Madera County
Domestic Well Inventory Update

Project Background/Objectives

- DWR Prop 68 Grant Funding
- GSPs included Domestic Well Mitigation Programs to avoid adverse impacts to this group of beneficial users
- Need for improved understanding of locations, density, construction of active domestic wells, and costs (Part 1: Domestic Well Inventory)
- Provide Input to Domestic Well Mitigation Program
- Identify/address additional monitoring needs with dedicated MWs (Part 2: Install new MWs in areas with clusters of domestic wells)

Project Background/Purpose

- Wells can experience three general types of problems: Pump, Well, Aquifer
- Pump Problem: Most wells pumps are designed to last up to 10-15 years before needing replacement (not related to declining water levels)
- Well Problem: Wells typically made of PVC or steel materials that degrade over time; typical well life may be 30-50 years (not related to declining water levels)
- Aquifer Problem: Declining water levels that may go below the bottom of a well, thereby causing no water to be available to well
- Intent of Domestic Well Mitigation Program is to assist well owners with "Aquifer" problem that occurs after submittal of GSP in January 2020.

June 2021 DWR Review of GSPs

- Cuyama Valley and Paso Robles Subbasin GSPs were not approved in part because of deficiencies related to handling of Groundwater Level SMC and mitigation specific to domestic wells
- DWR evaluations state, “While SGMA does not require all impacts to groundwater uses and users be mitigated, the GSA should consider including mitigation strategies describing how drinking water impacts that may occur due to continued overdraft during the period between the start of GSP implementation and achievement of the sustainability goal will be addressed.”

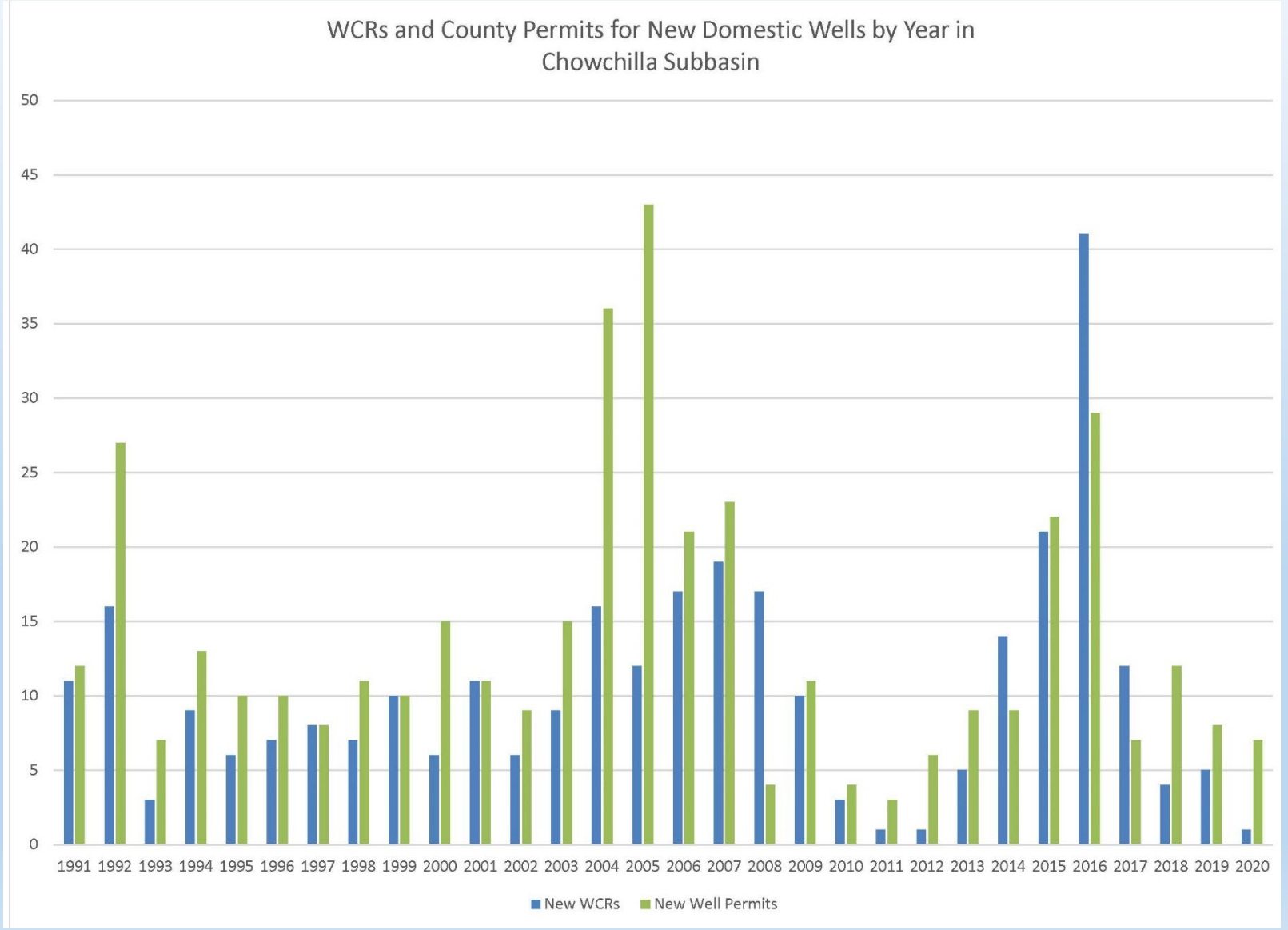
November 2021 DWR Review of GSPs

- Chowchilla Subbasin GSP was not approved in part because insufficient details of Domestic Well Mitigation Program were included in GSP. DWR evaluation states, "…it is unclear when the program will be implemented and financed by the GSAs in the Subbasin, or how rapidly the GSAs will be able to respond to developing domestic well impacts."
- Merced Subbasin GSP was not approved in part because of not having project/management actions to address drinking water impacts included in GSP. DWR evaluation states, "The GSAs should revise the GSP to describe how they would address drinking water impacts caused by continued overdraft during the period between the start of GSP implementation and achieving the sustainability goal."

