TECHNICAL MEMORANDUM

DATE 10 May 2021 **Project No.** 19126485-001-TM-Rev1

TO [redacted], Principal Environmental Advisor / Hydrogeologist, Santos

CC

FROM [redacted] **EMAIL** [redacted]

UPDATING GROUNDWATER IMPACT ESTIMATION – SANTOS COOPER BASIN OIL AND GAS FIELDS, SOUTH-WEST QUEENSLAND

1.0 INTRODUCTION

In accordance with the Queensland Water Act 2000 and the Guideline for Underground Water Impact Reports and Final Reports, Santos prepared an Underground Water Impact Report (UWIR) in 2013 (Santos, 2013), which was updated in 2016 and 2019 (Santos, 2016; Santos, 2019). The goal of the reports was to make predictions about and manage the impacts resulting from extraction of underground water by petroleum tenure holders where production testing or production is taking place.

To support Santos with groundwater impact estimations, Santos engaged Golder Associates Pty Ltd (Golder) to provide estimates of the decline in groundwater levels in response to the extraction of water from the Cooper and Eromanga Basins. Analytical calculations were updated periodically (2016 and 2019) to reflect changes in extraction rates, and proposed counts of future wells on existing and proposed new petroleum leases (PL).

This document reports the latest update of the Cooper and Eromanga Basin models, based on the data provided by Santos to Golder on 1 March 2021. It is Golder's understanding that the intent of this document is to support an Environmental Authority (EA) amendment application to increase the number of oil and gas wells on Santos tenements.

2.0 SCOPE OF WORK

Santos has requested Golder to complete the following scope of work:

- To update existing AnaqSim models (Cooper and Eromanga Basin) with revised extraction rates and numbers of proposed wells;
- To report results in a brief technical memorandum.

To complete these scope of work tasks, the following assumptions and limitations apply:

- The same assumptions and limitations apply as in case of the 2019 and 2020 UWIR reports (Santos, 2019; Santos, 2020);
- The number of existing wells does not change in the IAA (Immediately Affected Area) models, thus they are not required to be updated, results of IAA models can be found in (Santos, 2019);

- Only the long term affected area (LTAA) models are updated based on the new configuration of proposed wells;
- Extraction rates (extraction rate per well) are taken from the 2019 UWIR report (Santos, 2019);
- All other aspects (geometry, parametrization, boundary conditions, calibration) remain the same as they were reported in previous UWIR versions (Santos, 2013; Santos, 2016; Santos, 2019);
- In this technical memorandum only the LTAA model updates are documented, other aspects of an EA amendment are not considered here.

3.0 REVISED GROUNDWATER IMPACT MODELLING WORKFLOW

The revised impact modelling utilises the existing analytical models as documented in the last approved UWIR version (Santos, 2019). All groundwater impact model results described in this technical memorandum should be considered in comparison with the 2019 UWIR version.

To meet Santos requirements, Golder applied the following impact assessment workflow:

- Comparing new production well data sets provided by Santos (UWIR wells_20210226.xls) with 2019 data sets assigned to the models to determine the new LTAA well configuration for modelling;
- Updating Cooper Basin and Eromanga Basin LTAA analytical models with the new well configuration and rerunning those LTAA models;
- Summarising the revised groundwater impact simulation results for the LTAA (relevant tables, figures).

4.0 NEW PRODUCTION WELL DATA FOR 2021 UWIR

The number of existing wells in the Cooper and Eromanga Basin remained the same (212 and 250, respectively) as it was reported in (Santos, 2019). However, the number of proposed new wells increased significantly, as summarised in Table 1, based on data provided by Santos (UWIRwells_20210226.xlsx, issued 1 March 2021).

Table 1: Number of existing and additional wells in the 2021 UWIR long term affected area model compared with previous new well data (Santos, 2019) in brackets.

Basin	Number of Existing Wells	Number of Proposed New Wells at Existing PL's (well count in (Santos, 2019))	Number of Proposed New Wells at New PL's (well count in (Santos, 2019))
Eromanga	250	287 (157)	151 (62)
Cooper	212	348 (173)	263 (232)

The higher number of new wells in the model domains result in higher extraction rates which are summarised in Table 2. Extraction rate per well is calculated based on the 2019 extraction rates and documented in (Santos, 2019).

The number of existing and proposed gas and oil wells is listed in Attachment A.

Table 2: Updated 2021 UWIR water extraction rates compared with previous new well data (Santos, 2019) in brackets.

Analytical Model	Immediately Affected Area	Long Term Affected Area (data in (Santos, 2019)
Eromanga Basin	No. of representative wells = 250 Extraction per well = 49.92 m^3/day/well Total extraction = 4560 ML/year	No. of representative wells = 688 (469) Extraction per well = 49.92 m^3/day/well Total extraction = 12538 ML/year (8550 ML/year)
Cooper Basin	No. of representative wells = 212 Extraction per well = 4.01 m^3/day/well Total extraction = 310 ML/year	No. of representative wells = 823 (617) Extraction per well = 4.01 m^3/day/well Total extraction = 1205 ML/year (903 ML/year)

5.0 UWIR 2021 GROUNDWATER MODEL UPDATE

All results of the IAA models are documented in (Santos, 2019) and are still valid due to the fact that the existing well numbers and extraction rates are unchanged since the original 2019 predictions.

In this section of the technical memorandum only the LTAA groundwater impact assessment model results are presented for the Cooper and Eromanga Basin models.

