Appendix F

F1 Background

An alternate model calibration was completed to assess the consequence of uncertainty and non-uniqueness in the model; this alternative calibrated model was used to complete predictions for the *Yalyalup Dewatering*, *Yalyalup Water Supply* and *No Development Scenarios*. The model parameters were adjusted to provide a more conservative case - the key differences between the uncertainty and the calibrated model are outlined below:

- The horizontal hydraulic conductivity (Kh) and vertical hydraulic conductivity (Kv) values assigned to following Superficial aquifer units were adjusted:
  - The Bassendean Sand Kh was reduced from 10 to 5 m/d and the Kv was reduced from 1 to 0.5 m/d.
  - The Guildford Formation Kh was reduced from 0.3 to 0.15 m/d and the Kv was reduced from 0.03 to 0.015 m/d.
  - The Yoganup Formation Kh was reduced from 5 to 2.5 m/d and the Kv was reduced from 0.5 to 0.25 m/d.
- The unconfined storage values assigned to all of the Superficial Formation were adjusted:
  - The specific yield of the Safety Bay Sand was reduced from 20% to 10%
  - The specific yield of the Tamala Limestone was reduced from 20% to 10%
  - The specific yield of the alluvium, estuarine mud unit was reduced from 10% to 5%
  - The specific yield of the alluvium and estuarine deposits and sand unit was reduced from 10% to 5%
  - The specific yield of the Bassendean Sand was reduced from 20% to 10%
  - The specific yield of the Guildford Formation was reduced from 10% to 5%
  - The specific yield of the Yoganup Formation was reduced from 20% to 10%
- The modelled aquifer recharge was reduced. The 200 mm annual threshold was reduced to 150mm with recharge assigned as follows:
  - When annual rainfall is less than 850 mm, recharge to groundwater is assigned at 30% of monthly rainfall.
  - When annual rainfall exceeds 850 mm, recharge to groundwater is assigned at 20% of monthly rainfall.

  Over the model calibration period (1987 to 2019) these recharge rates result in calculated annual recharge to groundwater of between 13% and 26% of recorded annual rainfall. The average recharge to groundwater over the calibration period is 20% of annual recorded rainfall, with the median recharge of 21% of annual recorded rainfall. These recharge rates are approximately 50% of the values assigned to the Base Case calibrated model. These reduced recharge rates are at the lower end of the range of recharge values for the South West Swan Coast Plain (Baddock, 2005).

F2 Calibration Hydrographs

Calibration hydrographs for the Uncertainty and Base Case calibrated models are shown in Figures F1 to F20. The locations of monitoring bores screened in the Superficial aquifer and used for model calibration, are shown in Figure 44 of the main report. The locations of monitoring bores screened in the Leederville and Yarragadee aquifers and used for model calibration, are shown in Figure 45 of the main report. Model calibration performance is described by general location in the sections below. The water level calibration performance for the Uncertainty Model is compared to the Base Case model.

F2.1 Proposed Yalyalup Mine Area

Measured and modelled water levels for the Base and Uncertainty Case calibrations for the Superficial aquifer are shown in Figures F1 to F7. The Uncertainty Case calibration model replicates the measured seasonal water level trends and water level magnitudes in the mine area. The seasonal fluctuations in water level simulated by the Uncertainty calibration are generally less pronounced than those predicted by the Base Case calibration.

Measured and modelled water levels for the Base and Uncertainty Case calibrations for the Leederville aquifer are presented in Figures F7 to F10. The magnitude of the Leederville aquifer measured water levels is generally matched by the Uncertainty calibration, with a maximum difference between measured and modelled water levels of 6 m. The seasonal water level trend in the Leederville aquifer is also replicated by the Uncertainty calibration, however, the long term decrease in water levels does not appear to be matched in the mine area. Similar to the Base Case calibration, this difference could be related to changes in abstraction from the Leederville aquifer that are not replicated in the current model set up (i.e. due to the approximations made to simulate the abstraction of GWLs in the modelled catchment).

F2.2 Downstream of Yalyalup (Coastal Area)

Measured and modelled water levels for the Superficial aquifer in the coastal area downstream of the proposed Yalyalup mine for the Base Case and Uncertainty calibrations are presented in Figures F10 to F13 The seasonal peaks and recessions in measured water levels are matched by the Uncertainty calibration model (including the magnitude of the seasonal responses), with measured and modelled water levels in general agreement. The maximum difference in measured and modelled water levels in this area is 2m.

Measured and modelled water levels for the Base Case and Uncertainty calibrations for the Leederville aquifer in the coastal area downstream of the proposed Yalyalup mine are presented in Figures F12 and F13. The measured water level response at 61019056 (Figure F13) is well matched by the Uncertainty calibration. The Uncertainty calibration does not however, simulate the measured water level decrease in the Leederville aquifer until 2019, although the model does replicate the seasonal trend in measured water levels.

F2.3 Agricultural Areas

Measured and modelled water levels from the Superficial aquifer in farm areas for the Base Case and the Uncertainty calibrations are presented in are presented in Figures F14 to F17. Measured water levels at Superficial aquifer bores in agricultural areas are matched by the Base Case and Uncertainty calibrations, with both the seasonal trends and water level elevations well matched. There are a few locations (61000121 in Figure F14 and 61000020 in Figure F16) where the water level is less well matched by the Uncertainty calibration and the difference between measured and modelled water levels is at times up to 2m. At 6100128 (Figure F17) water levels fluctuate up to

3m in response to rainfall recharge, however at this location the modelled response to rainfall recharge is 1 to 1.5m. As per the Base Case calibration, outlined in Section 9.4.2, the model uses a uniform distribution of recharge and ET across the modelled catchment and these distributions have not been zoned or divided further to replicate the measured water level response at specific locations.

F2.4 Groundwater Level Contours

Contours of predicted water table elevation for February and August 2018 are presented in Figures F21 and F22. Also shown are available measured water levels for the two periods. The general groundwater flow direction toward the coast and the water table elevation is matched by the Uncertainty calibration. Modelled water levels are generally within 1m of measured values in the mine area.

F2.5 Measured and Modelled Water Levels

Measured and modelled water levels for February and August 2018 are shown in Figures F23 and F24. Predicted water levels are shown for the end of summer and winter. Measured and modelled water levels are shown for the Superficial and Leederville aquifers.

For the February 2018 measured water levels, the difference between measured and modelled water levels is generally less than 5m. In some areas, the difference between measured and modelled water levels is up to 8m (23073124 and Lot668 Bore 2 in the Leederville aquifer). The majority of these bores with larger differences between measured and modelled water levels are screened in the Leederville aquifer, where there are uncertainties associated with the pumping associated with GWLs. These uncertainties are related to the amount of pumping that is associated with each GWL and the seasonal distribution, dating back to the start of the calibration period. Similar to the Base Case calibration, this may explain why there is a mismatch between measured and modelled water levels measured in the Leederville aquifer at the end of summer. There is however, no systematic over or under prediction of measured water levels. The Scaled Root Mean Squared (SRMS) error as a percentage of the range of measured heads for the February 2018 measured and modelled water levels is 7.8%, compared to the 7.8% calculated for the Base Case calibration.

For the August 2018 measured water levels, the difference between measured and modelled water levels is generally less than 4m. At most locations, the difference between measured and modelled water levels is between 1 and 2m in both Superficial and Leederville aquifers. In some areas, the difference between measured and modelled water levels is up to 4m (23073124 and Lot668 Bore 2 in the Leederville aquifer (i.e. at the same locations where water levels were over predicted in February 2018, outlined above). During winter there is likely to be less abstraction for irrigation and hence there is a better match to measured water levels in the Leederville aquifer. Similar to the February 2018 data, there is also no systematic over or under prediction of measured water levels. The Scaled Root Mean Squared (SRMS) error as a percentage of the range of measured heads for the August 2018 measured and modelled water levels is 7.4%, compared to the 6.7% calculated for the Base Case calibration.

Aquifers parameters have been assigned to replicate the majority of measured water levels and local scale features have not been added to achieve a better model calibration in local areas and in turn improve the SRMS error. There are other uncertainties in the model set up which may also contribute to the differences to measured and modelled water levels, including the amount of dewatering completed at Cristal's nearby mining operation and the total abstraction and the seasonal distribution of abstraction associated with GWLs in the modelled catchment.

F2.6 Aquifer Parameters

Aquifer parameters assigned to the Uncertainty model are summarised in Table F1. Also shown in Table F1 are the parameters assigned to the Base Case calibrated model (in brackets and italics). The modelled aquifer zone distributions for model layers are unchanged from the calibrated model (refer Section 9.6.4.) Aquifer parameter values are generally consistent with published and test values, but are at the lower end of the parameter ranges.

Table F1: Calibrated Aquifer Parameters Uncertainty and Base Case Models

Layer	Aquifer Units	Horizontal Hydraulic Conductivity, Kh (m/d)	Vertical Hydraulic Conductivity, Kv (m/d)	S	Sy (%)
1	Alluvium, Estuarine Deposits, & Sand derived from Tamala Limestone	5 *(5)*	0.5 *(0.5)*	NA *(NA)*	5 *(10)*
	Alluvium and Estuarine Mud	0.01 *(0.01)*	0.0001 *(0.0001)*	NA *(NA)*	5 *(10)*
	Safety Bay Sand	15 *(15)*	0.15 *(0.15)*	NA *(NA)*	10 *(20)*
2	Bassendean Sand	5 *(10)*	0.5 *(1)*	NA *(NA)*	10 *(20)*
	Tamala Limestone	25 *(50)*	2.5 *(5)*	0.0001*(0.0001)*	10 *(20)*
3	Guildford Formation	0.15 *(0.3)*	0.015 *(0.03)*	0.0001 *(0.0001)*	5 *(10)*
4	Yoganup Formation	2.5 *(5)*	0.25 *(0.5)*	0.0001 *(0.0001)*	10 *(20)*
5	Leederville Formation Mowen Member	0.01 *(0.01)*	0.0001 *(0.0001)*	0.0001 *(0.0001)*	5 *(5)*
6	Leederville Formation Vasse Member North	1 *(1)*	0.0001 *(0.0001)*	0.0001 *(0.0001)*	10 *(10)*
6	Leederville Formation Vasse Member South	1 *(1)*	0.001 *(0.001)*	0.0001 *(0.0001)*	10 *(10)*
7	Yarragadee Formation	*7 (7)*	0.07 *(0.07)*	0.0001 *(0.0001)*	10 *(10)*

Apart from the changes outlined above, all other model details are unchanged from the Base Case calibrated model.

F2.7 Water Balance

Predicted water balances for the calibrated model for February 2018 and August 2018 for the Uncertainty Calibration are presented in Table F2. The corresponding values for the Base Case calibrated model are also shown in Table F2 in brackets and italics.

Table F2: Model Predicted Water Balances

Water Budget Component	August 2018		February 2018	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	0 *(0)*	113,160 *(399,670)*	36,315 *(86,560)*	0 *(0)*
Recharge	321,990 *(646,410)*	0 *(0)*	0 *(0)*	0 *(0)*
Catchment Inflow	42,455 *(42,520)*	0 *(0)*	71,380 *(73,070)*	0 *(0)*
Catchment Outflow	0 *(0)*	48,850 *(52,920)*	0 *(0)*	18,000 *(18,820)*
Cristal Dewatering	0 *(0)*	1,530 *(2,630)*	0 *(0)*	295 *(690)*
Licensed Abstraction	0 *(0)*	6,040 *(6,040)*	0 *(0)*	*57,540 (57,540)*
ET	0 *(0)*	195,135 *(227,670)*	0 *(0)*	31,595 *(82,580)*
Total	364,445 *(688,930)*	364,445 *(688,930)*	107,695 *(159,630)*	107,695 *(159,630)*

The model predicted water balances show the reduction rainfall recharge assigned to the Uncertainty calibration (and the associated reduction in groundwater storage) compared to the Base Case calibration. ET losses in the Uncertainty calibration are reduced compared to the Base Case calibration. However, ET is still one of the largest water balance fluxes from the modelled catchment during August 2018. In February 2018 however, licenced abstraction exceeds ET losses and all other outflows from the modelled catchment.

F3 Model Predictions

F3.1 Model Setup

Model predictions were run using the calibrated Uncertainty Model. Apart from the changes made to the assigned aquifer parameters and the modelled rainfall recharge outlined in Section F1, all other details of model predictions remain unchanged from the model predictions described in Section 9.8 of the main report. Wet and dry climatic rainfall recharge was calculated for the operational period using the recharge assumptions outlined in Section F1 and dry climatic conditions (July 2003 to December 2006) and wet climatic conditions (July 1997 to December 2000). Wet and dry climatic rainfall recharge was calculated for the closure period using the recharge assumptions outlined in Section F1 and dry climatic conditions (January 2007 to December 2016) and wet climatic conditions (January 2001 to December 2010).

A summary of model predictions completed is presented in Table F3.

Table F3: Summary of Model Predictions

Scenario	Operational Period (July 2021 to December 2024)	Closure Period (January 2025 to December 2034)
Yalyalup Dewatering Scenario 1	Initial conditions from calibrated model Abstraction from other users at 80% of GWL allocation (August to April for agricultural users and all year for non- agricultural users). Dewatering at Yalyalup Dry Climatic Conditions (July 2003 to December 2006)	No further mining at Yalyalup No further water supply pumping for Yalyalup Abstraction from other users at 100% of GWL allocation (September to April for agricultural users and all year for non- agricultural users). Climatic conditions from 1 January 2007 to 31 December 2016
Yalyalup Dewatering Scenario 2	Initial conditions from calibrated model Abstraction from other users at 80% of GWL allocation (August to April for agricultural users and all year for non- agricultural users). Dewatering at Yalyalup Wet Climatic Conditions (July 1997 to December 2000)	No further mining at Yalyalup No further water supply pumping for Yalyalup Abstraction from other users at 100% of GWL allocation (September to April for agricultural users and all year for non- agricultural users). Climatic conditions from 1 January 2001 to 31 December 2010
Yalyalup Water Supply Scenario 1	Initial conditions from calibrated model Abstraction from other users at 80% of GWL allocation (August to April for agricultural users and all year for non- agricultural users). Yalyalup Yarragadee Water Supply Dry Climatic Conditions (July 2003 to December 2006)	Abstraction from other users at 100% of GWL allocation (September to April for agricultural users and all year for non- agricultural users). No further water supply pumping for Yalyalup Climatic conditions from 1 January 2007 to 31 December 2016
Yalyalup Water Supply Scenario 2	Initial conditions from calibrated model Abstraction from other users at 80% of GWL allocation (August to April for agricultural users and all year for non- agricultural users). Yalyalup Yarragadee Water Supply Wet Climatic Conditions (July 1997 to December 2000)	Abstraction from other users at 100% of GWL allocation (September to April for agricultural users and all year for non- agricultural users). No further water supply pumping for Yalyalup Climatic conditions from 1 January 2001 to 31 December 2010
No Yalyalup Development Scenario 1	Initial conditions from calibrated model Abstraction from other users at 80% of GWL allocation (August to April for agricultural users and all year for non- agricultural users). Dry Climatic Conditions (July 2003 to December 2006)	Abstraction from other users at 100% of GWL allocation (September to April for agricultural users and all year for non- agricultural users). Climatic conditions from 1 January 2007 to 31 December 2016
No Yalyalup Development Scenario 2	Initial conditions from calibrated model Abstraction from other users (August to April for agricultural users and all year for non-agricultural users). Wet Climatic Conditions (July 1997 to December 2000)	Abstraction from other users Climatic conditions from 1 January 2001 to 31 December 2010

F3.2 Results

F3.2.1 Dewatering

Predicted monthly groundwater inflows for the wet and dry climatic conditions for the Uncertainty Calibration are shown in Figure F25. Also shown in Figure F25 are the predicted groundwater inflows for the Base Case calibration. Groundwater inflows are predicted to vary with depth of mining and season for both Cases. For the Uncertainty calibration and dry conditions, dewatering is predicted to peak at 1,450 kL/d in May 2023. There is a peak in groundwater inflows when wet conditions are included in the Uncertainty Case of 7,600 kL/d, in July 2023. Overall, groundwater inflows predicted for the Uncertainty Case predictions are less than those predicted for the Base Case predictions. There are some isolated peaks in predicted inflows predicted for the Uncertainty Case that includes wet conditions, however these are of short duration. Overall however, cumulative dewatering volumes for the Uncertainty Cases are less than the corresponding Base Cases.

Predicted cumulative annual abstraction from the Superficial aquifer over the life of the mine for the Uncertainty Case ranges from approximately 0.2 to 0.5 GL/year (average of 0.31 GL/year) for the wet climatic scenario and from 0.08 to 0.16 GL/year (average of 0.13 GL/year) for the dry climatic scenario. These predicted groundwater inflow rates are less than those predicted for the Base Case (refer Section 9.9.1.1).

F3.2.2 Predicted Water Levels

F3.2.2.1 Yalyalup Dewatering and Closure

Predicted water levels for selected shallow (Superficial aquifer) and Leederville observation locations over the calibration period (1987 to 2019), the operational period (2021 to 2024) and the subsequent closure period (2025 to 2034) for the *Yalyalup Dewatering* Scenarios for the Uncertainty and Base Case Predictions are shown in Figures F26 to F28. Predicted water levels are also shown for wet and dry climatic conditions. For positions of observation locations refer to Figure 70 of the main report.

Predicted water levels suggest that for the Uncertainty Case, similar water level responses are predicted when compared to the Base Case predictions. The predicted recovery of groundwater levels once mining is complete is similar for the Uncertainty and Base Case predictions.

F3.2.2.2 Yalyalup Water Supply Only

Predicted water levels for selected shallow (Superficial aquifer) and Leederville observation locations over the calibration period (1987 to 2019), the operational period (2021 to 2024) and the subsequent closure period (2025 to 2034) for the *Yalyalup Water Supply* Scenarios for the Uncertainty and Base Case Predictions are shown in Figures F29 to F31. For positions of observation locations refer to Figure 70.

