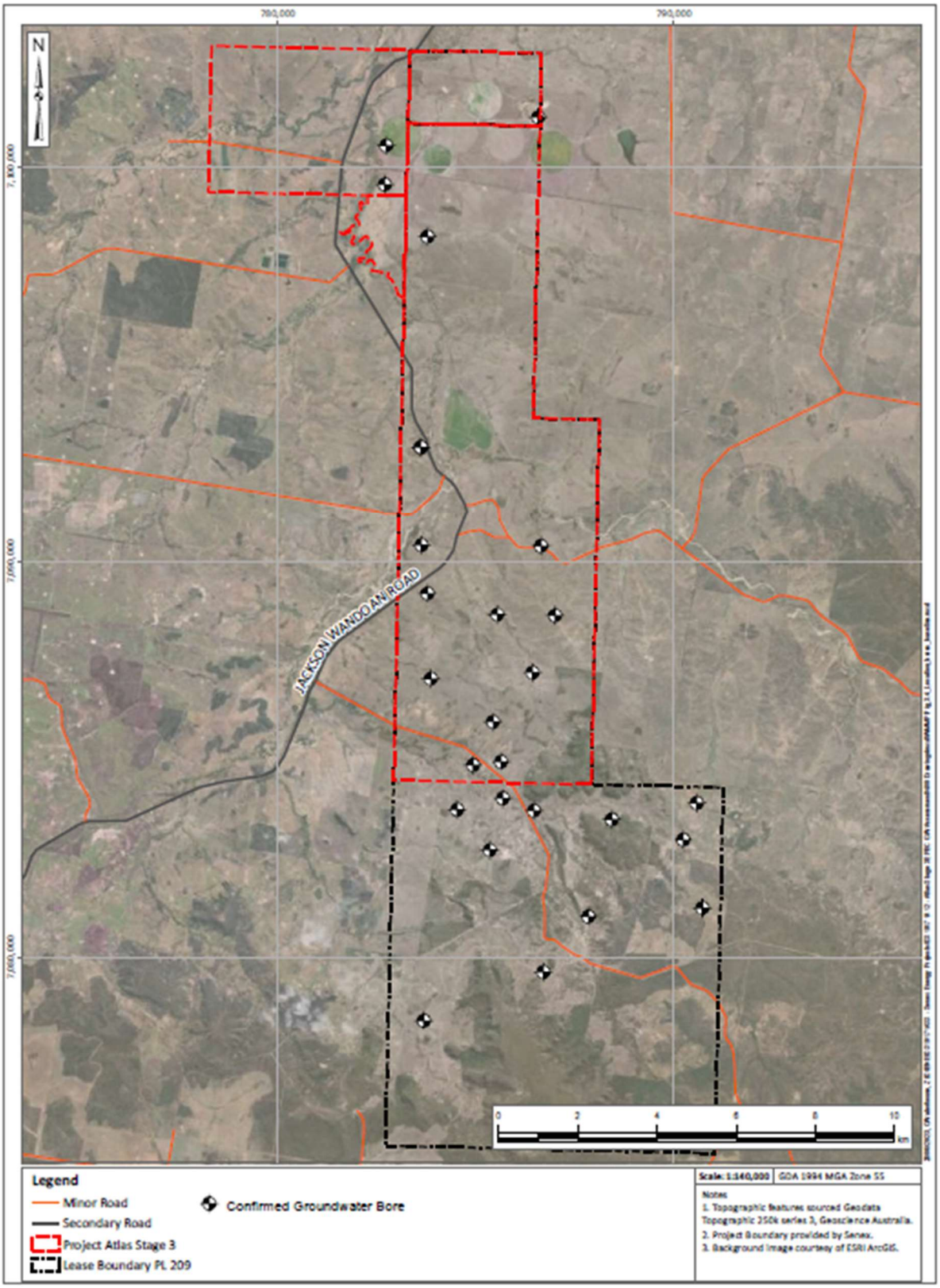


Figure 11-4: Location of Bores Confirmed / Existing during baseline assessment for ATP 2059, PL445 and PL209

11.5. Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDEs) are defined as 'Natural 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' (Richardson et al. 2011).

