EARL GREY PIT

MINE DEWATERING ASSESSMENT

REPORT

4 MTPA OPERATION

Prepared for:

Covalent Lithium Pty Ltd

Level 18, 109 St Georges Terrace

PERTH, WA 6000

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T: (+61 8) 9433 2222 **F:** (+61 8) 9433 2322 **ABN**: 97 107 493 292
P: Po Box 442, Bayswater, WA 6933

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Glossary of Terms

Aquifer	A saturated geological unit that is permeable enough to yield economic quantities of water.
Aquitard	A geological unit that is permeable enough to transmit water but not sufficient to yield economic quantities.
Aquiclude	A geological unit that is impermeable, *i.e.* cannot transmit water.
Confined Aquifer	An aquifer bounded above and below by an aquiclude, where the water level in the aquifer extends above the aquifer top and is represented by a pressure head, *i.e.* the aquifer is completely saturated.
Drawdown	The change in hydraulic head observed at a well in an aquifer, typically due to pumping.
Leaky Aquifer or Semi-Confined Aquifer	An aquifer with upper and/or lower boundaries as an aquitard, where the water level in the aquifer extends above the aquifer top and is represented by a pressure head. Pumping from the aquifer induces leakage from the neighbouring aquitard units.
Unconfined or Water table Aquifer	An aquifer that is bounded below by an aquiclude, but is not restricted on its upper boundary, which is represented by the water table.
Hydraulic Conductivity (K) [Permeability]	The volume of water that will flow in a unit time under a unit hydraulic gradient through a unit area. Analogous to the permeability with respect to fresh water (units commonly m/d or m/s).
Transmissivity (T)	The product of the hydraulic conductivity and the saturated aquifer thickness (units commonly $m^3/d/m$ or m^2/d)
Specific Storage (S_s)	The volume of water released from a unit volume of aquifer under a unit decline in hydraulic head, assuming confined aquifer conditions. Water is released because of compaction of the aquifer under effective stress and expansion of the water due to decreasing pressure (units commonly m^{-1}).
Storativity (S)	The volume of water released from a unit area of aquifer, i.e. the aquifer column, per unit decline in hydraulic head (dimensionless parameter).
Specific Yield (S_y)	The volume of water released from an unconfined aquifer per unit decline in the water table. The release of water is mostly from aquifer draining. Contributions from aquifer compaction are generally small. Analogous with effective porosity (dimensionless parameter).

Terms referenced from Kruseman GP and deRidder NA (1994) 2nd edition, Analysis and Evaluation of Pumping Test Data. ILRI Publication 47 The Netherlands

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1.0 INTRODUCTION

Covalent Lithium Pty Ltd (Covalent) manages the Mt Holland Lithium Project on behalf of joint venture partners Wesfarmers Chemicals, Energy and Fertilisers Limited (WesCEF) and Sociedad Quimica y Minera de Chile (SQM). The project is located at the abandoned Bounty gold mine, about 105 km south-south east of Southern Cross in the Eastern Goldfields Region of WA (Figure 1) and is centred around the large hard rock lithium deposit at Earl Grey. Covalent has approval to mine Earl Grey based on a 2 Mtpa, 10 year open pit operation, which is planned to commence in late 2023. Ore will be crushed and processed to produce a lithium concentrate, which will then be transported to Covalent's lithium refinery at Kwinana, located 35 km south of the Perth CBD.

Covalent are expecting global lithium demand to remain strong for some time and are looking to expand production from Mt Holland to 4 Mtpa. Covalent have begun work on the relevant approvals for the expansion that would include the Life of Mine (LoM) mining operation, which is scheduled to last for 27 years, and have engaged Groundwater Resource Management Pty Ltd. (GRM) update the mine dewatering estimate for the Earl Grey pit based on the project moving to a 4 Mtpa mining operation and 23 year mine life from Year-6.

GRM have undertaken a number of hydrogeological studies and assessments at Mt Holland since 2016 when the project was previously owned by Kidman Resources. These studies have included two previous dewatering assessments for the Earl Grey pit using three dimensional (3D) numerical groundwater flow modelling and the *MODFLOW* finite difference code with the *Groundwater Vistas* software.

This report presents the results of the updated dewatering assessment based on the latest Earl Grey mining schedule for the 4 Mtpa operation and includes:

- Review of the existing conceptual hydrogeological model for the Earl grey pit
- Review of the results from the previous hydrogeological investigations around the Earl Grey pit.
- Review of the previous *MODFLOW* modelling undertaken for the Earl Grey pit dewatering
- Development of a new *MODFLOW* groundwater flow model for Earl Grey with an expansion of the model domain to include the full 27 year mine life footprint.

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2.0 BACKGROUND

2.1 Project Description

The Earl Grey deposit comprises a large, hard rock pegmatite hosted lithium orebody, located at the site of the abandoned Bounty gold mine. Covalent plan to mine the orebody via conventional drill and blast open cut methods over a 27 year LoM. . The final pit is expected to be about 2 km long, 800 m wide and up to 340 m deep. The project is currently approved for a 2 Mtpa operation over 10 years with concentrating operations expected to commence in the latter part of 2023. The mining and concentrating operations will increase to 4 Mtpa from the latter part of 2027 subject to project approvals and final investment decision. Waste rock will be used to develop a permanent Integrated Waste Landform (IWL) to the northeast of the Earl Grey pit. The IWL will cover the legacy Twinings and Darjeeling waste dumps, and extend to the east and north with a final footprint covering an area of around 2.4 km². A portion of the mined waste rock material will also be used to:

- construct TSFs which will be developed as IWL/TSFs with an inner TSF surrounded by waste rock, as well as
- progressive backfill of the Earl Grey pit void in the later years of the operation, to help reduce the final IWL footprint as much as possible.

The ore will be crushed and processed on site to produce a spodumene concentrate. Two processing steams are planned, comprising a first stage dense media separation followed by a conventional floatation circuit. Waste from the dense media separation, made up of gravel rejects (coarse tailings), will be managed in the same way as the waste rock. Fine tailings from the floatation circuit will initially be deposited into TSF 1 which will be constructed to the eastern side of the Earl Grey pit. TSF 2 will be constructed in the early years of the operation to the west of the catchment divide, around 2 km to the northwest of the Earl Grey pit. TSF 2 will be commissioned prior to the closure of TSF 1, which is scheduled for decommissioning at the end of Year-10.

Other project infrastructure will include a refurbished and expanded airstrip at the site of the old Bounty airstrip, village, power plant, stockpile, workshops and offices and top soil stockpiles. Evaporation Ponds (EPs) to manage excess hypersaline groundwater from mine dewatering will utilise either:

- the existing Twinings/Darjeeling pit voids to the north of the Earl Grey pit, or
- be constructed within the adjacent IWL, or a combination of both.

A map showing the expanded project layout of the LoM is presented in Figure 2.

2.2 Climate

The climate in the Earl Grey project area is arid with hot dry summers and mild winter days with cool nights. Mean daytime temperatures range from 16°C in July to 35°C in July and January; and mean night-time temperatures from 4°C to 17°C also in July and January respectively.

Rainfall is predominantly associated with the winter months, related to frontal activity extending up from the Great Australian Bight. Summer rainfall is typically associated with remnant tropical cyclones, which form rain-bearing depressions that travel south after crossing the coastline in the

North West. Generally winter rainfall is more reliable but has a lower intensity. Summer rainfall, especially when resulting from cyclone activity, can be heavy and cause flooding.

Information on the nearest active weather stations to Mt Holland is provided in Table 1.

Table 1: Nearest Meteorological Stations

Station Name	Station ID	Record Duration	Station Location
Lake Carmody	10670	1905-2021	54 km southwest
King Rocks	10581	1930-2018	62 km west southwest
Mulgara	12298	1984-2018	49 km northwest

The mean monthly rainfall totals from the three weather stations are provided Table 2 below. There are no evaporation records for the nearby stations. Therefore, monthly mean pan evaporation rates were estimated using isopleths sourced from the Bureau of Meteorology (BoM), which were provided by SRK Consulting (Australasia) Pty Ltd.

Table 2: Meteorological Station Mean Monthly Rainfalls

Month	Lake Carmody	King Rocks	Mulgara	Evaporation
Jan	17.8	20.1	18.9	319
Feb	18.8	23.1	24.2	260
Mar	21.9	22.1	25.2	230
Apr	24.1	23.5	28.1	146
May	35.6	37.4	36.4	88
Jun	40.5	45.7	37.3	61
Jul	41.0	45.7	44.6	63
Aug	37.8	39.4	42.9	79
Sep	25.3	26.3	22.2	116
Oct	20.3	22.1	16.9	185
Nov	18.1	19.0	18.1	239
Dec	12.8	15.6	19.7	300
Annual	**313.7**	**344.0**	**326.6**	**2086**

2.3 Geology

Mt Holland lies in the southern part of the Southern Cross-Forrestania Greenstone Belt. The belt strikes north-northwest for over 300 km and comprises a lower ultramafic meta-volcanic sequence, overlain by clastic metasediments. The greenstones are predominantly mafic and ultramafic flows, generally intercalated with banded iron formations (BIF), cherts, and clastic sediments. Regional metamorphism is to amphibolite grade, with localised zones of annealed (retrograde) greenschist facies.

The Belt is bounded by syngeneic ovoid granite-gneiss complexes, with numerous east-west cross-cutting dolerite dykes of Proterozoic age. Major shear zones are recorded within the Forrestania Belt which separate the main lithological domains. Numerous smaller shears are recorded, parallel to and cross-cutting stratigraphy.

The banded iron formation units of the lower sequence form most of the ridges in the belt, including the Mount Holland hills which are stratigraphically thickened because of folding. The banded iron formation exists as several distinct units, up to 30 m in total thickness. The formation is interlayered with the ultramafic sequences, and it is typically these contacts which host gold mineralisation of the Mount Holland area.

The Earl Grey lithium mineralisation is hosted by three pegmatite sills which are typically 900 m wide, and dip around 15 degrees over 1,400 m of strike. The ore body extends below the previously mined out Earl Grey gold pit in the south to the old Darjeeling and Jasmine gold mine pits in the north.

2.4 Regional Hydrogeology

Regionally, the main groundwater sources in the Southern Cross Province are derived from:

- Regional catchment controlled flow systems in fresh and weathered fractured rock.
- Tertiary paleochannel sands.
- Calcrete units that commonly overlie paleochannel deposits.
- Shallow alluvium.

