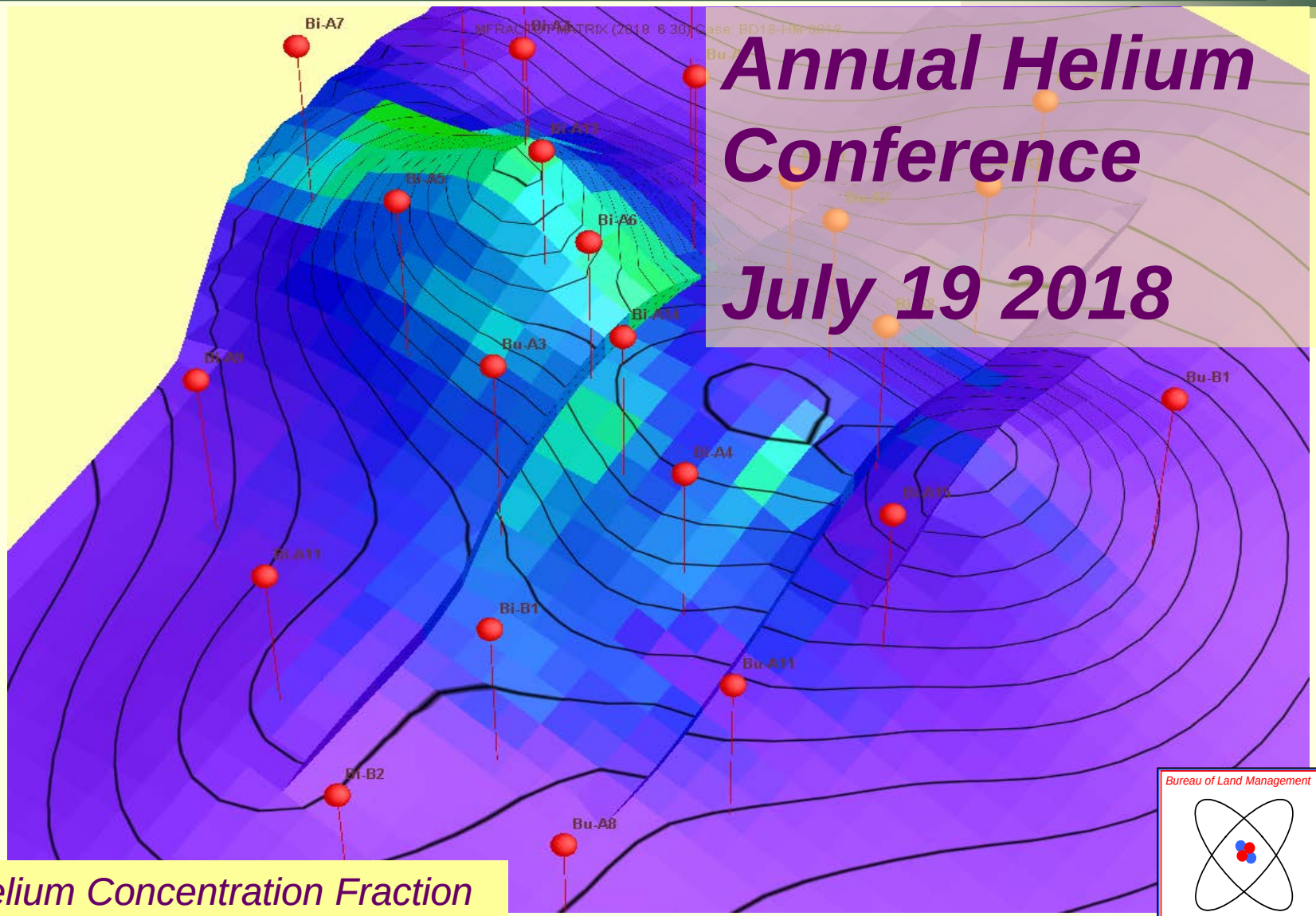
Bush Dome Helium Reservoir



Annual Helium Conference

July 19 2018

Helium Concentration Fraction
June 30 2018

Bureau of Land Management
Helium Operations

Disclaimer

- *Predictions of the Bush Dome reservoir's future performance, plus any other analysis contained within this presentation, are interpretive, using accepted reservoir engineering practices with the data made available for this work. NITEC LLC does not warrant or guarantee that any interpretation or proposed operation will perform as forecast.*

Outline

- Reservoir Status (Operations: 2017-2018)
- Simulation Model Status
- Predictions
- Conclusions

Colorado National Monument, Grand Junction, CO

Reservoir Status 2018

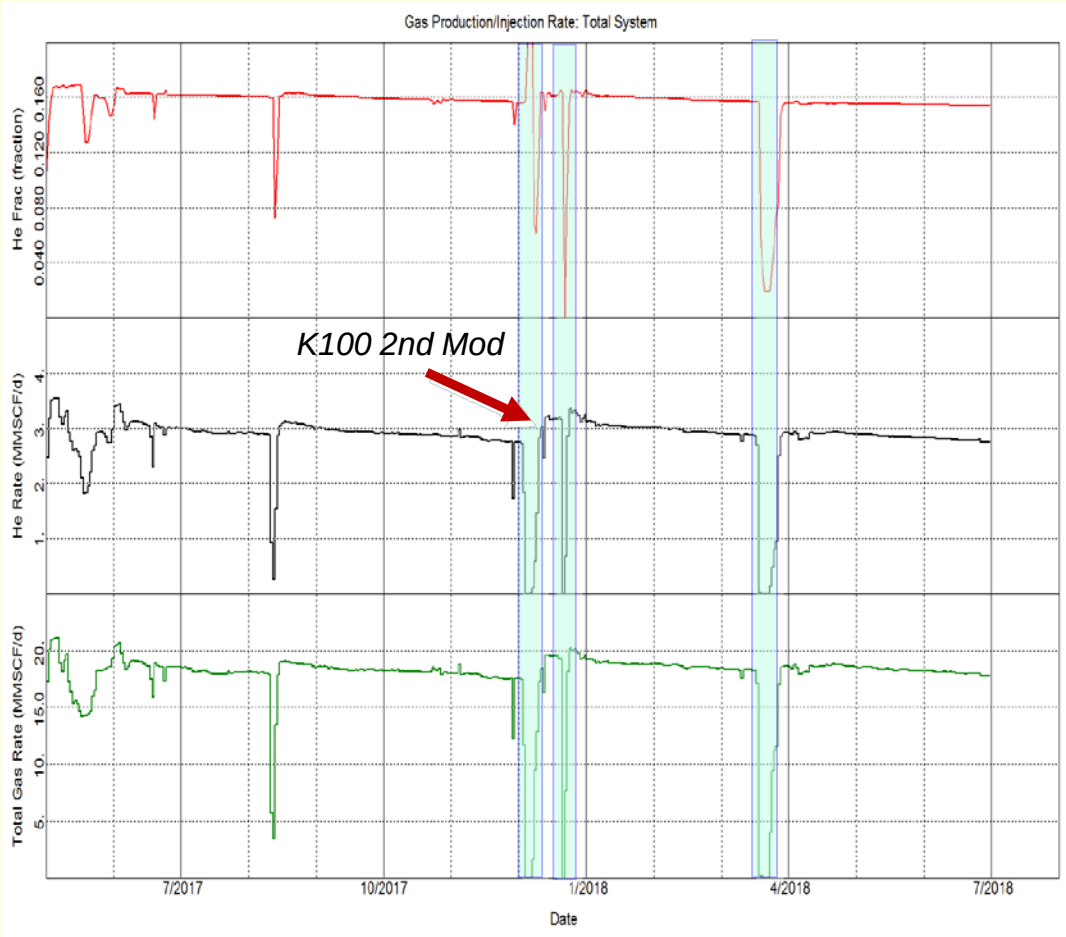
- Field Operations Summary:
  - July 2017 – 2018
  - Comparison to prior years
  - Bi-A6 Summary
- Production Analysis
- Helium Concentration Maps
- Flowing WHP
- Water Encroachment

Reservoir Status 2018

- **Summary – 2017-18 Operations**
  - Field/HEU currently at minimum suction pressure and maximum flow
  - High helium demand throughout the year; No He injection
  - Central compression installed but not up and running
  - K100 modified for lower suction pressure (was ~192 psia, now ~155 psia)
  - Water encroachment was less of an issue then last year
  - Well measurement system maintenance work (Dec 2017)
  - Overall reservoir performance was as expected, given flowing pressure constraints

Reservoir Status 2018

Field & HEU Summary	July-July 2017-18	
HEU Operating	356	days
HEU Down	9	days
He rate < 1MM/d	18	days
He rate > 6.25mm/d	0	days
Beg. Avg Flowing Press	197.0	psia
End Avg Flowing Press	158.0	psia
Change in Flowing Press	-39.0	psi
Total Gas Produced	6.427	BCF
Net Gas	6.427	BCF
He Produced	1.042	BCF
He Net	1.042	BCF
He Concentration - 7/1/17	13.1	%
He Concentration - 6/30/18	12.3	%
He Concentration Change	-0.8	%

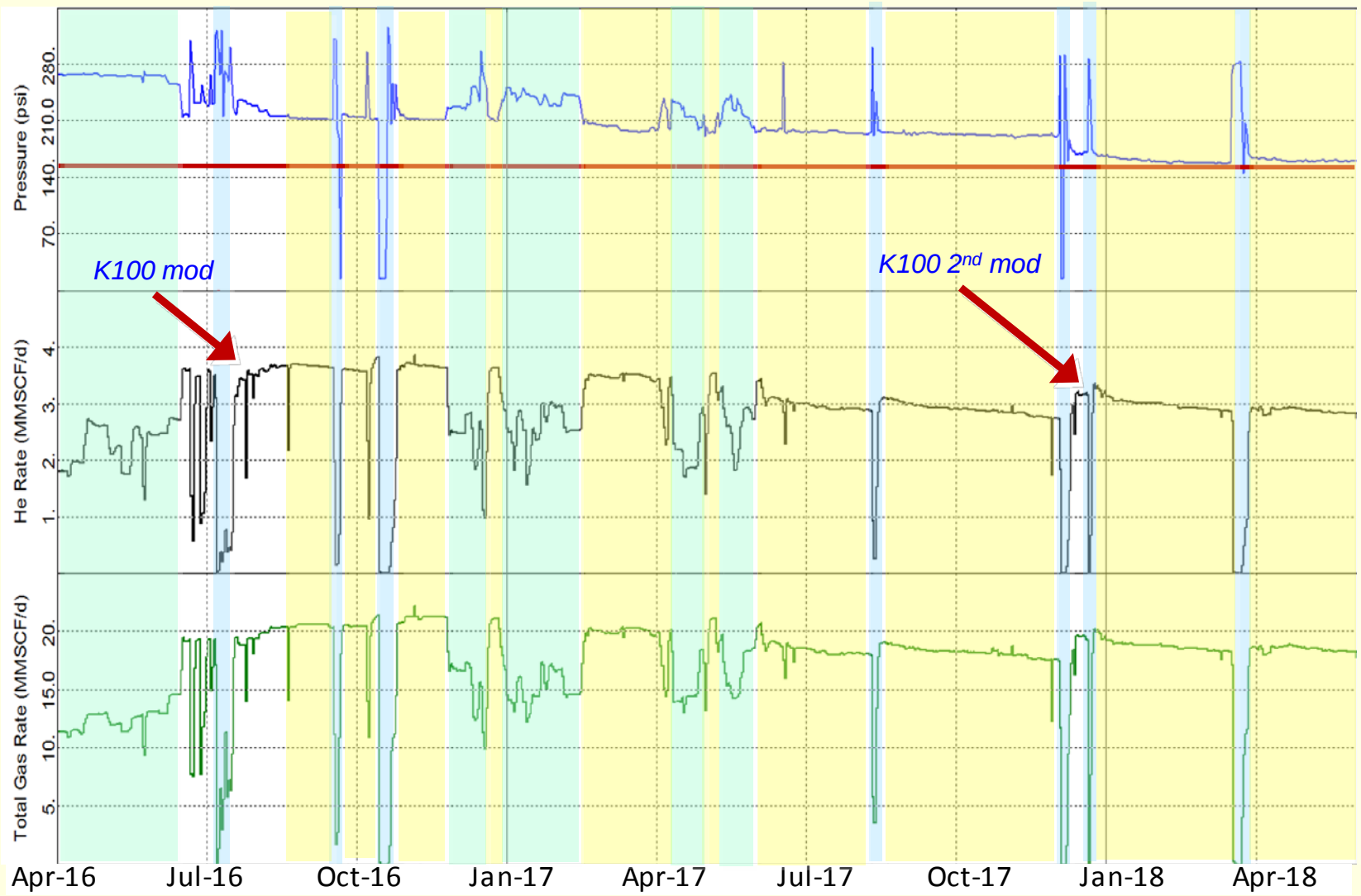


Reservoir Status 2018

- **Summary – 2017-18 Operations: min Pressure**
  - Current K100 modifications (2018) provide for minimum flowing pressure of ~140 psig (~155 psia FWHP)
  - Central compressor is installed, but not on-line
    It will provide significantly lower flowing pressures (~60 psig, ~75 psia FWHP)
  - Operating at or close to minimum flowing pressure and maximum rates

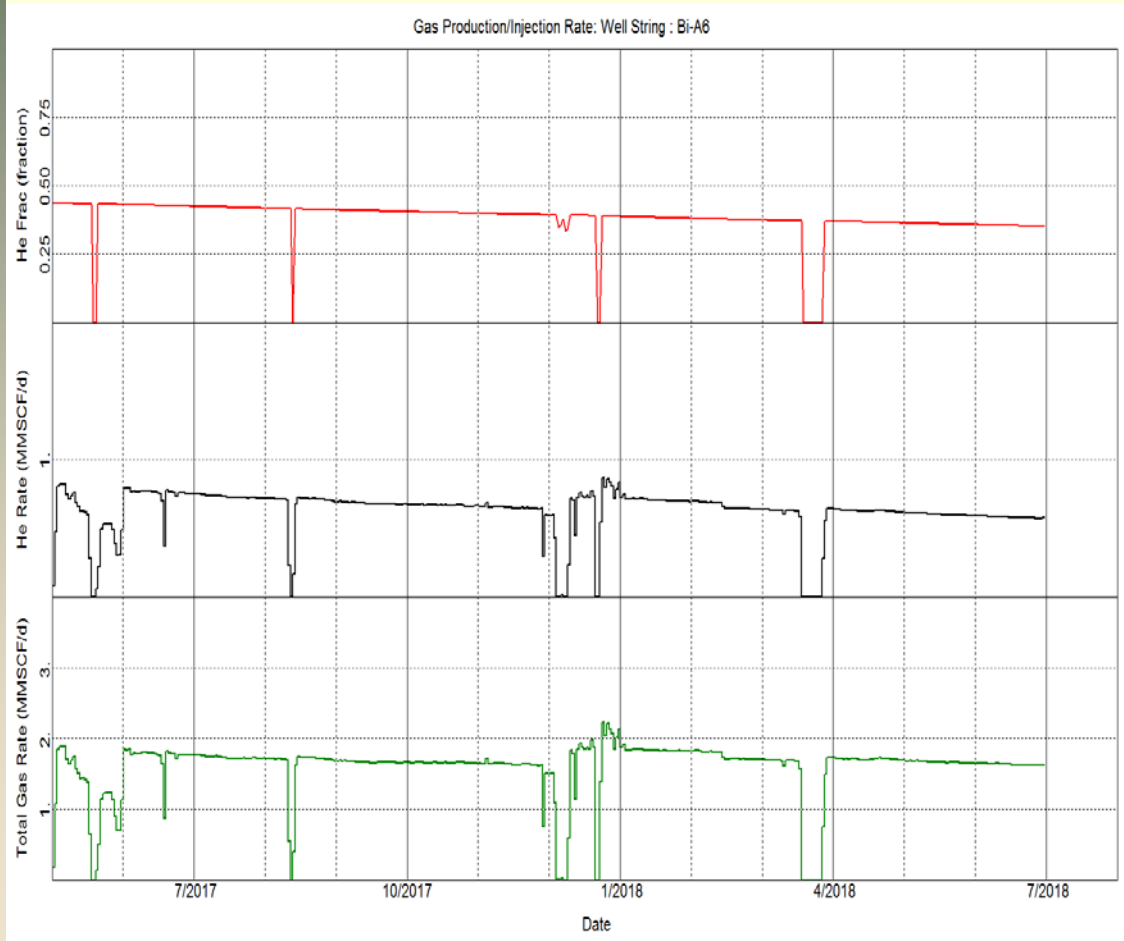
Reservoir Status 2018

- **Summary – 2016-18 Operations: Pmin**



Reservoir Status 2018

Summary – 2017-18 Operations: Bi-A6



Bi-A6 Summary	July-July 2017-18	
Producing	348	days
Injecting	0	days
No Flow	17	days
Total Gas Produced	589.68	MM
Total Gas Injected	0.0	MM
Net Gas	589.7	MM
He produced	255.84	MM
He injected	0.0	MM
Net He	255.8	MM
Beginning He %	45.27%	
Ending He%	41.99%	
Change in He%	-3.28%	
Bi-A6 produced 24.5% of 2017-2018 Helium		

Reservoir Status 2018

Field & HEU Summary	July-July 2017-18	
HEU Operating	356	days
HEU Down	9	days
He rate < 1MM/d	18	days
He rate > 6.25mm/d	0	days
Beg. Avg Flowing Press	197.0	psia
End Avg Flowing Press	158.0	psia
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He Concentration - 7/1/17	13.1	%
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Beginning He %	45.27%	
Ending He%	41.99%	
Change in He%	-3.28%	
Bi-A6 produced 24.5% of 2017-2018 Helium		

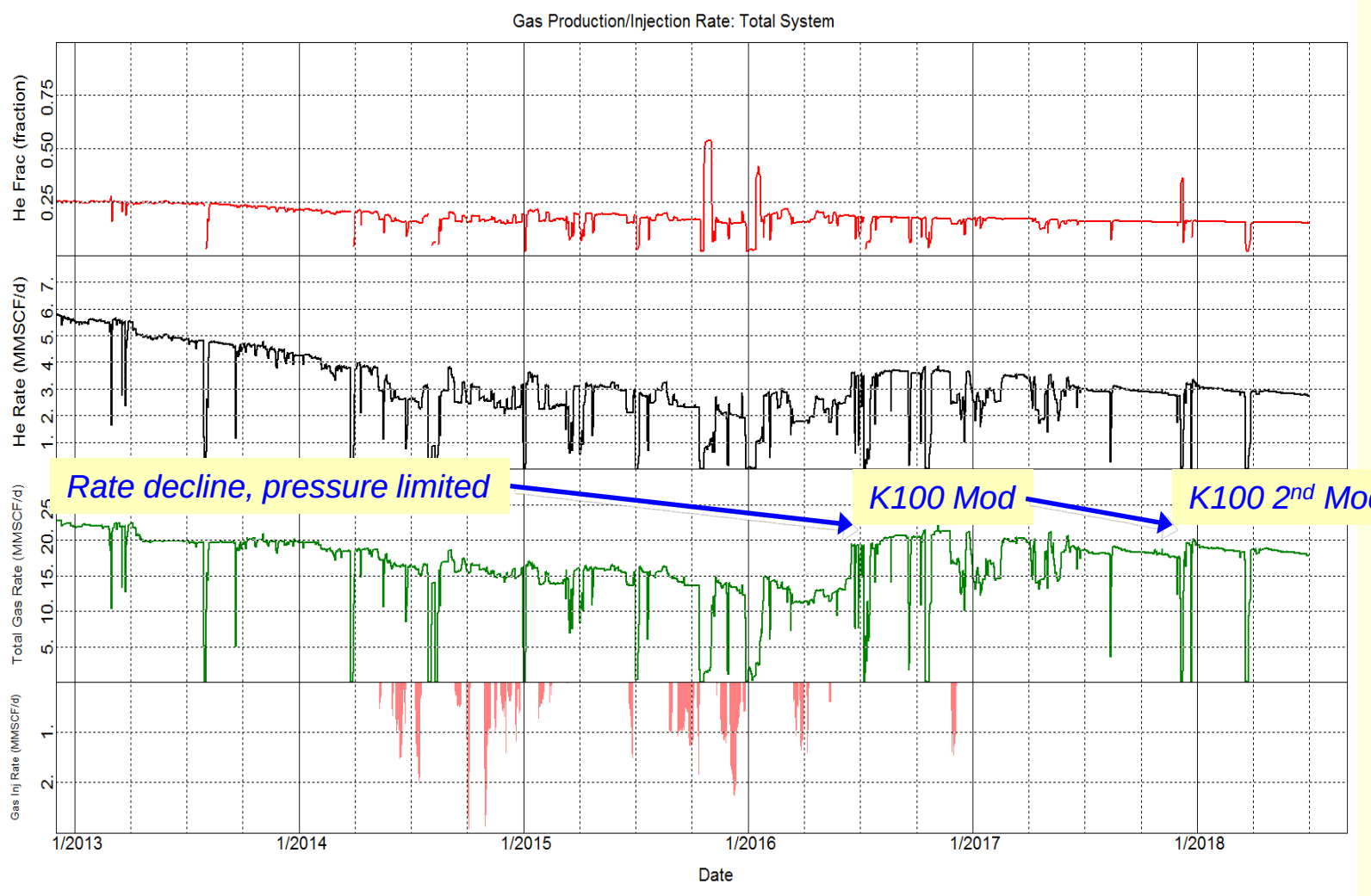
Reservoir Status 2018

Field Production: 2013- 2018

Field & HEU Summary							
beginning	July	2013	2014	2015	2016	2017	5 Year
ending	July	2014	2015	2016	2017	2018	Totals
HEU Operating	days	359	355	307	347	349	1717
HEU Down	days	6	10	58	18	16	108
He rate < 1MM/d	days	11	29	45	7	4	96
He rate > 6.25mm/d	days	0	0	0	0	0	0
Beginning Pressure	psia	287**	277**	255**	232**	197**	287**
Ending Pressure	psia	277**	255**	232**	197**	158**	158**
Change	psi	-10	-22	-23	-35	-39	-129
Total Gas Produced	BCF	6.669	5.322	4.272	6.353	6.427	29.043
Total Gas Injected	BCF	-0.021	-0.080	-0.100	-0.010	0.000	-0.211
Net Gas	BCF	6.648	5.242	4.172	6.343	6.427	28.832
He Produced	BCF	1.428	0.916	0.751	1.059	1.042	5.195
He Injected	BCF	-0.015	-0.060	-0.074	-0.007	0.000	-0.156
He Net	BCF	1.412	0.856	0.677	1.052	1.042	5.039
**Flowing Pressures		K100 Modified		K100 2nd Modification			

