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Groundwater
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Consultants

Report on

GS29

Lower Namoi Alluvium Stage 5

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GS29 – Lower Namoi Alluvium

Stage 5 – Assessment through multiple lines of evidence

The Lower Namoi Alluvium (GS29) is located within the Namoi catchment in northwestern New South Wales. It encompasses an extensive alluvial aquifer system comprising mostly unconfined to semi-confined units of the Narrabri and Gunnedah Formations (Figure 1). Groundwater entitlements are concentrated in the central and eastern areas of GS29, around Narrabri and Wee Waa, and loosely align with the Namoi River and Pian Creek (Figure 1). GS29 spans approximately 7,607 km², with a sustainable diversion limit (SDL) of 88.30 GL/year and a long-term average recharge of 68.20 GL/year (Table 1). Between 2013 and 2023, the average annual extraction was 76.25 GL/year, which exceeds recharge by 8 GL/year (~12%) and accounts for 86% of the SDL (Figure 2). Groundwater use primarily supports irrigation and stock and domestic supplies, and supplements surface water supply during years of below-average rainfall (Figure 2). Long-term climate observations show a persistent below-average rainfall signal for the 2011–2020 period, with a mild recovery around 2015 and a reverse signal post-2020 (Figure 3).

Groundwater levels are relatively shallow in the east and southeast of GS29, with long-term median depths within 10 m of the ground surface (Figure 4a). Deeper water tables (30-50 m) are observed in the northeast of GS29, with broad areas also in the 20-30 m range (Figure 4a). In a central corridor between these zones, there is an area where the watertable is about 15 m to 20 m, likely maintained by interaction with the Namoi River or higher recharge. Groundwater flows from east to west mimicking topographic gradients, with the Namoi River influencing flow directions locally in the southeast of GS29 (Figure 4b, Crosbie et al., 2023). Long-term (1974–2024) and short-term (2012–2024) median water levels fall within a multi-decadal fluctuation envelope (Figure 5). In several areas, the bottom of this zone is now defined by short-term (recent) water levels, indicating that current levels are the lowest recorded in the monitoring period. Water quality is generally fresh, with EC values below 2,240 µS/cm across most of the aquifer (Figure 6). A zone of elevated salinity flanks a central freshwater pocket, particularly in the west and isolated parts of the east and south. Salinity data coverage is good in the east and central parts of GS29, but sparse in the west and southwest. Long-term water level trends indicate persistent decreases in central and eastern zones (Figure 7), reflecting cumulative drawdown from legacy pumping, climate, and aquifer response (Figure 7; Figure 9; Figure 10). Short-term trends indicate partial stabilisation, with widespread recovery observed after 2020. Salinity time series show no clear deterioration, but are limited by sparse and irregular data records (Figure 8).

Recharge for GS29 is estimated at 68.20 GL/year based on MDBA (2020), incorporating diffuse, floodplain, and in-stream recharge from a regional groundwater model. The model domain, however, does not cover the whole GS29 spatial domain. More recently, the MD-SY2 project (Crosbie et al., 2025) revised the recharge estimate to 98.69 GL/year, but only accounting for the diffuse recharge mechanism. A conservative approach is therefore adopted, with the 68.20 GL/year recharge estimate used in Stage 2 of this assessment. Table 1 shows that the storage-to-recharge (S/R) exceeds the “low responsiveness” threshold¹ from Rojas et al. (2022), suggesting strong buffering capacity and limited short-term climate sensitivity. However, the high extraction-to-recharge (E/R) and SDL-to-recharge (SDL/R) ratios (Table 1) imply long-term pressure on the productive base due to overallocation.

¹ S/R ratio: High responsiveness: 29 to 111.
Medium responsiveness: 11 to 333.
Low responsiveness: >333.

The productive base supports high-intensity groundwater use, especially across the central and eastern portions of GS29, where entitlement density is high (Figure 1). The resource shows significant signs of stress, with long-term water level declines affecting broad areas of GS29. Statistically significant ($\alpha = 0.05$) long-term (1974–2024) declining trends are observed in areas between Narrabri and Wee Waa, as well as north and northwest of Wee Waa (Figure 9). Hydrographs indicate that many bores have decreased gradually but consistently since the 1970s, with cumulative losses of 5 to 20 meters over 50 years (Figure 7). Localised recovery is observed southeast of Wee Waa. While short-term trends (2012–2024) are mostly stable, many bores still show flat or mildly decreasing trends, particularly near Wee Waa, indicating only partial recovery. Figure 10 shows a mix of significant declines, flat trends, and bores with insufficient data, with no apparent spatial clustering. The short-term period coincides with six out of eleven years exceeding SDL, below-average rainfall (Figure 3), and a sharp decline in take post-2020 driven by a positive rainfall anomaly (Figure 2). Persisting declines in water levels are reflected in a sharp increase in the proportion of losing stream reaches upstream of Mollee, and the identification of Pian Creek and the Namoi River as ‘always losing’ between 2000 and 2019 (Crosbie et al., 2023). Groundwater-dependent ecosystems (GDEs), including riparian and floodplain vegetation, are widespread and may be impacted where water levels fall below ecological thresholds (Figure 1).

Stage 4 of this BPR technical groundwater review, based on a quantitative assessment of resource condition indicators (RCIs) within a 5 km buffer around extraction points (asset area), shows that 73% of the productive base, 67% of river connectivity, and 64% of GDE asset areas experienced long-term water level declines (Table 2). In the short term, these values fell to 31%, 40%, and 32%, respectively, indicating partial recovery but not enough to confidently shift ESLT values into the stable or improving region (Figure 11). Between 37% and 49% of the asset areas have shown some improvement in the short term, with uncertainty levels remaining similar or increasing, especially in the water quality (salinity) ESLT, where over 94% of the short-term asset area is classified as ‘insufficient data’ for trend analysis.

The NSW state-based risk assessment (NSW DoI, 2019) assigns high risks in GS29 across ESLT values, except for river connectivity. Productive base risks are high for structural aquifer integrity and drawdown impacts on groundwater access, with residual risks also rated high but tolerable. GDEs face high risks due to falling groundwater levels, supported by the widespread water level declines (Figure 10) and extensive GDE mapping (Figure 1). Water quality risks due to induced salinity mobilisation are also rated high, consistent with the salinity fringe zones observed in Figure 6 and the limited recent trend data. Water level data availability is strong, but salinity data remain sparse, contributing to residual risk and uncertainty.

Future projections from the MD-SY2 project suggest that diffuse recharge in GS29 may increase by 2050 due to more intense rainfall events (Crosbie et al., 2025). Conversely, floodplain recharge during high-flow or overbank events is projected to decline by 11–17% (Crosbie et al., 2025), potentially reducing (localised) episodic recharge during dry periods. These opposing trends create uncertainty about net future recharge in GS29. Under climate change, the groundwater drawdown area (Area of Influence, Aol₂) is projected to expand marginally, with the median future Aol (P50) slightly larger than the present (Figure 12). An increase in the projected SDL/R ratio also supports the conclusion of Stage 6, which classified the impact of future climate change on GS29 groundwater resources as very high, based on both long- and short-term water level evidence.

² Area of influence is defined as the area impacted by drawdown caused by groundwater extraction. For the quantitative assessment of Stage 4, this is equivalent to the percentage asset area showing a deteriorating condition, statistically significant declining trend in groundwater levels.