Paleochannel, calcrete and shallow alluvial deposits can form significant aquifers in the Southern Cross region, although the groundwater quality varies considerably with salinity tending to increase downstream along the drainage lines and with depth. The lowest salinity groundwater tends to occur beneath the catchment divides and in areas of preferential recharge (i.e. along current drainage lines where calcrete and alluvium are present). The nearest Tertiary paleochannel sediments occur to the east of the Mt Holland and comprise gypsiferous silt and sands of the Deborah Palaeovalley.

Deep weathering of the ultramafic and basaltic sequences is characteristic of the Southern Cross region, and results in a thick siliceous caprock over these units. Modest supplies of groundwater can be derived from these caprock zones where they are sufficiently fractured and saturated, such as at the Bounty borefield to the south of Mt Holland. The groundwater supplies from these types of aquifers are typically saline to hypersaline.

Fractured basement aquifers are characterised by secondary porosity and permeability, resulting in complex fracturing enhanced by chemical dissolution. Small quantities of potable water are known to occur in fractures within granite outcrops in the Southern Cross Province. These supplies are typically modest, because of the limited exposure of granite and low recharge potential.

2.5 Mt Holland Area Hydrogeology

The Mt Holland project is located within the north-south trending Forrestania Greenstone Belt, on the eastern side of the local catchment divide. Fractured rock aquifers are the dominant aquifer types in the project area and are commonly heterogeneous with variable aquifer properties. The Earl Grey lithium deposit is hosted in a low to very-low permeability aquifer, with previous test work identifying zones of moderately higher permeability along some of the north striking local faults and shears, as well as cross cutting structures.

Aquifer water levels in the Earl Grey pit area are around 65 to 70 mbgl, and mostly below the base of the weathering profile. Minimal groundwater level data is available outside the current project area. However, it is likely that east of the local catchment divide, the groundwater flow direction is to the east and southeast towards the Deborah Palaeovalley.

Numerous northerly and east-north-easterly trending dolerite dyke sets intrude the greenstone belt. Previous hydrogeological drilling (GRM, 2017) indicate that these dykes mostly form aquitards in the project area and alter the groundwater flow directions locally. These dykes could also contribute to the development of high hydraulic gradients around the Earl Grey pit as it dewaters.

Groundwater quality regionally as well as locally is mostly hypersaline. In the Earl Grey pit area however, water quality can vary from brackish to hypersaline, with drilling and airlift testing identifying discrete areas of lower salinity groundwater, probably resulting from localised recharge around the margins of some dolerite dykes and along permeable faults. Away from recharge areas, the groundwater becomes rapidly hypersaline reaching in excess of 100,000 mg/L Total Dissolved Solids (TDS) in the main palaeochannel drainages. A hydrogeological map of the local project area is shown in Figure 3.

3.0 PREVIOUS MINE DEWATERING STUDIES

Several hydrogeological investigations in the Earl Grey deposit area were undertaken by GRM as part of earlier studies (GRM, 2017) and included the following:

- A field programme comprising airlift testing on 14 selected resource drill-holes was carried out in February 2017 to characterise the groundwater conditions and provide preliminary hydraulic conductivity estimates.
- A hydrogeological drilling and testing programme completed in October 2017, involving the drilling and installation of nine monitoring bores, and the small-scale testing of the five higher yielding bores. The drilling targeted structural features in the vicinity of the Earl Grey deposit, including faults and shears around the pit perimeter. The programme aims included:
  - further characterisation of the groundwater system associated with the deposit,
  - assessment of likely yields from potential fractured rock aquifers, better estimation of aquifer properties (hydraulic conductivity and aquifer storage), and
  - collection of groundwater samples for hydrochemical analysis.
- Development of conceptual hydrogeological and numerical groundwater flow models for the Earl Grey deposit to estimate dewatering rates during mining and impacts upon the surrounding groundwater environment.

The results from the investigation drilling are summarised in Table 3 and shown spatially on the map in in Figure 4. Results of RC airlift-testing which are summarised in the earlier study (GRM,2017) but also shown spatially on the map in Figure 4. These results indicate the Earl Grey deposit is characterised by generally very low to low permeability conditions. The highest airlift yield was 3.9L/s from RC hole KEGR098 appears to align with the Mid-Eastern shear zone and so is likely structurally related. Investigation holes drilled on the northern side of dolerite dykes, along the Mt Holland shear and within metasediments generally had low airlift yields or were dry.

Table 3:- Earl Grey Investigation Drilling Summary Results

Bore ID	mE (MGA94 Zn50)	mN (MGA94 Zn50)	Maximum Airlift Yield (L/s)	Field EC (mS/cm)	SWL (mbtoc)	Mean K (m/d)	Storativity
EGH01	759,103	6,446,661	0.8	16.2	72.51	4.50E-03	1.00E-03
EGH02	759,104	6,446,246	~0.1	140	70.53		
EGH03	759,099	6,445,654	Dry	90	86.1		
EGH04	759,692	6,445,712	Dry	100	99.59		
EGH05	759,404	6,446,772	0.4	12	69.53	4.14E-02	NA
EGH06	759,056	6,447,108	~0.2	NA	69.25		
EGH07	759,854	6,446,612	0.5	19	63.46	3.84E-02	1.00E-03
EGH08	759,949	6,447,007	1.2	95	65.79	5.89E-02	NA
EGH09	760,078	6,446,341	1	47	65.95	9.00E-04	6.00E-09

Notes: EC=electrical conductivity, K=hydraulic conductivity, mbtoc=metres below top of casing, NA=not applicable.

Groundwater samples collected from the five higher yielding monitoring bores were submitted for laboratory analysis. The water quality results, which are summarised in Table 4, indicate variable hydrochemistry across the deposit, with salinities ranging from brackish (7,640 mg/L Total Dissolved Solids – TDS) to hypersaline (88,900 mg/L TDS). All groundwaters were of sodium chloride type with a circum neutral to slightly alkaline pH and extremely hard.

Table 4:- Earl Grey Water Quality Results

Analyte	Unit	LoD	Sample ID [Sampling Date]				
			EGH01	EGH05	EGH07	EGH08	EGH09
pH Value	pH Unit	0.01	7.49	8.16	8.08	7.23	7.75
Electrical Conductivity @ 25°C	µS/cm	1	17,000	11,100	26,300	90,800	51,600
Total Dissolved Solids @180°C	mg/L	10	12,300	7,640	19,500	88,900	43,800
Hydroxide Alkalinity ($CaCO_3$)	mg/L	1	<1	<1	<1	<1	<1
Carbonate Alkalinity ($CaCO_3$)	mg/L	1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity ($CaCO_3$)	mg/L	1	78	218	291	145	280
Total Alkalinity $CaCO_3$)	mg/L	1	78	218	291	145	280
Silicon as SiO_2 (dissolved)	mg/L	0.1	33.4	36.2	31.4	30.3	21.2
Silicon (dissolved)	mg/L	0.05	15.6	16.9	14.6	14.1	9.91
Sulphate as SO_4	mg/L	1	1,220	1,290	1,620	3,830	2,520
Chloride	mg/L	1	5,790	3,620	9,380	41,200	19,700
Calcium	mg/L	1	367	52	200	1860	794
Magnesium	mg/L	1	548	245	965	5,420	2,560
Sodium	mg/L	1	2,660	2,230	4,190	15,900	8,830
Potassium	mg/L	1	92	84	156	481	280
Total Hardness as $CaCO_3$	mg/L	1	3,170	1,140	4,470	27,000	12,500
Fluoride	mg/L	0.1	0.4	0.8	0.6	0.1	0.1
Ammonium as N	mg/L	0.01	0.15	0.07	0.04	0.79	0.45
Nitrite as N	mg/L	0.01	<0.01	<0.01	0.01	<0.01	<0.01
Nitrate as NO_3	mg/L	0.01	<0.01	0.09	0.13	<0.01	0.18
Reactive Phosphate	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Anions	meq/L	0.01	190	133	304	1240	614
Total Cations	meq/L	0.01	181	122	276	1,240	642
Ionic Balance	%	0.01	2.37	4.48	4.91	0.08	2.21
Metals (field filtered- 45µm)							
Barium	mg/L	0.001	0.075	0.012	0.024	0.127	0.118

Analyte	Unit	LoD	Sample ID [Sampling Date]				
			EGH01	EGH05	EGH07	EGH08	EGH09
Strontium	mg/L	0.001	1.09	0.298	0.908	12.7	4.14
Vanadium	mg/L	0.01	0.07	0.03	<0.05	0.10	0.20
Boron	mg/L	0.05	1.00	1.20	1.67	2.05	1.91
Iron	mg/L	0.001	4.42	<0.05	<0.25	7.51	0.63

Notes: LoD=Limit of Detection.

3.1 Pit Inflow Estimates

Three previous dewatering estimates were undertaken by GRM for the Earl Grey pit using the three dimensional (3D) *MODFLOW* finite difference code with the *Groundwater Vistas* software. These comprised:

- An initial estimate undertaken in 2017 as part of the original hydrogeological feasibility studies (GRM,2017); which estimated a maximum inflow rate of around 12 L/s in the final year of a Stage-5, 12-Year mining operation. The footprint of the 12-Year pit covered around a third of the lithium orebody.
- A second dewatering estimate was undertaken in September 2019 based on a 2 Mtpa operation using a then updated Stage-6, 12-Year pit design (GRM,2019a). The model predicted that peak groundwater inflows would reach 10 to 15L/s at the end of Year-12, with the drawdown impact in the local aquifer extending up to around 400m from the pit boundary.
- A third dewatering estimate was undertaken in November 2019 based on a Stage-8, 15-Year mine plan to align with the mining proposal submission (GRM,2019b). The model predicted that pit inflows would range between 10 and 15 L/s from Year-6 to Year-12, and potentially increase to around 18 L/s from Year-13 to Year-15. The results were based on a conceptual hydrogeological model which assigned a higher permeability fracture zone along the southern side of the west-east striking, central dolerite dyke.