Reservoir Status 2018

Field Production: 2013 – 2018 (5 years)



Reservoir Status 2018

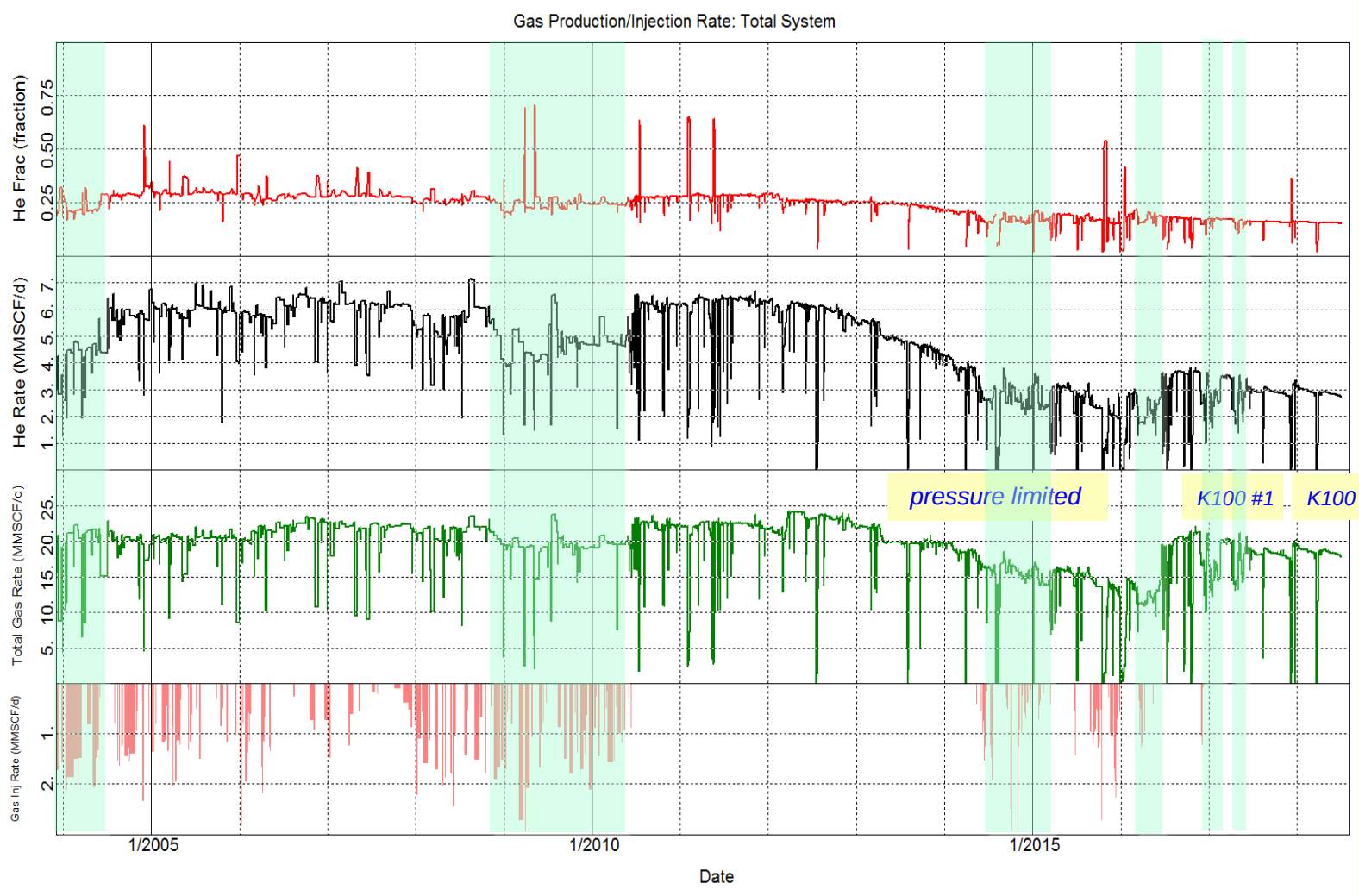
Field Production: 2003 - 2018

Field & HEU Summary																		
beginning	July	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	5 Year	2003-18
ending	July	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Totals	Totals
HEU Operating	days	248	332	348	334	351	348	361	351	355	361	359	355	307	347	349	1717	5106
HEU Down	days	118	33	17	31	15	17	4	14	0	4	6	10	58	18	16	108	361
He rate < 1MM/d	days	8	35	0	0	1	0	0	2	0	4	11	29	45	7	4	96	146
He rate > 6.25mm/d	days	16	30	82	189	43	35	28	222	242	3	0	0	0	0	0	0	890
Beginning Pressure	psia	648	626	601	575	548	523	362*	334*	310*	278*	287*	277*	255*	232*	197*	287*	648
Ending Pressure	psia	626	601	575	548	523	498	334*	303*	278*	251*	277*	255*	232*	197*	158*	158*	158*
Change	psi	-22	-25	-26	-27	-25	-25	-28	-31	-32	-27	-10	-22	-23	-35	-39	-129	-490
Total Gas Produced	BCF	6.156	5.026	7.226	7.509	7.431	7.174	7.155	7.279	8.154	7.797	6.669	5.322	4.272	6.353	6.427	29.043	99.950
Total Gas Injected	BCF	-0.179	-0.060	-0.041	-0.060	-0.183	-0.279	-0.209	0.000	0.000	0.000	-0.021	-0.080	-0.100	-0.010	0.000	-0.211	-1.222
Net Gas	BCF	5.977	4.966	7.185	7.449	7.248	6.895	6.946	7.279	8.154	7.797	6.648	5.242	4.172	6.343	6.427	28.832	98.727
He Produced	BCF	1.289	1.262	2.077	2.176	1.930	1.852	1.817	2.123	2.263	1.970	1.428	0.916	0.751	1.059	1.042	5.195	23.954
He Injected	BCF	-0.139	-0.047	-0.033	-0.048	-0.144	-0.218	-0.163	0.000	0.000	0.000	-0.015	-0.060	-0.074	-0.007	0.000	-0.156	-0.946
He Net	BCF	1.150	1.215	2.045	2.128	1.786	1.634	1.654	2.123	2.263	1.970	1.412	0.856	0.677	1.052	1.042	5.039	23.008

*Flowing Pressures	K100 Modified	K100 2nd Modification

Reservoir Status 2018

Field Production: 2004 - 2018



Reservoir Status 2018

Well Performance Table – 2017-18 Volume

Well Helium Prod		
Well	Helium Concentration 6/30/2018 Percent	Total Helium Flow MMscf/D
Bivins A-6	41.99	255.837
Bivins A-14	27.60	138.267
Bivins A-13	32.05	136.908
Bush A-5	26.01	134.190
Bush A-3	32.05	119.340
Bivins A-5	18.58	64.079
Bivins A-4	11.00	49.991
Bivins A-7	29.85	40.550
Bush A-4	8.91	22.179
Bush A-2	5.29	21.408
Bivins A-9	2.68	10.230
Bivins B-1	2.42	9.391
Bivins A-2	3.50	8.909
Bivins A-11	2.93	7.880
Bivins A-15	1.69	7.253
Bivins B-2	1.84	6.768
Bush A-8	1.81	4.266
Bush A-11	2.36	3.763
Bush B-1	1.72	0.890
Bivins A-3	6.57	0.000
Fuqua A-1	1.92	0.000
Bush A-9	0.00	0.000
Fuqua A-3	0.00	0.000

Reservoir Status 2018

Well Performance Table – 2017-18 Volume

Well Helium Production Comparison				
Well	Helium Concentration 6/30/2018 Percent	Total Helium Flow MMscf/D	Produced Helium Contribution Percent	Produced Helium Total Contribution Percent
Bivins A-6	41.99	255.837	24.55	24.55
Bivins A-14	27.60	138.267	13.27	37.82
Bivins A-13	32.05	136.908	13.14	50.96
Bush A-5	26.01	134.190	12.88	63.83
Bush A-3	32.05	119.340	11.45	75.28
Bivins A-5	18.58	64.079	6.15	81.43
Bivins A-4	11.00	49.991	4.80	86.23
Bivins A-7	29.85	40.550	3.89	90.12
Bush A-4	8.91	22.179	2.13	92.25
Bush A-2	5.29	21.408	2.05	94.30
Bivins A-9	2.68	10.230	0.98	95.29
Bivins B-1	2.42	9.391	0.90	96.19
Bivins A-2	3.50	8.909	0.85	97.04
Bivins A-11	2.93	7.880	0.76	97.80
Bivins A-15	1.69	7.253	0.70	98.49
Bivins B-2	1.84	6.768	0.65	99.14
Bush A-8	1.81	4.266	0.41	99.55
Bush A-11	2.36	3.763	0.36	99.91
Bush B-1	1.72	0.890	0.09	100.00
Bivins A-3	6.57	0.000	0.00	100.00
Fuqua A-1	1.92	0.000	0.00	100.00
Bush A-9	0.00	0.000	0.00	100.00
Fuqua A-3	0.00	0.000	0.00	100.00

Reservoir Status 2018

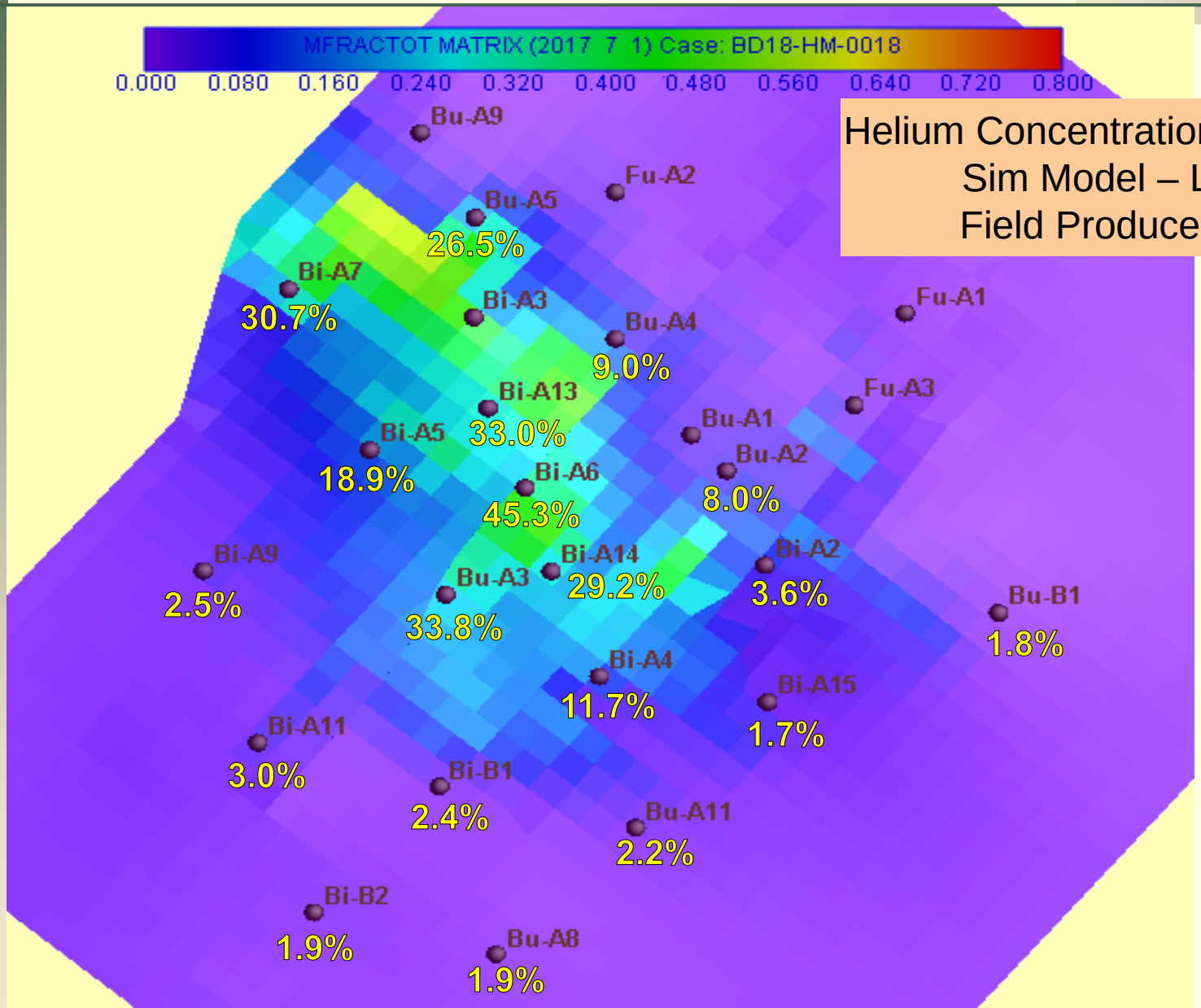
Well Performance Table – 2017-18 Volume

Well Helium Production Comparison					
Well	Helium Concentration 6/30/2018 Percent	Total Helium Flow MMscf/D	Produced Helium Contribution Percent	Produced Helium Total Contribution Percent	Total Gas Produced MMscf/D
Bivins A-6	41.99	255.837	24.55	24.55	589.679
Bivins A-14	27.60	138.267	13.27	37.82	490.515
Bivins A-13	32.05	136.908	13.14	50.96	421.918
Bush A-5	26.01	134.190	12.88	63.83	516.342
Bush A-3	32.05	119.340	11.45	75.28	374.002
Bivins A-5	18.58	64.079	6.15	81.43	344.928
Bivins A-4	11.00	49.991	4.80	86.23	448.512
Bivins A-7	29.85	40.550	3.89	90.12	139.004
Bush A-4	8.91	22.179	2.13	92.25	250.507
Bush A-2	5.29	21.408	2.05	94.30	295.225
Bivins A-9	2.68	10.230	0.98	95.29	396.287
Bivins B-1	2.42	9.391	0.90	96.19	397.134
Bivins A-2	3.50	8.909	0.85	97.04	255.264
Bivins A-11	2.93	7.880	0.76	97.80	269.241
Bivins A-15	1.69	7.253	0.70	98.49	422.775
Bivins B-2	1.84	6.768	0.65	99.14	362.793
Bush A-8	1.81	4.266	0.41	99.55	233.631
Bush A-11	2.36	3.763	0.36	99.91	168.027
Bush B-1	1.72	0.890	0.09	100.00	51.649
Bivins A-3	6.57	0.000	0.00	100.00	0.000
Fuqua A-1	1.92	0.000	0.00	100.00	0.000
Bush A-9	0.00	0.000	0.00	100.00	0.000
Fuqua A-3	0.00	0.000	0.00	100.00	0.000

Reservoir Status 2018

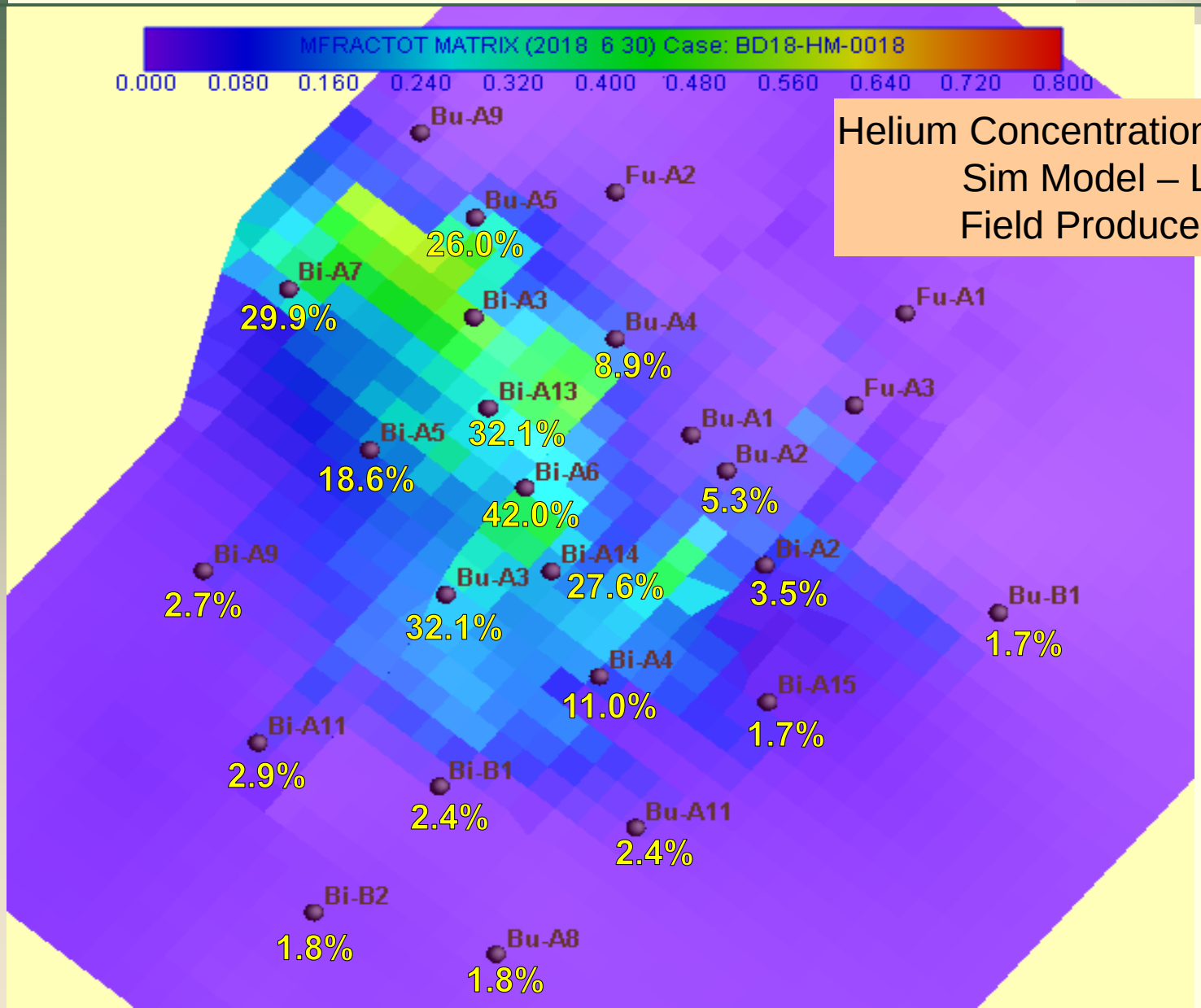
- Helium concentration maps
  - July 1 2017
  - June 30 2018
  - Change in He %
- Flowing WHP – June 30 2018

