Western Surat Gas Project Water Monitoring and Management Plan

Date: 5 April 2024

Document: SENEX-WSGP-EN-PLN-011

Revision: 3

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Document Status

Revision History

Revision	Release Date	Document Status	Revision Comments	Author
A	May 2017	Issued for Review	Document creation	CK (KCB)
B	June 2017	Issued for Approval	Revised following Senex comments	CK
0	December 2017	Issued for Approval	Revised following IESC comments	KCB
1	July 2018	Issued for Approval	Hydrocarbon monitoring	HW
2	17 August 2023	Issued for Approval	General Update	PW
3	05 April 2024	Issued for Approval	Updated post DCCEEW feedback	PW

Document Approval

Originator	Name and role	**Signed**	Date
	Phill Wilkinson – Approvals Support	Phill Wilkinson	05/05/2024
Reviewed by	Damian Newham – Senior Hydrogeologist	Damian Newham Damian Newham (Apr 5, 2024 14:09 GMT+10)	05/05/2024
Approved by	Jacob Cumpstay – Environment Manager		05/05/2024

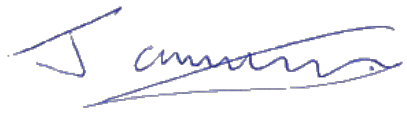
Approved Action Details

Title of Action	Stuart Petroleum Cooper Basin Gas Pty Ltd Western Surat Gas Project, NE of Roma, Queensland (EPBC 2015/7469)
Person to whom the approval is granted	Stuart Petroleum Cooper Basin Gas Pty Ltd
Proponent ABN	130 588 055
Date of decision	10 August 2018
Expiry date of approval	30 June 2068
Contact Details	Level 30, 180 Ann Street, Brisbane Queensland 4000
Date of preparation of plan	05 April 2024

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:



Full name: Jacob Cumpstay

Organisation: Senex Energy Pty Ltd

Date: 05/04/2024

Abbreviations and Acronyms

ATP	means authority to prospect granted under the *Petroleum Act 1923 (Qld) or the Petroleum Gas (Production and Safety) Act 2004*
CSG	means coal seam gas where gas is stored within coal deposits or seams
CWMP	Coal Seam Gas Water Management Plan (SENEX-WSGP-EN-PLN-008)
EA	Environmental Authority
Exploration	means drilling, seismic or technical studies to identify and evaluate regions or prospects with the potential to contain hydrocarbons
LNG	means liquefied natural gas, which is natural gas that has been liquefied by refrigeration for storage or transportation
PER	Public Environmental Report
PL	means Petroleum lease granted under the *Petroleum Act 1923* (Qld) or the *Petroleum Gas (Production and Safety) Act 2004* (Qld)
Production Area	means the area within the WSGP where CSG production will take place and will consist of Petroleum Leases 1022, 1023 and 1024
Project Area	means the coal seam gas field over approximately 915km^2 of Senex permits PL1022, 1023 and 1024, and ATP 767
RO	means reverse osmosis, a water treatment technology
Senex	Senex Energy Limited, ABN 50 008 942 827
Surat Basin	means the sedimentary geological basin of Jurassic to Cretaceous in southern Queensland and northern New South Wales
WCM	Walloon Coal Measures (the target gas production unit)
WMMP	Water Monitoring and Management Plan
WSA	Water Supply Agreement
WSGP	Western Surat Gas Project

EPBC approval conditions and where addressed in this document

Relevant EPBC Condition	Where addressed in this CSG WMMP
8. The approval holder must implement the following management plans: b. Western Surat Gas Project Coal Seam Gas Water Monitoring and Management Plan	Rev 1 of this document was submitted and approved December 2017.
9. Between years three (3) and five (5) after the approval date, the approval holder must submit a revised Western Surat Gas Project Coal Seam Gas Water Management Plan and Western Surat Gas Project Water Monitoring and Management Plan for the written approval of the Minister. The revised plans must:	This updated document forms Rev 3 and is submitted to achieve compliance with condition 9 of EPBC approval 2015-7469.
a. be in accordance with the Department's Environmental Management Plan guidelines;	This plan has been prepared to align with the requirements of the Department's EMP guidelines (2014). Environmental management maps and diagrams are provided by Figures 3-4 to 3-6 and 4-1 Section 4 details environmental management activities controls and performance targets, including monitoring programs and trigger values relating to groundwater. Section 4-4 provides details of corrective actions and non-compliance reporting as per the Joint Industry Framework (JIF) risk assessment framework. Section 6-2 details audit and review requirements (environmental schedules).
b. include an assessment of the effectiveness of the measures contained in the Western Surat Gas Project Coal Seam Gas Water Management Plan and Western Surat Gas Project Water Monitoring and Management Plan in avoiding, mitigating and managing impacts on protected matters; and	The effectiveness of measures in avoiding, mitigating and managing impacts is provided in section 5.
c. include a comparison of impacts on protected matters against impacts predicted in the Public Environmental Report.	A comparison of impacts on protected matters against impacts predicted in the PER is provided in section 5.1
10. The approval holder must not implement the revised Western Surat Gas Project Coal Seam Gas Water Management Plan and Western Surat Gas Project Water Monitoring and Management Plan until the revised plans have been approved by the Minister. The approved revised plans must be implemented within 12 months of plan approval.	This document forms the revised plan and will not be implemented until it is formally approved by the Minister.

Water Monitoring and Management Plan

1 Introduction

Senex Energy Limited (Senex) (ACN 008 942827), on behalf of its wholly-owned subsidiary Stuart Petroleum Cooper Basin Gas Pty Ltd, is proposing to produce and supply raw or treated gas to domestic markets and neighbouring operators (third parties) and distribute gas via existing pipelines and LNG processing facilities through its Western Surat Gas Project (WSGP).

The Production Area within the WSGP covers an area of ~686 km^2 and is located approximately 30 km northeast of Roma, in Queensland's Surat Basin. Gas field production activities are planned to commence in 2018, subject to approvals, and will include the following activities:

- Drilling, installation, operation and maintenance of up to 425 coal seam gas (CSG) production wells (all vertical), targeting the Walloon Coal Measures (WCM) of the Surat Basin, over an estimated 47-year project life;
- Installation, operation and maintenance of gas and water gathering flowlines;
- Installation, operation and maintenance of associated supporting infrastructure (e.g. temporary workforce accommodation, access roads, field compression facilities, pipelines, power and communication systems, laydowns, stockpiles and storage areas);
- Decommissioning and rehabilitation of infrastructure and disturbed areas; and
- Installation, operation and maintenance of water storage and water management facilities.

1.1 Aim and Objectives of the CSG WMMP

CSG water production is required as part of the CSG extraction process. Groundwater is removed (pumped) from CSG production wells to depressurise the CSG target production coal seams. This depressurisation generates gas flow, and sustains a groundwater flow to maintain the target producing operational pressure of each production well.

The removal of groundwater for this purpose is regulated under the *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017a), where petroleum tenure holders can exercise underground water rights. The Act identifies underground water rights for petroleum tenures, and states that the holder of a petroleum tenure may take or interfere with underground water in the area of the tenure if the taking or interference happens during the course of, or results from, the carrying out of another authorised activity for the tenure.

Abstraction of groundwater as part of CSG production may cause a drawdown in groundwater levels / pressure and therefore may impact existing water-dependent assets within the vicinity of the WSGP, such as groundwater bores, or groundwater dependent ecosystems.

This CSG Water Monitoring and Management Plan (WMMP) has been prepared to outline Senex's proposed monitoring, management and mitigation measures to specifically address impacts to groundwater from the WSGP.

1.2 Regulatory and Policy Framework

1.2.1 WSGP Approval Status

Key State and Commonwealth legislation relevant to the WSGP include:

- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth of Australia 2016);
- *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2017a);
- *Environmental Protection Act 1994* (State of Queensland 2016); and
- *Water Act 2000* (State of Queensland 2017b).

A summary of the WSGP's current approval status under these Acts is provided in Table 1-1.

Table 1-1: Summary of the WSGP Approval Status under State and Commonwealth Legislation

Act/Policy	Approval Status
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth of Australia 2016)	Approved 10/08/2018 (EPBC 2015/7469)
Petroleum and Gas (Production and Safety) Act 2004 (State of Queensland 2017a)	PL1022 granted 26/4/2018 PLI1023 granted 23/07/2019 PL1024 granted 23/07/2019
Environmental Protection Act 1994 (State of Queensland 2016)	Exploration activities are authorised under Environmental Authority (EA) EPPG00651513.
Water Act 2000 (State of Queensland 2017b)	WSGP is included within the Surat Cumulative Management Area (CMA) Underground Water Impact Report (UWIR), that came into effect on 1 May 2022 (OGIA 2021). The Office of Groundwater Assessment (OGIA) has provided Senex with obligations required to comply with the Surat CMA UWIR.

1.2.2 Surat Cumulative Management Area Underground Water Impact Report

Under the *Water Act 2000* (State of Queensland 2017b), where there is an area of concentrated development, a cumulative management area (CMA) can be declared. The WSGP is located within the Surat CMA, which was declared in 2011.

The Office of Groundwater Impact Assessment (OGIA) was established under the *Water Act 2000* and is responsible for predicting regional impacts on water pressures in aquifers; developing water monitoring and spring management strategies; and assigning responsibility to individual petroleum tenure holders for implementing specific parts of the strategies within CMAs. These predictions, strategies and responsibilities are set out in the Surat CMA Underground Water Impact Report (UWIR), prepared and maintained by OGIA.

The Surat CMA UWIR was first published by Queensland Water Commission (QWC) in 2012 (QWC 2012) to assess the cumulative impacts to the Surat and southern Bowen Basin, as a result of the expansion of CSG production by multiple, adjacent developers. The current UWIR came into effect on 1 May 2022 (OGIA 2021).

OGIA has provided Senex with obligations to comply with the Surat CMA UWIR Water Monitoring Strategy (WMS). These include:

- For groundwater monitoring: the location, type of facilities, target aquifer and frequency of monitoring required;
- For baseline assessment: details of bores that are required to be included in a baseline assessment; and
- For springs: the complex to be surveyed and monitored by Senex and the frequency of monitoring required.