4.0 CONCEPTUAL HYDROGEOLOGICAL MODEL

The conceptual hydrogeological model for the Earl Grey pit area developed by GRM was reviewed based on updated geological surfaces, structural models and geotechnical information developed since the previous groundwater modelling was undertaken in 2019. The results of the review does not change the existing conceptual model significantly, and is still based around three main hydrostratigraphic units (HSUs), all three of which are considered either minor aquifers or aquitards and comprise;

- Saprock (HSU1); - partially saturated, clayey, low permeability transition rock between the weathered clay saprolite and the lower fresh bedrock, which acts as a minor aquifer and thought to be around 15 m thick on average.
- Fresh bedrock (HSU2): - comprising fresh, mafic, ultramafic, schists and other units, with minor fractures and low to very low permeability and storage, which overall acts as an aquitard
- Fractured bedrock (HSU3): - mostly thought to now be associated with the three main north striking faults and shear zones which are shown on the map in Figure 4, and are summarised as follows:
  - Mt Holland Shear, located on the western side of the Earl Grey pit which is indicated to have fairly negligible permeability except to the north of the Twinings-Darjeeling pits.
  - Mid-Western Shear, which runs through the Earl Grey expansion pit. This structure is indicated to have moderate permeability to the north of the central dolerite dyke, and negligible permeability on the southern side of the dyke.
  - Mid-Eastern Shear, located on the eastern side of the expansion pit is thought to have moderate permeability associated with it, at least north of the central dyke. South of the dyke, permeabilities along it are probably low. However, a parallel feature identified in hydrogeological drilling to the east is indicated to have some moderate permeability.

A moderately thick 30 to 50m clay saprolite profile is also developed in the Earl Grey pit area, but due to the deep water table (around 65 to 70 mbgl), this unit is largely unsaturated and therefore not considered a hydrostratigraphic unit. The margins of the southern dolerite dyke are thought to have very low permeability, as seen in bores EGH03 and EGH04 which were dry. Reinterpreted drilling results from around the central dolerite dyke, also indicate its margins have low to very low permeability.

No significant groundwater recharge or discharge zones are thought to exist in the Earl Grey pit area. Groundwater velocities will likely be very low, due to the low hydraulic gradients and the low permeabilities of the hydrostratigraphic units. Groundwater inflow to any large-scale excavation would therefore be mostly from aquifer storage . A schematic representation of the conceptual hydrogeology in the Earl Grey pit area is shown in Figure 5.

5.0 NUMERICAL FLOW MODELLING

A new numerical groundwater flow model was developed for the Earl Grey pit area to estimate the dewatering rates required in order to maintain dry conditions for the expanded Earl Grey pit and 4 Mtpa operation. The expanded model was developed from the results of a review of the *MODFLOW* groundwater models previously developed for the Earl Grey dewatering, which included a reinterpretation of some aquifer units. The new groundwater flow model will also be used to assess drawdown impacts on the local groundwater system from dewatering. The groundwater model constructed has an active area of 25.8 km² and was developed through the following stages:-

- A steady state model was initially developed representing the pre-mining groundwater conditions, which was calibrated to the available open file and project hydrogeological data including previous drilling and testing results and the latest geological and structural interpretations .
- The steady state model was then run dynamically to estimate the dewatering rates during mining and the resulting drawdown extents, based on the 4 Mtpa mine schedule provided by Covalent.

5.1 Model Design

The model was developed using the *Groundwater Vistas version 8.16 (Build 18)* software (ESI). Groundwater Vistas is a commercially available front-end for the *MODFLOW* range of model engines. *MODFLOW* is a 3- dimensional (3D) finite-difference groundwater modelling software and is used extensively throughout the world for groundwater simulations.

The model grid comprises 154 rows and 102 columns with grid cell dimensions of 100 by 100 m along the outer edges of the model, reducing to 25 by 25 m in the mining area with a total of 56,528 active cells over four layers. A map showing the active model grid is presented in Figure 6.

The three HSUs are contained within model layers 2 to 4 with Layer 1 mostly unsaturated and assigned a low permeability and an average thickness of 45 m . All of the fractured rock aquifers (HSU3s) are contained within Layers 2 and 3 which are assumed to extend to a maximum depth of 120 m below topography, as inferred from the previous hydrogeological drilling results.

5.2 Model Settings

The *MODFLOW-SURFACT* (in preference to the *MODFLOW2000*) numerical engine was used in the groundwater modelling as it uses a much faster (PCG5) solver and implements partially saturated flow which can more accurately estimate the unconfined groundwater level. *MODFLOW-SURFACT* is also better able to model steep hydraulic gradients when dewatering in low permeability and fractured rock environments such as those that exist in the Earl Grey pit area.

The predictive model (*J2308_Earl Grey 4Mtpa.gwv*) comprises 27 stress periods, with the individual stress period lengths set at yearly intervals, using 18 time-steps per stress period and a timestep multiplier of 1.2. The *MODFLOW-SURFACT* engine ran the *PCG5* solver with a head change criterion set at 0.03 and the Newton- Raphson Linearisation active with a Backtracking factor of 0.9 to prevent convergence issues developing with the steep hydraulic gradients that develop around the pit margin. The mining schedule comprised a 27-year mine life starting in late 2023 and finishing in late 2051.

5.3 Steady State Calibration

A total of 507 Constant Head cells were assigned around the model boundary as part of the steady state calibration to the groundwater level data, these constant head values were assigned as follows:

- A line with heads values set at 384 mAHD from north to south on the western side of the model along the catchment divide.
- Separate lines of constant heads along the northern and southern model boundaries with head values were set within a tapering range from 384 mAHD to 365 mAHD along the southern model boundary from west to east, and from 384 mAHD to 360 mAHD along the northern boundary of the model also from west to east.
- Along the eastern side of the model the constant head values ranged from 360 mAHD in the north to 365 mAHD in the south.

All of the constant head cells were allocated based on the layer elevations and so fell within Layers 2 and 3. Steady state inflows to the model from the constant heads during calibration were found to be about 16 m^3/d. This value roughly equates to a recharge rate of around 1% or less of the average annual rainfall if it is assumed that most of the recharge occurs:

- in a restricted zone along the catchment divide, as well as
- along the margins of the main dolerite dykes, and
- from incident rainfall into the existing pit voids that lie within the model domain.

A recharge rate of 1% or less of rainfall is generally considered fairly typical for the goldfields region.

5.4 Model Parameters

The model parameters were derived from analysis of the previous drilling and testing results as well as previous modelling and published data for similar lithologies. These parameters were refined during model calibration with a summary of the adopted model parameters for the Base Case simulation provided in Table 5.

Table 5:- Base Case Model Parameters

Layer	Zone	Description	Hydraulic Conductivity (m/d)		Specific Storage (m^{-1})	Specific Yield (%)
			Kh	Kv	Ss	Sy
1	1	Clay saprolite, laterite and colluvium (unsaturated)	0.01	0.01	Unconfined	1
2	2	HSU1:- saprock zone; weathered and fractured bedrock and clay	0.02	0.02	6.7 x 10^{-5}	1
3-4	3	HSU2:- fresh, massive bedrock, weakly fractured and jointed	0.001	0.001	5 x 10^{-6}	1
2&3	4	HSU3:- fracture zone aquifers along local shears; low to moderate permeability and storage	0.1	0.1	1.7 x 10^{-6}	1

5.5 Sensitivity Analysis

The groundwater investigations and previous studies undertaken to date indicate the hydrogeological environment in the Earl Grey area is one of generally low to very low permeability and storage with low rates of recharge. Although some hydrogeological testing has previously been undertaken north of the old Earl Grey pit, the main shear zones in the northern area remain largely untested (Figure 4).

To better understand the uncertainties within the hydrogeological test data, two sensitivity runs were undertaken which involved adjusting key aquifer parameters. The two sensitivity runs comprised separate upper and lower bound cases which were:

- Upper Bound Case:- Increasing the hydraulic conductivity (Kh and Kv) in the fracture zone aquifers (HSU3) by half an order of magnitude to 0.5 m/d.
- Lower Bound Case:- Reducing the specific yield (Sy) in the fresh bedrock (HSU2) by half to 0.5%.

For the sensitivity runs all other hydraulic parameters were not altered from the base case settings.

5.6 TSF Operation

The groundwater modelling also attempts to include potential seepage from the operation of TSF 1, located east of the Earl Grey pit. TSF 1 is planned to operate for 10 years before being decommissioned. From the end of Year-10 it is understood all tailings will then report to TSF 2, located around 2 km to the northwest of the Earl Grey pit, which is outside the model domain, so only the seepage from TSF 1 is accounted for in the model simulations at this stage.

Seepage is simulated using *MODFLOW's* recharge package, with recharge applied only to the top layer. The recharge flux, or in effect, the seepage rate applied was 4.51 x 10^{-4} m/d which was calculated using the footprint area of TSF 1 supplied by Covalent and the seepage rate estimated by Coffey Services Australia in their IWL/TSF design report (Coffey,2021).

For the purposes of the Part IV assessment, it is reasonable to assume that seepage rates for the proposed TSF 2 might be similar in magnitude to that adopted in the TSF 1 modelling. However, even if the seepage rates are similar, mounding in the groundwater table around TSF 2 may prove to be greater than that predicted by the model for the TSF 1 area, as the the Earl Grey pit acts as a local groundwater sink during mining, thereby drawing some seepage westward from TSF 1. No such sink is active around TSF 2.

However, at the end of the operation of TSF 1 in Year 10 and on the eastern (downgradient) side away from the Earl Grey pit, water table mounding is predicted by the model to get to around 14m on the eastern side of TSF 1, with the 1m mounding contour extending to around 700 m to the east of the TSF 1 perimeter. Groundwater mounding could potentially be of similar magnitude around TSF 2 at the EoM. However it should be noted that only minimal hydrogeological data is available for the TSF 2 area and more detailed hydrogeological data, including investigation drilling and testing should be collected to inform any extension of the groundwater model domain to cover the TSF 2 area.

5.7 Mine Dewatering Estimates

Mine dewatering was simulated using *MODFLOW's* drain package, which allows flow out of the model domain based upon a drain cell head elevation and a conductance term. The drain cells were applied over the footprint of the Earl Grey pit within each layer based on the stage developments. The drain cell head, which is equivalent to the elevation of the mine groundwater level, was adjusted at each stress period to simulate dewatering of the pit. A total of 1991 drain cells were applied over the four model layers to simulate the pit dewatering over the 27 year mine life.

Time series graphs of the modelled mine dewatering rates are provided in Figures 7 for the Base Case simulation and Figure 8 for the sensitivity analysis with the Upper and Lower Bound Cases.