5.1 2021 UWIR Impact Assessment Results

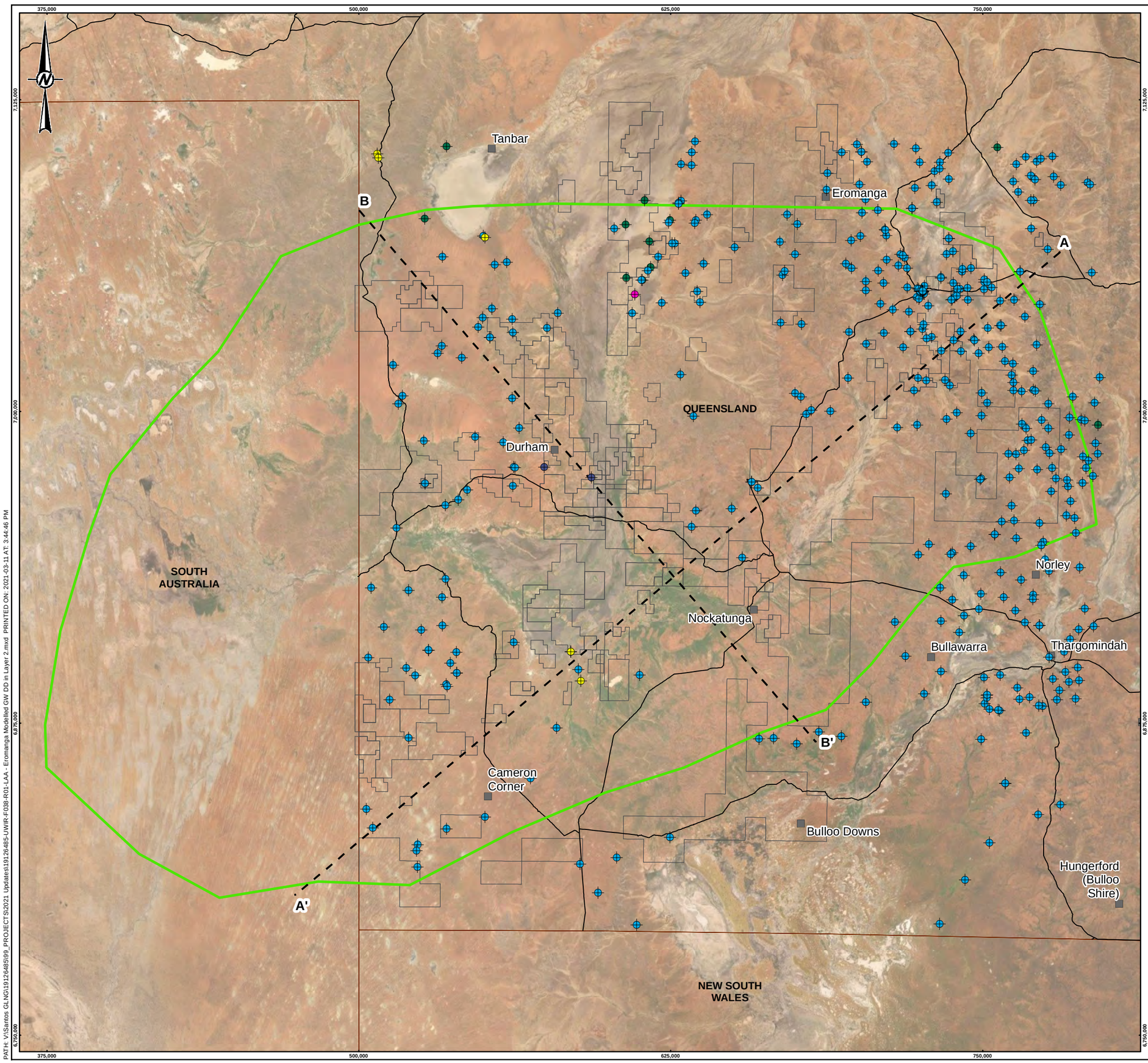
Predicted maximum drawdown along two cross sections in the Eromanga Basin (Figure 1 - Figure 6) and the one cross section in the Cooper Basin (Figure 7 - Figure 9) are summarised in Table 3 and Table 4, respectively. The drawdowns for the LTAA are based on the revised 2021 UWIR modelling, while the IAA predicted drawdowns in Table 3 and 4 are based on the 2019 UWIR.

Table 3: Calculated maximum drawdown along sections A-A' and B-B' in the Eromanga Basin

Layer Number	Layer Description	Maximum Drawdown in the Eromanga Basin (m)	
		Immediately Affected Area	Long Term Affected Area
2	Quaternary, Tertiary and Winton Formation	2	4
3	Alluru, Toolebuc and Wallumbilla Formations	11	21
4	Cadna-owie Formation and Hooray Sandstone	57	115
5	Westbourne, Adori and Birkhead Formations / Hutton Sandstone and Poolowanna Formation	182	268

Table 4: Calculated maximum drawdown along lines of section - Cooper Basin

Layer Number	Layer Description	Maximum Drawdown in the Eromanga Basin (m)	
		Immediately Affected Area	Long Term Affected Area
2	Tinchoo and Arraburry Formations	2	7
3	Toolachee to Patchawarra Formations	10	25



LEGEND

Registered Bore

Formation Description

- Tertiary Sedimefrom
- Tertiary - Undefined
- Quaternary - Undefined
- Winton Formation
- Winton/Muckunda Formation
- Bounded Locality
- Groundwater Line in Section
- Roads/Tracks
- Eromanga Model Extent
- Santos Operated Permits
- Australian State Boundary

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

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REFERENCE(S)

1. Australian State Boundaries, Bounded Localities, Petroleum Leases, Roads/Tracks: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
2. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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CLIENT
SANTOS LIMITED

PROJECT
SANTOS UWIR UPDATE SOUTHWEST QLD

TITLE
LONG TERM AFFECTED AREA - EROMANGA BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 2