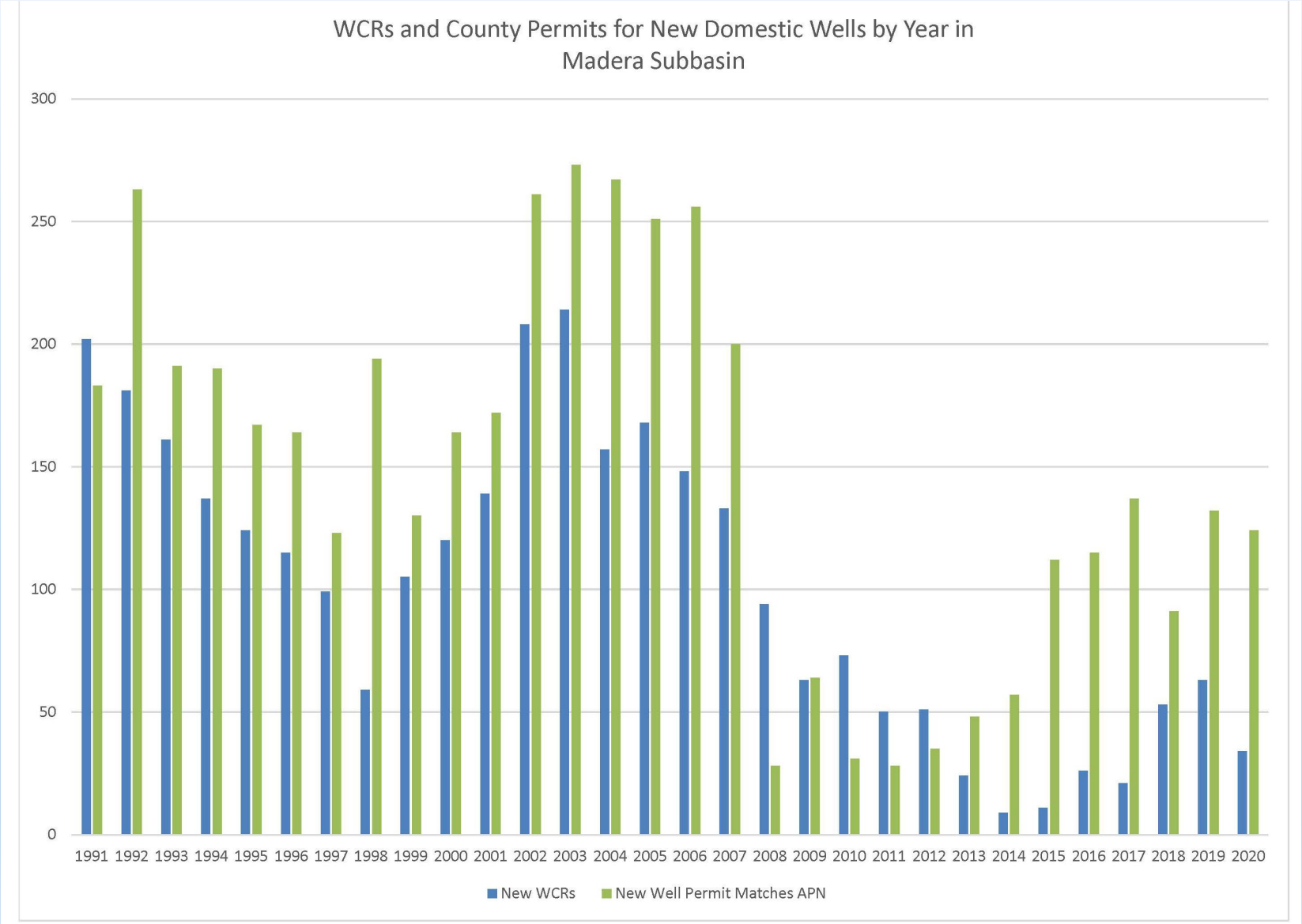
Inventory Dataset Characteristics

Data Source	Historical Well Presence	Well Status (active)	Location Accuracy	Construction (depth, screens)
DWR Well Completion Report Database	Since early 1900s	**No**	**Variable** (some only to PLSS section)	Usually included
County Well Permit Database	Since 1990s (Mad=1990, Mer=1998)	**No**	**By APN** (not all match parcel GIS data) **or Address**	**No** (only seal depth)
County Parcel Data	**Inferred from Use/Dwelling Code**	**No**	**By APN**	**No**
Census Information	**Inferred from # Households**	**No**	**By Census Block**	**No**

Domestic Well WCRs vs. County Permits



Domestic Well WCRs vs. County Permits



Comparison of Total Numbers of WCRs and Permits to Estimated Number of Parcels with a Dwelling Outside of Water System Boundaries

Years	Chowchilla Subbasin	Madera Subbasin
WCRs (since 1970)	**500**	**4822**
WCRs (since 1990)	**374**	**3446**
Permits (since 1990)	**439**	**4210**
Ratio Permits to WCRs (since 1990)	**1.2**	**1.22**
Estimated Potential Domestic Wells from Upscaled WCR Data (since 1970)	**600**	**5883**
Parcels with Dwellings Outside Water Systems	**967**	**5898**