The results indicate that

- Groundwater inflows to the Earl Grey pit are not likely to become apparent until around the end of Year – 1 when minor flows of 1-2L/s could be expected.
- Pit inflows will be fairly modest across the life of the mine from an initial 1 to 2 L/s, building to a peak of around 12 L/s in Year-18, reducing to around 6 L/s at the end of mining.
- The peak groundwater inflow rates are indicated to occur from Year-17 to Year-22 and be around 10 to 12L/s. The higher flows occur as development deepens on the northern side of the central dolerite dyke and the permeable sections of the Mid-Eastern and Mid-Western shears are mined through.
- The sensitivity analysis indicates that:
    - inflows could increase to around 12 to 14 L/s if higher permeabilities are encountered along the main shear zones.
    - If the storage in the bedrock is lower than expected then pit inflows could be marginally lower overall compared to the Base Case estimate, and from Year-22 to the end of mining could reduce to around 6 L/s or so.

Overall, the groundwater inflow estimates are inline with predictions from previous modelling, in spite the increase in the mining rate to 4 Mtpa. This is due to the overall low to very low permeability and low storage nature of the local groundwater system, the deep water table and low aquifer recharge.

It should be noted that the results of the dewatering estimate assume the following:

- No ex-pit bores are installed to assist with the mine dewatering. Given the low permeability environment and low dewatering rates, ex-pit dewatering bores would likely not be particularly effective due to the probably low pumping rates and the uncertainty in targeting dewatering bores effectively.
- The estimated pit dewatering rates do not take evaporation into account, which is more than five times the average annual rainfall in the Mt Holland area (Table 2). As the Earl Grey pit develops and the excavation footprint becomes increasingly large, the high evaporation rates may reduce the groundwater inflows reporting to the inpit sumps from those estimated in the modelling.
- All pit crest and flood diversion bunding is in place during the mining such that surface water runoff into the pit is minimal.

5.8 Drawdown Impacts

Mine dewatering will cause a cone of depression in the local groundwater table which will propagate outward over time from the Earl Grey pit. A map showing the predicted End of Mine (EoM) drawdown and mounding extent at the end of Year - 27 is provided in Figure 9, with a map showing the predicted groundwater level in mRL at the EoM presented in Figure 10. A map showing the groundwater level in mRL at the end of Year-10, just as the TSF 1 is decommissioned is shown in Figure 11. The maps show the following:

- At the EoM an elliptical drawdown cone will have developed centring on the northern side of the Earl Grey pit with the 1 m drawdown contour potentially extending to around 2 km to the north and south, and around 1.5 km to the west.
- Residual mounding in the water table as a result of seepage from TSF 1 is modelled to still be up to around 10 m or so above pre-mining water levels at the EoM. This is likely due in part to the slow migration of seepage to the water table through the large unsaturated zone below TSF 1.
- The residual 1 m mounding contour in the local groundwater table at the EoM could extend to around 1.5 km to the north and south of the TSF 1, and to around 1 km to the east.
- Steep hydraulic gradients could develop between the eastern side of the Earl Grey pit and TSF 1 potentially effecting pit wall stability. The impacts of this should be reviewed by Covalent's geotechnical engineer.

6.0 SUMMARY AND CONCLUSIONS

Covalent Lithium are undertaking work on the relevant approvals for the Mt Holland expansion and engaged GRM to update the mine dewatering estimate for the Earl Grey pit based on the project moving to a 4 Mtpa mining operation and 27 year LoM.

The Mt Holland project is located within the north-south trending Forrestania Greenstone Belt, on the eastern side of a local catchment divide. Fractured rock aquifers are the dominant aquifer types in the project area and are commonly heterogeneous with variable aquifer properties. The Earl Grey lithium deposit is hosted in a low to very-low permeability aquifer, with previous test work identifying zones of moderately higher permeability along some of the north striking local faults and shears, as well as cross cutting structures.

Three previous dewatering estimates were undertaken by GRM for the Earl Grey pit using the three dimensional (3D) *MODFLOW* finite difference code with the *Groundwater Vistas* software. The results from these estimates predicted that peak groundwater inflows could range between 12 and 18 L/s. Results of a review of the conceptual hydrogeological model for the Earl Grey pit area did not change the existing understanding significantly, which is still based around three main hydrostratigraphic units, all three of which are considered either minor aquifers or aquitards.

Results of the updated modelling for the 4 Mtpa mine expansion found:

- Groundwater inflows to the Earl Grey pit are not likely to become apparent until around the end of Year – 1 when minor flows of 1-2 L/s could be expected.
- Pit inflows will be fairly modest across the life of the expanded mining operation, from an initial 1 to 2 L/s, building to a peak of around 12 L/s in Year-18, reducing to around 6 L/s at the end of mining.
- The peak groundwater inflow rates are indicated to occur from Year-17 to Year-22 and be around 10 to 12L/s. The higher peak flows could occur as development deepens on the northern side of the central dolerite dyke and the permeable sections of the Mid-Eastern and Mid-Western shears are mined through, although additional hydrogeological investigation would be required in the northern pit area to confirm this.
- At the EoM an elliptical drawdown cone will potentially have developed centring on the northern side of the Earl Grey pit with the 1 m drawdown contour extending to around 2 km to the north and south, and around 1.5 km to the west.
- The residual 1 m mounding contour in the local groundwater table at the EoM could extend to around 1.5 km to the north and south of the TSF 1, and to around 1 km to the east.
- Steep hydraulic gradients could develop between the eastern side of the Earl Grey pit and TSF 1 potentially effecting pit wall stability.

6.1 Recommendations

From the results of the modelling study a number of recommendation are made to address data gaps in the hydrogeological understanding of the project area. These are summarised as follows:

- Although some hydrogeological testing has previously been undertaken north of the old Earl Grey pit, the main shear zones in the northern area remain largely untested. Therefore additional hydrogeological drilling and testing would be required to confirm the nature of permeabilities along the Mid-Eastern, Mid-Western and Mt holland shear zones north of the central dyke.

- There is a risk of steep hydraulic gradients developing between the eastern side of the Earl Grey pit and TSF 1, which may potentially effect pit wall stability in the medium term. Covalent's geotechnical engineering consultant should be made aware of these risks and it is recommended that GRM liaise with them to provide advice for the targeting and installation of a series of vibrating wire piezometers (VWPs) to monitor pore pressures along the eastern pit batters.

Signatures

Groundwater Resource Management Pty Ltd

Peter Mayers

PRINCIPAL HYDROGEOLOGIST

Doc Ref: J2308R01

REFERENCES

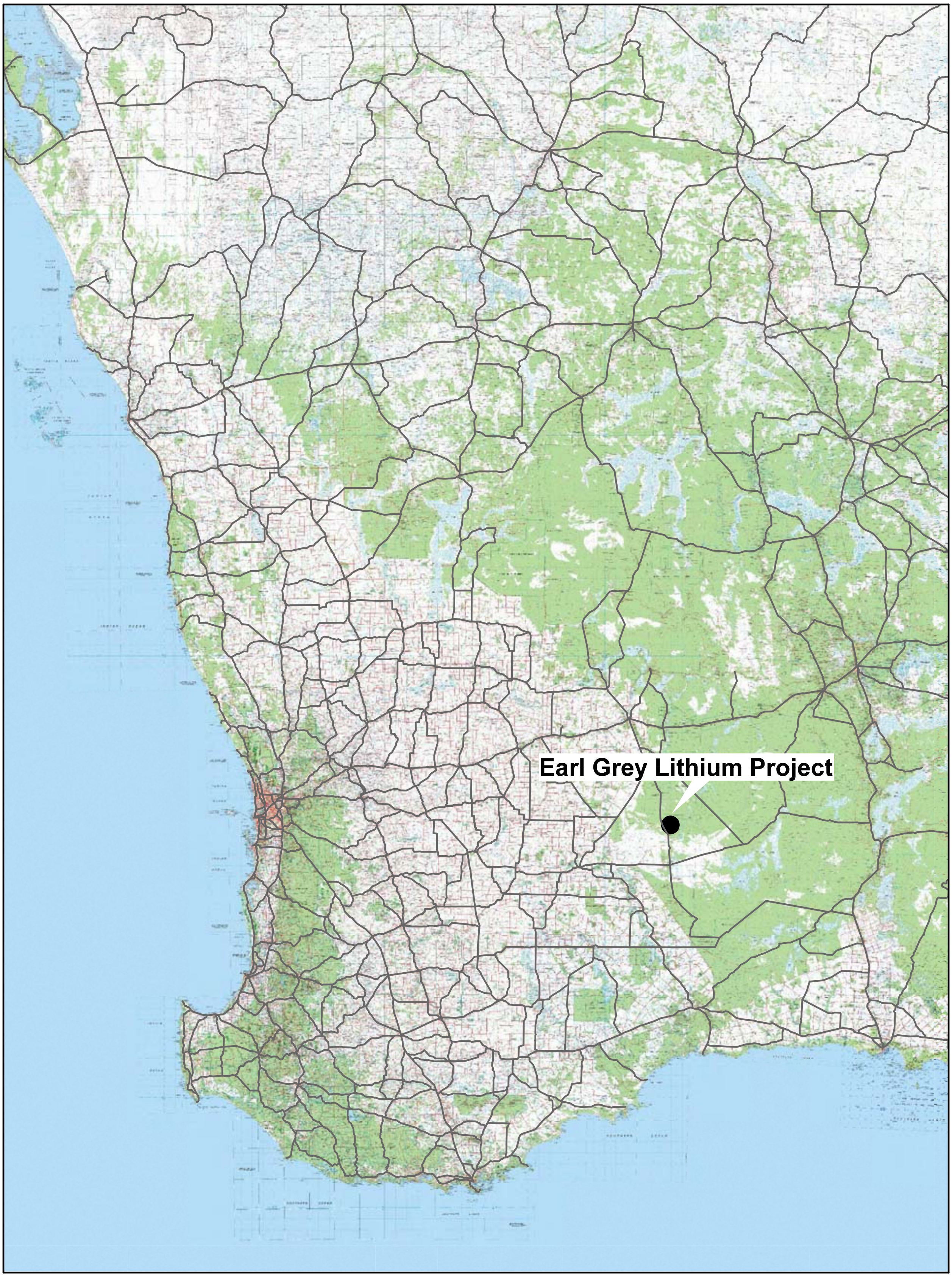
Coffey, 2021; Mt Holland Lithium Project IWL/TSF Design Report. Unpublished Engineering Report 754-PERGE276922 for Covalent Lithium Limited.