CONSULTANT
GOLDER

DD-MM-YYYY	11-03-2021
DESIGNED	DW
PREPARED	DW
REVIEWED	KB
APPROVED	KB

PROJECT NO.	CONTROL	REV.	FIGURE
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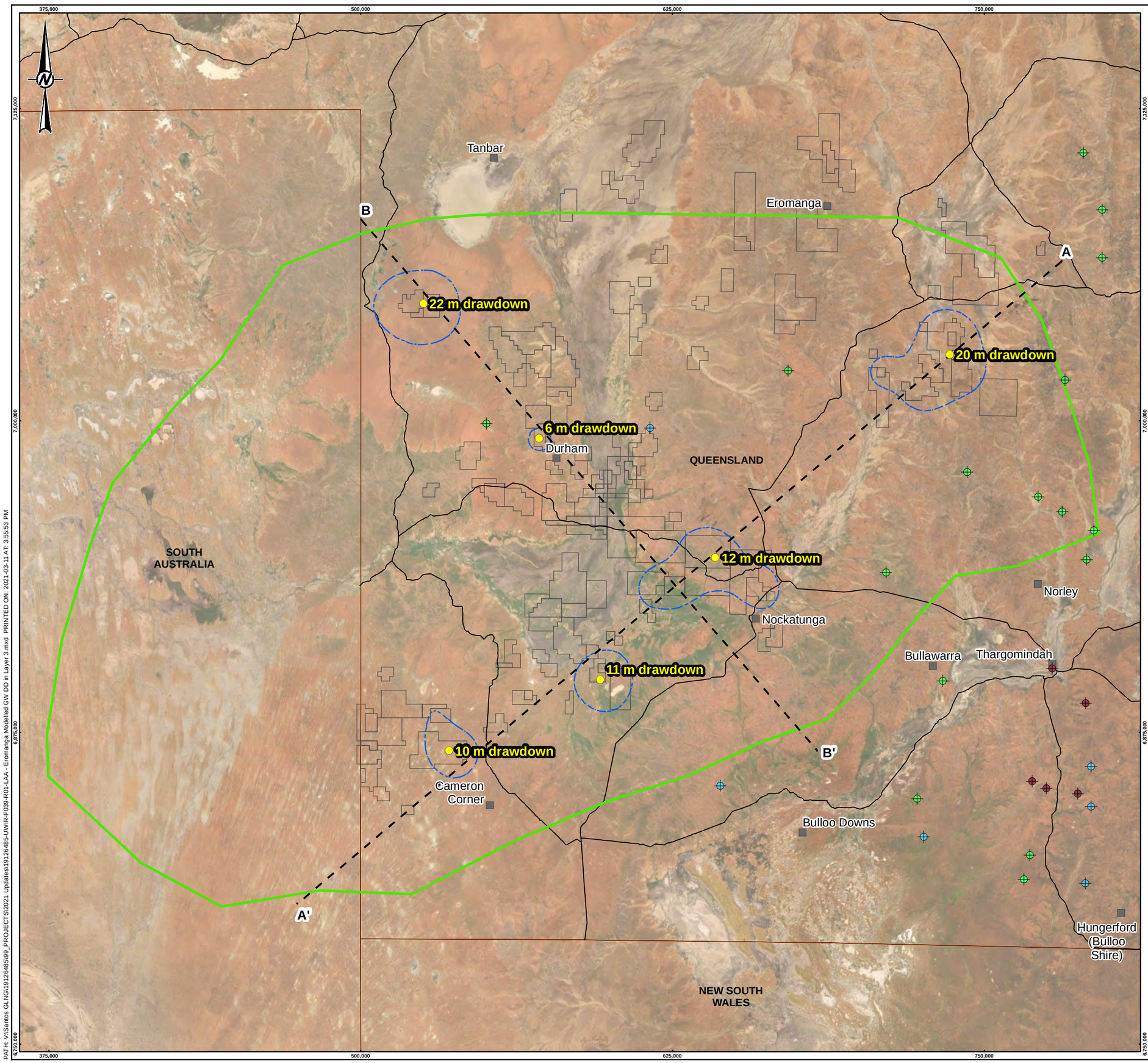

LEGEND

Registered Bore

Formation Description

- Makunda Formation
- Allaru Mudstone
- Wallumbilla Formation
- Maximum Drawdown (m AHD)
- Bounded Locality
- Groundwater Line in Section
- Drawdown (5 m)
- Roads/Tracks
- Eromanga Model Extent
- Australian State Boundary
- Santos Operated Permits

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

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REFERENCE(S)

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CLIENT
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PROJECT
SANTOS UWIR UPDATE SOUTHWEST QLD

TITLE
LONG TERM AFFECTED AREA - EROMANGA BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 3

CONSULTANT
GOLDER

DD-MM-YYYY	11-03-2021
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PREPARED	DW
REVIEWED	KB
APPROVED	KB

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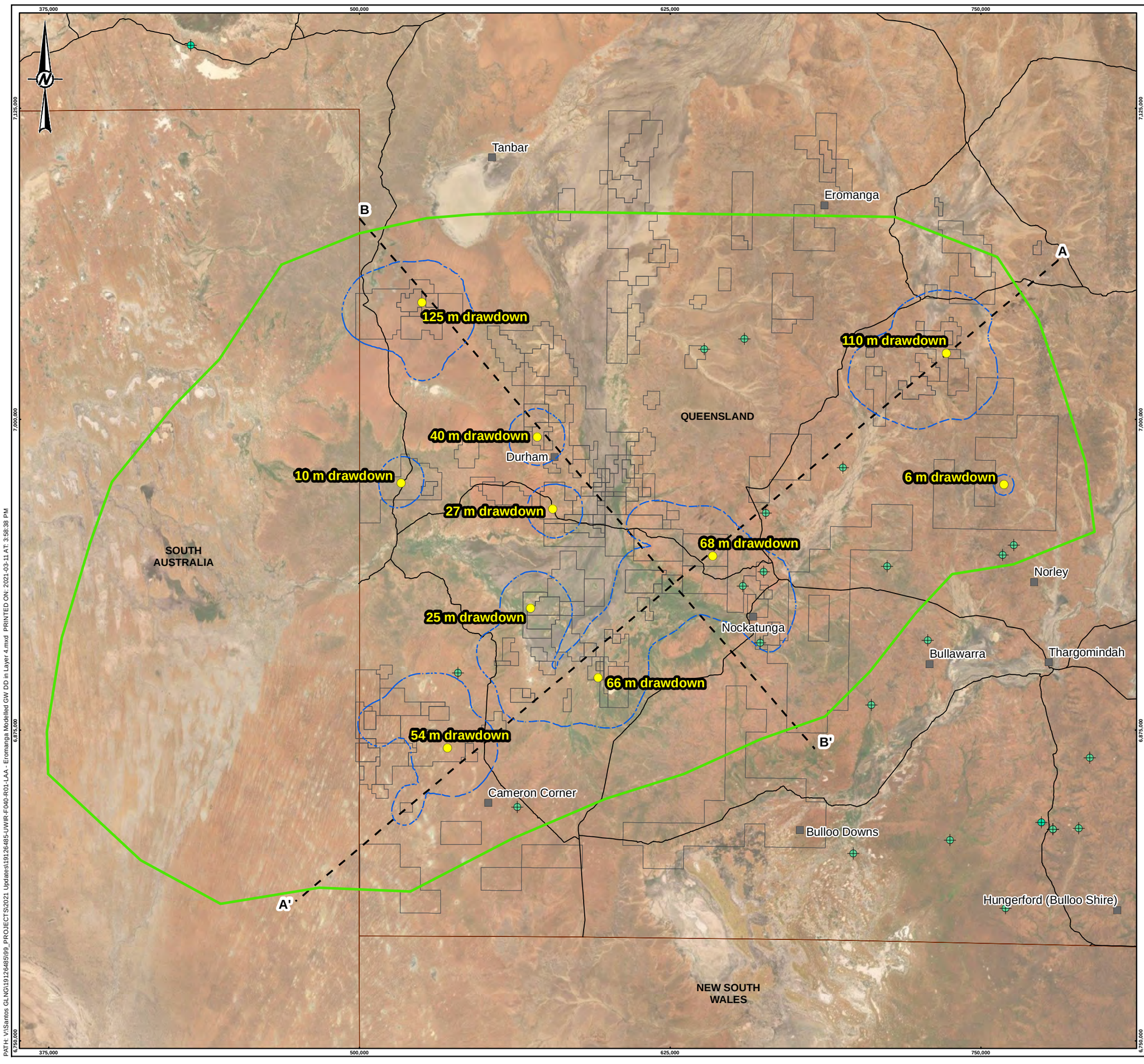

