

## **Appendix E Parameter bounds**

### **E1 Hydraulic conductivity**

**Table E1-1 Upper and lower parameter bounds imposed on horizontal hydraulic conductivity ( $K_h$ ) during the calibration process.**

Stratigraphic unit(s)	Model layer	Lower bound for $K_h$ (m/d)	Upper bound for $K_h$ (m/d)
Condamine Alluvium <sup>a</sup>	1	1.90E+00	4.00E+01
Other Quaternary Alluvium <sup>b</sup>	1	3.44E+00	4.00E+01
Main Range Volcanics <sup>b</sup>	1	2.10E-02	1.45E+00
Other Basalt <sup>b</sup>	1	2.10E-02	1.45E+00
Cenozoic Sediments <sup>b</sup>	1	1.45E-02	1.00E+00
Weathered Surat or Bowen strata	1	1.45E-02	1.00E+00
Upper Cretaceous <sup>b</sup>	2	1.00E-02	1.00E+00
Wallumbilla Formation <sup>b</sup>	3	1.00E-02	7.84E-01
Bungil Formation <sup>c</sup>	4	5.00E-03	4.56E-01
Mooga Sandstone <sup>c</sup>	5	1.00E-02	3.33E+00
Orallo Formation <sup>c</sup>	6	5.00E-02	5.66E+00
Gubberamunda Sandstone <sup>c</sup>	7	5.00E-02	9.34E+00
Westbourne Formation <sup>d</sup>	8	6.75E-05	1.29E-03
Upper Springbok Sandstone <sup>d</sup>	9	1.15E-04	4.48E-03
Lower Springbok Sandstone <sup>d</sup>	10	2.43E-04	2.83E-03
Walloon Coal Measures non-productive zone <sup>e</sup>	11	3.49E-07	8.19E-02
Upper Walloon Coal Measures <sup>d</sup>	12	1.10E-05	2.71E-02
Middle 1 Walloon Coal Measures <sup>d</sup>	13	2.32E-06	3.14E-02
Middle 2 Walloon Coal Measures <sup>d</sup>	14	2.32E-06	3.14E-02
Middle 3 Walloon Coal Measures <sup>d</sup>	15	2.32E-06	3.14E-02
Lower Walloon Coal Measures <sup>d</sup>	16	1.14E-06	4.87E-02
Durabilla Formation <sup>d</sup>	17	1.16E-05	2.00E-04
Upper Hutton Sandstone <sup>g</sup>	18	1.35E-03	1.00E+01
Lower Hutton Sandstone <sup>g</sup>	19	1.32E-04	1.00E+01
Upper Evergreen Formation <sup>d</sup>	20	1.58E-05	2.53E-04
Boxvale Sandstone <sup>h</sup>	21	9.65E-05	1.00E+01
Lower Evergreen Formation <sup>d</sup>	22	1.58E-05	2.53E-04
Precipice Sandstone <sup>d</sup>	23	1.04E-02	1.00E+02
Moolayember Formation <sup>i</sup>	24	1.00E-04	8.14E-02
Clematis Sandstone <sup>i</sup>	25	1.00E-04	1.00E+01
Rewan Group <sup>i</sup>	26	5.00E-05	3.13E-02
Bandanna Formation non-productive zone <sup>j</sup>	27	1.00E-04	7.48E-02
Upper Bandanna Formation <sup>j</sup>	28	1.00E-04	7.48E-02
Lower Bandanna Formation <sup>j</sup>	29	1.00E-04	7.48E-02
Undifferentiated Bowen Basin strata <sup>i</sup>	30	5.00E-06	9.41E-03
Cattle Creek Formation non-productive zone <sup>j</sup>	31	1.00E-04	7.48E-02
Upper Cattle Creek Formation <sup>j</sup>	32	1.00E-04	7.48E-02
Lower Cattle Creek Formation <sup>j</sup>	33	1.00E-04	7.48E-02
Undifferentiated Bowen Basin strata <sup>i</sup>	34	5.00E-06	9.41E-03