Reservoir Status 2018



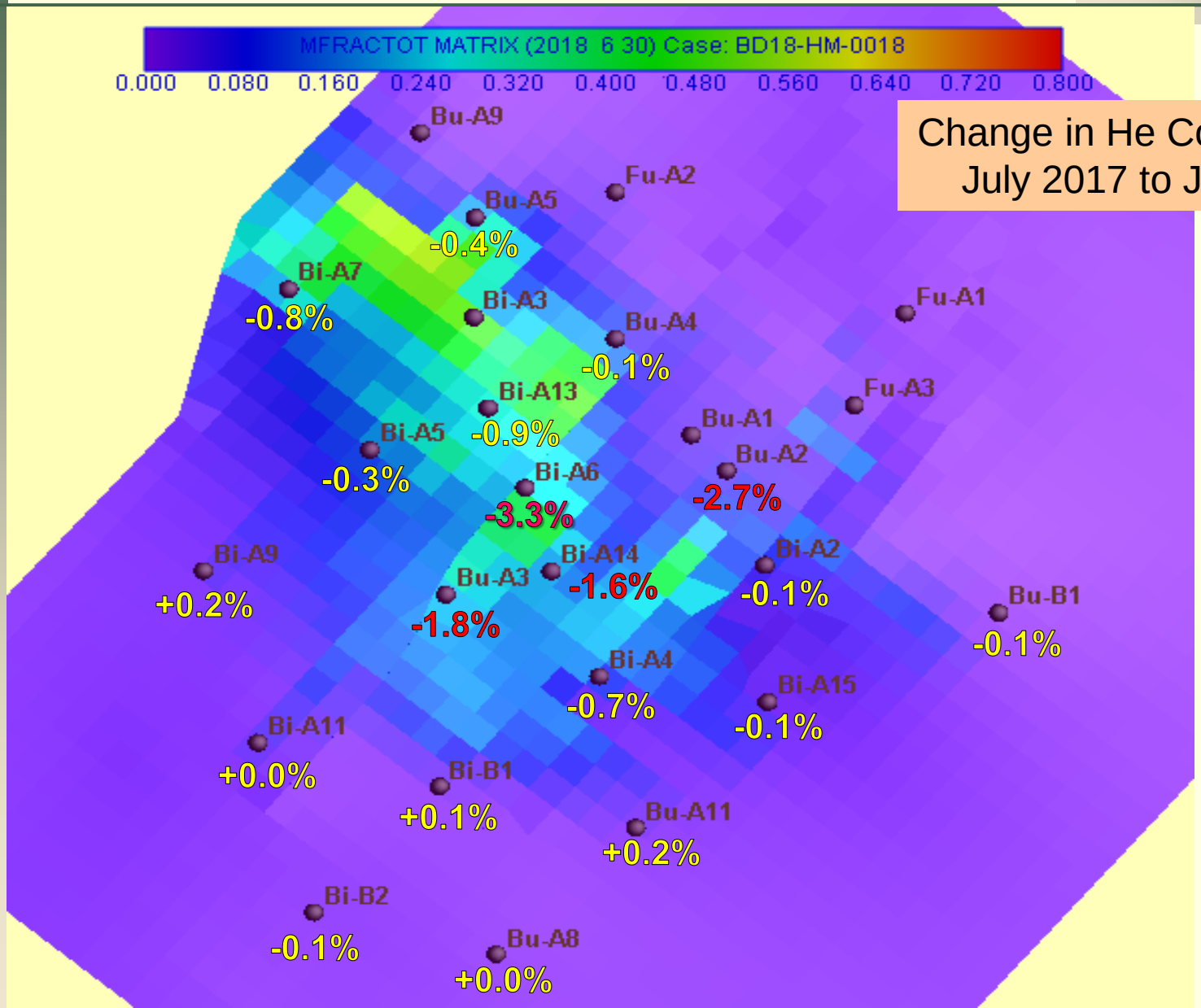
Helium Concentration – **July 2017**
Sim Model – Layer 7
Field Produced HE%

Reservoir Status 2018



Helium Concentration – **June 2018**
Sim Model – Layer 7
Field Produced HE%

Reservoir Status 2018

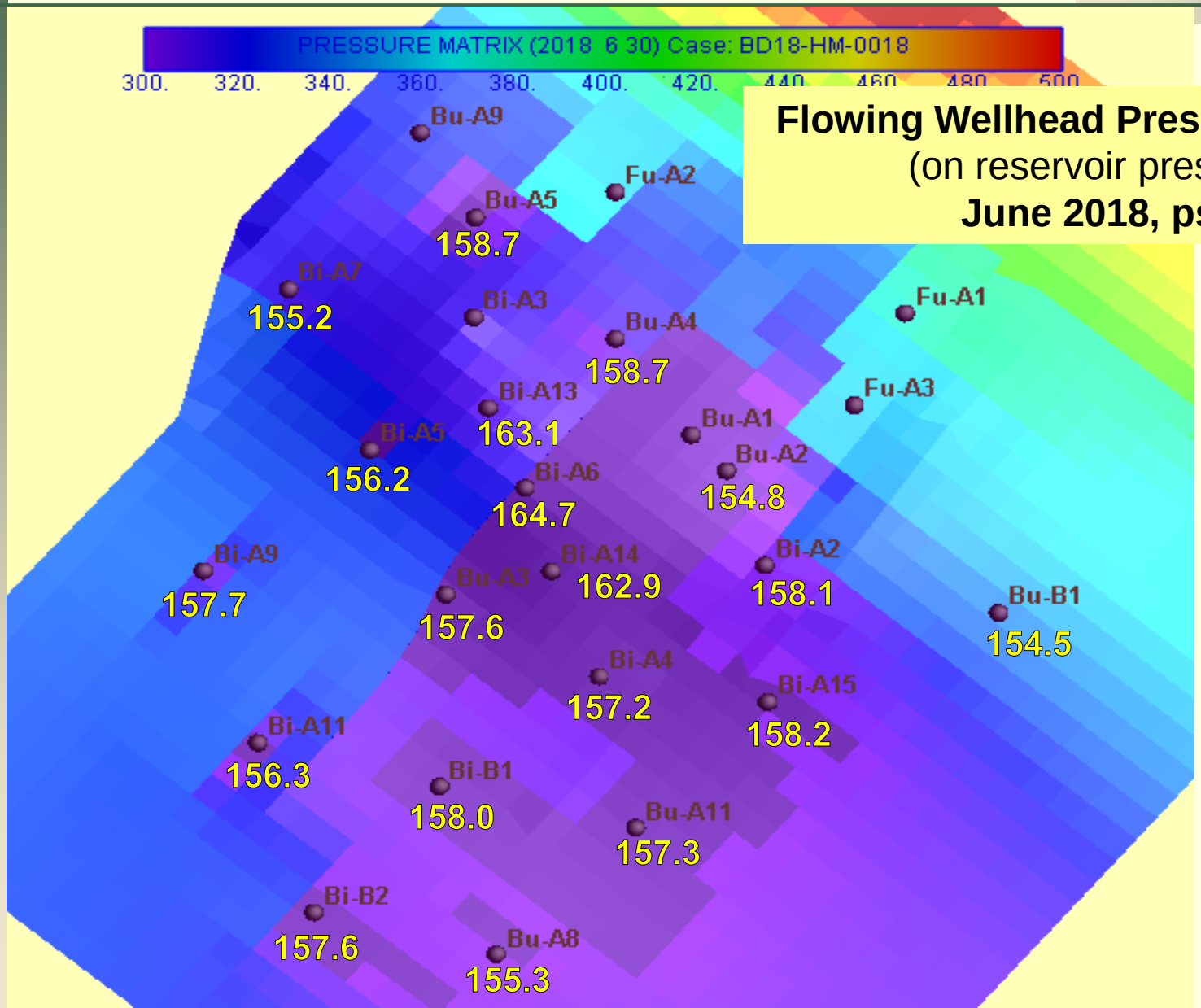


Change in He Concentration
July 2017 to June 2018

Reservoir Status 2018

- Helium concentration maps
  - July 1 2017
  - June 30 2018
  - Change in He %
- Flowing WHP – June 30 2018

Reservoir Status 2018



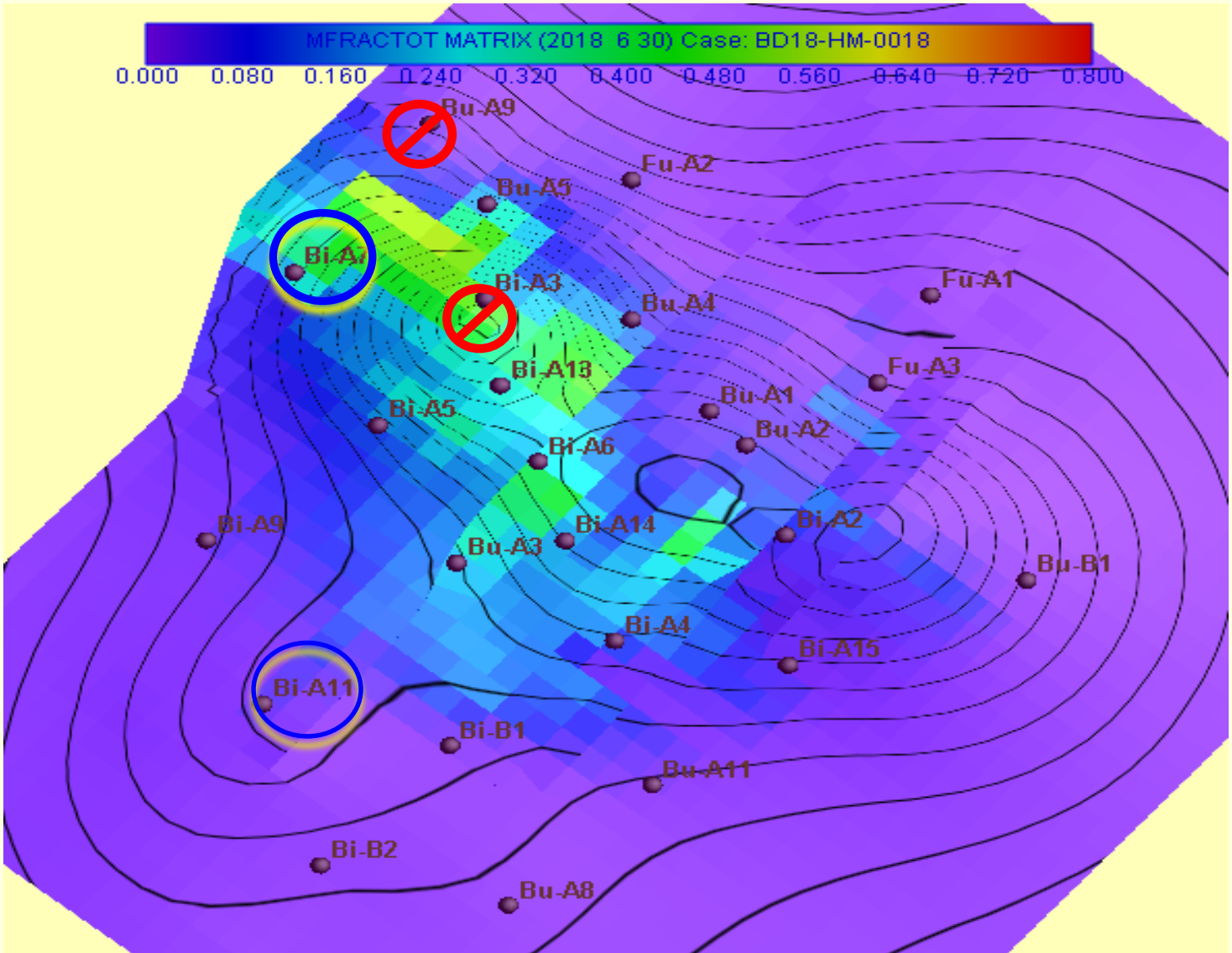
Flowing Wellhead Pressure (FWHP)
(on reservoir pressure)
June 2018, psia

Reservoir Status 2018

- **Water Encroachment – Well Issues**
  - **2 wells shut-in (Bi-A3 & Bu-A9)**
  - **2 wells show some water but improved in 2018 Bi-A7 & Bi-A11**
  - **Bi-A7:**
    - **Helium well in north**
    - **Was #10 in helium prod (2017), now up to #8**
    - **Currently flowing normally**
  - **Bi-A11:**
    - **Methane well in outer area, south & west**
    - **Impacts methane availability for HEU startup**
    - **Currently flowing normally**

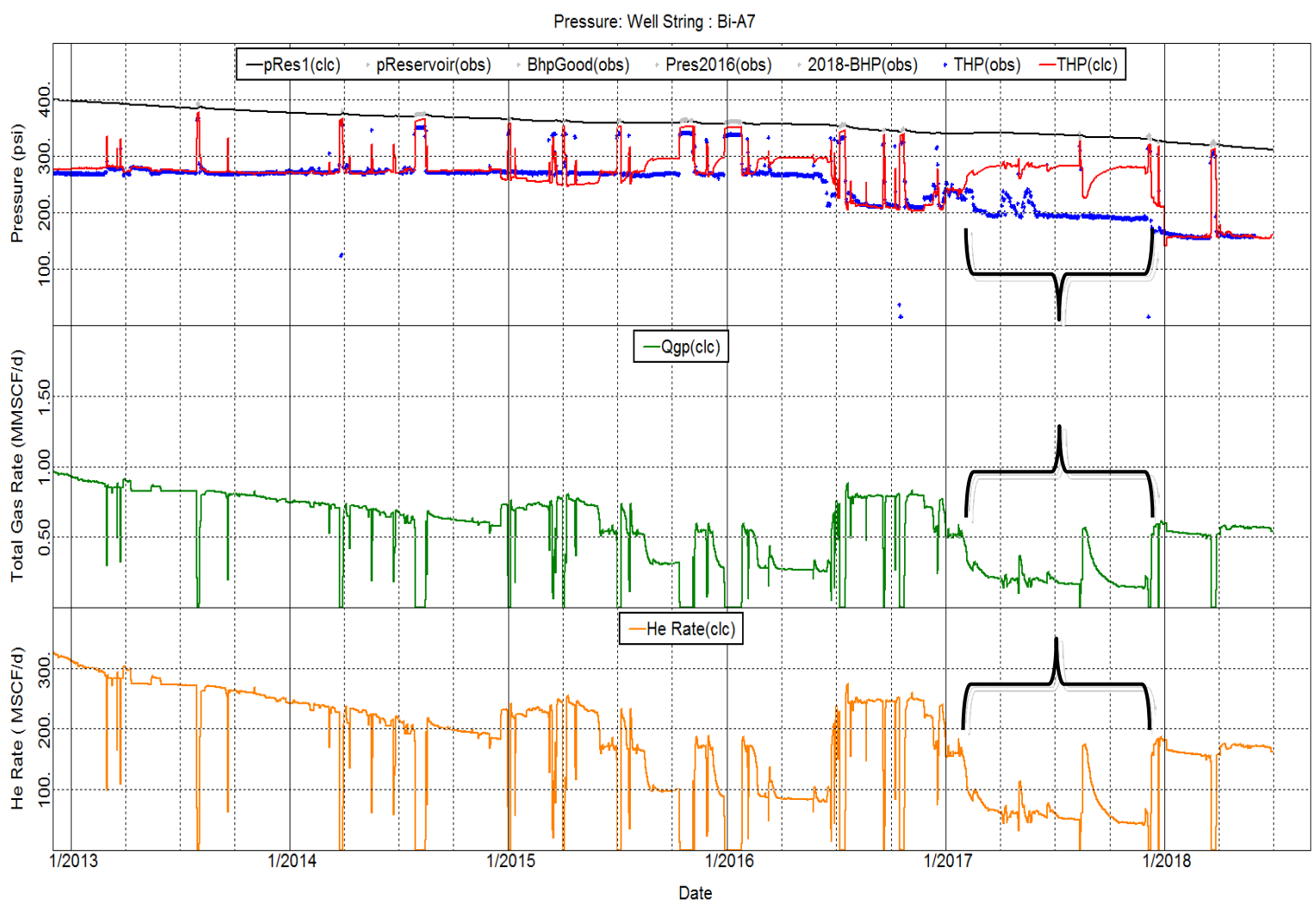
Reservoir Status 2018

- Water encroachment



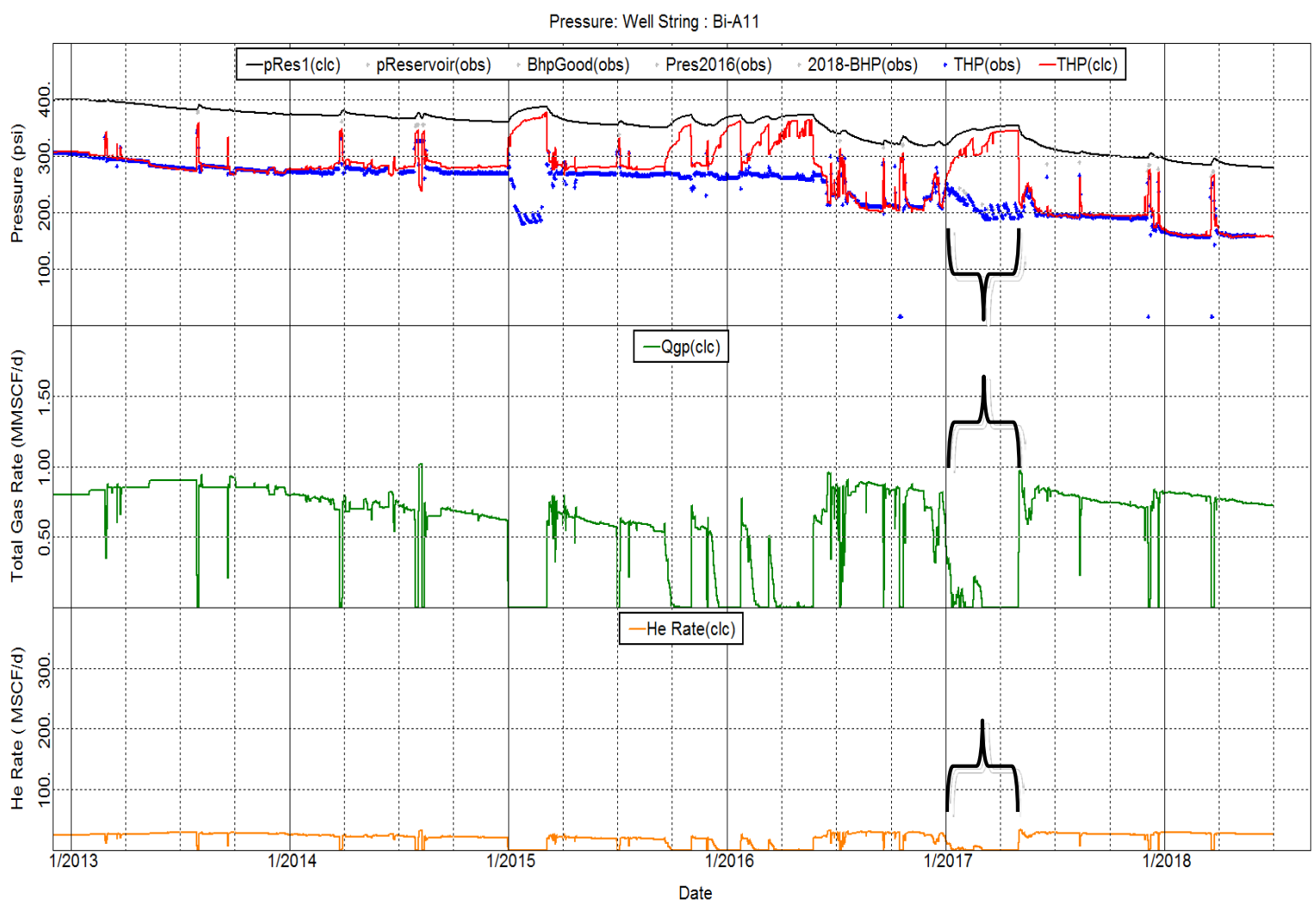
Reservoir Status 2018

Water encroachment – Bi-A7



Reservoir Status 2018

Water encroachment – Bi-A11



Reservoir Status 2018

- **Conclusions**
  - **Field is at max total gas / max helium until central compression is online**
  - **Total gas and He rates will decline over time until min flowing pressure is addressed.**
  - **He concentration below 42% for all wells**
  - **Water encroachment showed some improvement, but may return.**
    Most likely will impact outer wells in the future with minimal impact on helium, except if Bi-A7 is encroached.