There are three categories of GDEs:

- Aquatic GDEs, which are ecological communities dependent on the surface expression of groundwater, including springs other than EPBC-listed springs, river baseflow systems (watercourse springs), riparian ecosystems and wetlands;
- Terrestrial GDEs, which are surface ecosystems dependent on the subsurface presence of water (i.e., terrestrial vegetation accessing the water table below ground), including ecosystems that are intermittently and permanently dependent on groundwater; and
- Subterranean GDEs, which are subterranean ecosystems dependent on the permanent presence of subsurface water. For the purposes of this document, this includes vertebrates and invertebrates only (i.e., excludes unicellular and simple multicellular organisms).

Potential surface expression GDEs and subsurface GDEs are mapped by DES (State of Queensland 2018) as potentially being present in the vicinity of the Project (Figure 3.8). These generally correspond with the location of the mapped alluvium associated with Woleebee Creek within the Project area and Wandoan Creek, Horse Creek and Juandah Creek further afield.

11.5.1. Potential Aquatic GDEs

There are no spring vents or complexes within the 25 km buffer of the Project.

Baseflow fed reaches of watercourses, or watercourse springs, are sections of a watercourse where groundwater from an aquifer enters the stream through the streambed (OGIA 2021f). A report published by OGIA in 2017 re-maps potential gaining streams (or baseflow fed reaches, watercourse springs) within the Surat CMA (OGIA 2017). This report identified sections of Woleebee Creek as a potentially gaining stream. OGIA more recently re-mapped watercourse springs within the Surat CMA for the 2021 UWIR report (OGIA 2021f), these are shown on Figure 11-5.

OGIA has identified three potential watercourse springs present within, or directly adjacent to, the Project area associated with Woleebee Creek (Table 11-3 and Figure 11-5). These watercourse springs are identified as being associated with the alluvium, Gubberamunda Sandstone, and the Orallo Formation. These are noted as springs of interest but not currently affected or listed as a mitigation site (OGIA 2021).

Table 11-3: Watercourse Springs Details

Site Number	Name	Source Aquifer
W279	Woleebee Creek	Alluvium
W280	Woleebee creek	Alluvium / Gubberamunda
W281	Woleebee Creek	Alluvium / Orallo Formation