Predicted water levels suggest that for the Uncertainty Case, similar water level responses are predicted when compared to the Base Case predictions.

F3.3 Water Balance

The predicted water levels described in Section F3.2.1 above and shown in Figures F26 to F31 show that the water level impacts associated with mining are limited to the immediate mine area. Predicted water levels also show that water levels in the shallow aquifers recover rapidly after the end of mining. The modelled water balances for the Uncertainty Cases, that achieve model calibration by assuming lower aquifer specific yield values and less recharge (than the Base Case calibration) are compared to the Base Case predicted water balances below.

F3.3.1 Operational Period

The model predicted water balances for August 2023 and February 2024 are shown in Tables F4 and F5 for the *Yalyalup Dewatering* and *Yalyalup Water Supply* Predictions completed using the Uncertainty Calibration. Water balances are shown for wet and dry climatic inputs. Also shown in brackets and italics are the predicted water balance components for the corresponding Base Case *Yalyalup Dewatering* and *Yalyalup Water Supply* Scenarios.

The model predicted water balances for the Uncertainty and Base Case Predictions show:

- The changes in recharge to and ET from the modelled catchments

- A reduction in the predicted Doral dewatering and Cristal dewatering due to the reduction in assigned aquifer specific yield and hydraulic conductivity.
- Similar model groundwater inflows and outflow for the Base and Uncertainty predictions
- An overall reduction in the water fluxes in and out of the modelled catchment for the Uncertainty calibration, related to the reduced unconfined aquifer storage and modelled recharge.

Table F4: Yalyalup Dewatering Dry Climate Model Predicted Water Balance

Water Budget Component	Wet Season (August 2023)		Dry Season (February 2024)	
	In (kL/d)	**Out (kL/d)**	**In (kL/d)**	**Out (kL/d)**
Storage	1,480	92,120	39,680	160
	(1,260)	*(237,800)*	*(84,360)*	*(280)*
Recharge	242,100	0	0	0
	(486,620)	*0*	*0*	*0*
Catchment Inflow	65,090	0	75,910	0
	(66,540)	*(0)*	*(77,910)*	*(0)*
Catchment Outflow	0	22,460	0	18,180
	(0)	*(27,850)*	*(0)*	*(18,800)*
Estimated Cristal Dewatering*	0	2,800	0	1,060
	(0)	*(5,830)*	*(0)*	*(2,410)*
Doral Dewatering	0	450	0	170
	(0)	*(2,320)*	*(0)*	*(350)*
Doral Water Supply	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(58,030)*	*(0)*	*(58,030)*
ET	0	132,810	0	37,990
	(0)	*(222,590)*	*(0)*	*(82,400)*
Total	**308,670**	**308,670**	**115,590**	**115,590**
	(554,420)	***(554,420)***	***(162,270)***	***(162,270)***

Water balance components for the Base Case Yalyalup Dewatering and Water Supply Scenario shown in brackets and italics

Table F5: Yalyalup Dewatering Wet Climate Model Predicted Water Balance

Water Budget Component	Wet Season (August 2023)		Dry Season (February 2024)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	41,860	4,540	41,360	180
	(45,710)	*(20,440)*	*(90,090)*	*(250)*
Recharge	174,070	0	0	0
	(348,620)	*0*	*0*	*0*
Catchment Inflow	63,620	0	75,600	0
	(64,270)	*(0)*	*(77,550)*	*(0)*
Catchment Outflow	0	24,810	0	18,250
	(0)	*(32,460)*	*(0)*	*(18,830)*
Estimated Cristal Dewatering*	0	3,350	0	170
	(0)	*(7,060)*	*(0)*	*(2,510)*
Doral Dewatering	0	540	0	1,070
	(0)	*(1,070)*	*(0)*	*(360)*
Doral Water Supply	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(58,030)*	*(0)*	*(58,030)*
ET	0	188,280	0	39,260
	(0)	*(339,540)*	*(0)*	*(87,660)*
Total	**279,550**	**279,550**	**116,960**	**116,960**
	(458,600)	***(458,600)***	***(167,640)***	***(167,640)***

Water balance components for the Base Case Yalyalup Dewatering and Water Supply Scenario shown in brackets and italics

The model predicted water balances for August 2023 and February 2024 for the *Yalyalup Water Supply* Predictions are shown in Tables F6 and F7. Water balances are shown for wet and dry climatic inputs. Also shown in brackets and italics are the predicted water balance components for the corresponding Base Case *Yalyalup Water Supply* Scenarios.

The model predicted water balances for the *Yalyalup Water Supply* Scenario Uncertainty Case Predictions show similar changes to the modelled water balance components as the *Yalyalup Dewatering* Scenario (less recharge and ET and overall total modelled water balance). The total modelled water fluxes in and out of the modelled catchment are comparable to the Uncertainty *Yalyalup Water Supply* and *Yalyalup Dewatering* Scenarios.

Table F6: Yalyalup Water Supply Only Dry Climate Model Predicted Water Balance

Water Budget Component	Wet Season (August 2023)		Dry Season (February 2024)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	30,400	7,210	51,260	40
	(1,280)	*(238,040)*	*(84,780)*	*(20)*
Recharge	174,070	0	0	0
	(486,620)	*0*	*0*	*0*
Catchment Inflow	66,780	0	77,790	0
	(68,870)	*(0)*	*(80,500)*	*(0)*
Catchment Outflow	0	23,690	0	17,590
	(0)	*(27,020)*	*(0)*	*(17,870)*
Estimated Cristal Dewatering*	0	3,180	0	1,260
	(0)	*(5,800)*	*(0)*	*(2,390)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	4,380	0	4,380
	(0)	*(4,380)*	*(0)*	*(4,380)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(58,030)*	*(0)*	*(58,030)*
ET	0	174,760	0	47,750
	(0)	*(223,500)*	*(0)*	*(82,590)*
Total	**271,250**	**271,250**	**129,050**	**129,050**
	(556,770)	***(556,770)***	***(165,280)***	***(165,280)***

Water balance components for the Base Case Yalyalup Water Supply Scenario shown in brackets and italics

Table F7: Yalyalup Water Supply Only Wet Climate Model Predicted Water Balance

Water Budget Component	Wet Season (August 2023)		Dry Season (February 2024)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	46,380	18,990	90,770	0
	(46,160)	*(19,020)*	*(90,430)*	*(0)*
Recharge	348,620	0	0	0
	348,620	*0*	*0*	*0*
Catchment Inflow	69,870	0	82,990	0
	(66,640)	*(0)*	*(80,150)*	*(0)*
Catchment Outflow	0	29,630	0	16,120
	(0)	*(31,600)*	*(0)*	*(17,890)*
Estimated Cristal Dewatering*	0	7,020	0	2,480
	(0)	*(7,060)*	*(0)*	*(2,510)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	4,380	0	4,380
	(0)	*(4,380)*	*(0)*	*(4,380)*
Licensed Abstraction	0	64,260	0	64,260
	(0)	*(58,030)*	*(0)*	*(58,030)*
ET	0	340,590	0	86,520
	(0)	*(341,330)*	*(0)*	*(87,770)*
Total	**464,870**	**464,870**	**173,760**	**173,760**
	(461,420)	***(461,420)***	***(170,580)***	***(170,580)***

Water balance components for the Base Case Yalyalup Water Supply Scenario shown in brackets and italics

F3.3.2 Closure Period

The model predicted water balances for August 2033 and February 2034 for the Uncertainty Case *Yalyalup Dewatering and Water Supply* Scenarios, ten years after dewatering and water supply pumping has ceased are shown in Tables F8 and F9. Water balances are shown for wet and dry climatic inputs. Also shown in brackets and italics are the predicted water balance components for the corresponding Base Case Prediction.

The model predicted water balances for the *Yalyalup Dewatering* Scenario Uncertainty Case Predictions show similar changes to the modelled water balance components as the modelled water balance described above (less recharge and ET and overall total modelled water balance).

Table F8: Yalyalup Dewatering Dry Climate Model Predicted Water Balance (Closure)

Water Budget Component	Wet Season (August 2033)		Dry Season (February 2034)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	3,000	55,600	36,190	20
	(1,330)	*(180,930)*	*(70,740)*	*(0)*
Recharge	212,320	0	0	0
	440,620	*0*	*0*	*0*
Catchment Inflow	64,550	0	76,400	0
	(65,940)	*(0)*	*(78,620)*	*(0)*
Catchment Outflow	0	21,170	0	18,050
	(0)	*(28,290)*	*(0)*	*(18,530)*
Estimated Cristal Dewatering*	0	2,890	0	910
	(0)	*(5,940)*	*(0)*	*(2,010)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	0	0	0
	(0)	*(58,030)*	*(0)*	*(58,030)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(0)*	*(0)*	*(0)*
ET	0	142,180	0	35,580
	(0)	*(234,700)*	*(0)*	*(70,790)*
Total	**279,870**	**279,870**	**112,590**	**112,590**
	(507,890)	***(507,890)***	***(149,360)***	***(149,360)***

Water balance components for the Base Case Yalyalup Dewatering and Water Supply Scenario shown in brackets and italics

Table F9: Yalyalup Dewatering Wet Climate Model Predicted Water Balance (Closure)

Water Budget Component	Wet Season (August 2033)		Dry Season (February 2034)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	47,030	1,870	35,000	30
	(0)	*(412,000)*	*(68,220)*	*(0)*
Recharge	61,740	0	0	0
	(627,040)	*0*	*0*	*0*
Catchment Inflow	65,420	0	76,580	0
	(47,480)	*(0)*	*(78,770)*	*(0)*
Catchment Outflow	0	21,170	0	18,050
	(0)	*(48,290)*	*(0)*	*(18,500)*
Estimated Cristal Dewatering*	0	2,030	0	870
	(0)	*(6,170)*	*(0)*	*(1,960)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	0	0	0
	(0)	*(6,230)*	*(0)*	*(58,030)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(0)*	*(0)*	*(0)*
ET	0	91,090	0	34,600
	(0)	*(201,830)*	*(0)*	*(68,500)*
Total	**174,190**	**174,190**	**111,580**	**111,580**
	(674,520)	***(674,520)***	***(146,990)***	***(146,990)***

Water balance components for the Base Case Yalyalup Dewatering and Water Supply Scenario shown in brackets and italics

The model predicted water balances for August 2033 and February 2034 for the Uncertainty Case *Yalyalup Water Supply Only* Scenarios, ten years after dewatering and water supply pumping has ceased are shown in Tables F10 and F11. Water balances are shown for wet and dry climatic inputs. Also shown in brackets and italics are the predicted water balance components for the corresponding Base Case Prediction.

The model predicted water balances for the *Yalyalup Water Supply* Scenario Uncertainty Case Predictions show similar changes to the modelled water balance components as the modelled water balance described above (less recharge and ET and overall total modelled water balance).

Table F10: Yalyalup Water Supply Only Dry Climate Model Predicted Water Balance (Closure)

Water Budget Component	Wet Season (August 2033)		Dry Season (February 2034)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	1,160	99,150	36,190	20
	(1,330)	*(180,930)*	*(70,740)*	*(0)*
Recharge	266,310	0	0	0
	(440,620)	*0*	*0*	*0*
Catchment Inflow	66,400	0	76,400	0
	(65,940)	*(0)*	*(78,620)*	*(0)*
Catchment Outflow	0	21,640	0	18,050
	(0)	*(28,290)*	*(0)*	*(18,530)*
Estimated Cristal Dewatering*	0	2,790	0	910
	(0)	*(5,940)*	*(0)*	*(2,010)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	0	0	0
	(0)	*(58,030)*	*(0)*	*(58,030)*
Licensed Abstraction	0	58,030	0	58,030
	(0)	*(0)*	*(0)*	*(0)*
ET	0	152,260	0	35,580
	(0)	*(234,700)*	*(0)*	*(70,790)*
Total	**333,870**	**333,870**	**112,590**	**112,590**
	(507,890)	***(507,890)***	***(149,360)***	***(149,360)***

Water balance components for the Base Case Yalyalup Water Supply Scenario shown in brackets and italics

Table F11: Yalyalup Water Supply Only Wet Climate Model Predicted Water Balance (Closure)

Water Budget Component	Wet Season (August 2033)		Dry Season (February 2034)	
	In (kL/d)	Out (kL/d)	In (kL/d)	Out (kL/d)
Storage	0	171,530	34,140	20
	(0)	*(412,000)*	*(68,220)*	*(0)*
Recharge	312,310	0	0	0
	(627,040)	*0*	*0*	*0*
Catchment Inflow	45,720	0	76,680	0
	(47,480)	*(0)*	*(78,770)*	*(0)*
Catchment Outflow	0	43,910	0	18,030
	(0)	*(48,290)*	*(0)*	*(18,500)*
Estimated Cristal Dewatering*	0	3,040	0	850
	(0)	*(6,170)*	*(0)*	*(1,960)*
Doral Dewatering	0	0	0	0
	(0)	*(0)*	*(0)*	*(0)*
Doral Water Supply	0	0	0	0
	(0)	*(6,230)*	*(0)*	*(58,030)*
Licensed Abstraction	0	6,230	0	58,030
	(0)	*(0)*	*(0)*	*(0)*
ET	0	133,320	0	33,890
	(0)	*(201,830)*	*(0)*	*(68,500)*
Total	**358,030**	**358,030**	**110,820**	**110,820**
	(674,520)	***(674,520)***	***(146,990)***	***(146,990)***

Water balance components for the Base Case Yalyalup Water Supply Scenario shown in brackets and italics

F3.4. Drawdown

F3.4.1 Yalyalup Dewatering and Water Supply

Contours of predicted water table drawdown, over the mine life, for the Uncertainty Case *Yalyalup Dewatering* Scenarios are shown in Figures F32 to F35 for the dry climatic conditions. Predicted drawdown is shown for Quarter 4 of each year of mining.

These drawdowns are the difference between the water levels predicted at each selected time interval for the *Yalyalup Dewatering* Scenario and the corresponding *No Yalyalup Development* Scenario. Also shown on these figures are the corresponding Base Case contours of predicted drawdown. The drawdown predicted for the Uncertainty and Base Case predictions are similar for each year shown during mining with the drawdown predicted for the Uncertainty Case slightly less than that predicted for the Base Case.

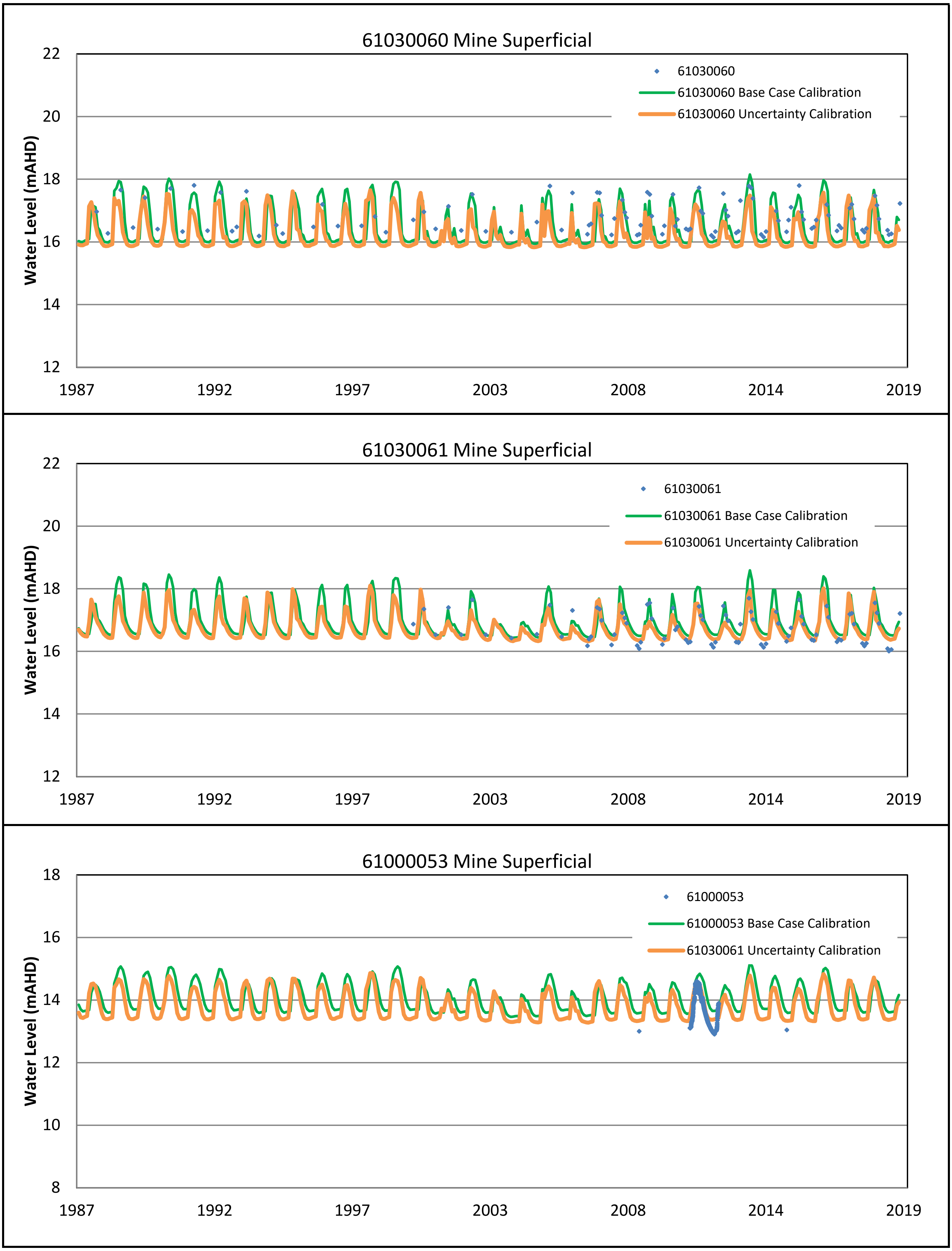
Contours of predicted drawdown in the Leederville aquifer from dewatering of the Yalyalup mine (*Yalyalup Dewatering* Scenario) are shown in Figure F36 for the Uncertainty Case. Contours of predicted drawdown are shown for September 2024, when predicted drawdown is greatest. This drawdown is calculated by subtracting predicted water levels for the Leederville aquifer for the Uncertainty Case *Yalyalup Dewatering* Scenario from the Uncertainty Case *No Yalyalup Development* Scenario . Also shown are the corresponding Base Case contours of predicted drawdown. Predicted drawdown is similar for both the Uncertainty and Base Cases with the drawdown predicted for the Uncertainty Case slightly less than that predicted for the Base Case.