LEGEND

Registered Bore

Formation Description

- Hooray Sandstone
- Maximum Drawdown (m AHD)
- Bounded Locality
- Groundwater Line in Section
- Eromanga Model Extent
- Drawdown (5 m)
- Roads/Tracks
- Australian State Boundary
- Santos Operated Permits

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

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REFERENCE(S)

1. Bounded Localities, Petroleum Leases, Roads/Tracks: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
2. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
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PROJECT
SANTOS UWIR UPDATE SOUTHWEST QLD

TITLE
LONG TERM AFFECTED AREA - EROMANGA BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 4

CONSULTANT
GOLDER

DD-MM-YYYY	11-03-2021
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REVIEWED	KB
APPROVED	KB

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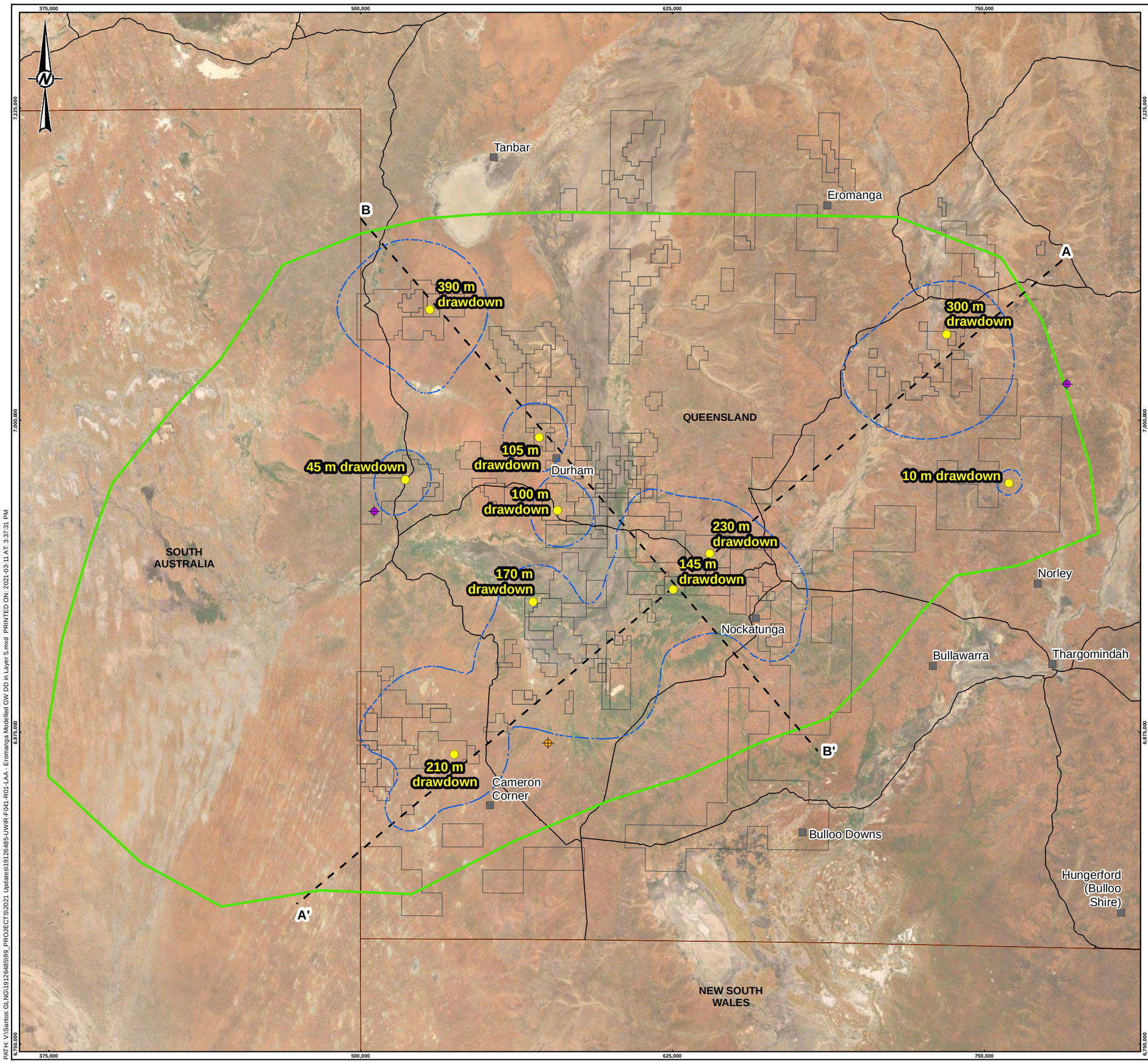

LEGEND

Registered Bore

Formation Description

- Hutton Sandstone
- Westbourne Formation
- Maximum Drawdown (m AHD)
- Bounded Locality
- Groundwater Line in Section
- Drawdown (5 m)
- Roads/Tracks
- Eromanga Model Extent
- Australian State Boundary
- Santos Operated Permits

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

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1. Australian State Boundaries, Bounded Localities, Petroleum Leases, Roads/Tracks: © State of Queensland (Department of Natural Resources, Mines and Energy) 2019
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TITLE
LONG TERM AFFECTED AREA - EROMANGA BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 5

CONSULTANT
GOLDER

DD-MM-YYYY	11-03-2021
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PREPARED	DW
REVIEWED	KB
APPROVED	KB

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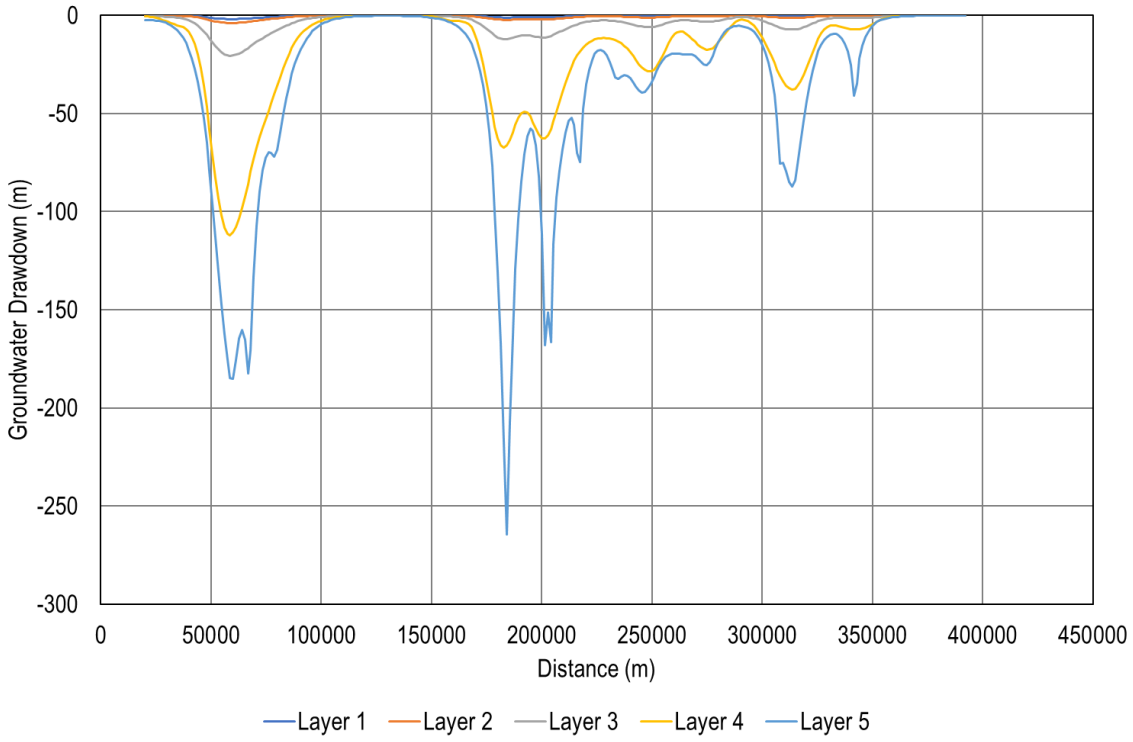