OGIA has also provided Senex with groundwater modelling predictions to assist with the development of a monitoring and mitigation strategy to address the predicted groundwater impacts.

1.3 Roles and Responsibilities

Responsible Person	Responsibility
Senex Business Unit Manager	Manage produced water in accordance with Senex processes and protocols
Senex Operations Engineering Team	Maintain management systems, processes and procedures
	Ensure water monitoring data is recorded and maintained in Senex's data management system for a minimum of 5 years
	Implement monitoring program
	Perform water monitoring data review as required
	Ensure monitoring equipment is installed, maintained and operated in proper condition
	Manage reporting in accordance with Section 6.2
Senex Environment Manager	Schedule assurance audits to ensure compliance with this Plan
	Undertake notifications as required under this plan
All Employees and Contractors	Comply with EHS legal obligations and other requirements that are applicable to Senex's operations and activities. For operations and activities that may produce, use or impact water resources ensure that these resources are managed sustainably.

1.4 Emergency Contacts and Procedures

Refer to Senex's Contingency Procedures for Emergency Environmental Incidents (SENEX-QLDS-EN-PRC-024).

2 Project Description

2.1 General Description

The WSGP Production area covers an area of ~686 km^2 and is located approximately 30 km northeast of Roma, in Queensland's Surat Basin. The location of the WSGP is presented in Figure 2-1.

The Western Surat Gas Project (WSGP) (also known as Roma North) comprises PLs 1022, 1023 and 1024 and ATP 767. The WSGP is located approximately 30 km northeast of Roma, in Queensland's Surat Basin (Figure 2-1). The CSG production target for the WSGP is the Walloon Coal Measures (WCM).

The WSGP is located adjacent to other CSG tenure holders targeting the WCM, including Santos' Roma Gas Field, located immediately to the south, and Origin's Combabula Development Area located to the east of the WSGP. Origin's Spring Gully Development Area is located to the northeast of the WSGP and targets the Bandanna Formation of the Bowen Basin.

WSGP production activities, include the following:

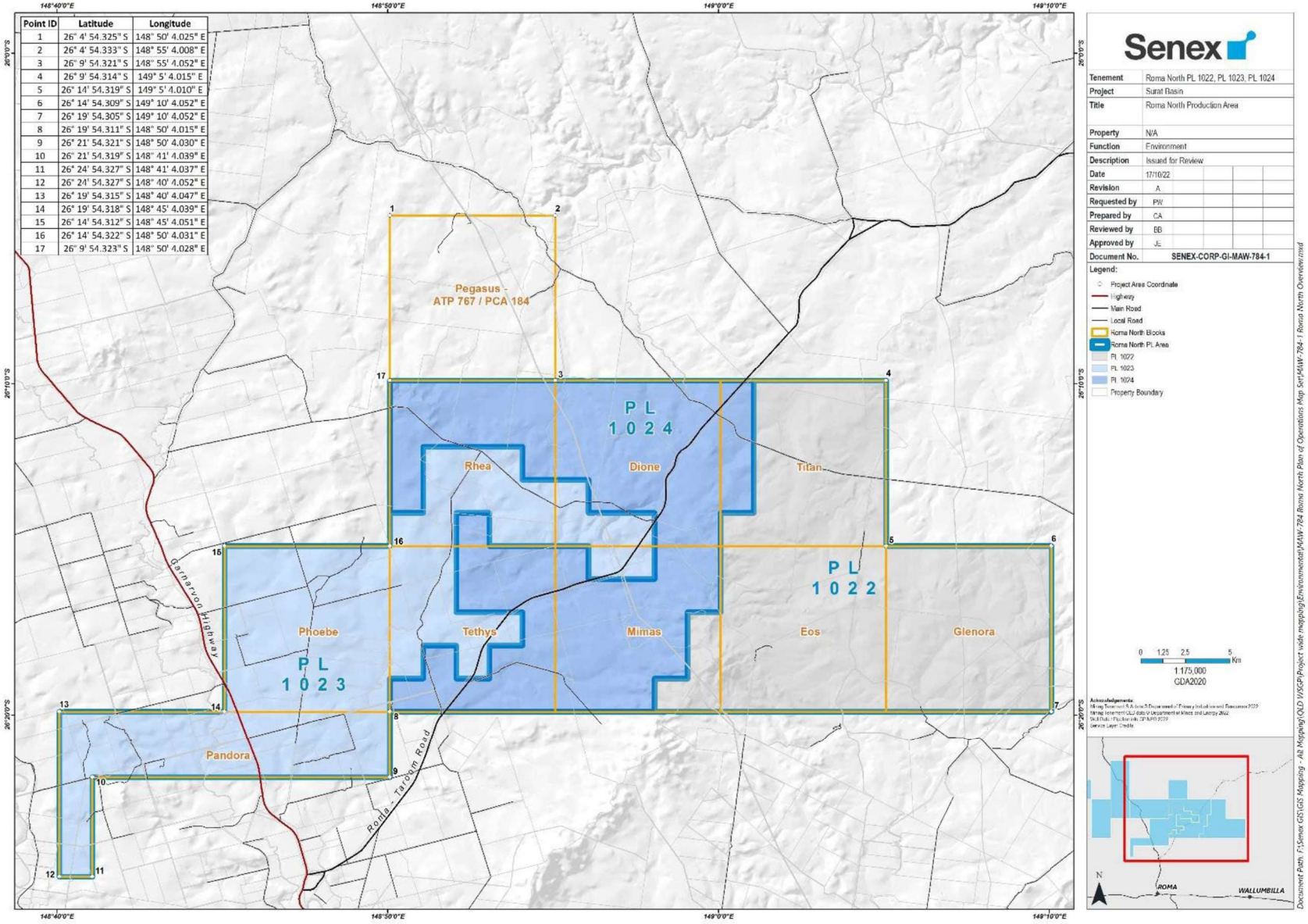
- Up to 425 CSG production wells;
- Gas and water gathering lines;
- Field compressor facilities;
- Medium pressure infield pipelines;
- Central processing facility;
- Water storage and water management facilities;
- Access roads and tracks;
- Maintenance facilities, workshop, construction support and administration buildings (during construction and operation);
- Construction phase accommodation facilities;
- Utilities – power generation, water supply;
- Communications;
- Borrow pits; and
- Details of the project components, including location and size, will be determined progressively over the life of the WSGP project.

Activities undertaken to date (including rehabilitation) are detailed in Table 2-1.

Table 2-1: Activities to date

Infrastructure	Area / length	Number	No. Decommissioned / Rehabilitated (if any)
Wells	53.80 ha	64	22.96 ha of rehabilitation commenced
Gathering lines	62.81 km	N/A	62.81 ha of rehabilitation commenced
Access Tracks	40.10 km	N/A	-
Dams	10.63 ha	2	-
Laydown areas	5.12 ha	7	-
Borrow pits	0.0 ha	0	-
Comms towers	0.0 ha	1	-
Pump stations (water)	3.68 ha	2	-

Figure 2-1: Location of the WSGP



2.2 CSG Water Production

CSG water production is required as part of the CSG extraction for the WSGP. Groundwater is removed via CSG production wells to depressurise the coal seams. This depressurisation generates gas flow and maintains the target producing operational pressure.

Produced water volumes and rates are predicted using an analytical modelling tool with probabilistic distributions applied to several key reservoir parameters (i.e. permeability, porosity and net coal). The predictions generate a production profile (type curve). These production profiles are used in field development planning to provide a water forecast.

Figure 2-2 presents the forecast CSG water production profile for the WSGP. The CSG water production profile indicates that:

- The peak CSG water production is predicted to occur at the end of 2025 at a rate of 7.3 ML/day;
- Following the peak production rate, the production profile gradually decreases between 2028 and 2049 with fluctuations in the profile as a result of new wells being commissioned; and
- After 2049, the water production profile is forecast to decrease for the remainder of the project lifetime.

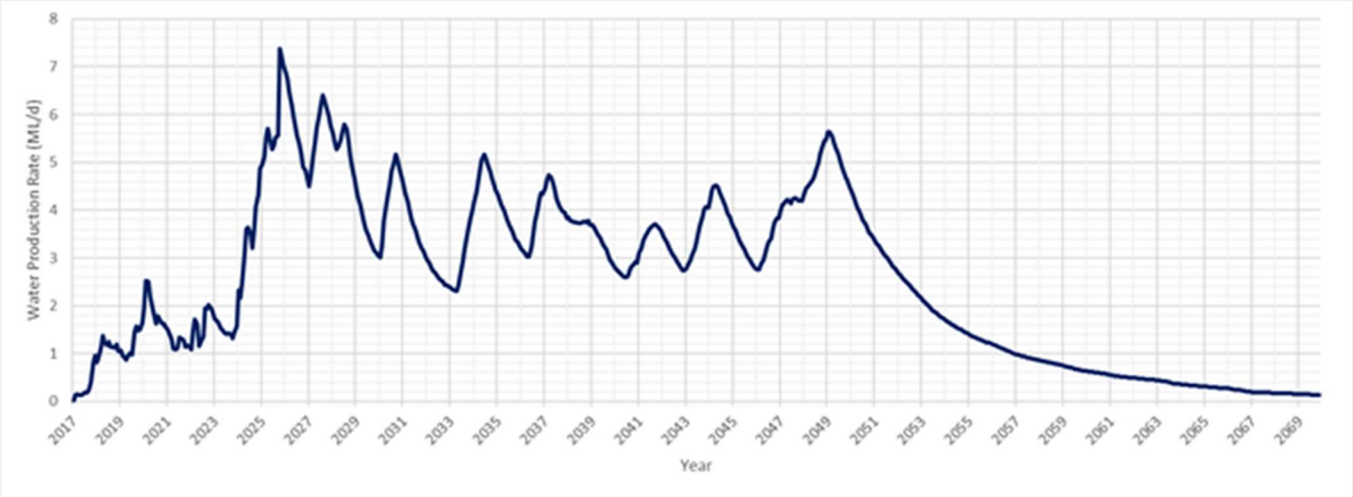


Figure 2-2: WSGP Forecast Water Production Rate (All CSG Production Wells)

Figure 2-3 presents the total annual volumes of CSG water produced from the WSGP, based on the water production profile presented in Figure 2-1. The total volume of water forecast to be produced over the WSGP lifetime is approximately 48.9 GL, an increase from the previously predicted 35GL.

The CSG water production profile will be reviewed throughout project development and updated as new / additional data allows modelling inputs / assumptions to be progressively refined.

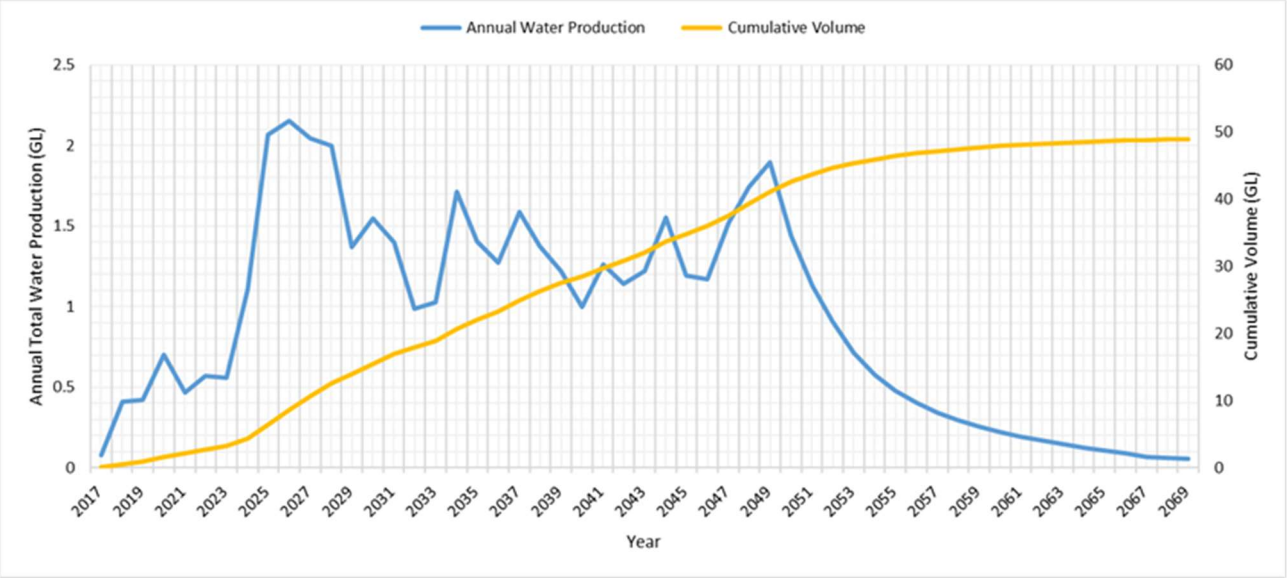


Figure 2-3: Annual Water Production and Cumulative Project Volume (Gigalitres – GL)

2.3 CSG Water Management

CSG produced water for the WSGP will be collected via water gathering systems. The WSGP will include water storage facilities that include:

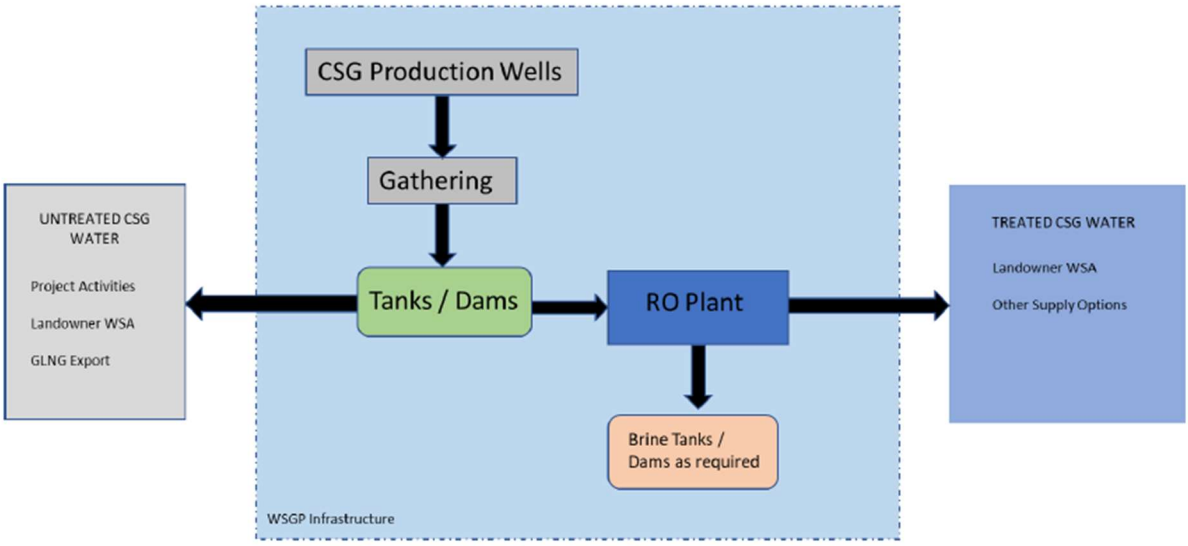
- Dams for aggregating untreated CSG produced water;
- Temporary tanks or dams for pilot production;
- Dams for blending treated water; and
- Dams or tanks for storage of brine.[1]

The infrastructure and process associated with water management is provided in Figure 2-4.

Senex's strategy for CSG water management at the WSGP has been developed based on the DEHP Prioritisation Hierarchy (DEHP 2012). The water management options have been developed to maximise beneficial use of water, which includes use for WSGP activities and Landowner Water Supply Agreements (WSA).

[1] The treatment of CSG produced water using desalination technologies result in brine.

Figure 2-4: Water Management Infrastructure Schematic for the WSGP



The CSG Water Management Plan (SENEX-WSGP-EN-PLN-008) provides further information related to the management of CSG water and associated water storage.

3 Groundwater and the WSGP

3.1 Hydrogeological Overview

The WSGP is located within the geographical extent of 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 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 (2021) presents the hydrostratigraphy of the Surat and Bowen Basin, included as Figure 3-1.

The main aquifers within the GAB, from the deepest to the shallowest, are the Precipice Sandstone, Hutton Sandstone, Springbok Sandstone, Gubberamunda Sandstone, 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 2021). Minor discontinuous aquifers include the Wallumbilla Formation and Orallo Formation. The major aquitards are the Evergreen Formation, Eurombah Formation, Westbourne Formation, Surat Siltstone and Griman Creek Formation (Figure 3-1). WCM is the target formation for CSG production for the WSGP.

Many of these Surat Basin units outcrop within the vicinity of the WSGP. The sections show the units dipping from outcrop towards the south. Generally, all units are laterally extensive and continuous across the WSGP area, except for the Precipice Sandstone, which is thin or absent across much of the area.

Figure 3-2 presents the local basinal hydrostratigraphy sourced from the OGIA Surat CMA geological model surfaces (OGIA 2017) and indicates the outcrop areas associated with the WSGP, including the Springbok Sandstone, Westbourne Formation, Gubberamunda Sandstone, Orallo Formation and Mooga Sandstone. The WCM outcrop is located immediately to the north of the WSGP.

North-south and west-east oriented cross sections through the WSGP are presented in Figure 3-3, with the section locations provided on Figure 3-2.

Figure 3-1: Regional Hydrostratigraphy (OGIA 2021)

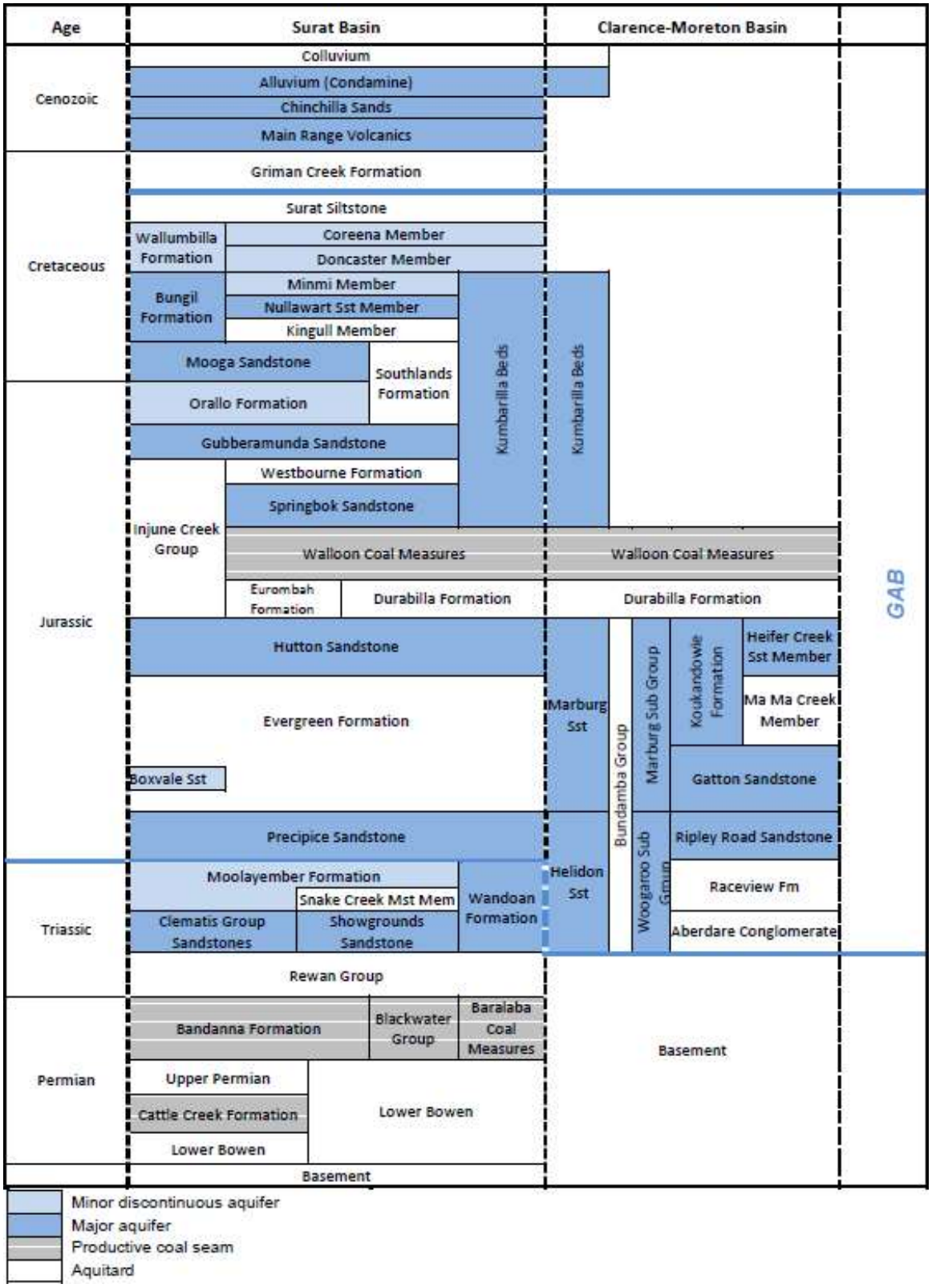


Figure 3-2: Local Geology and Cross Section Locations (after OGIA 2017)

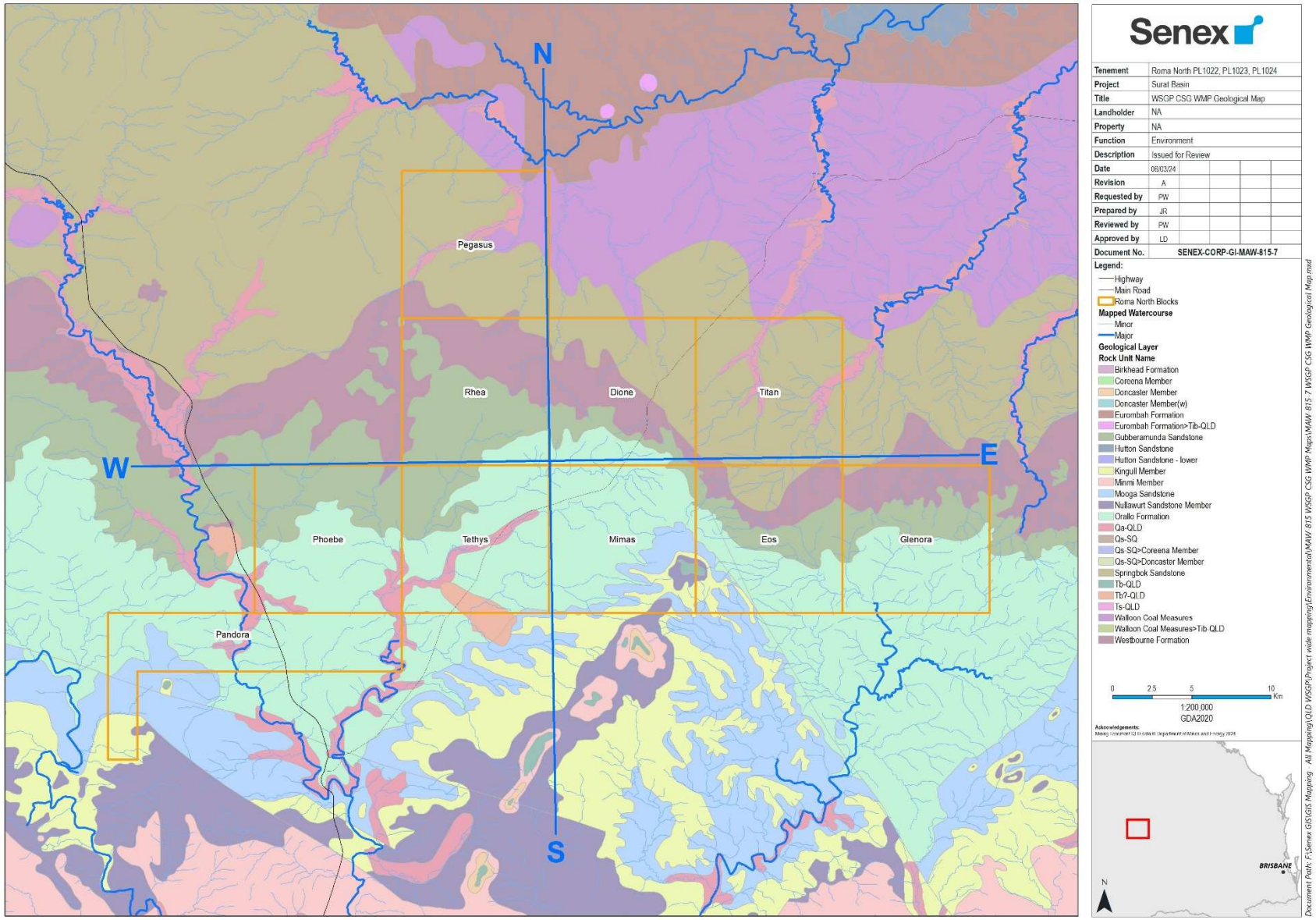
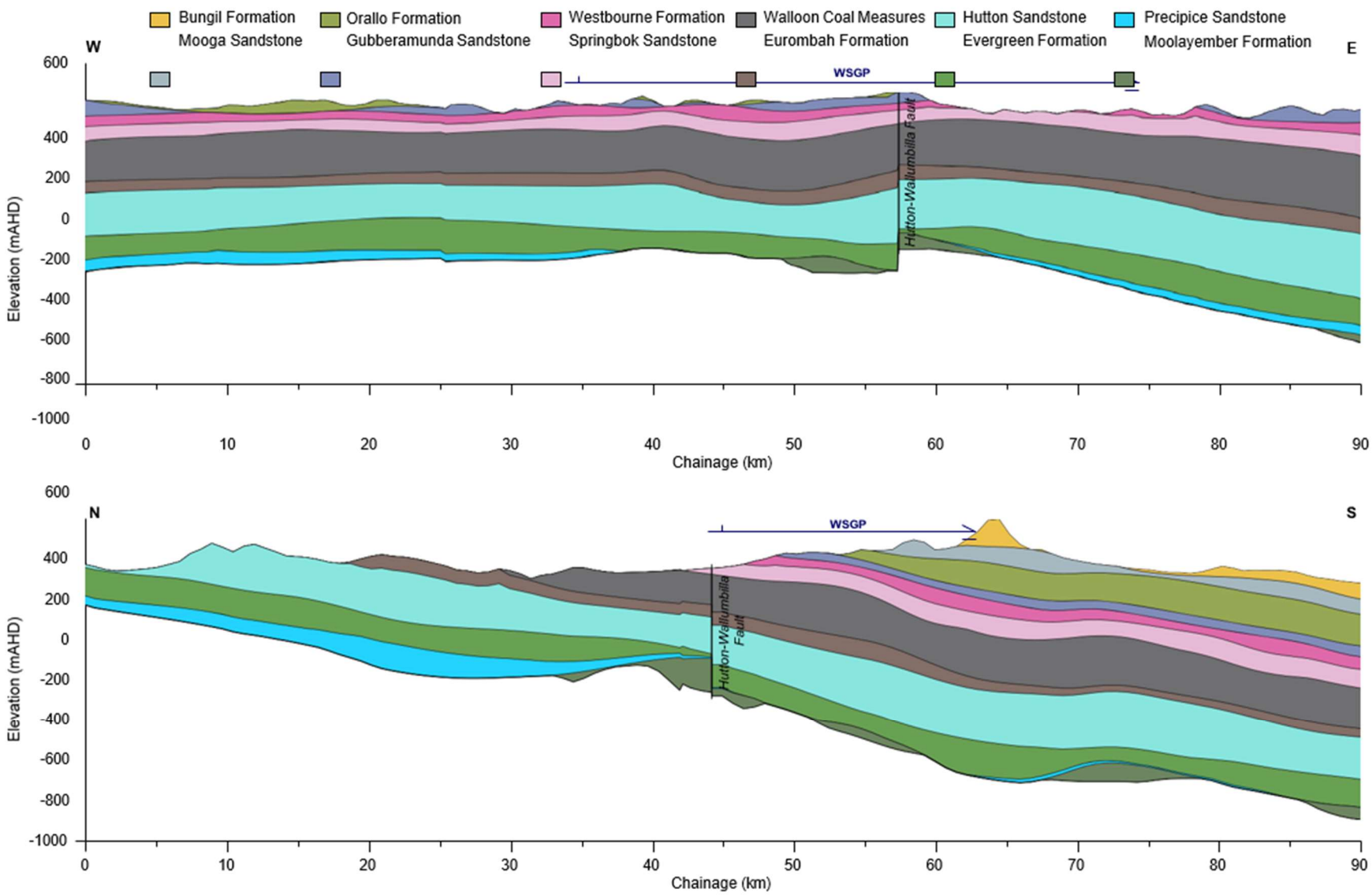


Figure 3-3: West-East and North-South Geological Cross Section (after OGIA 2017)



3.2 Groundwater-Dependent Assets

3.2.1 Groundwater Bores

In the vicinity of the WSGP (within the WSGP tenure and a 25 km buffer of the WSGP extent), there are an estimated 1,015 bores which access water from Surat Basin units, with a combined water use estimate of 1,790 ML/yr (KCB 2017). The location of these bores is presented in

Figure 3-4. The highest water usage is attributed to the Orallo Formation, Gubberamunda Sandstone, Walloon Coal Measures and Hutton Sandstone. Stock and domestic use is the most common groundwater abstraction purpose within the vicinity of the WSGP. There are 30 bores that are utilised for an alternative purpose, including three bores licensed for agricultural purposes within the WSGP boundary.