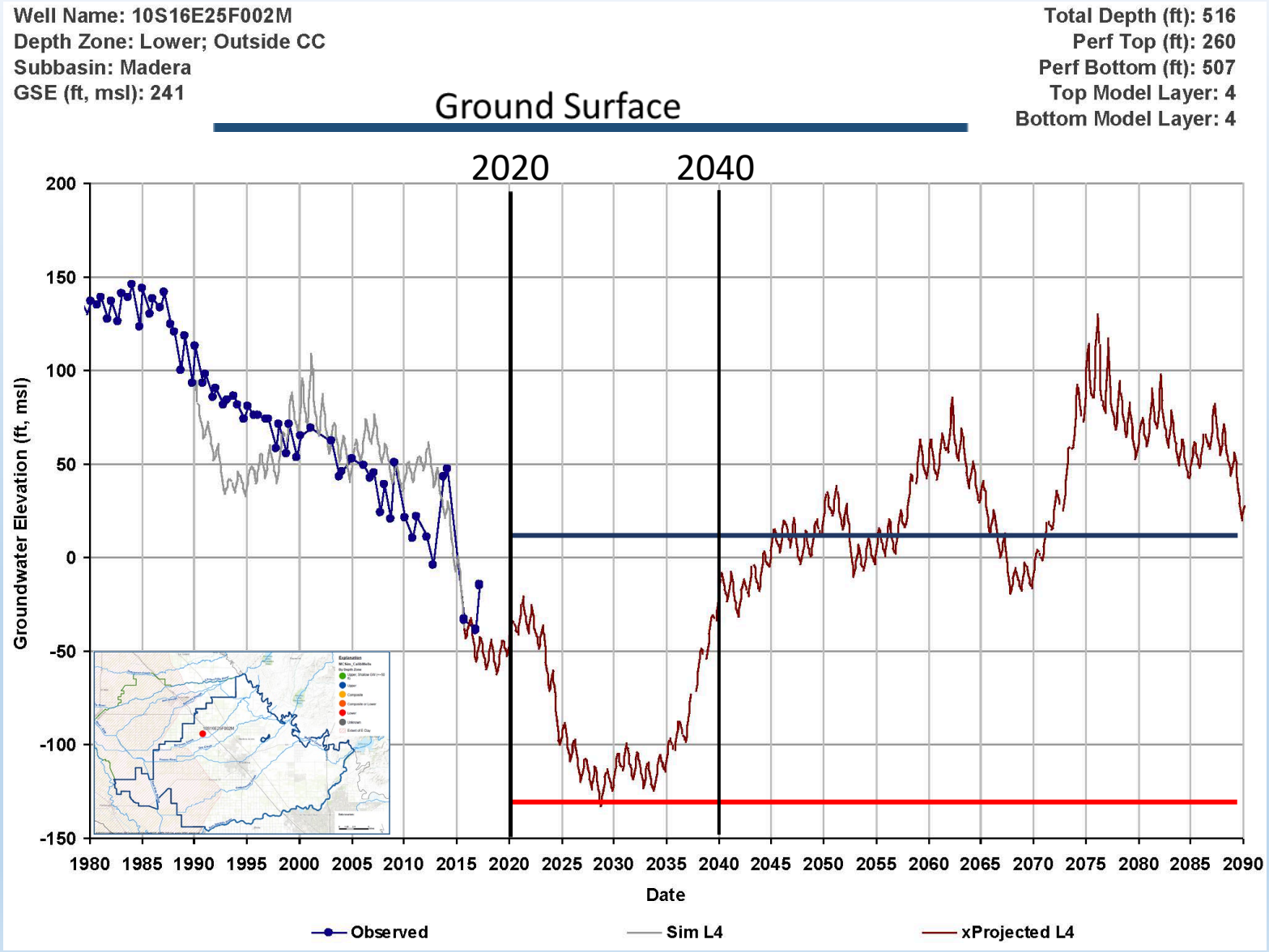
Note: This table provides WCRs since 1990 to allow comparison to permits. However, the analyses are based on WCRs since 1970.