Outline

- *Reservoir Status (Operations: 2017-2018)*
- *Simulation Model Status*
- *Predictions*
- *Conclusions*

Echo Lake near Mt. Evans, CO

Ute Pass, CO

Simulation Model Status- 2018

- No changes to model in 2017-18 update
- Updated rates and pressures for 2017-18:
  - Helium match:
    - Field Level: 97.1% of 2017-18 He produced

      Annual volume: 1.042 vs. 1.012 Bcf (meas.vs. model)
    - Most wells (17 of 22) within +/- 3% He fraction (vg+)
    - The problem wells identified in 2017 showed increased divergence, causing He production mismatch to increase from 1% to 2.9%
  - Pressure match:
    - Very good to excellent reservoir pressure match

Simulation Model Status- 2018

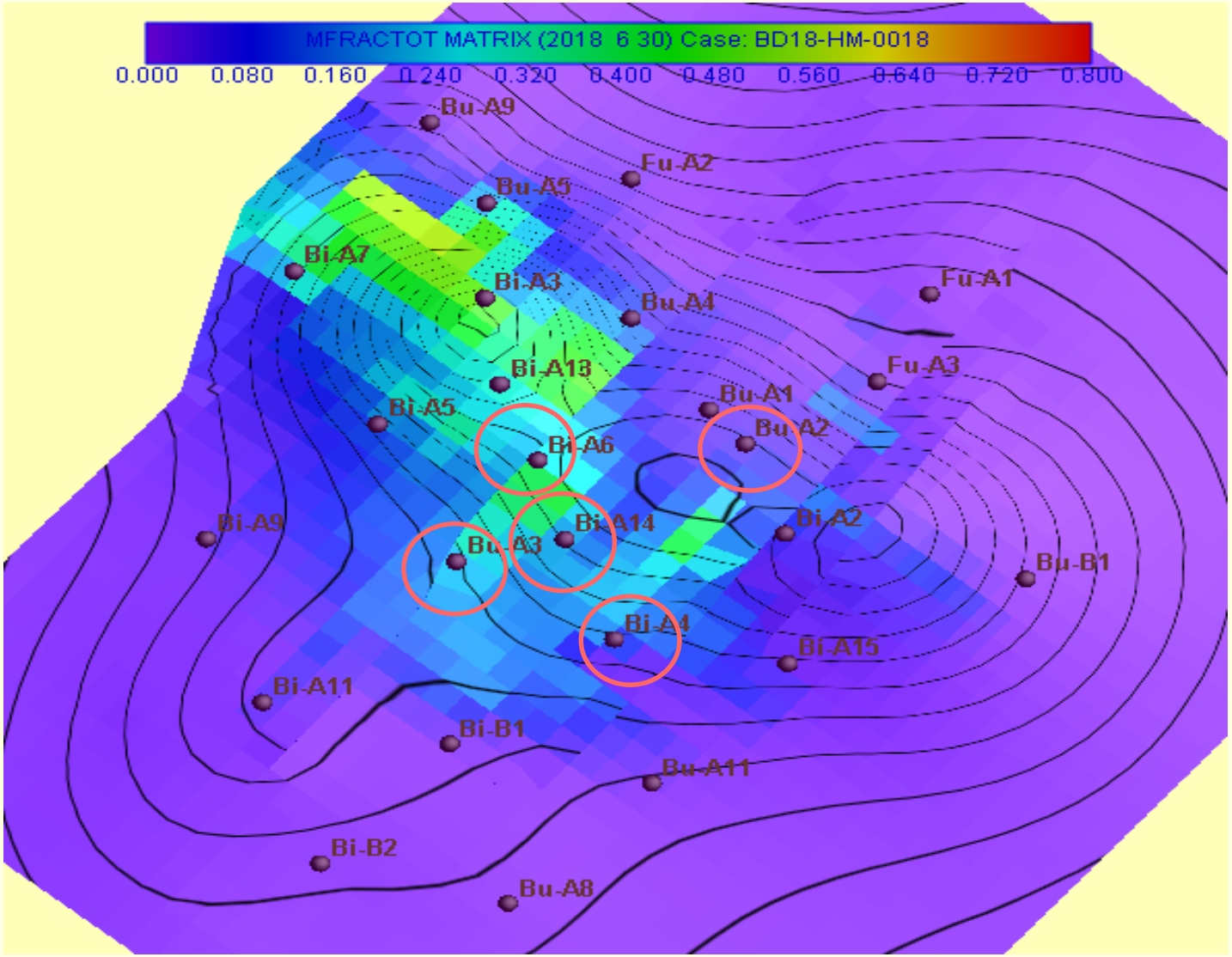
- Q: How accurate is the simulation model ?
  - Field Level – most important for He forecast
    - Very good history match on pressure
    - Good history match on He Prod, but decreasing trend
    - Previous predictions track well with historical trends
  - Well Level – key wells very important
    - Very good match on pressure and most well He Prod.
    - 4 wells have weaker He match
    - Mismatches are mostly balanced between wells (Field match)
  - Examples

Simulation Model Status- 2018

- Examples – History Match Graphs
  - South Wells
    - Bi-A6 – #1 He producer, weaker He match (-7%)
    - Bi-A14 – #2 He producer
    - Bu-A3 – #5 He producer, weaker He match (-10%)
    - Bi-A4 - #7 He producer
    - Bu-A2 – #10 shows significant methane invasion

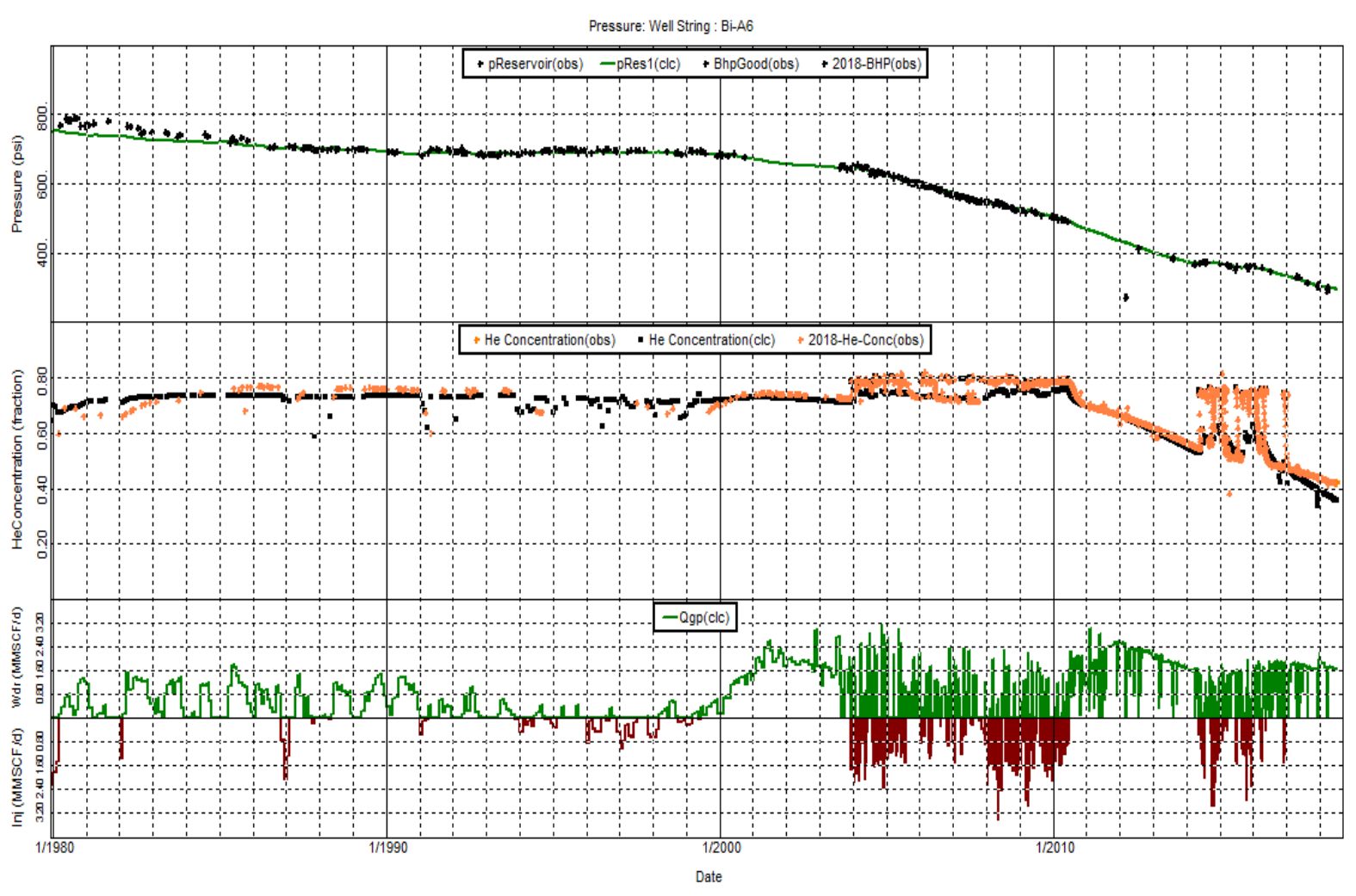
Simulation Model Status - 2018

- South Wells



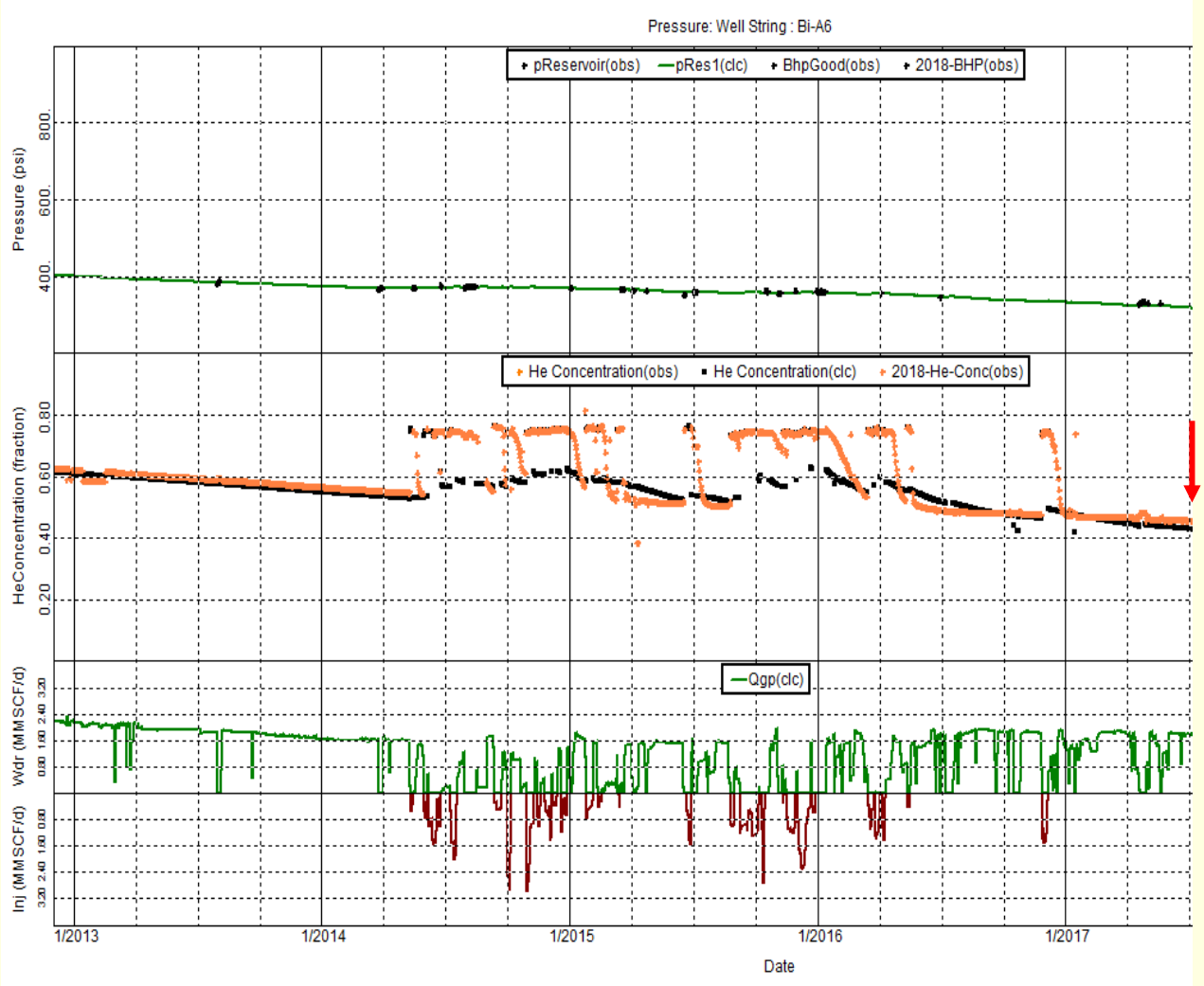
Simulation Model Status - 2018

- HM Plot – Bi-A6 (South Well)



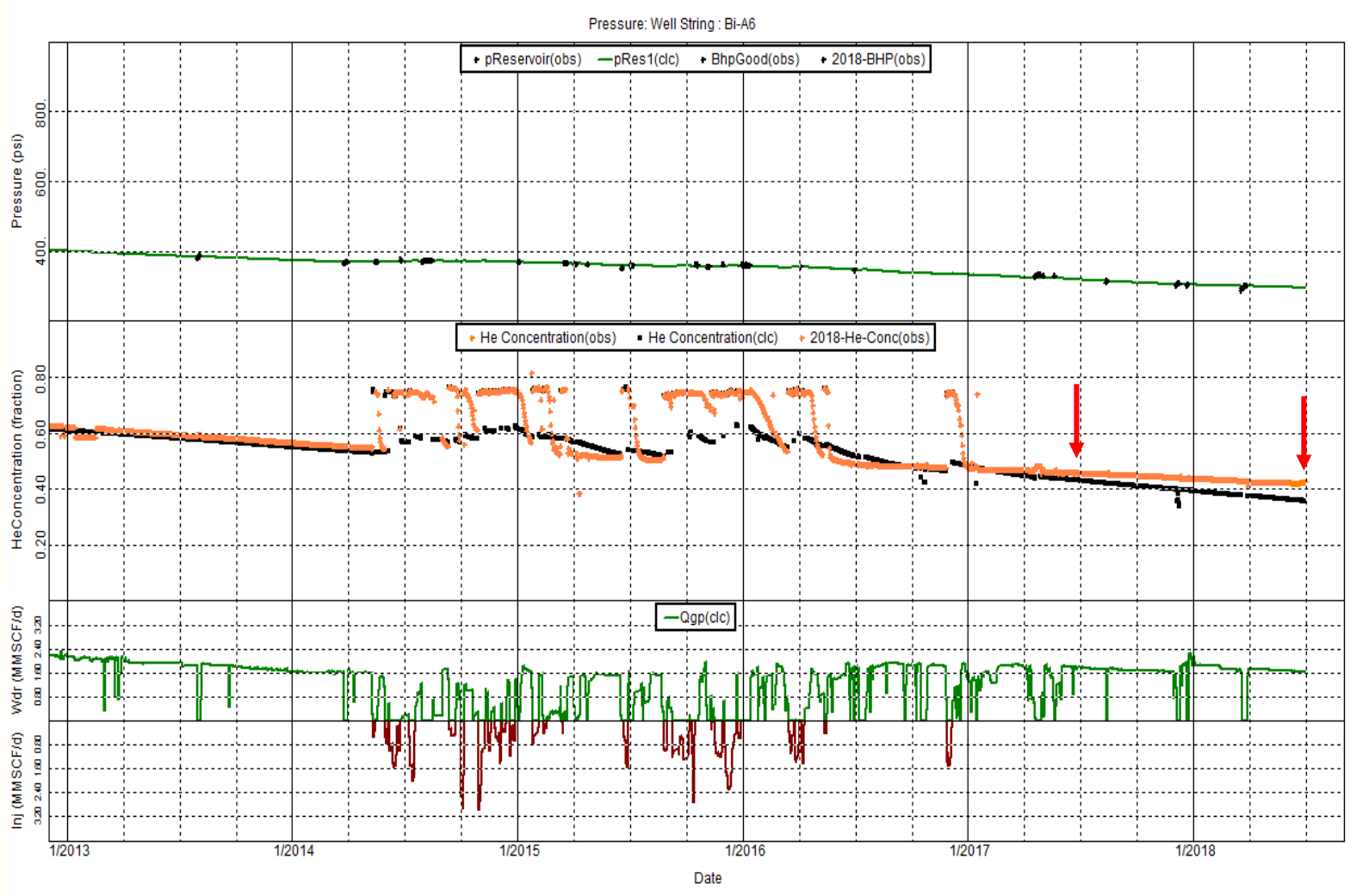
Simulation Model Status - 2018

- HM Plot – Bi-A6 (South Well)



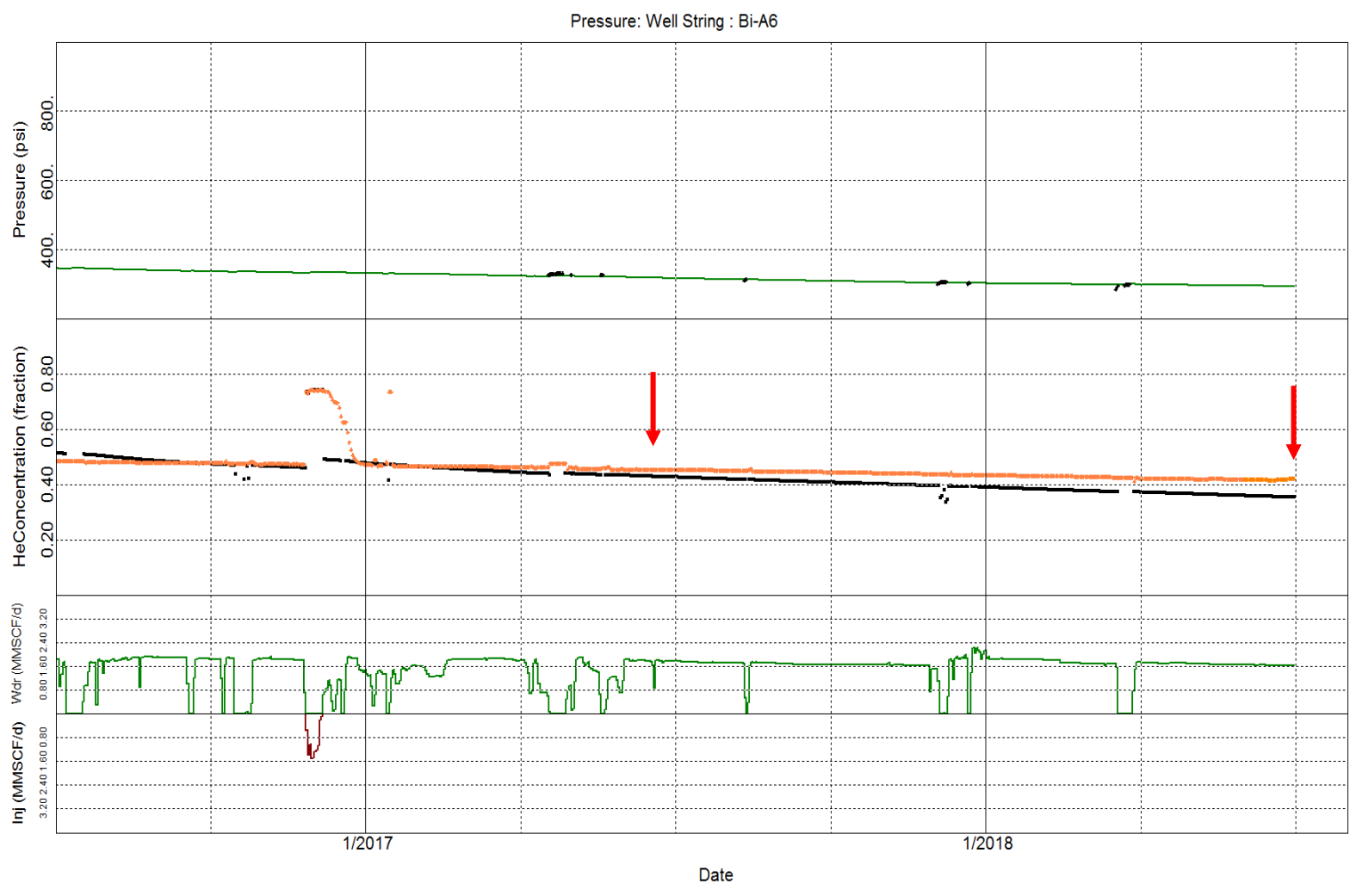
Simulation Model Status - 2018

- HM Plot – Bi-A6 (South Well)



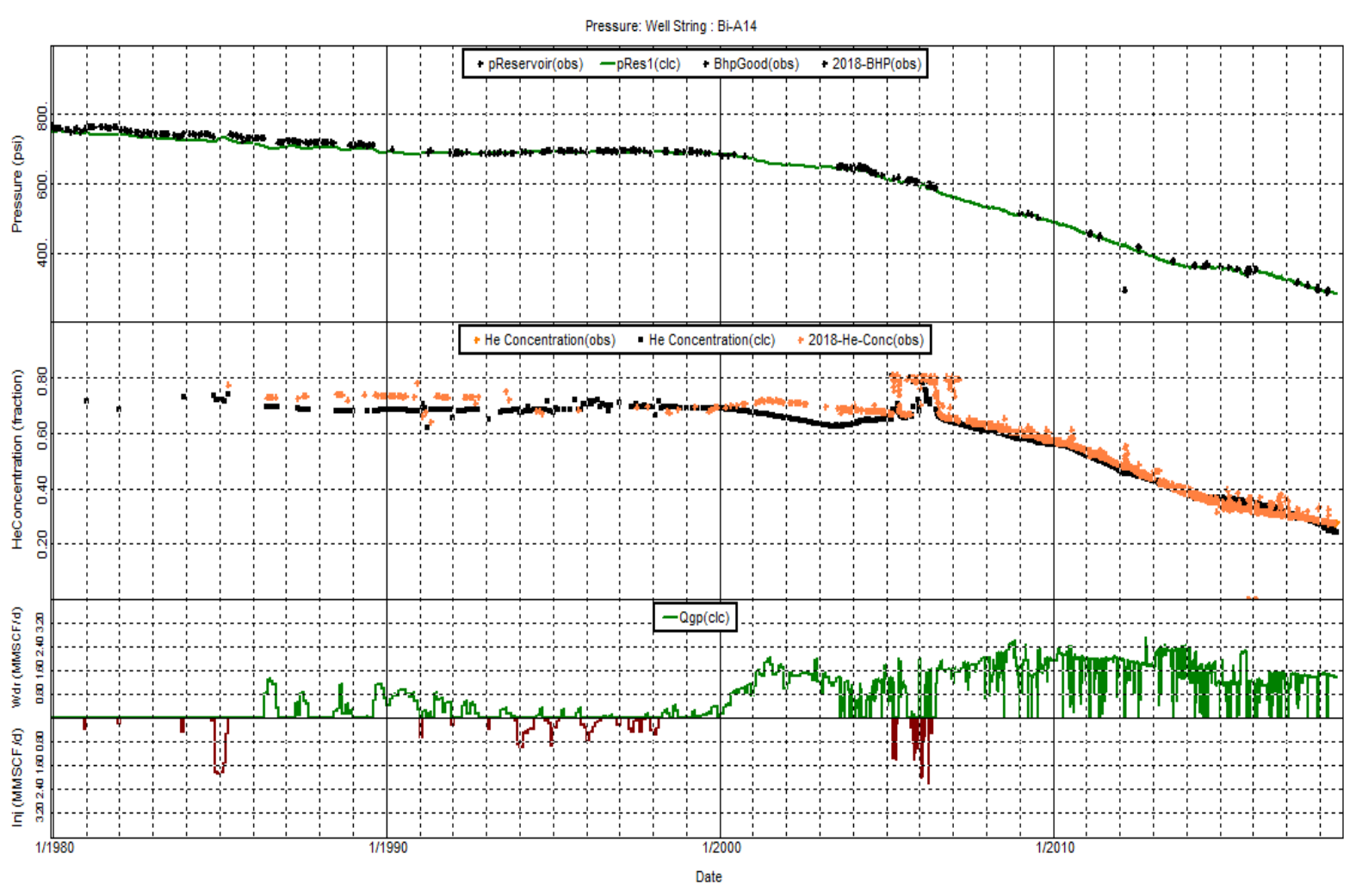
Simulation Model Status - 2018

- HM Plot – Bi-A6 (South Well)