F3.4.2 Yalyalup Water Supply Only

For the Uncertainty Case *Yalyalup Water Supply* Scenario, contours of predicted water level drawdown for the Leederville and Yarragadee aquifers at the end of 2024 for dry climatic conditions are shown in Figures F37 and F38. Similar to the predicted water table drawdown contours, these contours are calculated as the difference between predicted water levels for the Leederville and Yarragadee aquifers for the Uncertainty Case *Yalyalup Water Supply* Scenario and the Uncertainty Case *Yalyalup No Development* Scenario. Also shown are the corresponding Base Case contours of predicted drawdown. Predicted drawdown is similar for both the Uncertainty and Base Cases.

F4 Conclusions

The model predicted water levels and contours of predicted drawdown suggest that the predicted drawdown impacts of mine dewatering and water supply for the Yalyalup mine are similar for the Uncertainty Case and the Base Case. As would be expected from a model that is calibrated using lower values of aquifer storage and rainfall recharge, the Uncertainty model predicts lower groundwater inflows to the proposed Yalyalup mine and a lower modelled catchment water balance. The Uncertainty Case also predicts a smaller reduction in water table drawdown when compared to the Base Case.



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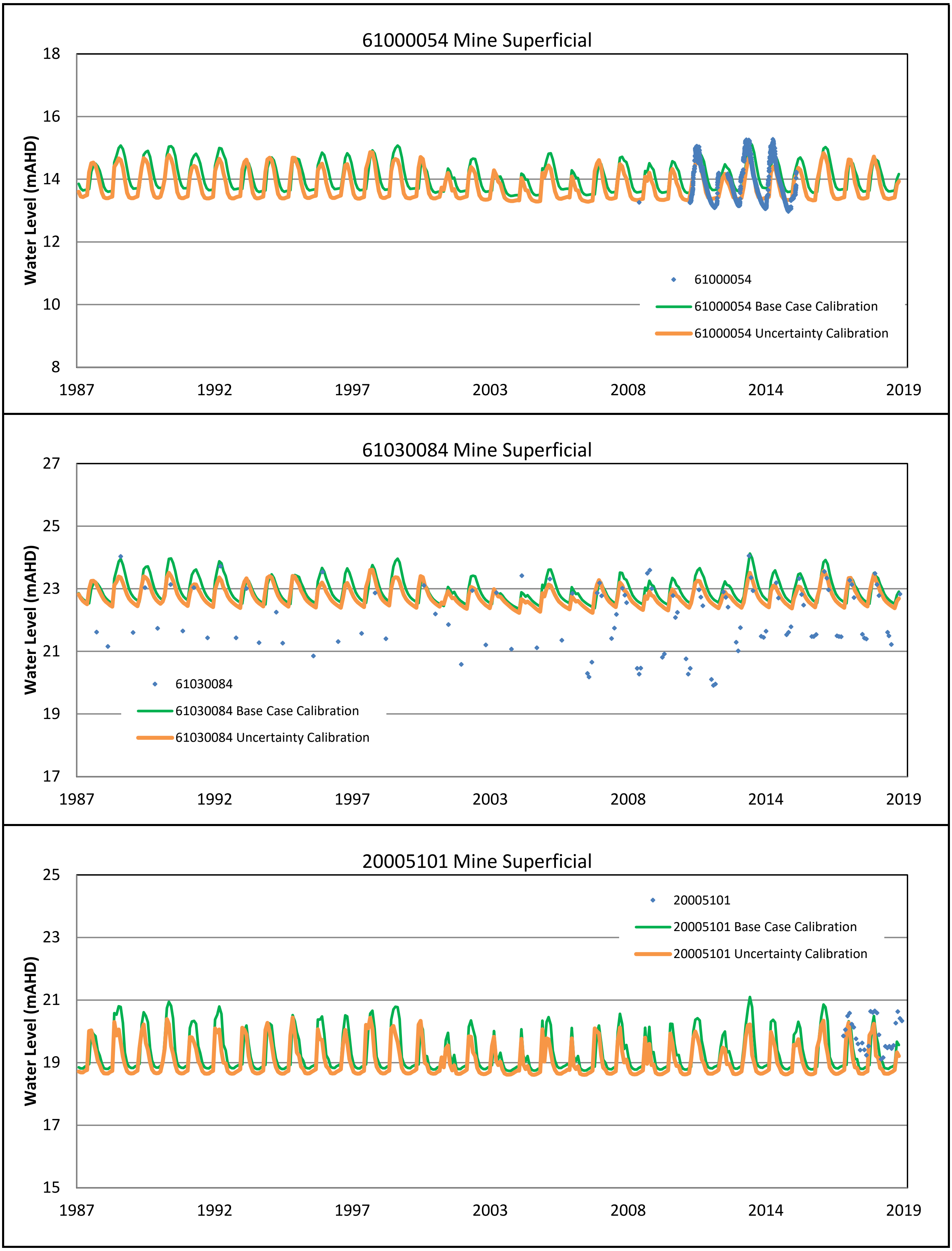
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F1

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F1



CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F2

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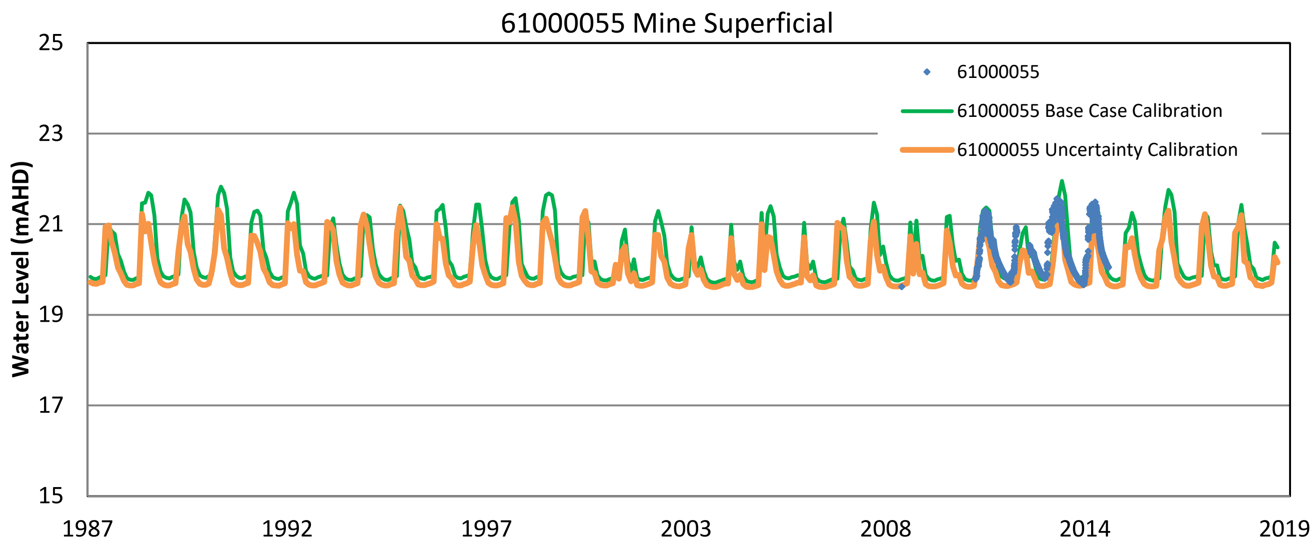

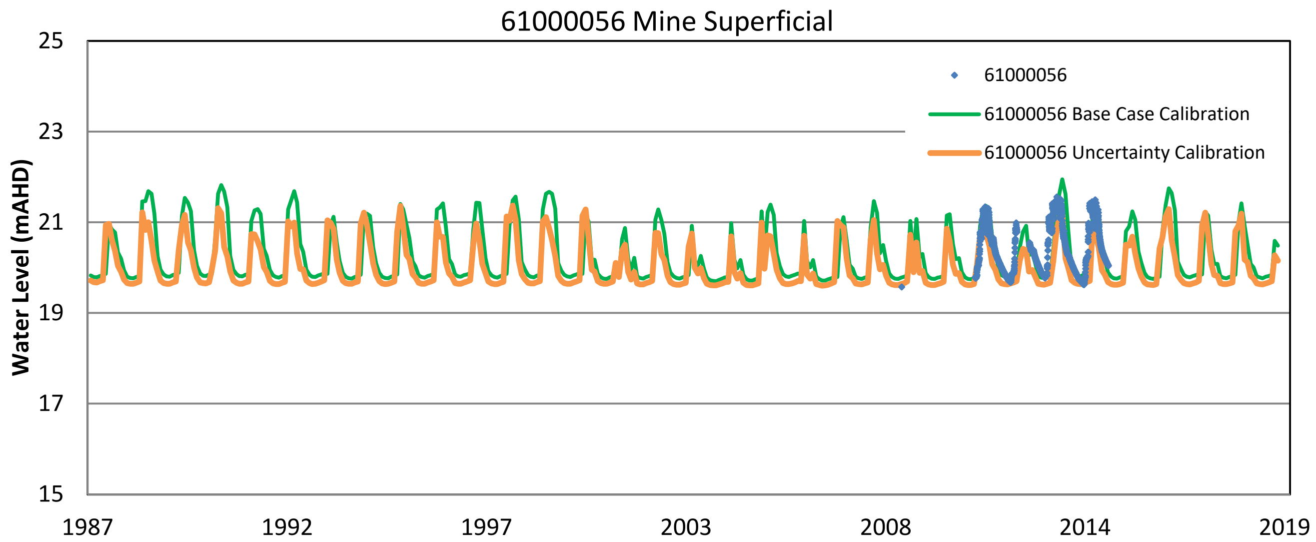

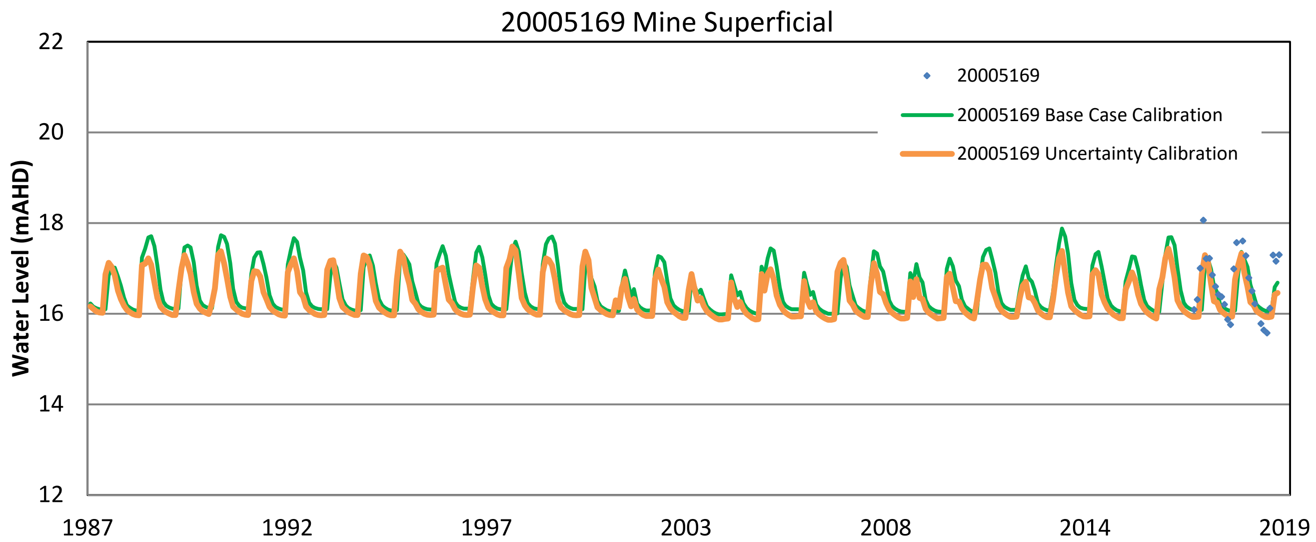

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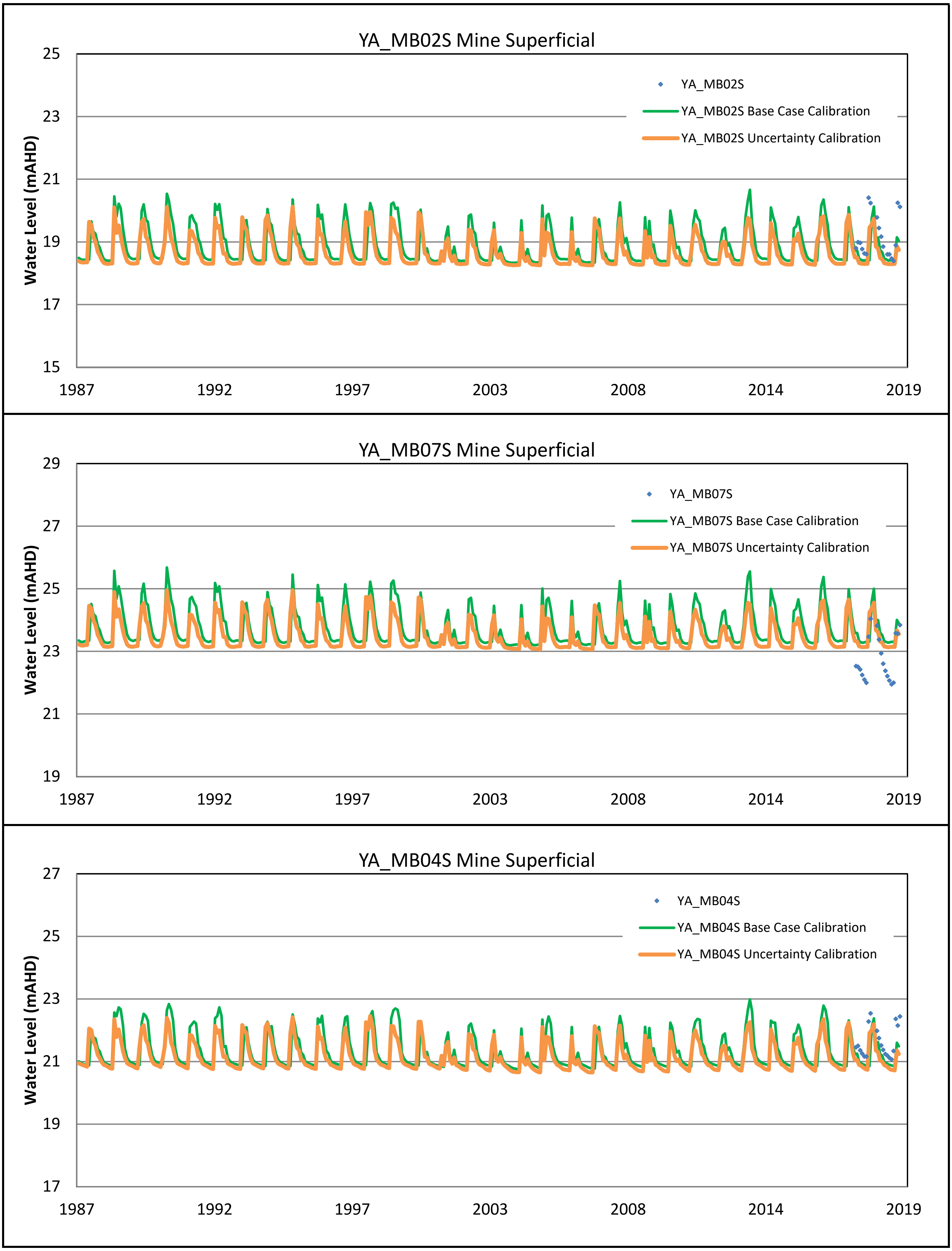
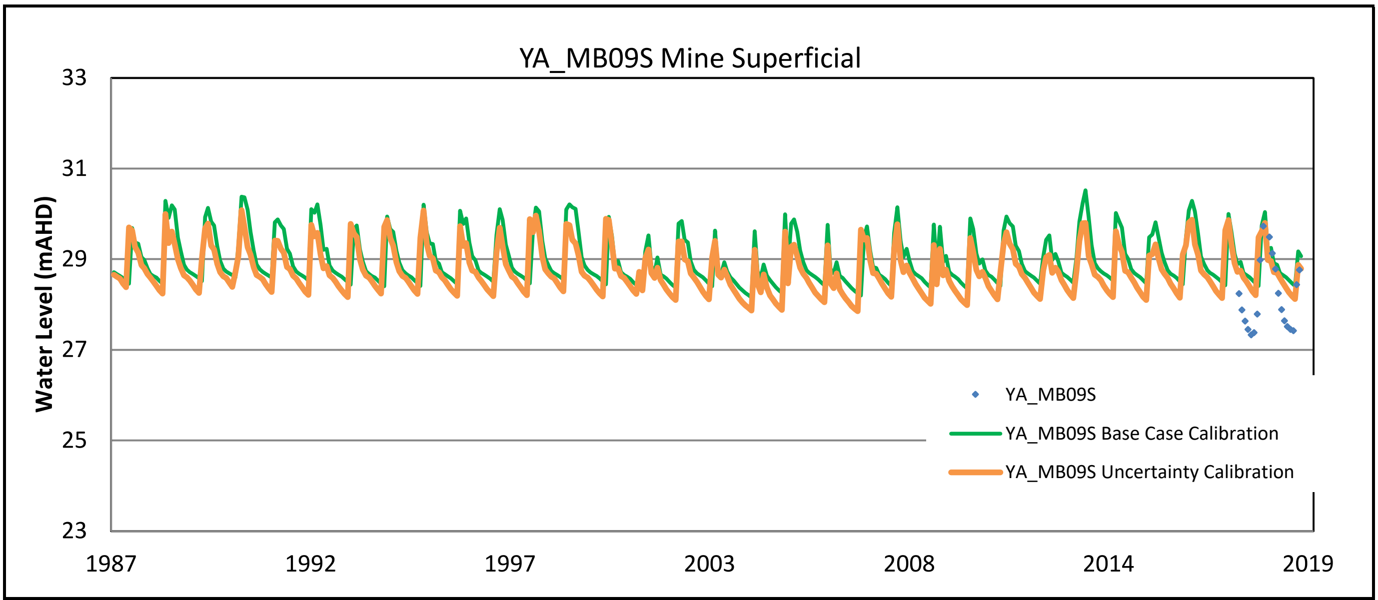
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F3