Refined Analysis of Dry Domestic Wells

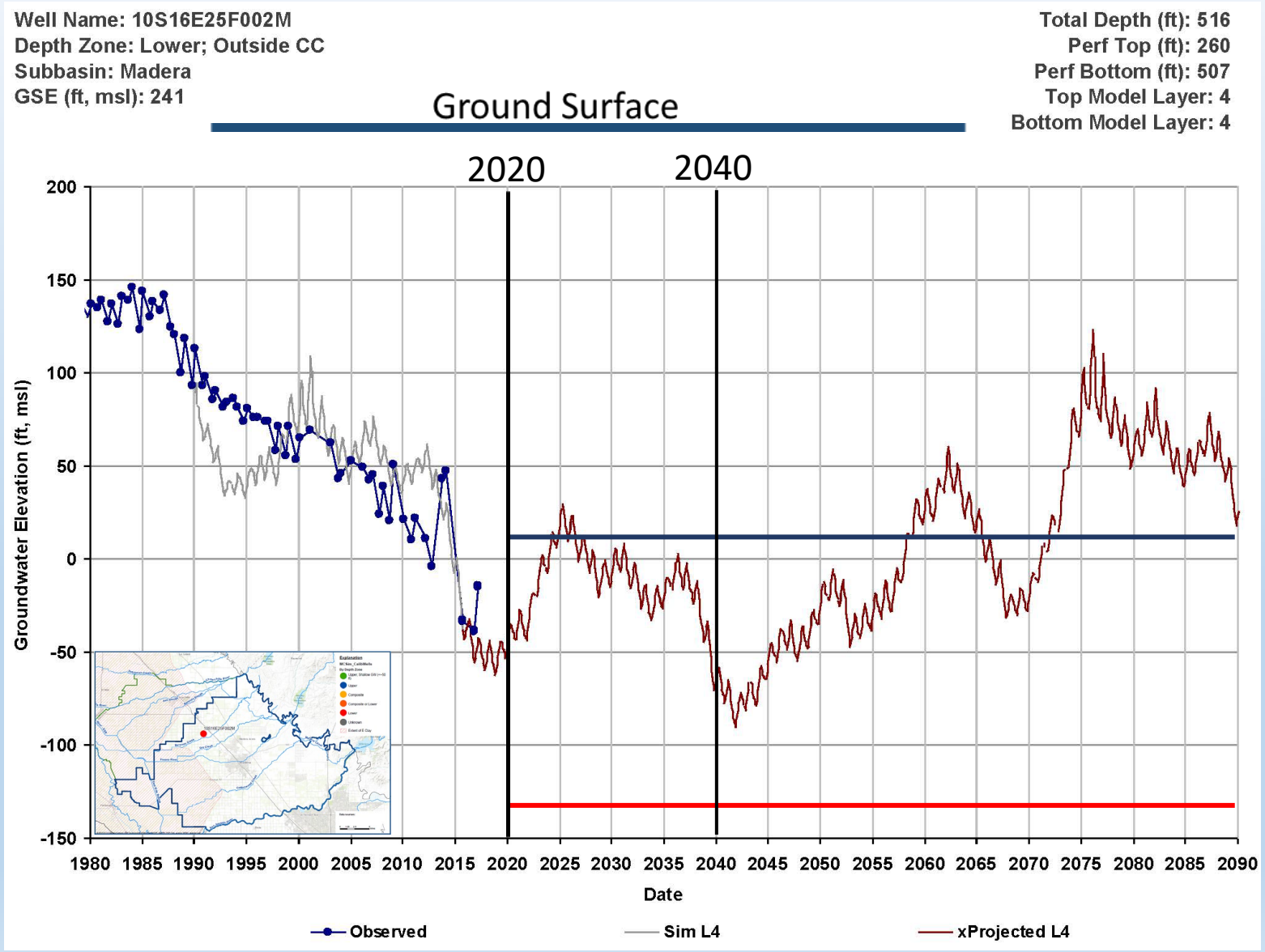
Typical Definition of Dry Well: Regional groundwater level below bottom of well or insufficient well saturation (e.g., 10 feet above bottom of well).

Note: A water level below a pump does not necessarily constitute a dry well – pump may just need to be lowered.

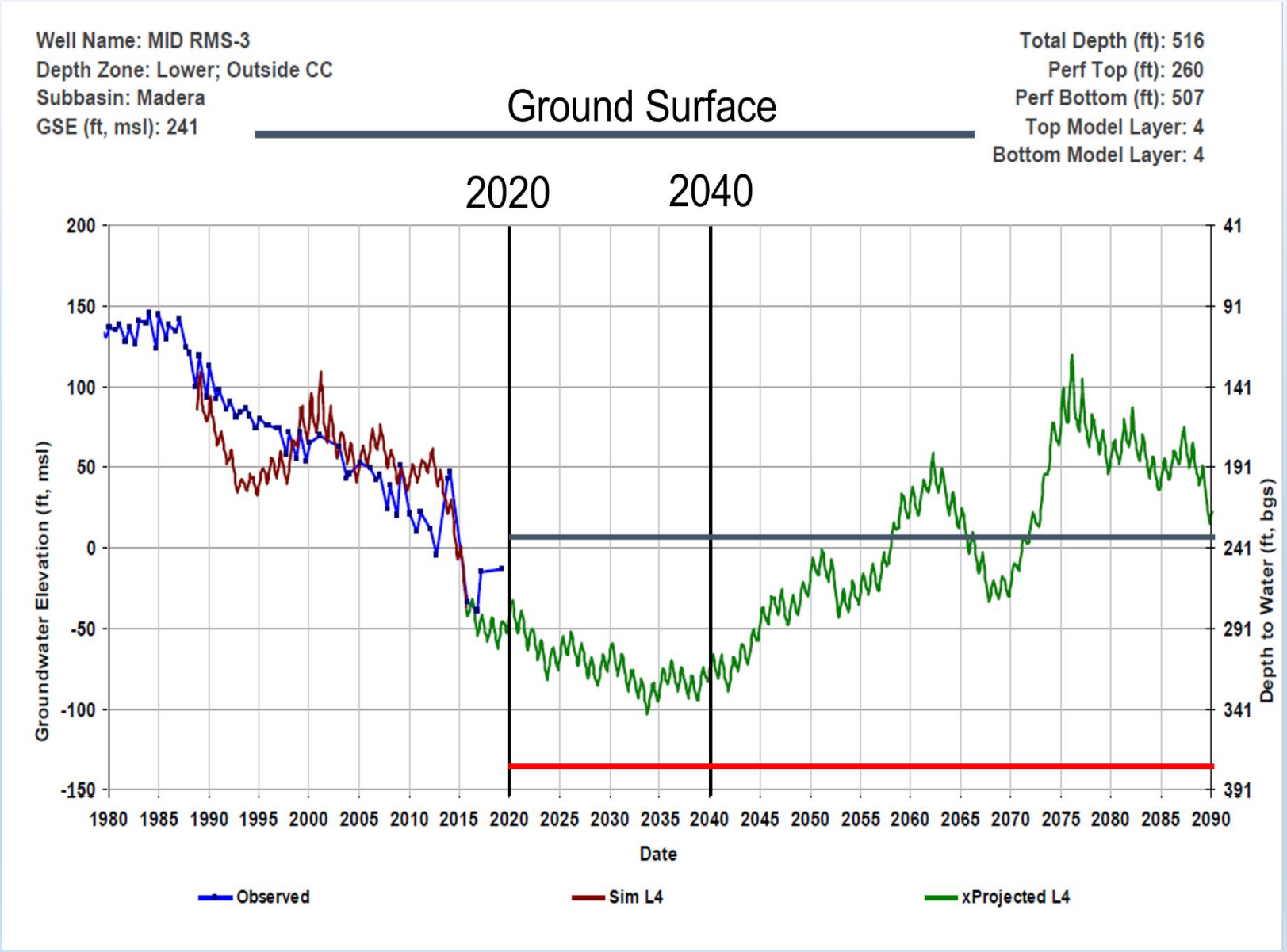
Sensitivity Run – Outside CC, with Projects, Dry Years Start to IP