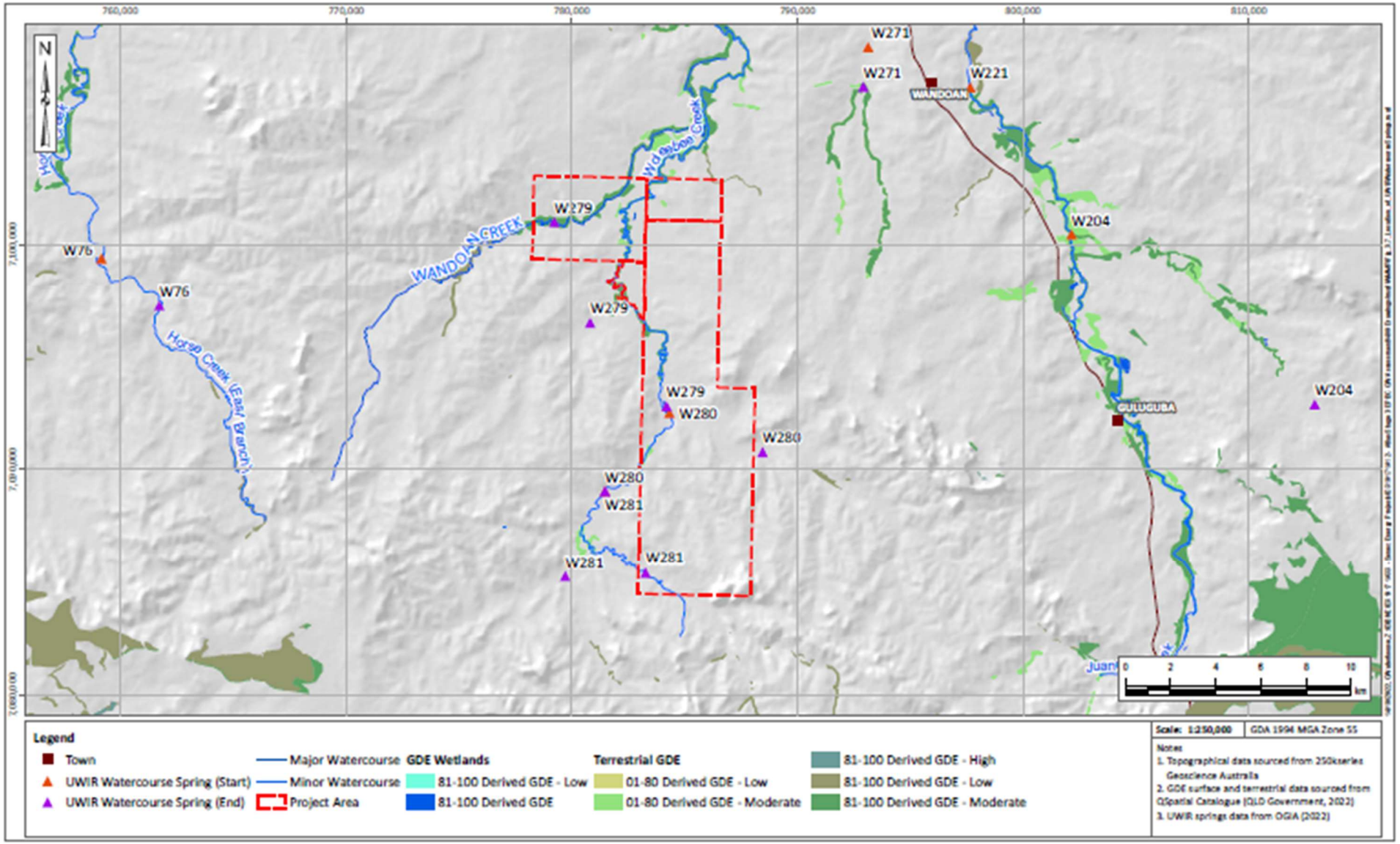


Figure 11-5: Location of UWIR watercourse Springs and Mapped GDEs (DES 2018 and OGIA 2021)

The watercourses within the Project area, Wandoan and Woleebee Creeks, are characteristically ephemeral and typically flow only during significant rainfall events. Pooled water may remain after significant rainfall events, which provides a habitat for a limited number of aquatic species. Shallow pools were identified in the watercourses but were turbid with water quality results indicating that these pools are fresh and surface water sourced. The identified aquatic ecosystems are generally of low to fair habitat and had presence (but low diversity) of non-conservation significant native aquatic fauna and flora.

Baseflow contributions from the alluvium and Surat Basin units to the watercourses are considered unlikely (the presence of watercourse springs has not been confirmed). This has been concluded through previous site verification in 2018 along these creek systems in PL 1037 from site observations and water quality analyses (freshwater quality but high turbidity) (KCB 2018). It is likely that the groundwater system in the alluvium is replenished by surface water during prolonged wet periods when the ephemeral creek system is flowing.

The alluvial systems present within the Project area are generally associated with Wandoan and Woleebee Creeks. Alluvial bank heights of up to 8 m have been observed along Woleebee Creek within PL 445. Alluvium thickness (encountered during the site investigation) varied across the Project from seven to thirteen metres, with the thickness of the alluvium decreasing away from Woleebee Creek. The regional water quality of the alluvium indicates that it is recharged and replenished by surface water during prolonged periods of rainfall and during periods of creek flow. The groundwater quality from specific locations along the alluvium indicate that saline groundwater quality is present in isolated sections of the alluvium where evaporative concentration has likely increased the salinity (salinity of this alluvium is higher than both the Westbourne Formation and Springbok Sandstone). Both regional and site-specific alluvium water qualities are distinct from groundwater in the underlying Westbourne Formation or Springbok Sandstone.

11.5.2. Potential Terrestrial GDEs

Potential terrestrial GDEs have been identified and are generally associated with Wandoan and Woleebee Creek systems and their adjacent alluvial plains (Figure 3.8). The ecology survey identified flora and fauna that do not depend on the permanent presence of water (ERM 2022). The ephemeral nature of these creek systems, which follow the episodic cycle of wetting and drying, with dry periods followed by wet periods in which the creek system flows, support the high resilience in these vegetation communities.

RE 11.3.25 (Forest Red Gum *Eucalyptus tereticornis* or River Red Gum *Eucalyptus camaldulensis* woodland fringing drainage lines) is the most widely abundant vegetation community identified that has the potential to be a GDE. However, interconnected patches of other REs are present. Historic land clearing is known to have occurred throughout the Project area that has impacted the condition of potential terrestrial GDEs, particularly along creek lines and water courses. Grazing pressure is also likely to influence the ecological condition of RE patches and their value for maintaining biodiversity levels.