GRM, 2017; Mount Holland Lithium Project Hydrogeological Study December 2017. Unpublished hydrogeological report J160015R01 for Kidman Resources Limited.

GRM, 2019a; Groundwater Flow Model Review. Unpublished technical memorandum J1920M02 to Covalent Lithium Limited. September 2019.

GRM, 2019b; Earl Grey Stage 8 Pit Groundwater Model Update and Legacy Pit Lake Storage Review. Unpublished technical memorandum to Covalent Lithium. November 2019.

FIGURES



NOT TO SCALE

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 1
MT HOLLAND
PROJECT LOCATION

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Coordinate System
NA
Notes

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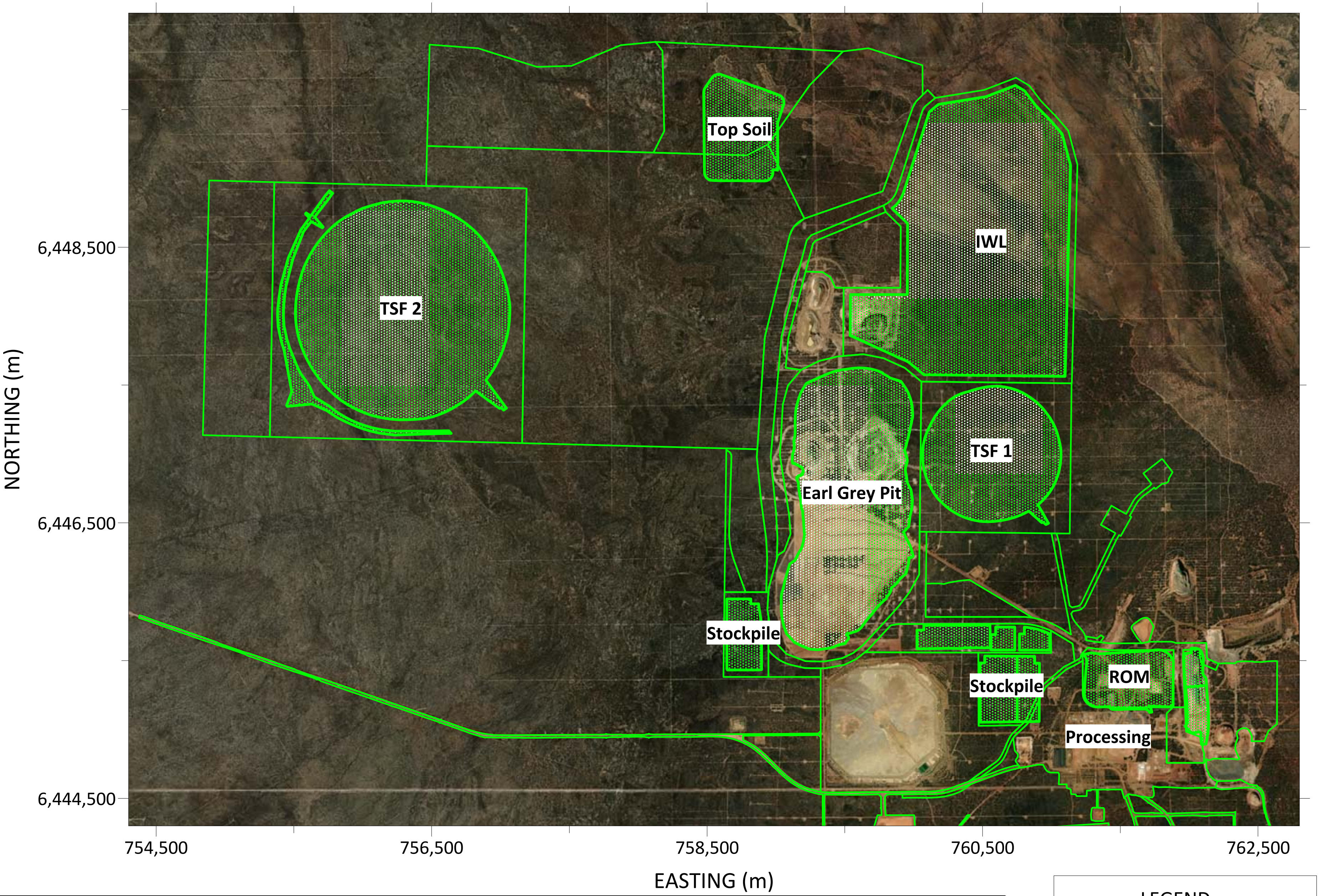

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 2
PROJECT LAYOUT

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Coordinate System
GDA94 Zone 51

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LEGEND

Project envelope

Infrastructure

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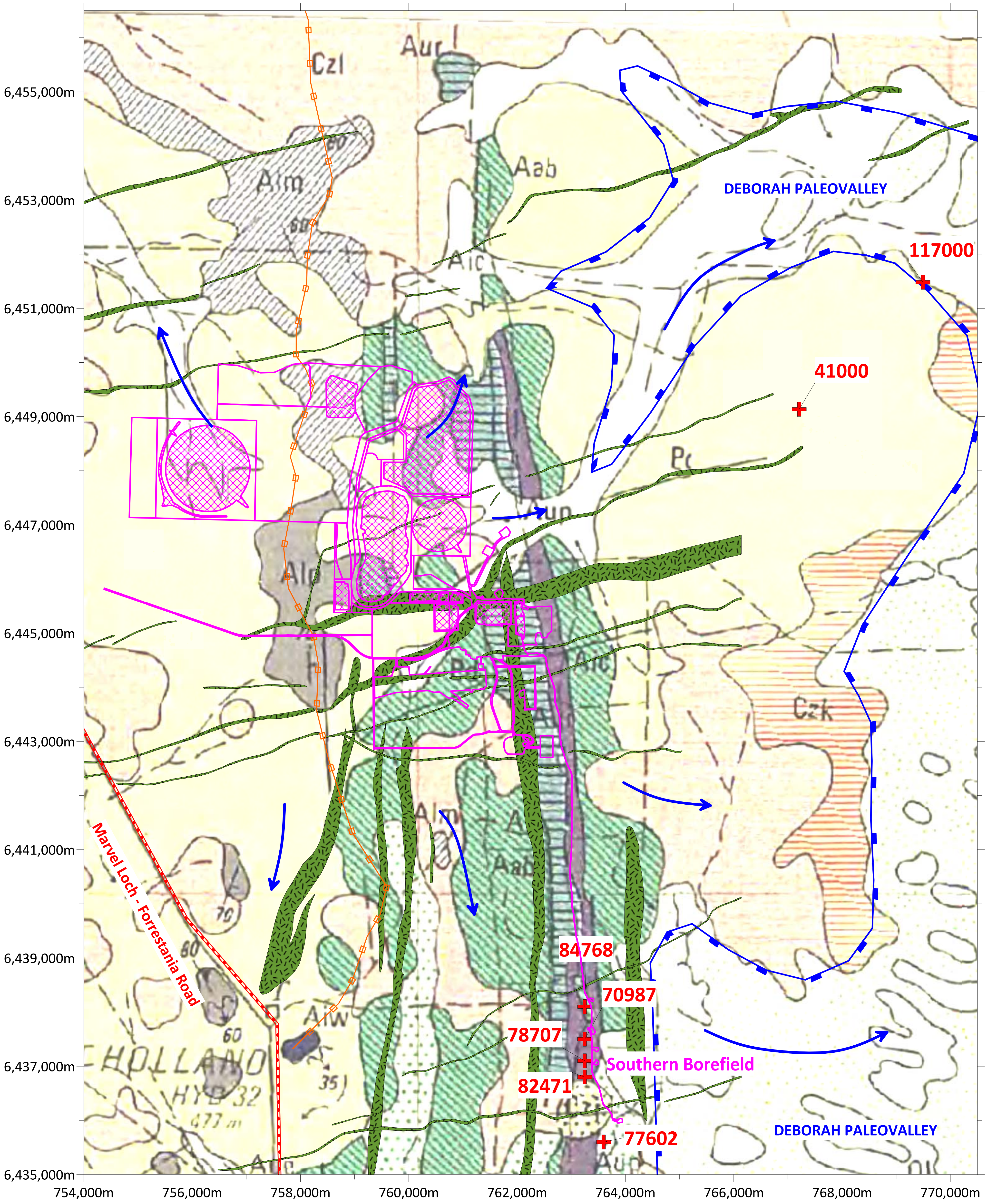

LEGEND

Infrastructure Footprint	Dolerite Dyke	Paleovalley Boundary (Interpreted)
Regional Roads	Amphibolite & Metabasalt	WIR Bore (with salinity TDS) 70987
Catchment Divide	Schist - Schist and Quartzite	Groundwater Flow Drection

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 3
MT HOLLAND HYDROGEOLOGY

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Coordinate System
GDA94 Zone 50