Alternative – Outside CC, with Projects, Wet Years Start to IP



GSP Baseline – Outside CC, with Projects, Avg Years Start to IP



Potential Domestic Well Impacts Analyses Completed

Analysis Components	GSP Projected Base Case Hydrology	Alternative Projected Dry Start Hydrology	Comment
Domestic WCR Well Counts (since 1970)	X	X	
Domestic WCRs (since 1970) Upscaled to County Permits	X	X	
Domestic WCRs (since 1990) Upscaled to County Permits	X		Corresponds to Well Permit Period
Based on Fall GWL in Years 2019/2024/2029/2034/2039 (5-Year Updates and IMs)	X	X	More dry wells after 2020 than in Min Years
Based on Fall GWL Years 2018/2023/2028/2033/2038 (Min GW Levels)	X	X	
Dry Well Saturation Thresholds 0-100 ft	X	X	Max. # dry wells occurred at 30 feet

Results Summary

- Dry-Year Sequence to Start GSP Implementation Period (for initial cost estimates)
- Adjusted domestic well WCR count for County Domestic Well Permits with a scaling factor
- Using all wells since 1970
- Using a 10-feet well saturation threshold

Analysis of Dry Domestic Wells Using Average-Year and Dry-Year Start Sequences to Start GSP Implementation Period Adjusted for County Permits (Chowchilla Subbasin)

Years	Total Number of Wells	Base Case Hydrology	Dry Start Hydrology	Average of Two Sequences
2020 to 2024	480	48	102	75
2025 to 2029	378	0	73	37
2030 to 2034	305	50	1	25
2035 to 2039	304	1	0	1
Total 2020 to 2040		99	176	138

Notes: Analysis includes wells drilled since 1970 and assumes dry well threshold is 10 feet of well saturation above bottom of well. Total Number of Wells is based on Dry Year Sequence, and does not include dry wells occurring before 2020.

Analysis of Dry Domestic Wells Using Average-Year and Dry-Year Start Sequences to Start GSP Implementation Period Adjusted for County Permits (Madera Subbasin)

Years	Total Number of Wells	Base Case Hydrology	Dry Start Hydrology	Average of Two Sequences
2020 to 2024	4962	350	427	389
2025 to 2029	4535	185	1,017	601
2030 to 2034	3518	406	134	270
2035 to 2039	3384	0	0	0
Total 2020 to 2040		941	1,578	1,260

Notes: Analysis includes wells drilled since 1970 and assumes dry well threshold is 10 feet of well saturation above bottom of well. Total Number of Wells is based on Dry Year Sequence, and does not include dry wells occurring before 2020.

Refined Analysis of Dry Domestic Wells

Issue	Type of Problem	Solution	Related to GSP	Typical Cost
Water level in well below pump setting depth	**Pump**	**Lower Pump**	**Yes/No**	**$1,000 to $2,000**
Pump not working (old age or pump-related issue)	**Pump**	**Replace Pump and Equipment**	**No**	**$5,000 to $7,000**
Well casing/screen failure (due to old age)	**Well**	**Replace Well**	**No**	**$25,000 to $35,000**
Water level below bottom of well	**Aquifer**	**Replace Well**	**Yes**	**$25,000 to $35,000**

Notes: Costs for lowering pump based on lowering pump by 100 to 150 feet; Pump replacement cost includes column pipe, wiring, control box, etc.; Replacement well cost is for drilling/installing new 600-foot deep well and does not include new pump/equipment; Well deepening for domestic wells is not a realistic option

Cost Analysis of Dry Domestic Wells Using the Dry-Year Sequence to Start GSP Implementation Period Adjusted for County Permits (Chowchilla Subbasin)

Years	Average Year Sequence	Dry Year Sequence	Average of Two Sequences	Replacement Well Cost (Million $)
2020 to 2024	48	102	75	3.1
2025 to 2029	0	73	37	2.2
2030 to 2034	50	1	25	0.0
2035 to 2039	1	0	1	0.0
Total 2020 to 2040	99	176	138	5.3

Notes: Replacement Well Costs based on Dry Year Start Climatic Sequence and $30,000/well

Cost Analysis of Dry Domestic Wells Using the Dry-Year Sequence to Start GSP Implementation Period Adjusted for County Permits (Madera Subbasin)

Years	Average Year Sequence	Dry Year Sequence	Average of Two Sequences	Replacement Well Cost (Million $)
2020 to 2024	350	427	389	12.8
2025 to 2029	185	1,017	601	30.5
2030 to 2034	406	134	270	4.0
2035 to 2039	0	0	0	0.0
Total 2020 to 2040	941	1,578	1,260	47.3

Notes: Replacement Well Costs based on Dry Year Start Climatic Sequence and $30,000/well

Comparison of Modeled Results to Dry Well Reports – Chowchilla Subbasin

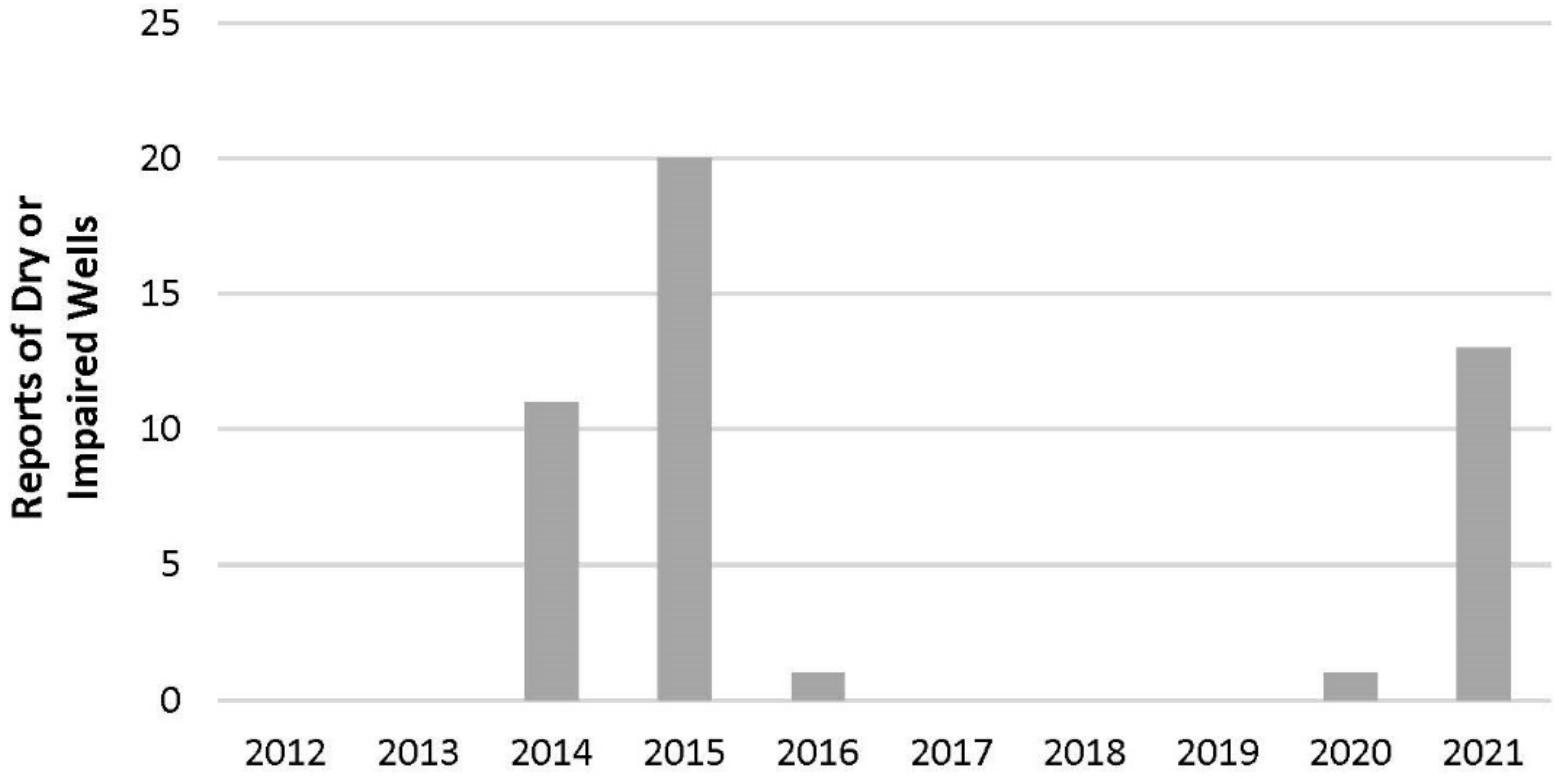


Figure 1. Chart of Household Water Supply Shortage Report Records in Chowchilla Subbasin