Eucalypts (including Forest Red Gums) have two rooting systems (known as a dimorphic rooting system), with the ability to access deep groundwater during periods of time where shallower soil moisture is limited, they have shown physiological responses allowing them to adapt to water stress (CDM Smith 2022).

The potential terrestrial GDEs located along the creek systems may be groundwater dependent as they occur within an alluvial system (associated with creeks) and the ecosystem is associated with streamlines. This alluvial system, as discussed above, is replenished during prolonged wet periods when the ephemeral creek system is flowing and is considered likely to be disconnected from the Westbourne Formation and Upper Springbok Sandstone.

11.6. Impact Assessment

The activities proposed in this amendment application are to construct and operate a number of low consequence and regulated structures. The proposed construction and operation of water storages will be undertaken at ground-level and does not involve the drilling of any CSG wells or extraction of groundwater. As a result, deeper groundwater will not be impacted, and identified potential impacts have been limited to shallow groundwater only. Potential impact pathways are also addressed via the CCA failure scenarios (Section 0), namely:

- Seepage impacting shallow groundwater
- Emergency releases impacting shallow groundwater
- Catastrophic failure resulting in impacts to shallow groundwater.

Preventative controls implemented during the design and construction process (Section 4.2, Section 4.3 and Section 5), such as the use of dam liners, leak collection systems, and DSA, MRL and ESS storage allowances, mean that impacts to shallow groundwater are not expected.

Further, for regulated structures, existing EA condition (GG2) requires that a seepage monitoring program be developed (refer also Section 5.4) which requires:

- The identification of relevant groundwater parameters;
- The identification of specific trigger concentrations for each parameter;
- the installation of seepage monitoring bores around each regulated structure to detect adverse changes to shallow groundwater which may indicate seepage is occurring; and
- the development of seepage trigger action response procedures.

Operational management of dams (section 5) also means that frequent monitoring and inspections occur to maintain the dams within preferred operating parameters (i.e. below MOL, sound of structure and where appropriate leak collection systems are operating within design parameters.

With the implementation of the above construction and operational controls, impacts to shallow groundwater, or groundwater users as a result of the proposed activities are not expected.

12. Air

The proposed project does not include any plant or equipment that would trigger the fuel burning or power generation ERAs. As such it is expected that emissions to air will be limited to fugitive emissions of particulate matter from construction and operational activities, including:

- Clear and Grade of well pads, access tracks; and gathering Right of Ways (RoWs);
- Wind erosion of disturbed areas / stockpiles;
- Gathering installation; and
- Wheel-generated dust during construction and day-to-day operations.

It is expected that the construction of a regulated structure would require up to 20 vehicles comprising construction plant (Table 13-3) and light utility vehicles. Emissions associated with diesel engines may result in localised increases in pollutant concentrations but given the small scale and dispersed nature of proposed activities, the potential for any criteria to be exceeded at surrounding sensitive receptors or sensitive areas is minimal and combustion-related emissions have not been considered further.

12.1. Environmental Values

The environmental values prescribed by the EPP Air are:

- the qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and
- the qualities of the air environment that are conducive to human health and wellbeing; and
- the qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and
- the qualities of the air environment that are conducive to protecting agricultural use of the environment.

The EPP Air is designed to achieve the objectives of the EP Act in relation to the air environment. The air quality goals prescribed for the key pollutants of concern in this study (particulate matter) are shown in Table 12-1.

Table 12-1: EPP (Air) 2019 Ambient Air Quality Objectives for Particulate Matter (SLR, 2023)

Indicator	Environmental Value	Air Quality Objectives µg/m³ at 0°C	Averaging Period	Source
PM_{10}	Health and wellbeing	50	24 Hours	(Qld Gov, 2019), (NEPC, 2021)
		25	Annual	(Qld Gov, 2019), (NEPC, 2021)
$PM_{2.5}$	Health and wellbeing	25	24 Hours	(Qld Gov, 2019), (NEPC, 2021)
		8	Annual	(Qld Gov, 2019), (NEPC, 2021)
TSP	Health and wellbeing	90	Annual	(Qld Gov, 2019)

Section 8(2) of the EPP Air provides the following management hierarchy for activities which may generate air emissions:

- Avoid air emissions;
- Recycle air emissions;
- Minimise air emissions; and
- Manage air emissions.