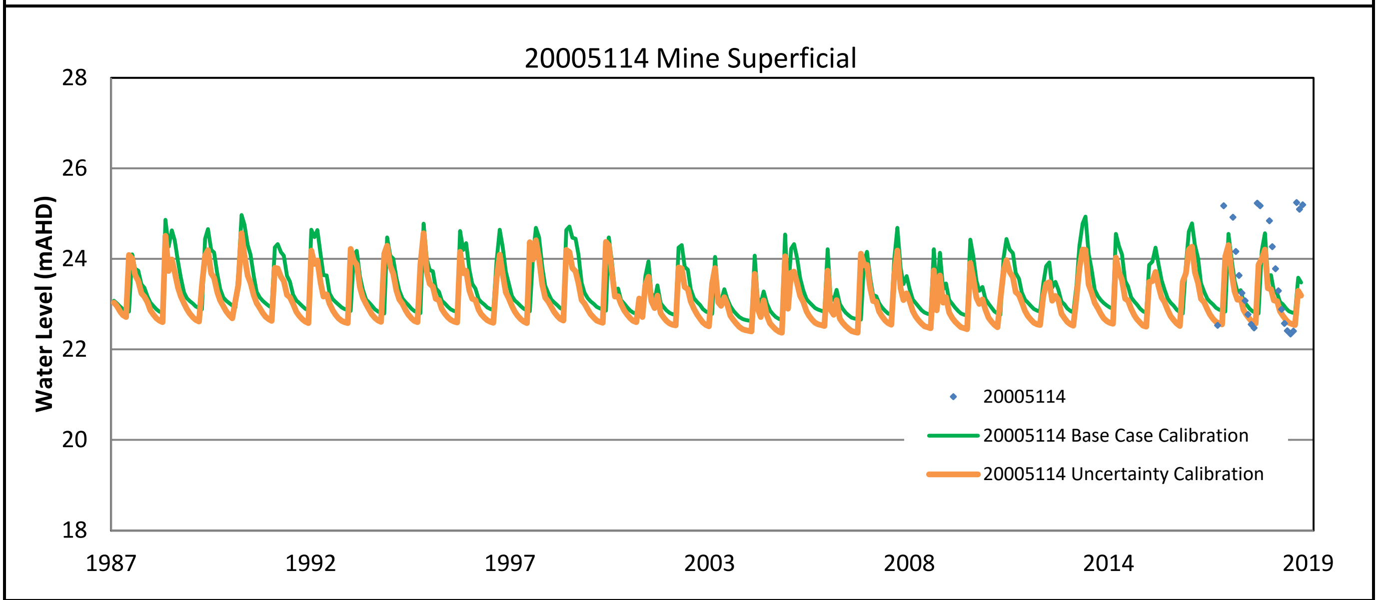
F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F3

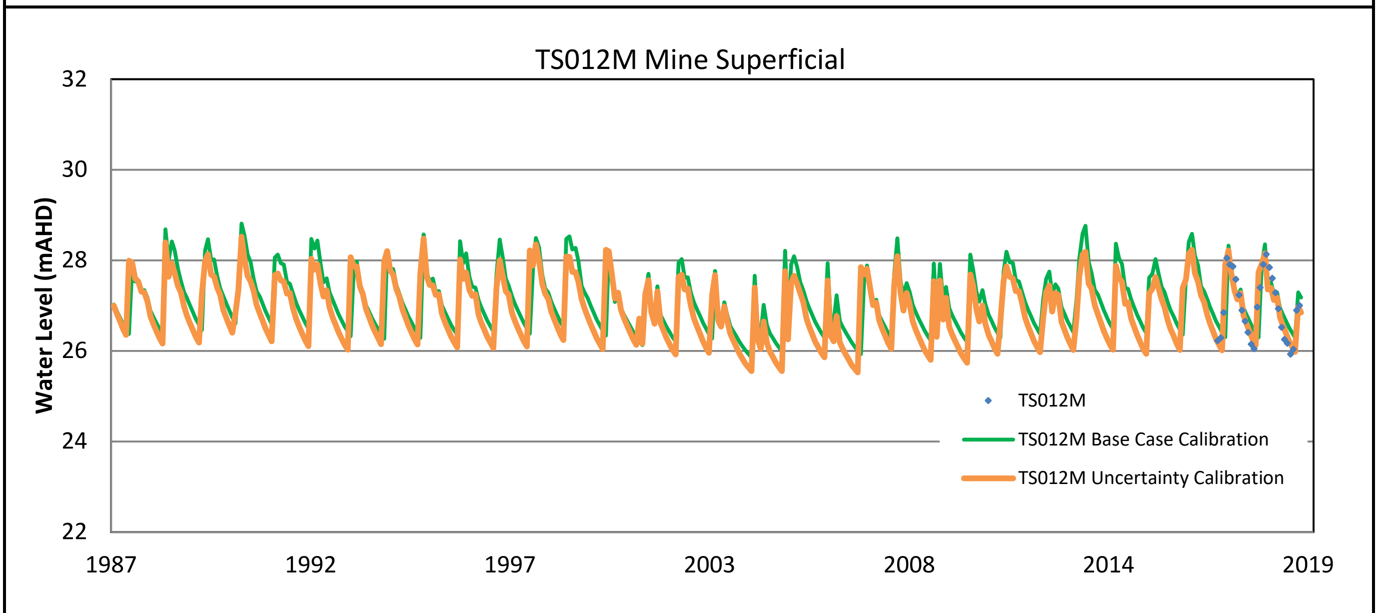


CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F4

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F4







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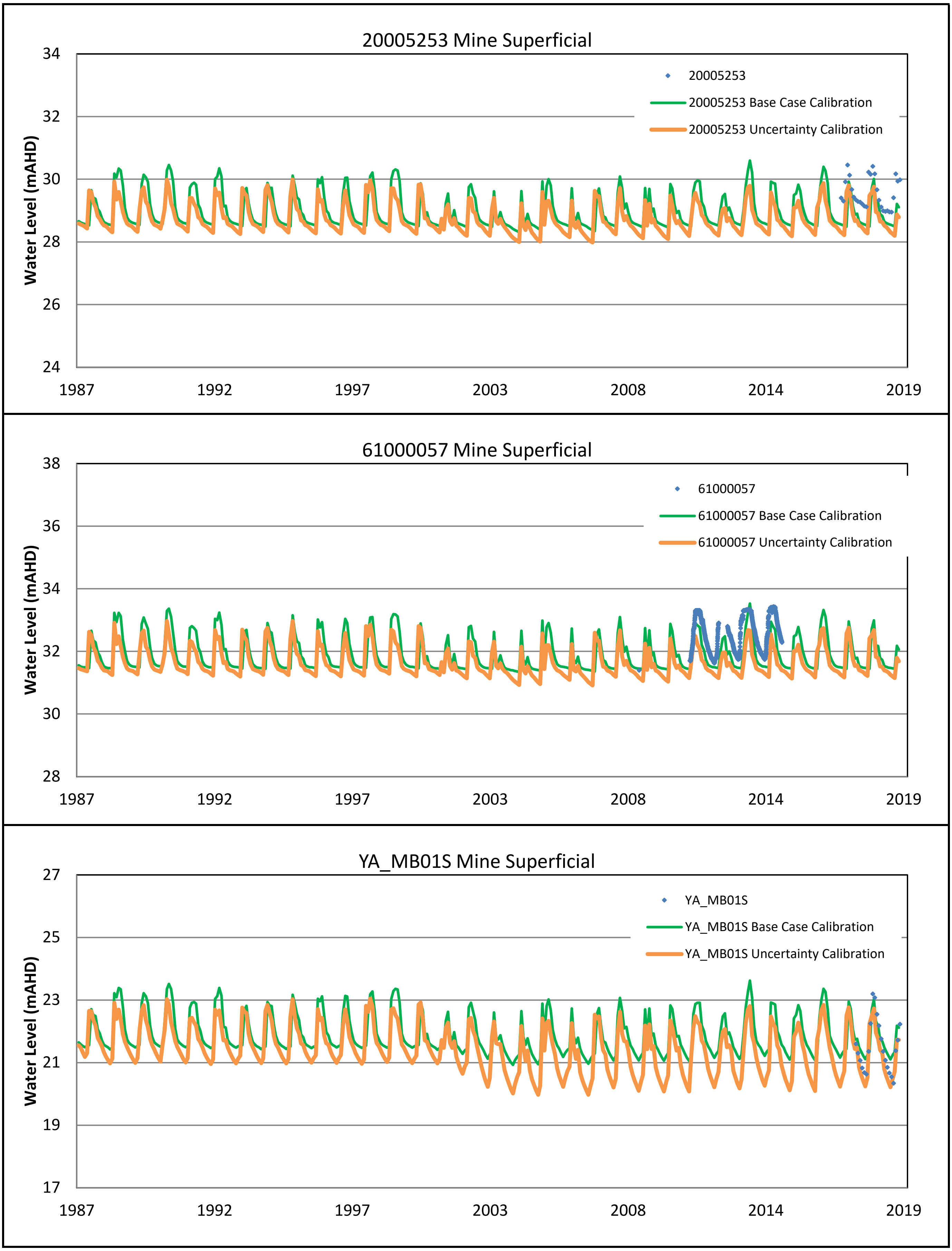
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F5

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F5



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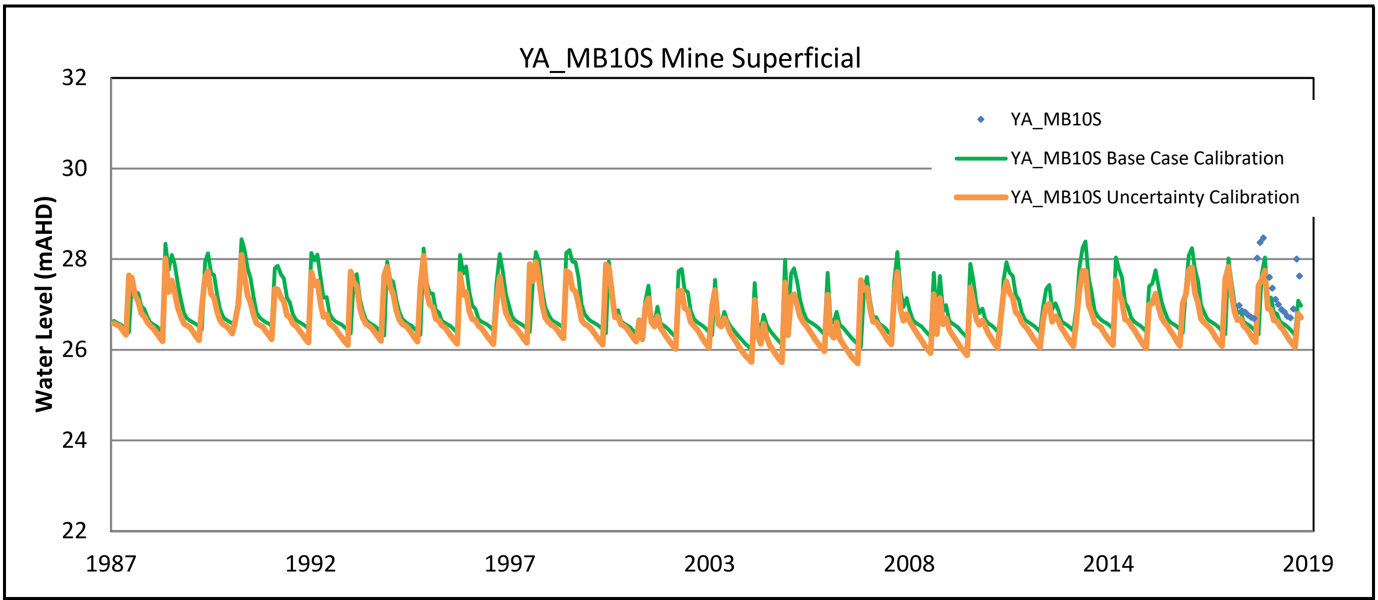
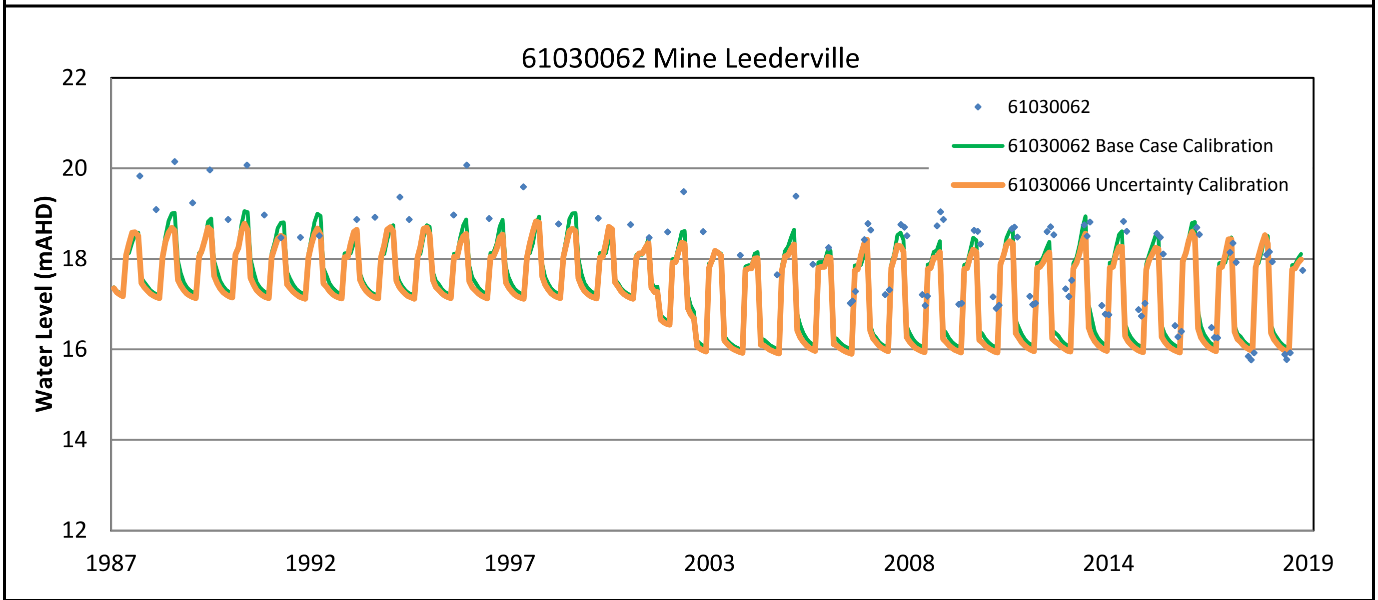
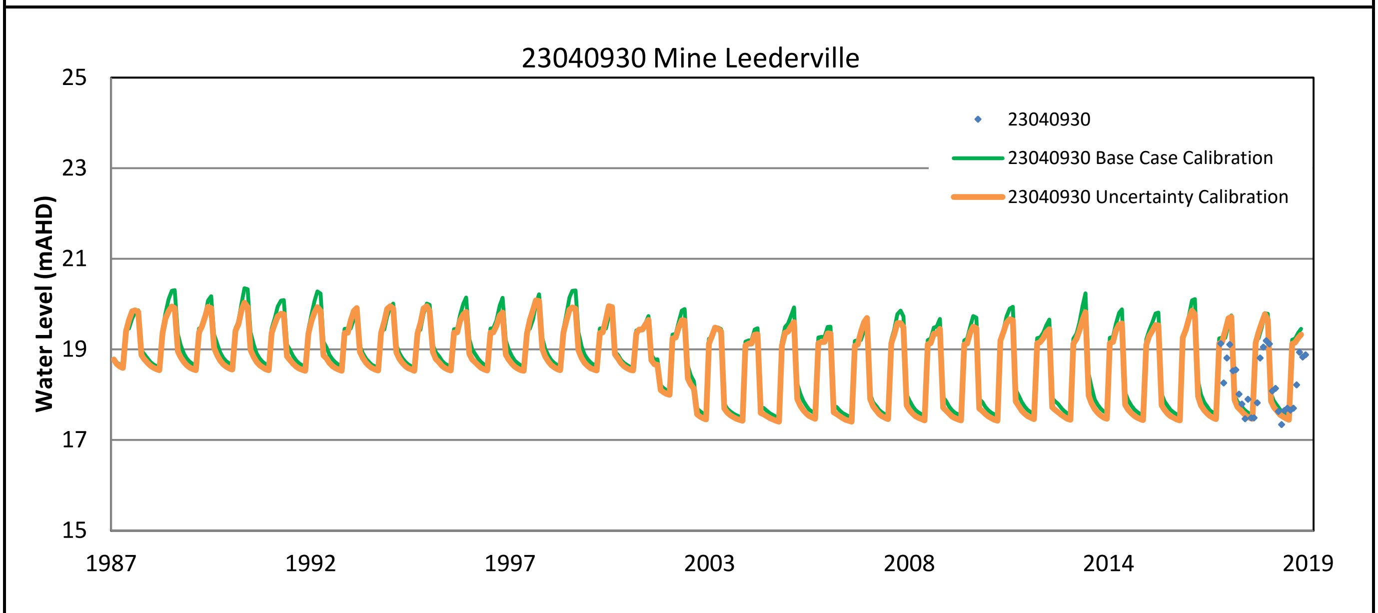
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F6