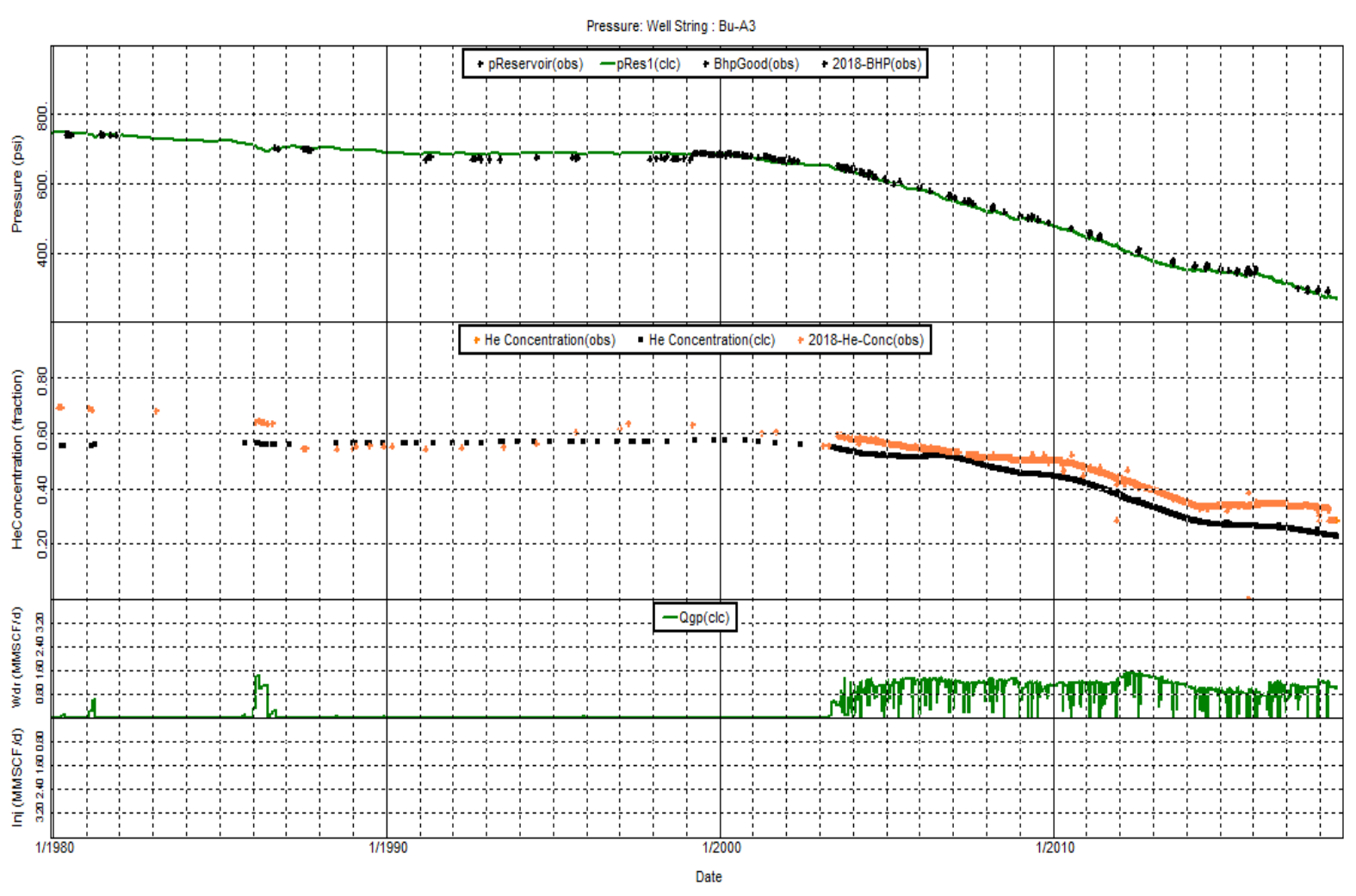
Simulation Model Status - 2018

- HM Plot – Bi-A14 (South Well)



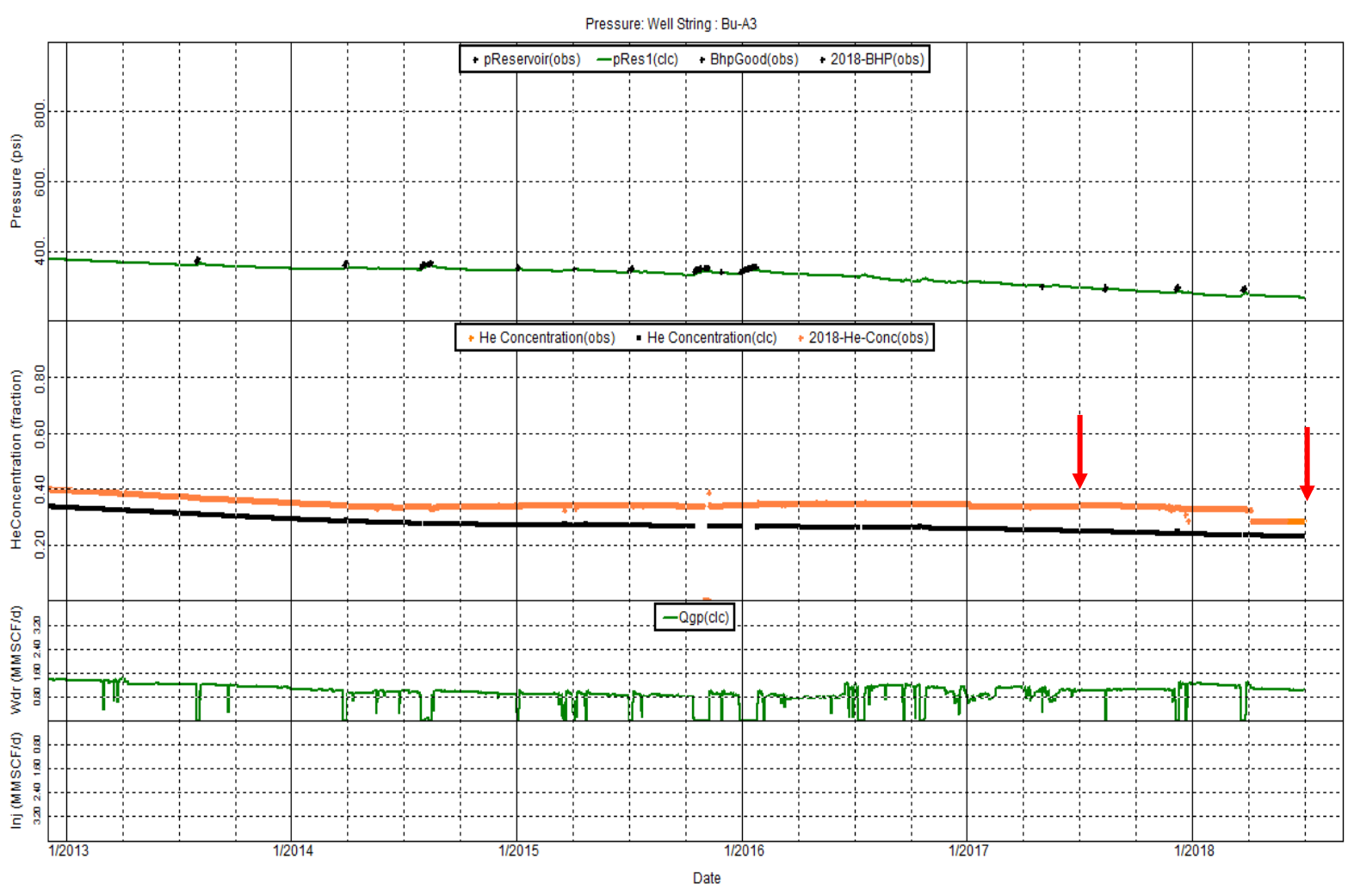
Simulation Model Status - 2018

- HM Plot – Bu-A3 (South Well)



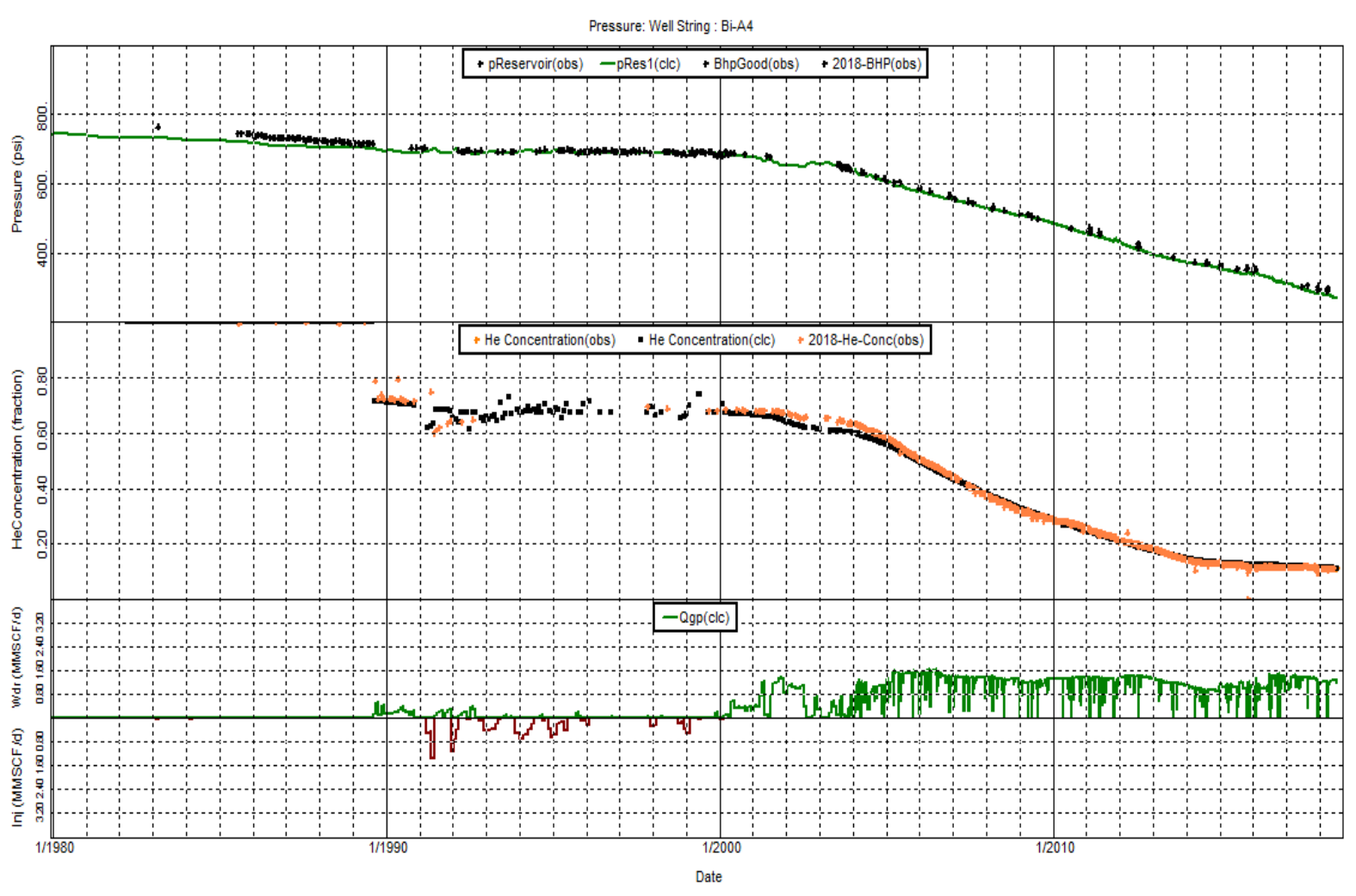
Simulation Model Status - 2018

- HM Plot – Bu-A3 (South Well)



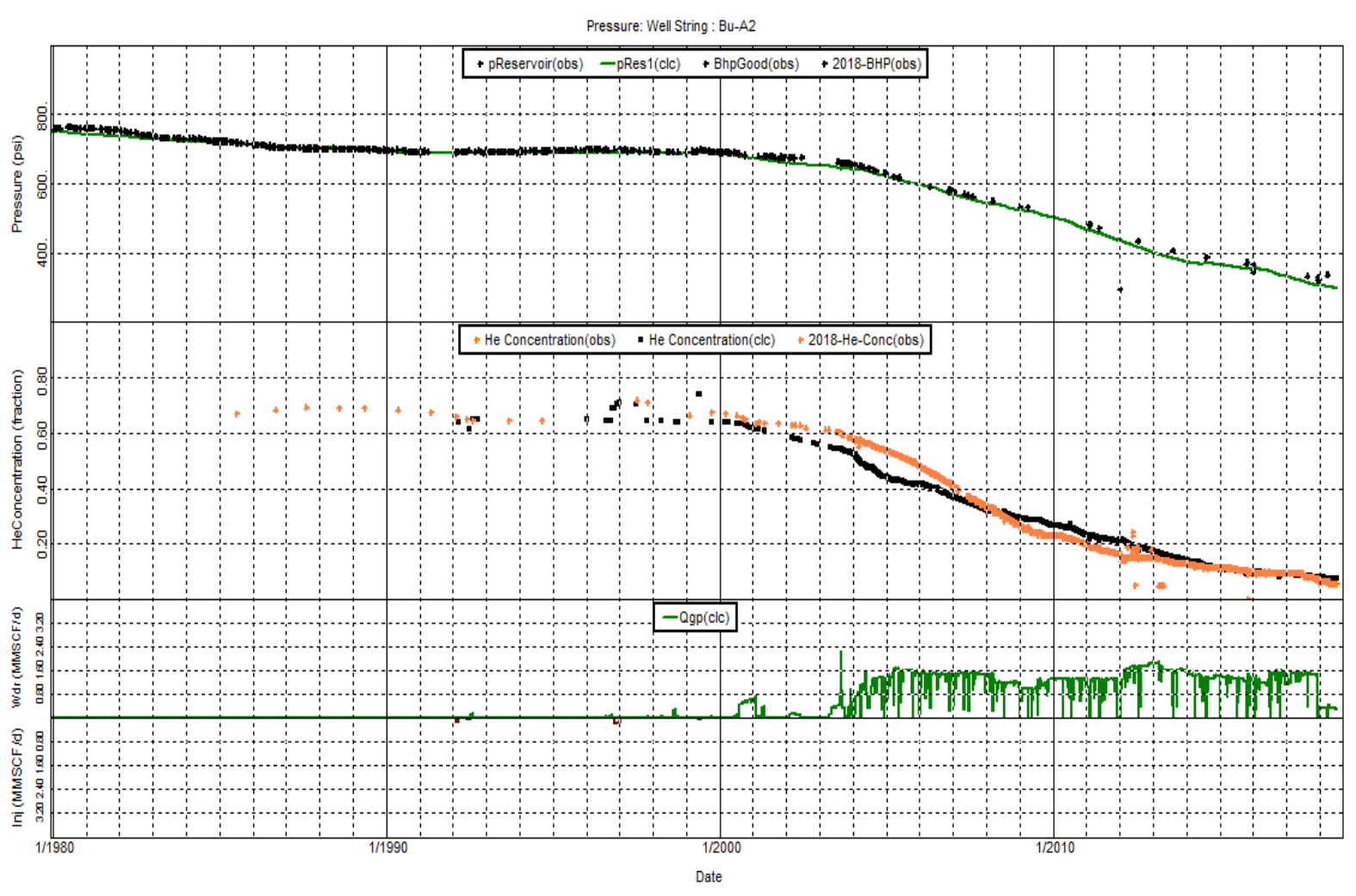
Simulation Model Status - 2018

- HM Plot – Bi-A4 (South Well)



Simulation Model Status - 2018

- HM Plot – Bu-A2 (South Well)

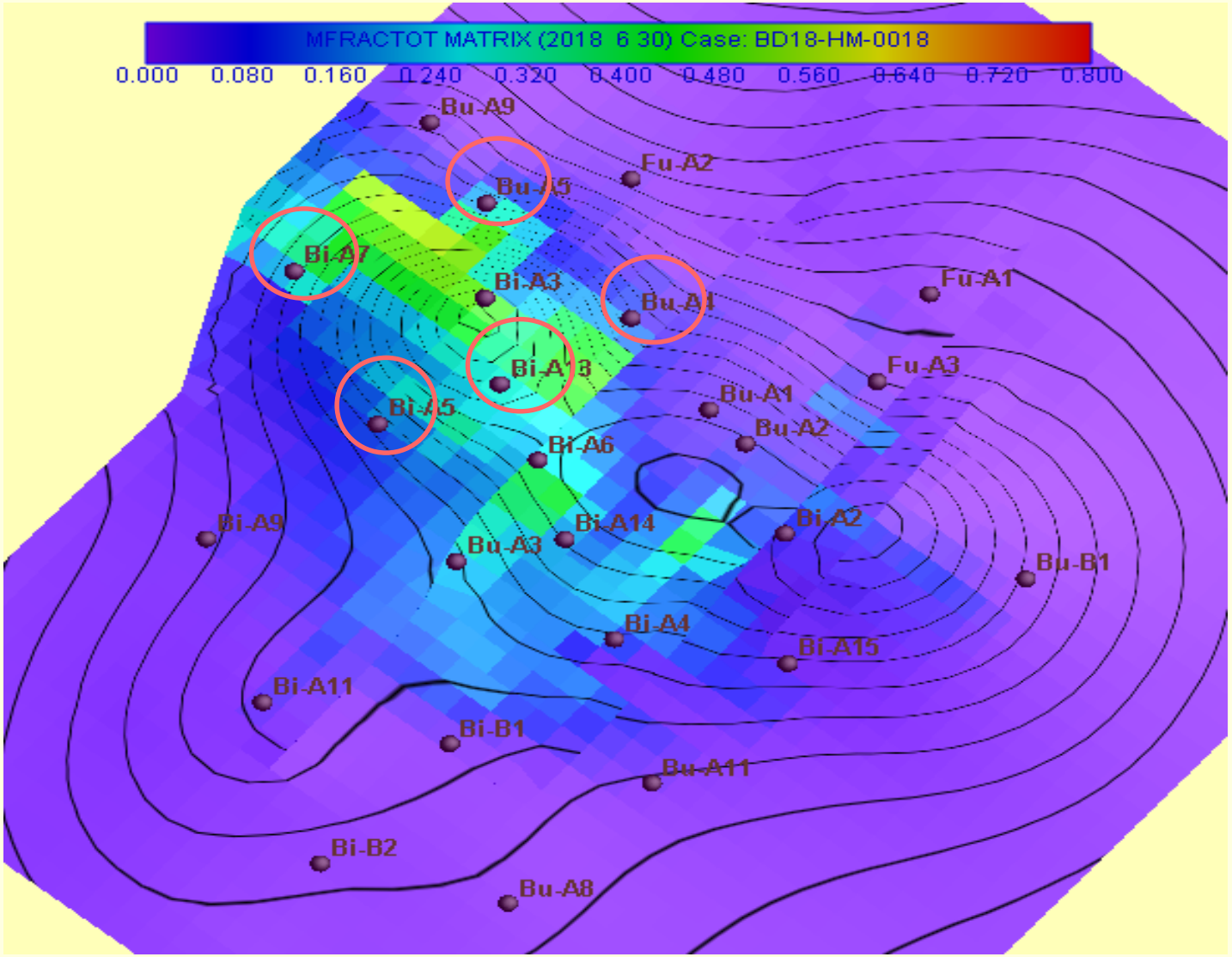


Simulation Model Status- 2018

- Examples – History Match Graphs
  - North Wells
    - Bi-A13 – #3 He producer, best in north area
    - Bu-A5 - #4 He producer, 2nd best in north area
    - Bi-A5 – #6 He producer, 3rd best in north area
    - Bi-A7 – #8 Good He conc., prior water issue
    - Bu-A4 – #9 He producer, weaker He match (+10%)