Overall, short-term groundwater trends (2012–2024) indicate partial recovery or stable conditions across ESLT values in GS29, while uncertainty remains comparable to that of the long-term assessment (1974–2024). Some areas continue to experience legacy declines in water levels, under a generally drying climate, despite the reduced groundwater extraction driven by a positive rainfall signal. However, uncertainty in salinity trends has worsened, with more than 94% of the asset area classified as ‘insufficient data’ for trend analysis. The current average extraction (76.25 GL/year) is close to the SDL (88.30 GL/year) and higher than a conservative recharge estimate used in the assessment (68.20 GL/year). However, the SDL exceeds this recharge estimate, meaning the full SDL utilisation impacts remain unrealised. High inherent and residual risks to the productive base, GDEs, and water quality, combined with high uncertainty regarding water quality (salinity), underscore the need for targeted monitoring. Climate projections indicate reduced episodic (localised) recharge from floodplain processes and possible increases in diffuse recharge; thus, future net recharge remains uncertain. Collectively, the analysis suggests GS29 exhibits high pressure on the productive base, partially offset by the system buffering capacity and post-2020 extraction reductions, but with very high sensitivity to future climatic variability.

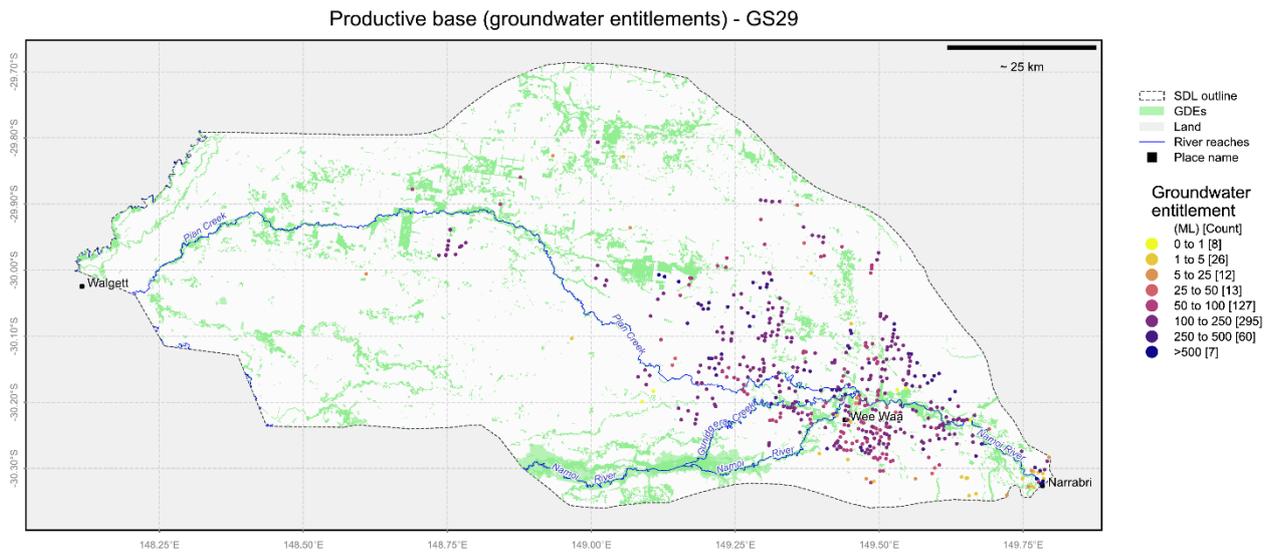


Figure 1 Productive base (groundwater entitlements)

Annual groundwater take and rainfall anomaly for GS29

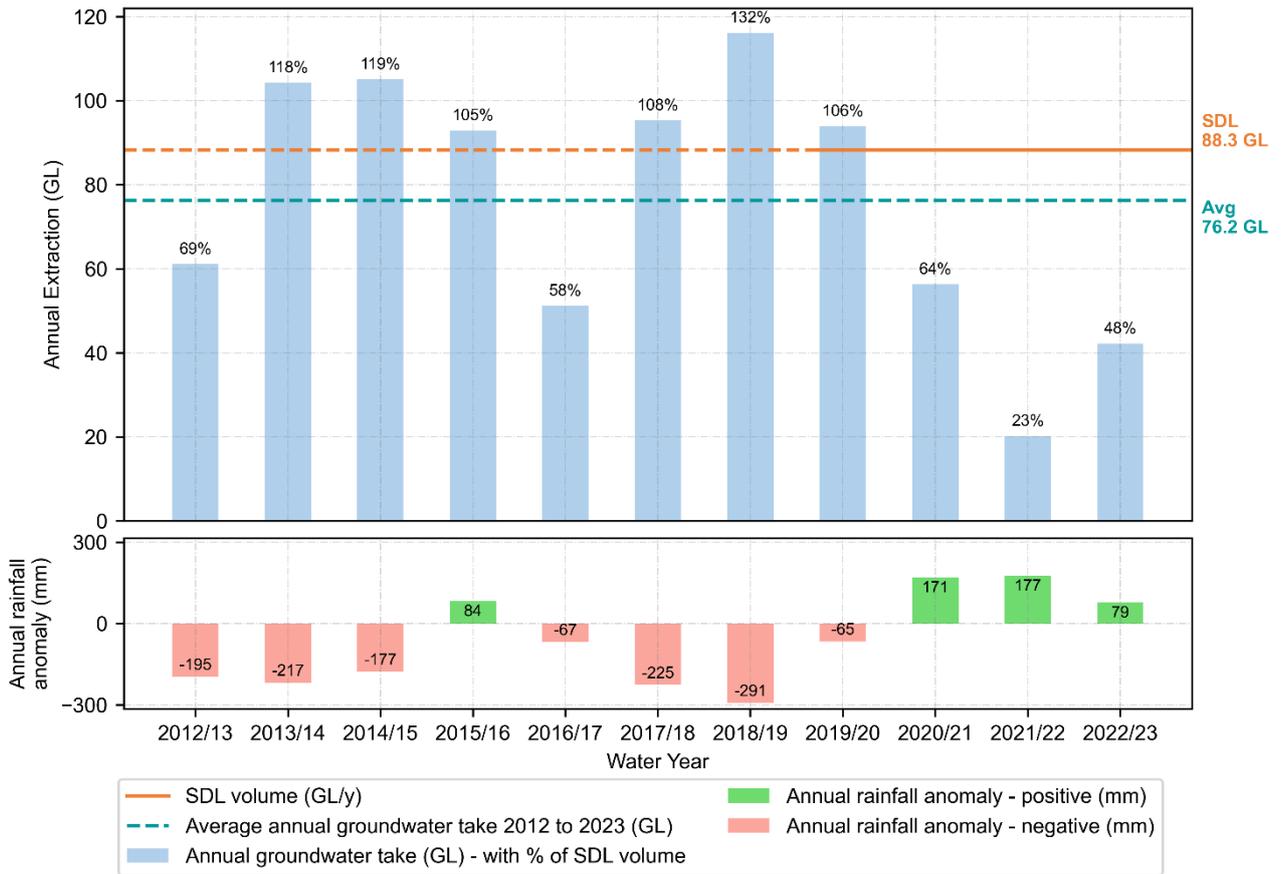


Figure 2 Groundwater take in the SDL since 2012

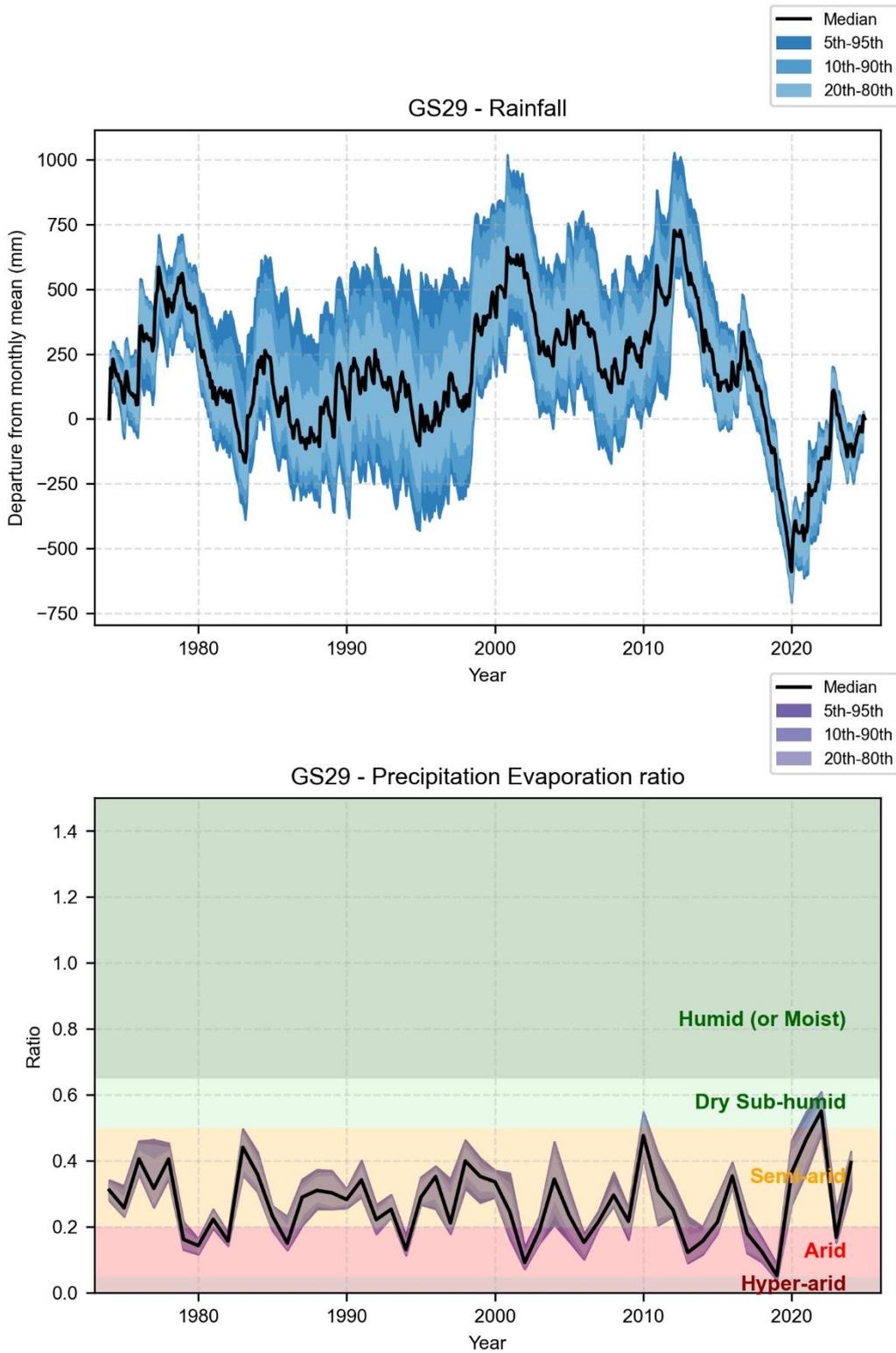


Figure 3 Historical climate trends

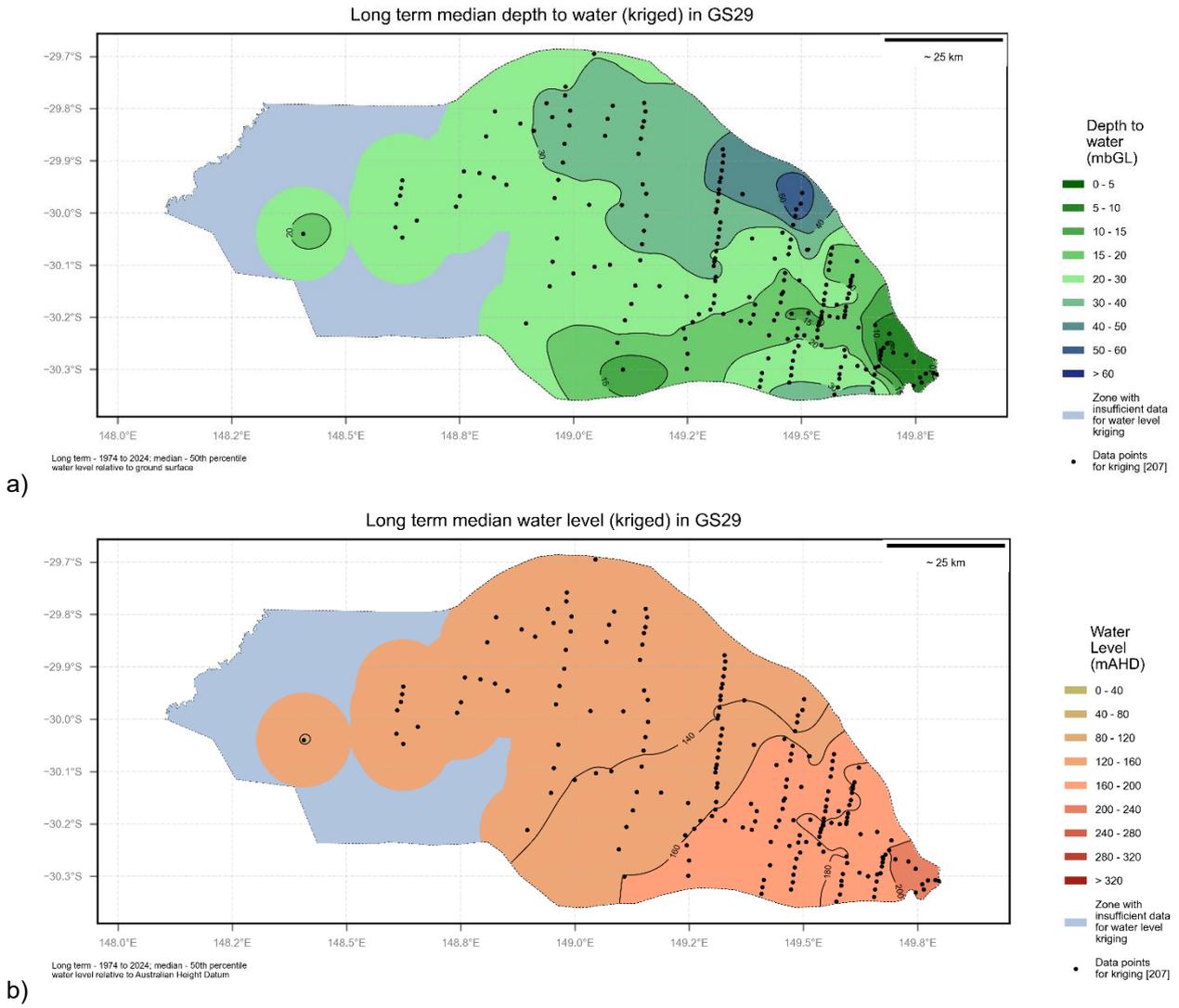
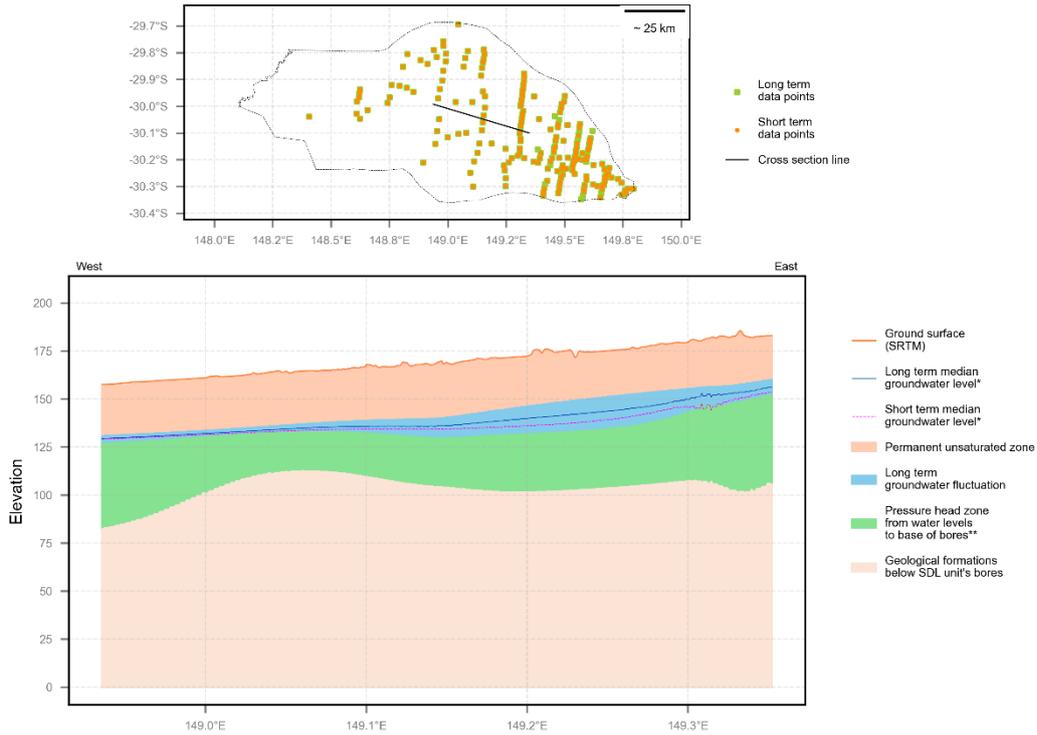


Figure 4 Long-term median (a) depth to water and (b) water level elevation

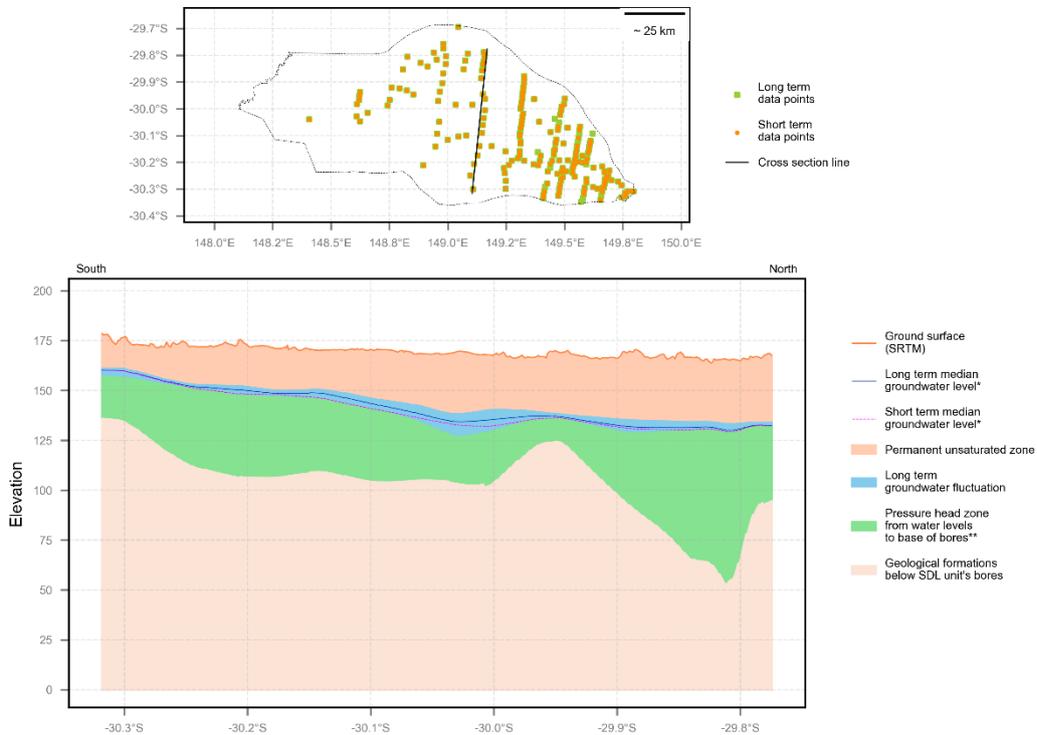
Water level elevation cross section for GS29



*Long term - 1974 to 2024; Short term - 2012 to 2024; median - 50th percentile
 **This cross-section is a scaled representation of bore data specific to the SDL resource unit.
 The data are temporally and spatially aggregated, resulting in some smoothing of the representation of water levels and aquifer formations that is different from the detail of reality.
 The blue zone represents the long term fluctuation in groundwater levels, as indicated by the 5th and 95th percentiles of groundwater levels from 1974 to 2024.
 The green pressure head zone may be representative of the total available drawdown (TAD), as it shows the water column in bores of the SDL resource unit (measured as the difference between the long-term 5th percentile groundwater level and the base of the bores of the SDL resource unit).
 This cross-section is for interpretation purposes only and should not be used for planning or compliance purposes.

a)

Water level elevation cross section for GS29



*Long term - 1974 to 2024; Short term - 2012 to 2024; median - 50th percentile
 **This cross-section is a scaled representation of bore data specific to the SDL resource unit.
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b)

Figure 5 (a) West to east and (b) south to north distribution of water levels in the SDL resource unit

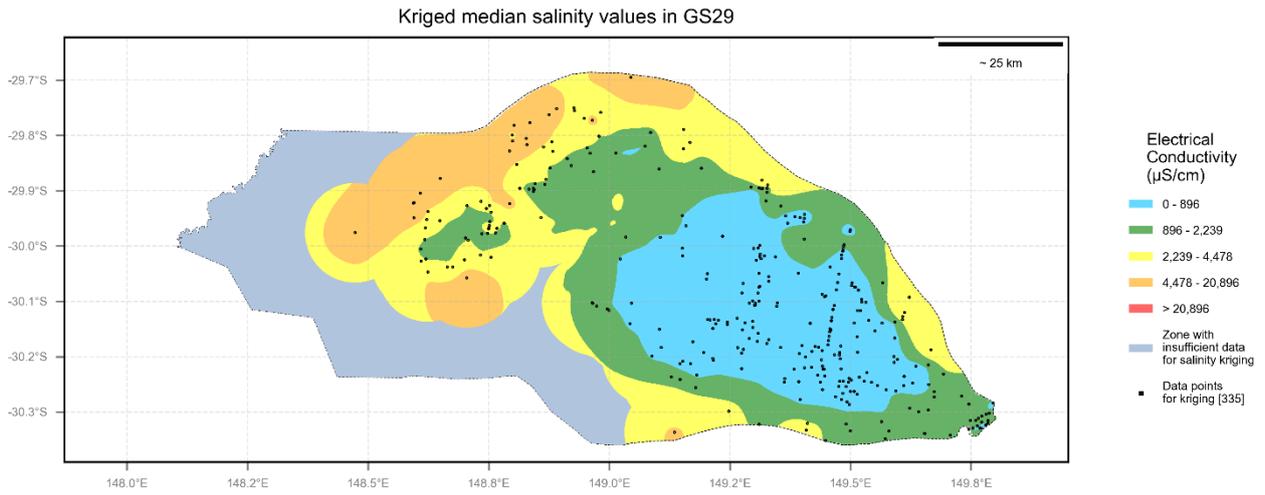


Figure 6 Groundwater salinity distribution

Table 1 Table of groundwater metadata for the SDL resource unit

Parameter	Unit	Long-term (1974 to 2024)	Short-term (2012 to 2024)	SDL resource unit data
SDL volume	GL/y	-	-	88.30
SDL resource unit area	km ²	-	-	7,607
Average annual take (2013 to 2023)	GL/y	-	-	76.25
Number of groundwater entitlement bores	-	-	-	548
SDL resource unit storage estimate*	GL	-	-	86,608
Recharge estimate (SY1)	GL/y	-	-	68.20
Recharge estimate (Stage 2)	GL/y	-	-	68.20
Diffuse recharge estimate (SY2 - WAVES)	GL/y	-	-	98.69
Extraction/SDL (E/SDL) (Stage 2 result)	-	-	-	0.86
SDL/Recharge (SDL/R) (Stage 2 result)	-	-	-	1.29
SDL/Recharge (SDL/R) (SY2 or modelled recharge)	-	-	-	1.29
Storage/Stage 2 Recharge (S/R)	-	-	-	1,270
Storage/SY2 or modelled Recharge (S/R)	-	-	-	1,270
Number of bores in the SDL unit	-	3,236	3,236	-
Number of bores for water level trend analysis	-	220	201	-
Number of bores for water level trend with sufficient data	-	212	187	-
Number of bores with decreasing water level trend	-	183	66	-
Number of bores with increasing water level trend	-	6	6	-
Number of bores with no statistically significant water level trend	-	23	115	-
Mean water level trend magnitude	m/y	-0.12	-0.05	-
Minimum water level trend magnitude	m/y	-0.54	-2.37	-
5%ile water level trend magnitude	m/y	-0.34	-0.3	-
10%ile water level trend magnitude	m/y	-0.29	-0.22	-
50%ile water level trend magnitude	m/y	-0.11	-0.06	-
90%ile water level trend magnitude	m/y	-0.01	0.11	-
95%ile water level trend magnitude	m/y	0.03	0.29	-
Maximum water level trend magnitude	m/y	1.44	1.79	-
Number of bores for salinity trend analysis	-	349	7	-
Number of bores for salinity trend with sufficient data	-	34	7	-
Number of bores with decreasing salinity trend	-	0	0	-
Number of bores with increasing salinity trend	-	4	0	-
Number of bores with no statistically significant salinity trend	-	30	7	-
Mean salinity trend magnitude	µS/cm/y	40	52	-
Minimum salinity trend magnitude	µS/cm/y	-217	-120	-
5%ile salinity trend magnitude	µS/cm/y	-25	-120	-
10%ile salinity trend magnitude	µS/cm/y	-2	-119	-
50%ile salinity trend magnitude	µS/cm/y	4	4	-
90%ile salinity trend magnitude	µS/cm/y	186	275	-
95%ile salinity trend magnitude	µS/cm/y	290	347	-
Maximum salinity trend magnitude	µS/cm/y	369	419	-

Note: *Groundwater resource storage estimate source: WERP (RQ8b).

Table 2 Table of results from spatial analysis of RCI trends in ESLT asset areas

ESLT Value	Asset area (m2)	Long-term				Short term			
		Proportion of asset area with improving/stable RCI trends	Proportion of asset area with deteriorating RCI trends	Proportion of asset area with uncertain RCI trends	Trend grouping	Proportion of asset area with improving/stable RCI trends	Proportion of asset area with deteriorating RCI trends	Proportion of asset area with uncertain RCI trends	Trend grouping
Productive base	3,505,555,299	9%	73%	18%	Deteriorating trends	49%	31%	20%	Variable trends
GDEs	1,743,804,848	6%	64%	30%	Deteriorating trends	37%	32%	32%	Variable trends
River connectivity	1,675,541,457	14%	67%	19%	Deteriorating trends	41%	40%	19%	Variable trends
Water quality	3,446,343,435	32%	3%	65%	Insufficient data	6%	0%	94%	Insufficient data

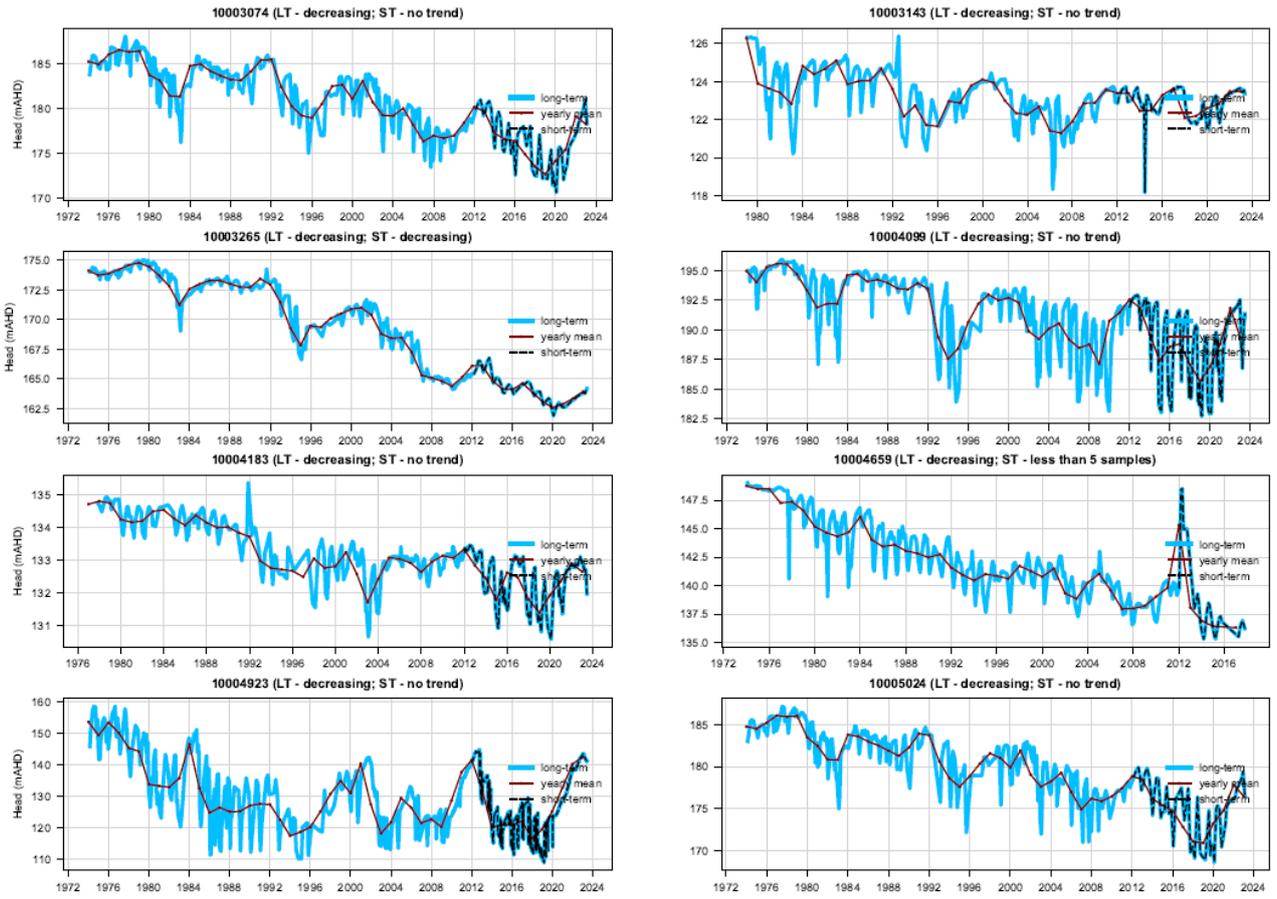


Figure 7 Representative groundwater hydrographs for the SDL resource unit

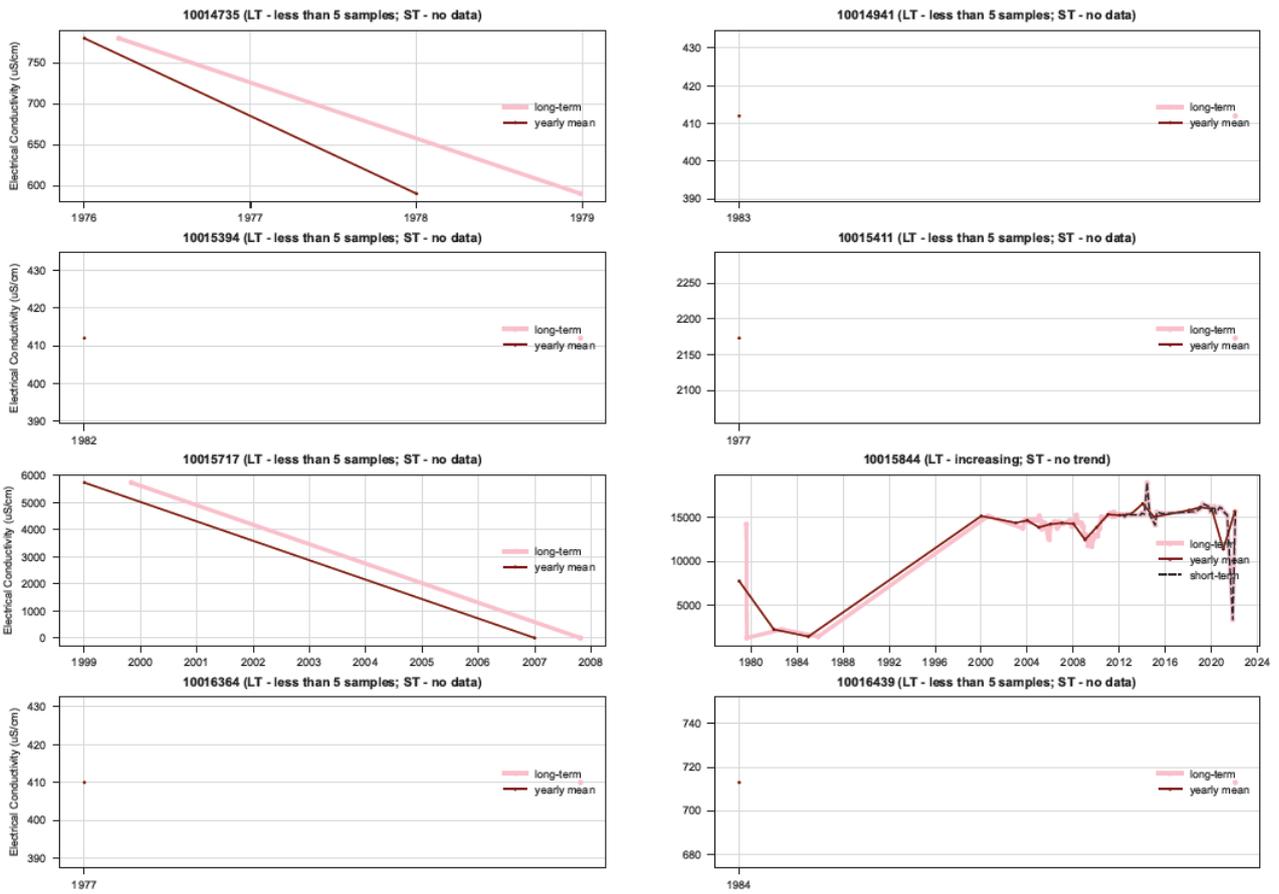


Figure 8 Representative groundwater salinity time series for the SDL resource unit

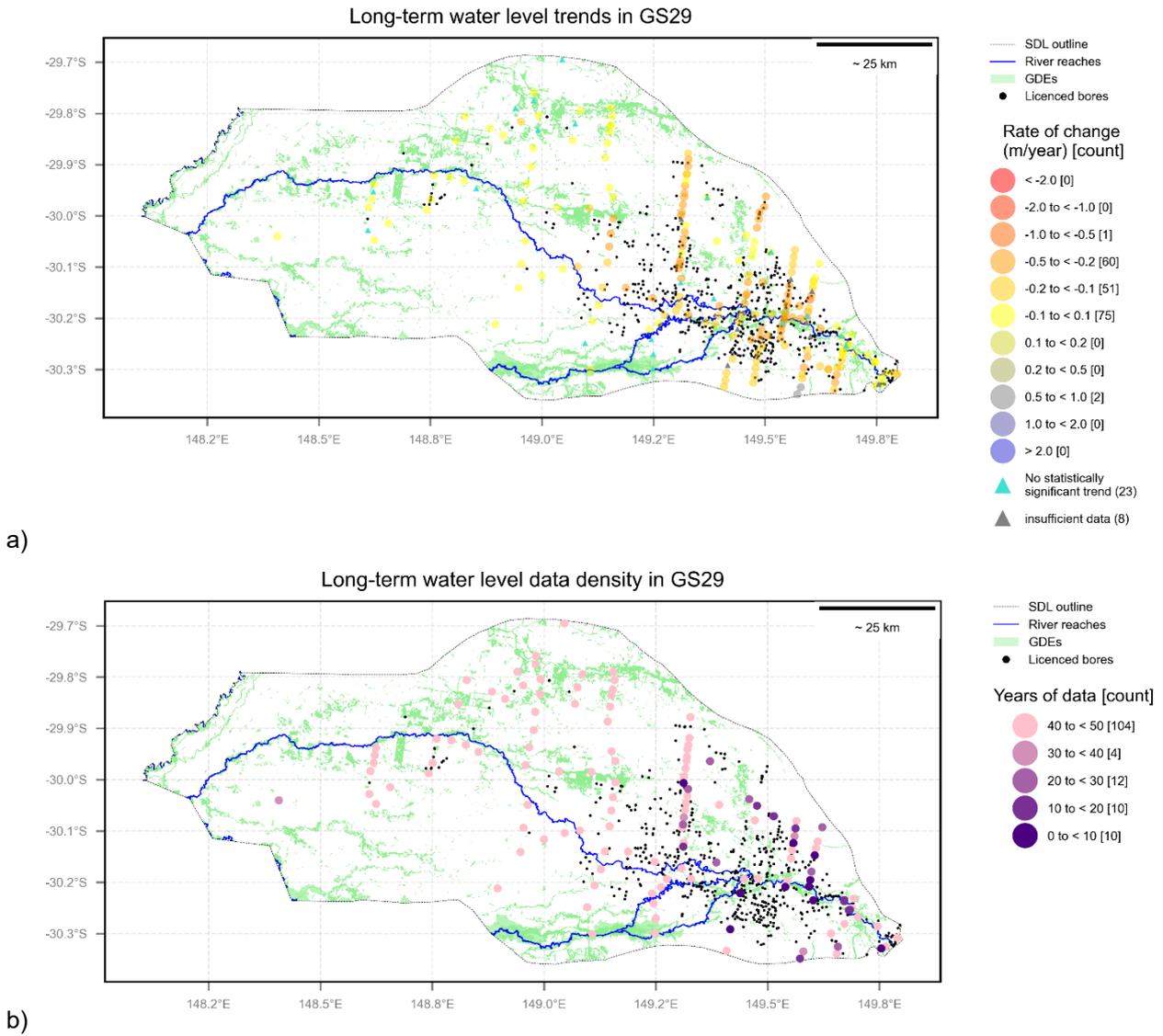


Figure 9 Long-term (1974 to 2024) (a) groundwater level trends and (b) data availability

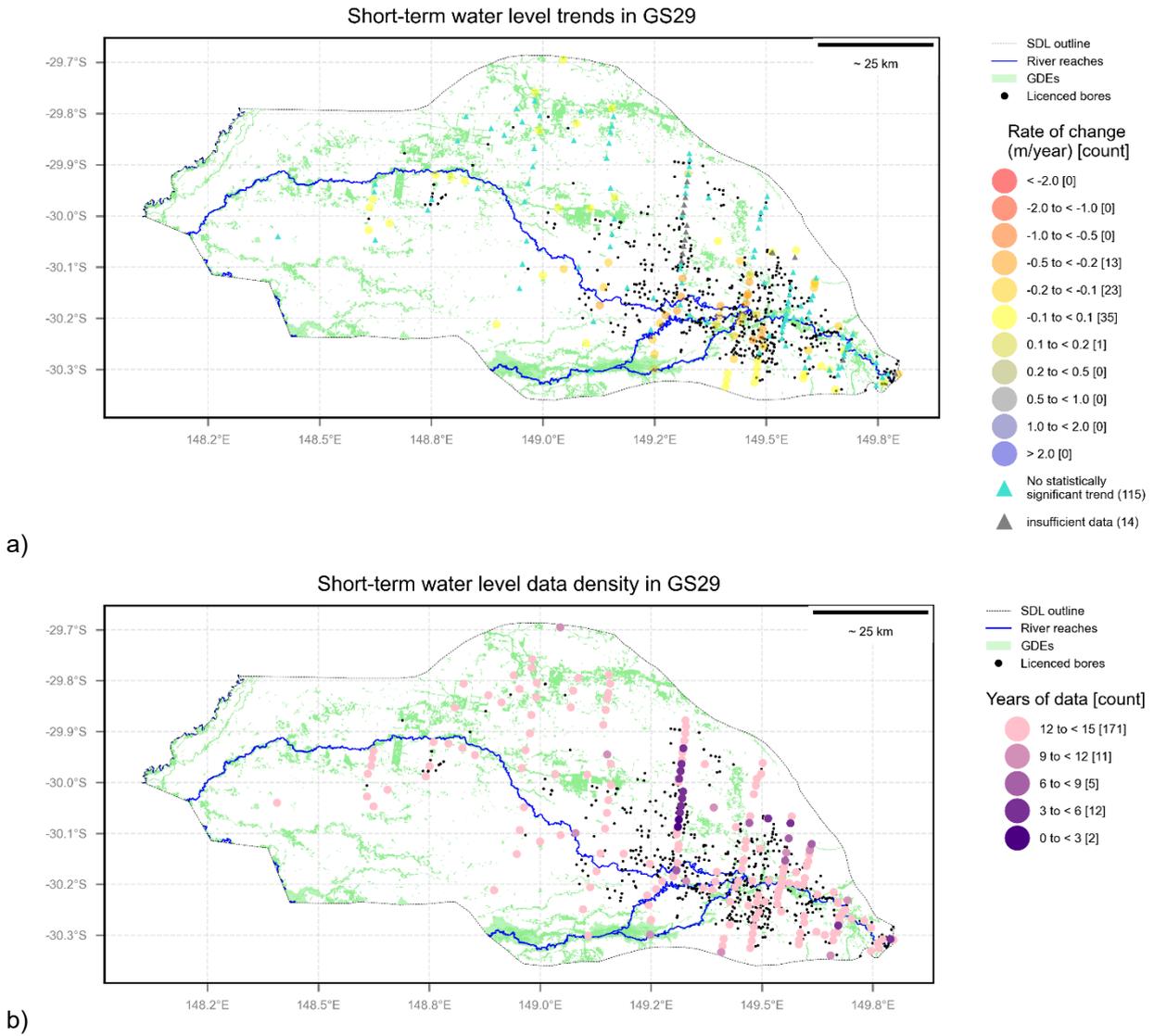


Figure 10 Short-term (2012 to 2024) (a) groundwater level trends and (b) data availability

Ternary plot for GS29

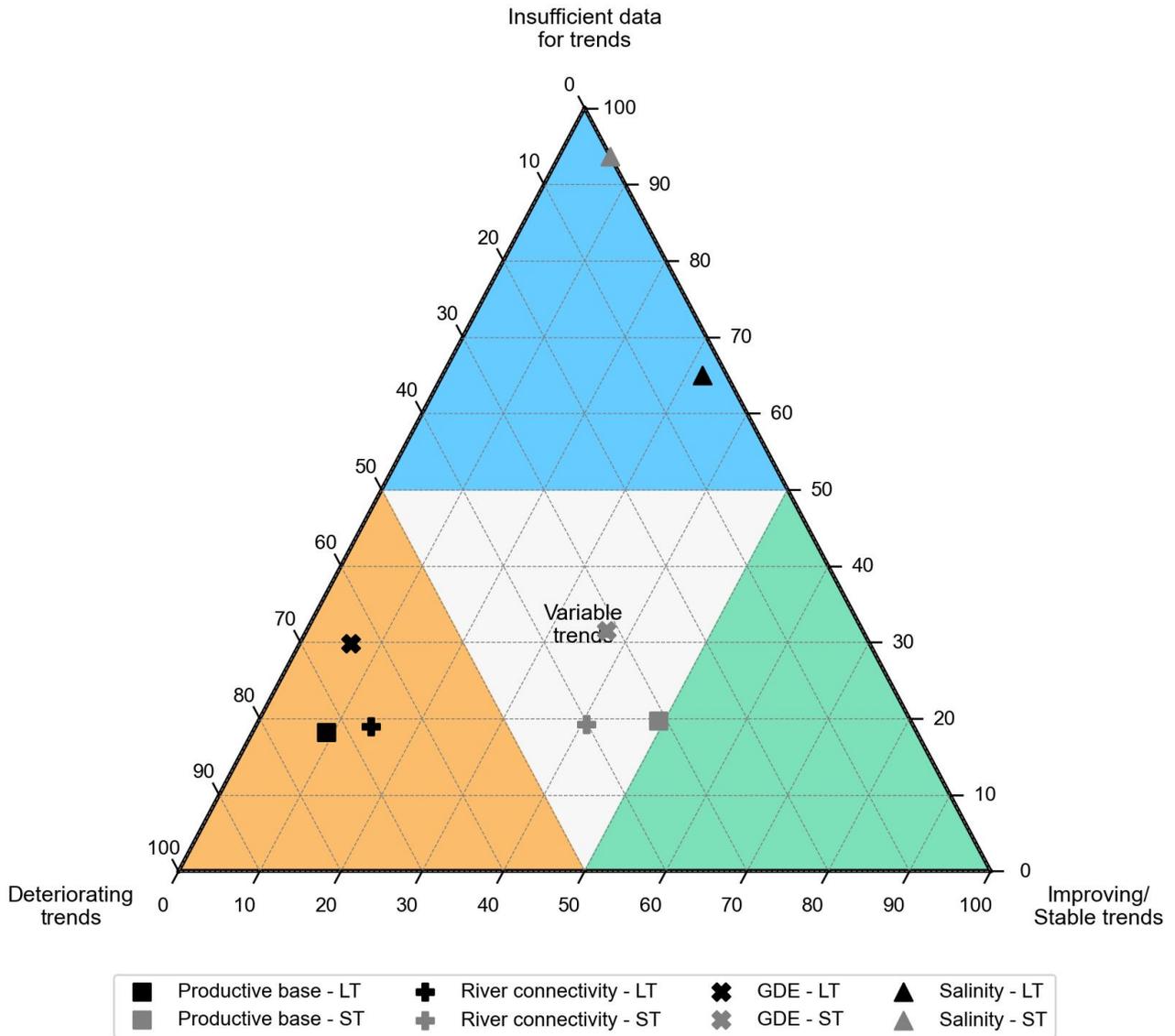


Figure 11 Stage 4 assessment outcome: trends in resource condition indicators for ESLT values

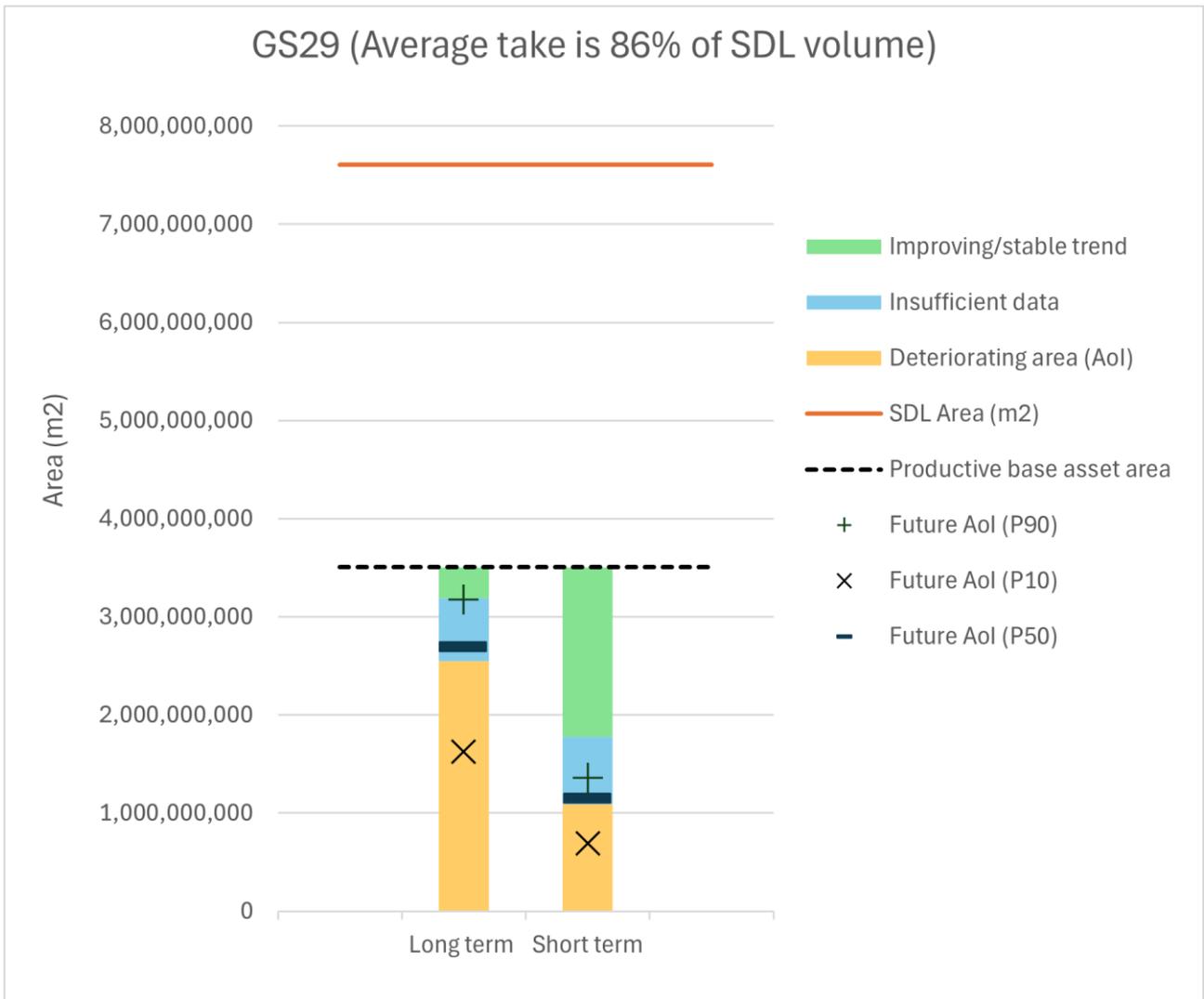


Figure 12 Estimates for change in area of influence (AoI) due to climate change

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