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F6

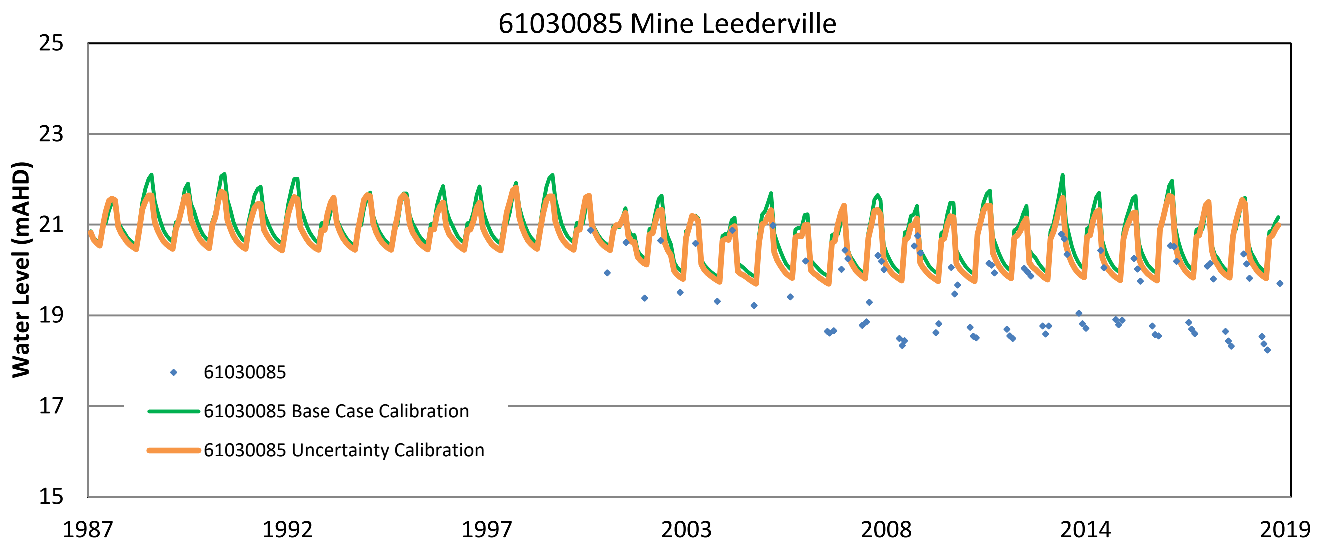


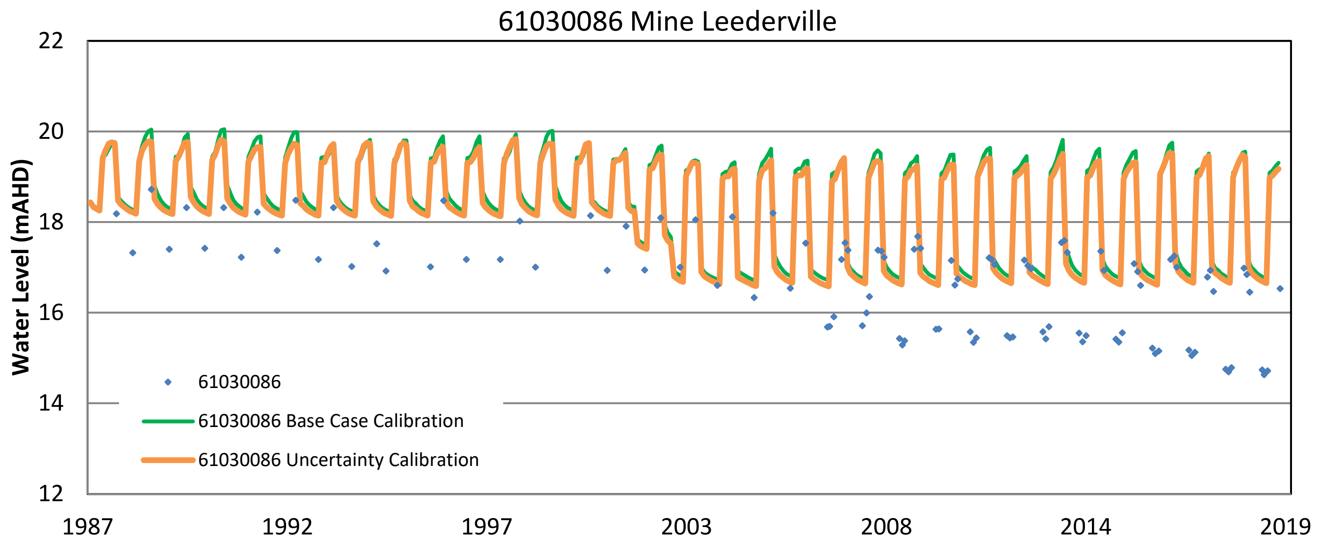


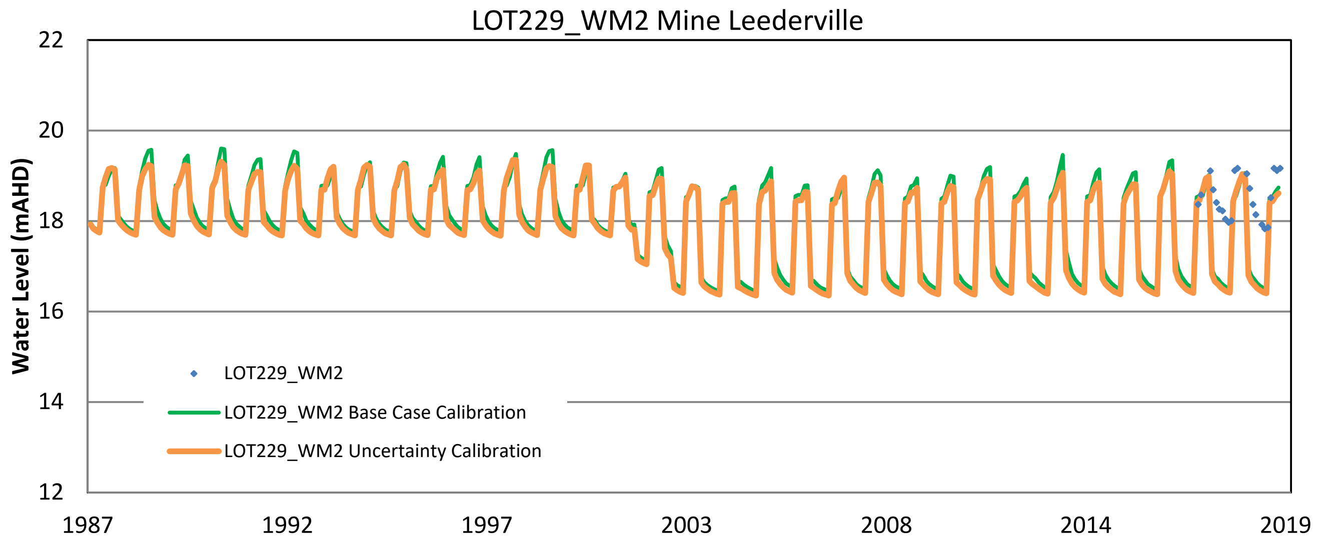


CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F7

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F7







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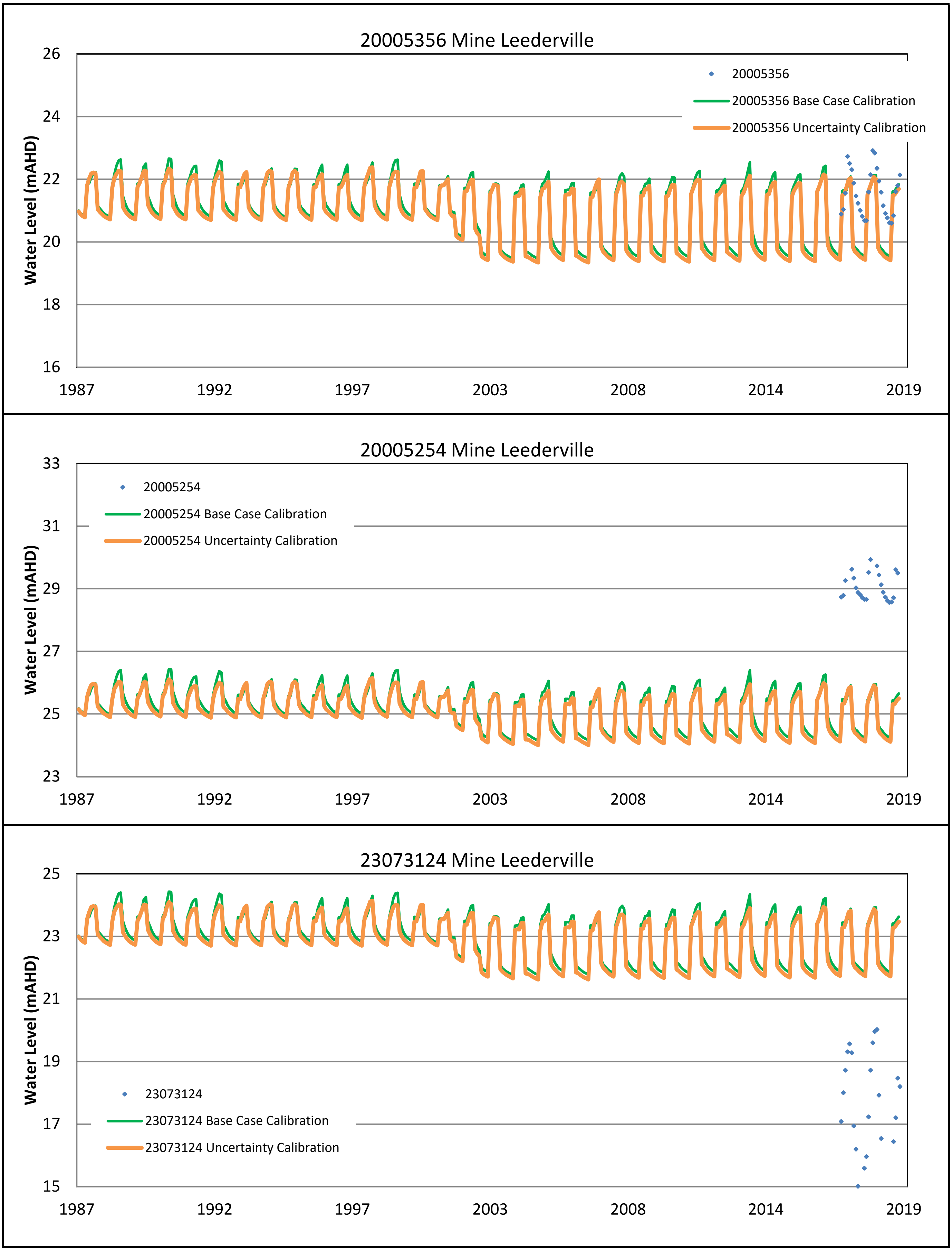
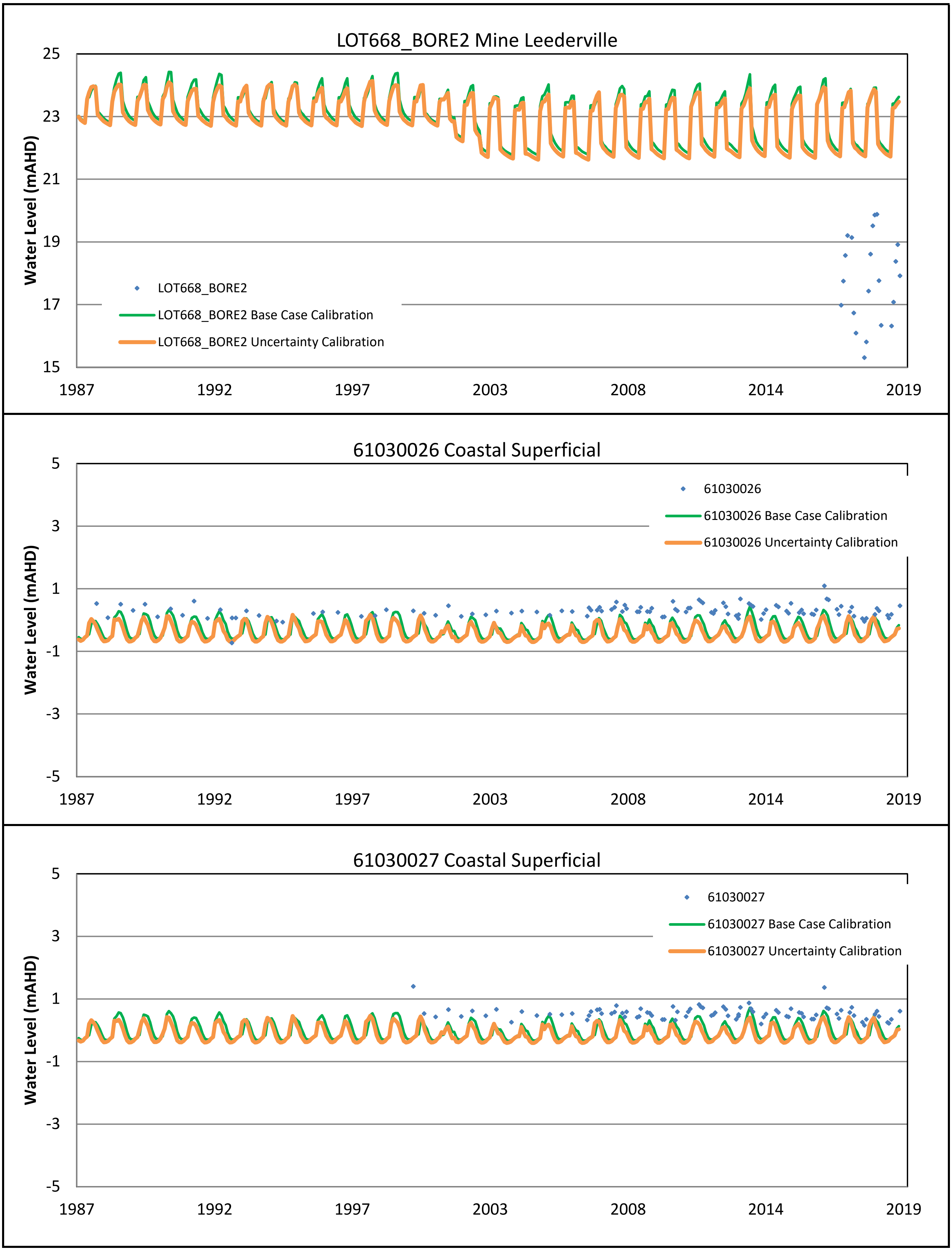
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F8

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F8



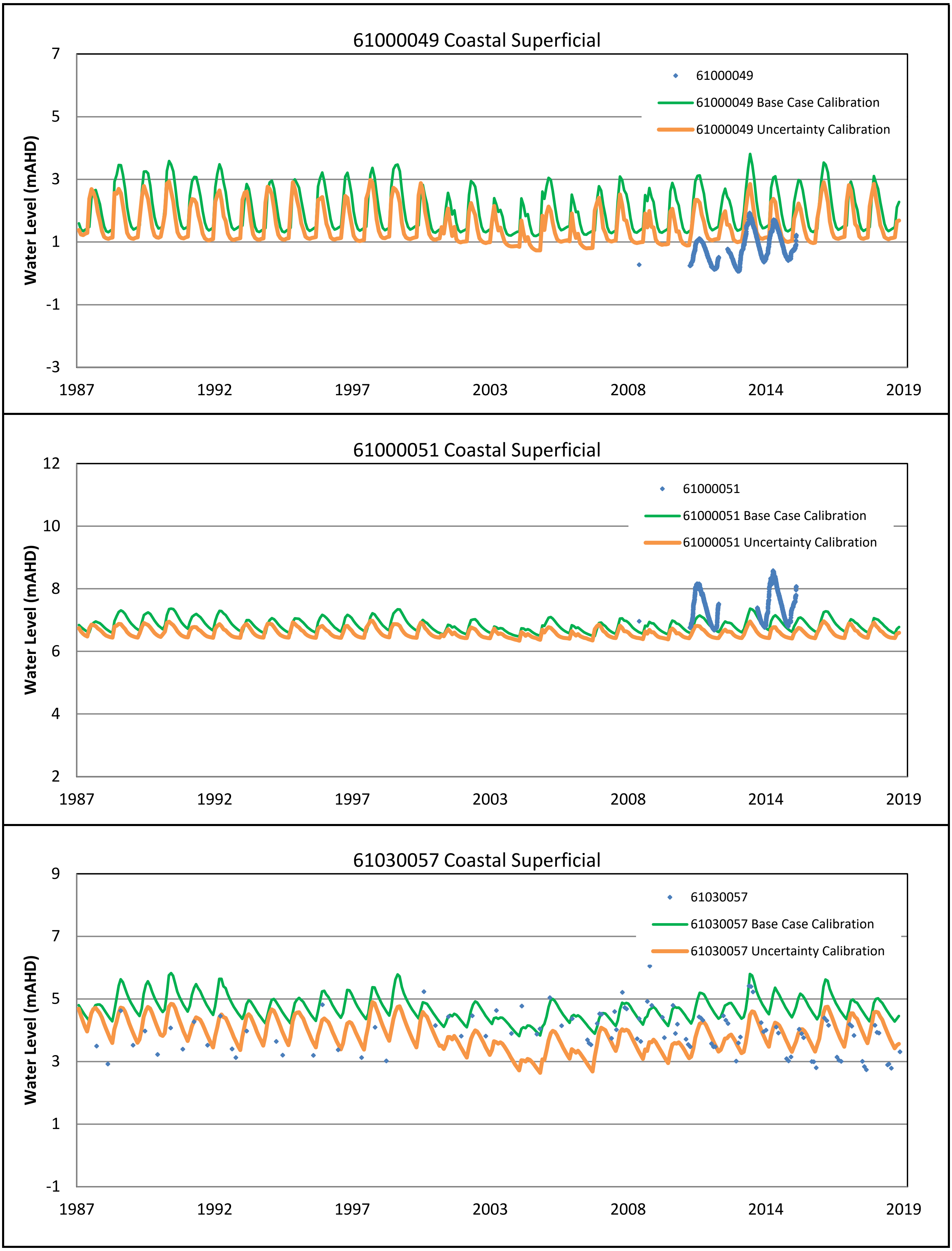
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F9