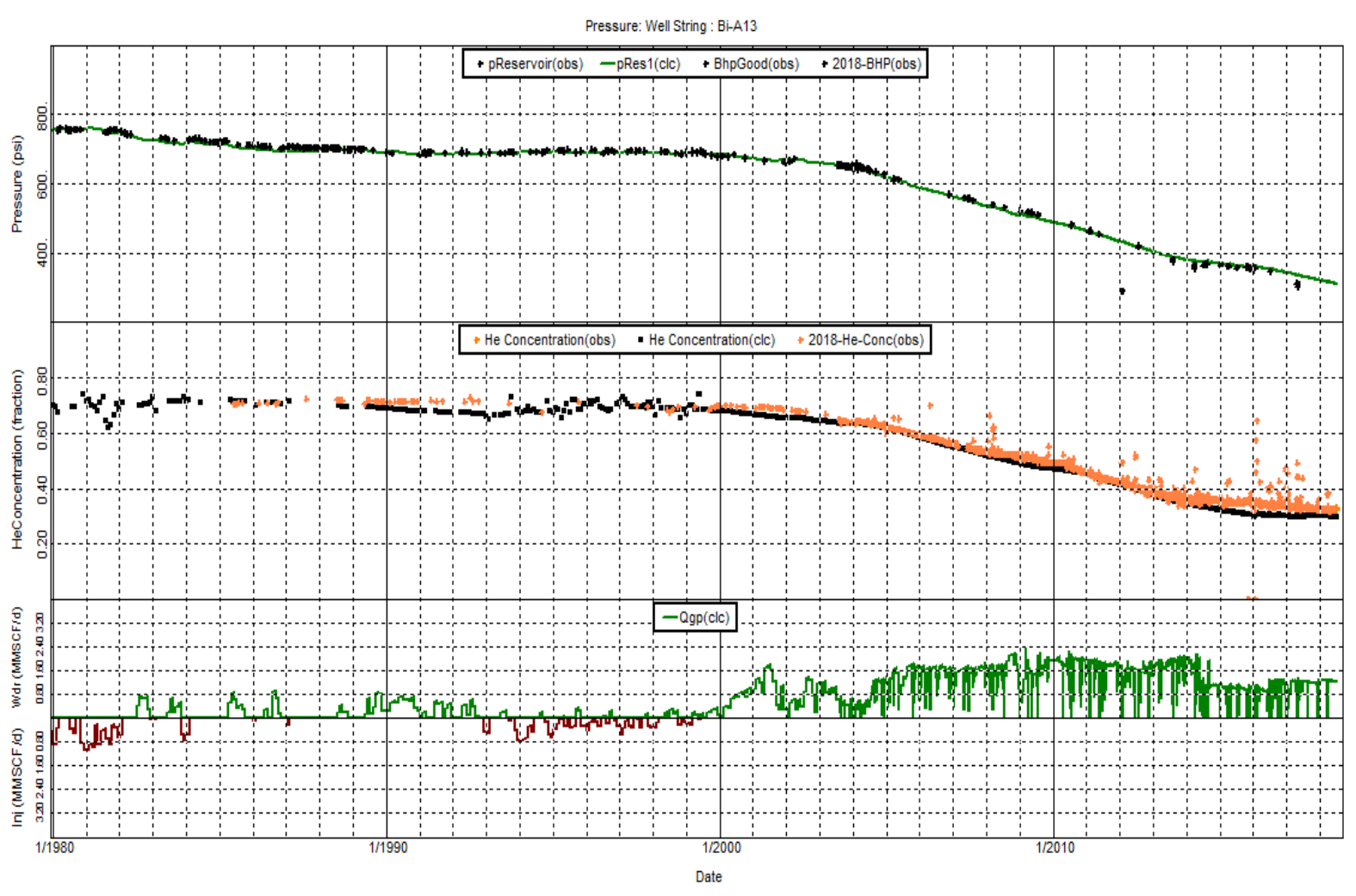
Simulation Model Status - 2018

- North Wells



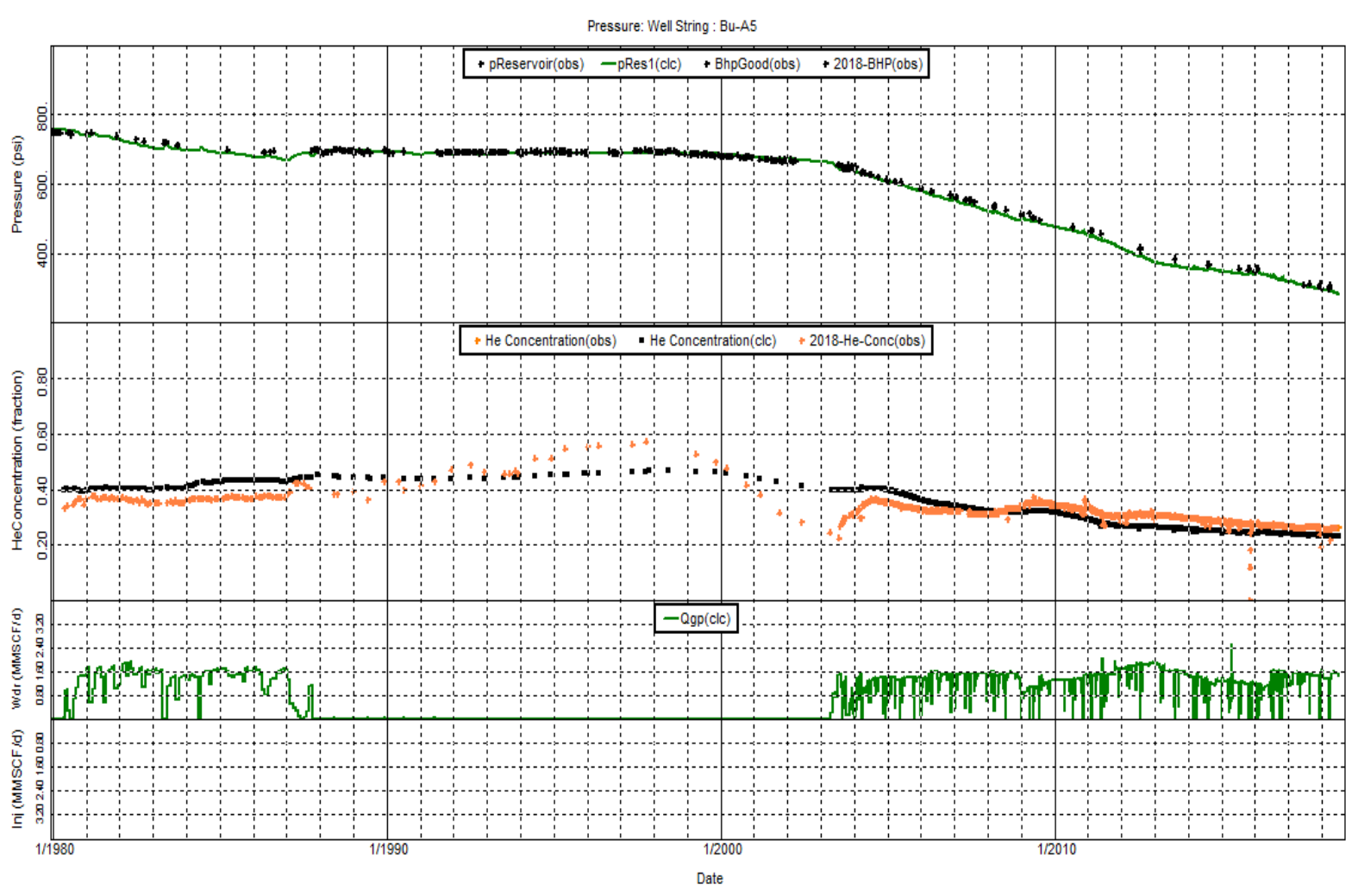
Simulation Model Status - 2018

- HM Plot – Bi-A13 (North Well)



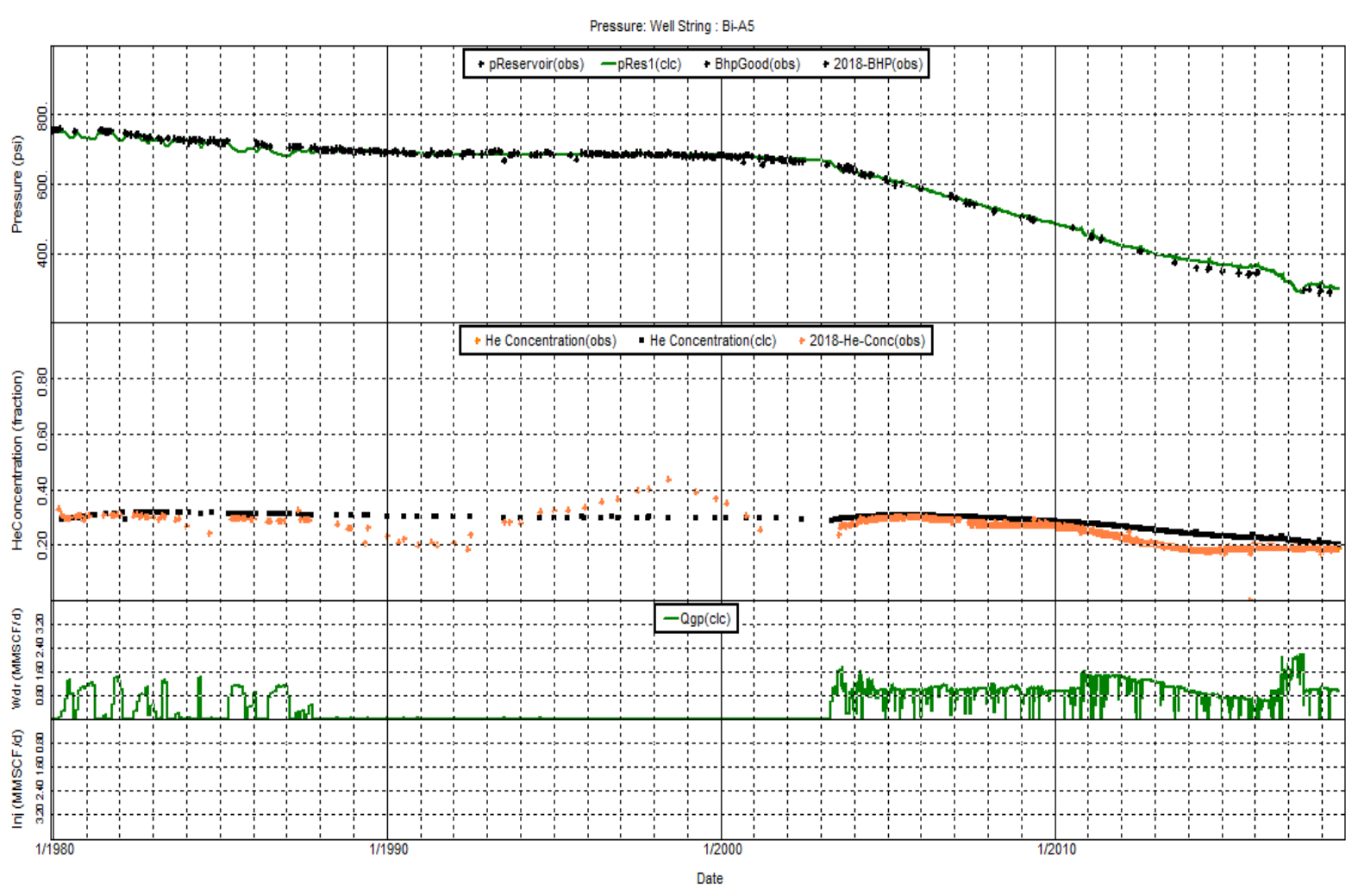
Simulation Model Status - 2018

- HM Plot – Bu-A5 (North Well)



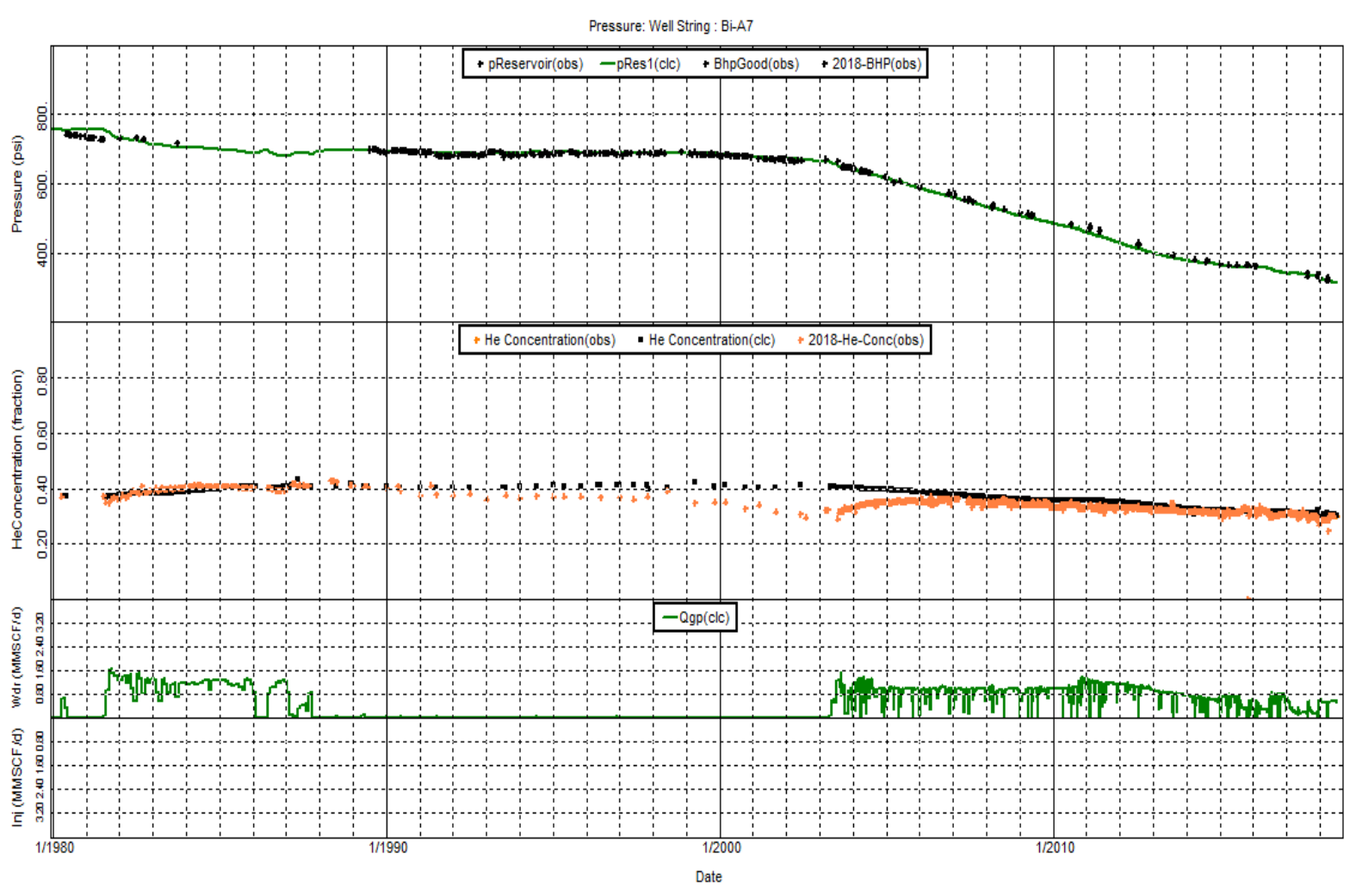
Simulation Model Status - 2018

- HM Plot – Bi-A5 (North Well)



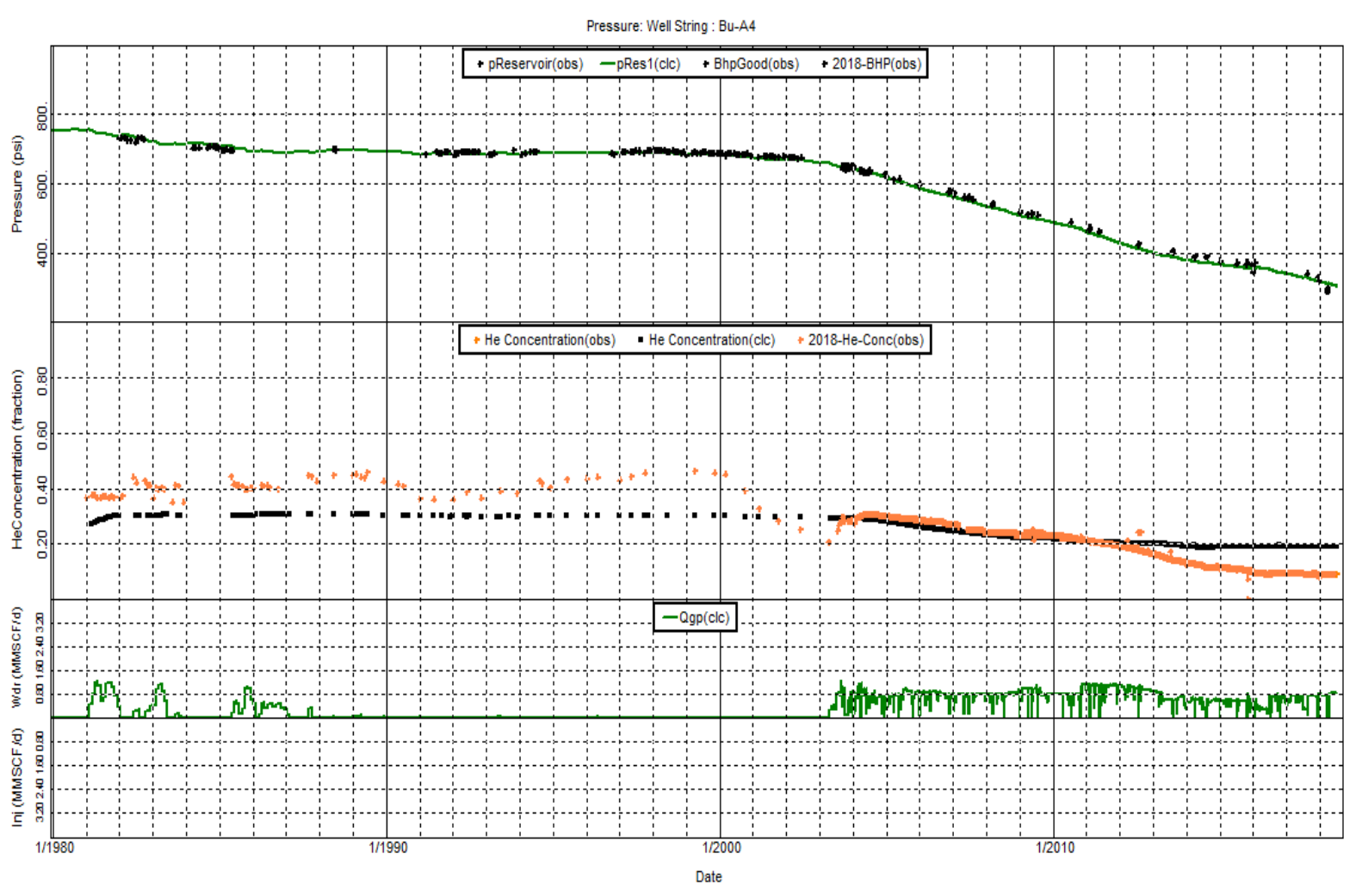
Simulation Model Status - 2018

- HM Plot – Bi-A7 (North Well)



Simulation Model Status - 2018

- HM Plot – Bu-A4 (North Well)



Simulation Model Status - 2018

- Conclusions
  - Model shows very good-excellent match at field level, for helium rate / concentrations (VG), and for pressure (VG-E)
  - Individual well match on helium rate / fraction shows wider variations, but averages out at field level

Implications on Predictions - 2018

- Helium Rate / Fraction
  - Expect model will continue with similar level of accuracy, but will somewhat under predict helium production (~3 - 6%) in the first few years.
  - Ultimate recovery should remain similar to previous predictions.

- Water Encroachment
  - Provides indications of effects of water encroachment.
  - At this time the model does not accurately predict which wells could be shut-in due to water encroachment and low flow rates.
  - The model can not predict the sudden water breakthroughs due to unidentified fracture connections.