Figure 5. Eromanga Basin: Modelled Long Term Affected Area Groundwater Drawdowns in Cross Section A-A'

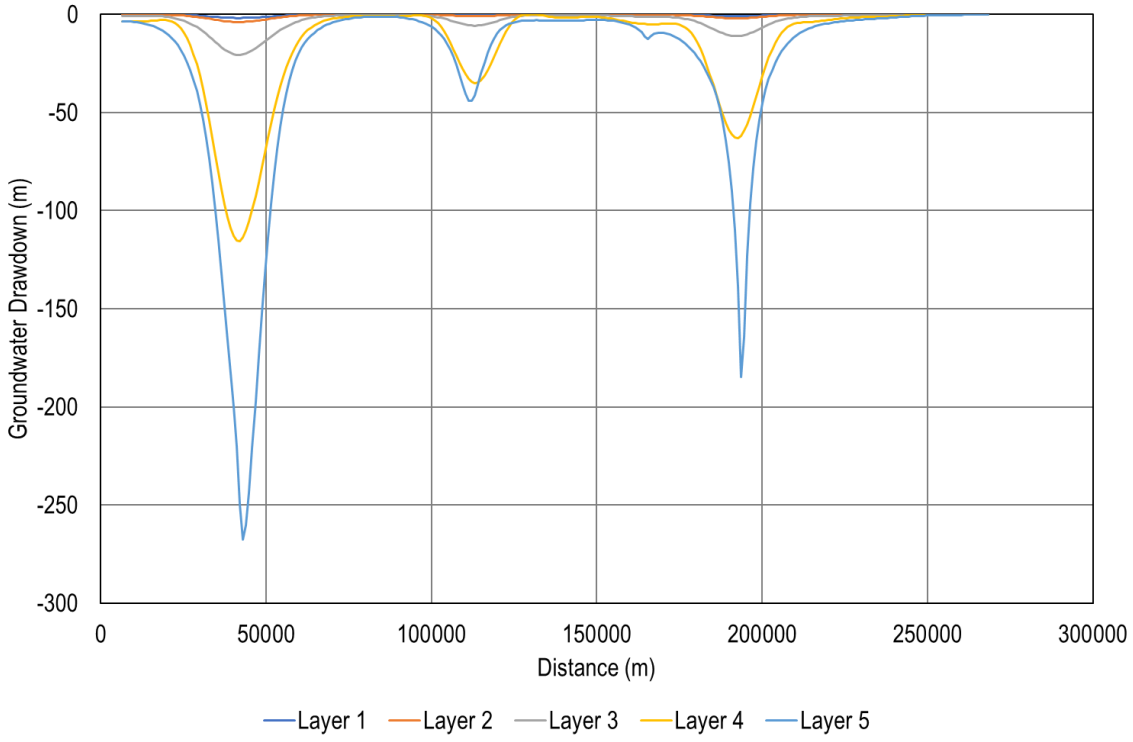
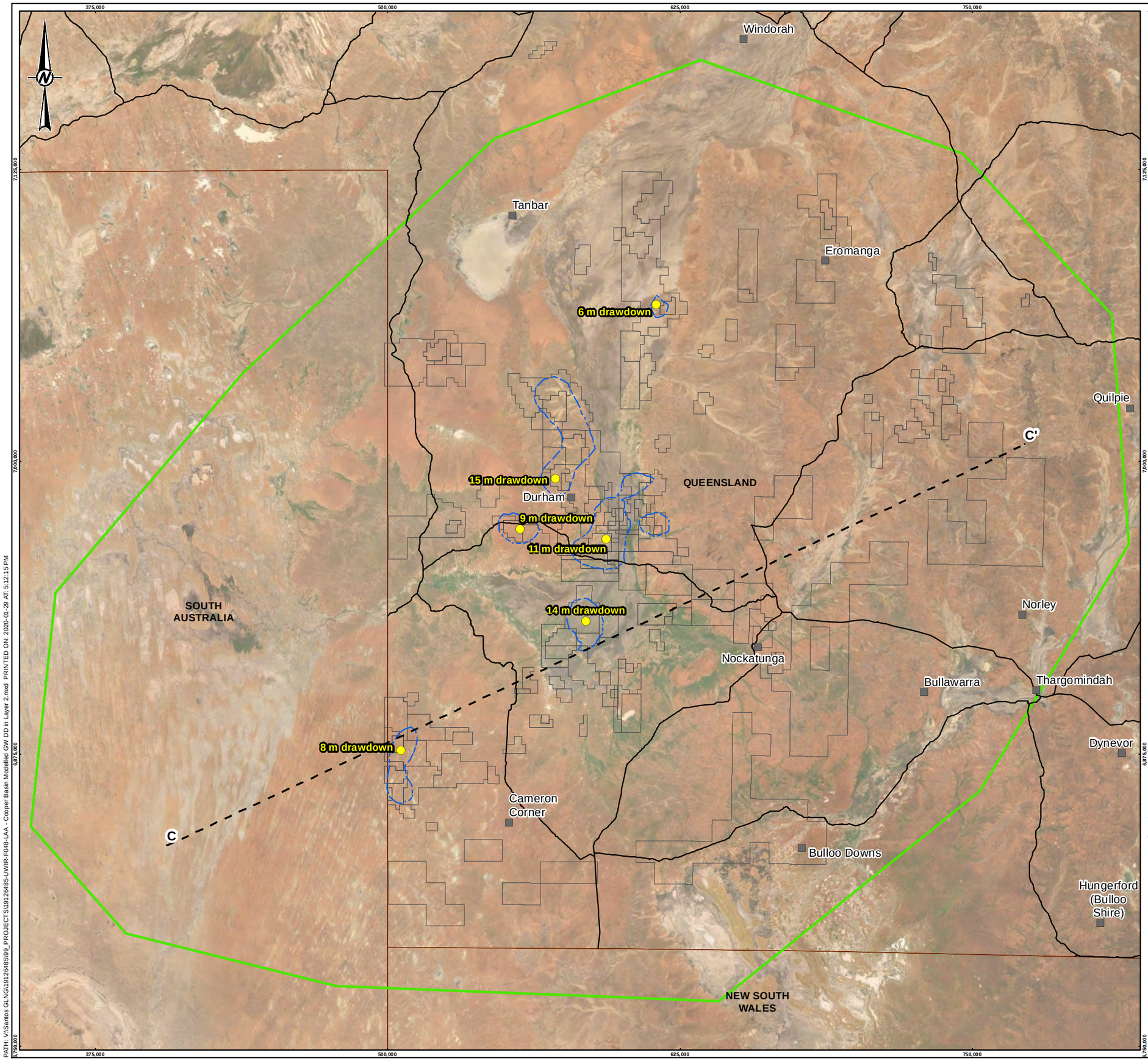