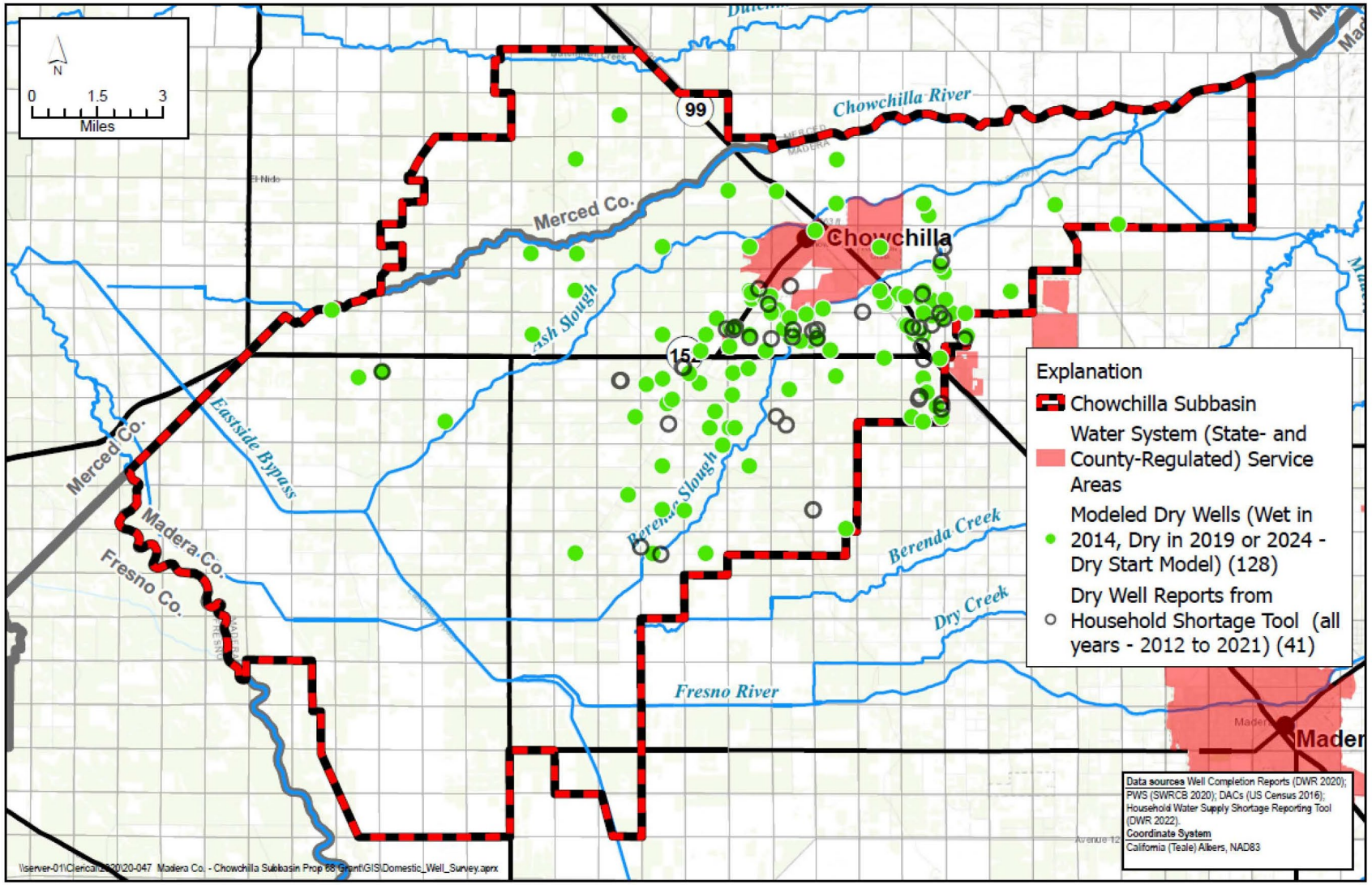


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Figure 5
Comparison of DWR Dry Well Reports with Modeled Dry Wells Between 2015 and 2024
Chowchilla Subbasin Groundwater Sustainability Planning