**Table E1-1 Notes.**

- <sup>a</sup> Initial or expected values and upper and lower bounds taken from the Condamine Alluvium Model (KCB, 2011)
- <sup>b</sup> Initial or expected values and upper and lower bounds based on previous regional modelling results (GHD, 2012) and ranges from numerical permeameter calculations (section 4.3.3)
- <sup>c</sup> Initial or expected values and upper and lower bounds based on core and DST test results for this stratigraphic unit and numerical permeameter calculations for the upper Springbok Sandstone (section 4.3.3).
- <sup>d</sup> Initial or expected values and upper and lower bounds based on numerical permeameter calculations for this stratigraphic unit (section 4.2)
- <sup>e</sup> Initial or expected values and upper and lower bounds based on the median, P5 and P95 values from detailed lithofacies modelling using Petrel within current and proposed CSG development areas and numerical permeameter calculations outside of such areas (section 4.4.1).
- <sup>f</sup> Expected values and upper and lower bounds initially based on numerical permeameter calculations for this stratigraphic unit before being adjusted upwards as necessary based on comparison with actual measurements (section 4.4.2)
- <sup>g</sup> Expected values and upper and lower bounds based on numerical permeameter results for the Evergreen Formation adjusted to account for the generally higher permeability of the Boxvale Sandstone compared to its host formation (section 4.3.2)
- <sup>h</sup> Initial or expected values and lower bounds based on numerical permeameter calculations for this stratigraphic unit (section 4.2). Upper bound Kh increased to 10m/d since data for the Precipice Sandstone suggests numerical permeameters may underestimate horizontal hydraulic conductivity in major aquifer units (section 4.4.3).
- <sup>i</sup> Initial or expected values and upper and lower bounds based on core and DST test results for this stratigraphic unit and numerical permeameter calculations for the Evergreen Formation (section 4.3.3).
- <sup>j</sup> Initial or expected values and upper and lower bounds based on the median, P5 and P95 values from available core and DST test results.

**Table E1-2 Upper and lower parameter bounds imposed on vertical hydraulic conductivity ( $K_v$ ) during the calibration process.**

Stratigraphic unit(s)	Model layer	Lower bound for $K_v$ (m/d)	Upper bound for $K_v$ (m/d)
Condamine Alluvium <sup>a</sup>	1	1.90E+00	4.00E+01
Other Quaternary Alluvium <sup>b</sup>	1	1.88E-01	4.00E+01
Main Range Volcanics <sup>b</sup>	1	3.07E-05	2.07E-02
Other Basalt <sup>b</sup>	1	3.07E-05	2.07E-02
Cenozoic Sediments <sup>b</sup>	1	5.30E-06	3.57E-03
Weathered Surat or Bowen strata	1	5.30E-06	3.57E-03
Upper Cretaceous <sup>b</sup>	2	5.00E-06	3.57E-03
Wallumbilla Formation <sup>b</sup>	3	4.16E-06	2.80E-03
Bungil Formation <sup>c</sup>	4	8.64E-07	5.82E-04
Mooga Sandstone <sup>c</sup>	5	6.31E-06	4.25E-03
Orallo Formation <sup>c</sup>	6	1.00E-05	7.22E-03
Gubberamunda Sandstone <sup>c</sup>	7	1.00E-05	1.19E-02
Westbourne Formation <sup>d</sup>	8	1.09E-07	1.20E-06
Upper Springbok Sandstone <sup>d</sup>	9	3.05E-08	1.45E-06
Lower Springbok Sandstone <sup>d</sup>	10	3.09E-07	2.80E-05
Walloon Coal Measures non-productive zone <sup>e</sup>	11	6.18E-08	2.59E-03
Upper Walloon Coal Measures <sup>d</sup>	12	1.02E-08	1.00E-06
Middle 1 Walloon Coal Measures <sup>d</sup>	13	3.81E-09	1.00E-06
Middle 2 Walloon Coal Measures <sup>d</sup>	14	3.81E-09	1.00E-06
Middle 3 Walloon Coal Measures <sup>d</sup>	15	3.81E-09	1.00E-06
Lower Walloon Coal Measures <sup>d</sup>	16	1.27E-09	1.00E-06
Durabilla Formation <sup>d</sup>	17	7.62E-09	1.00E-06
Upper Hutton Sandstone <sup>g</sup>	18	7.62E-08	1.08E-05
Lower Hutton Sandstone <sup>g</sup>	19	1.14E-08	1.00E-06
Upper Evergreen Formation <sup>d</sup>	20	5.08E-09	1.00E-06
Boxvale Sandstone <sup>h</sup>	21	3.11E-08	1.00E-06
Lower Evergreen Formation <sup>d</sup>	22	5.08E-09	1.00E-06
Precipice Sandstone <sup>f</sup>	23	1.84E-06	1.24E-03
Moolayember Formation <sup>i</sup>	24	1.00E-07	8.27E-05
Clematis Sandstone <sup>i</sup>	25	1.00E-07	1.67E-04
Rewan Group <sup>i</sup>	26	1.00E-08	3.18E-05
Bandanna Formation non-productive zone <sup>j</sup>	27	1.00E-08	7.59E-05
Upper Bandanna Formation <sup>j</sup>	28	1.00E-08	7.59E-05
Lower Bandanna Formation <sup>j</sup>	29	1.00E-08	7.59E-05
Undifferentiated Bowen Basin strata <sup>i</sup>	30	1.00E-09	9.55E-06
Cattle Creek Formation non-productive zone <sup>j</sup>	31	1.00E-07	7.59E-05
Upper Cattle Creek Formation <sup>j</sup>	32	1.00E-07	7.59E-05
Lower Cattle Creek Formation <sup>j</sup>	33	1.00E-07	7.59E-05
Undifferentiated Bowen Basin strata <sup>i</sup>	34	1.00E-09	9.55E-06