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F9



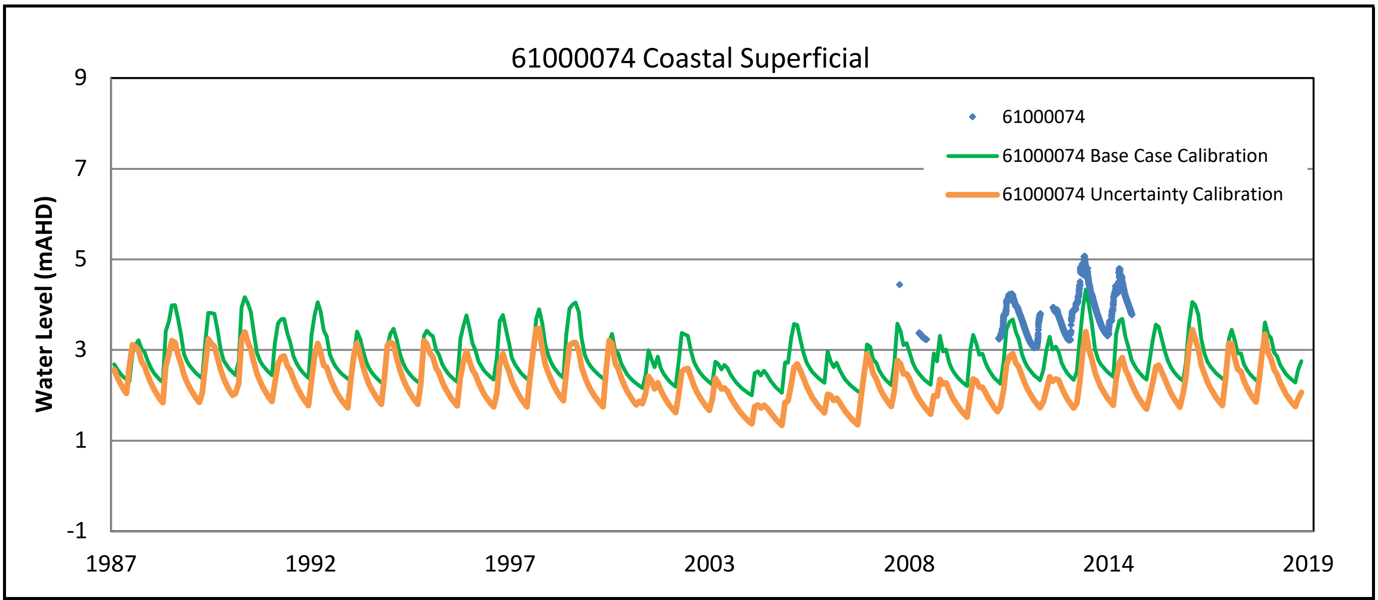
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE 55

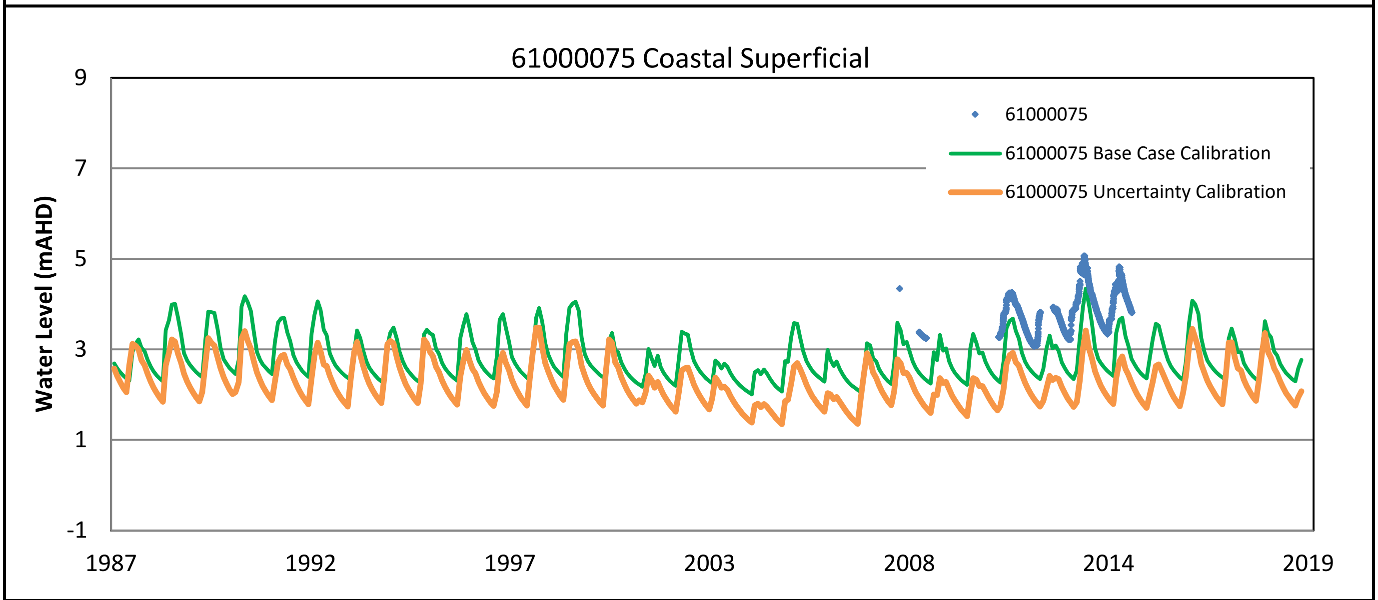
F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F10

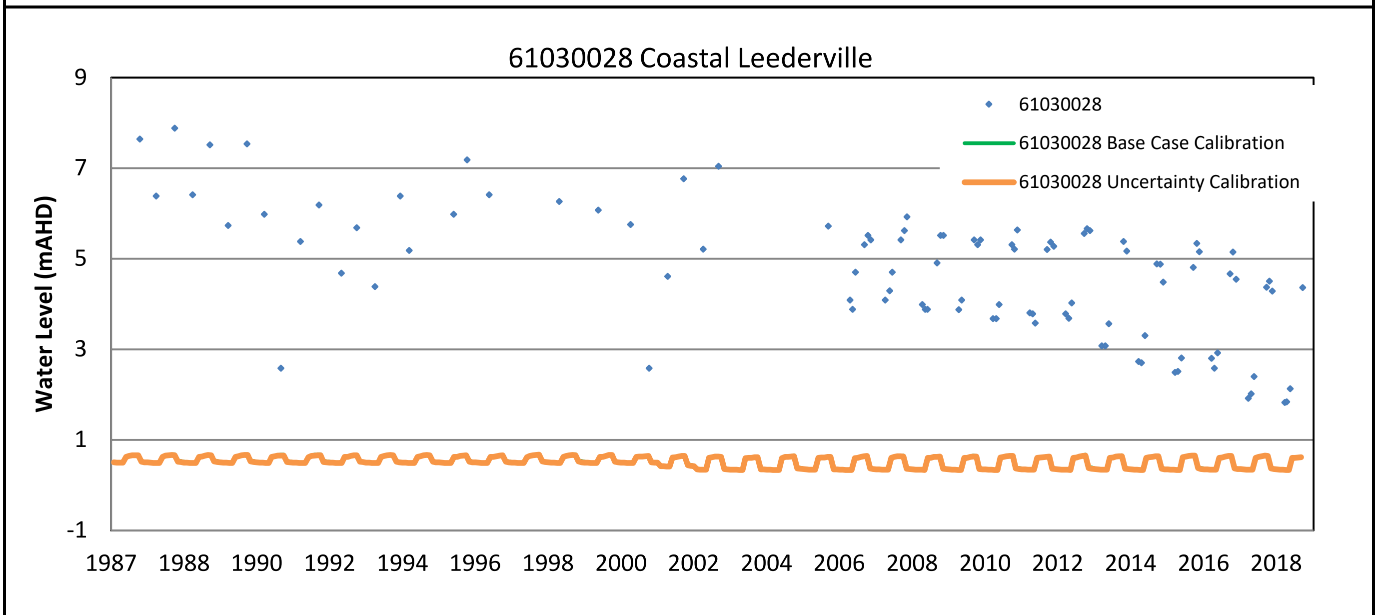


CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F11

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F11







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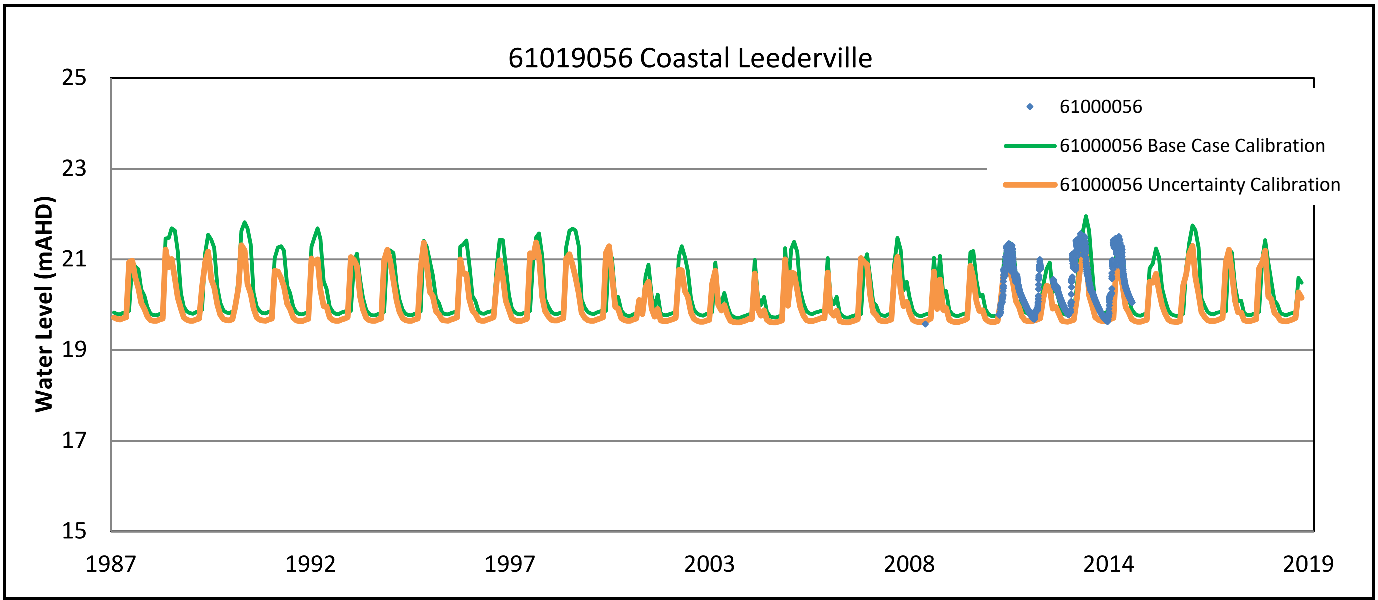
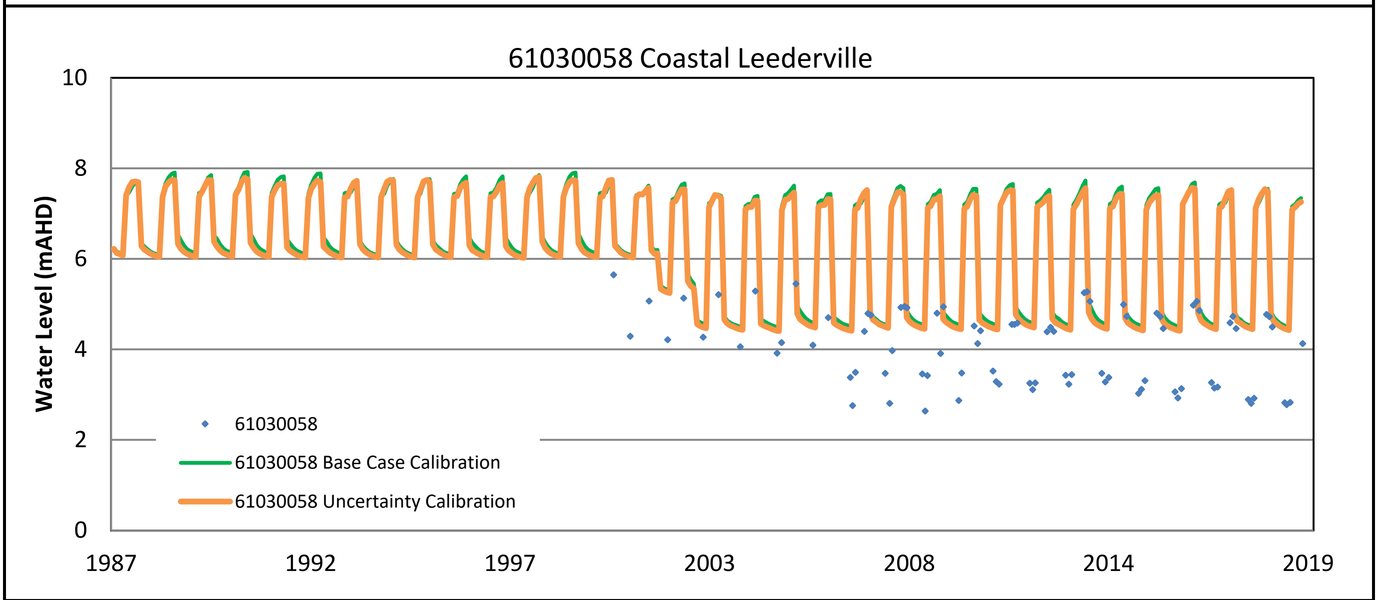
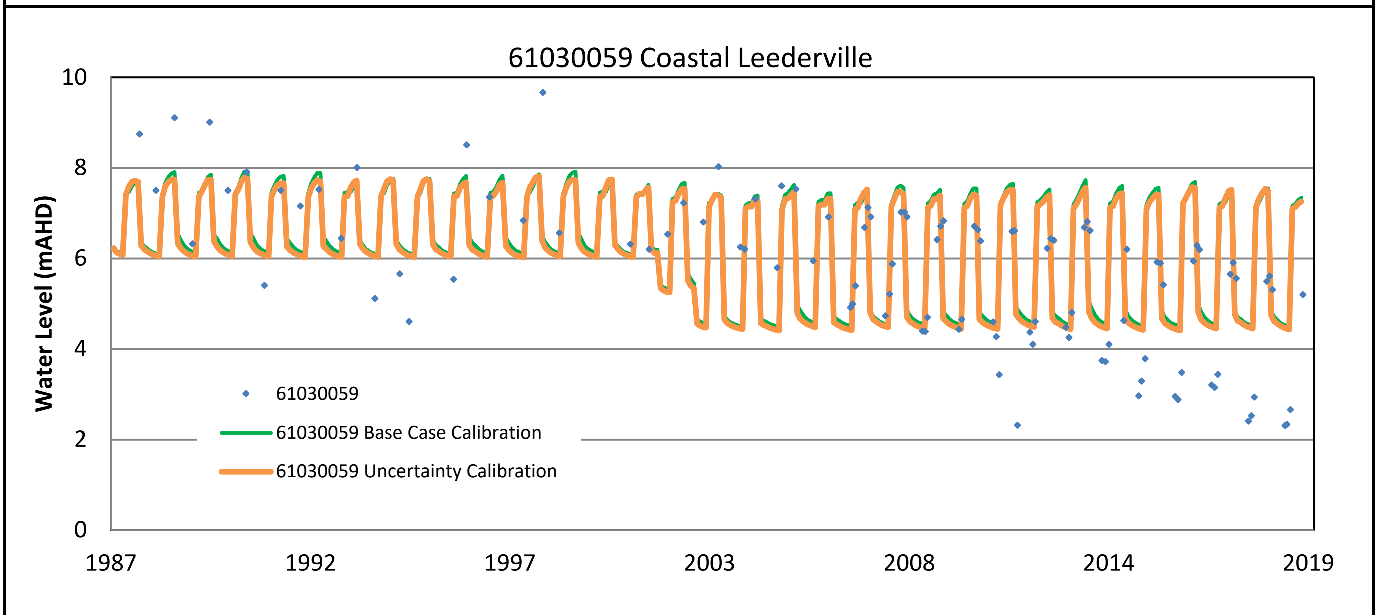
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F12