Figure 6. Eromanga Basin: Modelled Long Term Affected Area Groundwater Drawdowns in Cross Section B-B'



KEY MAP

LEGEND

- Maximum Drawdown (m AHD)
- Bounded Locality
- Groundwater Line in Section
- Drawdown (5 m)
- Roads/Tracks
- Cooper Model Boundary
- Australian State Boundary
- Santos Operated Permits

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

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PROJECT
SANTOS UWIR UPDATE SOUTHWEST QLD

TITLE
LONG TERM AFFECTED AREA - COOPER BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 2

CONSULTANT
GOLDER

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PREPARED	HG
REVIEWED	DP
APPROVED	KB

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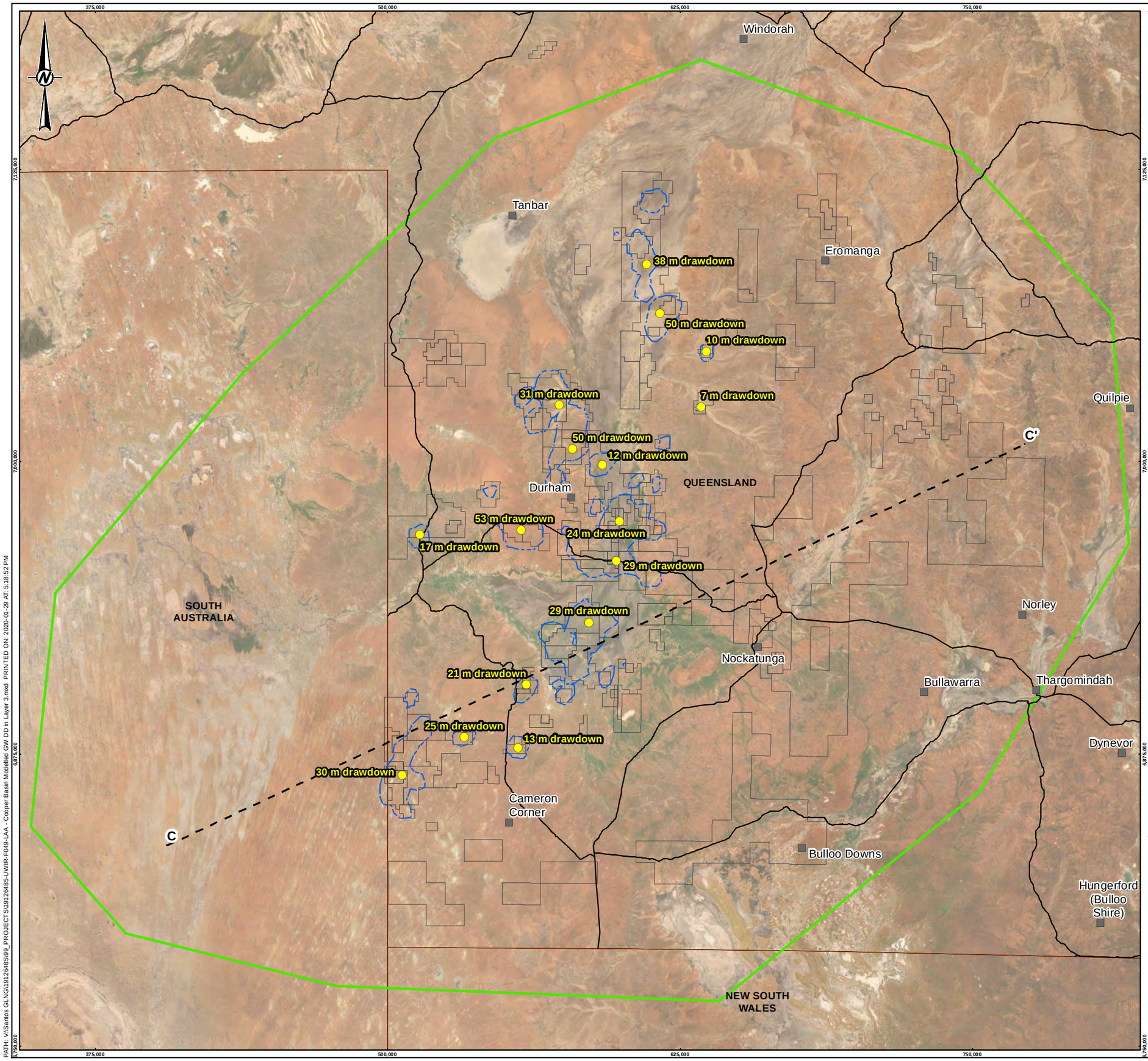

LEGEND

- Maximum Drawdown (m AHD)
- Bounded Locality
- Groundwater Line in Section
- Drawdown (5 m)
- Roads/Tracks
- Cooper Model Boundary
- Australian State Boundary
- Santos Operated Permits

Coordinate System: GDA 1994 MGA Zone 54
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REFERENCE(S)

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2. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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SANTOS UWIR UPDATE SOUTHWEST QLD