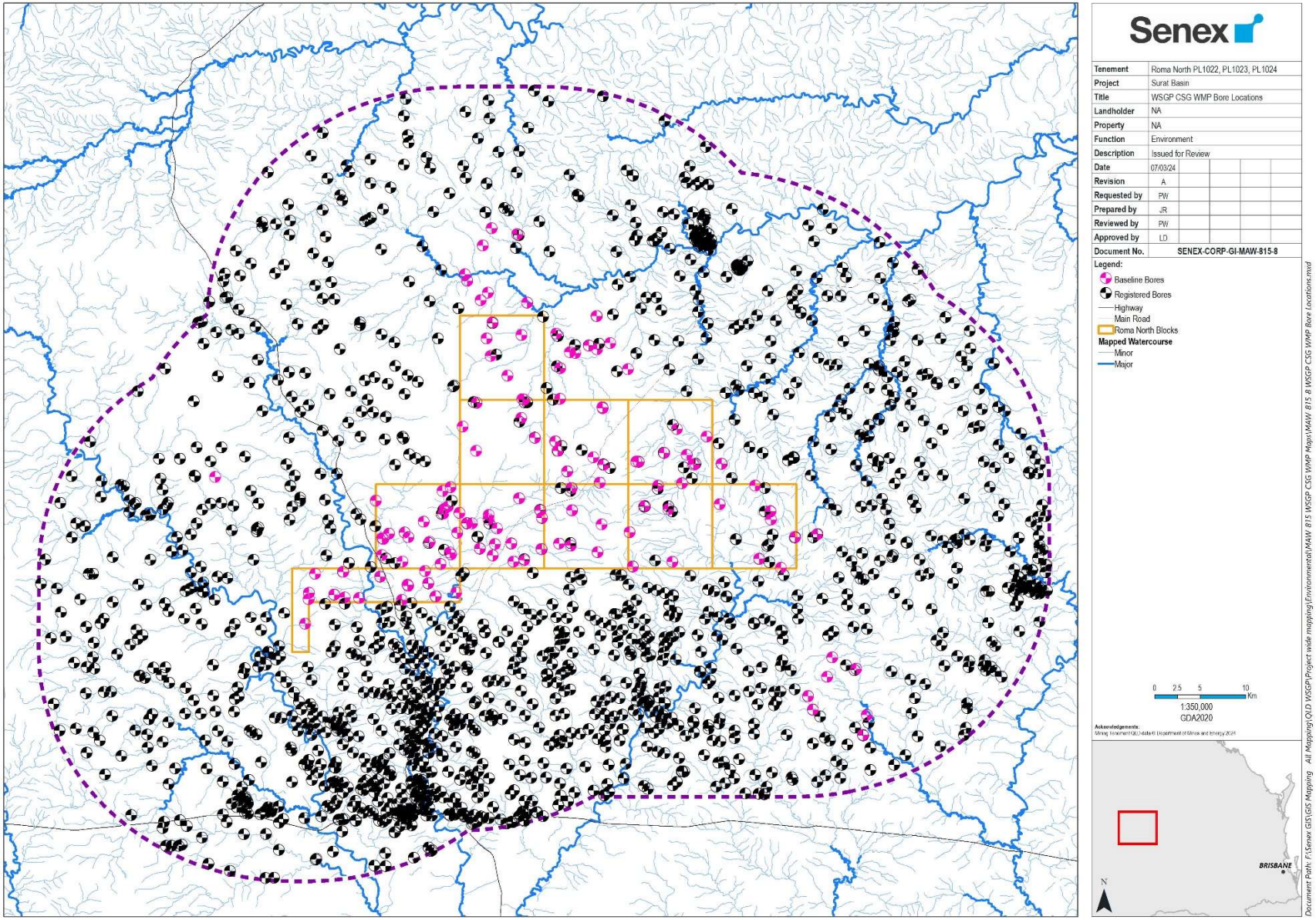
Senex are required as part of the Surat CMA UWIR WMS (under the Water Act 2000) to undertake baseline assessments for bores within the WSGP area. Early in 2015, Senex submitted its Western Surat Basin baseline assessment plan (BAP). The BAP defines the proposed rationale and schedule of the baseline assessments. The field component of the baseline assessments started in June 2015 and was completed in November 2016. A total of 120 bores were initially identified in the Queensland Governments Groundwater Database (GWDB). A first contact with landholders identified an additional 15 bores not registered in the database. Out of the 135 bores, 95 bores were assessed. The remaining 40 bores could not be assessed as land access could not be confirmed or was refused. The baseline assessments were undertaken by Cardno, with details of the assessments provided in the 'Bore Baseline Assessment Summary Report' (Cardno 2017).

Between 2021 and 2022, a further 15 Baseline Assessments were undertaken to include bores that were missed in the 2015/16 campaign, and new bores identified that were not previously baseline assessed.

Baseline assessments were carried out in accordance with the 'Baseline Assessment Guideline' (DEHP 2017), Australian Standard for water quality sampling (AS/NZS 5667.11 1998) and other relevant guidelines. The field assessments included an interview with the bore owner, bore inspection, water level measurement (where possible) and water quality sampling (where possible).

Following field data collection, an assessment of the baseline results was undertaken. This included collation of the available data to estimate the screened interval for each landholder bore. This was also cross-checked against Senex's geological model. Data from the baseline assessment, including the estimated screened interval, was provided to OGIA for incorporation into their aquifer attribution dataset.

Figure 3-4: Location of Registered Groundwater Bores within the vicinity of the WSGP



3.2.2 Groundwater Dependent Ecosystems

Surface expression Groundwater Dependent Ecosystems (GDEs) are defined as:

> 'ecosystems dependent on the discharge of 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. Surface expression GDEs include drainage lines, spring wetlands and regional ecosystems that have some groundwater dependency' (DSITI 2015).

In the GAB, these are referred to as Spring Vents / Complexes and Watercourse Springs. Table 3-1 presents a summary of springs and watercourse springs within the vicinity of the WSGP, with their locations presented on Figure 3-5.

Table 3-1: Surface expression GDEs within the vicinity of the Project

GDE Type	Complex/Site Number	Name	Vent	Source Aquifer	Distance from the Project Boundary
Spring Vents	506	Spring Ridge	184.1, 185.1, 186.1	Gubberamunda Sandstone	Within Project (Rhea Block)
	283	Barton	702.1, 703.1	Gubberamunda Sandstone	6.7 km east
	358	Gubberamunda (VI Mile)	187.1, 679.1, 680.1, 680.1.1	Gubberamunda Sandstone	5.0 km west
	649	Kangaroo Creek	1162_1 1291_1 1292_1	Cainozoic Sediments	18 km northeast
	737	Nugget	1497_1	Hutton Sandstone	20 km east
Watercourse Springs	W10	Blyth Creek	N/A	Mooga Sandstone, Orallo Formation	10 km south
	W16	Bungeworgorai Creek		Gubberamunda Sandstone	22.6 km
	W17	Bungeworgorai Creek		Mooga Sandstone	1.6 km west
	W18	Bungil Creek		Gubberamunda Sandstone	1.6 km west
	W19	Bungil Creek		Mooga Sandstone	6.3 km south
	W59	Eurombah Creek		Upper Hutton Sandstone	22.8 km
	W181	Bungeworgorai Creek		Orallo Formation	5 km west
	W234	Mooga Mooga Creek		Mooga Sandstone	5 km south

Additional work by OGIA (2017b) to re-map gaining streams (or baseflow-fed reaches, watercourse springs) identified three further reaches of creeks, within the vicinity of the WSGP, as potentially gaining streams. Details of the three further reaches are provided in Table 3-2 with their location shown on Figure 3-5. Blyth Creek (W10) and Eurombah Creek (W59) were also included in the assessment.

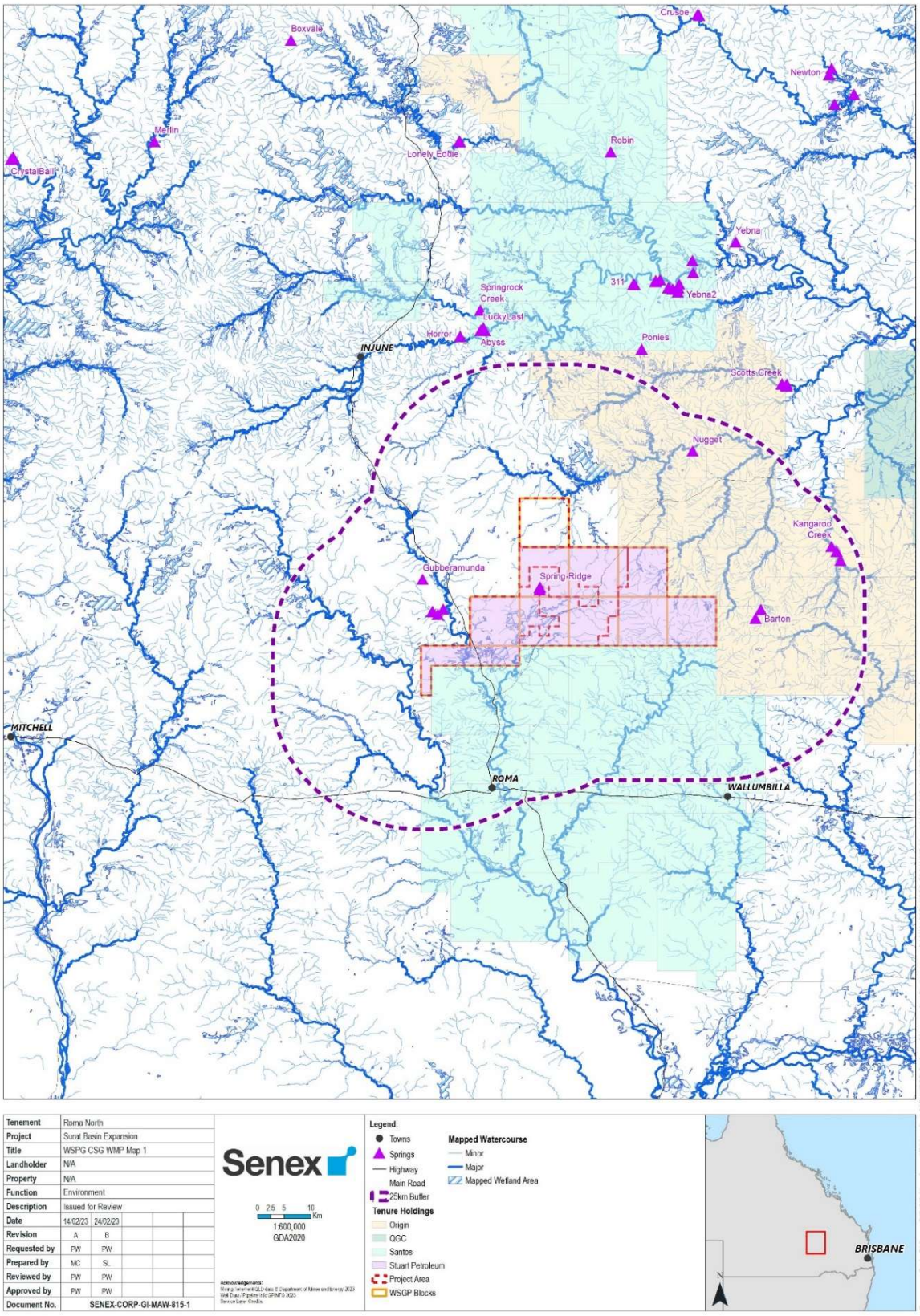
Table 3-2: Details of Potentially Gaining Streams (Watercourse Springs) from OGIA (2017b)

Name	Potential Source Aquifer	Distance from WSGP Boundary	Information Source
Sugarloaf Creek	Alluvium / Westbourne Formation / Springbok Sandstone / WCM	4.2 km	OGIA (2017b)
Barton Creek	Alluvium / Springbok Sandstone	10.6 km	OGIA (2017b)
Kangaroo Creek	Gubberamunda Sandstone / Westbourne Formation / Springbok Sandstone	23.8 km	OGIA (2017b)

The Spring Ridge complex is located centrally within the WSGP boundary, inside the Rhea block. Senex commissioned a spring survey of this complex in 2015. OGIA (2016a) identifies groundwater discharge at this spring as being controlled by the outcrop geology of the Gubberamunda Sandstone and is associated with a perched aquifer. The spring is described as a 'Type 4b wetland', which is a semi-permanent fresh riverine-to-palustrine wetland with minor wetland soils and moderate vegetation cover, mainly connected to local groundwater systems. These wetlands are located within riverine-to-palustrine environments with shallow-to-nil consolidated material. These wetlands can form in areas of significant topography. The Spring Ridge complex does not support an EPBC groundwater community.[2]

[2] Community of species dependent on natural discharge for groundwater from the GAB.

Figure 3-5: Location of Spring Complexes / Vents and Watercourse Springs



3.3 Predicted Impacts

Since 2012 the Office of Groundwater Impact Assessment (OGIA) has been using a numerical groundwater model to predict groundwater pressure impacts resulting from multiple petroleum and gas tenure developments. The latest iteration of the Surat Basin Cumulative Management Area (CMA) Underground Water Impact Report (UWIR) was released in 2021.

The primary purpose of the model is to predict regional water pressure or water level changes in aquifers within the Surat CMA footprint in response to extraction / production of water from the various producing coal seams. In particular, the OGIA numerical groundwater model is used to assess potential impacts to landholder groundwater bores and springs relative to the Water Act 2000 trigger thresholds.

CSG water production from the WSGP has been included in the 2021 iteration of the Surat CMA UWIR based on a well count of 425 wells. The 2021 UWIR identified an additional three bores within the immediately affected area (IAA) for which Senex are the Responsible Tenure Holder (RTH). Previous iterations of the UWIR had identified six bores within the IAA for which Senex were the RTH. Make Good Agreements have been finalized for these six bores.

3.3.1 Immediately Affected Bores

An 'Immediately Affected Area' is defined by *Water Act 2000* as an aquifer in the area within which water pressures are predicted to fall by more than the trigger threshold within three years. Bores within immediately affected areas are subject to make good arrangements under the *Water Act 2000*, as assigned by OGIA.

Senex currently has nine IAA bores within the WSGP area:

- RN16211
- RN48951
- RN48955
- RN48956
- RN58103
- RN58533
- RN22723
- RN7659
- RN9288

3.3.2 Long-Term Affected Bores

Results from the cumulative impact assessment undertaken to support the initial WSGP approval (KCB 2017) indicated that 57 bores, attributed to the WCM, are predicted to experience a drawdown greater than the bore trigger threshold by 2042. This is as a result of the WSGP and other proposed and existing CSG developments in the area.

This included 55 bores which are triggered as a result of the WSGP and two additional bores where the WSGP has greater than 50% contribution to drawdown at the bore. Thirty-seven (37) bores are located within the WSGP, with 20 bores located beyond the WSGP extent.

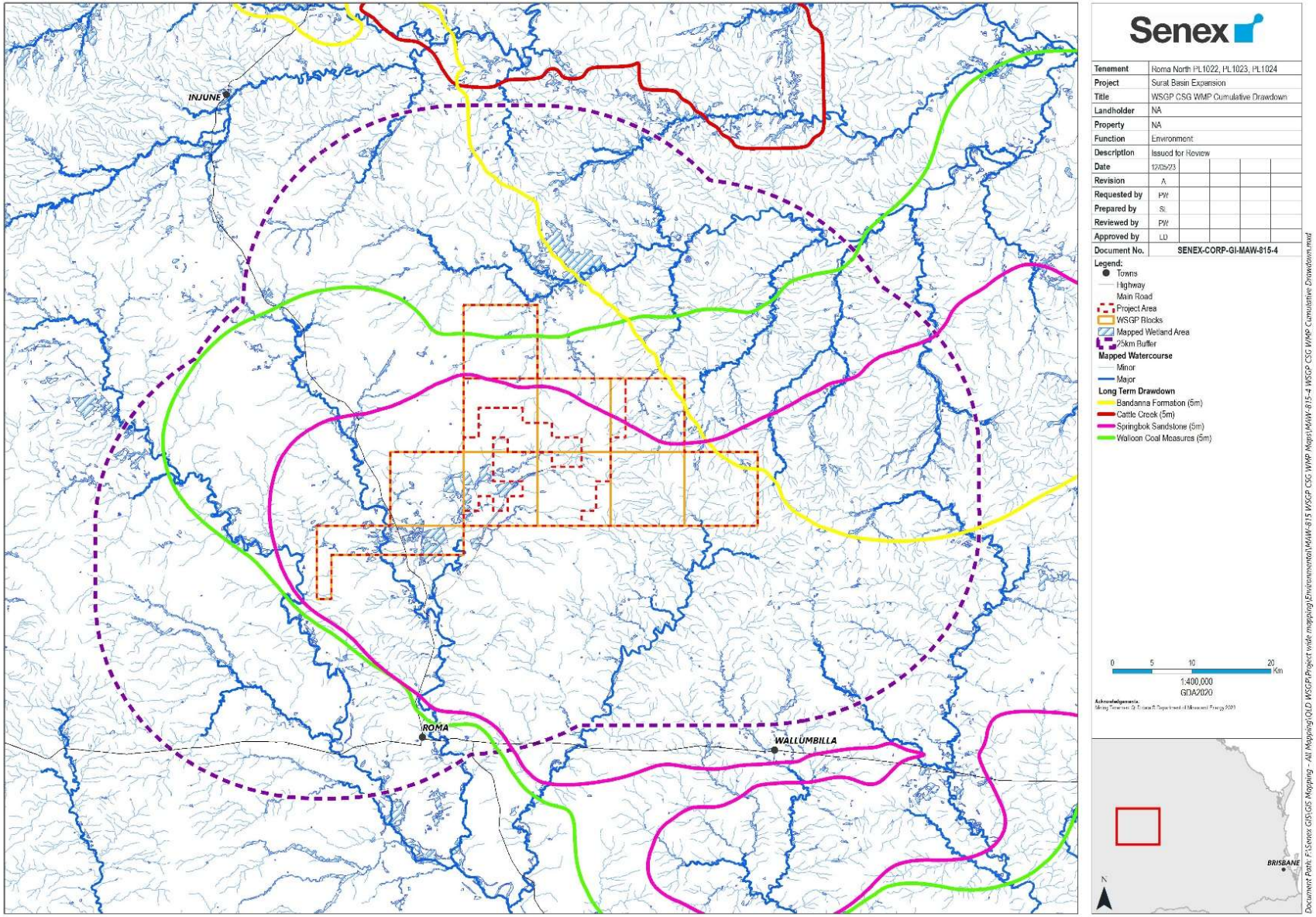
The UWIR 2021 Long-term impact thresholds (5m drawdown) are presented in Figure 3-1.

3.3.3 GDE Impacts

The KCB, 2017 study predicted no impacts to GDEs as a result of proposed WSGP activities.

Senex will continue to meet its obligations should impacts to GDEs become identified through the UWIR process, and Senex is the RTH.

Figure 3-6: Predicted Cumulative Drawdown Impacts (UWIR 2021)



4 Groundwater Monitoring Program

4.1 Overview

The WSGP groundwater monitoring program has been designed with consideration to key legislation, policies, guidelines and standards. These are outlined in Table 4-1.

The WSGP groundwater monitoring network includes both existing and proposed facilities.

Table 4-1: Key legislation, policies and standards applicable to groundwater monitoring

Type	Name
Legislation	*Water Act 2000* (State of Queensland 2021b) *Environmental Protection Act 1994* (State of Queensland 2022a) *Petroleum and Gas (Production and Safety) Act 2004* (State of Queensland 2020) *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2022)
Guidelines and Policies	Bore Baseline Assessments Guideline (DES 2022a) Queensland Water Quality Guidelines 2009 (DEHP 2013) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) Monitoring and Sampling Manual: Environmental Protection (Water) Policy (DES 2018a) Australian and New Zealand Water Sampling Guidelines – Part 11 Guidance of sampling of groundwater (AS/NZS 5667.11 1998). Australian Groundwater's Sampling and Analysis – A Field Guide (Sundaram et al. 2009). Bore Assessments Guideline (DES 2022b)
Standards	Minimum Construction Requirements for Water Bores in Australia (NUDLC 2020) Minimum standards for the construction and reconditioning of water bores that intersect the sediments of artesian basins in Queensland (State of Queensland 2017)
Reports	Underground Water Impact Report for the Surat Cumulative Management Area (OGIA 2021d) Groundwater Sampling and Analysis – A Field Guide (Sundaram et al. 2009)

4.2 Regional Groundwater Monitoring Program

Groundwater monitoring forms a key mechanism for the early identification of the response to CSG water production within the WCM and other formations where groundwater receptors exist.

The groundwater monitoring requirements for CSG tenure holders within the Surat CMA are provided as part of the Underground Water Impact Report Water Monitoring Strategy (UWIR WMS) (OGIA 2021 and subsequent updates), which provides for establishment of baseline trends, identification of any changes within or near CSG development areas or locations of interest and information to inform future improvement of groundwater modelling. Through this, a substantial network of groundwater monitoring locations has been established across the Surat CMA with the primary objectives to:

- Improve the understanding of system response within production areas;
- Identify pressure changes near specific areas of interest;
- Improve understanding of background trends in pressure; and
- Provide sufficient data for model calibration.

Data collected from the greater UWIR monitoring network is considered to provide sufficient information to

account for the heterogeneous nature of the system. The monitoring of these locations has resulted in the collection of a significant data set describing baseline groundwater pressure and quality, and provides OGIA with systematic data for ongoing conceptualisation and calibration updates to its groundwater models.

Under the UWIR WMS, Senex is assigned monitoring obligations. Senex will continue to comply with any updates to the WMS that may be required in any future updates of the Surat CMA UWIR.

4.2.1 Senex Monitoring Locations

Senex's groundwater monitoring locations were selected and agreed upon through consultation with OGIA, to complement the existing UWIR monitoring network and monitoring of drawdown associated with the WSGP.

Table 4-2 provides details on each of the monitoring sites, including facility type, status and formations to be monitored, with the location of the facilities presented in **Error! Reference source not found.**.

Table 4-2: WSGP Groundwater Monitoring Bores and Monitoring Requirements

Site ID	Easting (m)	Northing (m)	Facility Type	Monitoring Formation	Groundwater Level/Pressure	Groundwater Quality Sampling
Glenora-4M	710543	7089038	Multi-Level Monitoring Bore	Springbok Sandstone,Upper Juandah CM,Lower Juandah CM,Taroom CM, Hutton Sandstone	Hourly	-
Glenora-6M	710473	7089038	Monitoring Bore	Gubberamunda Sandstone	Hourly	-
Tethys-6M	684860	7089687	Multi-Level Monitoring Bore	Springbok Sandstone,Upper Juandah CM, Lower Juandah CM, Taroom CM, Hutton Sandstone	Hourly	-
Tethys-7M	684881	7089694	Monitoring Bore	Gubberamunda Sandstone	Hourly	-
Dione-11M	693656	7099083	Multi-Level Monitoring Bore	Springbok Sandstone, Upper Juandah CM, Lower Juandah CM, Taroom CM, Hutton Sandstone	Hourly	-
Dione-12M	698888	7101823	Multi-Level Monitoring Bore	Lower Juandah CM, Tangalooma Sandstone, Taroom CM, Hutton Sandstone	Hourly	-
Glenora-49	709735	7090915	Production Well	WCM	-	Annually
Eos-1	703519	7086470	Production Well	WCM	-	Annually
Eos-2	704169	704169	Production Well	WCM	-	Annually
Eos-4	705763	7086415	Production Well	WCM	-	Annually
Eos-23	707579	7091580	Production Well	WCM	-	Annually

WCM comprises Upper and Lower Juandah Coal Measures, Tangalooma Sandstone and Taroom Coal Measures

4.2.1.1 Groundwater level/pressure monitoring program

Senex has currently installed six UWIR groundwater level/pressure monitoring bores at three different locations: Glenora, Tethys and Dione.

The Glenora (Glenora 4M and Glenora 6M) and Tethys (Tethys 6M and Tethys 7M) sites were required under the 2016 UWIR to monitor groundwater pressure in the following formations / reservoir units: Gubberamunda, Springbok, Upper Juandah, Lower Juandah, Taroom and Hutton.

Senex previously attempted to continue to monitor Glenora-24M, which was installed by the previous tenure holder, QGC, in 2013. However, there is limited confidence in the pressure readings for a number of the sensors, and Glenora-4M has been installed to replace this facility. Glenora-24M has been removed from the WMS and is scheduled to be decommissioned.

Dione 11M and Dione 12M are multi-level monitoring wells drilled on the eastern side and western side of the Hutton-Wallumbilla Fault respectively, approximately 42 - 48km northeast of Roma, on PL 1024. The objective of these monitoring wells installed late 2022/early 2023 is to record baseline pressure and long-term pressure variations in the aquifer zone (Hutton Sandstone) below the Walloon Subgroup, as well as pressure changes within zones of the CSG reservoir unit (lower Juandah Coal Measures, Tangalooma Sandstone and Taroom Coal Measures). These multi-level monitoring wells will provide data required to characterise aquifer connectivity in groundwater flow units and mitigate potential impacts on aquifers as legislated by the Office of Groundwater Impact Assessment (OGIA) in the 2019 Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (CMA).

Groundwater pressure will be monitored at all active monitoring network locations. The SCADA monitoring system records groundwater levels continuously at a frequency of one reading per hour (i.e. 24 readings per day) (OGIA 2021a).

4.2.1.2 Groundwater quality monitoring program

Senex has been assigned five (5) production well groundwater chemistry monitoring bores (Glenora-49, Eos-1, Eos-33[3], Eos-4 and Eos-23) (Figure 4-1). Production wells are sampled annually for the following parameters (OGIA 2021a):

- Field parameters: electrical conductivity, pH, Redox Potential, temperature, free gas at wellhead;
- Major cations and anions: calcium, magnesium potassium, sodium, bicarbonate, carbonate, chloride, sulphate, and total alkalinity;
- Metals (dissolved): arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, strontium, zinc;
- Fluoride, TDS;
- Gas (dissolved): Methane;
- Isotopes: Strontium (87Sr/86Sr); and
- Metals (dissolved): Strontium (Sr2+).

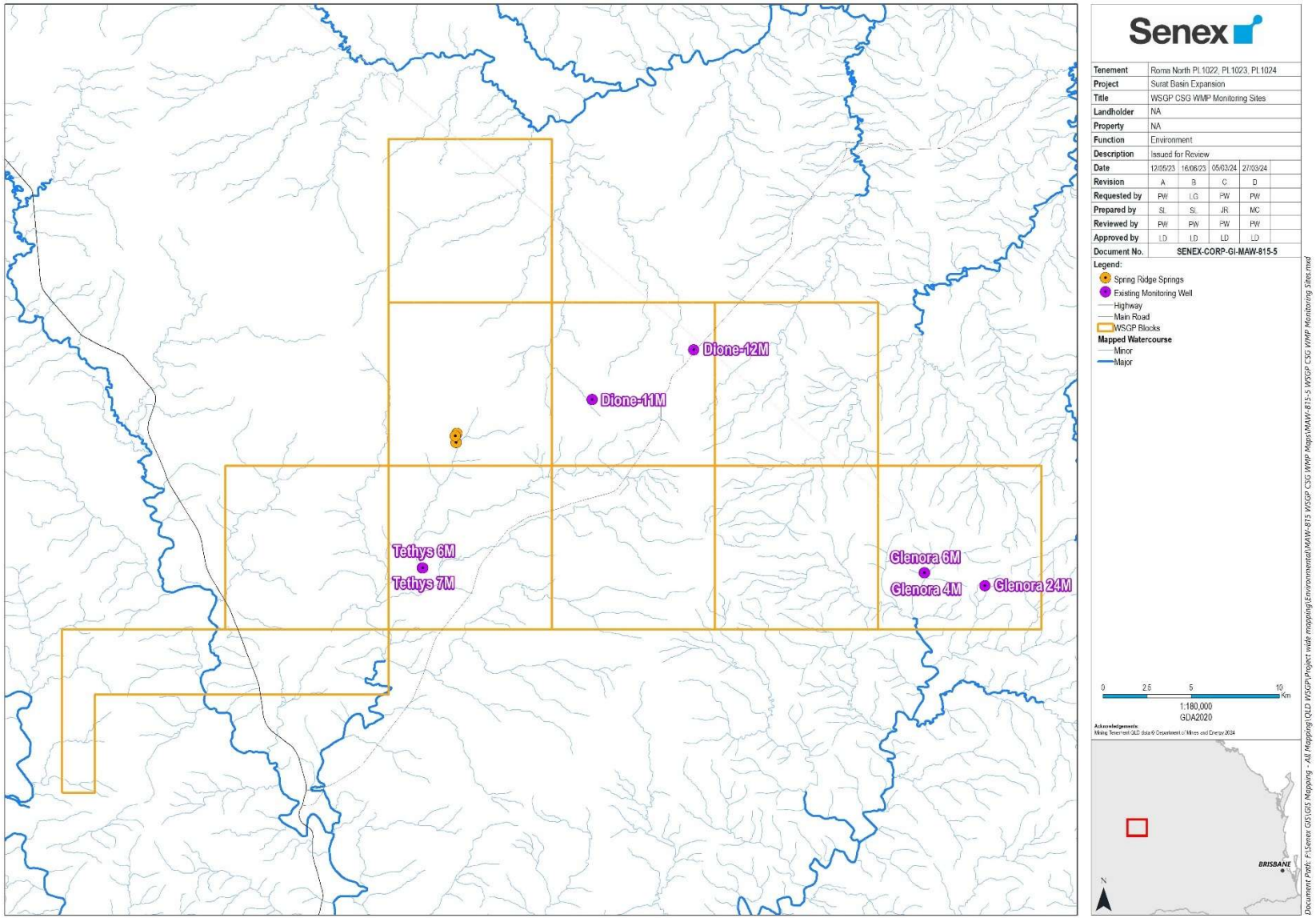
*4.2.1.*3 Report and Review

Senex will submit the following to OGIA every six months (following 1 April and 1 October each year) (OGIA 2021d):

- A WMS network implementation report that will include the current status of the groundwater monitoring points;
- A WMS water monitoring report that will include an explanation of any gaps in the monitoring record associated with maintenance issues or failure of a monitoring point; and
- The monitoring records for the reporting period.

[3] Eos-2 replacement

Figure 4-1: Monitoring Bore Locations



4.2.2 Spring Monitoring

The Spring Ridge Complex is located within the Rhea development block of the WSGP. The spring is considered to be associated with a perched aquifer within the Gubberamunda Sandstone. There are no impacts predicted at this spring complex. However, to verify the groundwater model predictions, monitoring bore Tethys-7M is installed in the Gubberamunda Sandstone, to the south of the complex (seeFigure 4-1).

4.2.3 Landowner Bore Monitoring

Senex are required as part of the Surat CMA UWIR WMS (under the Water Act 2000) to undertake baseline assessments for bores within the WSGP area. Early in 2015, Senex submitted its Western Surat Basin baseline assessment plan (BAP). The BAP defines the proposed rationale and schedule of the baseline assessments. The field component of the baseline assessments started in June 2015 and was completed in November 2016. Initially a total of 120 bores were initially identified in the Queensland Governments Groundwater Database (GWDB). A first contact with landholders identified an additional 15 bores not registered in the database. Out of the 135 bores, 95 bores were assessed. The remaining 40 bores could not be assessed as land access could not be confirmed or was refused. The baseline assessments were undertaken by Cardno, with details of the assessments provided in the 'Bore Baseline Assessment Summary Report' (Cardno 2017).

Should impacts to landowner bores be identified during the groundwater monitoring program (in accordance with the UWIR), Senex will negotiate a "make good" arrangement with the landowner of the impacted bore. Further details of this impact mitigation are provided in Section 4.4.1.

4.3 Data Management Analysis

4.3.1 Data Management

Data management procedures have been established to ensure that data are recorded and handled in a consistent and organised manner and stored securely (Commonwealth of Australia 2023). Monitoring data will continue to be collated and stored in the Senex database.

The database may include but not limited to the following information:

- Monitoring facility location details, aquifer and construction information;
- Landowner bore monitoring information from baseline assessments and the landowner bore monitoring program;
- Groundwater elevation monitoring data, as metres below ground level (mbGL) and metres above the datum (mAHD);
- Groundwater quality sampling results, including field measurements and laboratory analysis;
- Stratigraphic information;
- Relevant CSG production data; and
- Climate data, including barometric pressure and rainfall.

4.3.2 Validation and Analysis of Monitoring Data

Senex have developed a procedure for review and analysis of groundwater monitoring data. A summary of the monitoring data analysis, to understand and review potential impacts as a result of project development, is provided in the following:

- Collect and review data;
    - Monitoring data will be collected / downloaded and reviewed by a qualified hydrogeologist. Data will be reviewed and validated through a visual assessment of the groundwater elevation hydrographs and any data quality issues will be identified. Missing data,

unexpected values or variance from the historical range will be identified.

- Monitoring results will be checked to verify the data by:
  - Reviewing and checking data and field documents to identify transcription errors;
  - Reviewing and checking the calibration of measurement equipment (for example data loggers and piezometers);
  - Barometric compensation of uncompensated logger data; and
  - Obtaining further field data if necessary to confirm or clarify the results.

- Identify background or external influences / trends;
  - Groundwater elevations can be influenced by several factors, which can cause fluctuations and trends in groundwater elevations, both on a short-term (daily) or long-term (years or decades) scale. These may include:
  - Changes in barometric pressure;
  - Recharge following large precipitation events (short-term);
  - Longer term climatic response, such as wet / dry seasons as well as periods of drought or consecutive years of above average rainfall which overprint on season to season conditions;
  - Response to groundwater pumping; and
  - Response to aquifer depressurisation.

Results of the monitoring program will be made available to OGIA for ongoing trend analysis and reporting, update to hydrogeological conceptualisation and modelling, and subsequently to inform the UWIR risk assessment.

4.4 Risk Assessment Framework

Senex has committed to adopting the risk assessment and management framework defined in the JIF, which is applicable for this Project. The risk assessment and management frameworks defined in Section 3 to Section 7 of the JIF, relating to EPBC-listed Springs, Water Supply Bores, Aquatic GDEs, Terrestrial GDEs and Subterranean GDEs will be implemented by Senex. These frameworks are based on defined risk thresholds for each of the above receptors, and associated risk assessment process. The risk thresholds are based on the predicted drawdown from the OGIA model at the location of the receptor that is caused by CSG development. A summary of the risk thresholds that are applicable for the Project are provided as follows:

- Water supply bores;
- Unconsolidated formation – 2 m drawdown;
- Consolidated formation – 5 m drawdown;
- Terrestrial GDEs; and
- 0.2 m drawdown.

Should the above risk thresholds be exceeded based on the predicted results of the OGIA model, the applicable risk framework will be implemented for the assessment of potential impact and, if required, associated management/mitigation.

4.4.1 Make Good Agreements

The *Water Act 2000* outlines requirements for make good obligations of a resource tenure holder for a bore located in immediately affected areas. Tenure holders must carry out a bore assessment and enter into a make good agreement with the bore owner if the bores are located within an immediately affected area. The UWIR assigns bores to tenure holders located within immediately affected areas.

As indicated in Section 3.3.1, Senex currently have nine (9) make good obligations under the UWIR. Senex will comply with any updates to the make good arrangements in future UWIRs and continue to meet make good obligations.

Senex will also respond to any complaints made from landowners in relation to potential unanticipated impacts. This will be undertaken through a bore assessment to establish whether a water bore has an impaired capacity, or is likely to have an impaired capacity, as a result of the WSGP. Any bore assessments will be undertaken in accordance with the DES ‘Bore Assessments Guideline’ (DES 2022).

5 Effectiveness of Control Measures in avoiding, mitigating and managing impacts to Protected Matters

The cumulative impact on protected matters is assessed and managed by the State of Queensland in a coordinated manner across the Surat CMA through the Water Monitoring Strategy (WMS). The WMS is a key statutory component of the Underground Water Impact Report (UWIR) for the Surat Cumulative Management Area (OGIA, 2021).

The WMS includes the specification of a groundwater monitoring network, tenure holder obligations for implementation and biannual submission of groundwater monitoring data to OGIA. For Senex, the groundwater monitoring network includes six water level monitoring points and five water quality monitoring points in the WSGP.

The objectives of the WMS are to identify groundwater impacts from resource development, improve knowledge about the groundwater flow system (particularly near high value assets such as springs and water bores), support model calibration and evaluate effectiveness of impact management strategies.

In addition to WMS data providing a calibration target for the OGIA model, ongoing monitoring in accordance with the WMS post OGIA model calibration provides data for the validation of predicted impacts, which is undertaken during the legislated annual UWIR reviews and report.

The ongoing monitoring data provides a regional-scale early warning monitoring system for changes to potential risks to EPBC-listed springs and associated users. The adequacy of the monitoring network is also reviewed by OGIA, which may, at its discretion, add additional monitoring points.

The UWIR is also required to include a strategy for preventing or mitigating the predicted impacts on springs (the Springs Impact Mitigation Strategy (SIMS)). A risk assessment incorporates predictions of impact in the spring's source aquifer, spring condition and ecological value. The outcomes are used to determine locations for which plans for mitigation actions are required. To date, Senex has not been identified in the SIMS for the WSGP and therefore a Spring Impact Management Plan (SIMP) has not been required. However, Senex has been identified as the RTH for nine Immediately Impacted bores (IAA bores) for which make good agreements under Chapter 3 of the *Water Act 2000* (Qld) have either been executed or are currently being negotiated.

5.1 Comparison of impacts on Protected Matters against impacts Predicted in the WSGP Public Environmental Report

Impacts predicted in the Public Environmental Report (Feb, 2018)	***Impacts on protected matters (based on 2021 OGIA review of the UWIR)***
IAA Bores UWIR 2016 did not predict any drawdown triggers from the WSGP development within an 'Immediately Affected Area'	Senex currently has nine IAA bores within the WSGP area as listed below along with its make good status: • RN16211 (Finalised MGA) • RN48951 (Finalised MGA) • RN48955 (MGA Completed) • RN48956 (MGA Completed) • RN58103 (Finalised MGA) • RN58533 (MGA Completed) • RN22723 (MGA Completed) • RN7659 (In Negotiations) • RN9288 (In Negotiations)

Impacts predicted in the Public Environmental Report (Feb, 2018)	*Impacts on protected matters (based on 2021 OGIA review of the UWIR)*
LAA Bores The long-term drawdown results (year 2042) for the cumulative scenario indicate drawdown impacts within the vicinity of the WSGP area for the Springbok Sandstone, WCM and the Hutton Sandstone. There is an increase to the drawdown extent associated with the Springbok Sandstone and WCM, toward the east and southeast of the WSGP area, as a result of adjacent CSG developments. The results for the 'Project only' scenario conservatively indicated that at 55 bores, which are screened fully or partially across the WCM, groundwater level drawdown is anticipate to exceed the trigger threshold. This number increases to 123 bores for the Cumulative scenario.	In the 2021 UWIR, 44 IAA bores were identified where Senex is the RTH. Of these, 41 bores were attributed to the WCM and 3 bores were attributed to the Springbok Sandstone. Modelled predictions indicated the following: • 10 bores predicted to experience a drawdown greater than the bore trigger threshold between 2036-2045 • 24 bores predicted to experience a drawdown greater than the bore trigger threshold beyond 2045 • 3 bores were decommissioned • 3 bores became IAA bores and were made good (addressed above) • 4 bores were proactively made good (MGA finalised)
GDE Impacts There are no exceedances of the spring trigger threshold in the cumulative scenario. No impacted GDEs were identified through the UWIR process, where Senex is the RTH	There are no exceedances of the spring trigger threshold in the cumulative scenario. No impacted GDEs were identified through the UWIR process, where Senex is the RTH

6 Future Research and Reporting

6.1 Future Research

To develop further understanding of the hydrogeological conditions within the tenure, Senex will remain involved in any further assessment of the available geological information and may be updated as more geological information becomes available through drilling of CSG production wells.

Senex will provide the findings of relevant research to OGIA for incorporation into the next revision of the Surat CMA UWIR.

6.2 Plan Review and Reporting

This Water Monitoring and Management Plan will be reviewed and updated as new relevant information becomes available, or as required.

Senex will undertake all reporting as per the requirements under the State and Federal legislation, including to:

- OGIA as part of the UWIR requirements and in accordance with the Project's EA conditions; and
- DCCEEW as part of the JIF annual compliance requirements.

7 References

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SENEX-WSGP-EN-PLN-011_WMMP_5Apr24

Final Audit Report 2024-04-05

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