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F12

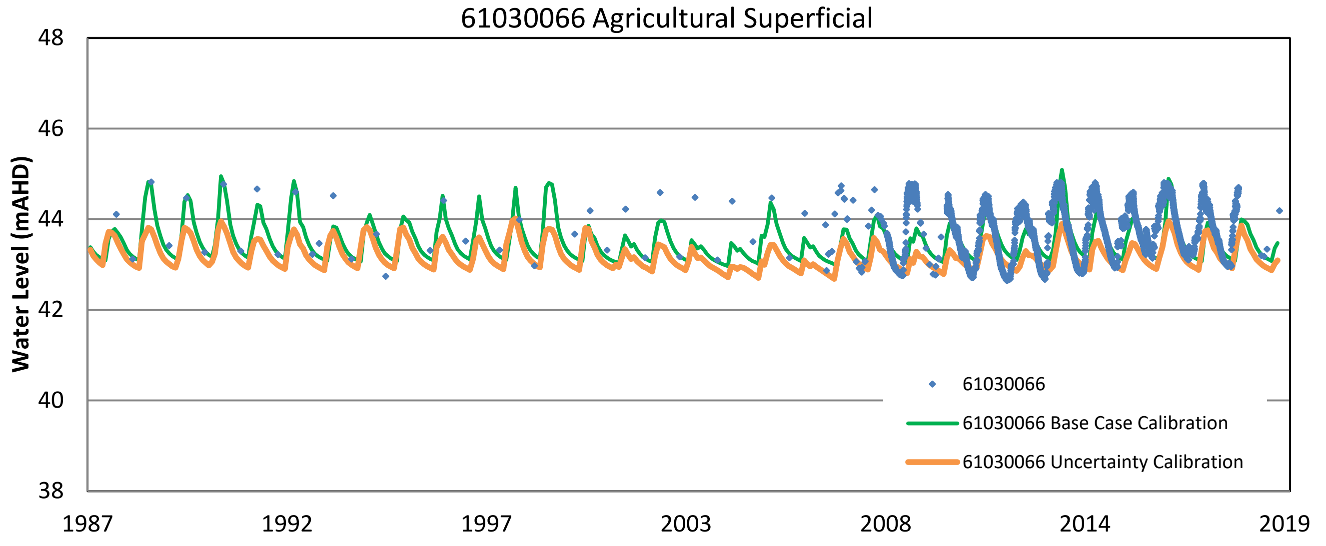


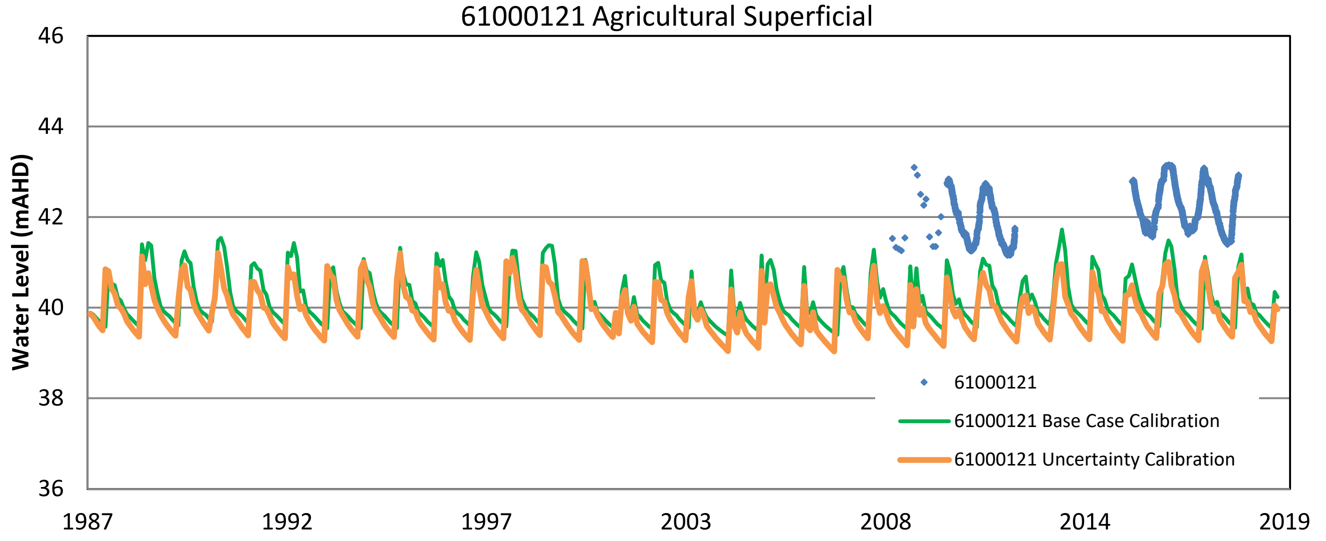


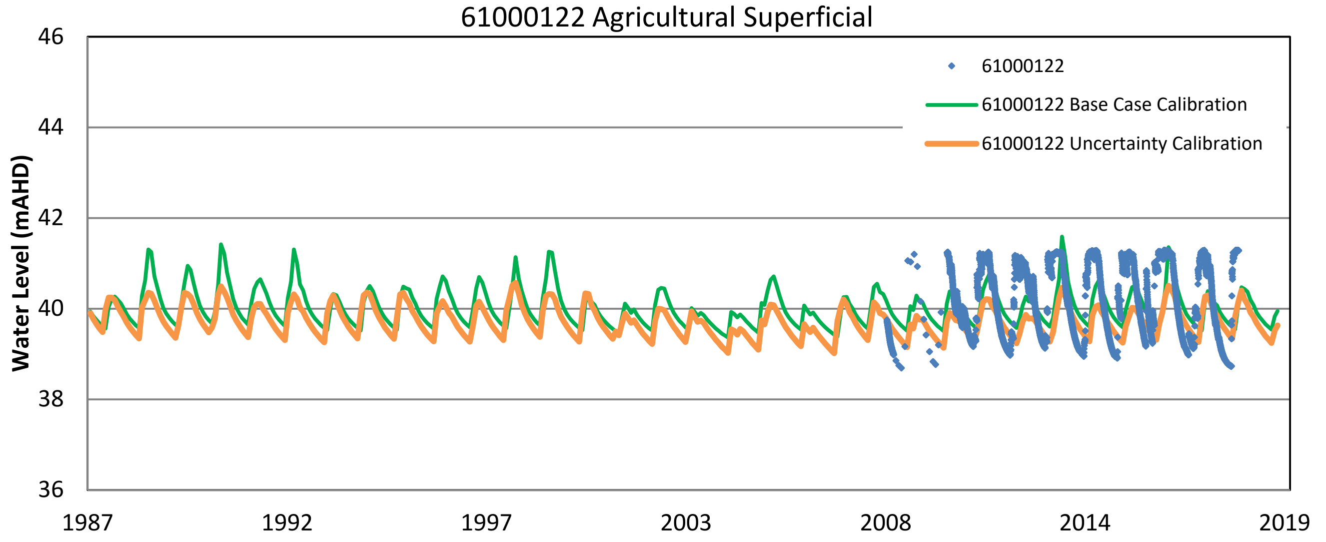


CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F13

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F13







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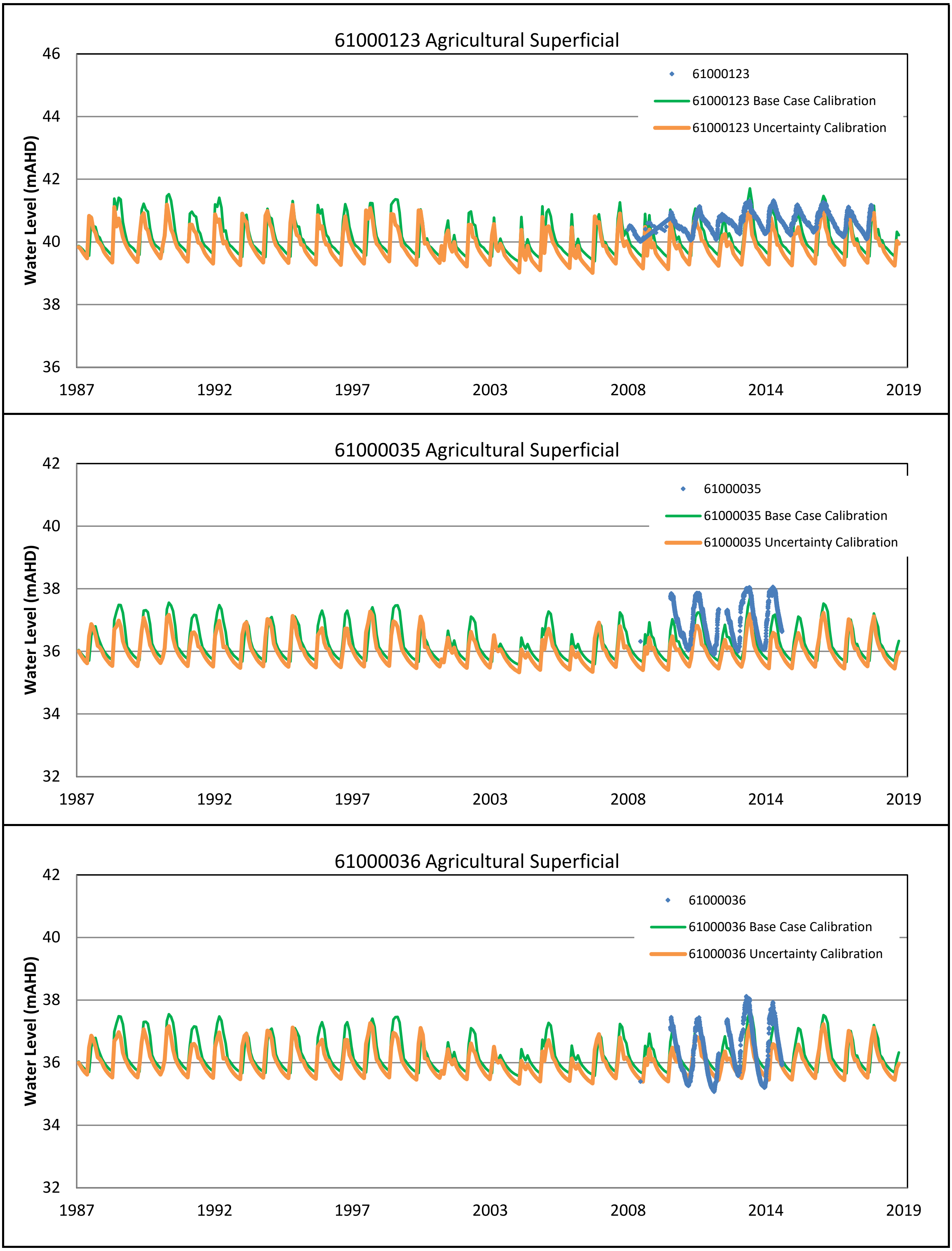
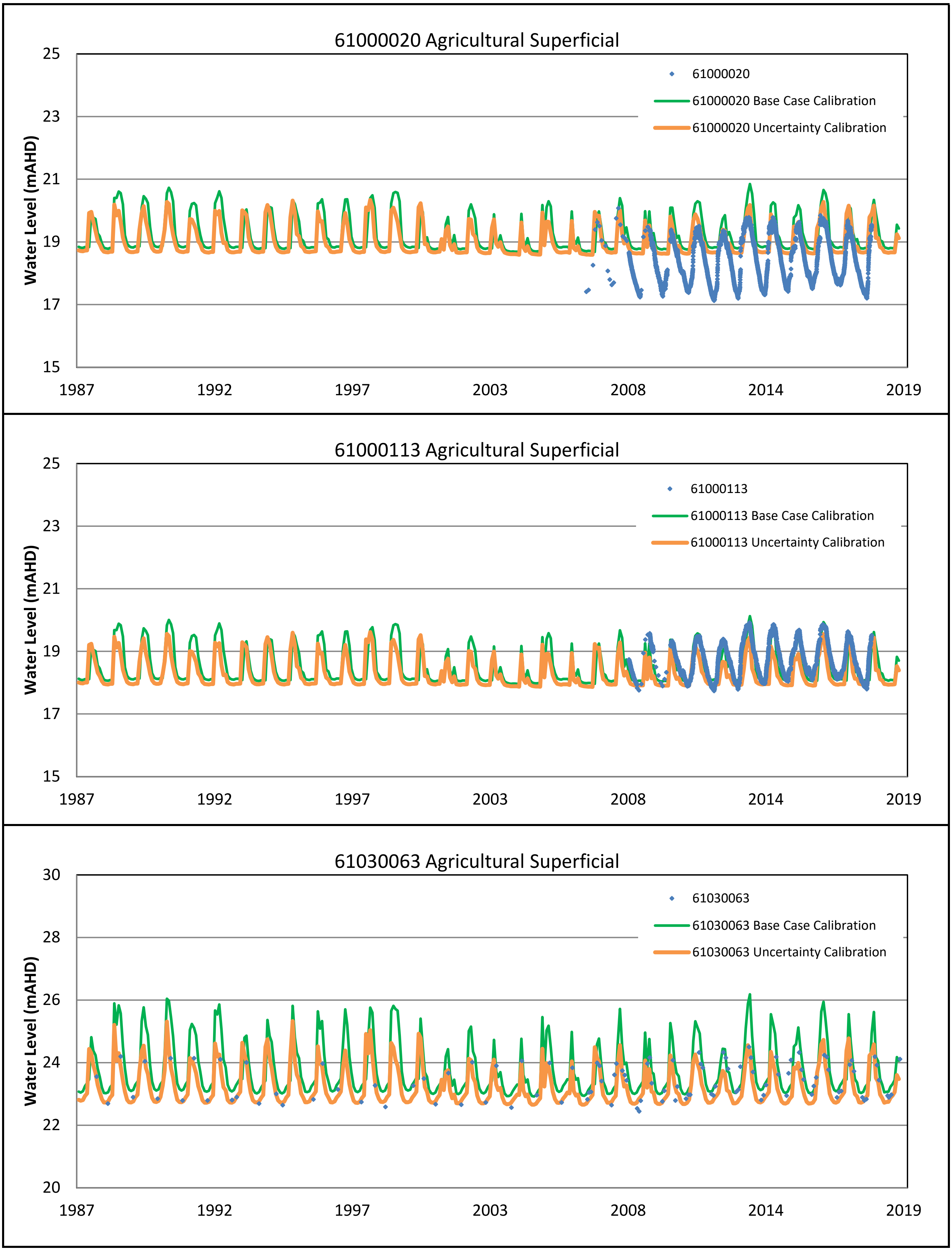
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F14

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F14



CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F15

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F15



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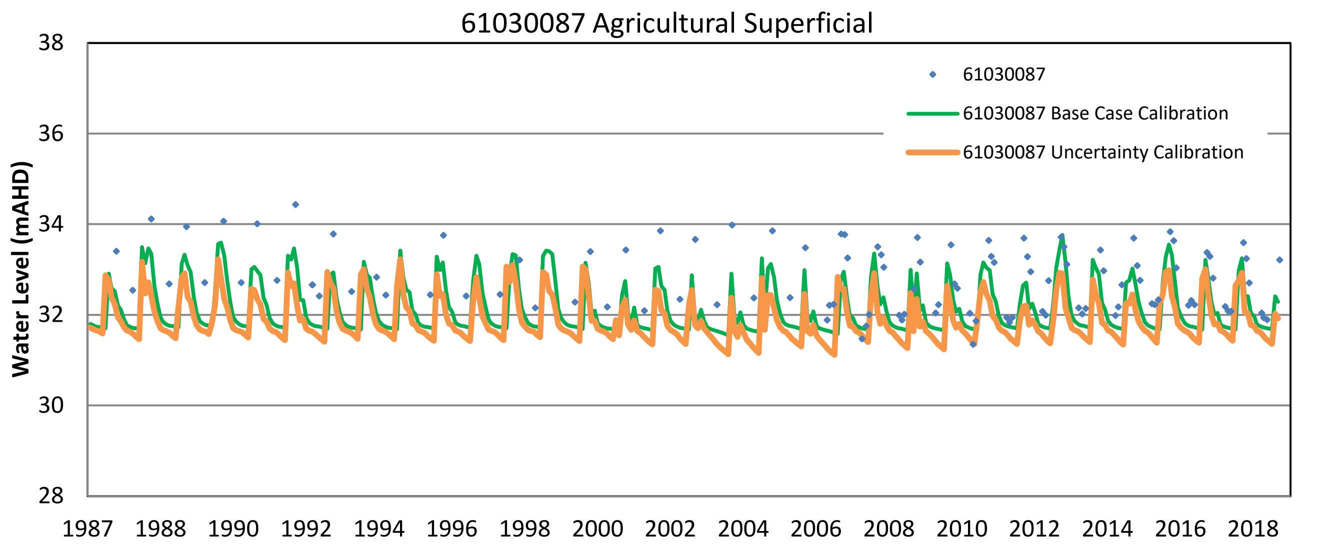
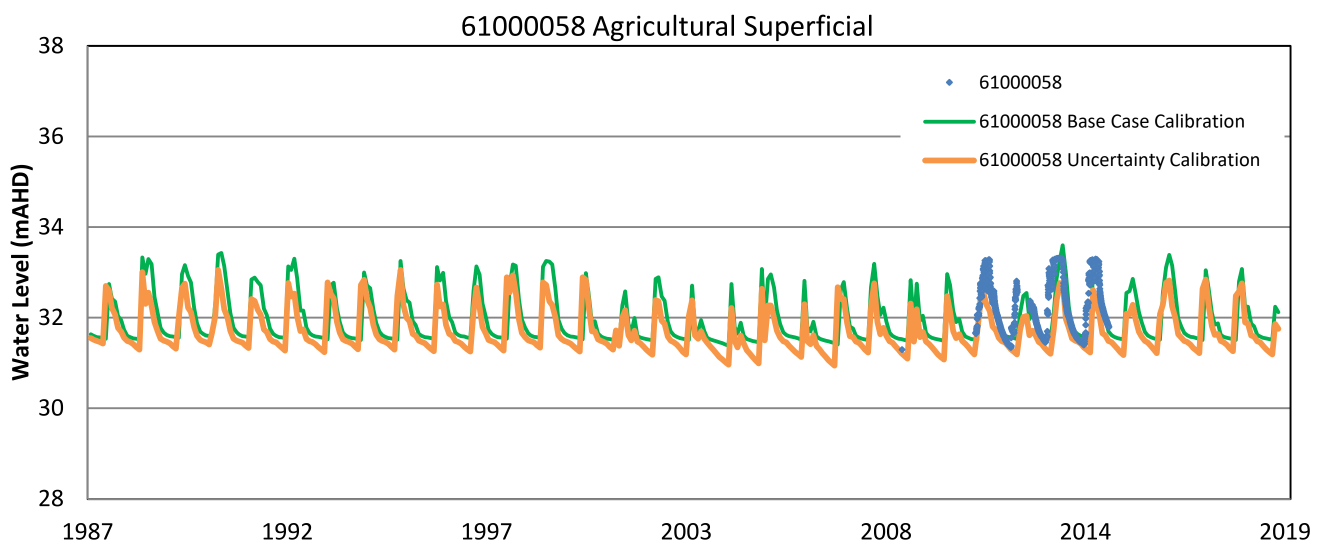
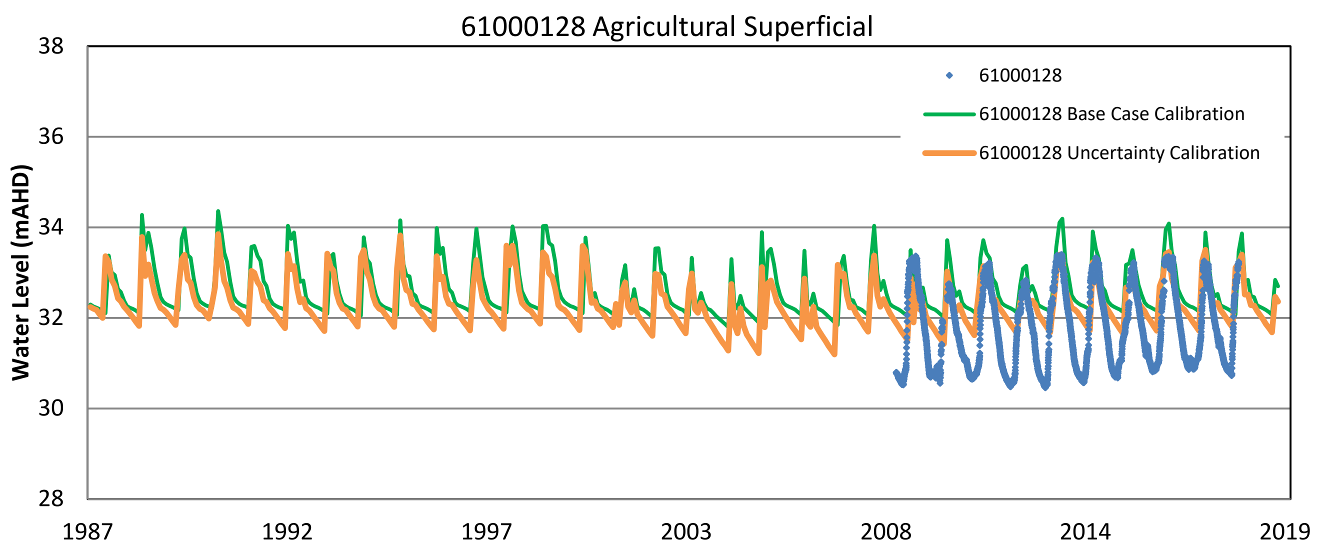
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F16