TITLE
LONG TERM AFFECTED AREA - COOPER BASIN MODELLED GROUNDWATER DRAWDOWN IN LAYER 3

CONSULTANT

GOLDER

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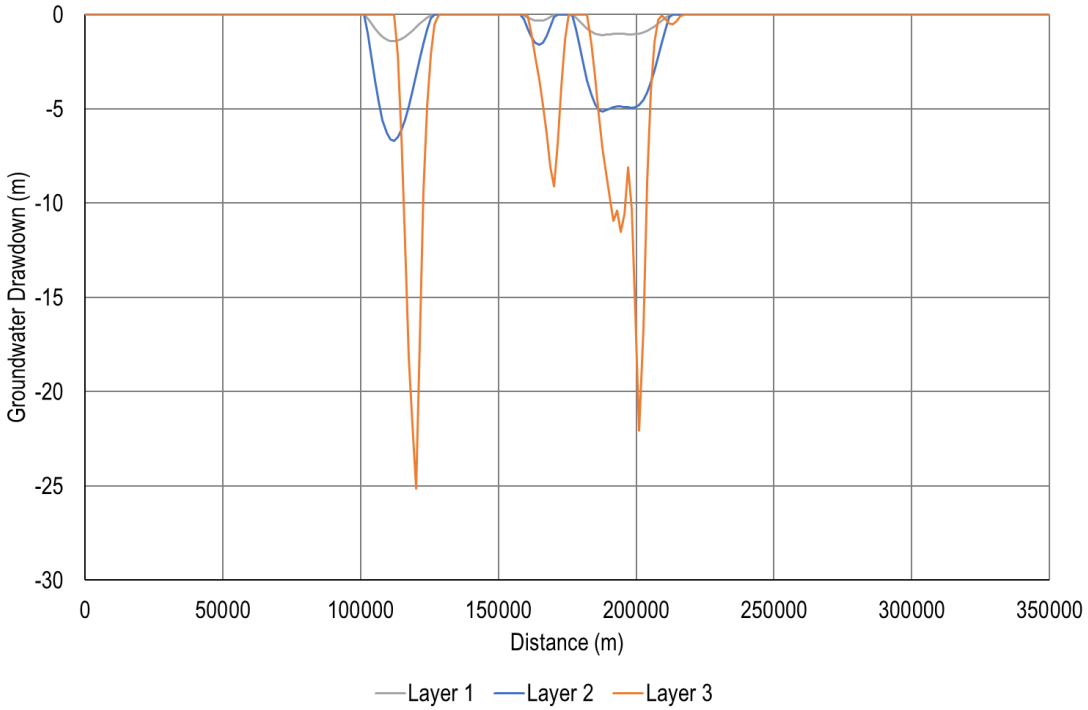

Figure 9. Cooper Basin: Modelled Long Term Affected Area Groundwater Drawdowns in Cross Section C-C'

A summary of the key outcomes s from the 2021 UWIR analytical modelling includes:

- One existing registered bore (RN23059) targeting the Mackunda, Cadna-Owie Formation or Hooray Sandstone may be potentially impacted based on the calculated LTAA in the Eromanga Basin (See Section 5.2). The most up-to-date groundwater database compiled by the Department of Natural Resources, Mines and Energy was used for the identification of registered bores within the modelled area (DNRME, 2021). The database identifies registered groundwater bore RN23059 as a GAB monitoring bore. It is unlikely that estimated drawdown in this area will impact local groundwater users.
- The impact of extraction from the Cooper Basin strata does not affect areas beyond the assumed extraction well locations at the top of the Cooper Basin stratigraphy. These impacts can therefore be discounted from the analysis of the overlying Eromanga Basin.
- The maximum predicted drawdown in the Eromanga Basin stratigraphy, in the strata directly underlying the unconfined Tertiary and Quaternary strata, is 4m under steady state conditions (Table 3). This is a worst-case scenario due to the limited number of extraction wells used in the calculation and the steady-state analysis conditions applied in the computation. The impact on the Tertiary and Quaternary strata is likely to be less than 4m.
- A maximum pressure decline of 115m (LTAA) is estimated for the modelled unit containing the Cadna-Owie Formation and Hooray Sandstone, however, the 5m contour line does not significantly extend outside of the tenements. Additionally, no private water supply bores targeting the Cadna-Owie Formation and Hooray Sandstone have been identified within the extent of the 5m contours.
- A maximum pressure decline of 268m (LTAA) was estimated for Westbourne Formation, Adori Sandstone, Birkhead Formation, Hutton Sandstone and Poolowanna Formation under the long term model run. The 5m drawdown contour does not extend outside of Santos tenements and no private bores targeting those formations have been identified.

5.2 Vulnerability of Groundwater Users

Based on the Queensland Groundwater Database (DNRME, 2021) and the simulated drawdown contours for LTAA, three private bores are identified within the LTAA.

Bore RN23372 is a water bore that was identified as being impacted in the 2016 UWIR. A Make Good Agreement, as required under provision in the Water Act, was executed in 2017. The amount of drawdown predicted in the next 3 years is 23m.

Bore RN23569 was investigated by DES (formerly, as DEHP) and found not to be an authorized bore (does not have a license that permits the owner to extract groundwater). It therefore does not qualify for protection and management in accordance with s363 of the Water Act (as advised by DEHP on 29 July 2014) and no further action is required.

Bore RN23059 is a water bore that has been identified as being impacted by production. The approximate drawdown calculated in the LTAA is 6m. The purpose of this bore is listed as GAB monitoring.

Table 5: Registered groundwater bores affected by modelled impacts - LTAA

Bore RN	Latitude	Longitude	Tenure	Date Drilled	Bore Name	Bore Type	Purpose / Status	Formation	Layer Description	Predicted Drawdown (m)
Long Term Affected Area										
23059	-27.92540012	142.6376904	PL245	1982	PPL Noccundra 1	Artesian	GAB Monitoring	Hooray Sandstone	Eromanga Layer 4	6
23372	-27.6653824	142.6485650	-	1986	PPL Balooma 1	Artesian	Stock / GAB Monitoring	Hooray Sandstone	Eromanga Layer 4	23
23569	-27.66538237	142.648565	PL33	1987	PPL Coothero 1	Artesian	GAB Monitoring	Hooray Sandstone	Eromanga Layer 4	27

6.0 SUMMARY

The updated Eromanga and Cooper Basin LTAA models have been rerun for the 2021 UWIR using the new production bore data set provided by Santos (number of proposed new wells). A revised set of drawdown predictions for the LTAA case have been provided in this technical memorandum in cross section and plan view format per formation. The outcomes of the modelling show that the long term affected area models and results do not change significantly since the 2019 UWIR. No new registered bores have been identified within the 5m drawdown impacted area. Immediately affected area models have not been assessed in the frame of this study, since the number of existing wells remained the same.

7.0 CLOSING

Golder trusts that this report satisfies your immediate requirements. Please do not hesitate to contact the undersigned should you require clarification and/or further information.

Your attention is drawn to the document – “Important Information”, which is included in Attachment B. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

8.0 REFERENCES

Santos. 2019. *Underground Water Impact Report, Santos Cooper Basin Oil and Gas Fields, South-West Queensland.* Brisbane : s.n., 2019.