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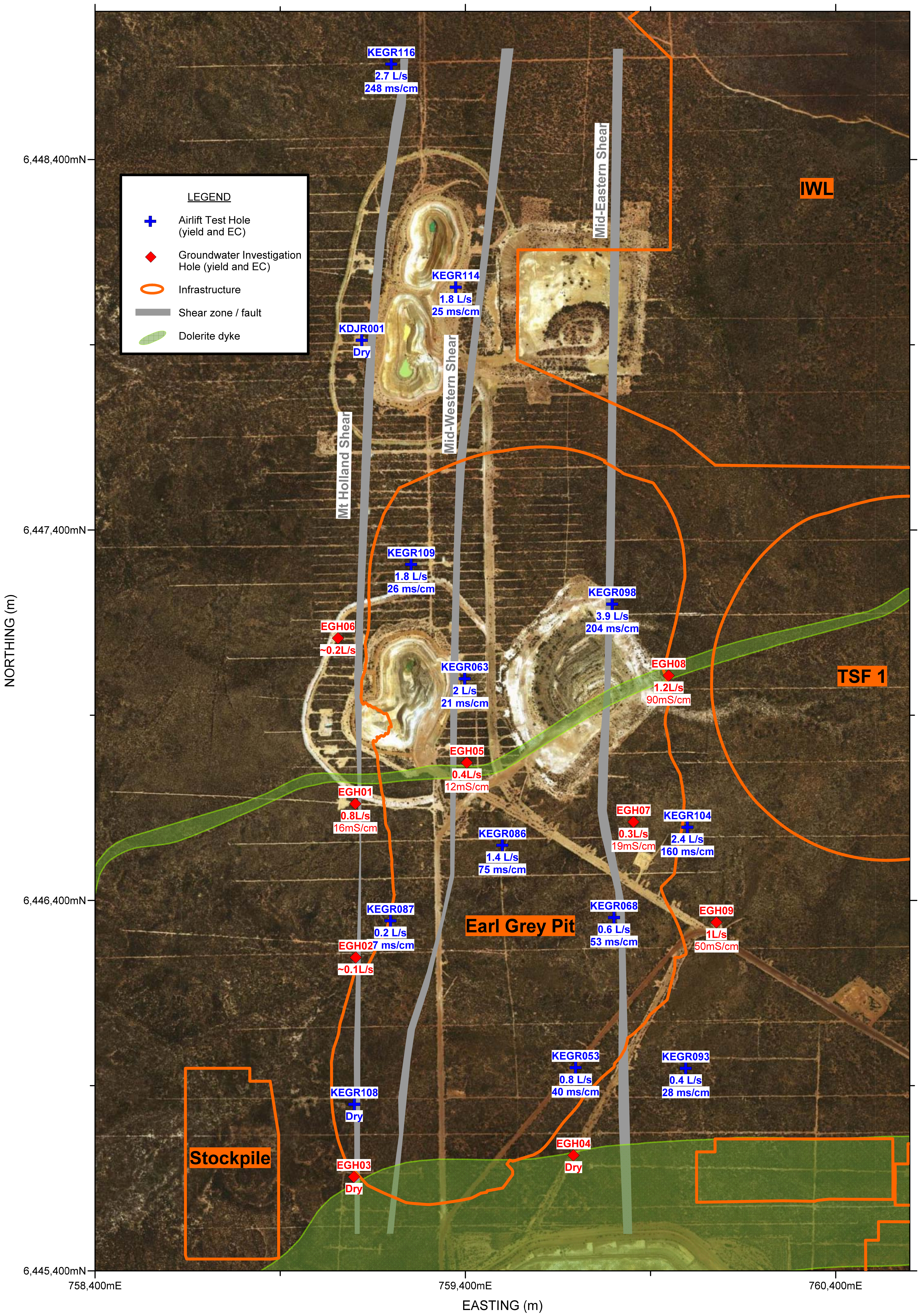

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 4
EARL GREY
FIELD INVESTIGATION
RESULTS 2017

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Coordinate System
GDA 94 Zone 50

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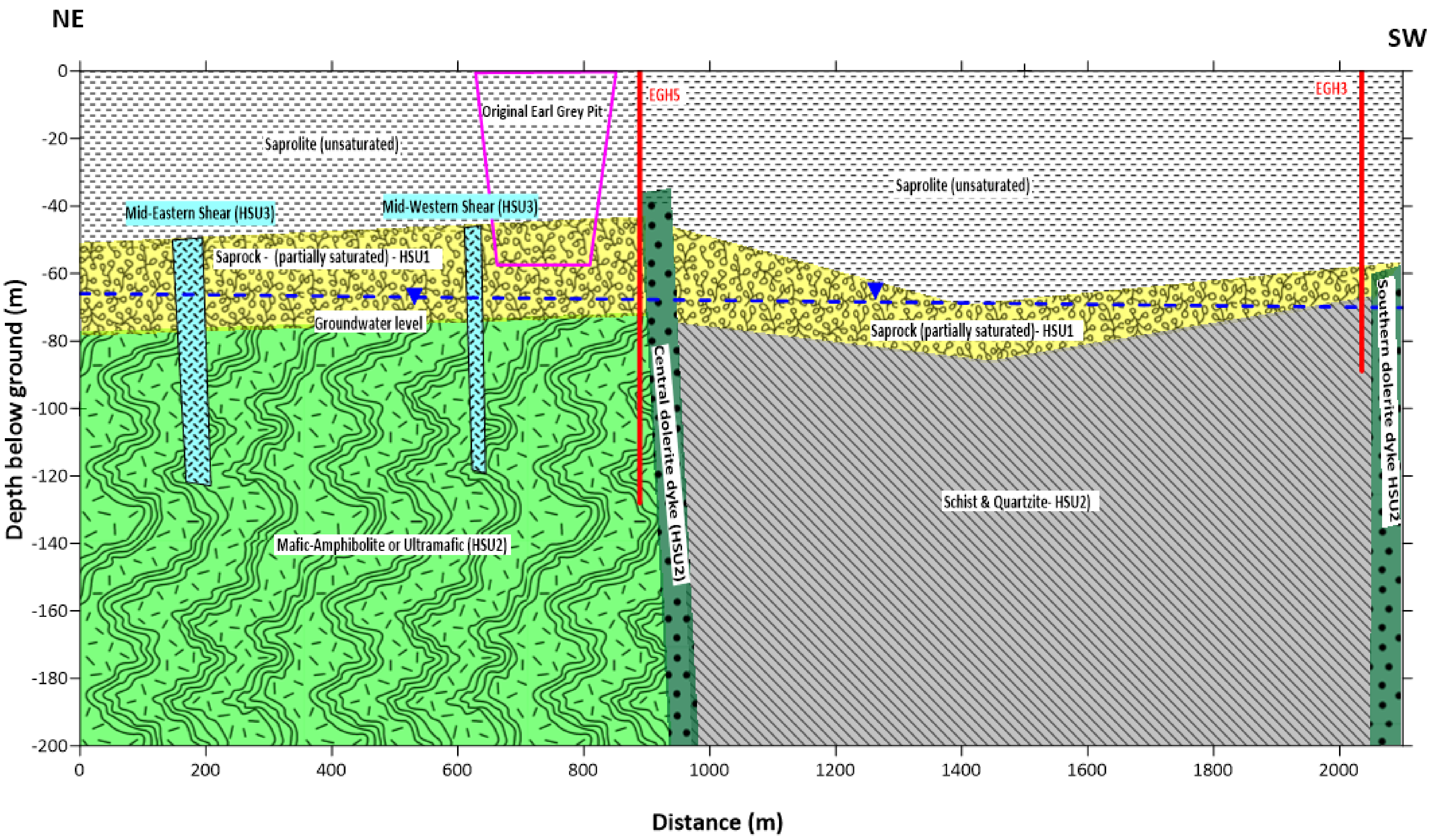

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 5
EARL GREY AREA CONCEPTUAL HYDROGEOLOGICAL MODEL

Date Jun 23
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Project Mt Holland Expansion
Document J2308R01

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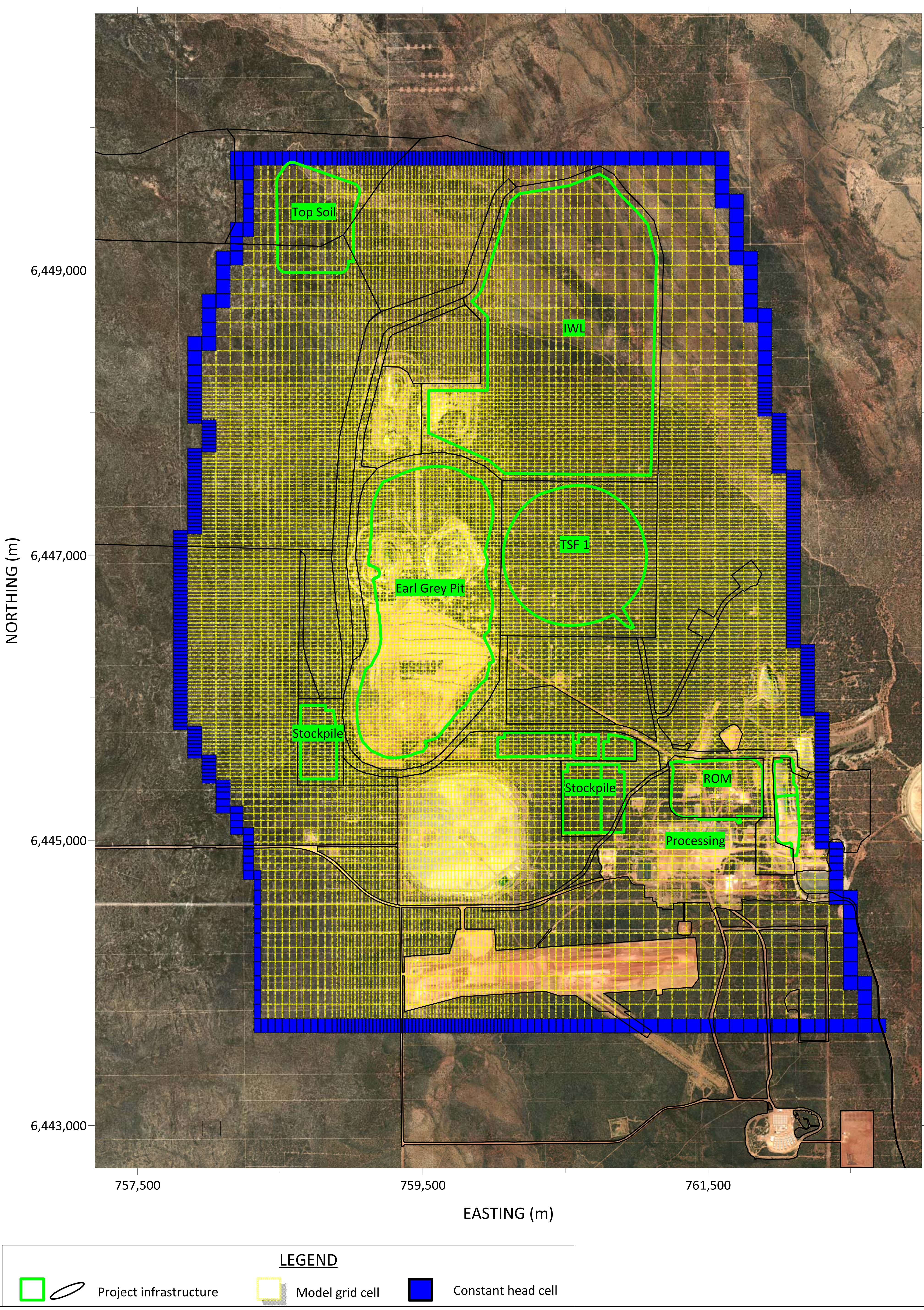

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 6
NUMERICAL MODEL GRID

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2208R01

Coordinate System
GDA94 Zone 50

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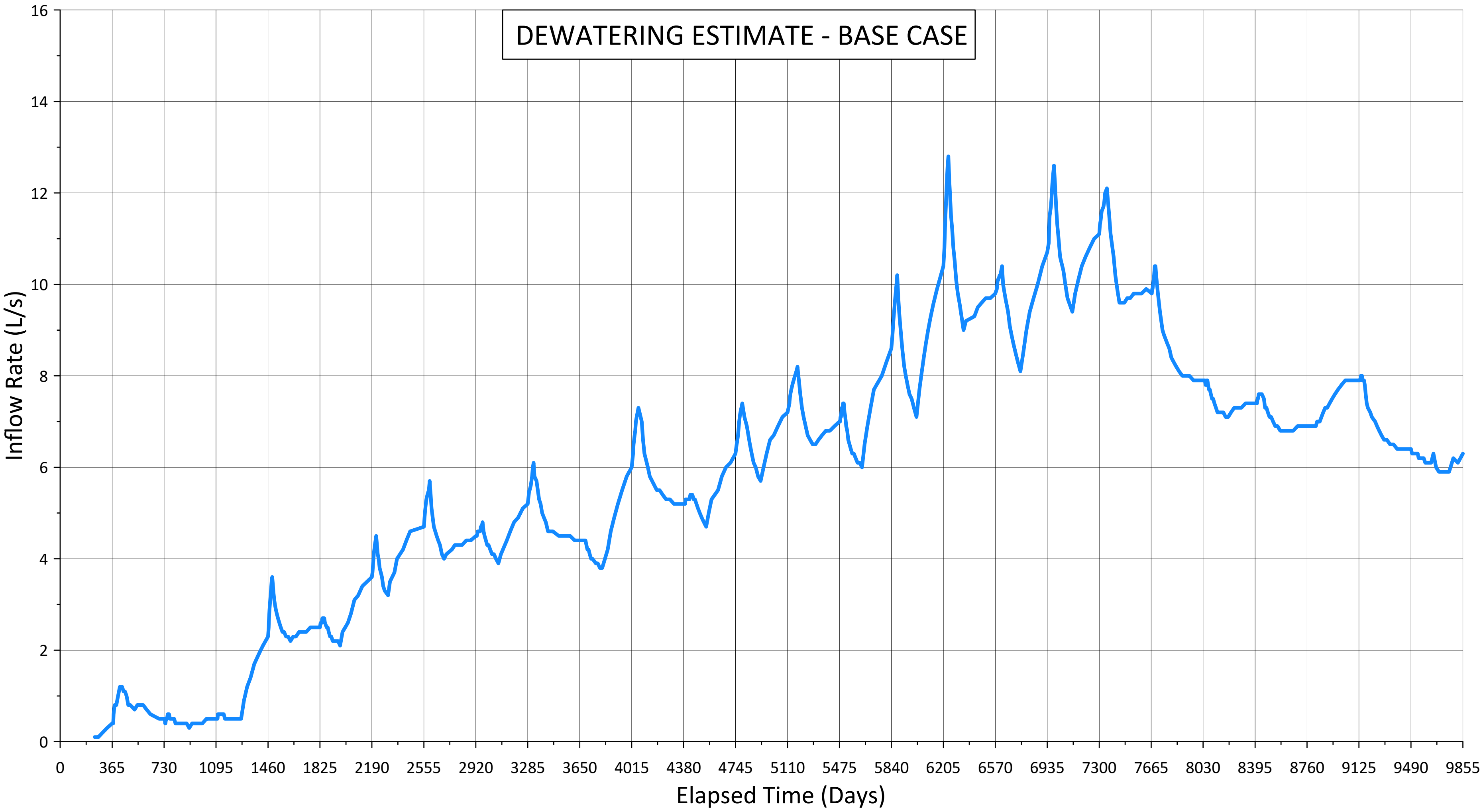
GROUNDWATER RESOURCE MANAGEMENT

FIGURE 7
EARL GREY PIT
MODELLED INFLOW

Date Jun 2023
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Notes:



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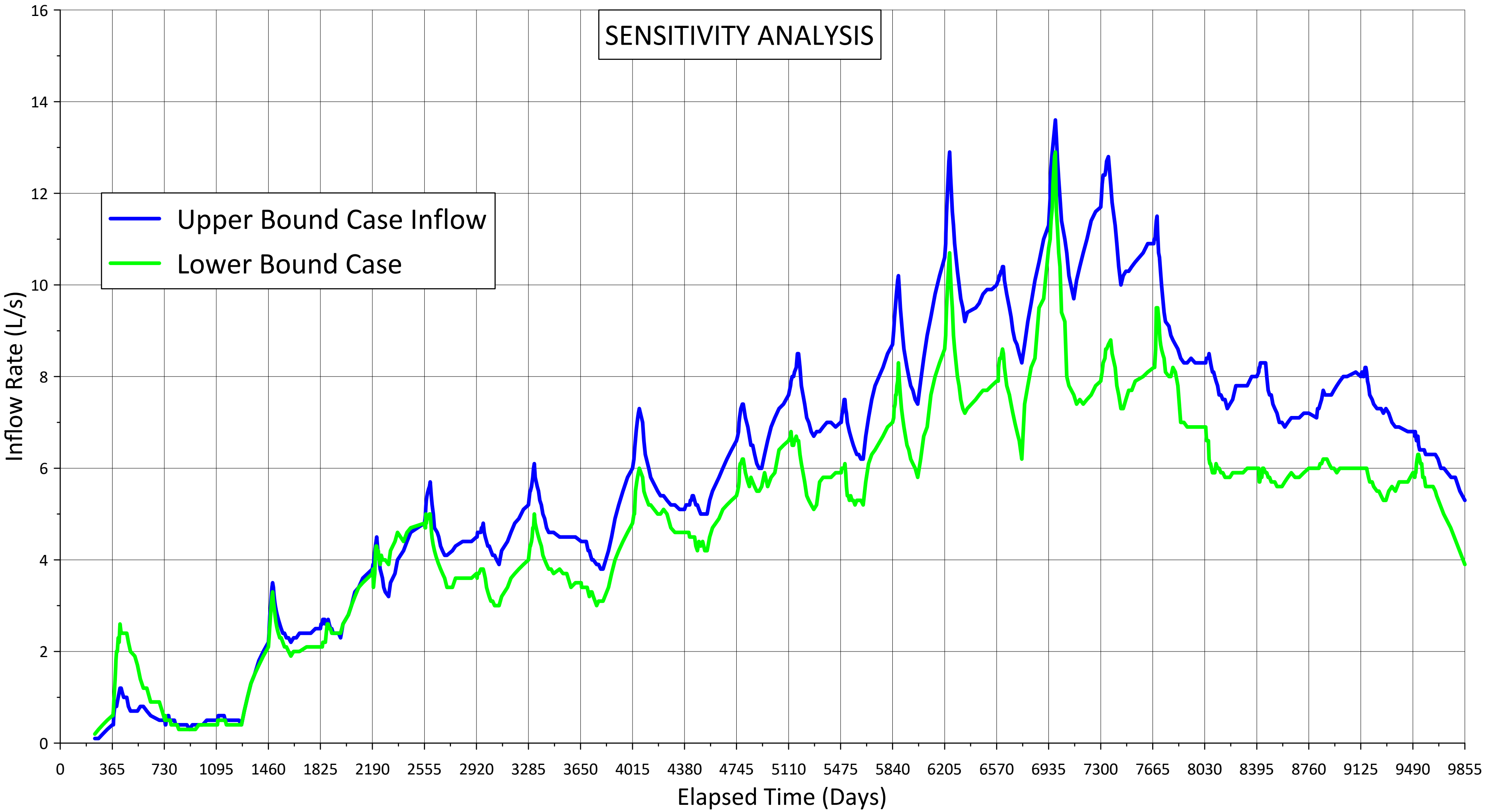
GROUNDWATER RESOURCE MANAGEMENT

FIGURE 8
EARL GREY PIT
MODELLED INFLOW
SENSITIVITY ANALYSIS

Date Jun 2023
Client Covalent Lithium
Project Mt Holland Expansion
Document J2308R01

Notes:



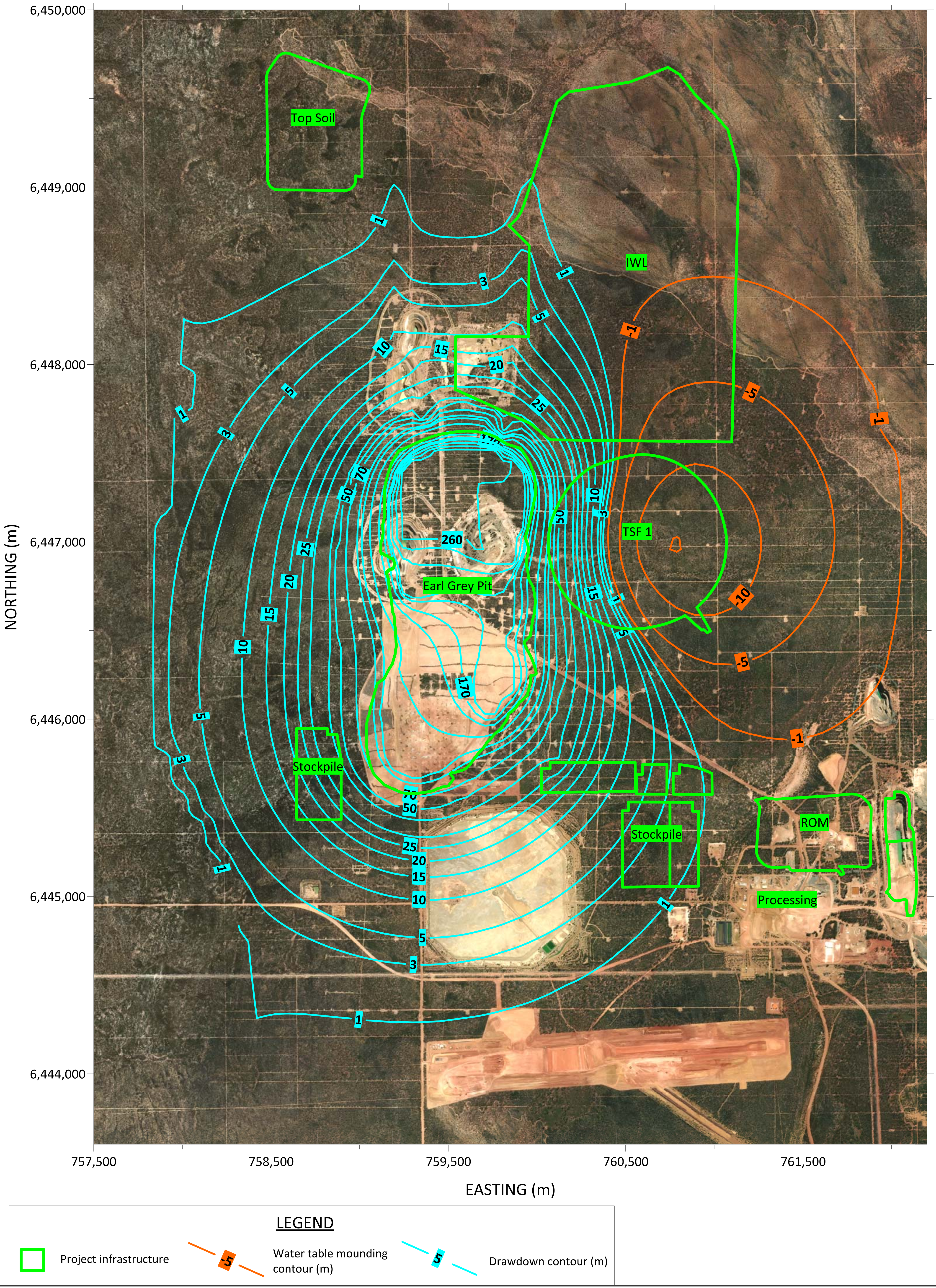


FIGURE 9
EARL GREY PIT DRAWDOWN & MOUNDING EXTENTS EoM

GROUNDWATER RESOURCE MANAGEMENT

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2208R01

Coordinate System
GDA94 Zone 50

SCALE 1:20,000
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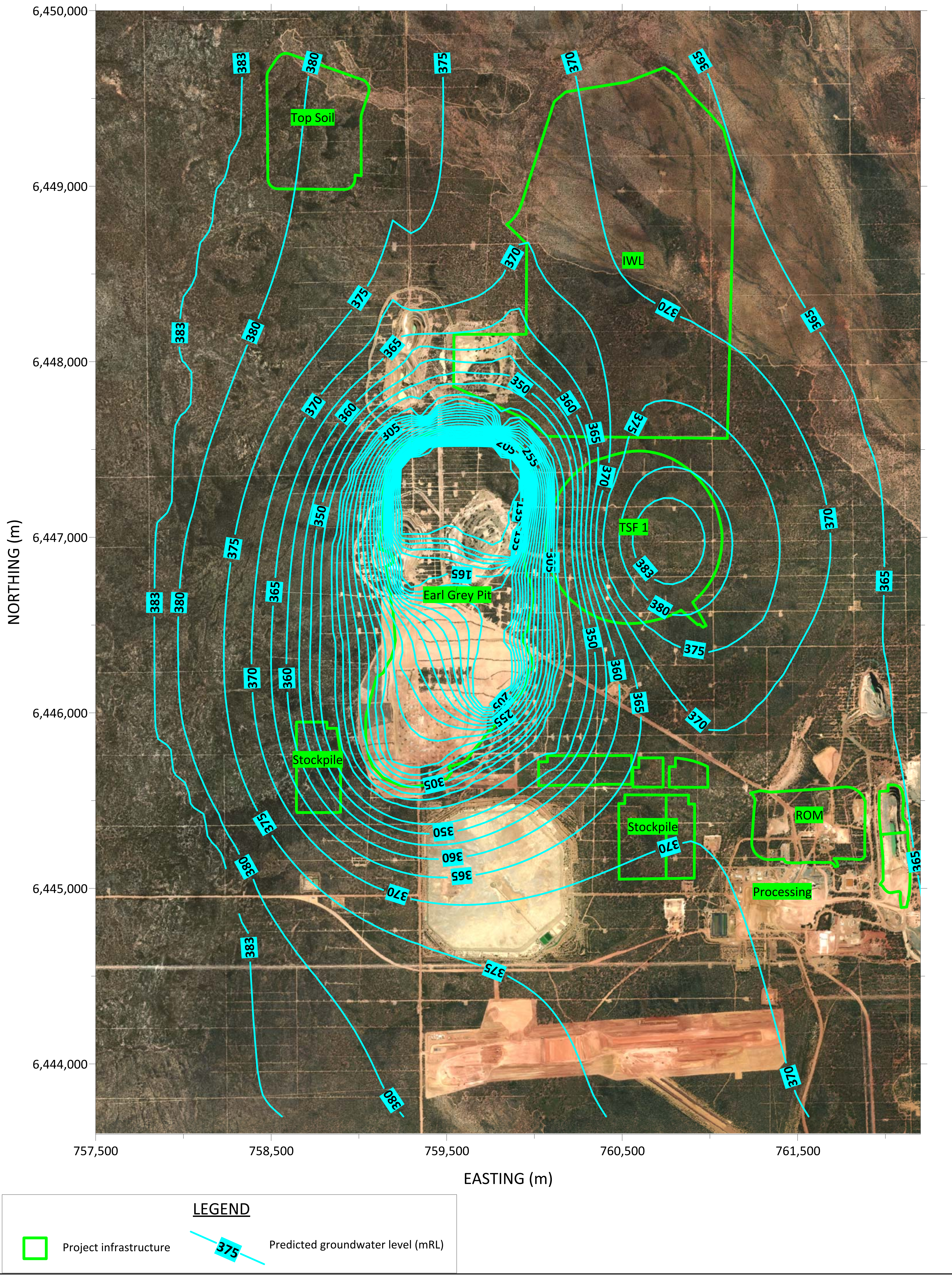

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 10
EARL GREY PIT GROUNDWATER LEVEL EoM

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2208R01

Coordinate System
GDA94 Zone 50

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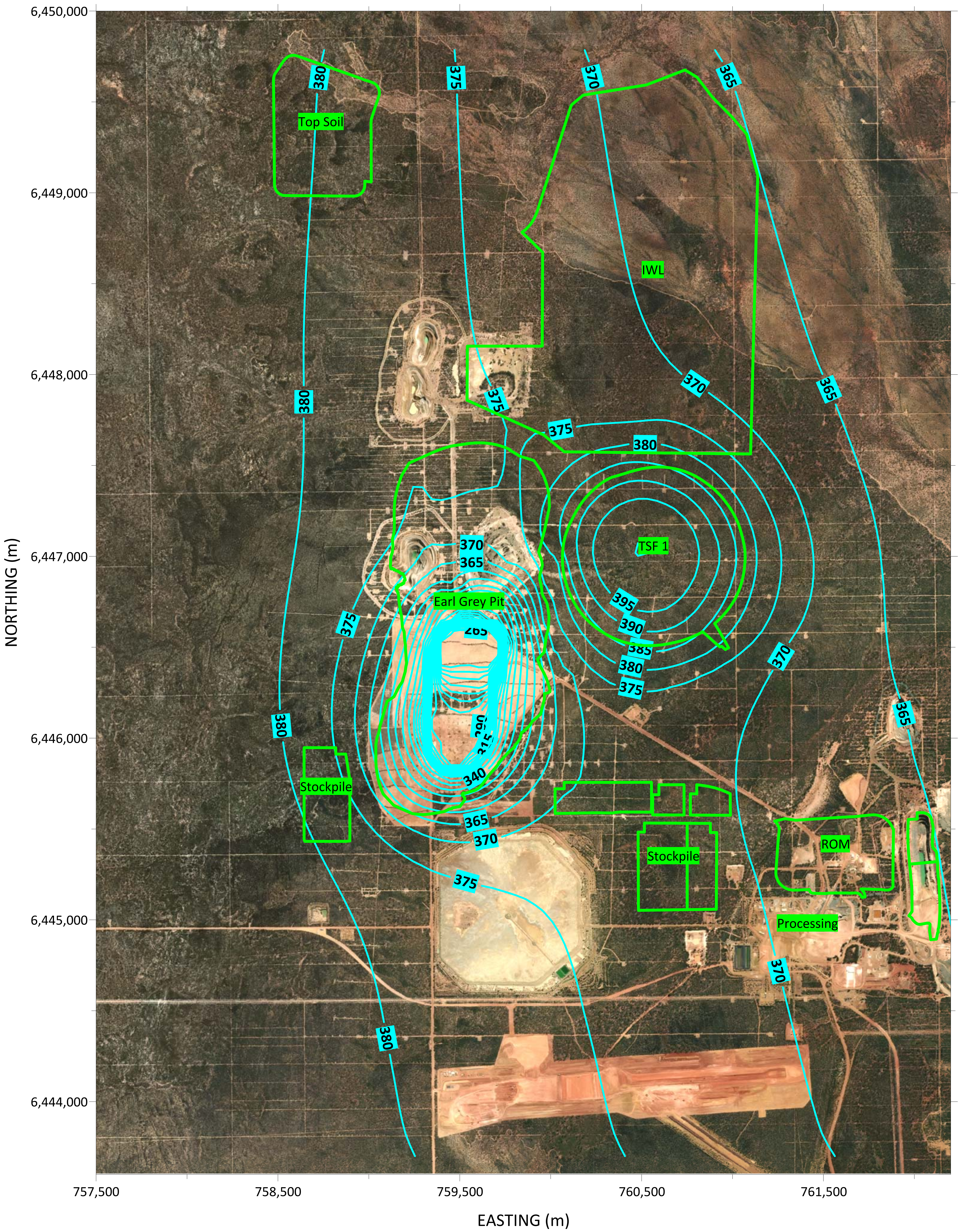

LEGEND

Project infrastructure

Predicted groundwater level (mRL)

GROUNDWATER RESOURCE MANAGEMENT

FIGURE 11
EARL GREY PIT
GROUNDWATER LEVEL
END OF YEAR-10

Date Jun 23
Client Covalent Lithium
Project Mt Holland Expansion
Document J2208R01

Coordinate System
GDA94 Zone 50

SCALE 1:20,000
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