**Table E1-2 Notes**

- <sup>a</sup> Initial or expected values and upper and lower bounds taken from the Condamine Alluvium Model (KCB, 2011)
- <sup>b</sup> Initial or expected values and upper and lower bounds based on previous regional modelling results (GHD, 2012) and ranges from numerical permeameter calculations (section 4.3.3)
- <sup>c</sup> Initial or expected values and upper and lower bounds based on core and DST test results for this stratigraphic unit and numerical permeameter calculations for the upper Springbok Sandstone (section 4.3.3).
- <sup>d</sup> Initial or expected values and upper and lower bounds based on numerical permeameter calculations for this stratigraphic unit (section 4.2)
- <sup>e</sup> Initial or expected values and upper and lower bounds based on the median, P5 and P95 values from detailed lithofacies modelling using Petrel within current and proposed CSG development areas and numerical permeameter calculations outside of such areas (section 4.4.1).
- <sup>f</sup> Expected values and upper and lower bounds initially based on numerical permeameter calculations for this stratigraphic unit before being adjusted upwards as necessary based on comparison with actual measurements (section 4.4.2)
- <sup>g</sup> Expected values and upper and lower bounds based on numerical permeameter results for the Evergreen Formation adjusted to account for the generally higher permeability of the Boxvale Sandstone compared to its host formation (section 4.3.2)
- <sup>h</sup> Initial or expected values and lower bounds based on numerical permeameter calculations for this stratigraphic unit (section 4.2). Upper bound Kh increased to 10m/d since data for the Precipice Sandstone suggests numerical permeameters may underestimate horizontal hydraulic conductivity in major aquifer units (section 4.4.3).
- <sup>i</sup> Initial or expected values and upper and lower bounds based on core and DST test results for this stratigraphic unit and numerical permeameter calculations for the Evergreen Formation (section 4.3.3).
- <sup>j</sup> Initial or expected values and upper and lower bounds based on the median, P5 and P95 values from available core and DST test results.

## **E2 Storage**

**Table E2-1 Upper and lower parameter bounds imposed on aquifer specific storage ( $S_s$ ) during the calibration process.**