—. 2020. *Underground Water Impact Report, Santos Cooper Basin Oil and Gas Fields, South-West Queensland.* Santos : s.n., 2020.

—. 2013. *Underground Water Impact Report, Santos Cooper Basin Oil and Gas Fields, South-West Queensland.* Brisbane : s.n., 2013.

—. 2016. *Underground Water Impact Report, Santos Cooper Basin Oil and Gas Fields, South-West Queensland.* Brisbane : s.n., 2016.

Golder Associates Pty Ltd

[redacted]
Senior Hydrogeologist

[redacted]
Principal Hydrogeologist

KB/TE/cpd

Attachments: Attachment A: Existing and Proposed Well Numbers
Attachment B: Important Information

https://golderassociates.sharepoint.com/sites/111929e/santosuwirupdatesouthwestqld/shared documents/uwir 2021/technical memo/rev 1/19126485-001-tm-rev1-model update 2021.docx

ATTACHMENT A

Existing and Proposed Well Numbers

Existing and Proposed Gas Wells – Cooper Basin

Tenure ID	PL 59	PL 60	PL 61	PL 81	PL 83	PL 85	PL 86	PL 288	PL 108	PL 111
Number of Existing Gas Wells	9	9	13	4	1	0	3	2	2	2
Number of Proposed Gas Wells	9	3	5	3	3	3	3	3	3	3

Tenure ID	PL 112	PL 131	PL 132	PL 135	PL 1035	PL 146	PL 147	PL 205	PL 1014	PL 208
Number of Existing Gas Wells	9	28	1	0	0	2	0	2	1	0
Number of Proposed Gas Wells	14	12	3	6	3	9	11	3	3	7

Tenure ID	PL 177	PL 152	PL 155	PL 151	PL 1013	PL 58	PL 136	PL 137	PL 159	PL 156
Number of Existing Gas Wells	4	0	2	0	3	11	0	0	0	1

Tenure ID	PL 177	PL 152	PL 155	PL 151	PL 1013	PL 58	PL 136	PL 137	PL 159	PL 156
Number of Proposed Gas Wells	9	9	21	22	10	15	6	6	6	9

Tenure ID	PL 249	PL 80	PL 25	PL 26	PL 62	PL 82	PL 87	PL 287	PL 133	PL 149
Number of Existing Gas Wells	0	13	4	2	3	0	0	6	0	0
Number of Proposed Gas Wells	3	17	6	6	3	3	3	3	3	3

Tenure ID	PL 175	PL 495	PL 496	PL 1047	PL 181	PL 182	PL 79	PL 1026	PL 37	PL 63
Number of Existing Gas Wells	2	1	1	1	2	1	2	0	1	7
Number of Proposed Gas Wells	3	0	3	4	3	3	3	2	6	10

Tenure ID	PL 84	PL 88	PL 129	PL 130	PL 134	PL 140	PL 142	PL 143	PL 144	PL 150
Number of Existing Gas Wells	10	3	4	2	0	1	1	0	1	10
Number of Proposed Gas Wells	6	6	6	6	6	6	6	6	6	7

Tenure ID	PL 186	PL 110	PL 1046	PL 241	PL 255	PL 113	PL 114	PL 141	PL 145	PL 148
Number of Existing Gas Wells	1	0	1	0	1	5	2	1	2	4
Number of Proposed Gas Wells	6	6	3	3	6	6	3	3	7	12

Tenure ID	PL 153	PL 157	PL 158	PL 1016	PL 187	PL 138	PL 154	ATP 1189	PL 117	PL 188
Number of Existing Gas Wells	0	0	0	1	0	0	0	0	0	0

Tenure ID	PL 153	PL 157	PL 158	PL 1016	PL 187	PL 138	PL 154	ATP 1189	PL 117	PL 188
Number of Proposed Gas Wells	10	6	12	6	3	3	3	17	1	1

Tenure ID	PL 254	PL 75	ATP 1174	PL 1055	PL 1058	PL 1077	PL 1087	PL 1107	PL 1108	PL 1093
Number of Existing Gas Wells	2	2	0	1	1	1	0	0	0	0
Number of Proposed Gas Wells	6	0	2	10	10	8	5	2	3	3

Tenure ID	PCA 248	PCA 250	PCA 252	PCA 254	PCA 268	PCA 270	PCA 272	PCA 273	PCA 274	PCA 276
Number of Existing Gas Wells	0	0	0	0	0	0	0	0	0	0
Number of Proposed Gas Wells	3	8	3	6	12	3	3	2	2	1

Tenure ID	PCA 277	PCA 279	PCA 281	PCA 282	PL 411
Number of Existing Gas Wells	0	0	0	0	0
Number of Proposed Gas Wells	9	1	11	10	1

Existing and Proposed Oil Wells – Eromanga Basin

Tenure ID	PL 61	PL 508	PL 509	PL 23	PL 24	PL 35	PL 36	PL 76	PL 77	PL 78
Number of Oil Existing Wells	9	6	11	33	6	7	8	1	3	1
Number of Oil Proposed Wells	5	7	17	14	3	14	17	6	3	3

Tenure ID	PL 29	PL 38	PL 39	PL 52	PL 57	PL 95	PL 169	PL 170	PL 295	PL 34
Number of Oil Existing Wells	2	6	23	20	15	0	2	7	6	21
Number of Oil Proposed Wells	6	6	6	7	3	2	3	14	41	21

Tenure ID	PL 63	PL 68	PL 75	PL 142	PL 502	PL 1046	PL 193	PL 255	PL 301	PL 303
Number of Oil Existing Wells	0	3	3	0	3	0	0	0	13	23
Number of Oil Proposed Wells	2	6	6	1	7	11	21	1	6	33

Tenure ID	PL 1028	ATP 752	PL 55	ATP 1189	ATP 636	PL 254	PL26	PL 33	PL 50	PL 51
Number of Oil Existing Wells	0	0	2	0	0	0	2	0	3	8
Number of Oil Proposed Wells	6	3	3	18	3	3	0	9	2	15

Tenure ID	PL 244	PL 302	PL 1058	PL 1060	PL 1077	PCA 155	PCA 206	PCA 207	PCA 248	PCA 271
Number of Oil Existing Wells	1	0	0	1	0	0	0	0	0	0
Number of Oil Proposed Wells	5	2	13	8	5	3	5	9	11	3

Tenure ID	PCA 275	PCA 279	PCA 280	PCA 282	PCA 283	PL 25
Number of Oil Existing Wells	0	0	0	0	0	1
Number of Oil Proposed Wells	3	5	2	2	8	0

ATTACHMENT B

Important Information

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification