CHOWCHILLA SUBBASIN

Sustainable Groundwater Management Act (SGMA)

Groundwater Sustainability Plan

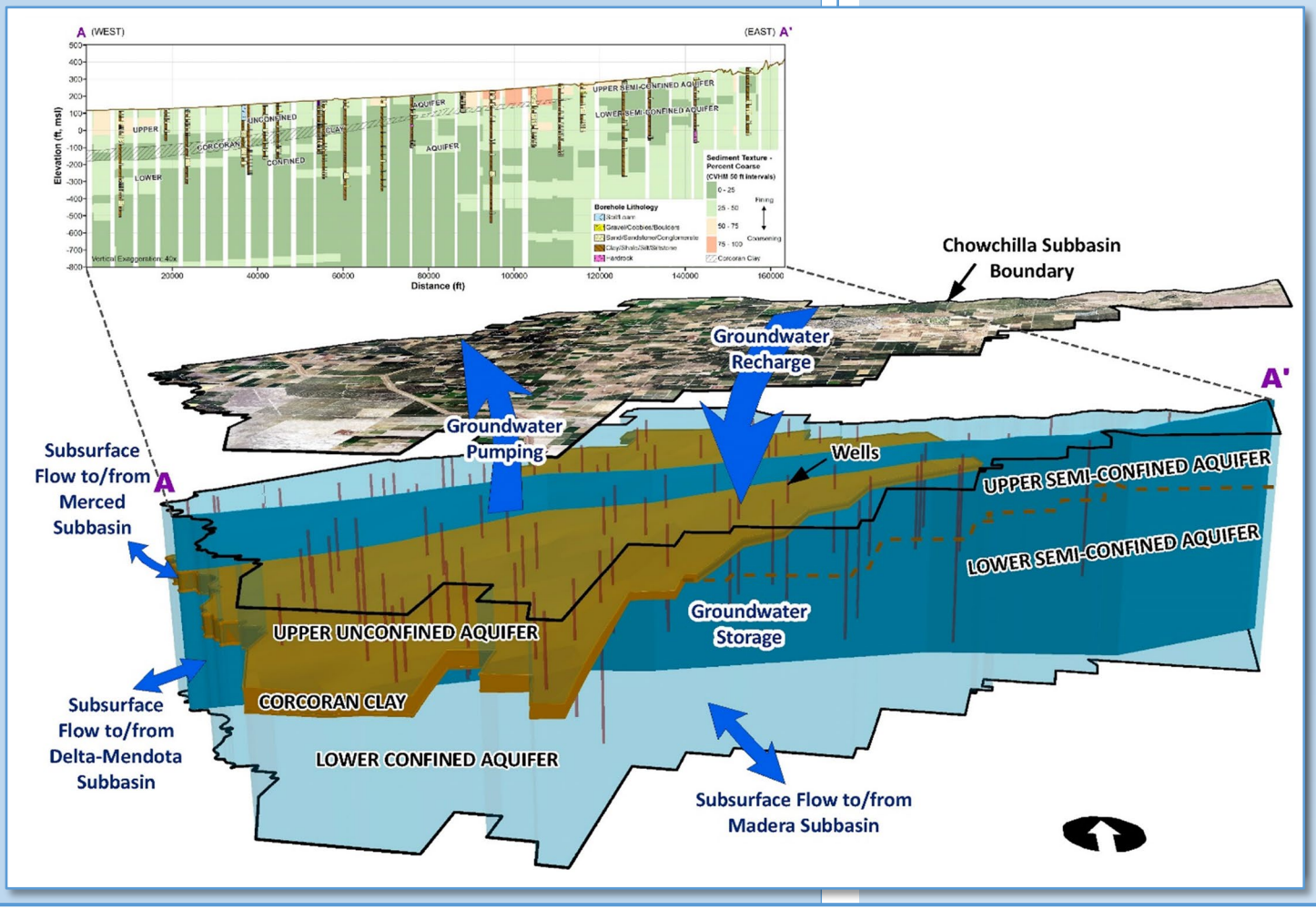
APPENDIX 3. SUSTAINABLE MANAGEMENT CRITERIA

Technical Appendices 3.A. through 3.D.

January 2020

Prepared by

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento



FINAL DRAFT

Chowchilla Subbasin

Sustainable Groundwater Management Act

Groundwater Sustainability Plan

Technical Appendices 3.A. through 3.D.

January 2020

Prepared For

Chowchilla Subbasin GSP Advisory Committee

Prepared By

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento

APPENDIX 3. SUSTAINABLE MANAGEMENT CRITERIA

3.A. Measurable Objectives and Minimum Thresholds for Groundwater Levels

3.B. Measurable Objectives and Minimum Thresholds for Groundwater Quality

3.C. Economic Analysis and Framework for Potential Domestic Well Mitigation Program

3.D. Monitoring Network

APPENDIX 3.A. MEASURABLE OBJECTIVES AND MINIMUM THRESHOLDS FOR GROUNDWATER LEVELS

DRAFT

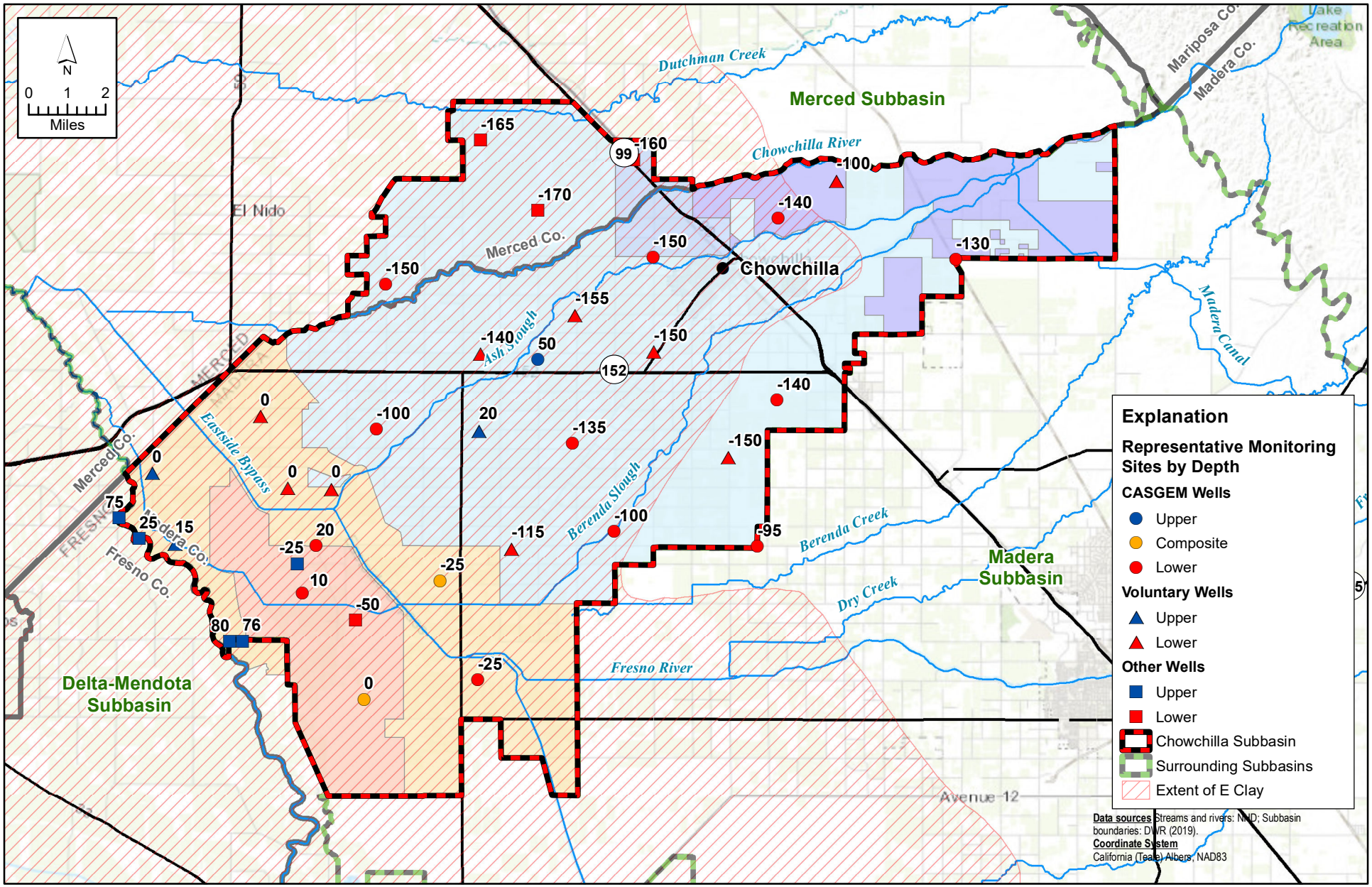
Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

GSP Team:

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento



X:\2018\18-017 Chowchilla GSP Development\GIS\Map files\Report Figures\Figure 3.A-1 Chowchilla Subbasin Elevation of Minimum Thresholds.mxd

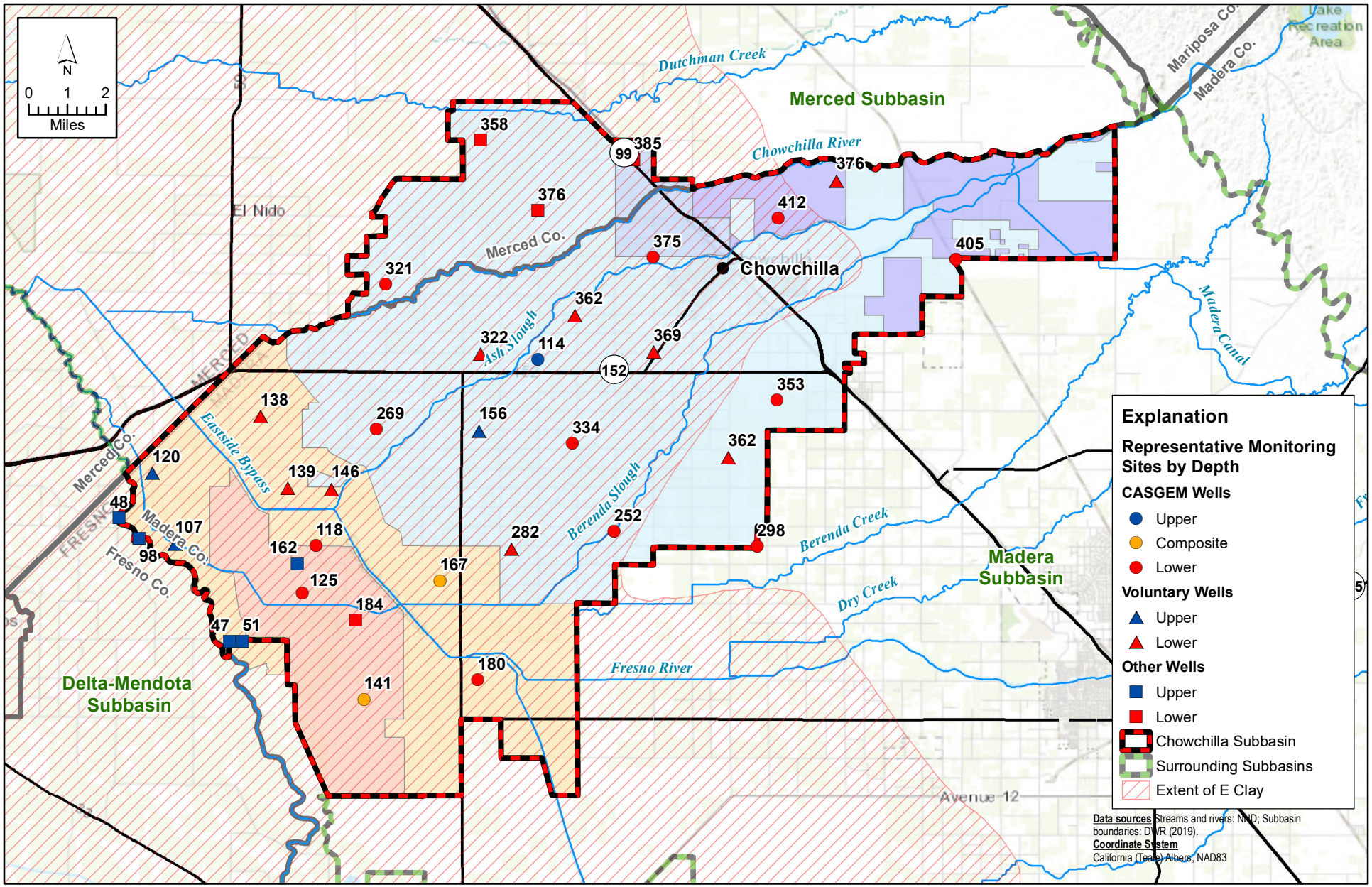
DAVIDS ENGINEERING, INC

Luhdorff & Scalmanini Consulting Engineers

FIGURE 3.A-1

Elevation of Minimum Thresholds

Chowchilla Subbasin
Groundwater Sustainability Plan



X:\2018\18-017 Chowchilla GSP Development\GIS\Map files\Report Figures\Figure 3.A-2 Chowchilla Subbasin Depth to Minimum Thresholds.mxd

DAVIDS ENGINEERING, INC

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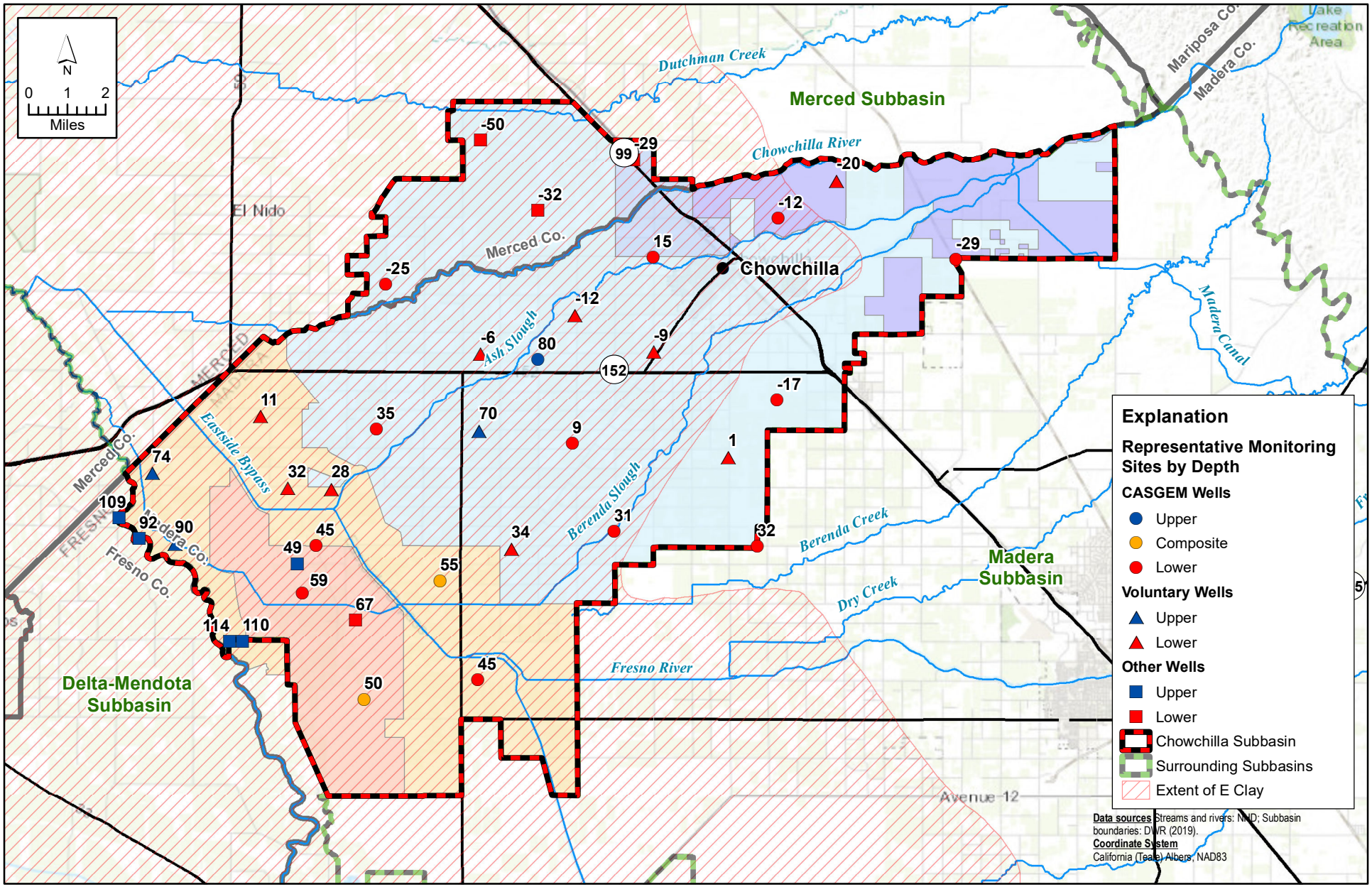
FIGURE 3.A-2

Depth to Minimum Thresholds

Chowchilla Subbasin
Groundwater Sustainability Plan



X:\2018\18-017 Chowchilla GSP Development\GIS\Map files\Report Figures\Figure 3.A-3 Chowchilla Subbasin Elevation of Measurable Objectives.mxd

DAVIDS ENGINEERING, INC

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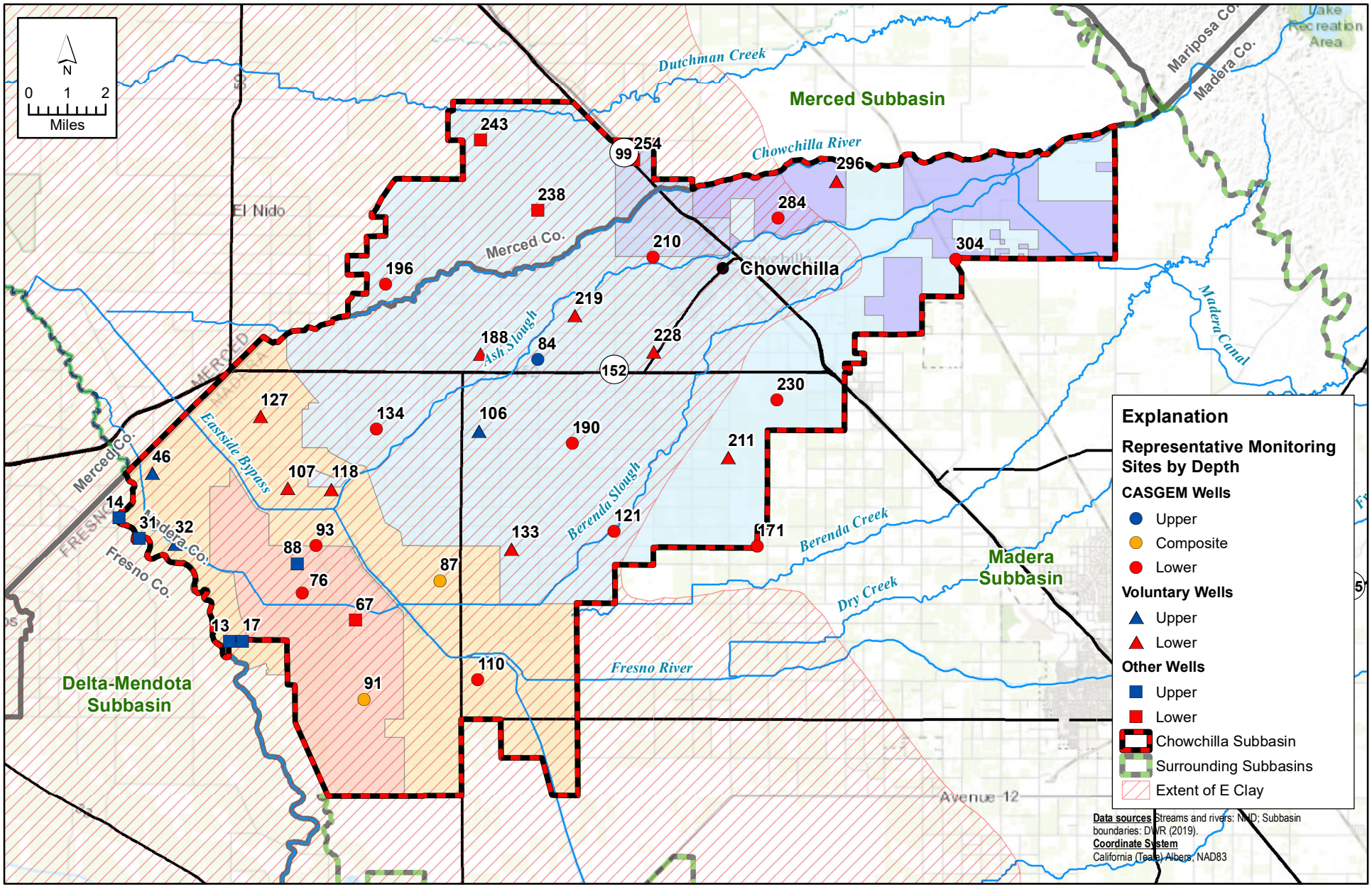
FIGURE 3.A-3

Elevation of Measurable Objectives

Chowchilla Subbasin
Groundwater Sustainability Plan



X:\2018\18-017 Chowchilla GSP Development\GIS\Map files\Report Figures\Figure 3.A-4 Chowchilla Subbasin Depth to Measurable Objectives.mxd

DAVIDS ENGINEERING, INC

Luhdorff & Scalmanini Consulting Engineers

FIGURE 3.A-4

Depth to Measurable Objectives

Chowchilla Subbasin
Groundwater Sustainability Plan

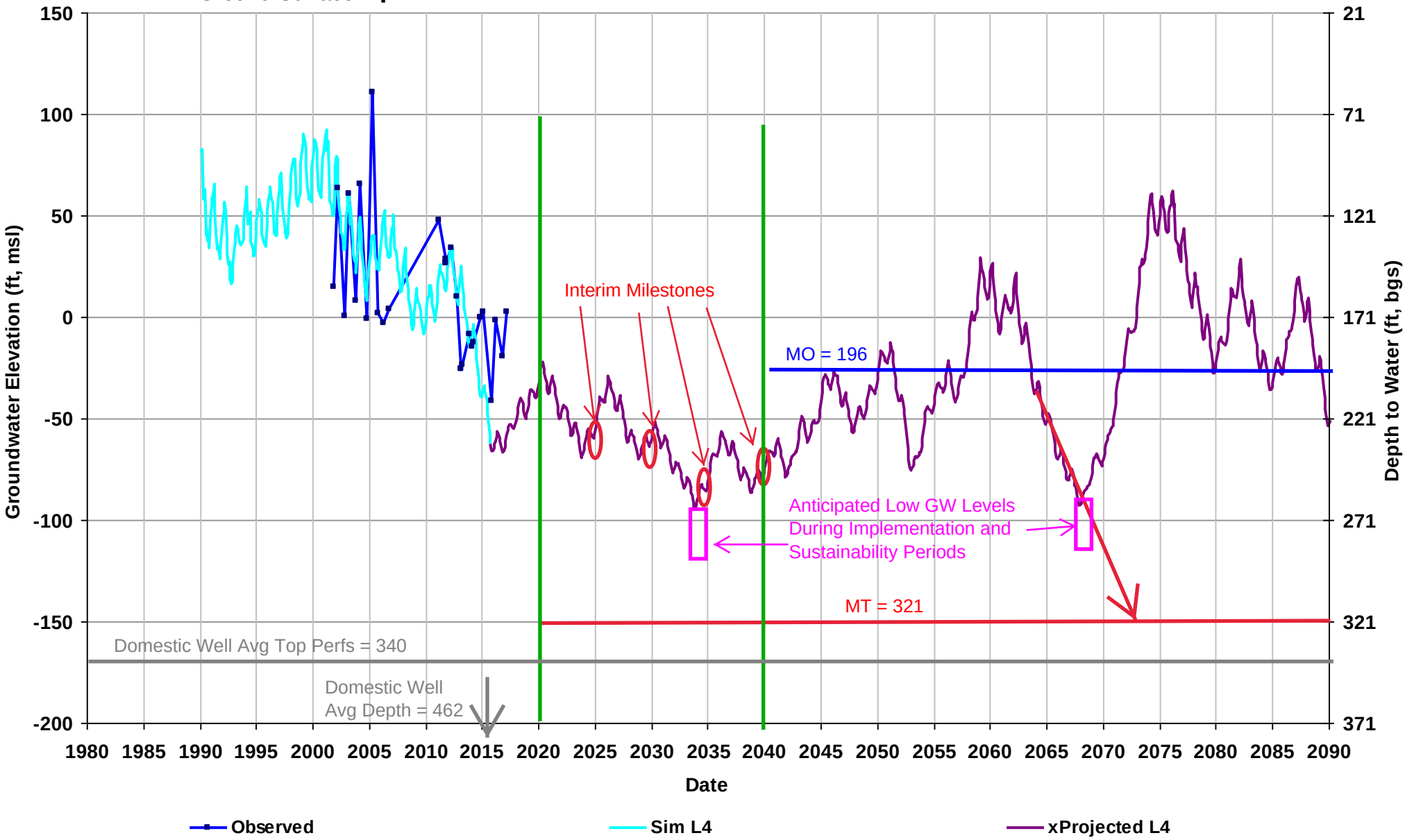
Well Name: 09S14E27R001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 171

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 7
Total Depth Average: 462
Total Depth Minimum: 459
Total Depth Maximum: 465

Top Perf. Count: 5
Top Perf. Average: 340
Top Perf. Minimum: 340
Top Perf. Maximum: 340

Total Depth (ft): 275
Perf Top (ft): 160
Perf Bottom (ft): 275
Top Model Layer: 4
Bottom Model Layer: 4



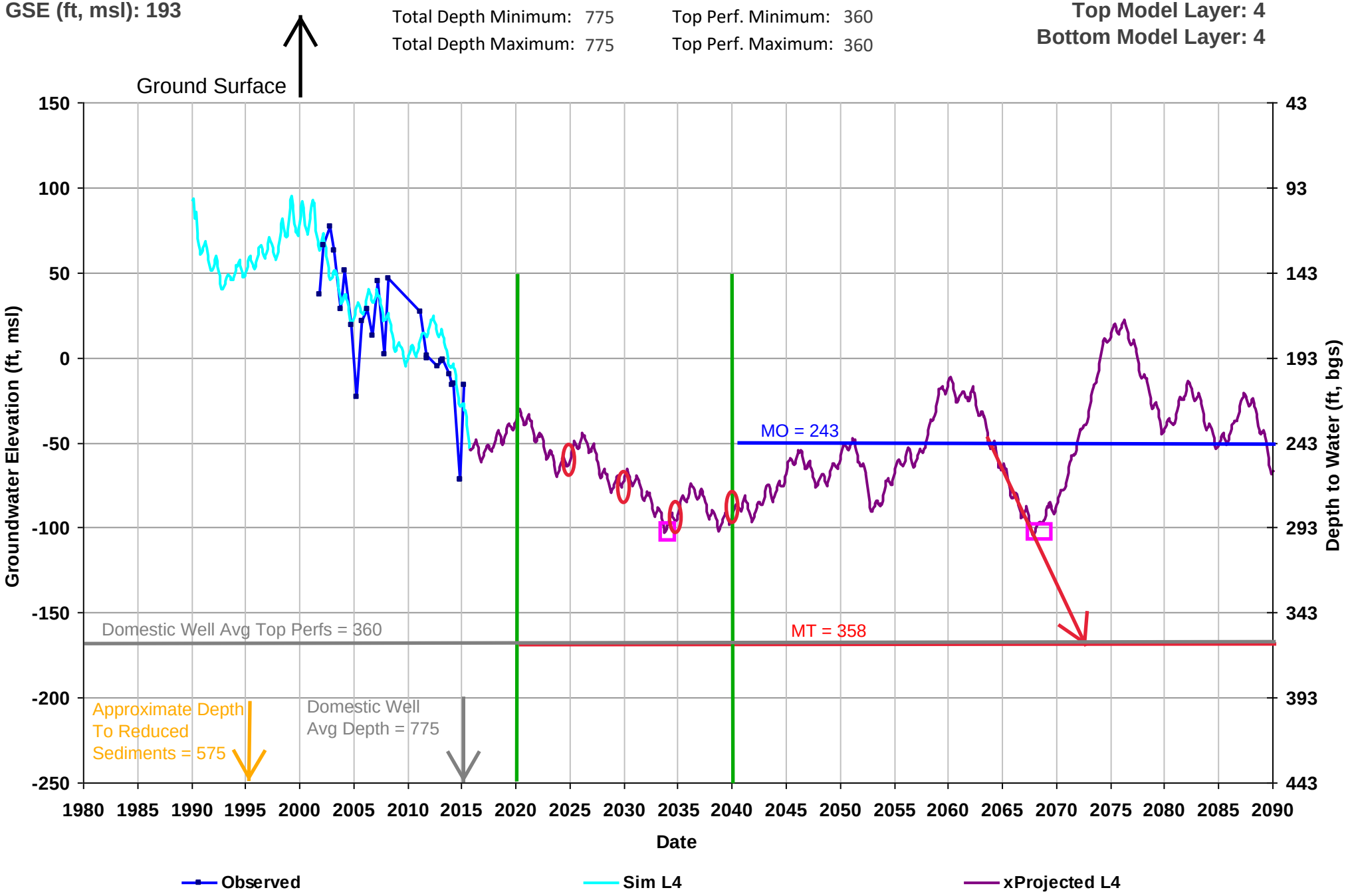
Well Name: 09S15E06P001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 193

Domestic Well Data: *Total Sections Included: 7*

Total Depth Count: 2
Total Depth Average: 775
Total Depth Minimum: 775
Total Depth Maximum: 775

Top Perf. Count: 2
Top Perf. Average: 360
Top Perf. Minimum: 360
Top Perf. Maximum: 360

Total Depth (ft): 780
Perf Top (ft): 230
Perf Bottom (ft): 775
Top Model Layer: 4
Bottom Model Layer: 4



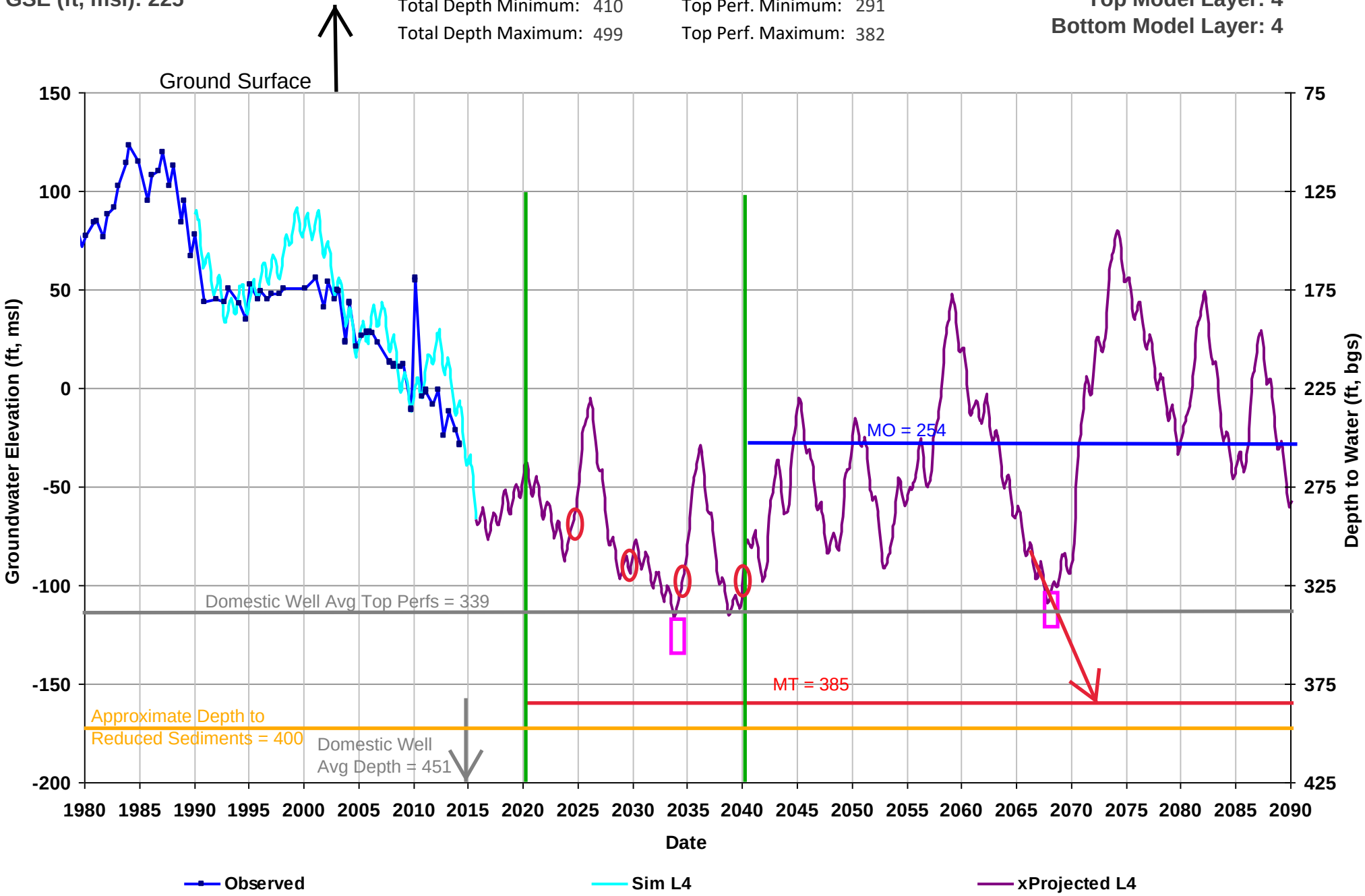
Well Name: 09S15E11F001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 225

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 11
Total Depth Average: 451
Total Depth Minimum: 410
Total Depth Maximum: 499

Top Perf. Count: 8
Top Perf. Average: 339
Top Perf. Minimum: 291
Top Perf. Maximum: 382

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



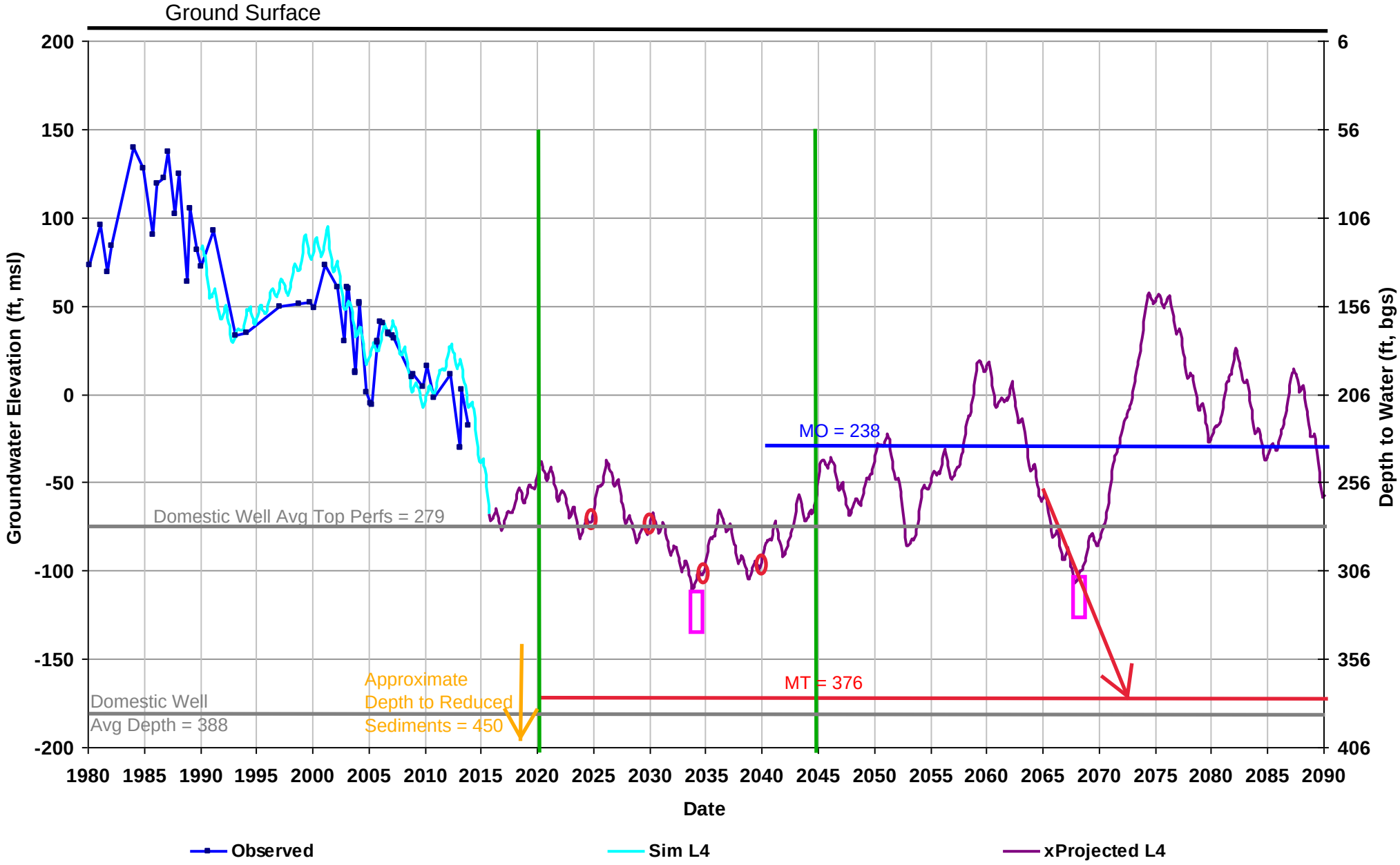
Well Name: 09S15E17R001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 206

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 2
Total Depth Average: 388
Total Depth Minimum: 309
Total Depth Maximum: 467

Top Perf. Count: 1
Top Perf. Average: 279
Top Perf. Minimum: 279
Top Perf. Maximum: 279

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



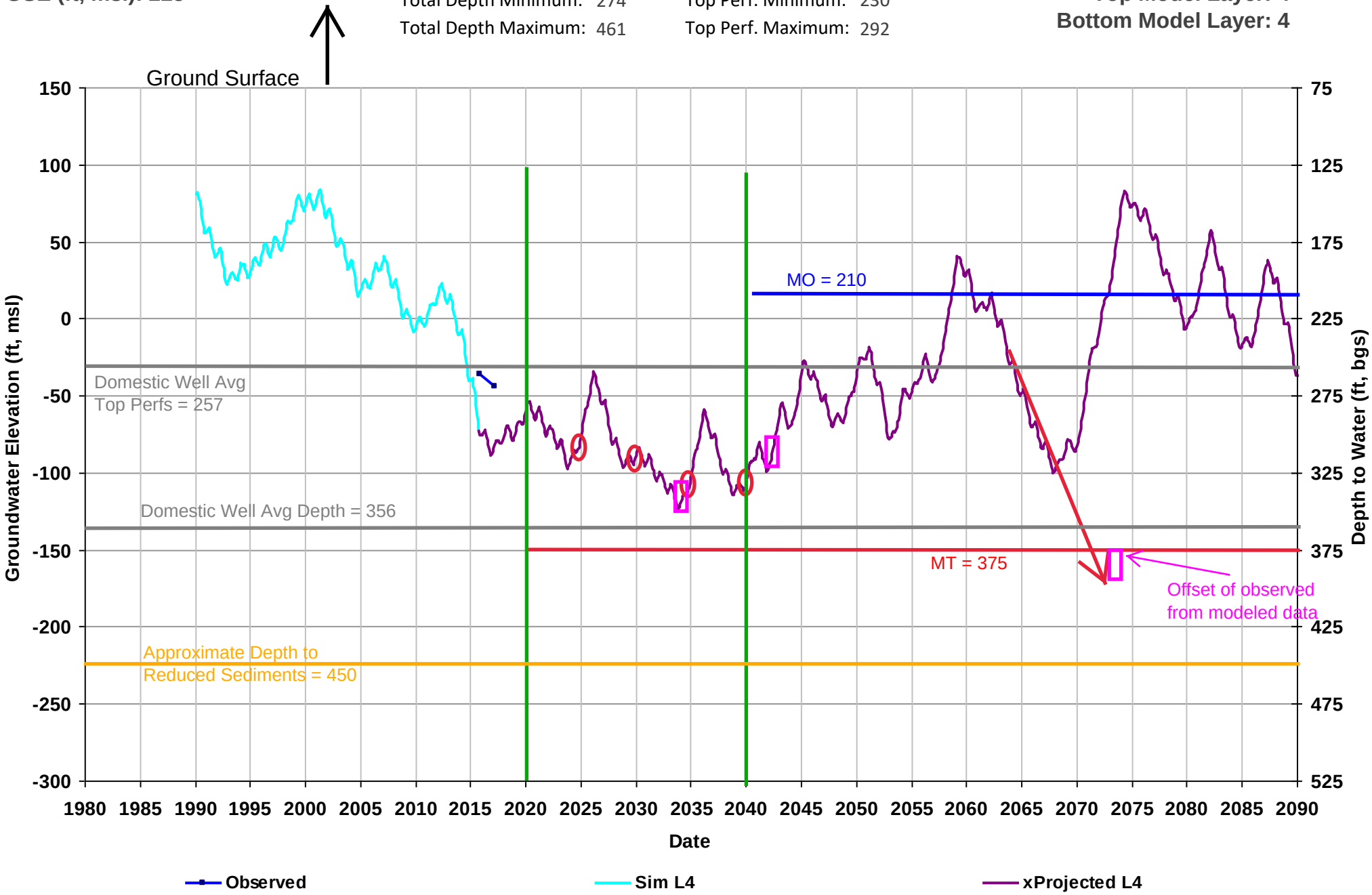
Well Name: 09S15E26A
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 225

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 38
Total Depth Average: 356
Total Depth Minimum: 274
Total Depth Maximum: 461

Top Perf. Count: 23
Top Perf. Average: 257
Top Perf. Minimum: 230
Top Perf. Maximum: 292

Total Depth (ft): 800
Perf Top (ft): 320
Perf Bottom (ft): 800
Top Model Layer: 4
Bottom Model Layer: 4

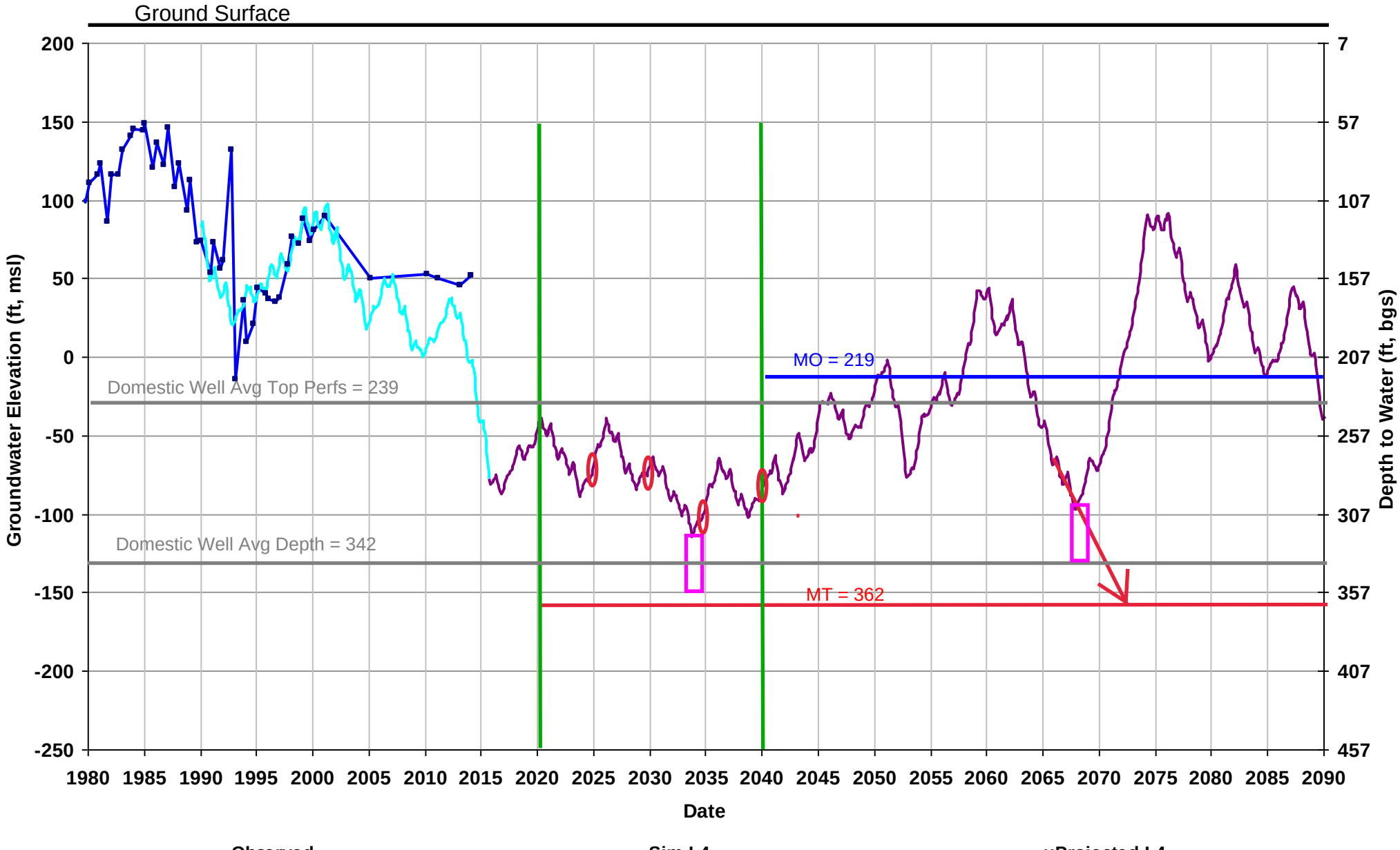


Well Name: 09S15E33J002M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 207

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 19	Top Perf. Count: 12
Total Depth Average: 342	Top Perf. Average: 239
Total Depth Minimum: 227	Top Perf. Minimum: 214
Total Depth Maximum: 436	Top Perf. Maximum: 260

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



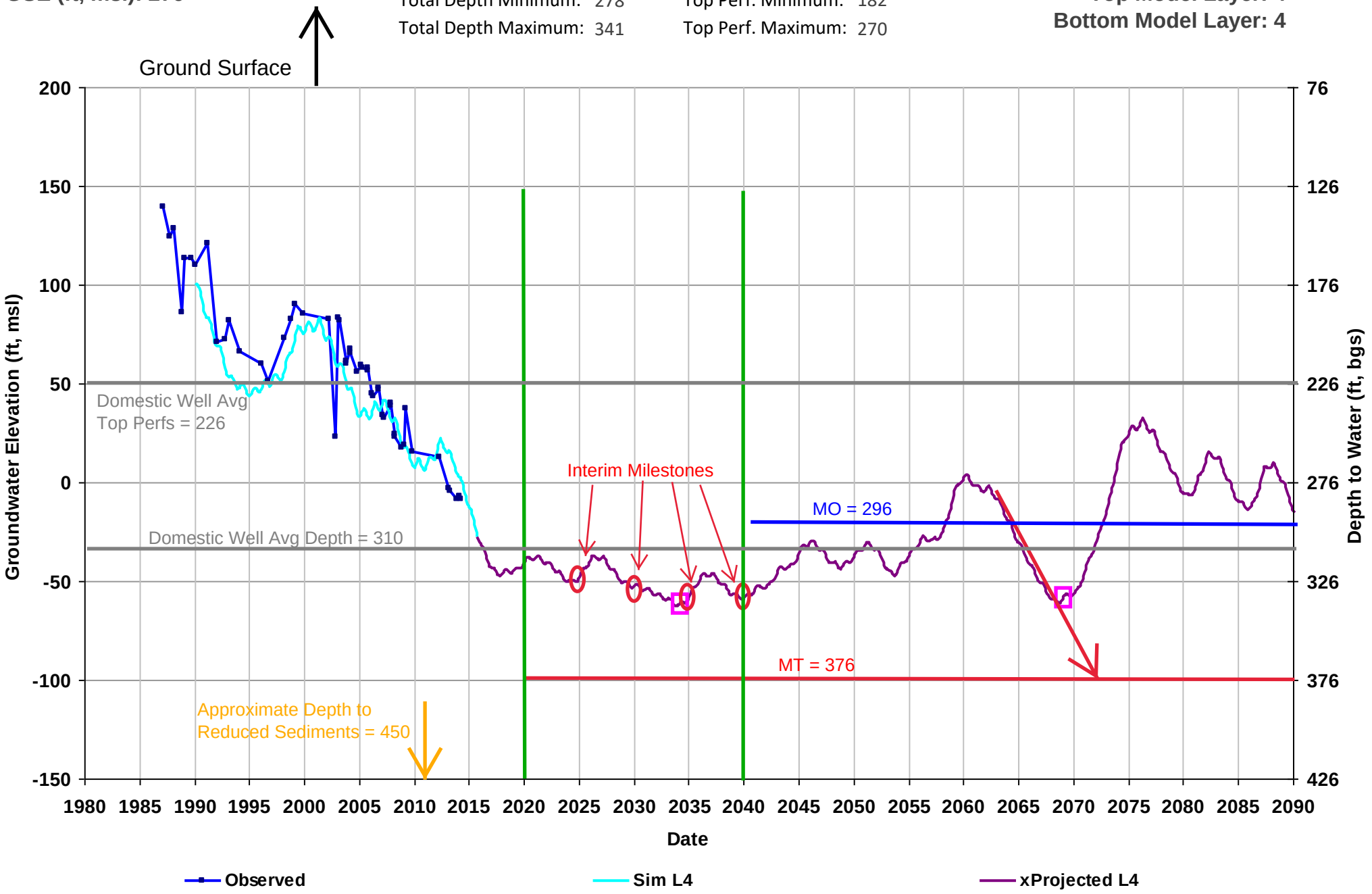
Well Name: 09S16E15B001M
Depth Zone: Unknown; Outside CC
Subbasin: Chowchilla
GSE (ft, msl): 276

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 6
Total Depth Average: 310
Total Depth Minimum: 278
Total Depth Maximum: 341

Top Perf. Count: 4
Top Perf. Average: 226
Top Perf. Minimum: 182
Top Perf. Maximum: 270

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



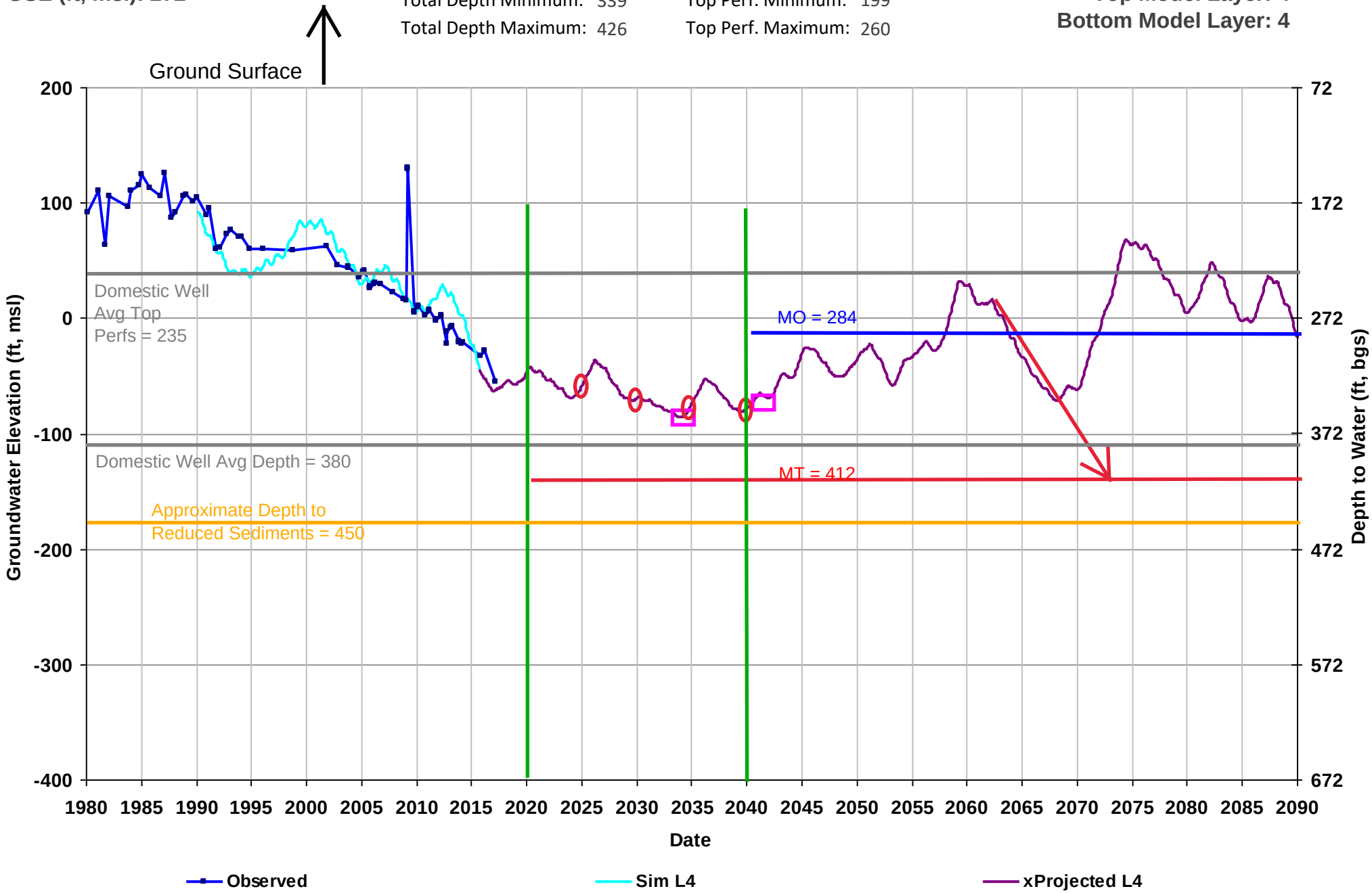
Well Name: 09S16E16N001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 272

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 14
Total Depth Average: 380
Total Depth Minimum: 339
Total Depth Maximum: 426

Top Perf. Count: 11
Top Perf. Average: 235
Top Perf. Minimum: 199
Top Perf. Maximum: 260

Total Depth (ft): 466
Perf Top (ft): 218
Perf Bottom (ft): 464
Top Model Layer: 4
Bottom Model Layer: 4



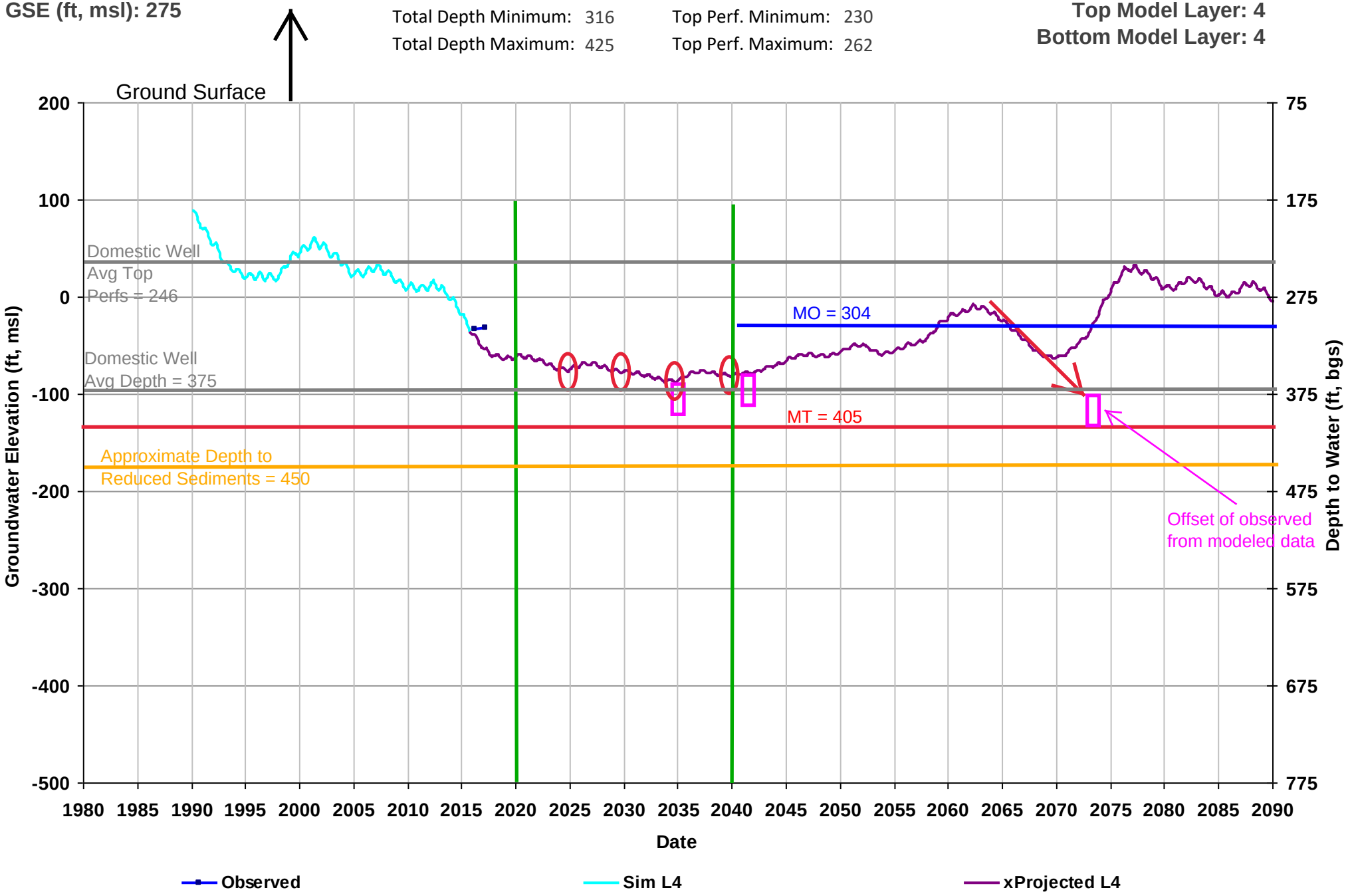
Well Name: 09S17E30A
Depth Zone: Lower; Outside CC
Subbasin: Chowchilla
GSE (ft, msl): 275

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 12
Total Depth Average: 375
Total Depth Minimum: 316
Total Depth Maximum: 425

Top Perf. Count: 6
Top Perf. Average: 246
Top Perf. Minimum: 230
Top Perf. Maximum: 262

Total Depth (ft): 820
Perf Top (ft): 257
Perf Bottom (ft): 726
Top Model Layer: 4
Bottom Model Layer: 4

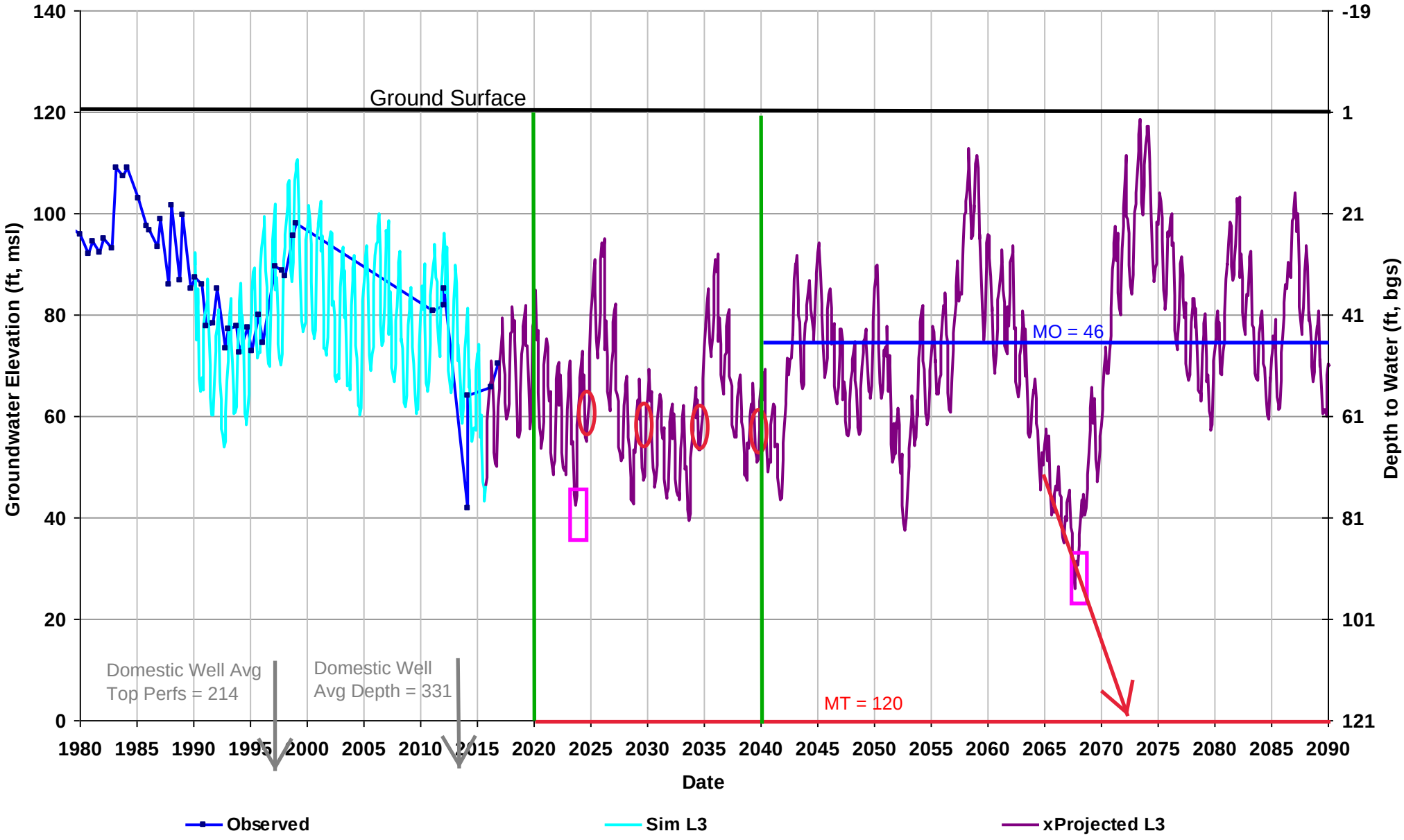


Well Name: 10S13E22R001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 121

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 9	Top Perf. Count: 6
Total Depth Average: 331	Top Perf. Average: 214
Total Depth Minimum: 265	Top Perf. Minimum: 207
Total Depth Maximum: 391	Top Perf. Maximum: 220

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 3
Bottom Model Layer: 3



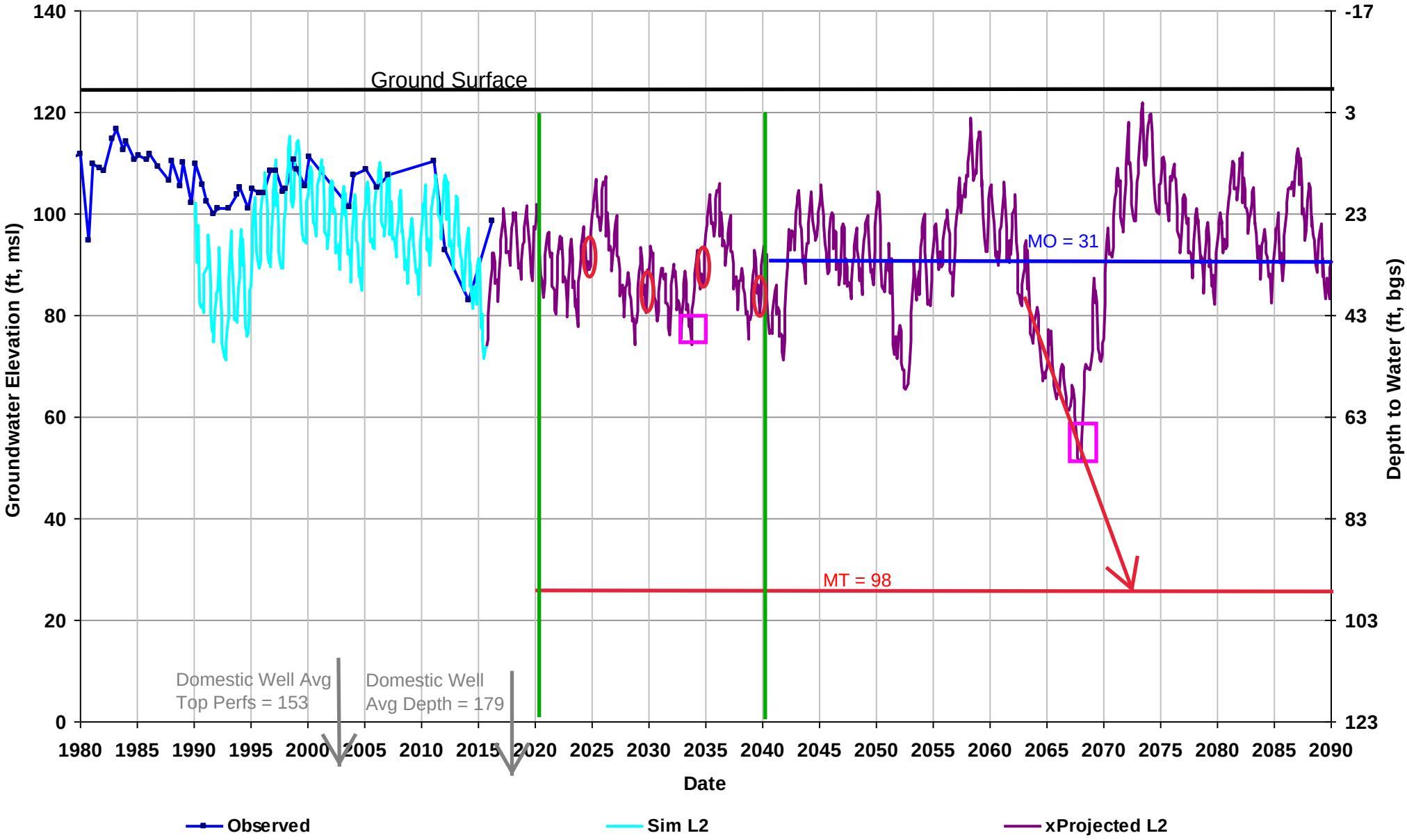
Well Name: 10S13E34G001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 123

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 6
Total Depth Average: 179
Total Depth Minimum: 164
Total Depth Maximum: 194

Top Perf. Count: 6
Top Perf. Average: 153
Top Perf. Minimum: 136
Top Perf. Maximum: 170

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 2
Bottom Model Layer: 2



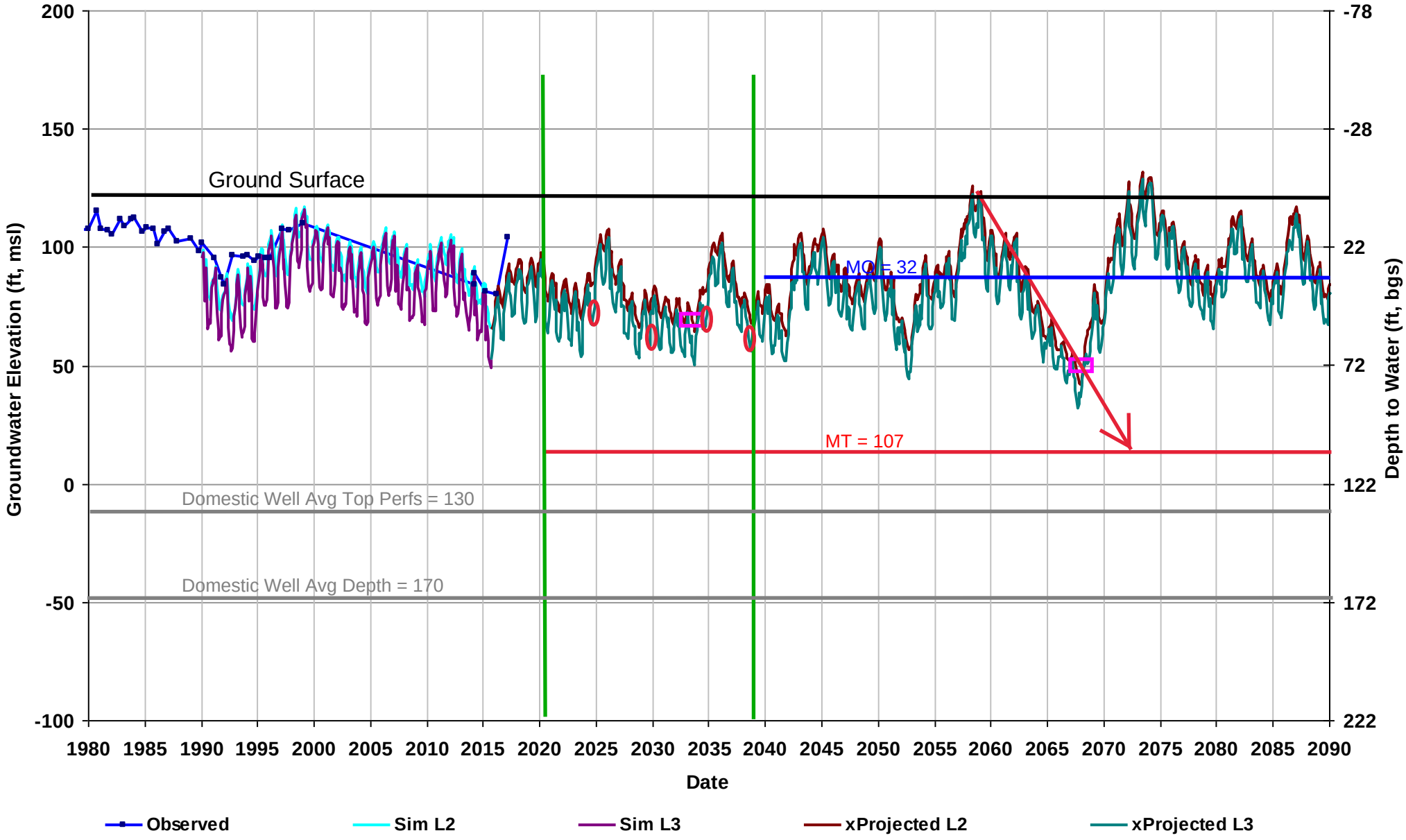
Well Name: 10S13E35K001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 122

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 2
Total Depth Average: 170
Total Depth Minimum: 220
Total Depth Maximum: 195

Top Perf. Count: 2
Top Perf. Average: 130
Top Perf. Minimum: 200
Top Perf. Maximum: 165

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 2
Bottom Model Layer: 3

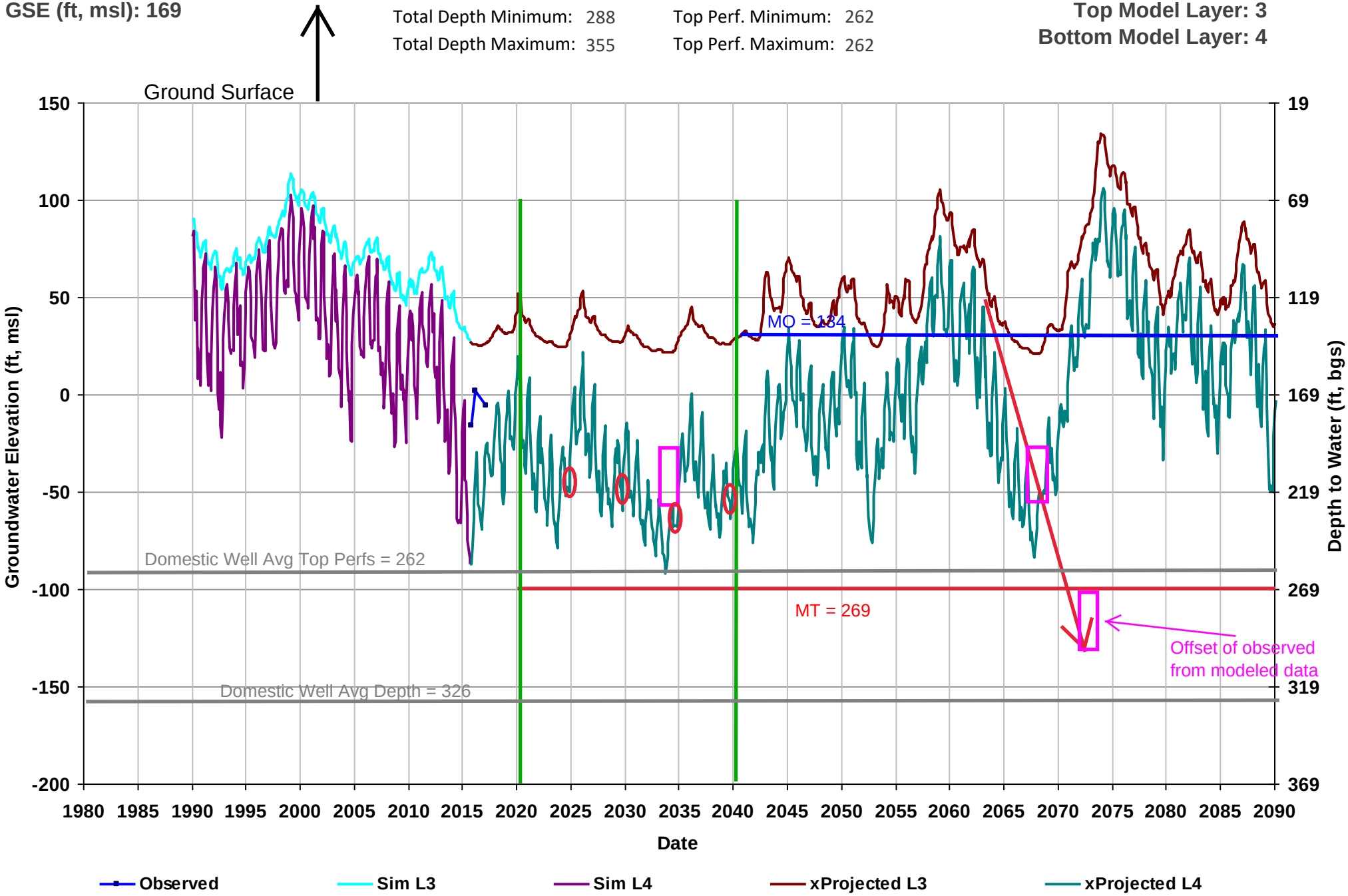


Well Name: 10S14E15J1
Depth Zone: Composite; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 169

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count:	12	Top Perf. Count:	5
Total Depth Average:	326	Top Perf. Average:	262
Total Depth Minimum:	288	Top Perf. Minimum:	262
Total Depth Maximum:	355	Top Perf. Maximum:	262

Total Depth (ft): 330
Perf Top (ft): 135
Perf Bottom (ft): 288
Top Model Layer: 3
Bottom Model Layer: 4



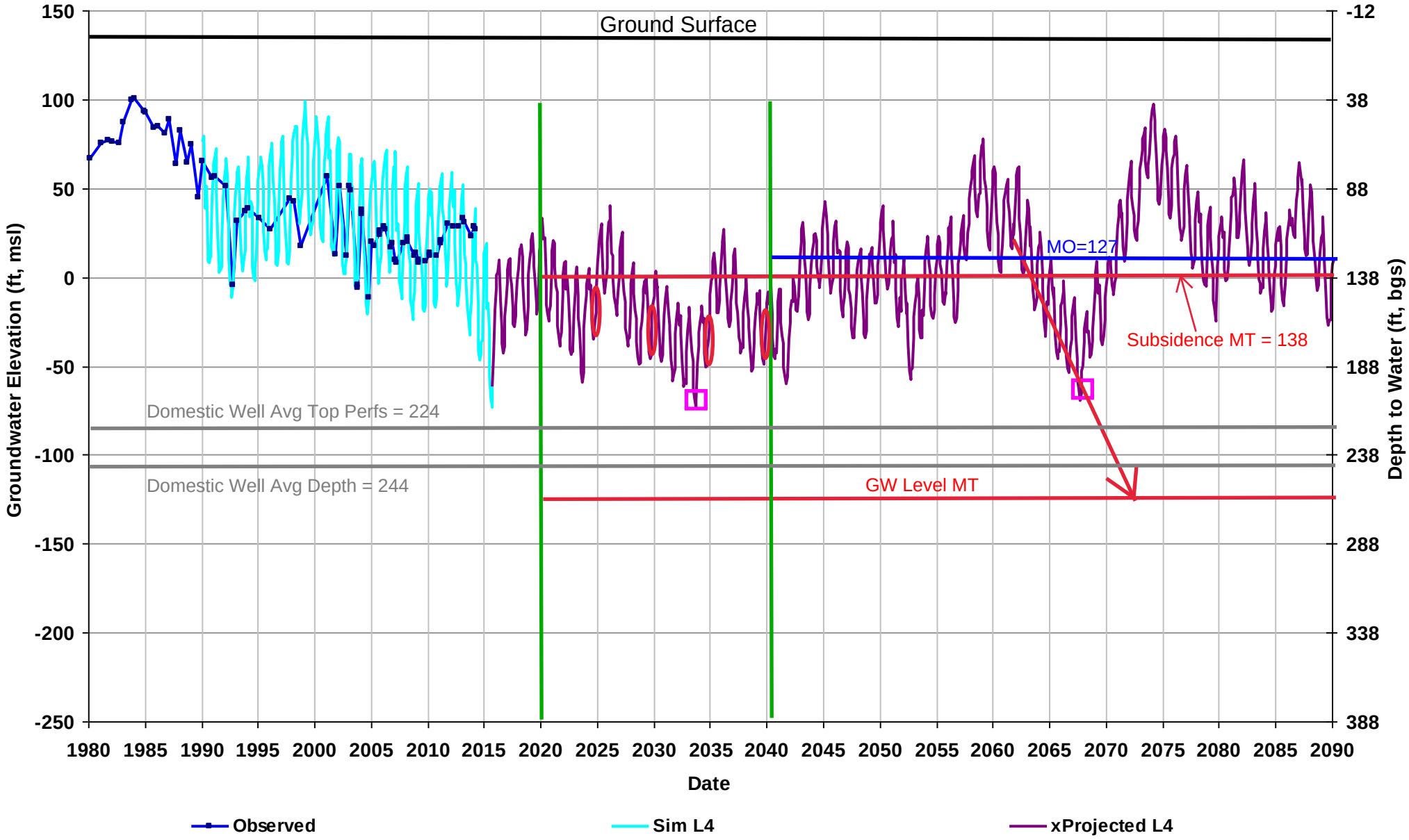
Well Name: 10S14E18K001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 138

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 7
Total Depth Average: 244
Total Depth Minimum: 211
Total Depth Maximum: 298

Top Perf. Count: 5
Top Perf. Average: 224
Top Perf. Minimum: 159
Top Perf. Maximum: 288

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4

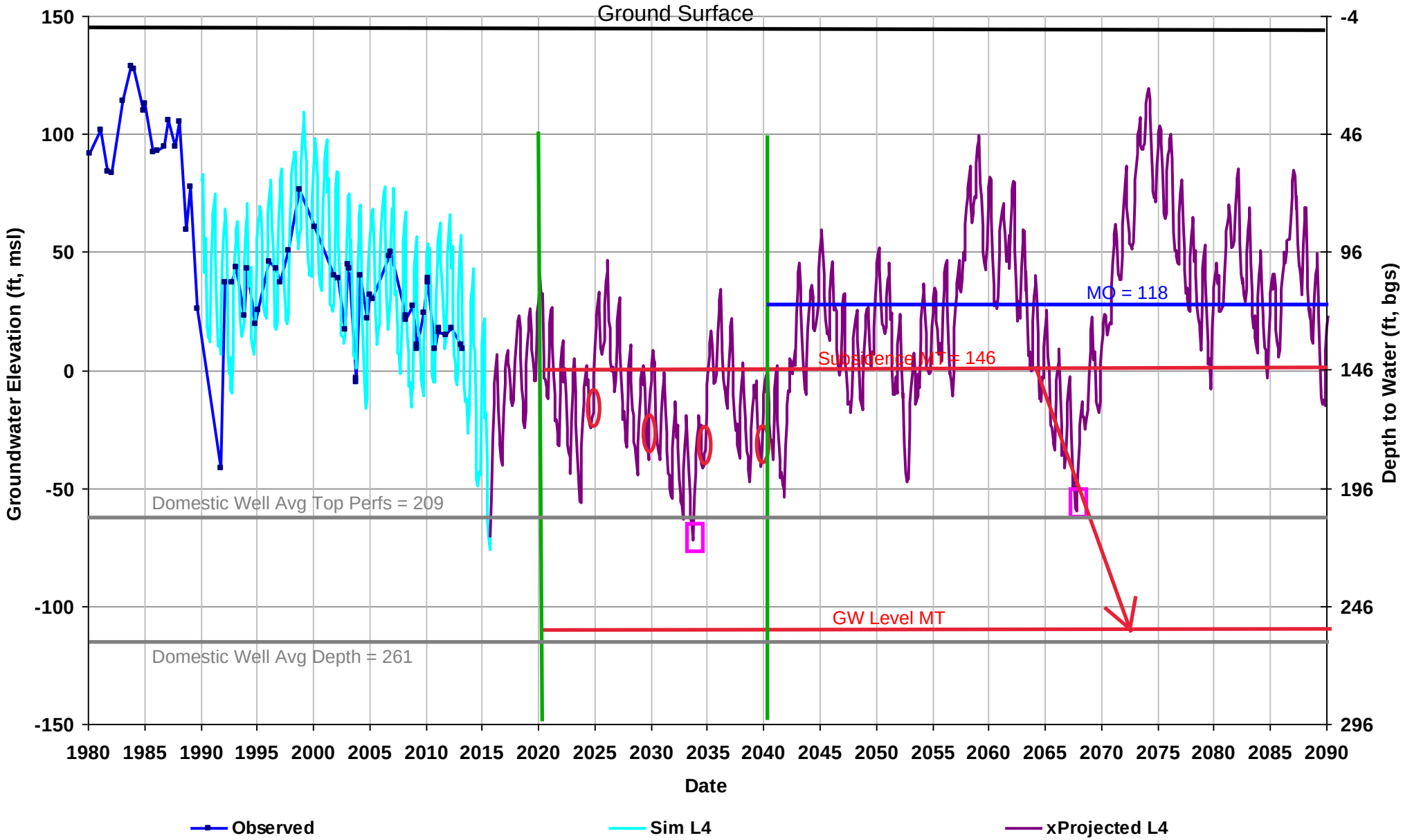


Well Name: 10S14E28B001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 146

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 6	Top Perf. Count: 4
Total Depth Average: 261	Top Perf. Average: 209
Total Depth Minimum: 242	Top Perf. Minimum: 176
Total Depth Maximum: 281	Top Perf. Maximum: 243

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



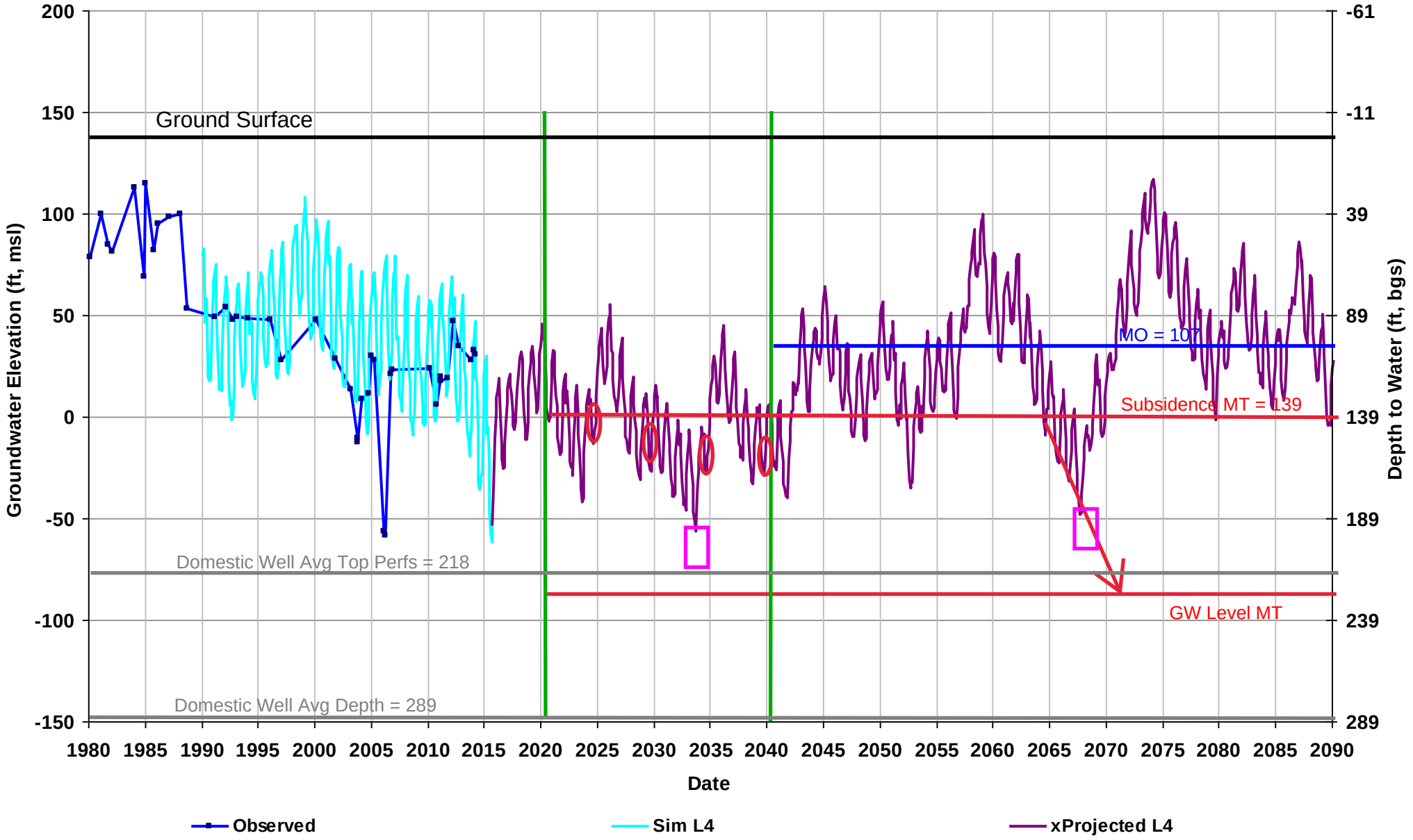
Well Name: 10S14E29C002M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 139

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 6
Total Depth Average: 289
Total Depth Minimum: 257
Total Depth Maximum: 321

Top Perf. Count: 5
Top Perf. Average: 218
Top Perf. Minimum: 160
Top Perf. Maximum: 277

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4

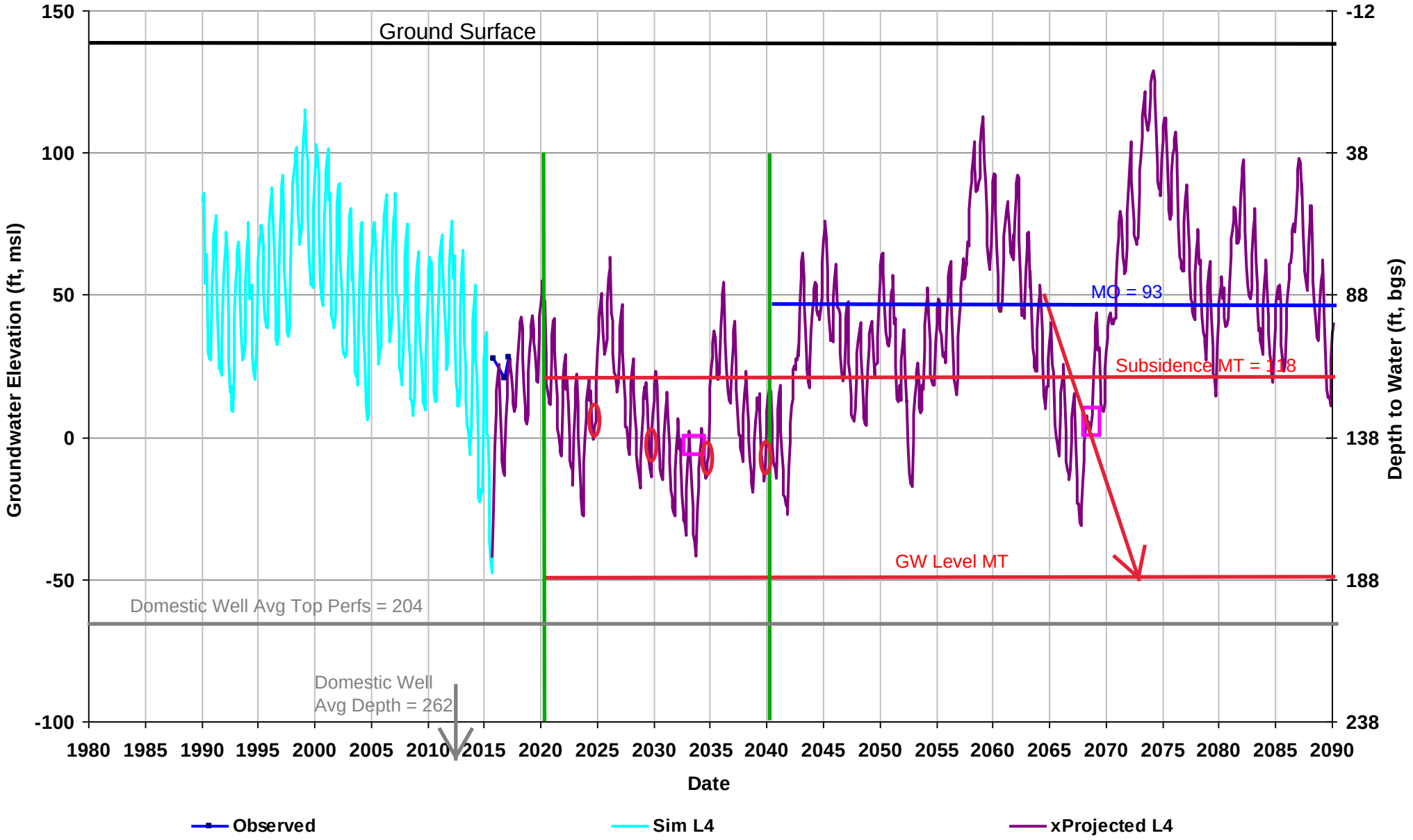


Well Name: 10S14E33M001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 138

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 3	Top Perf. Count: 3
Total Depth Average: 262	Top Perf. Average: 204
Total Depth Minimum: 213	Top Perf. Minimum: 154
Total Depth Maximum: 310	Top Perf. Maximum: 254

Total Depth (ft): 800
Perf Top (ft): 290
Perf Bottom (ft): 400
Top Model Layer: 4
Bottom Model Layer: 4

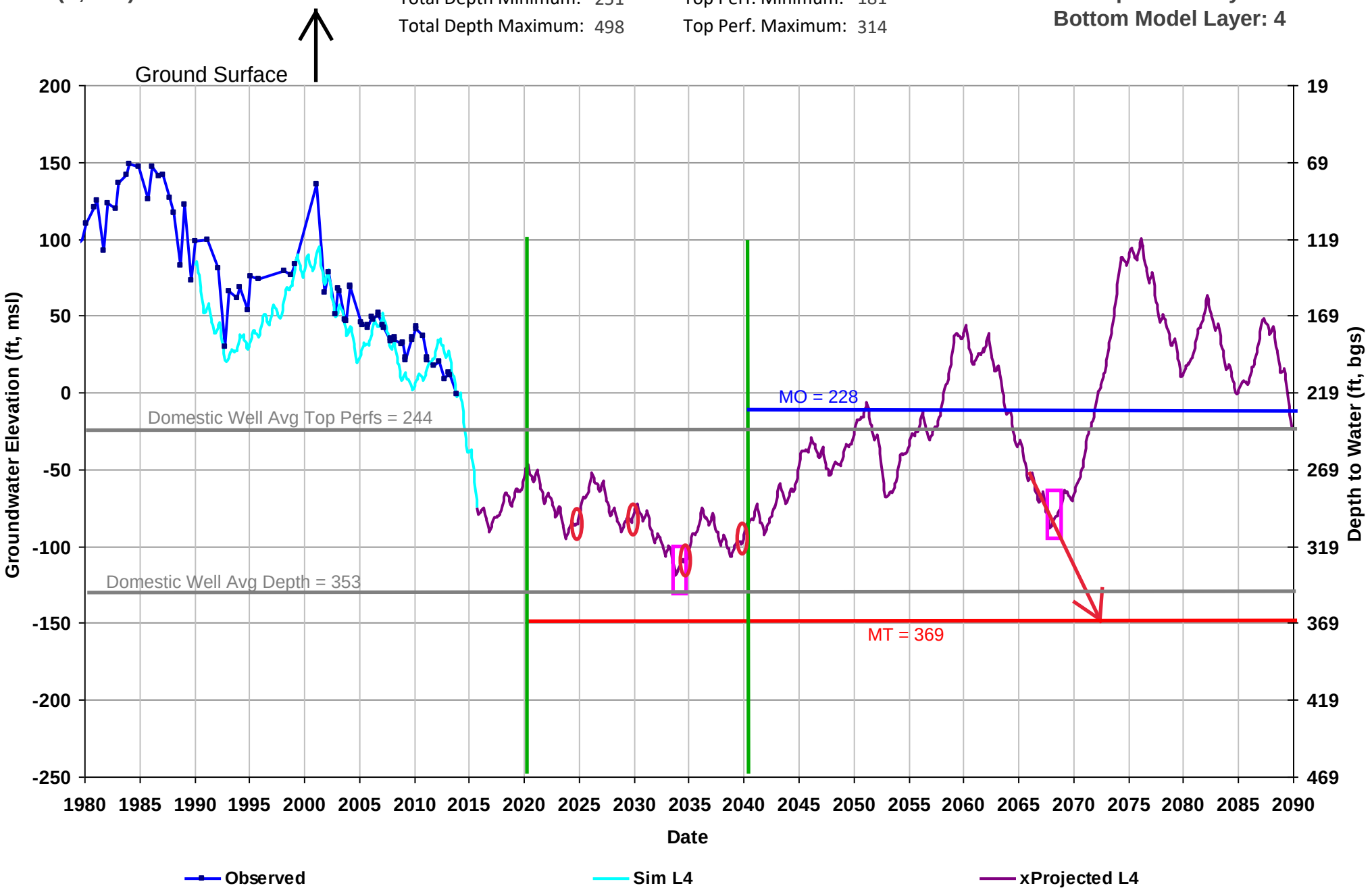


Well Name: 10S15E01E001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 219

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 78	Top Perf. Count: 55
Total Depth Average: 353	Top Perf. Average: 244
Total Depth Minimum: 251	Top Perf. Minimum: 181
Total Depth Maximum: 498	Top Perf. Maximum: 314

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4

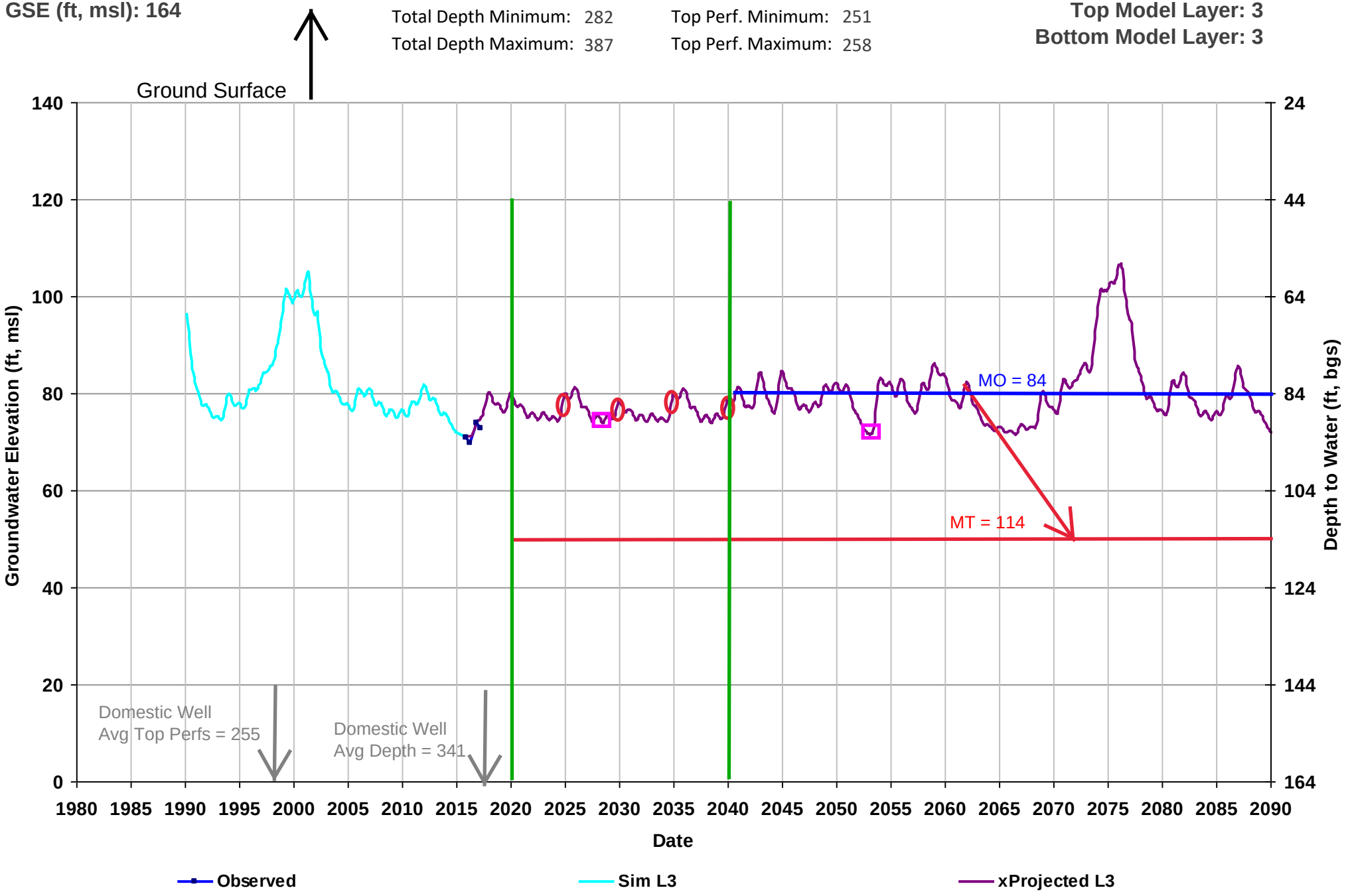


Well Name: 10S15E05J-1
Depth Zone: Upper; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 164

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 13	Top Perf. Count: 7
Total Depth Average: 341	Top Perf. Average: 255
Total Depth Minimum: 282	Top Perf. Minimum: 251
Total Depth Maximum: 387	Top Perf. Maximum: 258

Total Depth (ft): 97
Perf Top (ft): 82
Perf Bottom (ft): 97
Top Model Layer: 3
Bottom Model Layer: 3

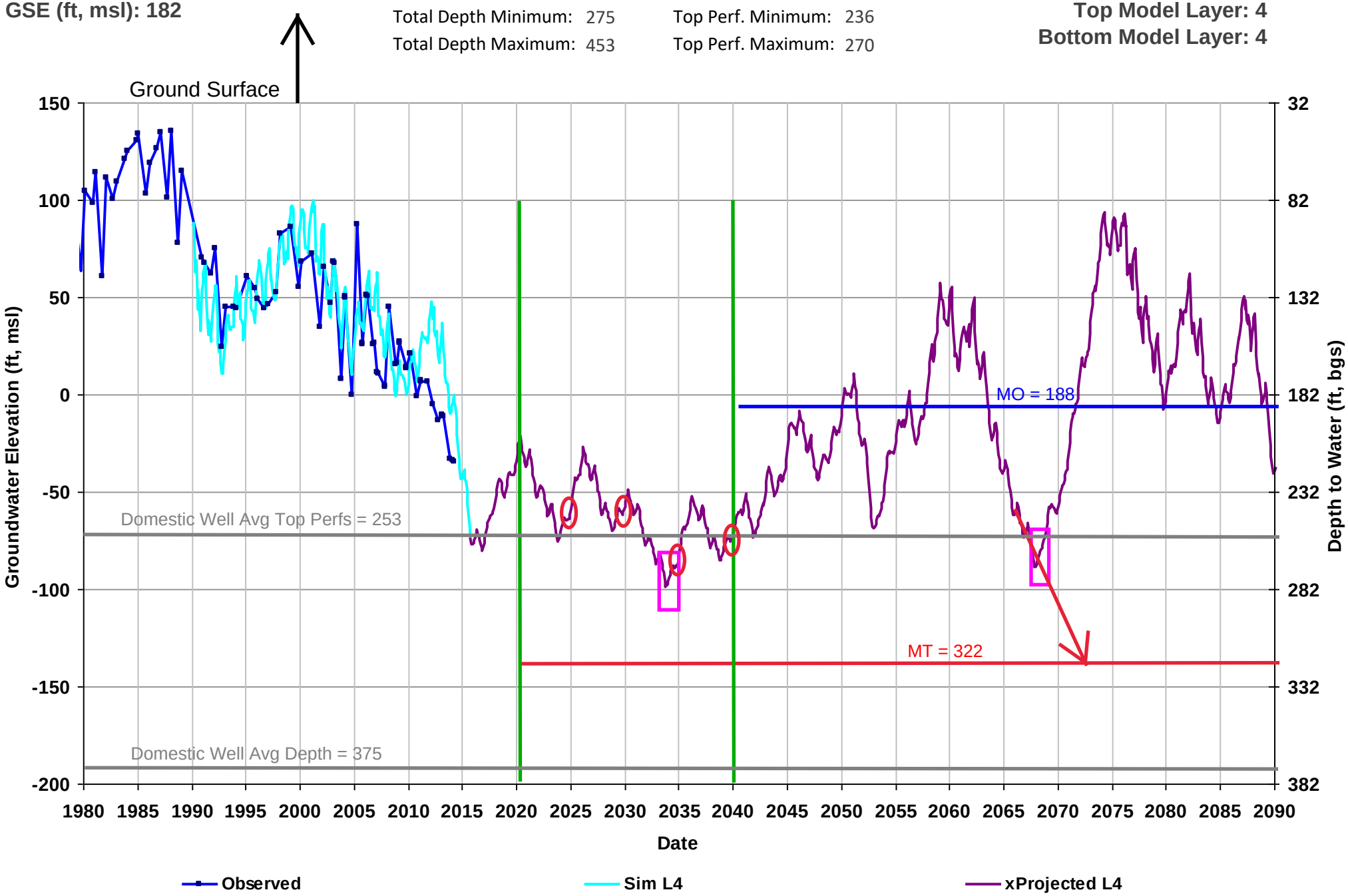


Well Name: 10S15E06L001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 182

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 10	Top Perf. Count: 7
Total Depth Average: 375	Top Perf. Average: 253
Total Depth Minimum: 275	Top Perf. Minimum: 236
Total Depth Maximum: 453	Top Perf. Maximum: 270

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



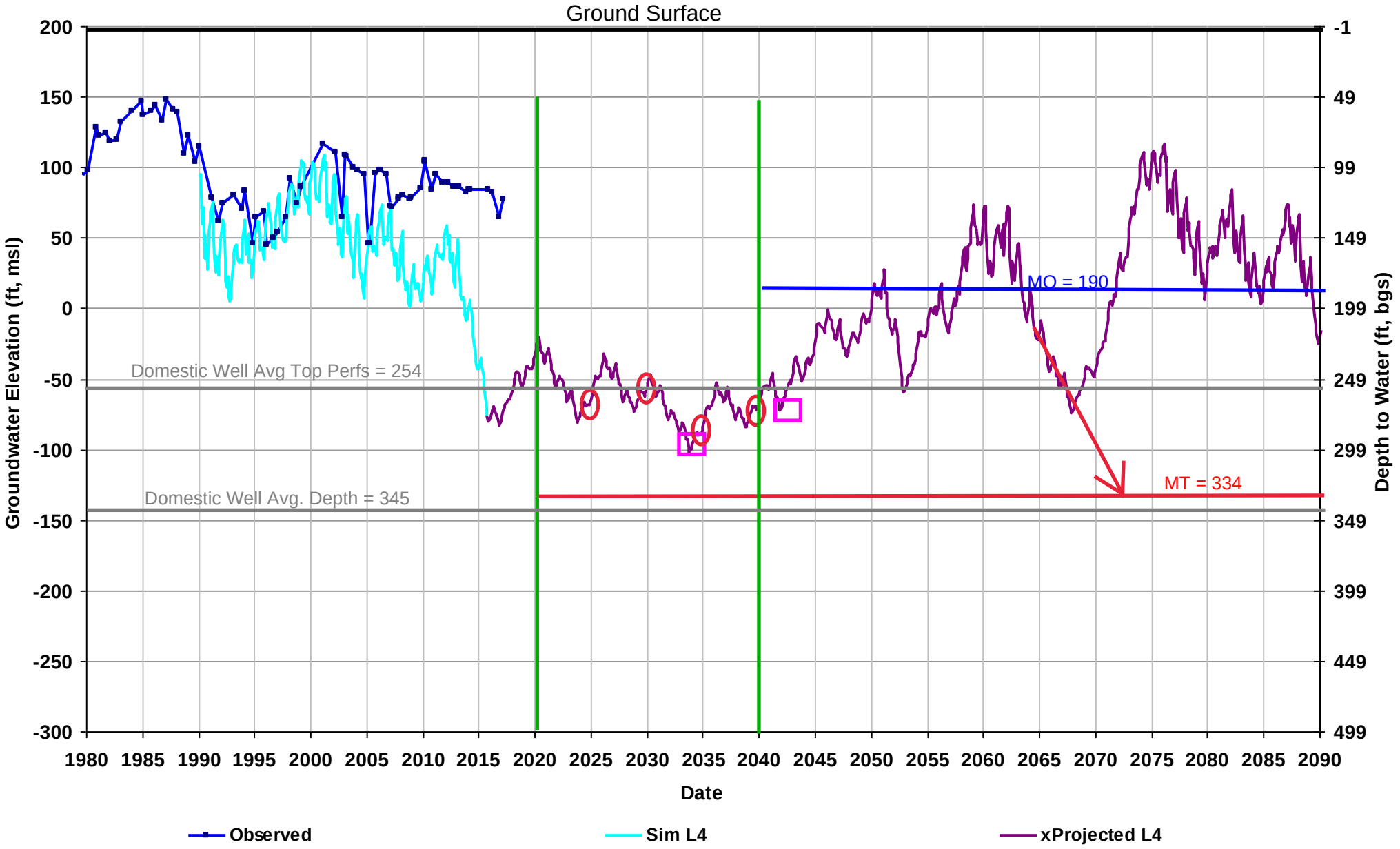
Well Name: 10S15E16R002M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 199

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 24
Total Depth Average: 345
Total Depth Minimum: 223
Total Depth Maximum: 474

Top Perf. Count: 14
Top Perf. Average: 254
Top Perf. Minimum: 229
Top Perf. Maximum: 282

Total Depth (ft): 529
Perf Top (ft): 187
Perf Bottom (ft): 529
Top Model Layer: 4
Bottom Model Layer: 4



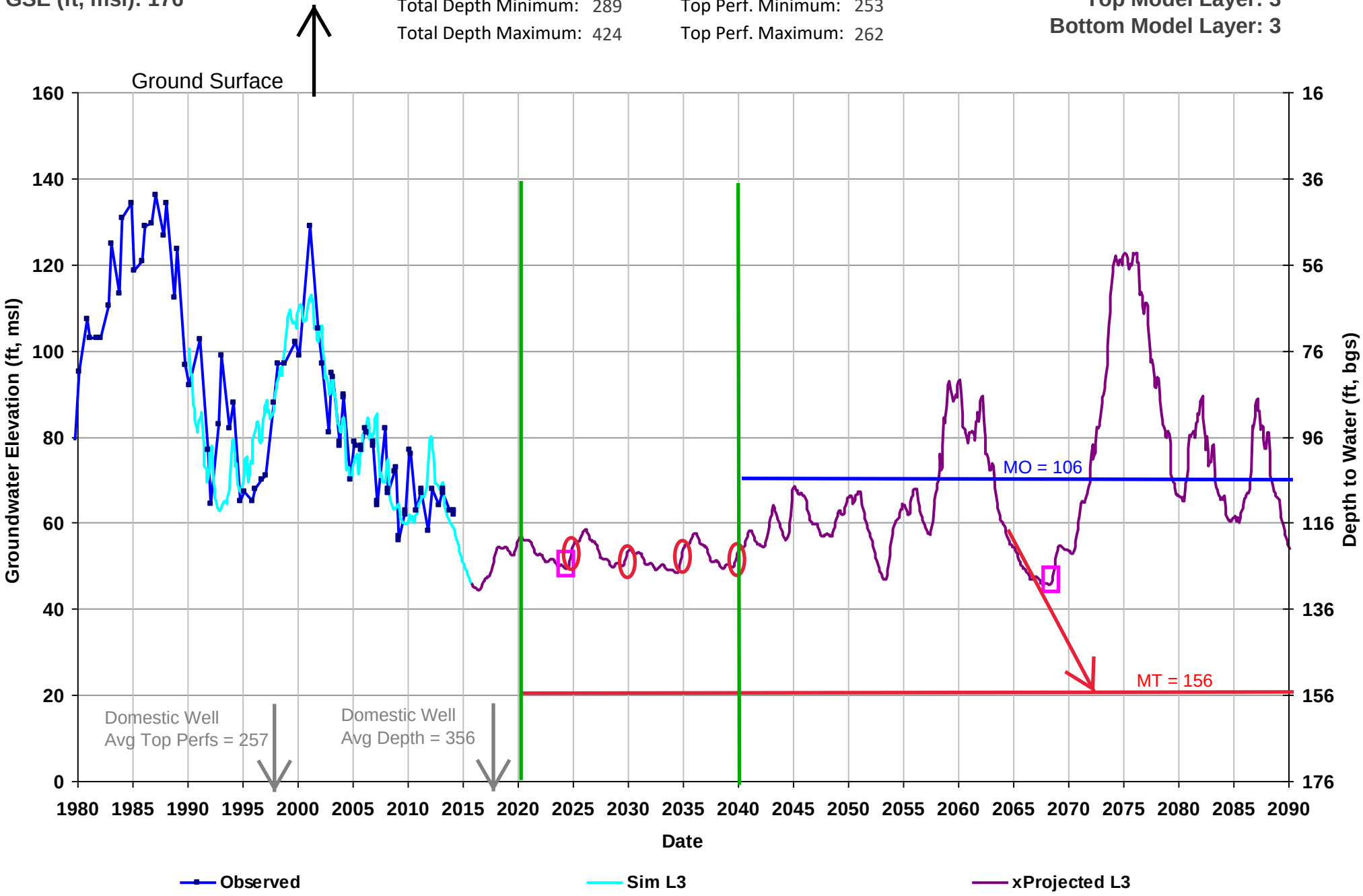
Well Name: 10S15E18L001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 176

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 11
Total Depth Average: 356
Total Depth Minimum: 289
Total Depth Maximum: 424

Top Perf. Count: 7
Top Perf. Average: 257
Top Perf. Minimum: 253
Top Perf. Maximum: 262

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 3
Bottom Model Layer: 3

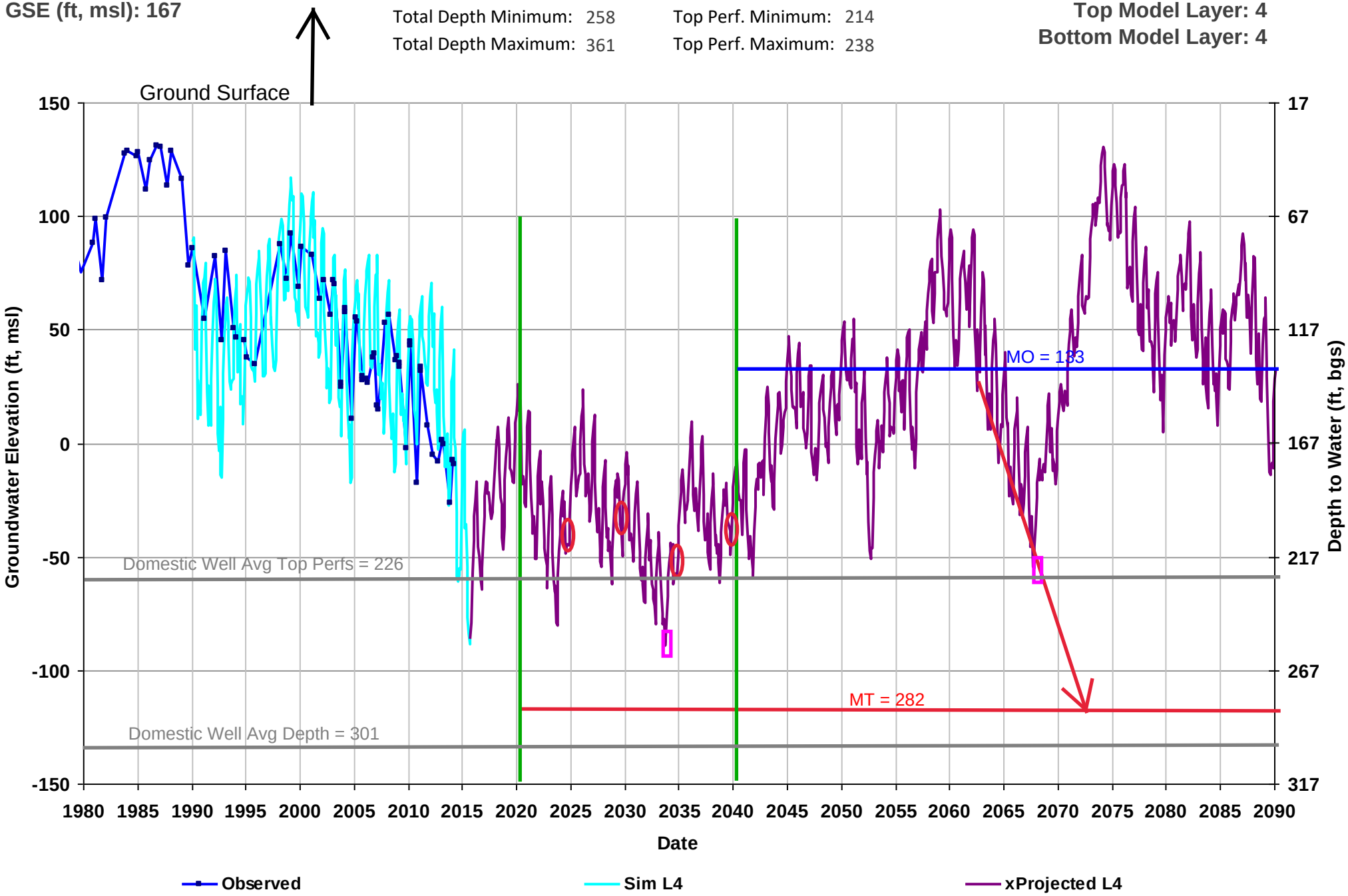


Well Name: 10S15E32L001M
Depth Zone: Unknown; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 167

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 20	Top Perf. Count: 14
Total Depth Average: 301	Top Perf. Average: 226
Total Depth Minimum: 258	Top Perf. Minimum: 214
Total Depth Maximum: 361	Top Perf. Maximum: 238

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



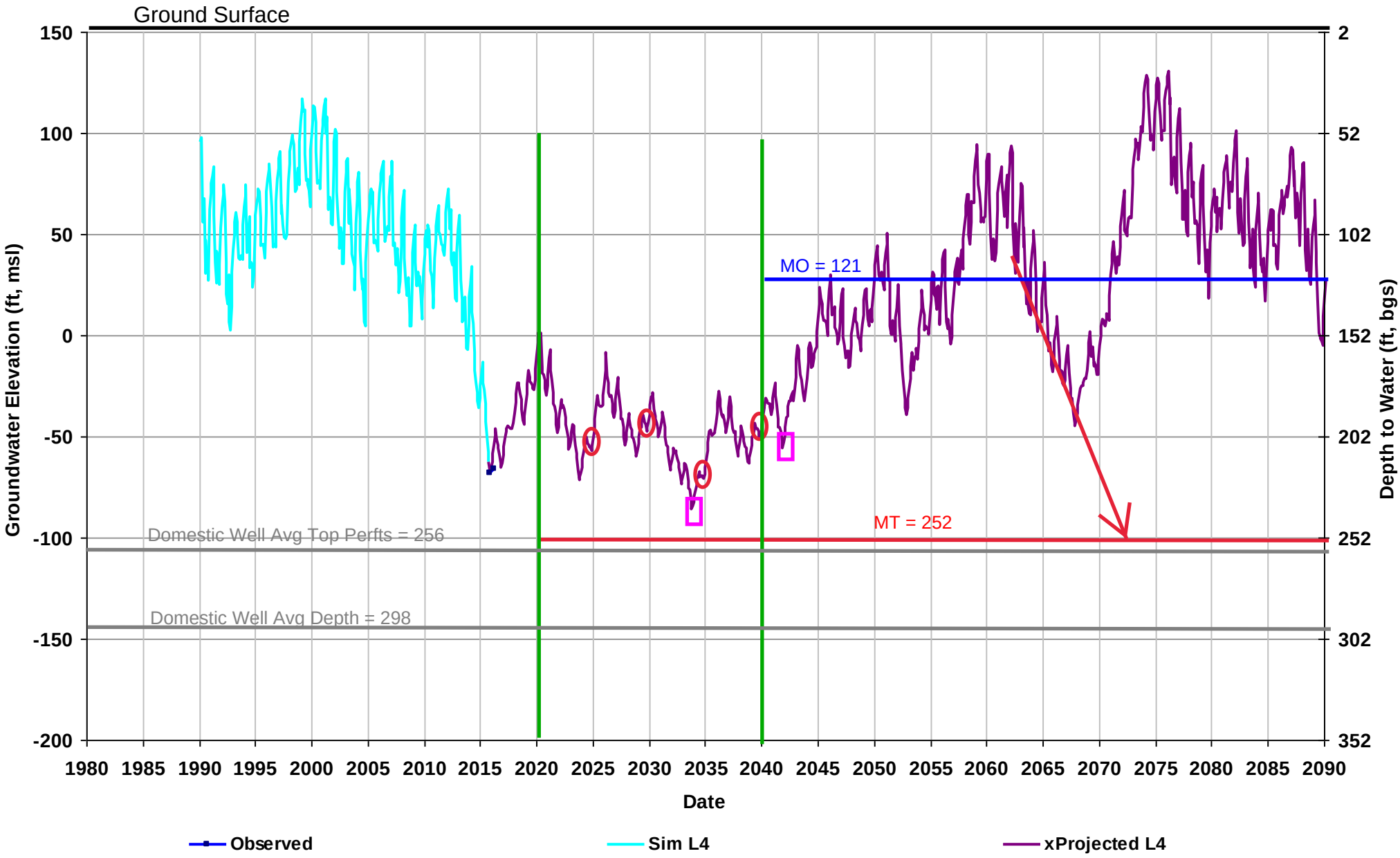
Well Name: 10S15E34A
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 152

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 27
Total Depth Average: 298
Total Depth Minimum: 234
Total Depth Maximum: 382

Top Perf. Count: 21
Top Perf. Average: 256
Top Perf. Minimum: 228
Top Perf. Maximum: 304

Total Depth (ft): 455
Perf Top (ft): 185
Perf Bottom (ft): 365
Top Model Layer: 4
Bottom Model Layer: 4



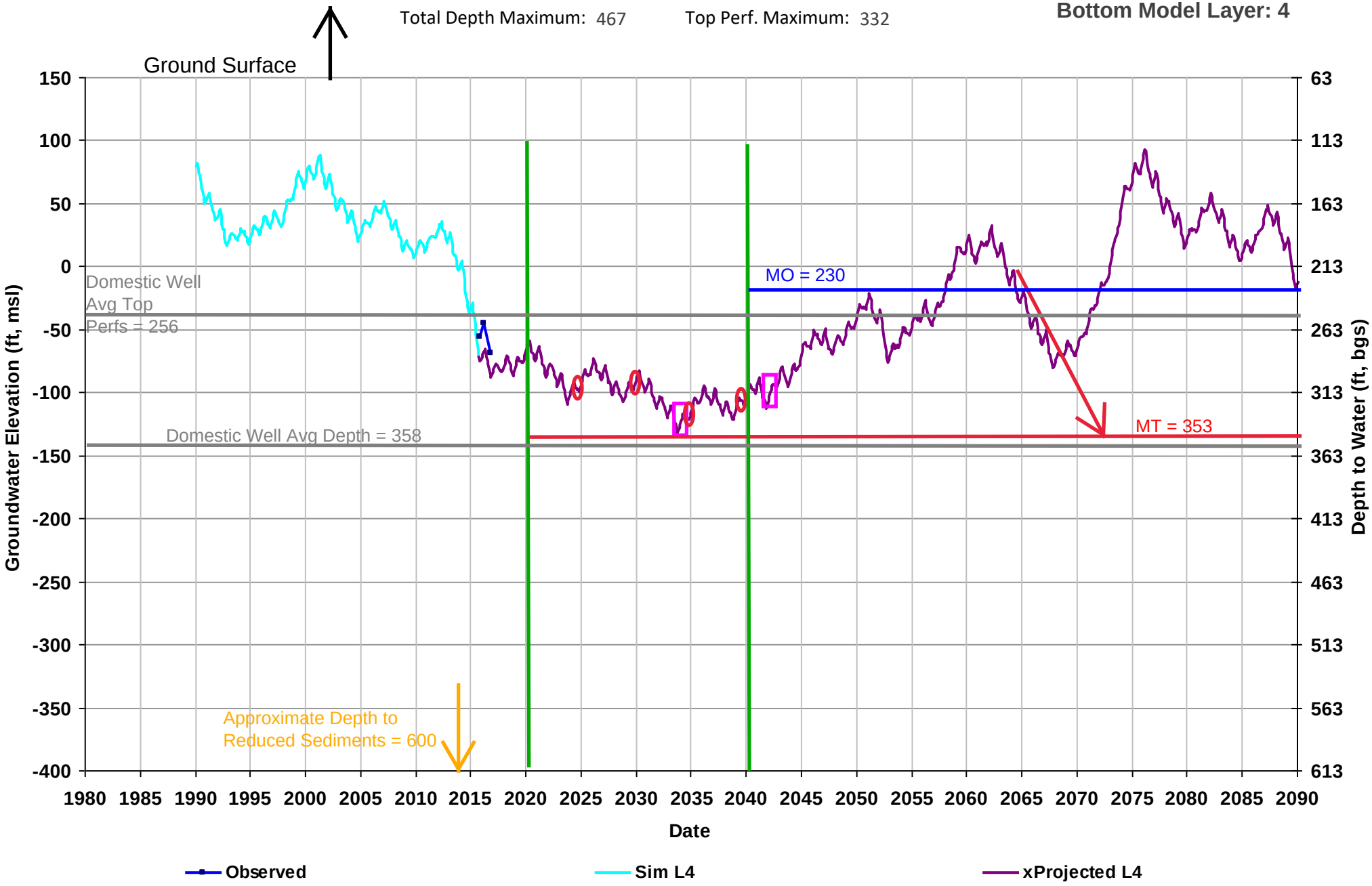
Well Name: 10S16E09M
Depth Zone: Lower; Outside CC
Subbasin: Chowchilla
GSE (ft, msl): 213

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 48
Total Depth Average: 358
Total Depth Minimum: 269
Total Depth Maximum: 467

Top Perf. Count: 30
Top Perf. Average: 256
Top Perf. Minimum: 207
Top Perf. Maximum: 332

Total Depth (ft): 955
Perf Top (ft): 290
Perf Bottom (ft): 935
Top Model Layer: 4
Bottom Model Layer: 4

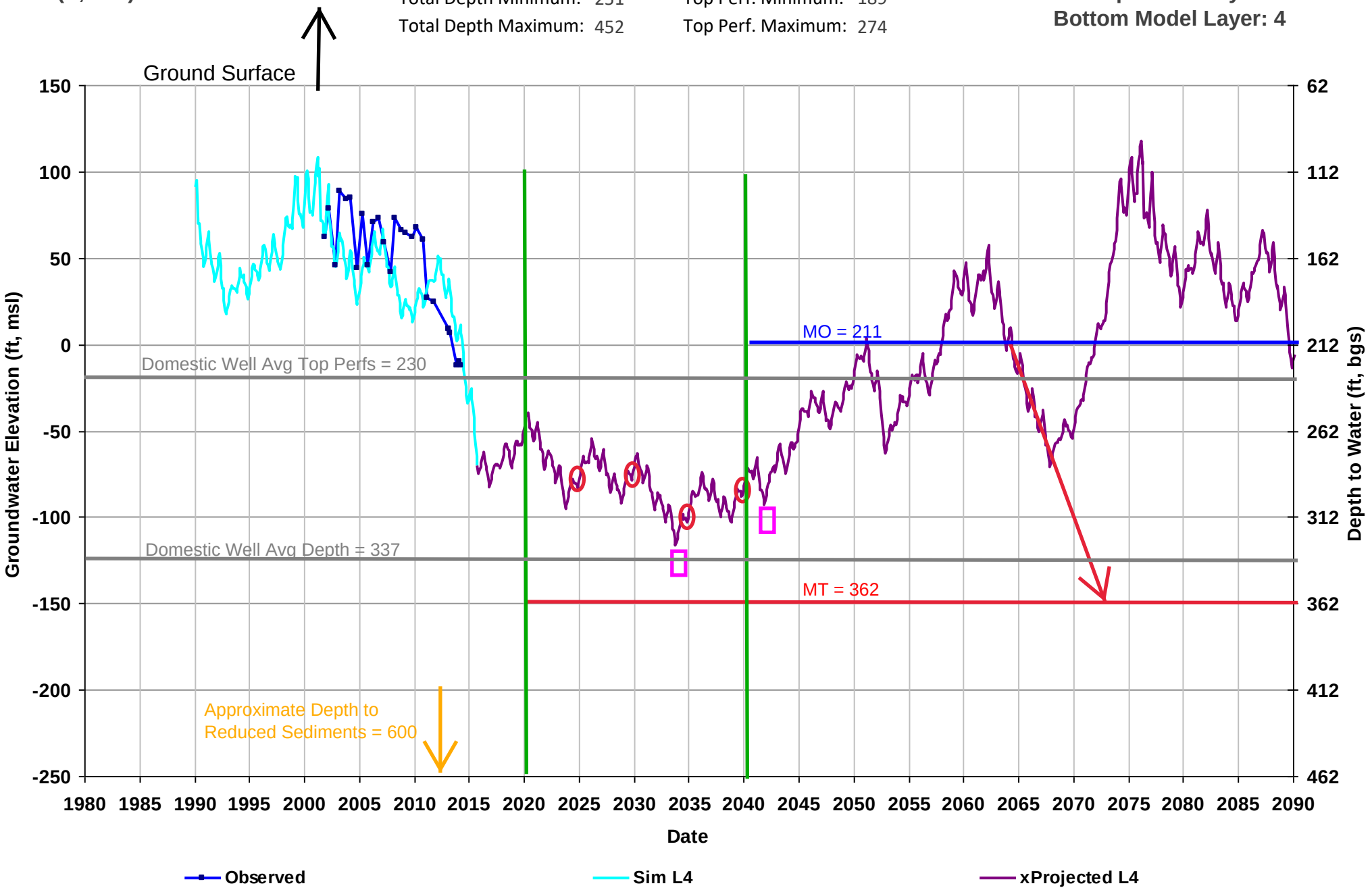


Well Name: 10S16E19A002M
Depth Zone: Unknown; Outside CC
Subbasin: Chowchilla
GSE (ft, msl): 212

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 19	Top Perf. Count: 11
Total Depth Average: 337	Top Perf. Average: 230
Total Depth Minimum: 251	Top Perf. Minimum: 189
Total Depth Maximum: 452	Top Perf. Maximum: 274

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 4
Bottom Model Layer: 4



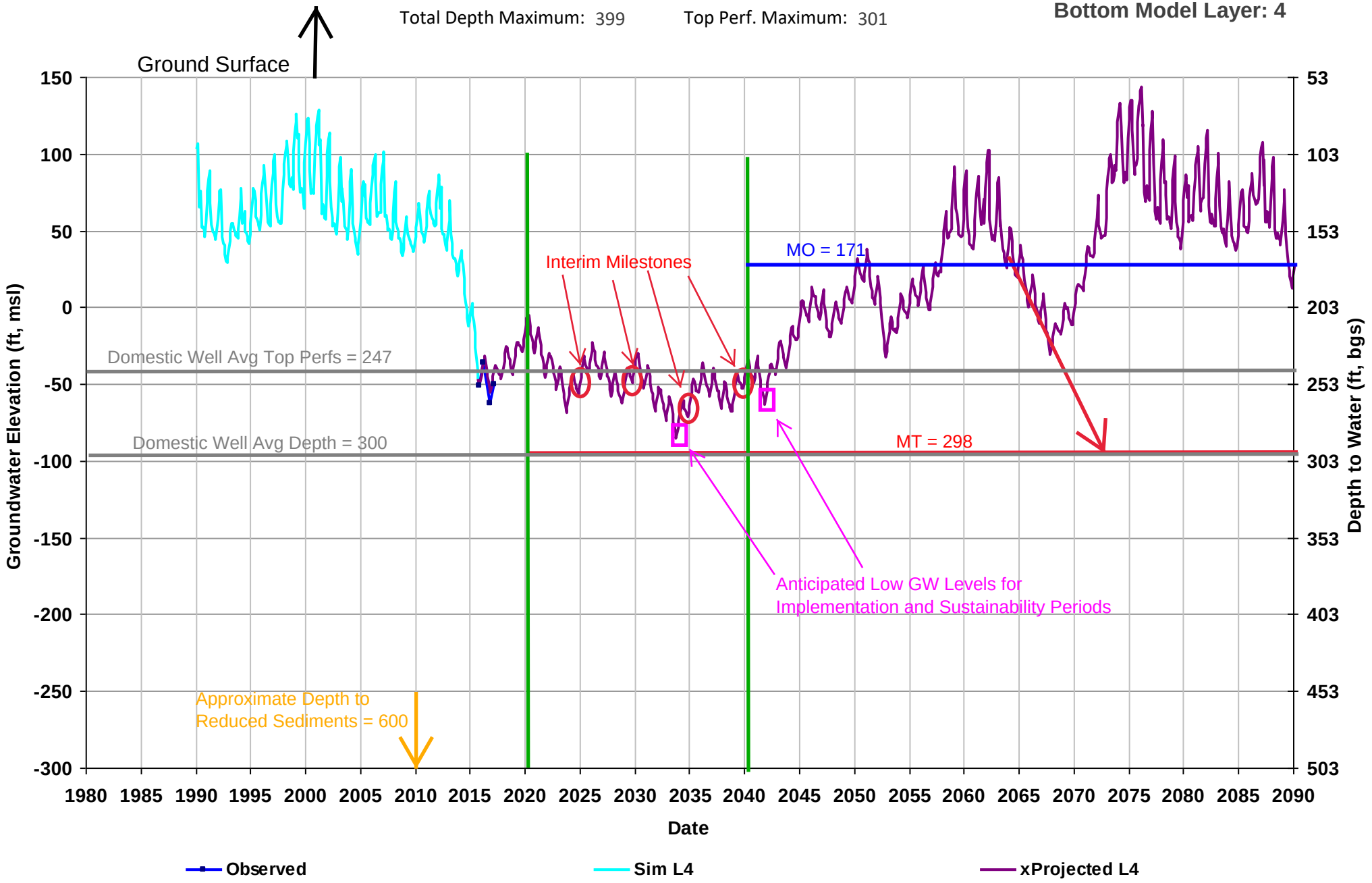
Well Name: 10S16E32K
Depth Zone: Lower; Outside CC
Subbasin: Chowchilla
GSE (ft, msl): 203

Domestic Well Data: *Total Sections Included: 7*

Total Depth Count: 17
Total Depth Average: 300
Total Depth Minimum: 229
Total Depth Maximum: 399

Top Perf. Count: 14
Top Perf. Average: 247
Top Perf. Minimum: 193
Top Perf. Maximum: 301

Total Depth (ft): 624
Perf Top (ft): 278
Perf Bottom (ft): 588
Top Model Layer: 4
Bottom Model Layer: 4



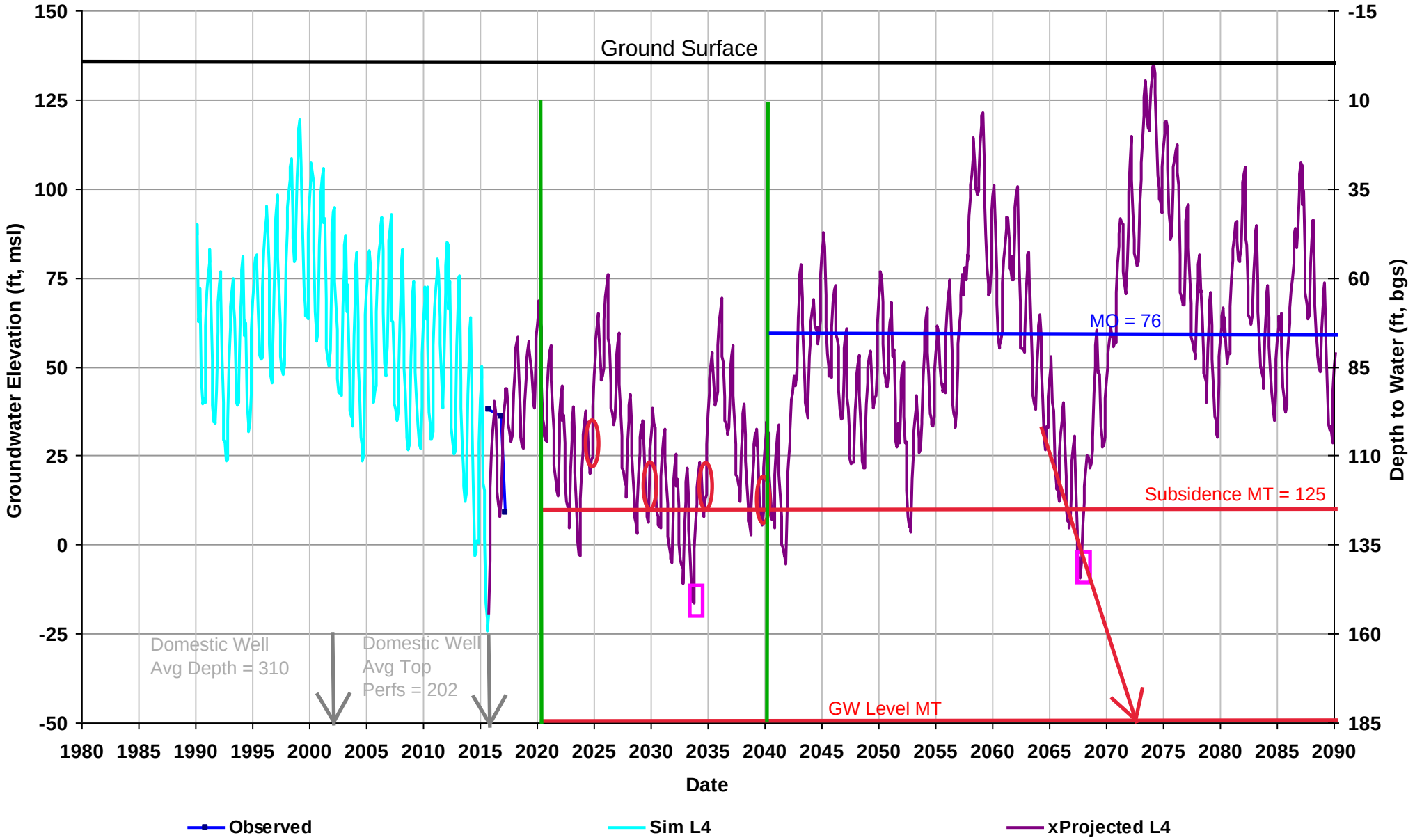
Well Name: 11S14E05J001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 135

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 7
Total Depth Average: 310
Total Depth Minimum: 240
Total Depth Maximum: 376

Top Perf. Count: 4
Top Perf. Average: 202
Top Perf. Minimum: 115
Top Perf. Maximum: 289

Total Depth (ft): 500
Perf Top (ft): 300
Perf Bottom (ft): 500
Top Model Layer: 4
Bottom Model Layer: 4



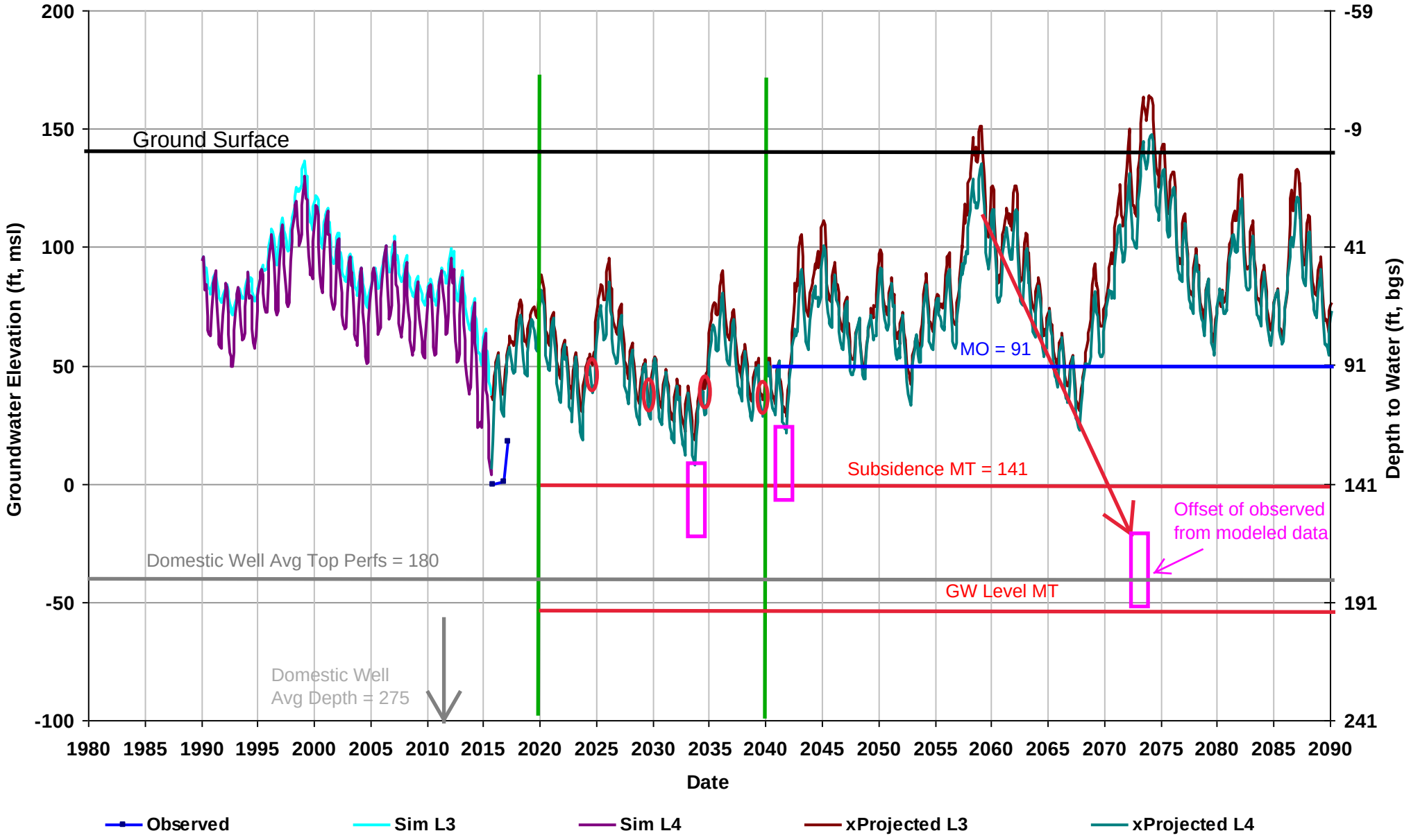
Well Name: 11S14E22F001M
Depth Zone: Composite; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 141

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 3
Total Depth Average: 275
Total Depth Minimum: 150
Total Depth Maximum: 444

Top Perf. Count: 1
Top Perf. Average: 180
Top Perf. Minimum: 180
Top Perf. Maximum: 180

Total Depth (ft): 840
Perf Top (ft): 190
Perf Bottom (ft): 260
Top Model Layer: 3
Bottom Model Layer: 4



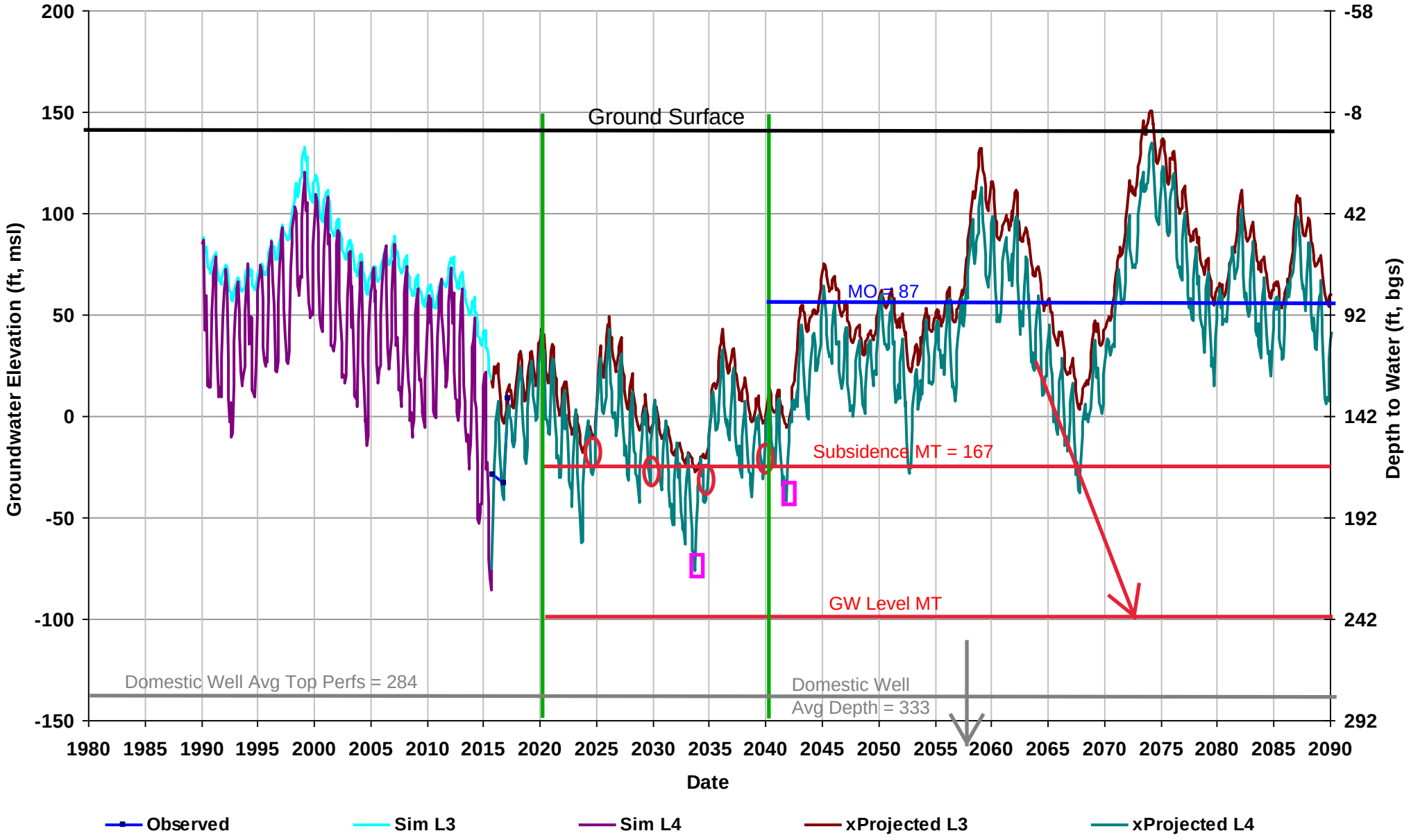
Well Name: 11S15E01F
Depth Zone: Composite; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 142

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 6
Total Depth Average: 333
Total Depth Minimum: 333
Total Depth Maximum: 333

Top Perf. Count: 4
Top Perf. Average: 284
Top Perf. Minimum: 270
Top Perf. Maximum: 297

Total Depth (ft): 480
Perf Top (ft): 160
Perf Bottom (ft): 475
Top Model Layer: 3
Bottom Model Layer: 4



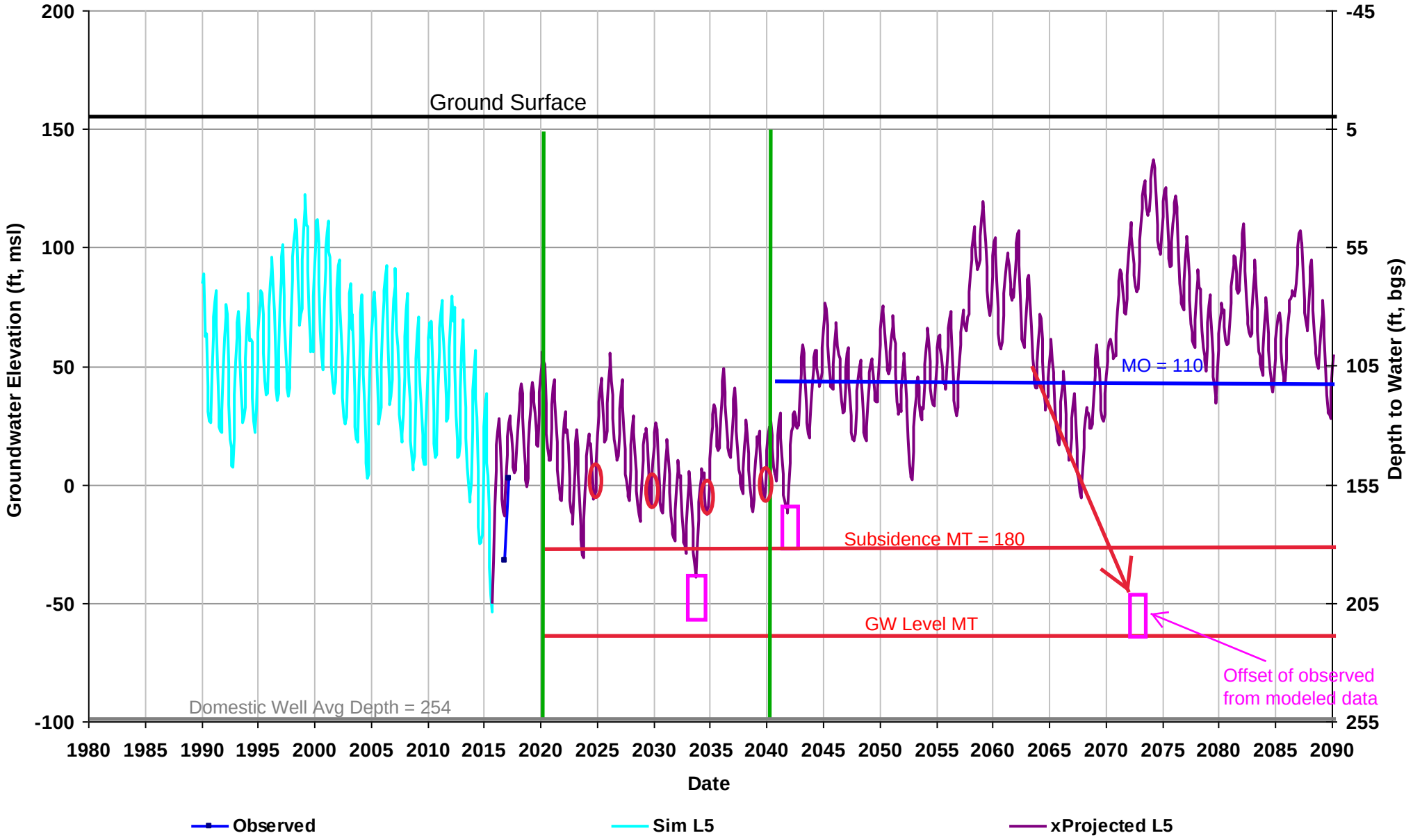
Well Name: 11S15E18P001M
Depth Zone: Lower; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 155

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 9
Total Depth Average: 254
Total Depth Minimum: 223
Total Depth Maximum: 286

Top Perf. Count: 3
Top Perf. Average: 269
Top Perf. Minimum: 234
Top Perf. Maximum: 304

Total Depth (ft): 700
Perf Top (ft): 265
Perf Bottom (ft): 696
Top Model Layer: 5
Bottom Model Layer: 5

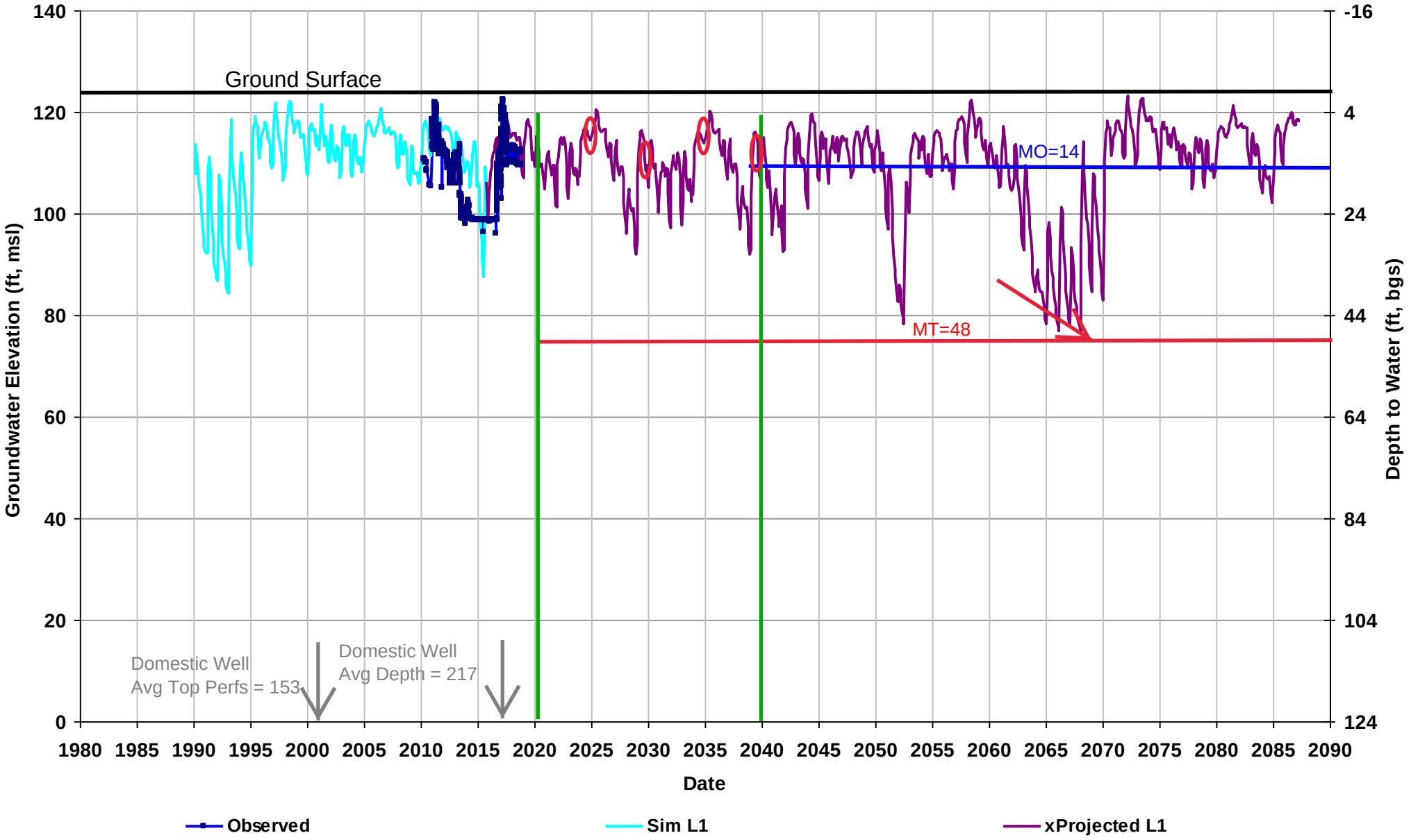


Well Name: SJRRP_MW-10-89
Depth Zone: Upper, Shallow GW; Wit
Subbasin: Chowchilla
GSE (ft, msl): 123

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count:	9	Top Perf. Count:	7
Total Depth Average:	217	Top Perf. Average:	153
Total Depth Minimum:	173	Top Perf. Minimum:	139
Total Depth Maximum:	255	Top Perf. Maximum:	166

Total Depth (ft): 26
Perf Top (ft): 10
Perf Bottom (ft): 25
Top Model Layer: 1
Bottom Model Layer: 1



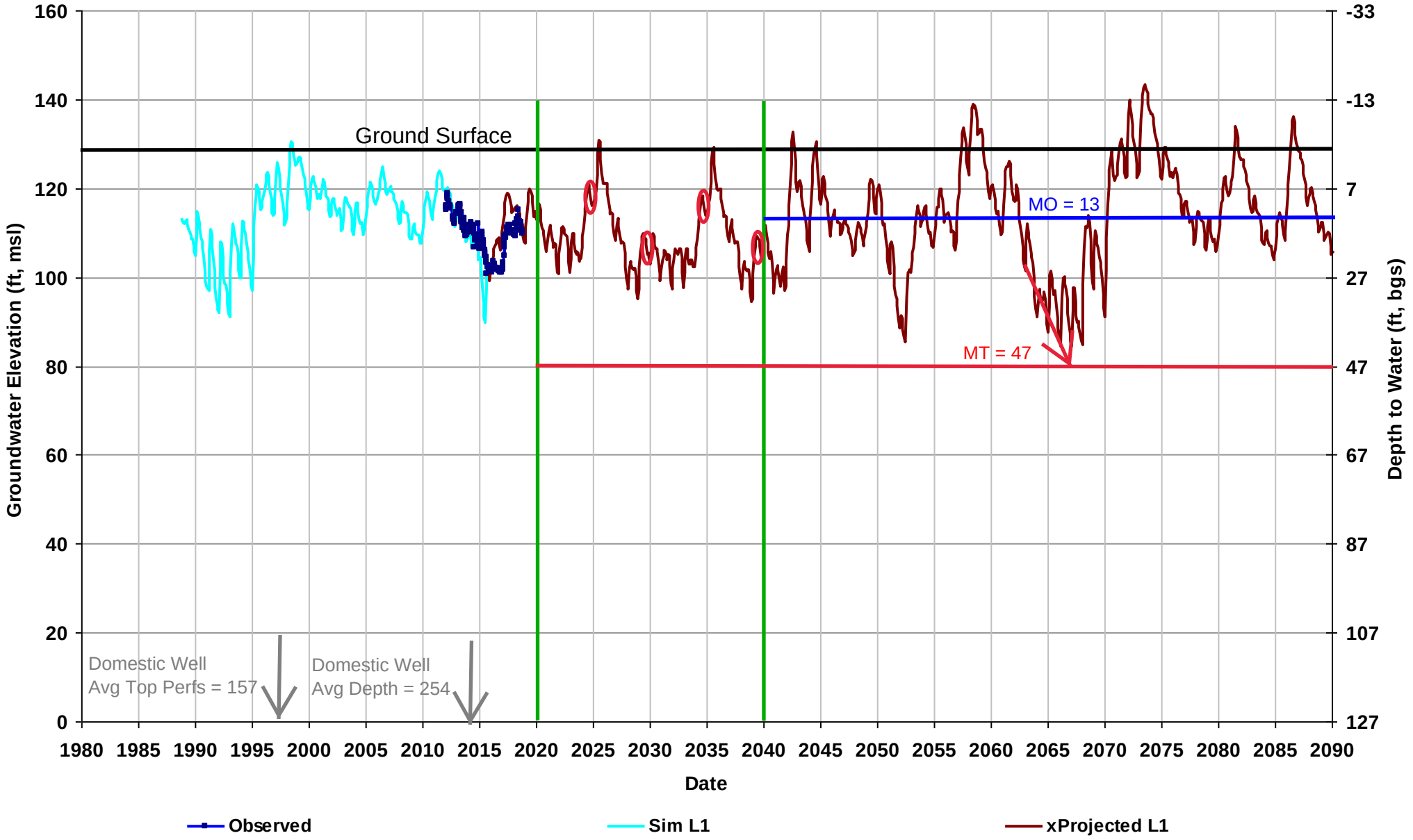
Well Name: SJRRP_MW-11-161
Depth Zone: Upper, Shallow GW; Wit
Subbasin: Chowchilla
GSE (ft, msl): 127

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 9
Total Depth Average: 254
Total Depth Minimum: 218
Total Depth Maximum: 310

Top Perf. Count: 8
Top Perf. Average: 157
Top Perf. Minimum: 117
Top Perf. Maximum: 217

Total Depth (ft): 30
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 1
Bottom Model Layer: 1



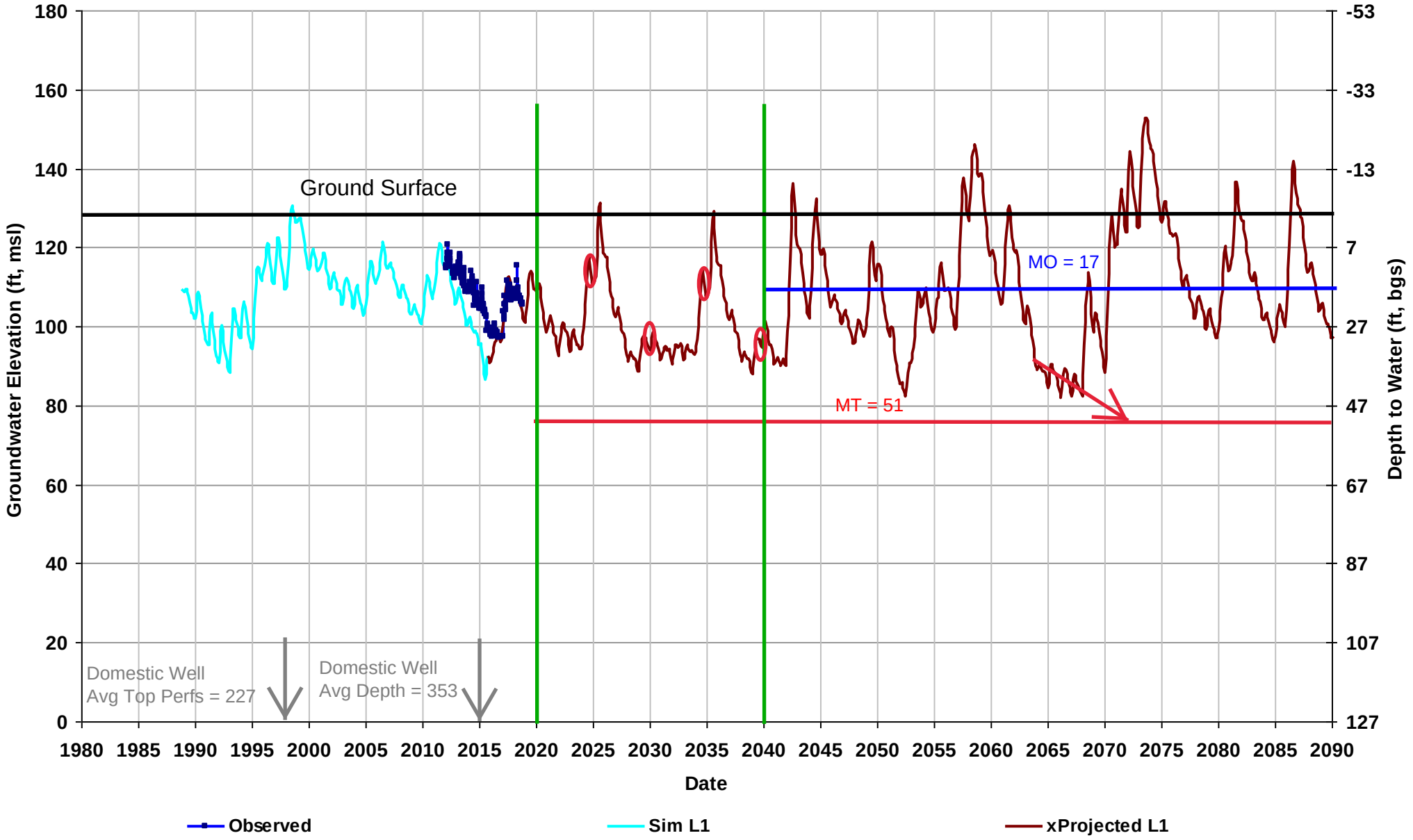
Well Name: SJRRP_MW-11-163
Depth Zone: Upper, Shallow GW; Wit
Subbasin: Chowchilla
GSE (ft, msl): 127

Domestic Well Data: *Total Sections Included: 9*

Total Depth Count: 4
Total Depth Average: 353
Total Depth Minimum: 290
Total Depth Maximum: 455

Top Perf. Count: 3
Top Perf. Average: 227
Top Perf. Minimum: 120
Top Perf. Maximum: 400

Total Depth (ft): 29
Perf Top (ft):
Perf Bottom (ft):
Top Model Layer: 1
Bottom Model Layer: 1



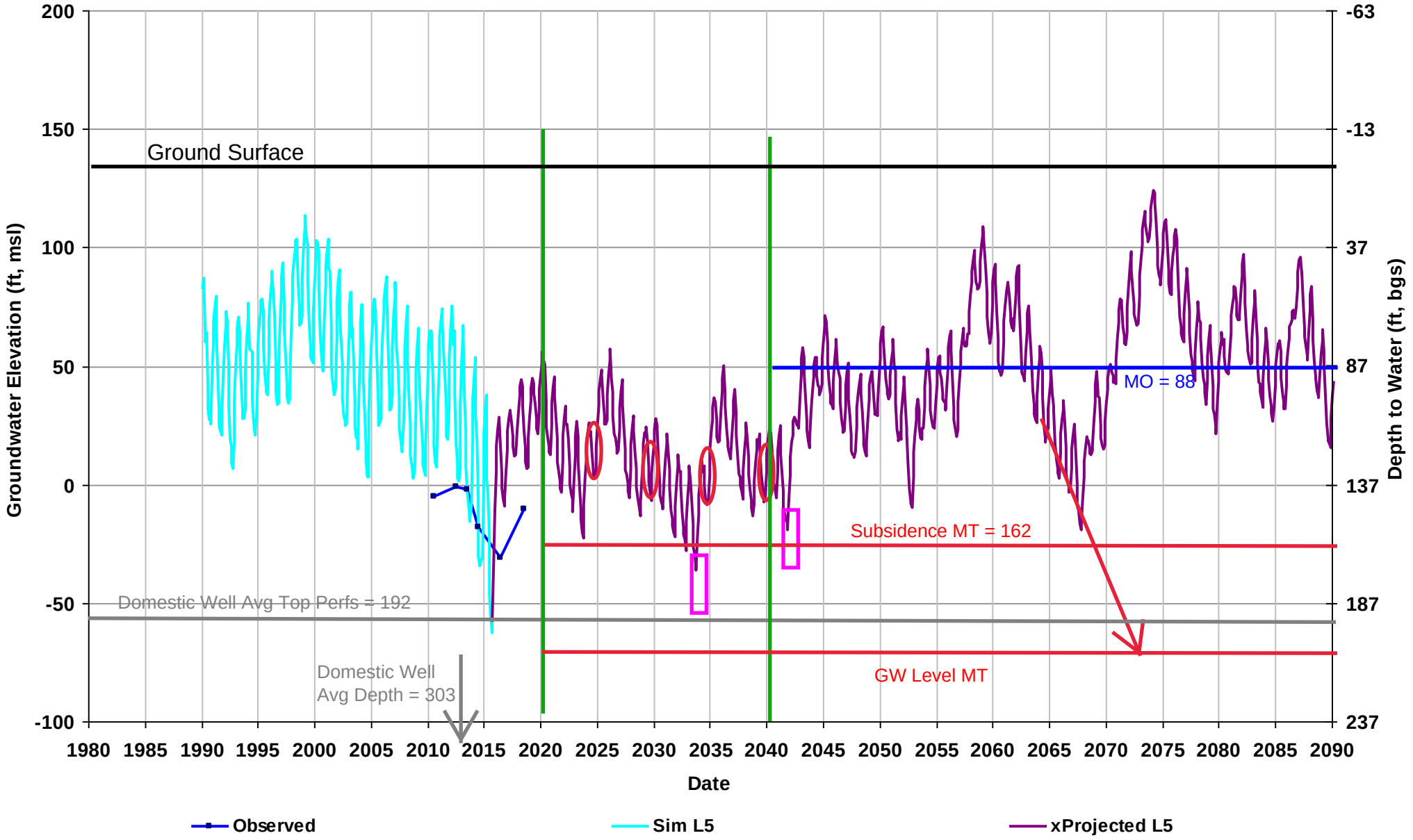
Well Name: TTR-27
Depth Zone: Composite; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 137

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 6
Total Depth Average: 303
Total Depth Minimum: 150
Total Depth Maximum: 472

Top Perf. Count: 3
Top Perf. Average: 192
Top Perf. Minimum: 155
Top Perf. Maximum: 229

Total Depth (ft): 799
Perf Top (ft): 168
Perf Bottom (ft): 790
Top Model Layer: 5
Bottom Model Layer: 5



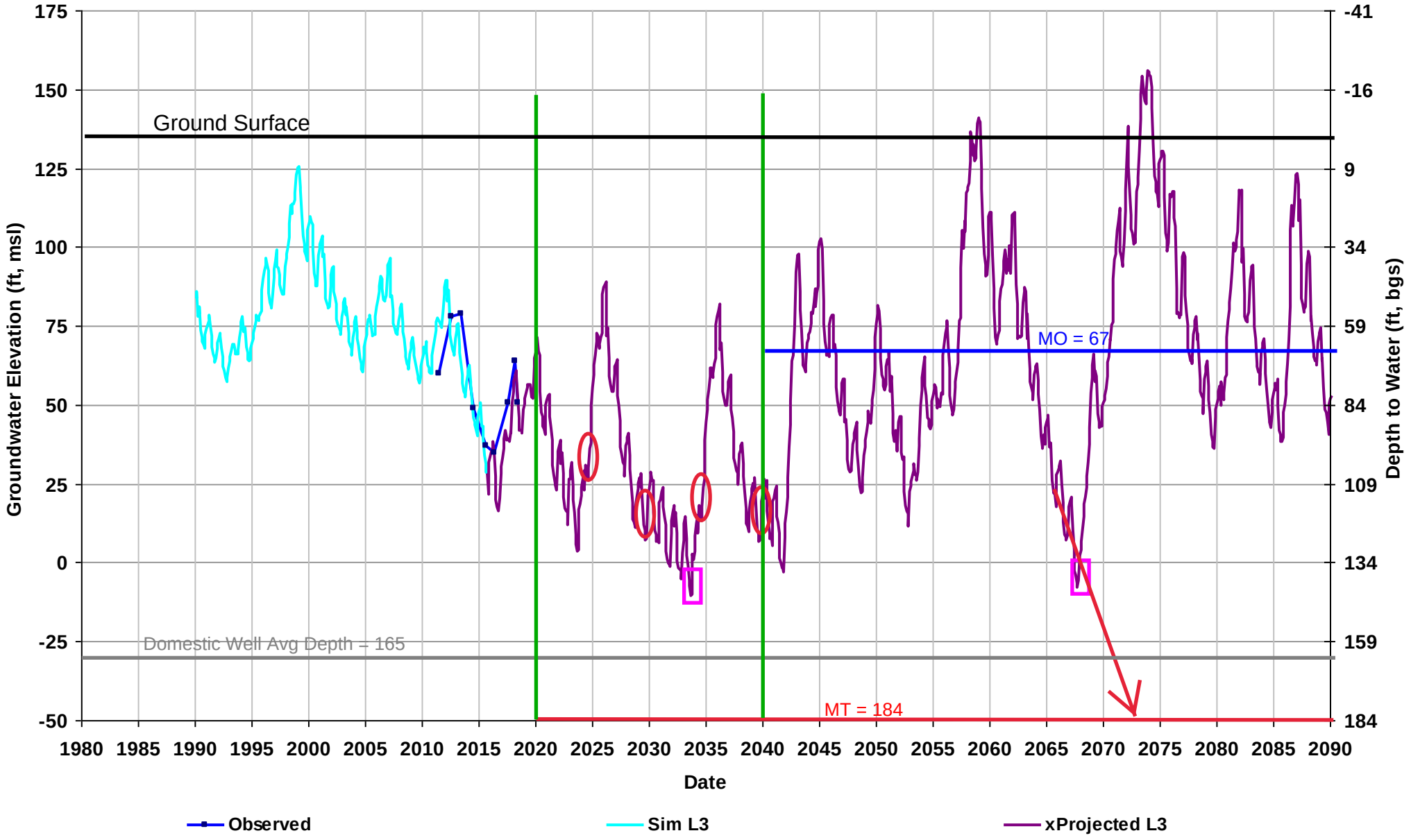
Well Name: TTR-6
Depth Zone: Upper; Within CC
Subbasin: Chowchilla
GSE (ft, msl): 134

Domestic Well Data: *Total Sections Included: 8*

Total Depth Count: 1
Total Depth Average: 165
Total Depth Minimum: 165
Total Depth Maximum: 165

Top Perf. Count: 0
Top Perf. Average: 0
Top Perf. Minimum: 0
Top Perf. Maximum: 0

Total Depth (ft): 196
Perf Top (ft): 158
Perf Bottom (ft): 192
Top Model Layer: 3
Bottom Model Layer: 3



APPENDIX 3.B. MEASURABLE OBJECTIVES AND MINIMUM THRESHOLDS FOR GROUNDWATER QUALITY

DRAFT

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

GSP Team:

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
California State University, Sacramento

Summary of Recent (Since January 2015) Results for Key Water Quality Constituents in Groundwater Quality Indicator Wells

	Arsenic Concentrations (µg/L)						Nitrate Concentrations (mg/L as nitrogen)						Specific Conductance (µS/cm)						TDS Concentrations (mg/L)					
Well ID	Minimum Result	Maximum Result	Average Result	Num. of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Num. of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Num. of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Num. of Observations	Date First Observation	Date Last Observation
2000511-001*	1.4	1.4	1.4	1	1/9/2018	1/9/2018	4.8	5.4	5.1	4	1/7/2015	1/9/2018	490	560	525	2	1/7/2015	1/9/2018	330	330	330	1	1/9/2018	1/9/2018
2000597-001	0.0	0.0	0.0	1	12/17/2015	12/17/2015	2.9	7.0	4.4	9	3/12/2015	3/7/2019	910	910	910	1	12/21/2017	12/21/2017						
2000681-002	0.0	0.0	0.0	1	12/13/2017	12/13/2017	1.5	2.2	1.9	2	12/13/2017	12/20/2018	250	250	250	1	12/13/2017	12/13/2017						
2010001-010							4.8	5.9	5.3	6	3/9/2015	3/18/2019	660	680	670	2	8/3/2015	8/18/2015	440	440	440	1	8/4/2016	8/4/2016
2010001-011	0.0	0.0	0.0	1	3/28/2017	3/28/2017	0.6	0.6	0.6	1	8/18/2015	8/18/2015	210	210	210	1	7/27/2016	7/27/2016						
2400216-001	4.4	4.4	4.4	1	10/24/2016	10/24/2016	1.6	1.8	1.7	4	5/4/2015	8/20/2018												
ESJ11							7.1	7.1	7.1	1	10/30/2018	10/30/2018	740	740	740	1	10/30/2018	10/30/2018	520	520	520	1	10/30/2018	10/30/2018

* Well was deepened in 2009. Nitrate concentrations prior to 2009 were near or above the MCL of 10 mg/L as nitrogen. After the well deepening in 2009, concentrations dropped initially to just below 3 mg/L and have been increasing since with recent concentrations around 5 mg/L.

Summary of All Historical Results for Key Water Quality Constituents in Groundwater Quality Indicator Wells

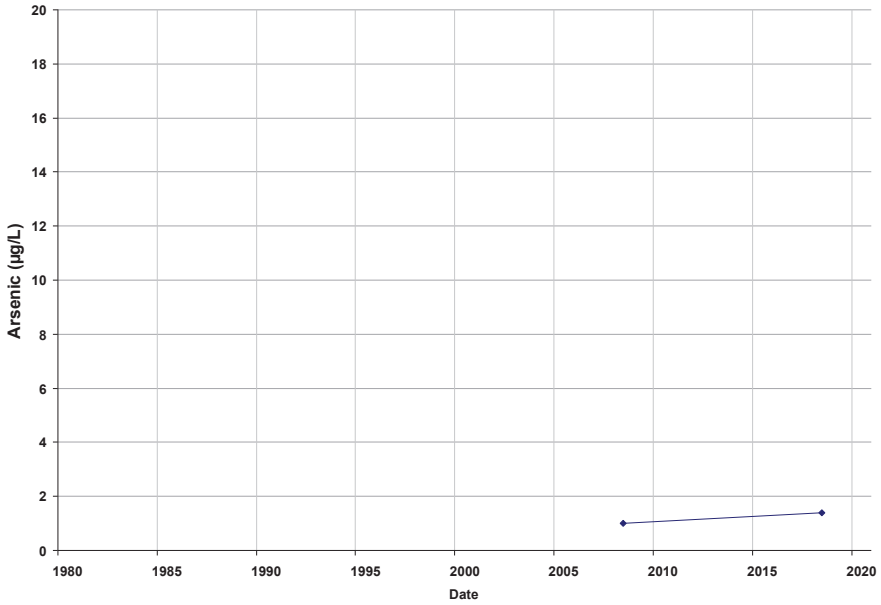
	Arsenic Concentrations (µg/L)						Nitrate Concentrations (mg/L as nitrogen)						Specific Conductance (µS/cm)						TDS Concentrations (mg/L)					
Well ID	Minimum Result	Maximum Result	Average Result	Number of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Number of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Number of Observations	Date First Observation	Date Last Observation	Minimum Result	Maximum Result	Average Result	Number of Observations	Date First Observation	Date Last Observation
2000511-001*	1.0	1.4	1.2	2	5/27/2008	1/9/2018	2.6	13.1	6.6	38	2/22/2006	1/9/2018	490	970	745	4	3/4/2008	1/9/2018	300	330	315	2	8/9/2012	1/9/2018
2000597-001	0.0	1.0	0.7	3	6/5/2006	12/17/2015	1.3	7.0	3.7	16	2/14/2006	3/7/2019	280	910	595	2	12/17/2009	12/21/2017	154	190	172	2	2/18/2003	12/17/2009
2000681-002	0.0	0.0	0.0	3	1/23/2012	12/13/2017	1.5	2.2	1.8	3	3/3/2009	12/20/2018	250	260	255	2	5/7/2013	12/13/2017						
2010001-008	0.0	2.2	1.5	5	12/13/2000	7/29/2015	0.8	2.3	1.3	16	10/10/1991	10/23/2017	120	230	198	9	10/10/1991	8/18/2015	108	190	168	7	10/10/1991	8/25/2010
2010001-010	0.0	3.0	1.2	6	12/1/1994	7/12/2012	3.4	6.7	5.3	24	12/12/2000	3/18/2019	180	700	550	8	12/15/1999	8/18/2015	160	440	343	8	12/15/1999	8/4/2016
2010001-011	0.0	3.0	1.7	4	12/12/2000	3/28/2017	0.6	1.7	0.9	10	12/15/1999	8/18/2015	170	230	205	11	8/19/1996	7/27/2016	120	190	173	8	8/19/1996	7/31/2013
2400216-001	4.3	5.3	4.7	3	8/10/2010	10/24/2016	1.0	1.8	1.5	14	3/20/2003	8/20/2018	160	166	162	3	8/10/2010	10/10/2013	160	180	170	2	8/10/2010	8/22/2013
ESJ11							7.1	7.1	7.1	1	10/30/2018	10/30/2018	740	740	740	1	10/30/2018	10/30/2018	520	520	520	1	10/30/2018	10/30/2018

* Well was deepened in 2009. Nitrate concentrations prior to 2009 were near or above the MCL of 10 mg/L as nitrogen. After the well deepening in 2009, concentrations dropped initially to just below 3 mg/L and have been increasing since with recent concentrations around 5 mg/L.

Well ID: 2000511-001
GSA Location: CWD
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

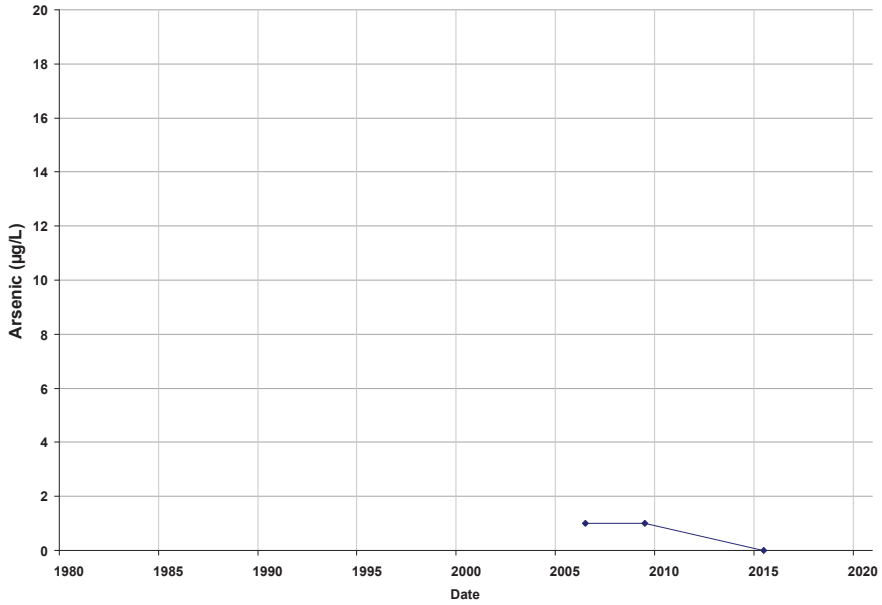
Arsenic



Well ID: 2000597-001
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 300-?

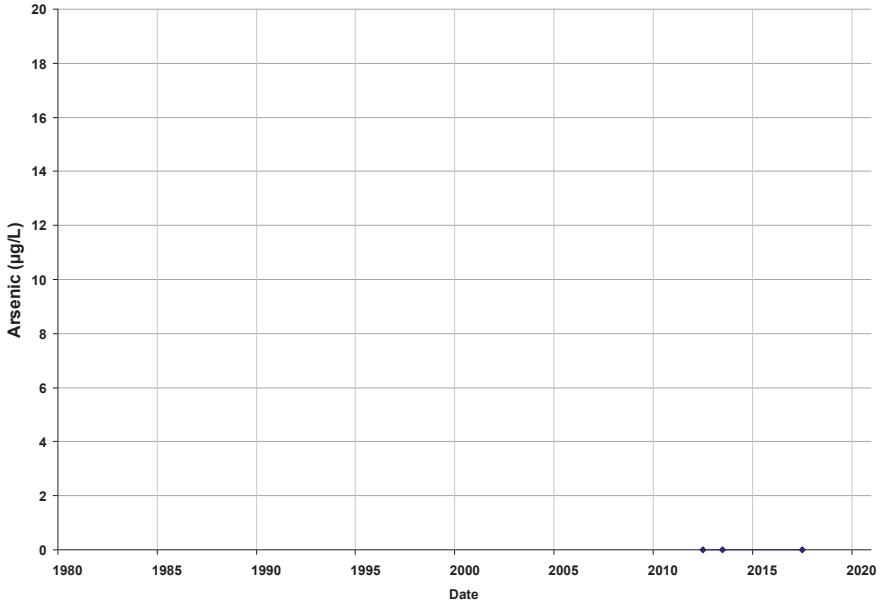
Arsenic



Well ID: 2000681-002
GSA Location: CWD
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

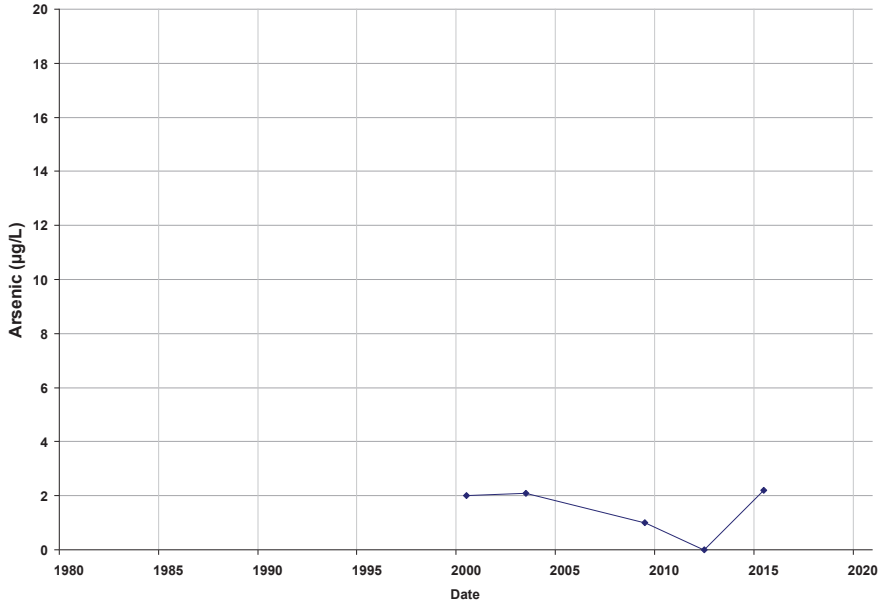
Arsenic



Well ID: 2010001-008
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 242-297

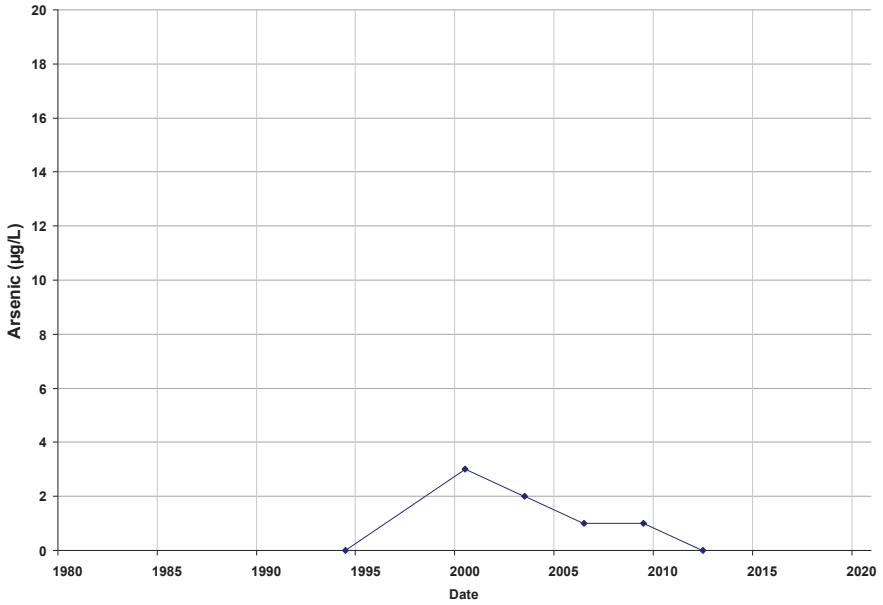
Arsenic



Well ID: 2010001-010
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 358-474

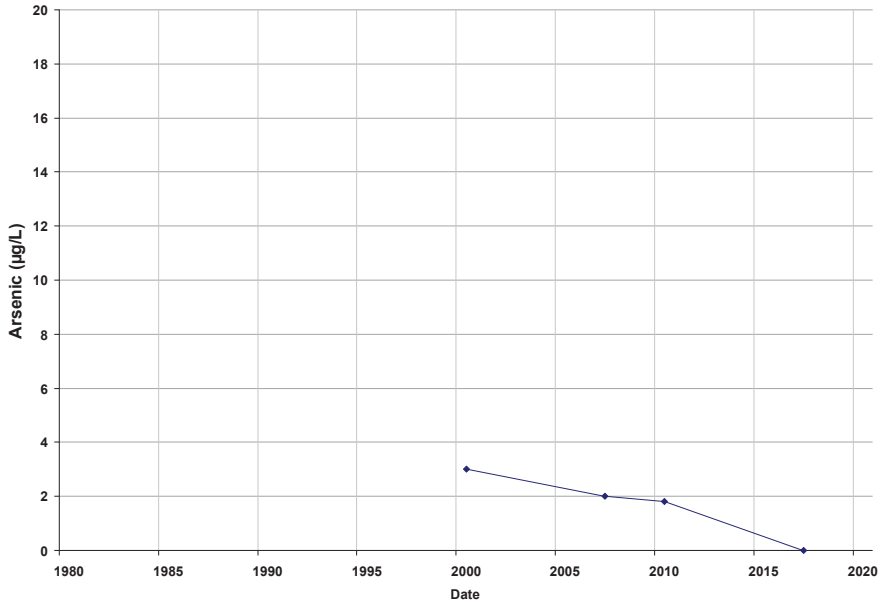
Arsenic



Well ID: 2010001-011
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 310-393

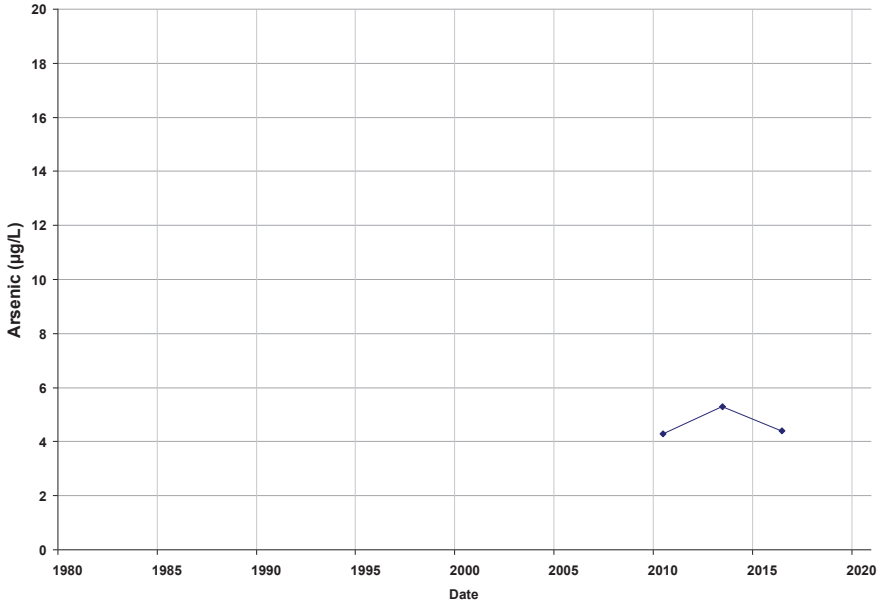
Arsenic



Well ID: 2400216-001
GSA Location: Madera County East
Depth Zone: Lower

Well Depth: Unknown
Screen: 400-460

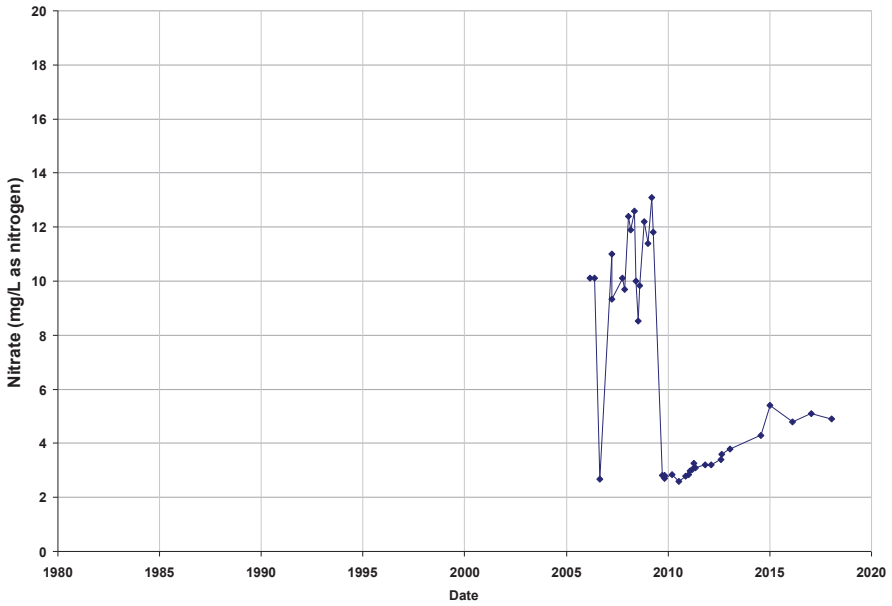
Arsenic



Well ID: 2000511-001
GSA Location: CWD
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

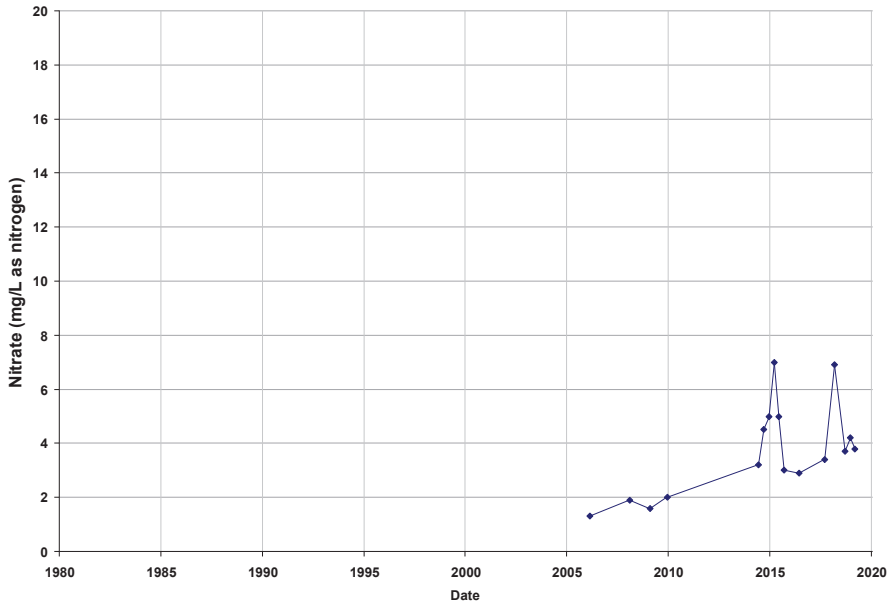
Nitrate as N



Well ID: 2000597-001
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 300-?

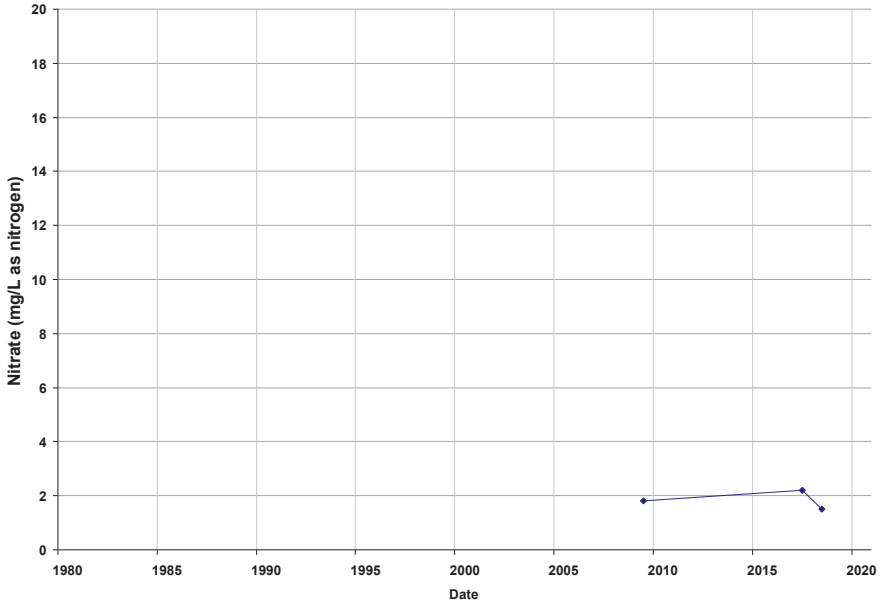
Nitrate as N



Well ID: 2000681-002
GSA Location: CWD
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

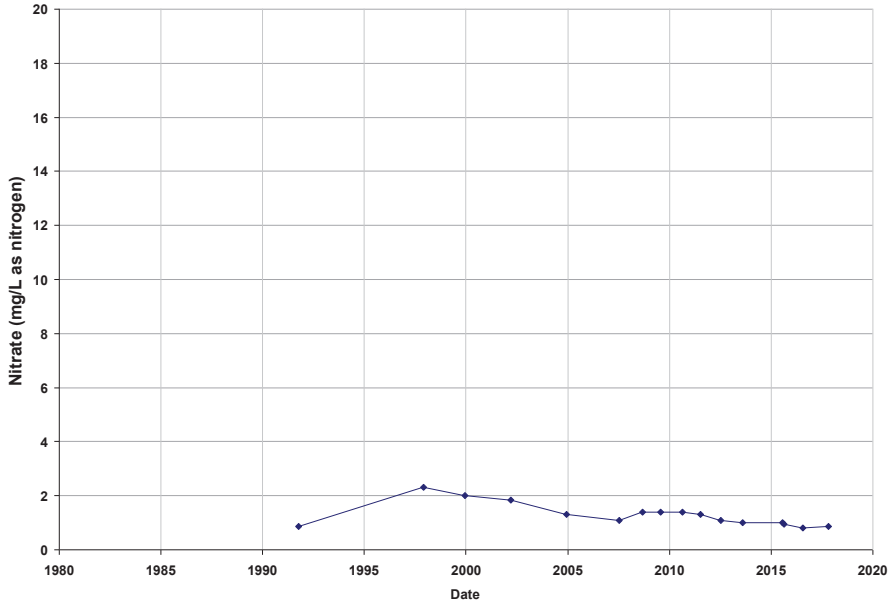
Nitrate as N



Well ID: 2010001-008
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 242-297

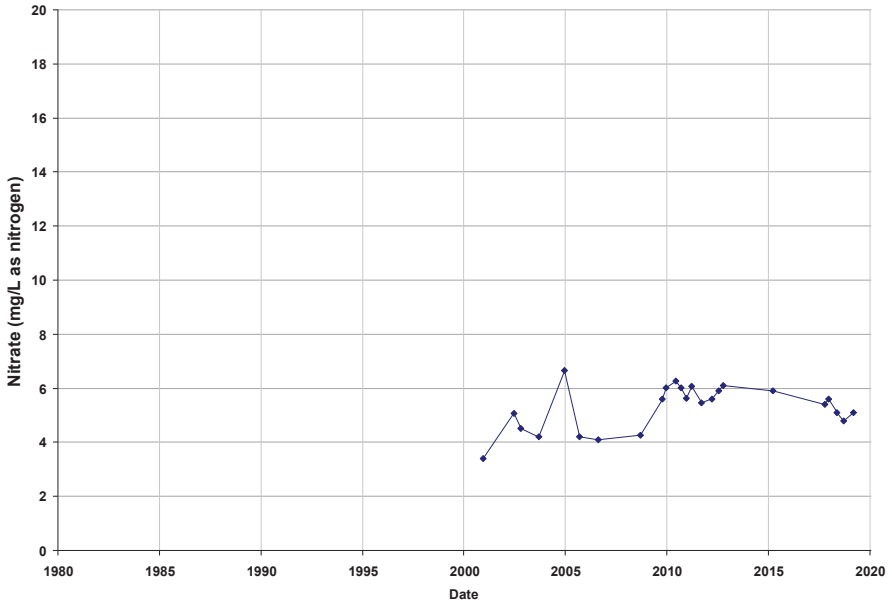
Nitrate as N



Well ID: 2010001-010
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 358-474

Nitrate as N



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GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
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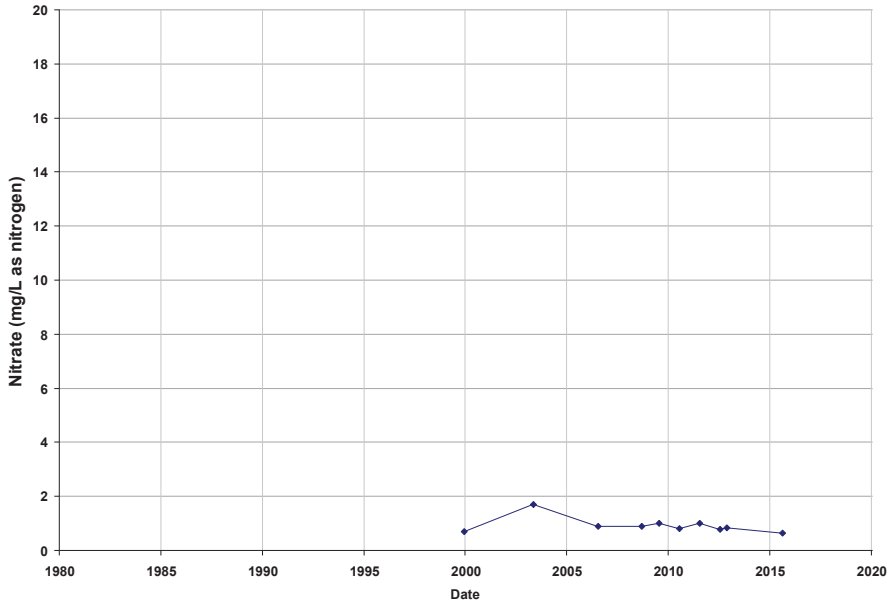
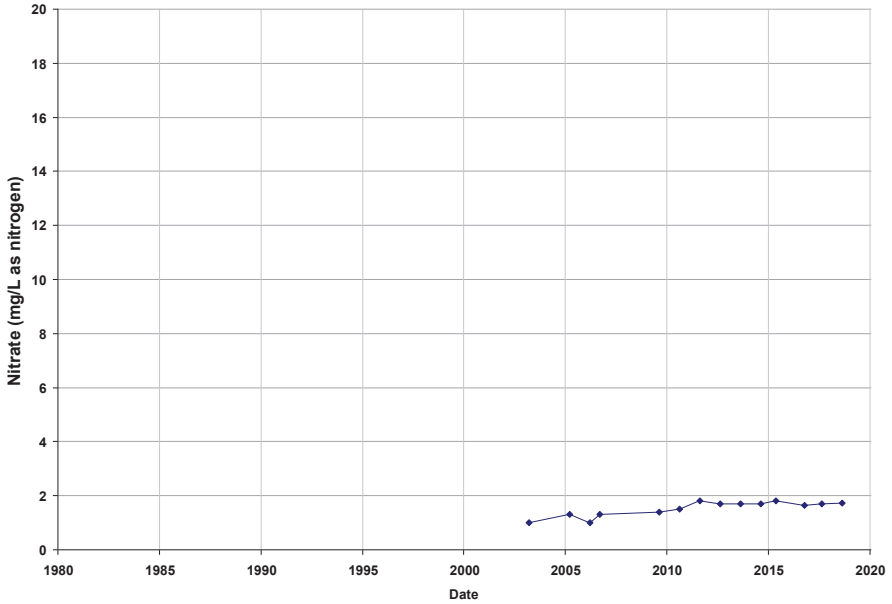
Nitrate as N



Well ID: 2400216-001
GSA Location: Madera County East
Depth Zone: Lower

Well Depth: Unknown
Screen: 400-460

Nitrate as N



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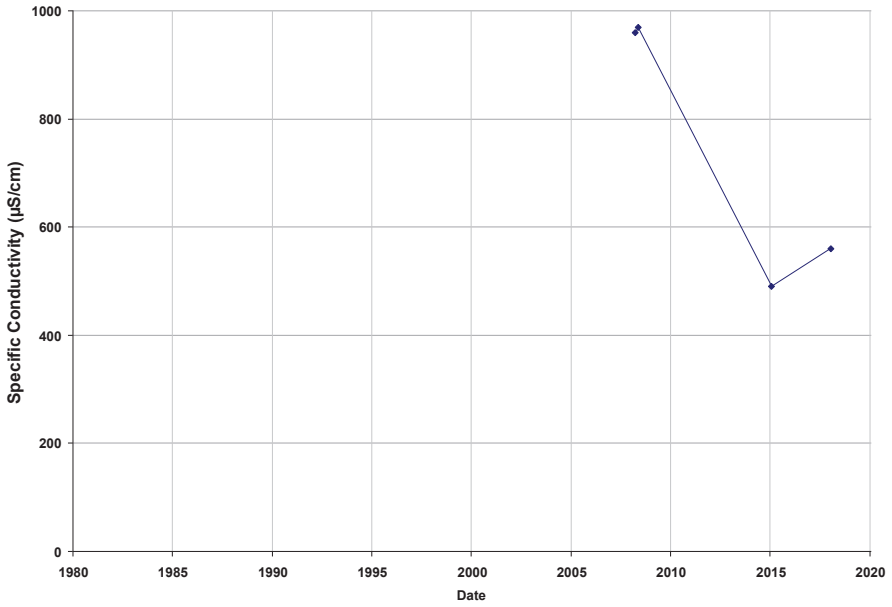
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

Specific Conductivity



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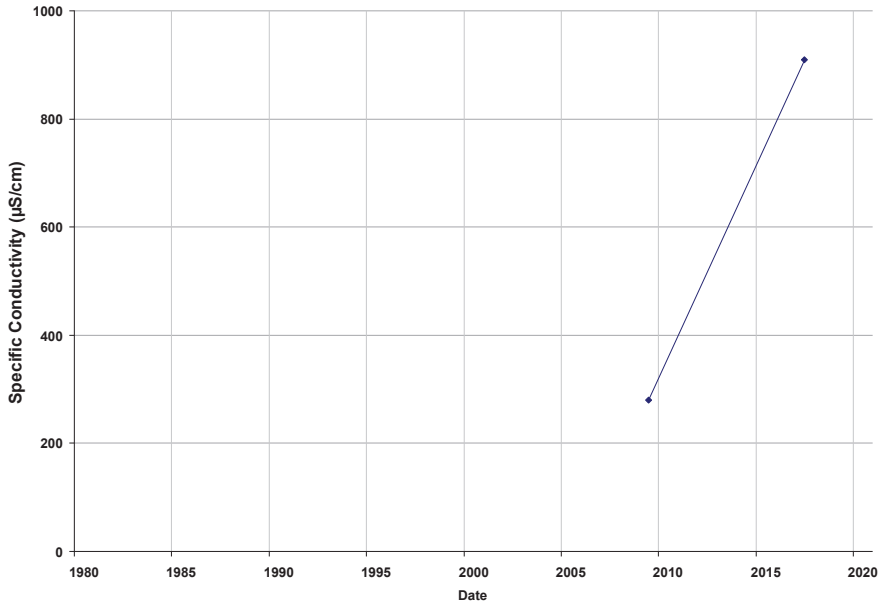
Depth Zone: Lower

Well Depth: Unknown
Screen: 300-?

Specific Conductivity



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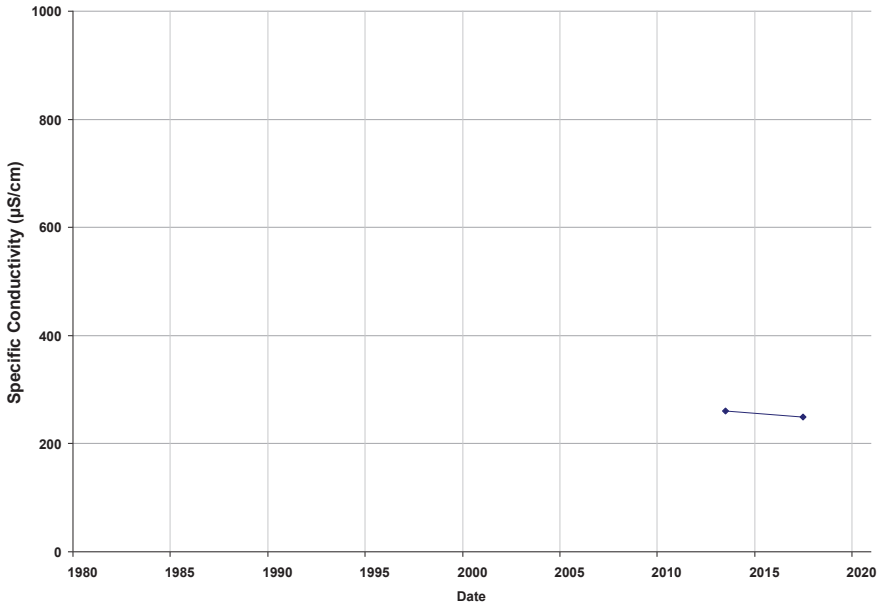
Well Depth: Unknown
Screen: Unknown

Specific Conductivity



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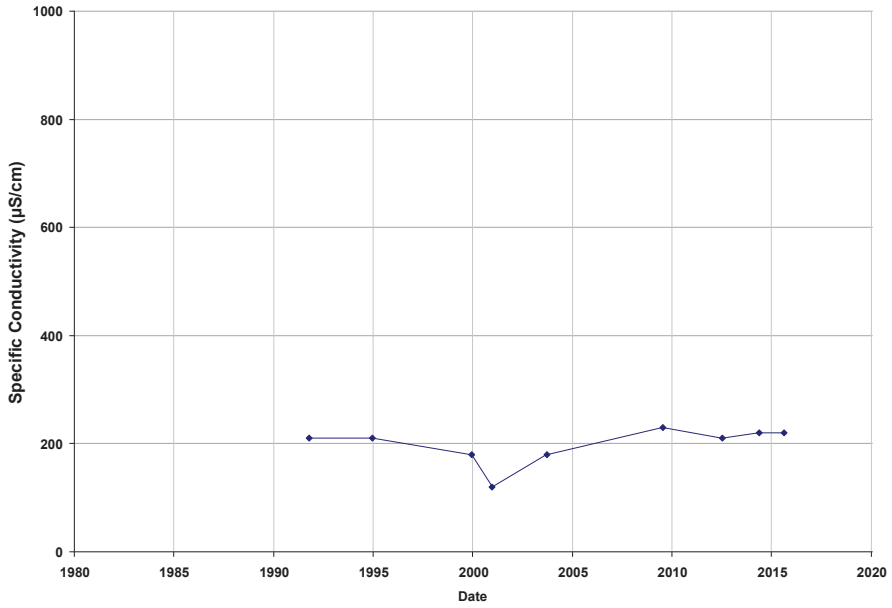
Well Depth: Unknown
Screen: 242-297

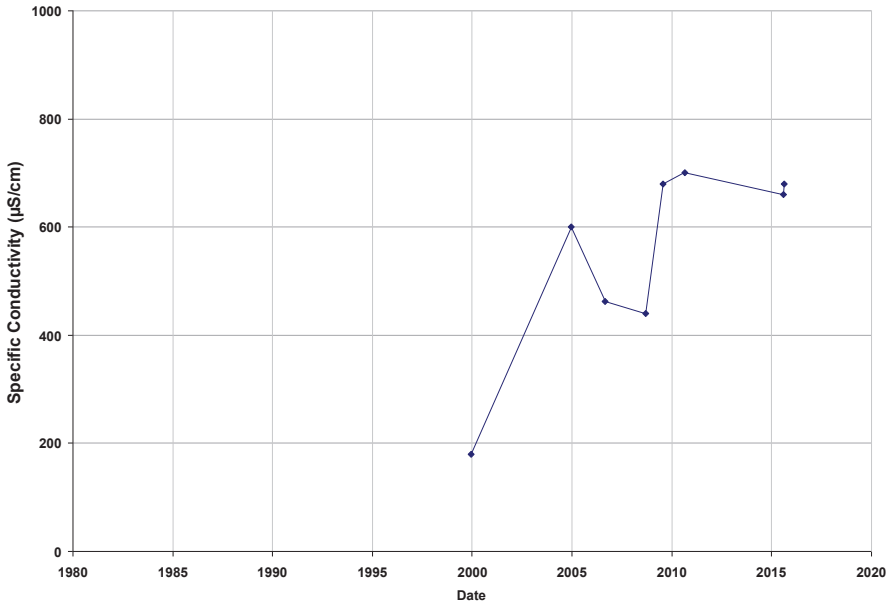
Specific Conductivity



Well ID: 2010001-010
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 358-474

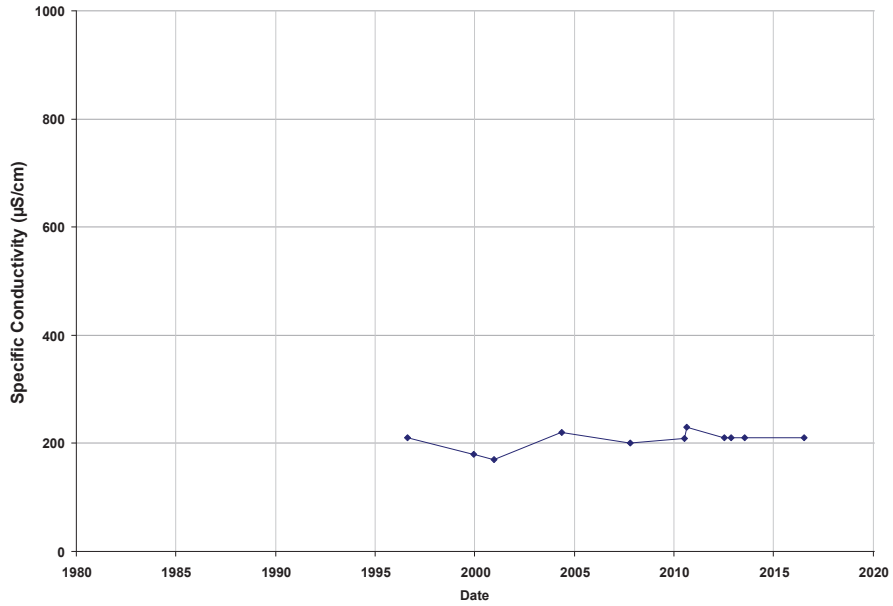
Specific Conductivity



Well ID: 2010001-011
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 310-393

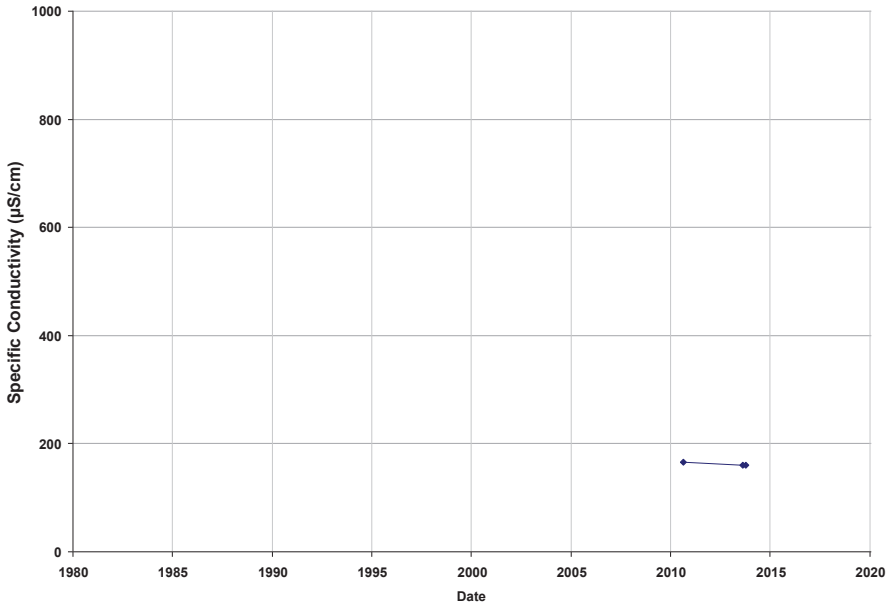
Specific Conductivity



Well ID: 2400216-001
GSA Location: Madera County East
Depth Zone: Lower

Well Depth: Unknown
Screen: 400-460

Specific Conductivity



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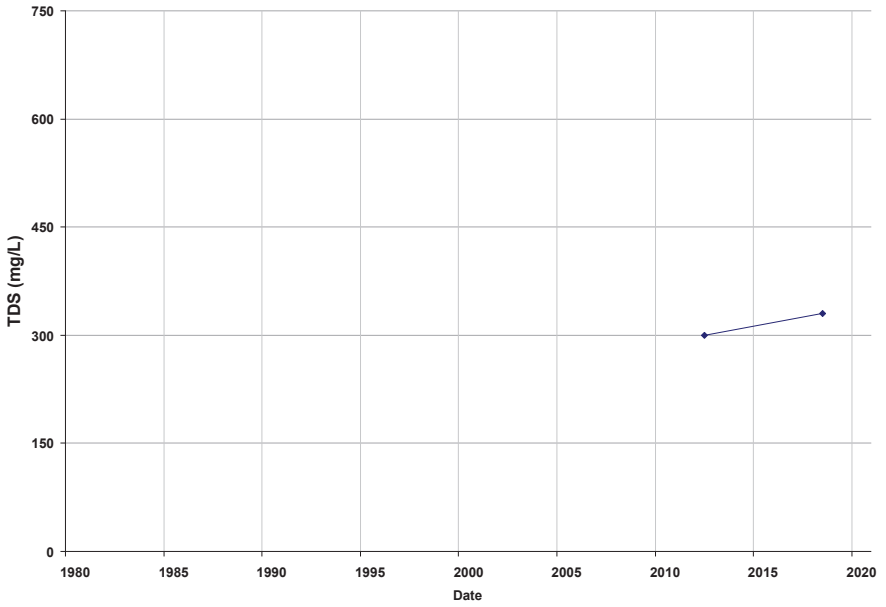
GSA Location: CWD
Depth Zone: Unknown

Well Depth: Unknown
Screen: Unknown

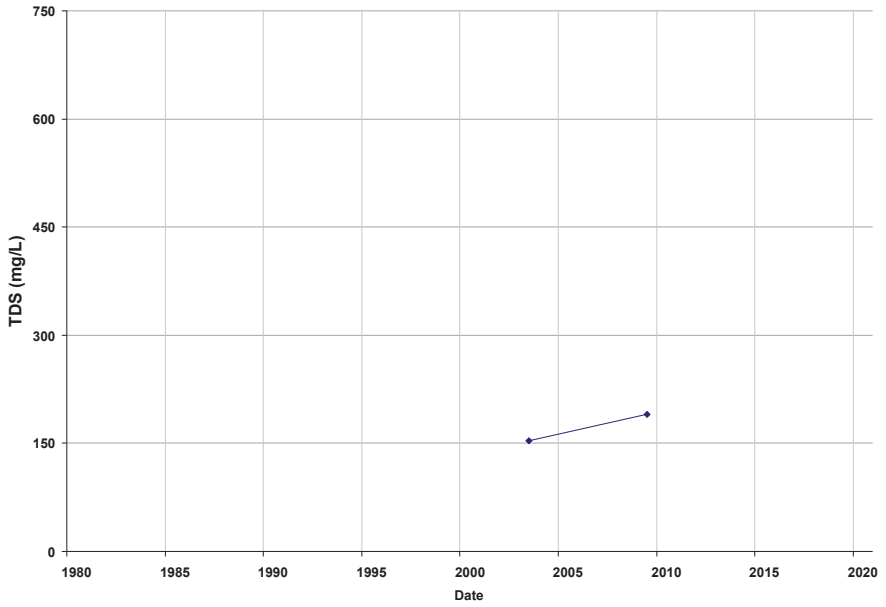
Total Dissolved Solids



Well ID: 2000597-001
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 300-?

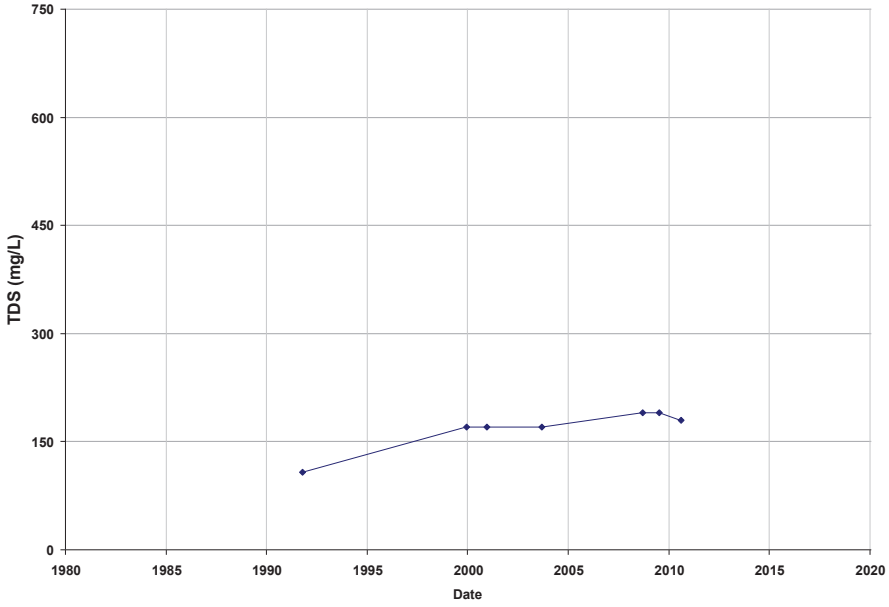
Total Dissolved Solids



Well ID: 2010001-008
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 242-297

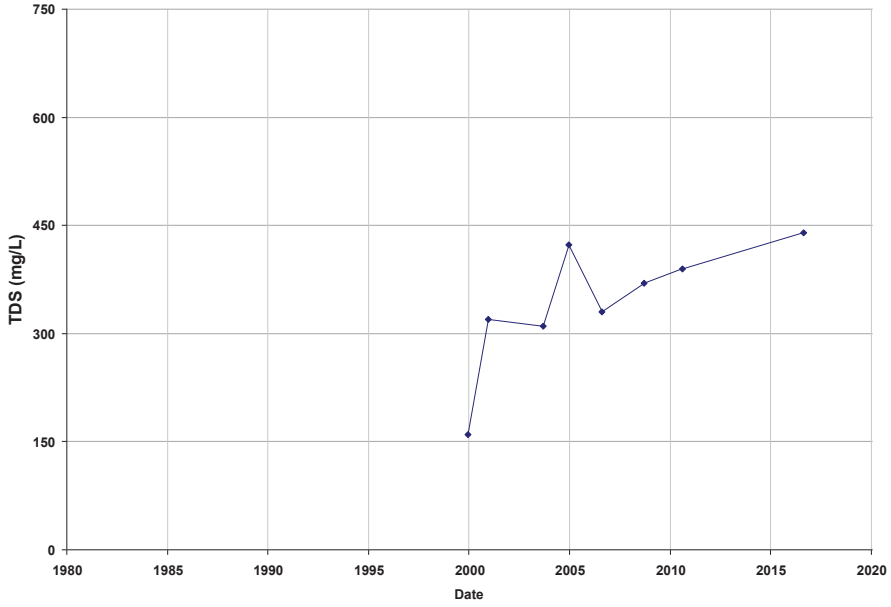
Total Dissolved Solids



Well ID: 2010001-010
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 358-474

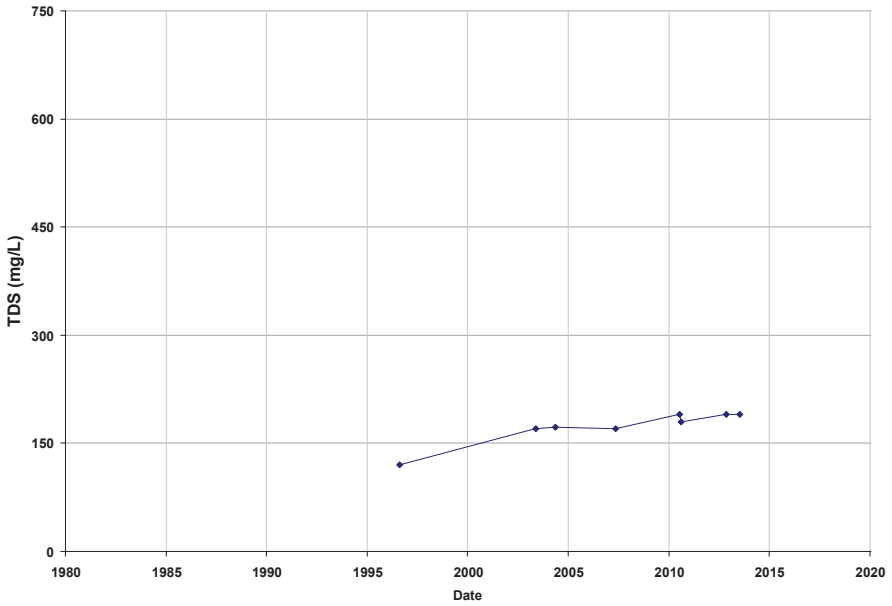
Total Dissolved Solids



Well ID: 2010001-011
GSA Location: CWD
Depth Zone: Lower

Well Depth: Unknown
Screen: 310-393

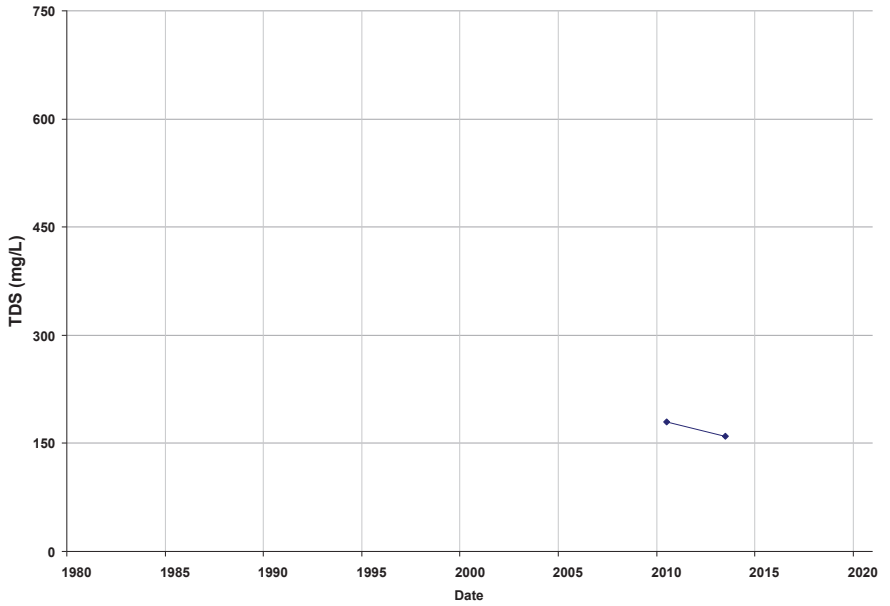
Total Dissolved Solids



Well ID: 2400216-001
GSA Location: Madera County East
Depth Zone: Lower

Well Depth: Unknown
Screen: 400-460

Total Dissolved Solids



APPENDIX 3.C. ECONOMIC ANALYSIS AND FRAMEWORK FOR POTENTIAL DOMESTIC WELL MITIGATION PROGRAM

DRAFT

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

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Davids Engineering, Inc
Luhdorff & Scalmanini
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California State University, Sacramento

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Table 1. Demand Management vs. Domestic Well Replacement - Summary Results for Chowchilla Subbasin, Present Value (PV) $ in Millions

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1 OVERVIEW

This appendix serves two purposes. The initial section, titled Benefits and Costs of Faster Implementation of Demand Management, assesses whether a faster trajectory toward sustainability during the implementation period would be economically justified. It compares the cost of implementing demand management more quickly against the benefits (avoided costs) of avoided well replacement and reduced pumping costs. The second section, titled Domestic Well Replacement Mitigation Program, estimates the total cost of replacing domestic wells potentially impacted by declining groundwater levels under the baseline conditions without SGMA and under the draft proposed SGMA implementation plan (with-SGMA). The second section can support discussions and consideration of potential mitigations for the cost of well replacement.

2 BENEFITS AND COSTS OF FASTER IMPLEMENTATION OF DEMAND MANAGEMENT

This section describes an initial analysis of how many domestic wells in the Chowchilla Subbasin might be impacted by the continued overdraft of groundwater during the transition from 2020 until full implementation of projects and management actions specified in the (draft) GSP and thereafter through 50 years of sustainable management[1]. The purpose of this reconnaissance-level analysis is to assess the costs to different stakeholder groups (agricultural pumpers and domestic well users) and to consider if a faster trajectory to sustainable management at higher groundwater levels would be cost-effective in the aggregate. If the initial analysis indicates that avoiding well replacement costs might be warranted, a more detailed analysis could be conducted.

In order to provide an initial answer, this analysis uses data inputs for and results from the Chowchilla Subbasin groundwater model. The units of analysis are domestic wells in each section (one square mile or 640 acres). Other key assumptions and simplifications for this initial analysis include:

- Projected depth to water simulated by the groundwater model for the 2020 – 2040 implementation period and subsequent 50-year sustainability period uses a single scenario of hydrology developed based on historical hydrology.
- The cost analysis only considers the cost of replacing domestic wells. It does not consider replacement of agricultural wells or the cost of declining well yields before a well is replaced.
- Well Completion Report (WCR) data from DWR are the basis for the quantity and characteristics of domestic wells in the Madera Subbasin used in the assessment. Wells not in DWR's WCR database are not included in the analysis. A sensitivity analysis is presented that evaluates how wells not in the WCR database may affect results of the analysis.
- As a simplification, for all Public Land Survey System (PLSS) sections in the Subbasin, the analysis compares the minimum depth to the top of the perforated interval for domestic wells with the average simulated September depth to water (DTW) in the Lower Aquifer.
- The timing, quantity, and location of projects is the same as the with-GSP scenario and no other alternatives are considered.

[1] For purposes of this memorandum, sustainable management means the state in which the long-term trend of declining groundwater levels has stabilized.

The analysis compares costs associated with groundwater pumping, well replacement, and management actions needed to reach sustainable management for two scenarios: 1) baseline conditions (without-SGMA) and 2) baseline conditions with the draft proposed GSP implementation plan (with-SGMA). Assuming that the GSP already includes implementation of water supply and recharge projects as soon as practical, the analysis focuses on demand management implementation as a possible means to speed the trajectory toward groundwater sustainability.

The following costs related to groundwater levels and management over time are considered:

- Costs to replace dewatered domestic wells.
- Changes in variable costs to pump groundwater, for both domestic and agricultural users.
- Costs to growers in foregone net return for demand management needed (if any) to achieve sustainable management after implementing supply and recharge projects.

2.1 Assumptions and Results

Assumptions and results below are summarized for each of the cost categories considered.

2.1.1 Costs to replace dewatered domestic wells.

For purposes of this analysis, a replacement cost of $25,000[2] per well is used. This cost is triggered when the groundwater level in the section the well is located in falls below the minimum depth to top perforation of the domestic wells in that cell. Once the wells in a section are replaced, that section is no longer tested against further changes in DTW. The simulated September depth to water value is used for each year's comparison, which typically reflects the lowest groundwater levels in a season. The process for each 2015-2090 scenario (without-SGMA and with-SGMA) is summarized as:

- For each section and year, compare the average DTW in the Lower Aquifer to the minimum depth to top of perforations of the domestic wells in that section.
- If DTW equals or exceeds the top perforation depth, all domestic wells in the section must be replaced.
- After a section's domestic wells are replaced, they are assumed to be drilled and screened deep enough to withstand any further increase in DTW.

In the Chowchilla subbasin, 127 domestic wells are impacted in the without-SGMA case, but 87 of those appear to be impacted prior to the 2020 implementation start (DTW is greater than minimum depth to top perforation). Therefore, 40 (127 minus 87) domestic wells are potentially affected in the comparison of scenarios. Thirty out of the 40 wells are impacted between 2021 and 2033, with the remaining 10 impacted by 2066. The present value (at 2020) of replacement costs for these 40 impacted domestic wells is $0.69 million. All but seven domestic well replacements are avoided in the with-SGMA scenario. The present value of replacement cost for these impacted domestic wells is $0.13 million. *The net domestic well replacement cost avoided by the draft proposed GSP implementation plan is $0.56 million in present value.*

[2] The cost of well replacement used in the analysis is based on feedback from well drillers that work in the area: (i) drilling a domestic well costs $35/foot, (ii) a sanitary seal for a domestic well is $2,000, and (iii) a pump for a domestic well is $4,500. This does not include permit costs. Assuming a well depth of approximately 500 feet results in an estimated cost of about $25,000 per well.

2.1.2 Changes in variable costs to pump groundwater, for both domestic and agricultural users.

This analysis applies an aggregate calculation of change in water depth and pumping cost, using an average depth over all sections (weighted by well count in each section). As DTW decreases in the with-SGMA scenario relative to without-SGMA, the benefit (reduced pumping lift and cost) grows year to year. Both domestic wells and agricultural users benefit from this, though the agricultural cost saving is many times greater simply due to volume pumped. A more precise estimate can be created using an estimate of agricultural and domestic pumping in each section. For the Chowchilla Subbasin, benefits after 10 years are about $105,000 per year in total for all domestic well pumping and $3.29 million per year for agricultural pumping. The present value of savings over the analysis period is about $5.94 million for domestic pumping and $169.84 million for agricultural pumping. *These savings are small relative to the loss of net return from demand management (see Table 1), so the benefit of achieving them sooner does not appear to be justified by implementing demand management sooner.*

2.1.3 Costs to growers in foregone net return for demand management needed (if any) to achieve sustainable management after implementing supply and recharge projects.

This analysis uses the estimated demand reduction in acre-feet needed to achieve sustainable management after accounting for the yield of supply and recharge projects. The cost of that reduction is based on a separate economic analysis of net return lost from crop production developed for the GSP. This loss increases with the level of demand management, and ranges from about $300 per AF to over $1,000 per AF. In this example analysis, a constant cost of $500 per AF of demand management is used, which represents the approximate cost of demand management in the Chowchilla Subbasin. The current water balance shows pumping to be approximately 309,000 AF/year on average. After implementation of projects specified in the GSP, pumping to maintain sustainable management is estimated to be about 246,000 AF/year. This analysis assumes that the difference – 63,000 AF per year – would be spread equally from 2021 to 2040 as a reduction of about 3,150 AF per year (note this is a simplifying assumption – actual demand reduction occurs unevenly in the GSP implementation plan). At $500 per AF, this adds a demand management cost of about $1.58 million per year, which accumulates, so that by 2040 the annual demand management cost is about $31.5 million per year. These values are discounted back to the start of implementation, resulting in a present value in 2020 of about $581 million (Table 1).

Table 1. Demand Management vs. Domestic Well Replacement - Summary Results for Chowchilla Subbasin, Present Value (PV) $ in Millions

	Without SGMA	With-SGMA	Difference
Domestic Well Repl. Cost			
Number of Domestic Wells Replaced	40	7	-33
PV of Cost	$0.69	$0.13	-$0.56
Pumping Cost (Savings), PV			
Domestic	NA	-$5.94	-$5.94
Agricultural	NA	-$169.84	-$169.84
Demand Mgmt. Cost, PV	NA	$580.96	$580.96

2.2 Discussion

Results indicate that the cost of implementing demand management on a faster trajectory (sooner in the implementation period) would not be cost effective from a subbasin-wide perspective. The avoided costs (fewer domestic wells requiring replacement) would be small, $0.13 million, relative to the lost agricultural net return, $581 (0.02 percent) million. The general conclusions are robust to the assumptions used – that is, results are not sensitive to reasonable ranges in key assumptions, including the loss in net return per AF of demand management, the total level of demand management, when demand management begins to scale in, or the cost of replacing a domestic well.

The analysis also considered different measures for comparing depth to water to well characteristics and different hydrologic sequences (one beginning with a wet period and one with a dry period), and the conclusions hold. Even doubling the number of affected wells (based on the possibility that some domestic wells in use are not logged in the WCR database) does not change the conclusion. The conclusions are strong enough that no further groundwater analysis is recommended for the sole purpose of evaluating whether more rapid demand management is justified by the aggregate avoided domestic well replacement.

Although the conclusion is that more rapid demand management is not cost-effective from a basin-wide or County-wide perspective, the distribution of the costs imposed on domestic well users should be acknowledged. Continued drawdown of groundwater levels during the GSP implementation period would be caused primarily by pumping for irrigation (because domestic wells are a smaller share of subbasin pumping), whereas the cost of domestic well replacement would be borne by domestic well users.

The above results use demand management as the policy variable to assess the tradeoff of its costs with the costs of domestic well replacement. Rather than use demand management for the cost comparison, another analysis could compare avoided well replacement and pumping costs with the cost of implementing supply or recharge projects sooner during the implementation period. However, that comparison is not possible with current information and the GSP implementation schedule already reflects an aggressive timeline for project implementation. The additional cost of accelerating a recharge project by, say 5 years, would be the increased present value of the capital and O&M cost stream. The benefit would be the change in expected present value of avoided well replacement and pumping costs. This benefit would need to be calculated based on a groundwater model analysis of the resulting expected DTW over time under the accelerated project implementation.

3 DOMESTIC WELL MITIGATION PROGRAM

Some GSAs in the Chowchilla Subbasin have discussed a program to replace domestic wells that are impacted by falling groundwater levels over the GSP implementation timeline. The May 29, 2019 GSP summary presentation outlined the general parameters of a domestic well mitigation program. The program is expected to be further developed during the first year of GSP implementation. Well owners would be required to sign up for the program and mitigation actions may include replacing or lowering existing wells, and in cases where it is feasible, connecting groups of wells to a community water system. The program would be funded by fees and external support including grants and low interest loan.

3.1 Chowchilla Subbasin Domestic Well Mitigation Program Costs

An analysis was developed to approximate the cost of a domestic well mitigation program in the Chowchilla Subbasin. The example program/analysis assumes:

- All pumpers pay into the program to fund full replacement of impacted domestic wells ($25,000/well).
- The number of affected wells is the total number affected under the with-SGMA scenario, including those potentially already impacted. Ninety-three wells are impacted in Chowchilla Subbasin based on the analysis described earlier in this memorandum (namely, uses the WCR data). The number of impacted domestic wells is doubled to account for potential under-reporting in the WCR data.
- The program cost ($/af) is based on the sustainable level of pumping. Pumping fees cover admin, replacement, and contingency program costs and are charged to every acre foot of groundwater pumped. The fee is calculated as an annual amount that will raise the required total expected mitigation program cost (in present value terms). A cash flow analysis has not been prepared at this time. All costs are expressed in real dollars.
- An annual program administration cost is assumed to cover staff time to run the program, manage the fund, and conduct technical review of any applications. For this estimate, the cost for Chowchilla Subbasin is estimated to be $100,000 per year plus $5,000 per replaced well.
- An additional program cost contingency of 30% is added to the average annual well replacement cost to account for higher than expected costs per well and unexpected impacts (e.g. longer drought cycles).
- A sensitivity analysis of well replacement cost, admin cost, and contingency cost is used to develop a program fee range ($/af). The actual program cost depends on the timing of well impacts, which depends on unknown future hydrologic sequences.

Summary results are as follows:

- **# impacted domestic wells**: 93 (doubled to 186 for cost estimation purposes)
- **Average annual program cost**: $198,000
- **Domestic well mitigation program fee per acre-foot** of sustainable yield: $1.44/AF (sensitivity range ~$1.05 - $3 per AF)

3.2 Draft Outline for Chowchilla Subbasin Domestic Well Mitigation Program

This section provides a general outline of a domestic well mitigation program for the Chowchilla Subbasin.

3.2.1 Domestic well mitigation program policy/purpose statement

Define the mission of the program. For example, the purpose of the Chowchilla Subbasin Domestic Well Mitigation program is to mitigate undesirable results on domestic wells due to GSP implementations.

3.2.2 Definition of undesirable results

Program should clearly define the types of impacts to domestic wells that will, and will not, be mitigated.

3.2.3 Inventory domestic wells

Develop a database and registration system and allow domestic well owners to sign up (if not already permitted/in the system). Initial information should include pumping level.

3.2.4 Mitigation measures

Define mitigation measures. Other well mitigation programs suggest the following potential mitigation measures:

- Deepen or replace well for domestic wells where municipal water service is not expected to exist in the near future
- Correct to municipal service for domestic wells near existing municipal water service
- Develop municipal system to serve the impacted community high density of domestic wells impacted within a small geographic area

The mitigation measures should consider and coordinate with any mitigation actions being undertaken by other programs such as the Nitrate Control Program and Salt Control Program being implemented by the State Water Resources Control Board and Regional Water Quality Control Board as part of the Central Valley's Water Quality Control Plans (i.e., Basin Plans). In areas of the Central Valley where drinking water supplies have been impacted by water quality, the Basin Plan includes new regulatory actions focused on managing nitrates locally while providing interim and long-term solutions for providing safe drinking water supplies.

3.2.5 Define mitigation costs

Define how the mitigation fund will pay for each type of impacted domestic well. Other well programs suggest the following examples:

- Establish payment of e.g. $/AF) to deepen wells. If well cannot be deepened, establish standard cost to replace well (e.g. $/well
- Decide how to compensate well owners that can connect to municipal system
- Establish "rapid response" approach for situations when wells go dry

3.2.6 Establish review process

Develop a board to review and approve domestic well mitigation claims consistent. Establish process for expedient review.

3.2.7 Financing

Financing program through groundwater extraction fees (see above for estimated costs).

3.3 Domestic Well Mitigation Programs Reviewed

A review of existing domestic well mitigation programs identified two examples that could be used as a policy template:

3.3.1 Truckee Meadows Water Authority

3.3.1.1 Motivation

Nevada Legislature identified a need to avoid, or mitigate, impacts to domestic wells and granted authority to the State Engineer to limit pumping in areas to avoid impacts. Impacts to domestic wells from

several sources (too many wells in the same area, new deep wells, etc.) in Washoe County. Truckee Meadows Water Authority (TMWA) eventually developed and approved the Mt. Rose/Galena Fan Domestic Well Mitigation Program.

3.3.1.2 Program overview

The program compensates domestic well owners who can demonstrate impacts to their well operation. It is the responsibility of the well owner to report impacts and request compensation from TMWA (https://tmwa.com/doing-business-with-us/wellmitigation/). A Board is established to review claims and approve/deny each application. If the application is approved, the home owner is compensated out of an existing fund to deepen their well.

3.3.1.3 Program financing and implementation

Compensation is specified by the program – wells can be deepened by 150 ft. Compensation (as of FY 2013) was $66/ft – meaning ~$10,000 for each well. Property owners are responsible for covering the cost of any other appurtenances (estimated around $4,500/well). If a well cannot be deepened, then the program pays for a new well and covers the cost of all appurtenances.

3.3.1.4 Applicability to Chowchilla GSP

Very applicable to the Chowchilla GSP. The program is a result of similar issues identified in the GSP – continued pumping for the benefit of the entire region is causing impacts to some shallower domestic wells. A fund is established to pay for those impacts so that pumping can continue in other parts of the basin. All users fund the program and it is the responsibility of individual well owners to submit impact claims. An independent board reviews the claims and approves/denies payment. https://www.leg.state.nv.us/Interim/76th2011/Exhibits/OverseeWRWC/E062812B.pdf

3.3.2 Yuba County Water Agency

3.3.2.1 Motivation

Potential groundwater substitution water transfers under the Yuba River Accord, or other transfers out of the Yuba County Water Agency (YCWA) area, could cause third-party impacts to other water users, including impacts to domestic wells.

3.3.2.2 Program overview

The program goal is to compensate domestic well owners that are demonstrably impacted by groundwater substitution water transfers. It was specified as Mitigation Measure 6-2 in the Lower Yuba River Accord EIR/S. In general. well owners are required to report impacts and a process is established for validating each claim. Monitoring wells (specified in Mitigation Measure 6-1) measure groundwater elevations throughout the season which are used to assess whether water transfers resulted in third-party domestic well impacts. The program description includes provisions to compensate or fully replace affected wells.[3]

[3] http://www.hdrprojects.com/engineering/ProposedLowerYubaRiverAccord/Chapter%206%20-%20MMRP-ECP.pdf

3.3.2.3 Program financing and implementation

No information on program financing was identified. No information on number of affected wells or if the program was ever fully implemented beyond being specified as a Mitigation Measure.

3.3.2.4 Applicability to Chowchilla GSP

Limited applicability to the Chowchilla Subbasin GSP. The YCWA program deals with short-term water transfer impacts, whereas the GSPs are concerned with long-term planned overdraft and cumulative impacts to domestic wells. The general program guidelines are applicable (compensate well owners that are impacted). However, the financing strategy is different. Compensation for third-party impacts can be included in the cost of a groundwater substitution transfer (the source of the impact), whereas the planned overdraft in the GSP is a benefit to all groundwater users in the subbasin.

DRAFT

APPENDIX 3.D. MONITORING NETWORK

DRAFT

Prepared as part of the

Groundwater Sustainability Plan
Chowchilla Subbasin

January 2020

GSP Team:

Davids Engineering, Inc
Luhdorff & Scalmanini
ERA Economics
Stillwater Sciences and
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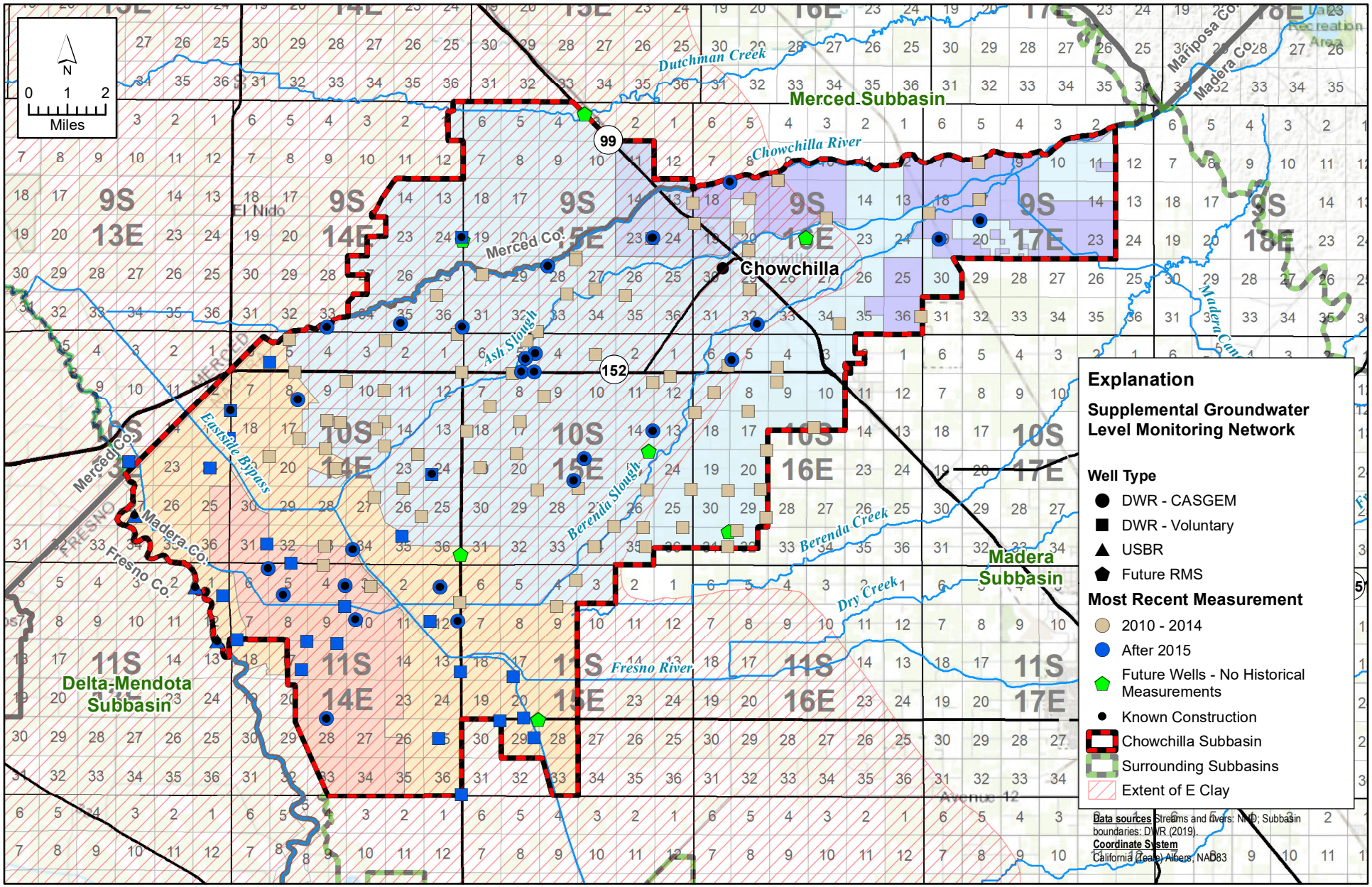

X:\2018\18-017 Chowchilla GSP Development\GIS\Map files\Report Figures\Figure 3.D-1 Chowchilla Subbasin Supplemental Groundwater Level Monitoring Network.mxd

DAVIDS ENGINEERING, INC

Luhdorff & Scalmanini Consulting Engineers

FIGURE 3.D-1

Supplemental Groundwater Level Monitoring Network

Chowchilla Subbasin
Groundwater Sustainability Plan

Table 3.D-1 - Supplemental Groundwater Level Monitoring Network, Chowchilla Subbasin

Well ID	Well Type	Latitude	Longitude	T/R/S	Well Depth	Screen Interval	Earliest Groundwater Level Measurement Date	Most Recent Groundwater Level Measurement Date	Count of Groundwater Level Measurements
09S14E24H	Voluntary	37.1343	-120.3831	9S/14E/24	900	324-828	11/3/2015	3/14/2019	8
09S14E33L	CASGEM	37.1001	-120.4467	9S/14E/33	290	265-285	10/28/2015	3/14/2019	8
09S14E35P	CASGEM	37.1018	-120.4120	9S/14E/35	452	257-447	5/9/2019	5/9/2019	0
09S14E36C001M	Voluntary	37.1124	-120.3952	9S/14E/36			2/9/1967	3/9/2011	83
09S14E36R1	CASGEM	37.1004	-120.3828	9S/14E/36	490	130-270	5/10/2019	5/10/2019	0
09S15E23J	CASGEM	37.1343	-120.2929	9S/15E/23	291		10/17/2016	3/14/2019	6
09S15E23J2	Voluntary	37.1341	-120.2935	9S/15E/23	291	290.5-291	2/23/1968	2/19/2014	85
09S15E27Q001M	Voluntary	37.1149	-120.3202	9S/15E/27			2/25/2013	2/18/2014	2
09S15E28A001M	Voluntary	37.1268	-120.3293	9S/15E/28			10/29/1935	2/22/2010	54
09S15E28A002M	Voluntary	37.1260	-120.3293	9S/15E/28			2/15/1963	2/18/2014	74
09S15E28C	CASGEM	37.1236	-120.3427	9S/15E/28	736	502-722	5/11/2019	5/11/2019	0
09S15E28R001M	Voluntary	37.1132	-120.3335	9S/15E/28			7/6/1939	2/18/2014	133
09S15E30G001M	Voluntary	37.1202	-120.3735	9S/15E/30			11/8/1939	2/22/2010	127
09S15E32R001M	Voluntary	37.0988	-120.3474	9S/15E/32			10/24/1952	2/22/2010	74
09S15E35C001M	Voluntary	37.1127	-120.3057	9S/15E/26			3/4/2013	2/18/2014	2
09S16E15Q001M	Voluntary	37.1418	-120.2110	9S/16E/15			2/6/1980	2/20/2014	56
09S16E16D001M	Voluntary	37.1560	-120.2338	9S/16E/16			1/30/1987	3/5/2010	41
09S16E17F001M	Voluntary	37.1491	-120.2474	9S/16E/17			2/6/1980	2/20/2014	58
09S16E18A	CASGEM	37.1554	-120.2565	9S/16E/18	800	320-762	10/30/2015	3/14/2019	8
09S16E18M001M	Voluntary	37.1474	-120.2741	9S/16E/18			2/6/1980	2/28/2011	56
09S16E19D001M	Voluntary	37.1396	-120.2732	9S/16E/19			2/25/2013	2/19/2014	2
09S16E20E001M	Voluntary	37.1382	-120.2521	9S/16E/20			10/14/1964	2/20/2014	82
09S16E20P002M	Voluntary	37.1296	-120.2477	9S/16E/20			3/7/1969	2/20/2014	83
09S16E29Q001M	Voluntary	37.1149	-120.2468	9S/16E/29			10/10/1941	2/20/2014	49
09S16E29Q002M	Voluntary	37.1149	-120.2474	9S/16E/29			2/21/1958	2/28/2011	73
09S16E32Q	CASGEM	37.1019	-120.2434	9S/16E/32	400	200-400	10/28/2015	3/14/2019	8
09S16E34J001M	Voluntary	37.1021	-120.2049	9S/16E/34			12/3/1959	2/20/2014	106
09S16E36J001M	Voluntary	37.1049	-120.1663	9S/16E/36			11/3/1952	2/20/2014	104
09S17E08F001M	Voluntary	37.1630	-120.1391	9S/17E/08			2/13/2013	2/19/2014	2
09S17E17F001M	Voluntary	37.1491	-120.1388	9S/17E/17			2/6/1980	3/1/2011	55
09S17E18N002M	Voluntary	37.1438	-120.1624	9S/17E/18			2/6/1980	3/1/2011	44
09S17E19L001M	CASGEM	37.1341	-120.1577	9S/17E/19	648	240-620	10/9/1964	3/14/2019	99
09S17E20C	CASGEM	37.1411	-120.1384	9S/17E/20	720	200-720	10/29/2015	3/14/2019	8
10S13E13J001M	Voluntary	37.0582	-120.4927	10S/13E/13			2/8/2012	3/11/2019	9
10S13E22F002M	Voluntary	37.0489	-120.5400	10S/13E/22			1/22/1999	10/16/2018	11
10S13E24L001M	Voluntary	37.0468	-120.5016	10S/13E/24			2/12/1964	3/8/2017	89
10S14E01A001M	Voluntary	37.0977	-120.3852	10S/14E/01			3/1/2013	2/28/2014	2
10S14E01R002M	Voluntary	37.0835	-120.3829	10S/14E/12			2/22/1968	2/28/2014	82
10S14E03A001M	Voluntary	37.0952	-120.4191	10S/14E/03			10/1/1928	2/11/2014	138
10S14E05C003M	Voluntary	37.0955	-120.4646	10S/14E/05			10/6/1976	2/11/2014	66
10S14E06R001M	Voluntary	37.0868	-120.4738	10S/14E/06			10/8/1976	3/11/2019	66
10S14E08B003M	Voluntary	37.0830	-120.4616	10S/14E/08			7/21/1961	2/26/2010	157
10S14E08D	CASGEM	37.0728	-120.4603	10S/14E/08	410	230-360	10/29/2015	3/15/2019	8
10S14E09A003M	Voluntary	37.0799	-120.4374	10S/14E/09			2/22/1968	2/12/2014	81
10S14E10H001M	Voluntary	37.0763	-120.4196	10S/14E/10			2/21/2013	2/12/2014	2
10S14E15H001M	Voluntary	37.0646	-120.4193	10S/14E/15			10/29/1935	2/12/2014	135
10S14E15J001M	Voluntary	37.0618	-120.4232	10S/14E/15			2/1/1999	2/26/2010	17
10S14E15R001M	Voluntary	37.0555	-120.4193	10S/14E/15			11/30/1937	3/1/2011	131
10S14E16F002M	Voluntary	37.0649	-120.4466	10S/14E/16			10/14/1964	2/12/2014	85
10S14E16H001M	Voluntary	37.0641	-120.4402	10S/14E/16			12/28/1950	2/12/2014	110
10S14E17J001M	Voluntary	37.0582	-120.4596	10S/14E/17			2/6/1980	2/12/2014	58
10S14E18D	Voluntary	37.0688	-120.4922	10S/13E/13	516	265-506	10/29/2015	3/15/2019	8
10S14E19A002M	Voluntary	37.0513	-120.4738	10S/14E/19			2/6/1980	2/11/2014	58
10S14E21C003M	Voluntary	37.0543	-120.4471	10S/14E/21			2/6/1980	3/1/2013	58
10S14E21G001M	Voluntary	37.0468	-120.4421	10S/14E/21			2/6/1980	2/21/2013	58
10S14E23A001M	Voluntary	37.0524	-120.4035	10S/14E/23			11/26/1941	2/13/2014	122
10S14E24M	Voluntary	37.0449	-120.3969	10S/14E/24	696	255-636	10/29/2015	3/15/2019	8
10S14E26C002M	Voluntary	37.0396	-120.4104	10S/14E/26			2/18/1963	2/12/2014	91
10S14E26R001M	Voluntary	37.0291	-120.4018	10S/14E/26			2/21/2013	2/28/2014	2
10S14E27H001M	Voluntary	37.0360	-120.4241	10S/14E/27			2/2/1999	2/25/2010	17
10S14E31H001M	Voluntary	37.0182	-120.4746	10S/14E/31			2/8/2012	3/18/2016	5
10S14E32Q001M	Voluntary	37.0110	-120.4632	11S/14E/05			10/16/1961	3/20/2019	93
10S14E33L002M	Voluntary	37.0177	-120.4474	10S/14E/33			2/6/1980	2/12/2014	58
10S14E34M001M	CASGEM	37.0163	-120.4341	10S/14E/34	870	295-850	10/8/2015	10/17/2017	2
10S14E35F001M	Voluntary	37.0216	-120.4110	10S/14E/35			2/13/1964	3/11/2019	133
10S15E03L001M	Voluntary	37.0902	-120.3199	10S/15E/03			2/28/2013	2/18/2014	2
10S15E05B001M	Voluntary	37.0955	-120.3524	10S/15E/05			3/21/1944	2/14/2014	120
10S15E05J-2	CASGEM	37.0906	-120.3483	10S/15E/05	104	84-104	10/29/2015	3/15/2019	8
10S15E05K	CASGEM	37.0885	-120.3528	10S/15E/05	105	85-105	10/29/2015	3/15/2019	8
10S15E05Q	CASGEM	37.0836	-120.3549	10S/15E/05	100	80-100	10/29/2015	3/15/2019	8
10S15E05R	CASGEM	37.0837	-120.3488	10S/15E/05	100	80-100	10/29/2015	3/15/2019	8

Table 3.D-1 - Supplemental Groundwater Level Monitoring Network, Chowchilla Subbasin

Well ID	Well Type	Latitude	Longitude	T/R/S	Well Depth	Screen Interval	Earliest Groundwater Level Measurement Date	Most Recent Groundwater Level Measurement Date	Count of Groundwater Level Measurements
10S15E07Q001M	Voluntary	37.0705	-120.3696	10S/15E/07			12/6/1961	2/25/2010	87
10S15E08C001M	Voluntary	37.0830	-120.3591	10S/15E/08			12/6/1961	2/14/2014	88
10S15E09M001M	Voluntary	37.0743	-120.3441	10S/15E/09			12/6/1961	3/4/2011	89
10S15E11H001M	Voluntary	37.0796	-120.2927	10S/15E/11			2/11/1963	2/14/2014	86
10S15E12C002M	Voluntary	37.0821	-120.2846	10S/15E/12			2/19/2013	2/14/2014	2
10S15E13F	CASGEM	37.0614	-120.2928	10S/15E/14	390	150-390	10/29/2015	3/15/2019	8
10S15E17G001M	Voluntary	37.0649	-120.3554	10S/15E/17			12/6/1961	2/14/2014	89
10S15E18M002M	Voluntary	37.0613	-120.3804	10S/15E/18			3/4/1960	2/14/2014	92
10S15E19F001M	Voluntary	37.0477	-120.3741	10S/15E/19			12/5/1961	2/28/2014	92
10S15E20C004M	Voluntary	37.0527	-120.3571	10S/15E/20			1/12/1979	2/14/2014	61
10S15E21R001M	CASGEM	37.0427	-120.3300	10S/15E/21	600	280-600	10/8/2015	3/28/2019	7
10S15E22D	CASGEM	37.0509	-120.3251	10S/15E/22	800	360-800	10/29/2015	3/15/2019	8
10S15E23K001M	Voluntary	37.0471	-120.3016	10S/15E/23			10/26/1920	2/13/2014	150
10S15E25A001M	Voluntary	37.0396	-120.2746	10S/15E/25			2/19/2013	2/13/2014	2
10S15E26A001M	Voluntary	37.0393	-120.2954	10S/15E/26			3/1/1927	2/13/2014	146
10S15E27D001M	Voluntary	37.0396	-120.3279	10S/15E/27			10/1/1928	3/3/2011	51
10S15E27R001M	Voluntary	37.0255	-120.3107	10S/15E/27			10/1/1928	2/13/2014	144
10S15E29A002M	Voluntary	37.0393	-120.3471	10S/15E/29			1/12/1979	2/13/2014	60
10S15E34L001M	Voluntary	37.0177	-120.3202	10S/15E/34			2/19/2013	2/13/2014	2
10S15E35A002M	Voluntary	37.0252	-120.2971	10S/15E/35			3/6/1969	2/13/2014	80
10S15E35J001M	Voluntary	37.0180	-120.2960	10S/15E/35			2/25/2013	2/13/2014	2
10S15E36A001M	Voluntary	37.0252	-120.2785	10S/15E/36			3/15/2002	3/15/2012	11
10S16E04N001M	Voluntary	37.0857	-120.2341	10S/16E/04			12/22/1934	3/1/2011	131
10S16E05M	CASGEM	37.0884	-120.2554	10S/16E/05	440	240-440	10/30/2015	3/15/2019	8
10S16E06R001M	Voluntary	37.0860	-120.2571	10S/16E/06			3/22/1944	2/21/2014	126
10S16E07K001M	Voluntary	37.0760	-120.2638	10S/16E/07			12/11/1961	2/25/2010	88
10S16E09E001M	Voluntary	37.0802	-120.2343	10S/16E/09			2/19/2013	2/21/2014	2
10S16E15F001M	Voluntary	37.0630	-120.2166	10S/16E/15			2/14/2013	2/20/2014	2
10S16E17C001M	Voluntary	37.0691	-120.2477	10S/16E/08			10/24/1952	2/21/2014	101
10S16E18D002M	Voluntary	37.0685	-120.2727	10S/16E/18			12/5/1961	2/21/2014	89
10S16E20A001M	Voluntary	37.0543	-120.2391	10S/16E/20			3/8/1969	3/2/2010	77
10S16E29A001M	Voluntary	37.0396	-120.2418	10S/16E/29			2/6/1980	2/13/2014	58
10S16E29R002M	Voluntary	37.0288	-120.2393	10S/16E/29			1/19/1979	3/2/2011	58
10S16E30A001M	Voluntary	37.0391	-120.2571	10S/16E/30			11/26/1941	2/28/2014	122
10S16E31J001M	Voluntary	37.0180	-120.2571	10S/16E/31			2/6/1980	2/21/2014	58
10S16E32D002M	Voluntary	37.0241	-120.2529	10S/16E/32			2/6/1980	2/25/2010	55
11S13E01Q001M	Voluntary	36.9988	-120.4952	11S/13E/01			10/16/1961	3/20/2019	94
11S14E01R001M	Voluntary	36.9968	-120.3835	11S/14E/01			10/15/2001	10/15/2010	19
11S14E03G001M	Voluntary	37.0024	-120.4254	11S/14E/03			10/26/2011	2/12/2014	6
11S14E04C001M	Voluntary	37.0105	-120.4479	11S/14E/04			3/13/1959	2/21/2014	91
11S14E04J001M	CASGEM	37.0025	-120.4377	11S/14E/04	900		10/8/2015	3/28/2019	7
11S14E05P	CASGEM	36.9991	-120.4667	11S/14E/05	860	290-840	5/13/2019	5/13/2019	0
11S14E06A	CASGEM	37.0092	-120.4738	11S/14E/06	840	170-230	5/14/2019	5/14/2019	0
11S14E07N001M	Voluntary	36.9821	-120.4885	11S/14E/18			2/13/1964	3/20/2019	67
11S14E08R001M	Voluntary	36.9818	-120.4554	11S/14E/17			10/16/1961	3/20/2019	94
11S14E09A003M	Voluntary	36.9949	-120.4377	11S/14E/09			10/16/1961	3/20/2019	95
11S14E10F	CASGEM	36.9899	-120.4326	11S/14E/10	710	170-690	5/15/2019	5/15/2019	0
11S14E12E001M	Voluntary	36.9893	-120.3974	11S/14E/12			10/5/1976	3/20/2019	68
11S14E12H1	CASGEM	36.9894	-120.3844	11S/14E/12	420		11/2/2015	3/14/2019	8
11S14E13R001M	Voluntary	36.9705	-120.3829	11S/14E/13			2/19/1963	3/13/2019	104
11S14E16A001M	Voluntary	36.9810	-120.4413	11S/14E/16			10/16/1961	3/20/2019	105
11S14E17J001M	Voluntary	36.9710	-120.4579	11S/14E/17			2/9/2012	3/9/2017	7
11S14E25L002M	Voluntary	36.9452	-120.3932	11S/14E/25			10/5/1976	3/13/2019	70
11S14E28C	CASGEM	36.9524	-120.4461	11S/14E/28	840	320-680	5/16/2019	5/16/2019	0
11S14E36R001M	Voluntary	36.9241	-120.3824	11S/14E/36			2/14/1964	3/10/2017	87
11S15E04H001M	Voluntary	37.0052	-120.3288	11S/15E/04			2/19/2013	2/28/2014	2
11S15E06L	CASGEM	37.0022	-120.3929	11S/14E/01	390	120-390	10/30/2015	3/19/2019	8
11S15E09C001M	Voluntary	36.9952	-120.3377	11S/15E/09			3/22/1950	2/13/2014	112
11S15E17P001M	Voluntary	36.9685	-120.3582	11S/15E/17			2/9/2012	3/10/2017	7
11S15E20Q001M	Voluntary	36.9530	-120.3532	11S/15E/20			2/9/2012	3/13/2019	9
11S15E29H001M	Voluntary	36.9457	-120.3482	11S/15E/29			7/28/1949	3/20/2019	105
11S15E30A001M	Voluntary	36.9521	-120.3643	11S/15E/30			2/14/1964	3/13/2019	91
Clayton WD Shallow Ag Well #2	Other	37.0051	120.5040	11S/13E/01			10/1/2001	4/1/2018	19
Site 1	Future RMS	37.1332	-120.3827	9S/15E/19					
Site 2	Future RMS	37.1811	-120.3254	9S/15E/03					
Site 3	Future RMS	37.1347	-120.2206	9S/16E/21					
Site 5	Future RMS	37.0539	-120.2947	10S/15E/23					
Site 6	Future RMS	37.0148	-120.3833	13S/16E/03					
Site 7	Future RMS	36.9527	-120.3463	11S/15E/20					
Site 9	Future RMS	37.0236	-120.2567	10S/16E/31					
SJRRP_MW-10-78	USBR	36.9817	-120.4978	11S/13E/13	28	43763	4/14/2010	10/31/2018	295

Table 3.D-1 - Supplemental Groundwater Level Monitoring Network, Chowchilla Subbasin

Well ID	Well Type	Latitude	Longitude	T/R/S	Well Depth	Screen Interval	Earliest Groundwater Level Measurement Date	Most Recent Groundwater Level Measurement Date	Count of Groundwater Level Measurements
SJRRP_MW-10-80	USBR	37.0018	-120.5081	11S/13E/01	27.9	43763	4/14/2010	7/27/2016	226
SJRRP_MW-11-162	USBR	37.0287	-120.5370	10S/13E/27	30		1/11/2012	10/31/2018	205

NOTE:
T/R/S location corresponds to Township/Range/Section grid on Figure A-X