Stratigraphic unit(s)	Model layer	Lower bound for $S_s$ ( $m^{-1}$ )	Upper bound for $S_s$ ( $m^{-1}$ )
Condamine Alluvium <sup>a</sup>	1	1.00E-03	1.25E-01
Other Quaternary Alluvium <sup>a</sup>	1	5.00E-03	1.00E-01
Main Range Volcanics <sup>a</sup>	1	5.00E-03	5.00E-02
Other Basalt <sup>a</sup>	1	5.00E-03	5.00E-02
Cenozoic Sediments <sup>a</sup>	1	5.00E-03	1.00E-01
Weathered Surat or Bowen strata <sup>a</sup>	1	5.00E-03	1.00E-01
Upper Cretaceous <sup>b</sup>	2	5.00E-07	1.33E-05
Wallumbilla Formation <sup>b</sup>	3	5.00E-07	1.33E-05
Bungil Formation <sup>b</sup>	4	5.00E-07	1.33E-05
Mooga Sandstone <sup>b</sup>	5	5.00E-07	1.33E-05
Orallo Formation <sup>b</sup>	6	5.00E-07	1.33E-05
Gubberamunda Sandstone <sup>b</sup>	7	5.00E-07	1.33E-05
Westbourne Formation <sup>c</sup>	8	1.09E-06	1.33E-05
Upper Springbok Sandstone <sup>c</sup>	9	1.18E-06	1.33E-05
Lower Springbok Sandstone <sup>c</sup>	10	8.95E-07	1.33E-05
Walloon Coal Measures non-productive zone <sup>c</sup>	11	1.01E-06	1.33E-05
Upper Walloon Coal Measures <sup>c</sup>	12	3.26E-07	1.33E-05
Middle 1 Walloon Coal Measures <sup>c</sup>	13	2.50E-07	1.33E-05
Middle 2 Walloon Coal Measures <sup>c</sup>	14	2.50E-07	1.33E-05
Middle 3 Walloon Coal Measures <sup>c</sup>	15	2.50E-07	1.33E-05
Lower Walloon Coal Measures <sup>c</sup>	16	6.59E-07	1.33E-05
Durabilla Formation <sup>c</sup>	17	7.99E-07	1.33E-05
Upper Hutton Sandstone <sup>c</sup>	18	8.04E-07	1.33E-05
Lower Hutton Sandstone <sup>c</sup>	19	7.80E-07	1.33E-05
Upper Evergreen Formation <sup>c</sup>	20	5.00E-07	1.33E-05
Boxvale Sandstone <sup>c</sup>	21	5.00E-07	1.33E-05
Lower Evergreen Formation <sup>c</sup>	22	5.00E-07	1.33E-05
Precipice Sandstone <sup>c</sup>	23	5.58E-07	1.33E-05
Moolayember Formation <sup>b</sup>	24	5.00E-07	1.33E-05
Clematis Sandstone <sup>b</sup>	25	5.00E-07	1.33E-05
Rewan Group <sup>b</sup>	26	5.00E-07	1.33E-05
Bandanna Formation non-productive zone <sup>b</sup>	27	5.00E-07	1.33E-05
Upper Bandanna Formation <sup>b</sup>	28	5.00E-07	1.33E-05
Lower Bandanna Formation <sup>b</sup>	29	5.00E-07	1.33E-05
Undifferentiated Bowen Basin strata <sup>b</sup>	30	5.00E-07	1.33E-05
Cattle Creek Formation non-productive zone <sup>b</sup>	31	5.00E-07	1.33E-05
Upper Cattle Creek Formation <sup>b</sup>	32	5.00E-07	1.33E-05
Lower Cattle Creek Formation <sup>b</sup>	33	5.00E-07	1.33E-05
Undifferentiated Bowen Basin strata <sup>b</sup>	34	5.00E-07	1.33E-05

**Table E2-1 Notes**

<sup>a</sup> Values pertain to the expected ranges of specific yield since layer 1 is used to represent unconfined surficial units (section 4.5)

<sup>b</sup> Non-permeameter model layer. Initial values based on application of equation 4.11 (section 4.5.2.1), lower bound based on minimum Ss values calculated for numerical permeameter layers and upper bound based on Rau, Acworth, Halloran, Timms, and Cuthbert (2018).

<sup>b</sup> Numerical permeameter model layer. Initial values and upper and lower bounds based on lithological realisations generated for numerical permeameter calculations (section 4.5.2.2) clipped where necessary based on Rau, Acworth, Halloran, Timms, and Cuthbert (2018).

based on application of equation 4.11 (section 4.5.2.1), lower bound based on minimum Ss values calculated for numerical permeameter layers and upper bounds based on Rau, Acworth, Halloran, Timms, and Cuthbert (2018).