12.2. Impact Assessment

The key potential air pollution and amenity issues associated with fugitive dust emissions from proposed construction activities are:

- Annoyance due to dust deposition (soiling of surfaces) and visible dust plumes; and
- Elevated suspended particulate concentrations (PM10).

Modelling of dust from construction activities is generally not considered appropriate, as emission rates can vary significantly depending on a combination of the activity and prevailing meteorological conditions (i.e. rainfall and wind speed), which cannot be reliably predicted.

The Institute of Air Quality Management (IAQM) screening criteria for further assessment is the presence of a 'human receptor' within:

- 350 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

As a matter of course, Senex implements dust suppression measures during construction to limit dust generation and it can be expected that such site dust control measures can adequately control dust emissions from the site activities, with no adverse off-site air quality impacts = expected.

The construction of a regulated structure will generally require a range of plant such as excavators, scrapers, graders and bulldozers. However, given the localised footprint, construction plant numbers will be <20 and the associated emissions are highly unlikely to impact the environmental value of the local air-shed.

In addition, the Project Area is sparsely populated and there are only four sensitive receptors identified within the proposed Atlas Stage 3 Gas Project area (Figure 7-1), and only two of those are within PL 209 and PL 445.This, together with the application of the Senex Constraints Protocol mean that it is unlikely that a proposed location for a regulated structure would be selected within 500m of a sensitive receptor.

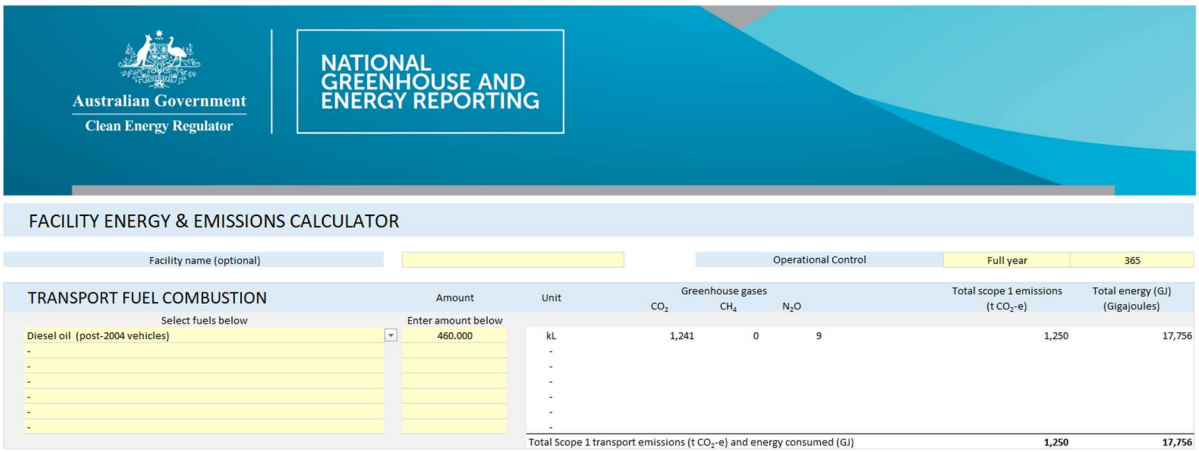
Based on the above, Senex is confident that it can construct and operate the proposed structures in compliance with existing EA conditions and without causing environmental nuisance in relation to the environmental values of air.

12.2.1. Greenhouse Gas Emissions

As previously stated, the proposed project does not include any plant or equipment that would trigger the fuel burning or power generation ERAs. In accordance with the Guideline – Greenhouse Gas Emissions (ESR/2024/6819) Greenhouse Gas (GHG) emissions associated with this proposed amendment will be limited to those from up to 20 vehicles (comprising construction plant and light utility vehicles) which are operating during construction. Operational emissions will be limited to period light utility vehicle movements associated with dam inspections.

Emissions from construction plant have been estimated based on the fuel consumption of a D6 Dozer (20L/hr), 8 hours a day, 6 days a week for six months. This gives a total diesel usage of 460kL. Using the NGERS emissions calculator (NGER calculators | Clean Energy Regulator (cer.gov.au)), this equates to 1,250tCO_2-e (Figure .

Such emissions are considered negligible and orders of magnitude below the threshold beyond which a carbon abatement plan is required (25kt CO2(e)/yr).