Outline

- *Reservoir Status (Operations: 2017-2018)*
- *Simulation Model Status*
- *Predictions*
- *Conclusions*

Vail Pass, CO

Maroon Bells - Aspen, CO

Prediction Cases 2018

- Prediction objectives:
  - Determine maximum possible annual helium production from July 1,2018 – Sep 30 2021
    - Current operating conditions (155 psia)
    - Central compression online (75 psia)
  - Evaluate impact of low helium demand 2019-21
  - Estimate helium recovery post 2021

Prediction Cases 2018

- Results
  - *Preliminary results to assist with future planning. Prediction results will be reviewed with BLM.*
  - *Since remaining government helium has reached the 3 BCF level, there will be no future annual sales per HSA-2013 mandates.*

Prediction Cases 2018

- Results
  - *Note: all results are simulation model estimates, indicating the future trends.*
  - *These predictions do not take into account production changes or future operational issues that can occur in any gas production field – such as (but not limited to)*
    - *Changes in He demand*
    - *Well damage/flow issues, water encroachment*
    - *Surface facility issues, upgrades, repairs….*

Prediction Cases 2018

- **Prediction cases**
  - **Case 1: Current operations**
    - Pmin for all wells = 155 psia
    - Maximum well rates (max He rate)
  - **Case 2: Central compression online 10/15/2018**
    - Pmin = 75 psia
    - Maximum well rates (max He rate)
  - **Case 3: Low Rate 10/2019 - 9/2021**
    - Case 2 until 10/2019 (max He, Cent. Cmpr)
    - 12 MM/d at 11% He 10/2019 to 9/2021
  - **All Cases:** Maximum well rates 9/2021 to 9/2029

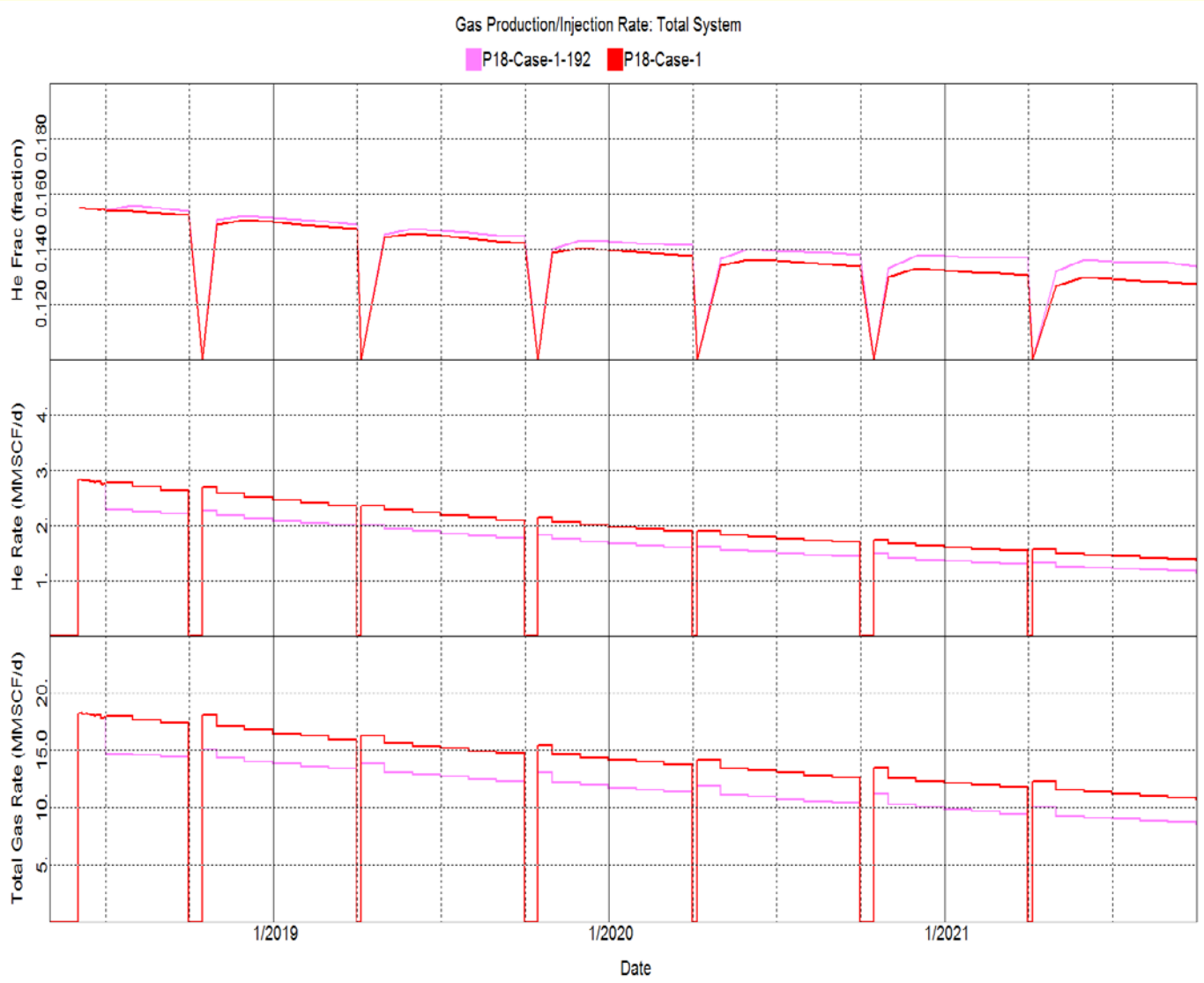
Prediction Cases 2018

- Results
  - Case comparisons
    - Graphs with rates and cumulative volumes
    - Tables with rates and cumulative volumes
  - Case 1
    - 2018 prediction used Pmin of 155 psia
    - 2017 prediction used Pmin of 192 psia
    - Ran an additional case to compare 192 psia (2017) vs 155 psia (2018)

Prediction Cases 2018

- Case 1 Compare (192 psia vs 155 psia)

95% Correction Factor Applied		
Case Compare	**Case 1-192**	**Case 1**
Pmin (psia)	192.0	155.0
Initial He Rate (MMscf/D)	2.172	2.627
Total He Produced (BCF)	1.794	2.123
Additional He Produced (BCF)		**0.346**

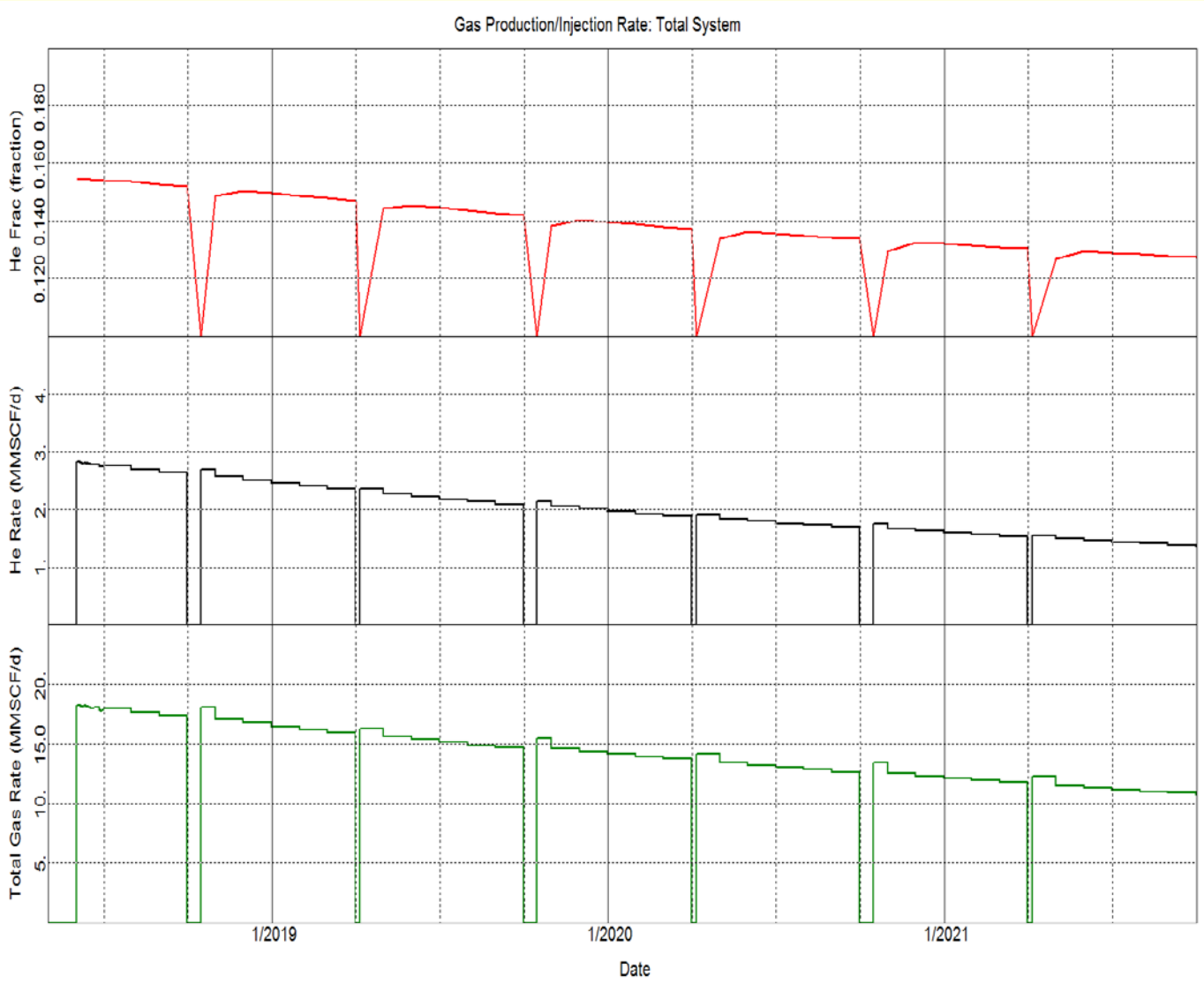


Prediction Cases 2018

- Case 1 Current Conditions – (Pmin 155 psia)

Annual Helium Vol (BCF)	
FY	Case 1
2018	0.236
2019	0.767
2020	0.618
2021	0.502
'18-'21	2.123

Annual Total Gas Vol (BCF)	
FY	Case 1
2018	1.560
2019	5.235
2020	4.512
2021	3.865
'18-'21	15.172

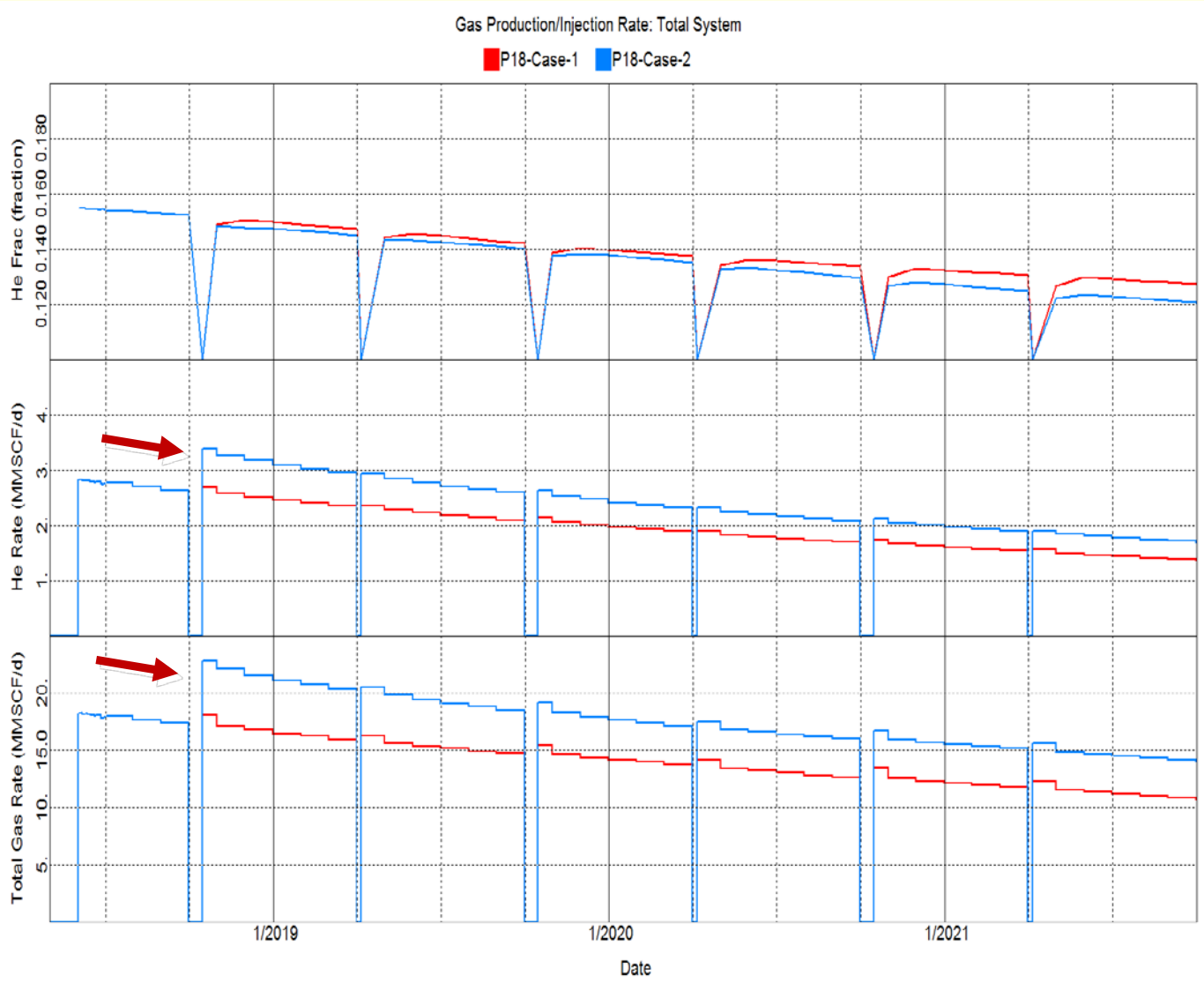


Prediction Cases 2018

- Case 1 & 2 Comparison

Annual Helium Vol (BCF)		
FY	Case 1	Case 2
2018	0.236	0.236
2019	0.767	0.960
2020	0.618	0.757
2021	0.502	0.616
'18-'21	2.123	2.570

Annual Total Gas Vol (BCF)		
FY	Case 1	Case 2
2018	1.560	1.560
2019	5.235	6.651
2020	4.512	5.640
2021	3.865	4.957
'18-'21	15.172	18.808

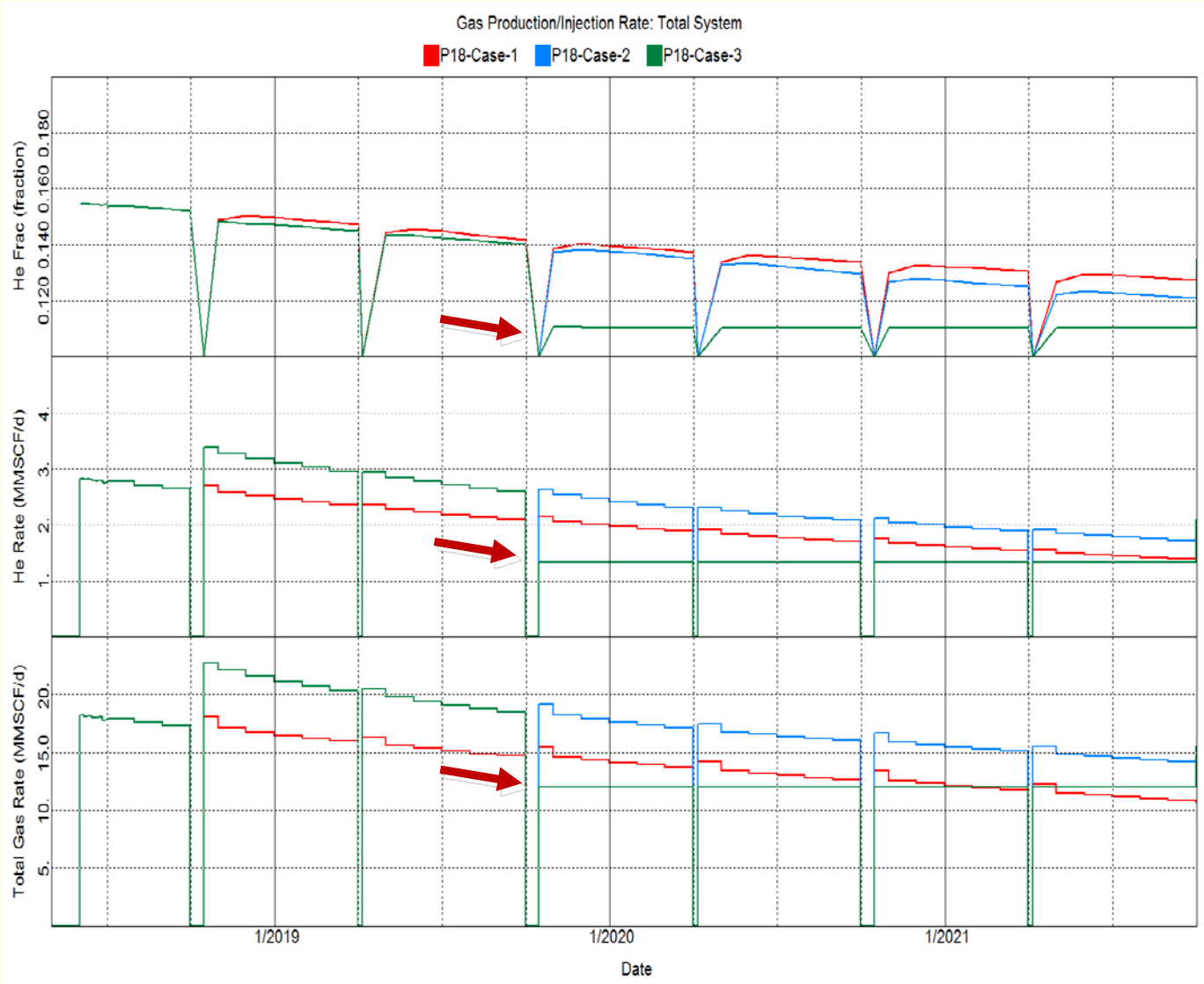


Prediction Cases 2018

- Case 3 Low Rate – 12 MM/d Total Gas, 1.320 MM/d He

Annual Helium Vol (BCF)			
FY	Case 1	Case 2	Case 3
2018	0.236	0.236	0.236
2019	0.767	0.960	0.960
2020	0.618	0.757	0.436
2021	0.502	0.616	0.434
'18-'21	2.123	2.570	2.066

Annual Total Gas Vol (BCF)			
FY	Case 1	Case 2	Case 3
2018	1.560	1.560	1.560
2019	5.235	6.651	6.651
2020	4.512	5.640	3.945
2021	3.865	4.957	3.933
'18-'21	15.172	18.808	16.088

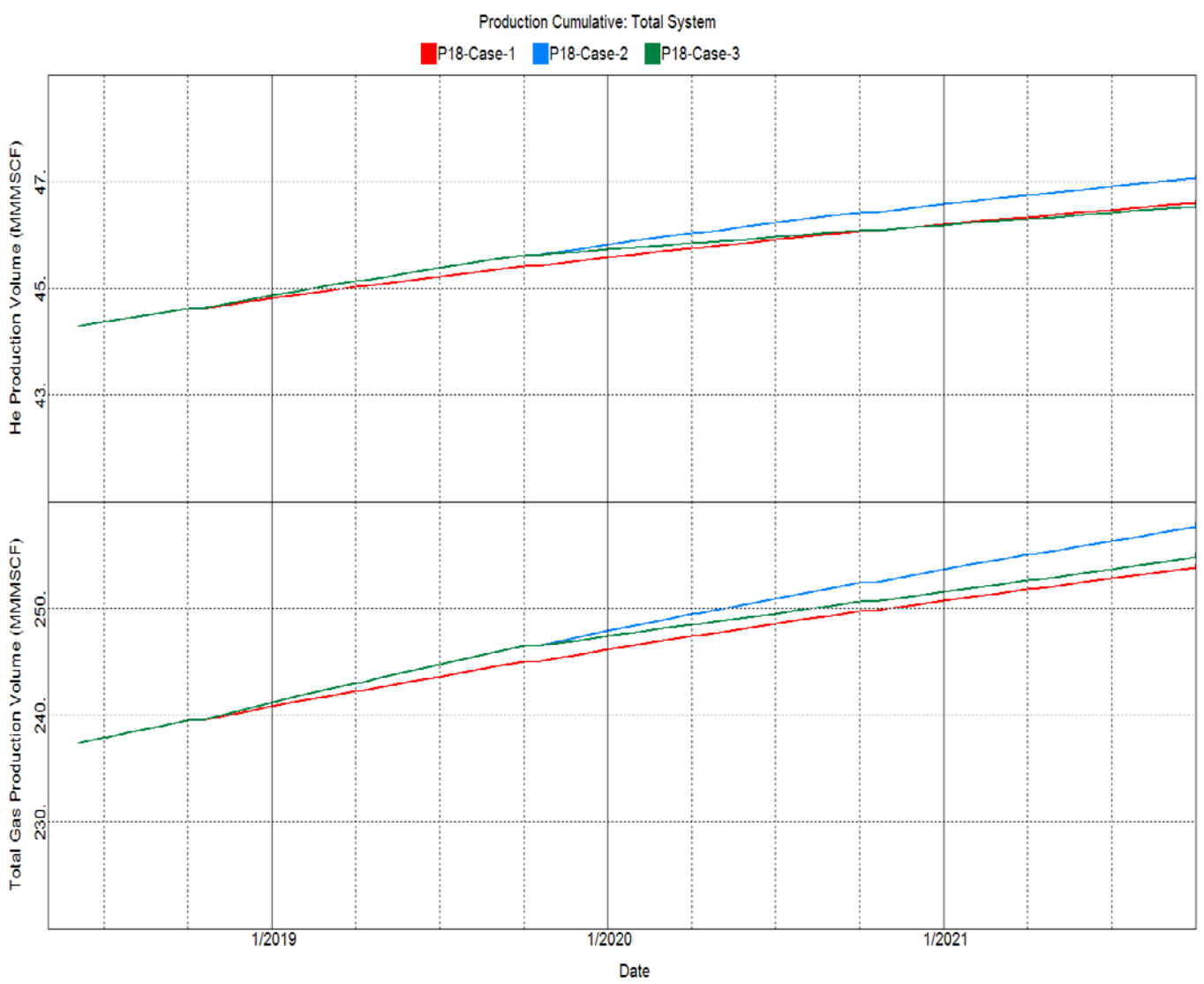


Prediction Cases 2018

- Total Production July 2018 – Sep 30 2021

Cumulative Helium Vol (BCF)			
FY	Case 1	Case 2	Case 3
2018	0.236	0.236	0.236
2019	1.003	1.196	1.196
2020	1.620	1.954	1.632
2021	2.123	2.570	2.066
'18-'21	2.123	2.570	2.066

Cumulative Total Gas Vol (BCF)			
FY	Case 1	Case 2	Case 3
2018	1.560	1.560	1.560
2019	6.795	8.211	8.211
2020	11.307	13.850	12.155
2021	15.172	18.808	16.088
'18-'21	15.172	18.808	16.088



Prediction Cases 2018

Helium Production

	Annual Production - 95%		
	Helium Produced Since July 1 2018		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2018 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2018	0.236	0.236	0.236
Oct-2019	0.767	0.960	0.960
Oct-2020	0.618	0.757	0.436
Oct-2021	**0.502**	**0.616**	**0.434**

	Cumulative Production - 95%		
	Helium Produced Since July 1 2018		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2018 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2018	0.236	0.236	0.236
Oct-2019	1.003	1.196	1.196
Oct-2020	1.620	1.954	1.632
Oct-2021	**2.123**	**2.570**	**2.066**
Difference between cases		*0.448*	*-0.504*

Prediction Cases 2018

Total Gas Production

	Annual Production - 95%		
	Total Gas Produced Since July 1 2018		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2017 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2018	1.560	1.560	1.560
Oct-2019	5.235	6.651	6.651
Oct-2020	4.512	5.640	3.945
Oct-2021	**3.865**	**4.957**	**3.933**

	Cumulative Production - 95%		
	Total Gas Produced Since July 1 2018		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2017 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2018	1.560	1.560	1.560
Oct-2019	6.795	8.211	8.211
Oct-2020	11.307	13.850	12.155
Oct-2021	**15.172**	**18.808**	**16.088**
Difference between cases		***3.636***	***-2.719***

Outline

- *Reservoir Status (Operations: 2017-2018)*
- *Simulation Model Status*
- *Predictions*
- *Conclusions*

Swan Mtn road, Keystone, CO

Conclusions

- **Conclusions**
  - Producing with only the K100 modification will reduce the total He produced by 9/30/2021 by -0.448 BCF when compared to central compression online by Oct 2018 *(Case1)*
  - With only the K100 modification, the total gas rate will drop below 10 MM/d after Oct 1 2021, which may be less than the current HEU can process.
  - Having central compression online by Oct 15 2018, will increase the total gas rate and He rate; the total He produced under this case is 2.570 BCF (July 2018 – Sep 30 2021) *(Case2)*
  - The low helium demand case will produce significantly less helium (-0.504 BCF) by Sep 2021; the total He produced with this case is 2.066 BCF

Conclusions

- **Conclusions – Cases 1 & 2**
  - Predicted annual He volumes are the sum of the daily production rate, which is on *a constant decline* from the first day of the FY to the last day of the FY.
  - Predicted production volumes represent the maximum volume of helium that *could be* delivered from the HEU; operations and demand will determine what will actually be produced

    The *declining rates* will impact the volume per month of helium available for private industry, which will be the helium production volume less in-kind federal requirements through Sep 2021.