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F16







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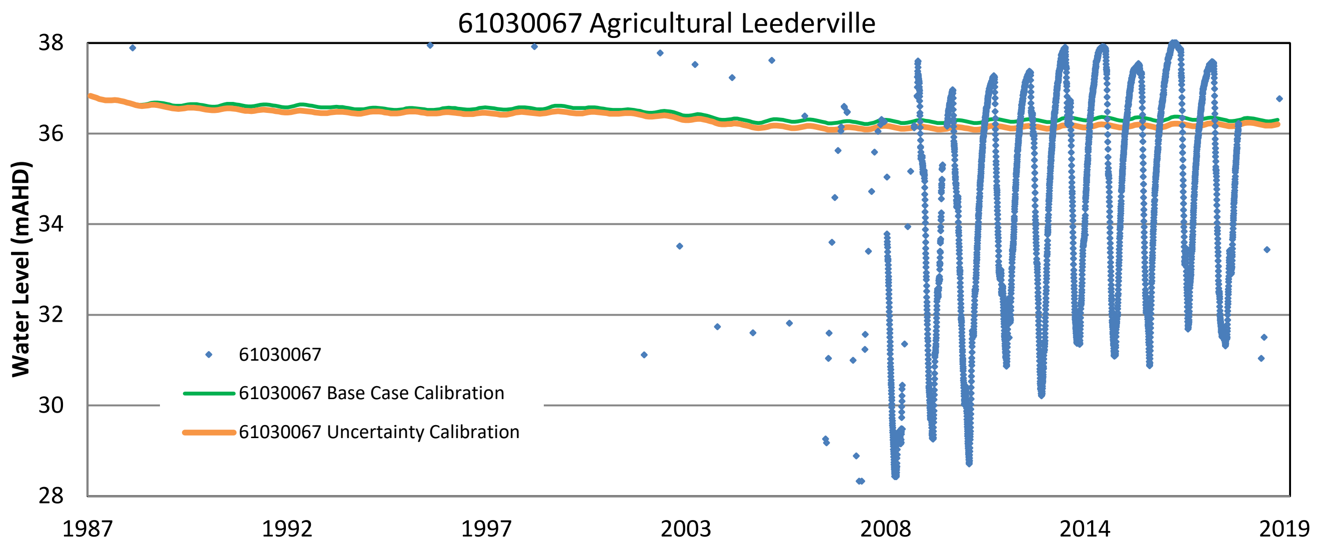
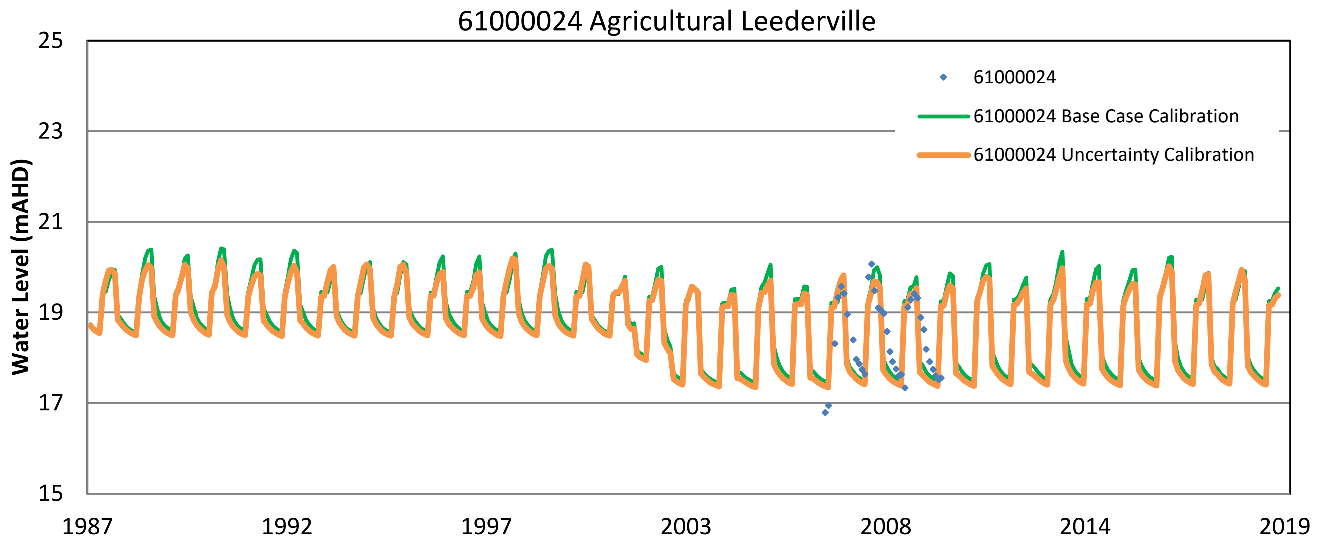
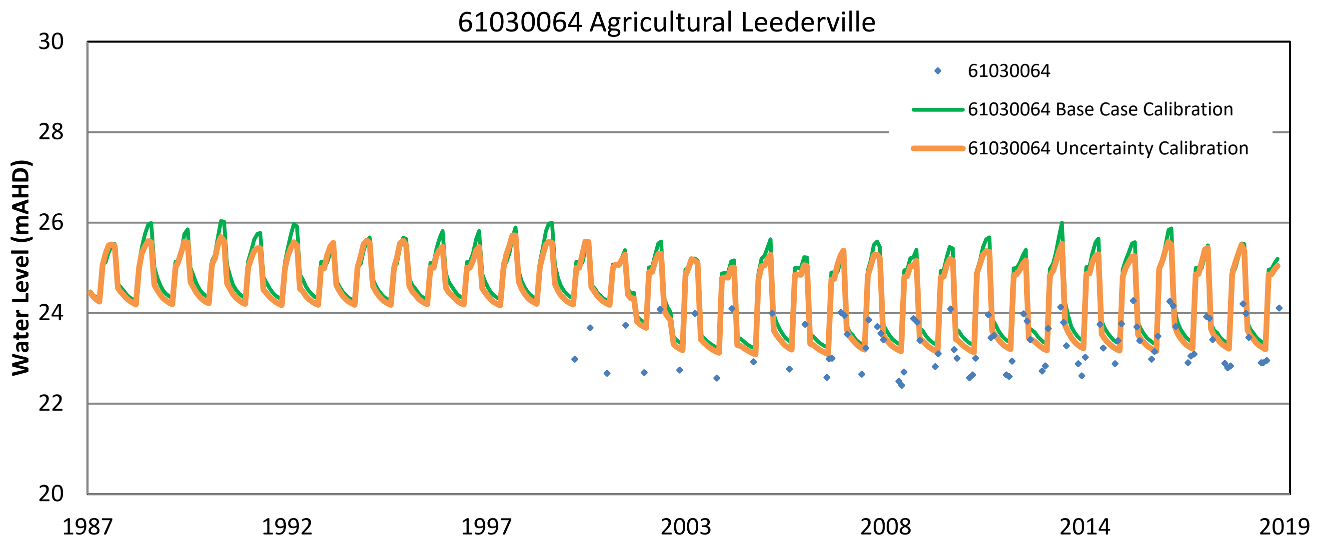
CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F17

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F17







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CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F18

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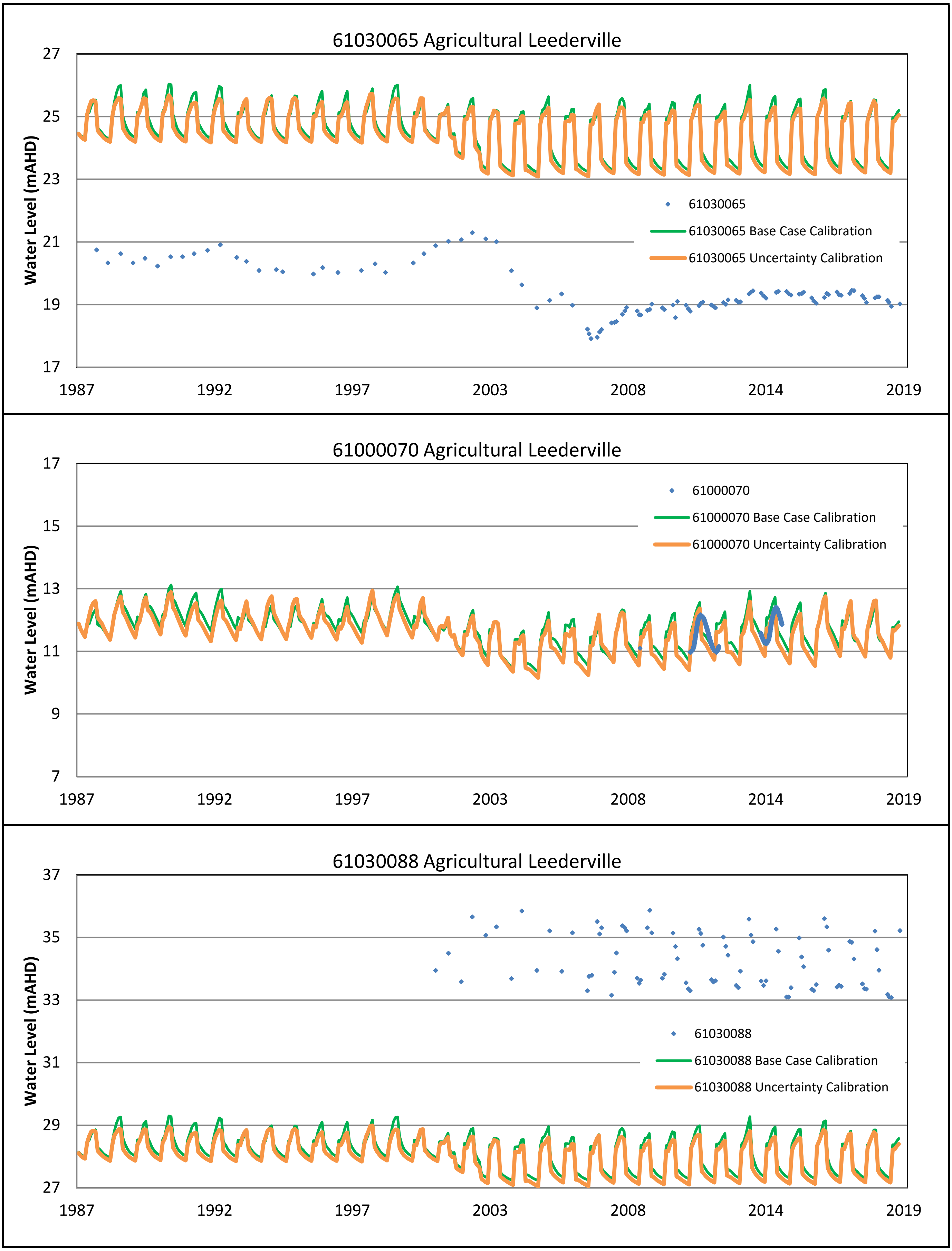

CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE F19

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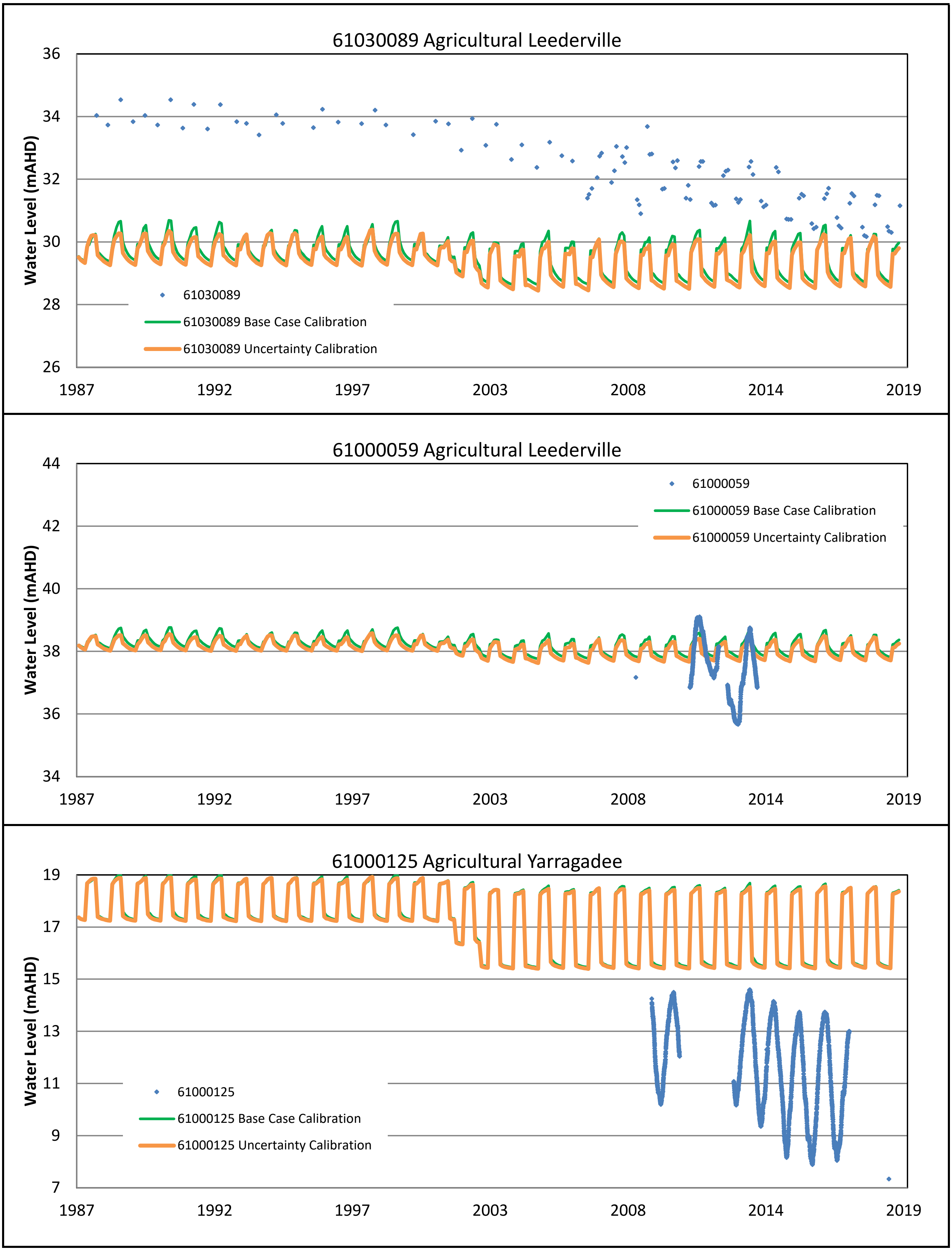

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CALIBRATION HYDROGRAPHS BASE CASE AND UNCERTAINTY FIGURE f20

F:\136\2. TECH\Groundwater Model\Model Results\Water Levels\[TS_850_Report_Figures.xlsx]Figure F20