Australian Government
Clean Energy Regulator

NATIONAL GREENHOUSE AND ENERGY REPORTING

FACILITY ENERGY & EMISSIONS CALCULATOR

Facility name (optional)		Operational Control	Full year	365

TRANSPORT FUEL COMBUSTION	Amount	Unit	Greenhouse gases CO_2	CH_4	N_2O	Total scope 1 emissions (t CO_2-e)	Total energy (GJ) (Gigajoules)
Select fuels below	Enter amount below						
Diesel oil (post-2004 vehicles)	460.000	kL	1,241	0	9	1,250	17,756
-		-					
-		-					
-		-					
-		-					
-		-					
-		-					
		Total Scope 1 transport emissions (t CO_2-e) and energy consumed (GJ)				**1,250**	**17,756**

Figure 12-1: NGERS Emissions Calculator - Construction Emissions

13. Noise

The proposed project does not include any plant or equipment that would trigger the fuel burning or power generation ERAs. As such it is expected that noise emissions from project activities will be limited to the following construction and operational activities:

- Clear and Grade of well pads, access tracks; and gathering RoWs;
- Drilling and completion;
- Gathering installation; and
- Vehicular noise from day-to-day operations.

Operational vehicular will predominantly be from light vehicles and together with the small scale and dispersed nature of proposed activities, the potential for any noise criteria to be exceeded at surrounding sensitive receptors or sensitive areas is minimal and operational noise emissions have not been considered further.

13.1. Environmental Values

The environmental values prescribed by the EPP Noise are:

(a) the qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and
(b) the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following—
    (i) sleep;
    (ii) study or learn;
    (iii) be involved in recreation, including relaxation and conversation; and
(c) the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

The EPP Noise also defines acoustic quality objectives (Table 13-1), and where these are met noise levels are deemed to achieve the environmental values. In addition, noise nuisance limits are specified in Condition C2 and 'Schedule C: Table 1 of the existing EA (Table 13-2).

Table 13-1: Acoustic Quality Objectives (SLR, 2023)

Sensitive Receptors	Time of Day	Acoustic Quality Objectives (Measured at the Receptor, dBA)			Environmental Value
		$L_{Aeq\ adj,\ 1hr}$	$L_{A10\ adj,\ 1hr}$	$L_{A1\ adj,\ 1hr}$	
Dwelling (for outdoors)	Daytime and Evening	50	55	65	Health and Wellbeing
Dwelling (for indoors)	Daytime and Evening	35	40	45	Health and Wellbeing
	Night time	30	35	40	Health and Wellbeing

Table 13-2: Schedule C: Table 1 - Noise Limits at Sensitive Receptors

Time Period	Metric	Short Term Noise Event	Medium Term Noise Event	Long Term Noise Event
7:00 am – 6:00 pm	LAeq,adj,15 min	45 dBA	43	40
6:00 PM – 10:00 PM	LAeq,adj,15 min	40	38	35
Noise from drilling activities undertaken from 10:00 pm – 7:00 am	LAeq,adj,15 min	30 dBA (measured indoors at any sensitive receptor)		
Noise from fixed plant in gas fields undertaken from 10:00 pm – 7:00 am	LAeq,adj,15 min	28 dBA (measured indoors at any sensitive receptor)		

The noise criteria from the existing EA (Table 13-2) has been selected as the most relevant criteria for the noise impact assessment.

13.2. Impact Assessment

Construction noise levels will inevitably depend upon the number of plant items and equipment operating at any one time and on their precise location relative to the receptor(s). Therefore, a receptor will experience a range of values representing “minimum” and “maximum” construction noise emissions depending upon:

- the location of the particular construction activity (i.e. if the plant item of interest were as close as possible to or further away from the receiver of interest); and
- the likelihood of the various items of equipment operating simultaneously.

Plant likely to be used in the construction of a regulated structure is listed in Table 13-3.

Table 13-3: Construction Plant Noise Emissions

Construction Plant Item	Individual Sound Power Level, dBA
Excavator CAT 330 – 30T	106
Dozer CAT D6	113
Grader	103
Loader 950H	106
637 Scraper	114

The plant listed in Table 13-3, are exactly the same as for clear and grade activities for which SLR (2023) modelled noise buffer distances to sensitive receptors (Table 13-4).