Outline

- *Reservoir Status (Operations: 2017-2018)*
- *Simulation Model Status*
- *Predictions*
- *Conclusions*
- *After Sept 30, 2021*

Freemont Pass, Copper Mtn to Leadville, CO

After Sept 30, 2021

- **Disclaimers / Limitations**
  - *As of October 1, 2021, the US government will have transferred all assets and delivery responsibilities to the purchasing entity.*

  After the transfer, the US government will no longer be responsible for helium production and delivery from the Bush Dome Reservoir.

After Sept 30, 2021

- **Disclaimers / Limitations**
  - *All forecast results are simulation model estimates, indicating the future trends base upon the current model's history match.*
  - *The estimated volumes in these predictions do not take into account possible changes in operations under new ownership.*
  - *The estimated volumes assume that the produced gas mixture can be processed.*

After Sept 30, 2021: Prediction Cases 2018

- Estimated Production Oct 1 2021– Sep 30 2029
  - Assumes maximum total gas and maximum helium rate
  - Assumes flowing well head pressure at 75 psia (Pmin)
  - Assumes all wells are able to flow, no water encroachment issues, no well integrity issues

After Sept 30, 2021: Prediction Cases 2018

- The model estimates that under the most optimistic conditions (Case 2, Max He), where private industry takes all the helium that can be produced from the field, the amount of undelivered private industry helium will be ~ 1.100* BCF on Sept 30, 2021
- The model estimates for Case 2 that an additional 2.560 BCF of helium could be produced by Sept 2029
- The model estimates for Case 2 that the total gas production rate will drop below 10 MMcf/d, by May 2024
- At that time the model estimates that an additional 1.300 BCF of helium could be produced (9/21-5/24)

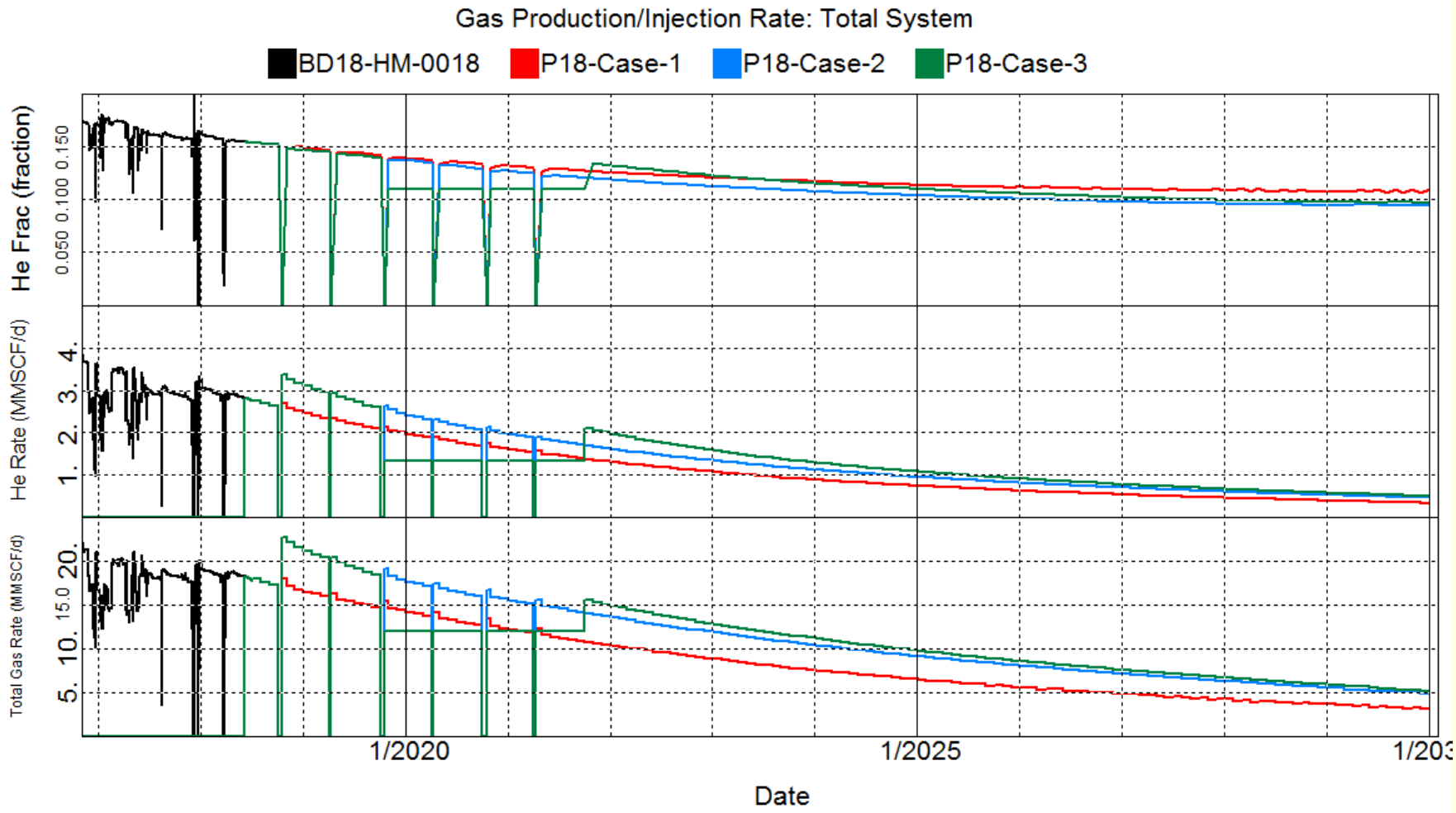
* *higher amount is due to ~200 MM additional 2018 sales then predicted in 2017*

After Sept 30, 2021: Prediction Cases 2018

- For the low helium demand case (Case 3), where private industry only requires helium at the rate of 1.320 MM/d (Oct 2019 – Sep 2021) with a total helium production of 2.066 BCF by Sep 2021, the model estimates that there will be ~1.650 BCF of undelivered purchased helium gas on Sep 30, 2021.
- For this case the model estimates that an additional 2.938 BCF of helium could be produced by Sept 2029.
- For this case, the model estimates that the total gas production rate will drop below 10 MMcf/d, by Nov 2024.
- At that time the model estimates that an additional 1.7500 BCF of helium could be produced (9/21-11/24)

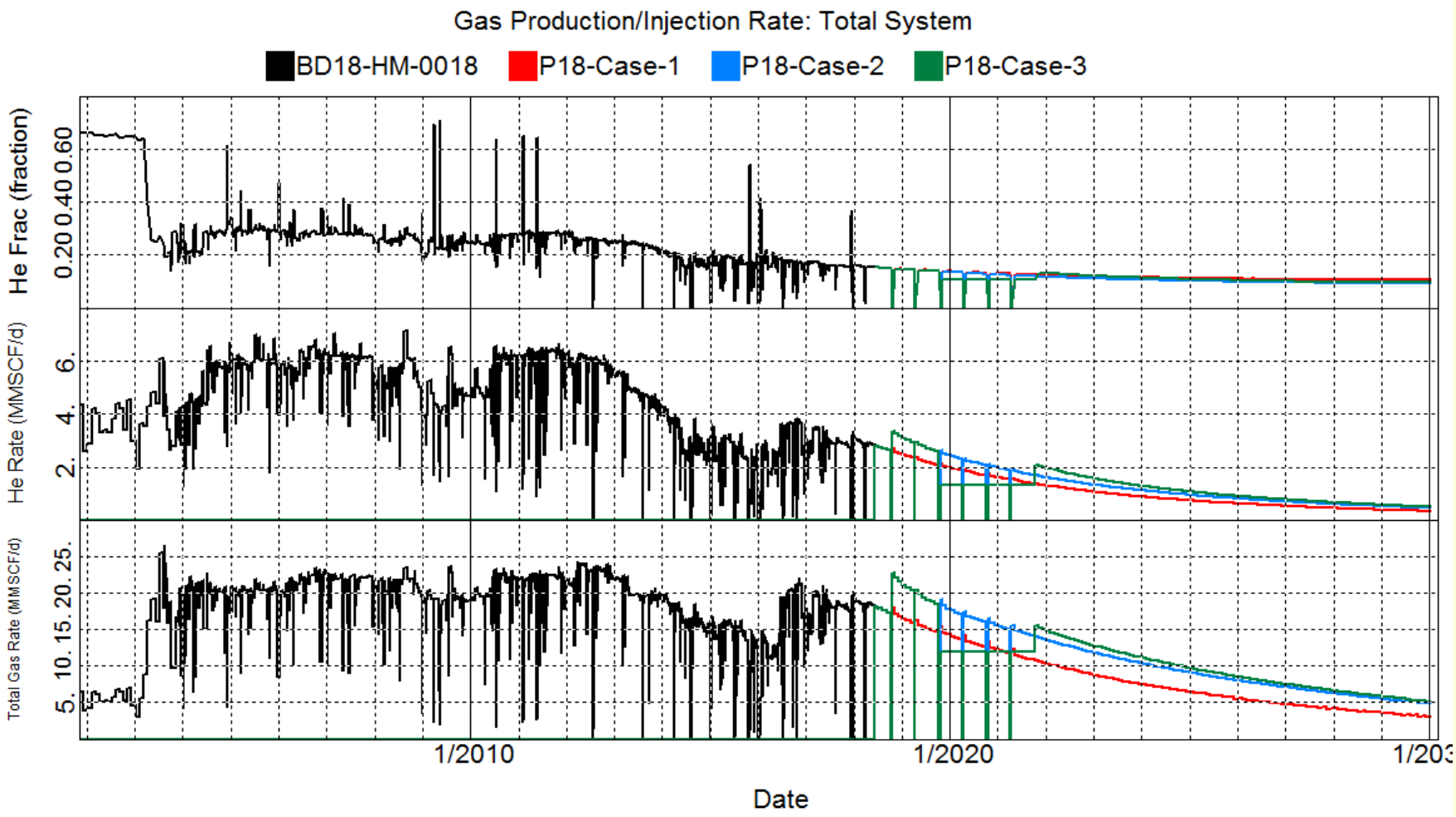
After Sept 30, 2021: Prediction Cases 2018

- Forecasted helium gas production, 2021 - 2029



After Sept 30, 2021: Prediction Cases 2018

- Historical & forecasted helium production, 2002 - 2029



After Sept 30, 2021: Prediction Cases 2018

- Forecasted helium gas production, 2021 - 2029

	Annual Production - 95%		
	Helium Produced Since Oct 1, 2021		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2018 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2022	0.432	0.535	0.649
Oct-2023	0.354	0.444	0.520
Oct-2024	0.295	0.375	0.429
Oct-2025	0.247	0.318	0.358
Oct-2026	0.210	0.272	0.304
Oct-2027	0.179	0.235	0.260
Oct-2028	0.154	0.204	0.224
Oct-2029	**0.132**	**0.177**	**0.194**

	Cumulative Production - 95%		
	Helium Produced Since Oct 1, 2021		
(1st of mth)	Case 1 Current (Bcf)	Case 2 CC 10/2018 (Bcf)	Case 3 Low Rate (Bcf)
Oct-2022	0.432	0.535	0.649
Oct-2023	0.786	0.979	1.169
Oct-2024	1.081	1.354	1.598
Oct-2025	1.328	1.671	1.956
Oct-2026	1.537	1.944	2.260
Oct-2027	1.716	2.179	2.520
Oct-2028	1.870	2.383	2.744
Oct-2029	**2.002**	**2.560**	**2.938**
Difference between cases		***0.558***	***0.378***
Jul 2018-Sep 2021	**2.123**	**2.570**	**2.066**
Oct 2021 - Sep 2029	**2.002**	**2.560**	**2.938**
Total Jul 2018 - Sep 2029	**4.125**	**5.131**	**5.004**
Difference between cases		***1.006***	***-0.127***

After Sept 30, 2021: Prediction Cases 2018

- Forecasted total gas production, 2021 - 2029

	Annual Production - 95%		
	Total Gas Produced Since Oct 1, 2021		
	Case 1 Current	Case 2 CC 10/2017	Case 3 Low Rate
(1st of mth)	(Bcf)	(Bcf)	(Bcf)
Oct-2022	3.466	4.561	4.991
Oct-2023	2.948	3.985	4.301
Oct-2024	2.527	3.503	3.758
Oct-2025	2.175	3.075	3.282
Oct-2026	1.875	2.718	2.892
Oct-2027	1.627	2.405	2.556
Oct-2028	1.406	2.127	2.256
Oct-2029	**1.223**	**1.863**	**1.980**

	Cumulative Production - 95%		
	Total Gas Produced Since Oct 1, 2021		
	Case 1 Current	Case 2 CC 10/2017	Case 3 Low Rate
(1st of mth)	(Bcf)	(Bcf)	(Bcf)
Oct-2022	3.466	4.561	4.991
Oct-2023	6.414	8.546	9.292
Oct-2024	8.941	12.049	13.049
Oct-2025	11.116	15.123	16.332
Oct-2026	12.991	17.841	19.223
Oct-2027	14.618	20.246	21.779
Oct-2028	16.024	22.373	24.035
Oct-2029	**17.246**	**24.235**	**26.015**
Difference between cases		***6.989***	***1.780***
Jul 2018 - Sep 2021	**15.172**	**18.808**	**16.088**
Oct 2021 - Sep 2029	**17.246**	**24.235**	**26.015**
Total Jul 2018 - Sep 2029	**32.418**	**43.043**	**42.104**
Difference between cases		***10.625***	***-0.939***

After Sept 30, 2021: Prediction Cases 2018

- Comparison 2017 vs 2018
  Forecasted total gas production, 2021 - 2029

2017

Cumulative Production - 95% Helium Produced Since Oct 1, 2021	Case 1 Current (Bcf)	Case 2 CC 10/2017 (Bcf)
Jul 2017 - Sep 2021	2.702	3.595
Oct 2021 - Sep 2029	1.713	2.554
Total Jul 2017 - Sep 2029	4.415	6.149

2018

Cumulative Production - 95% Helium Produced Since Oct 1, 2021	Case 1 Current (Bcf)	Case 2 CC 10/2018 (Bcf)
Jul 2017- Sep 2021	3.165**	3.612**
Oct 2021 - Sep 2029	2.002	2.560
Total Jul 2017 - Sep 2029	5.167	6.172
Difference 2018 - 2017	0.752	0.023

*** Includes Actual Historical Production from 7/1/2017-6/30/2018 & lower K100 pressure*

Discussion

Questions, comments, concerns ?

Some days are sunny (Lake Dillon, CO)

Discussion

Questions, comments, concerns ?

Some are stormy (Lake Dillon, CO)

Discussion

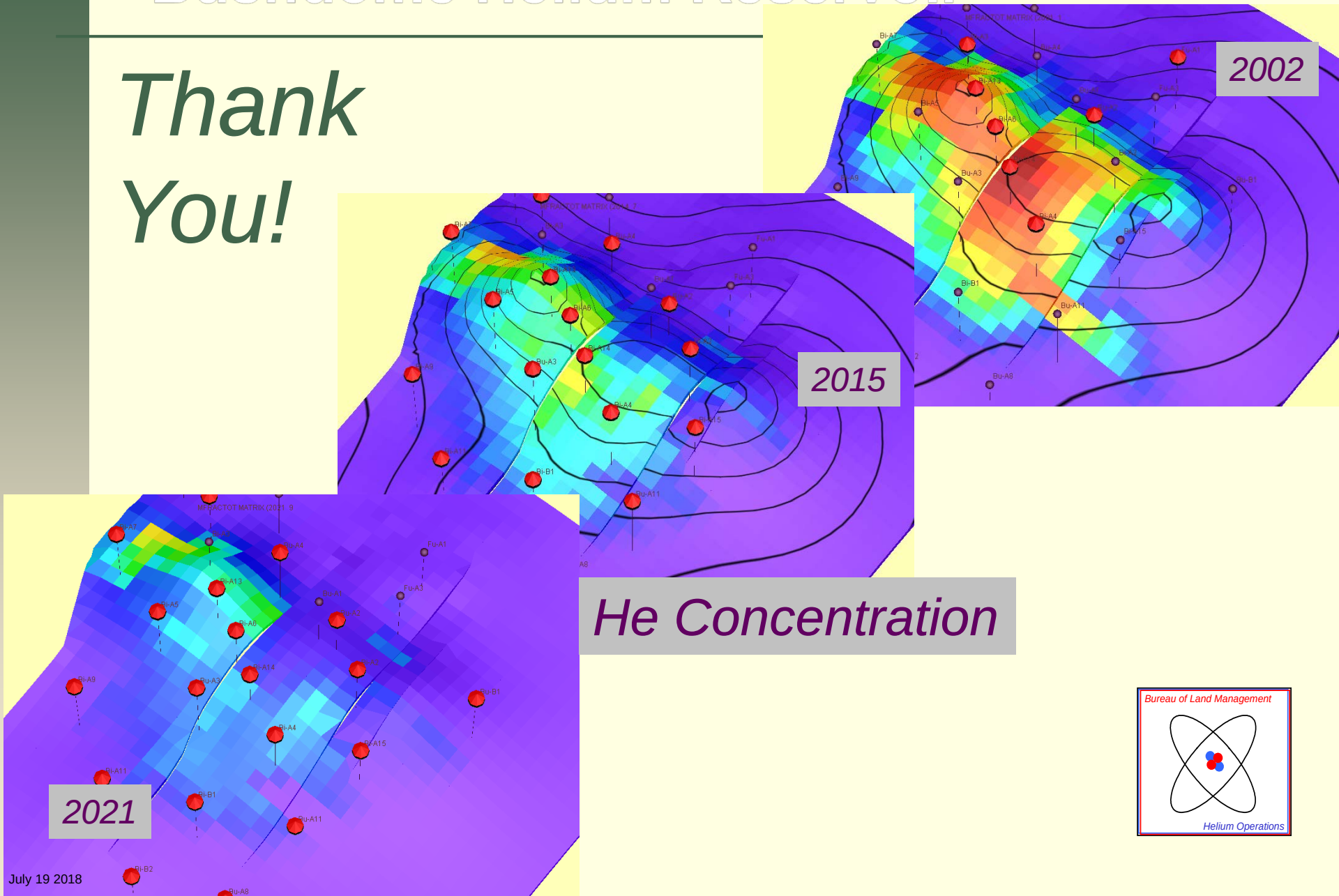
Questions, comments, concerns ?

You don’t have to be a cowboy to ride off into the sunset

Did you know that cowboys that ride off into the sunset quickly run out of daylight and have to camp just outside of town. They should have just stayed put for the night instead of being all dramatic…

Bushdome Helium Reservoir

Thank You!



Bureau of Land Management
Helium Operations