Table 13-4: Construction Noise Buffer Distances

Offset Distance (m)	Clear and Grade Predicted noise level (dBA)	
	Neutral	Adverse
100	63	64
200	55	58
300	50	54
400	47	51
500	44	49
600	42	47
800	38	43
1,000	35	41
1200	33	38

Offset Distance (m)	Clear and Grade Predicted noise level (dBA)	
	Neutral	Adverse
1400	31	36
1600	29	35

Notes:

Red – greater than 40dBA – exceeds long-term daytime criteria

Orange – 36dBA to 40dBA – achieves long-term daytime criteria (7am – 6pm)

Green – 29dBA to 35dBA – achieves daytime criteria and overnight criteria

Construction activities for regulated structures will be undertaken during daytime hours, meaning that a buffer distance of between 800 m and 1,200 m will be appropriate to ensure that EA noise nuisance thresholds will not be exceeded.

As identified in Section 7.5 (sensitive receptors), there are 7 receptors within the Project Area, only four of which are within the Atlas Stage 3 Gas Project EPBC referral area, and only 2 of which are within the Project Area.

Senex has not yet identified potential location/s for regulated structures. However, at the point that internal planning progresses beyond potential locations to preferred locations, Senex will ensure compliance with the above noise nuisance limits and where appropriate will undertake noise modelling to assess potential impacts to sensitive receptors associated with the construction of regulated structures (being the subject of this amendment).

Based on the above, Senex considers it can comply with the requirements of the current EA conditions (A17) and (C1) to (C4) and construct and operate the proposed structures in compliance with existing EA conditions and without causing environmental nuisance in relation to acoustic environmental values.

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14. Conclusion

While the amendment to include an ERA for regulated structures on the existing EA for PL 209 and PL 445 is likely to be considered a major amendment, impacts to identified environmental values are expected to be negligible for the following reasons:

1. No Environmentally Sensitive Areas will be cleared.
2. Proposed regulated and low consequence structures (the subject of this amendment) will not be located within the Primary Protection Zones of Category B or Category C ESAs.
3. No remnant or regrowth vegetation with habitat value for NC Act threatened species will be cleared.
4. Proposed activities will result in disturbance within areas of Koala and Southern Squatter Pigeon dispersal and Echidna habitat, but no significant residual impact will result.
5. The Senex Atlas Stage 3 Environmental Constraints Protocol for Planning and Field Development will be implemented to ensure impacts to other environmental constraints are first avoided, then minimised, then mitigated.
6. Structures will be constructed above the 1:100 Annual Exceedance Probability flood level for stream order 2 or higher watercourses.
7. All Structures will be designed, constructed and operated in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (ESR/2016/1933), the guideline Structures which are dams or levees constructed as part of environmentally relevant activities (ESR/2016/1934) and the conditions of Schedule J of the existing EA.
8. Structures are designed to be no-release and design controls as per the relevant guidelines and manuals will be implemented to ensure ongoing safe operation.
9. Environmental risk is managed by preventative controls required by the dam planning and design conditions of the existing EA.
10. The CCAs (Appendix G) and preliminary dam basis of design (Appendix H) demonstrate that controls implemented during dam design, construction and operation are a function of the consequence category assessment and independent of location or proximity to EVs.
11. Air emissions will be limited to vehicular emissions from up to 20 vehicles and dust and particulate emissions generated by short-term construction activities. Dust generation will be managed through the standard process of dust suppression. GHG emissions will be negligible.
12. Acoustic emissions will be limited to construction activities and relate to operation of construction machinery. There are a limited number of sensitive receptors in and around PL 209 and PL 445 and where construction activities may occur within identified noise buffer zones (1,200m) of a sensitive receptor Senex will (in order of preference):
    a. negotiate an alternate arrangement.
    b. implement noise mitigation controls; and
    c. amend the planned location.

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Appendix A – Conceptual Dam Locations

Appendix B – Coal Seam Gas Water Management Plan

Appendix C – Atlas Stage 3 EMP

Appendix D – Constraints Protocol

Appendix E – Waste Management Procedure

Appendix F – Rehabilitation Plan

Appendix G – Preliminary Consequence Category Assessment

Appendix H – Preliminary Basis of Design

Appendix I – Bow Tie Risk Assessments

Appendix J – Environmental Values in Proximity to Conceptual Dam Locations

Appendix K – Ecological Assessment

Louisiana Water Infrastructure EA Amendment Rev1.1_NoAppendices

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