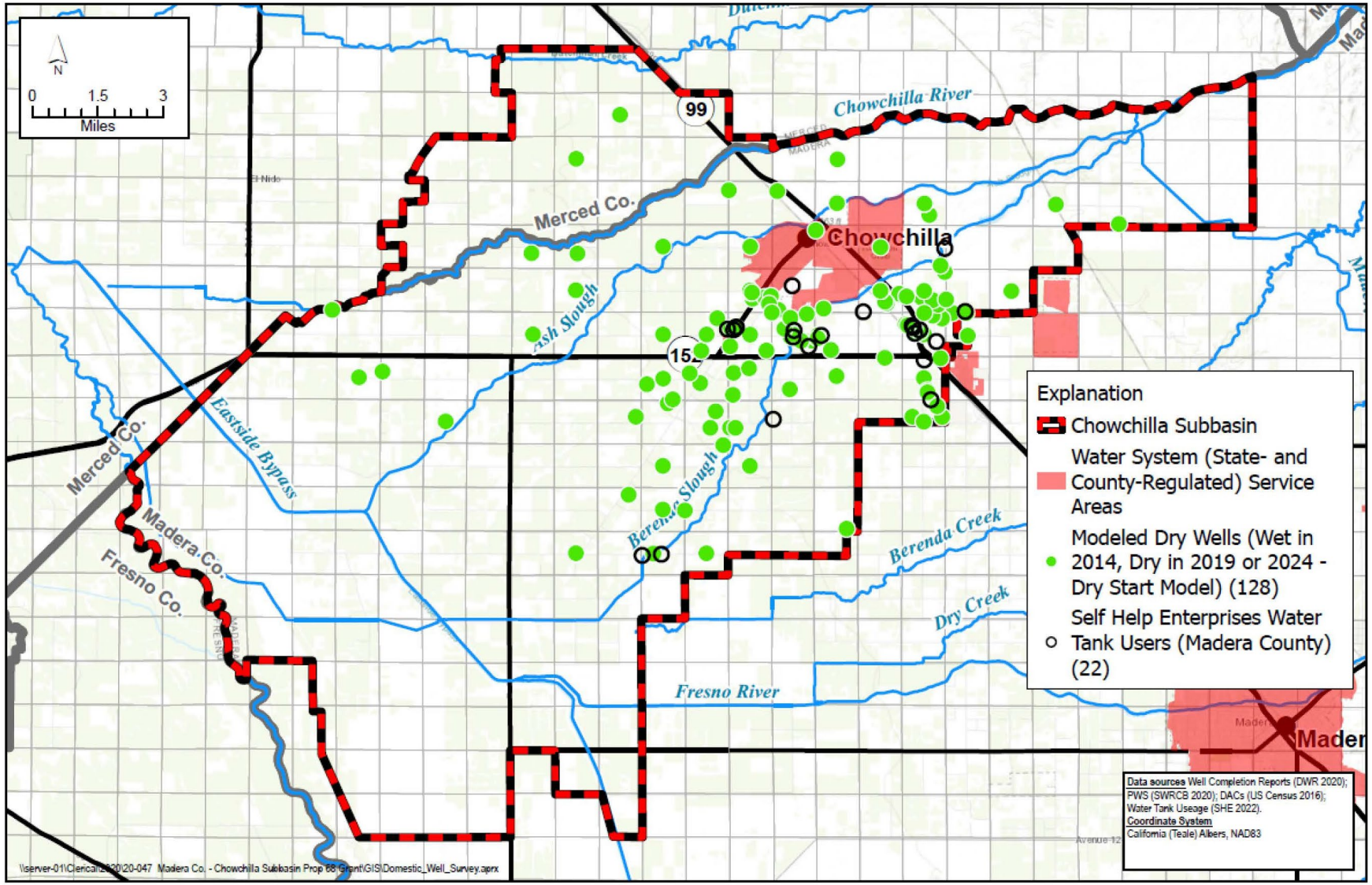

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Figure 7
Comparison of SHE Tank Water Participants with Modeled Dry Wells Between 2015 and 2024
Chowchilla Subbasin

Comparison of Modeled Results to Dry Well Reports – Madera Subbasin

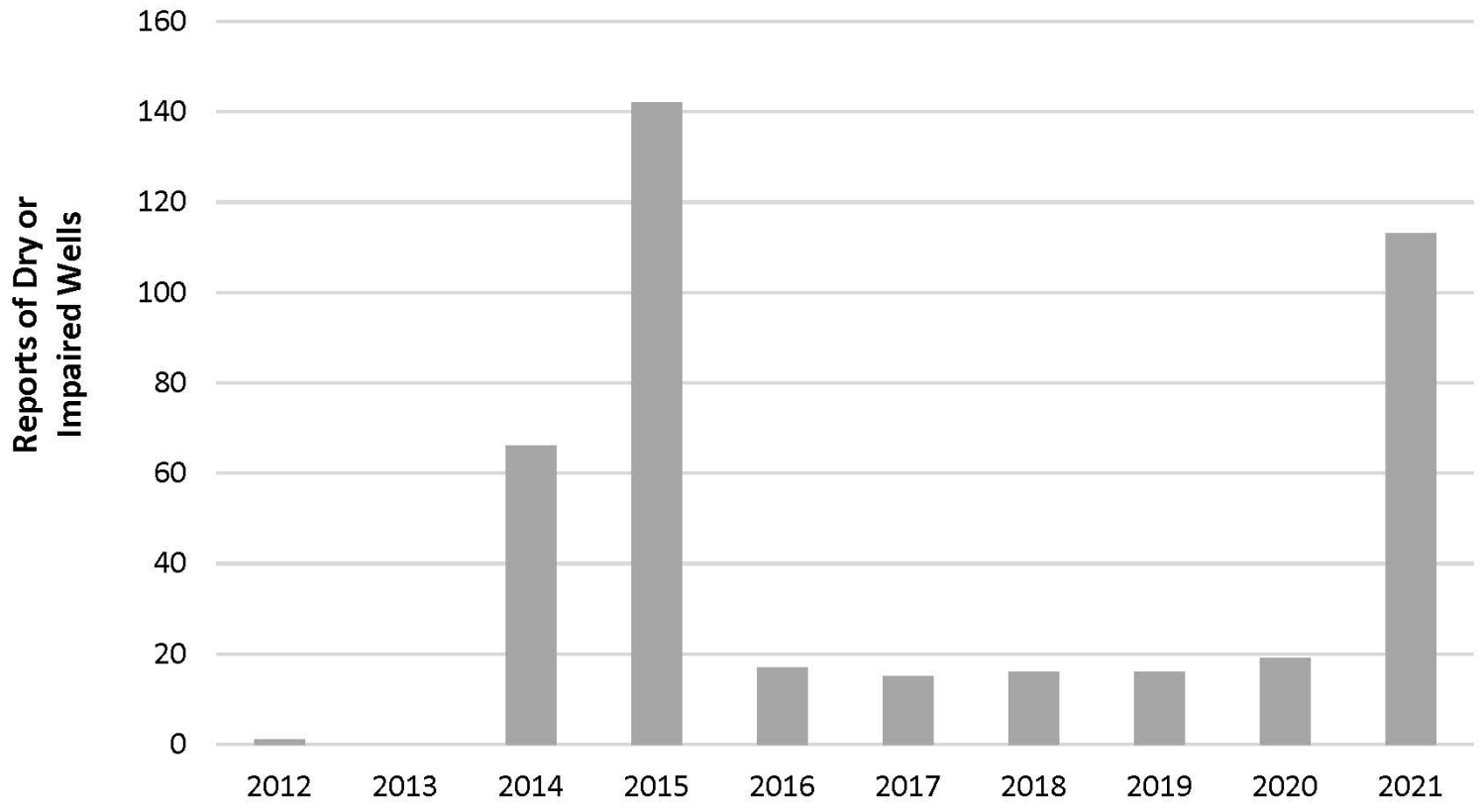
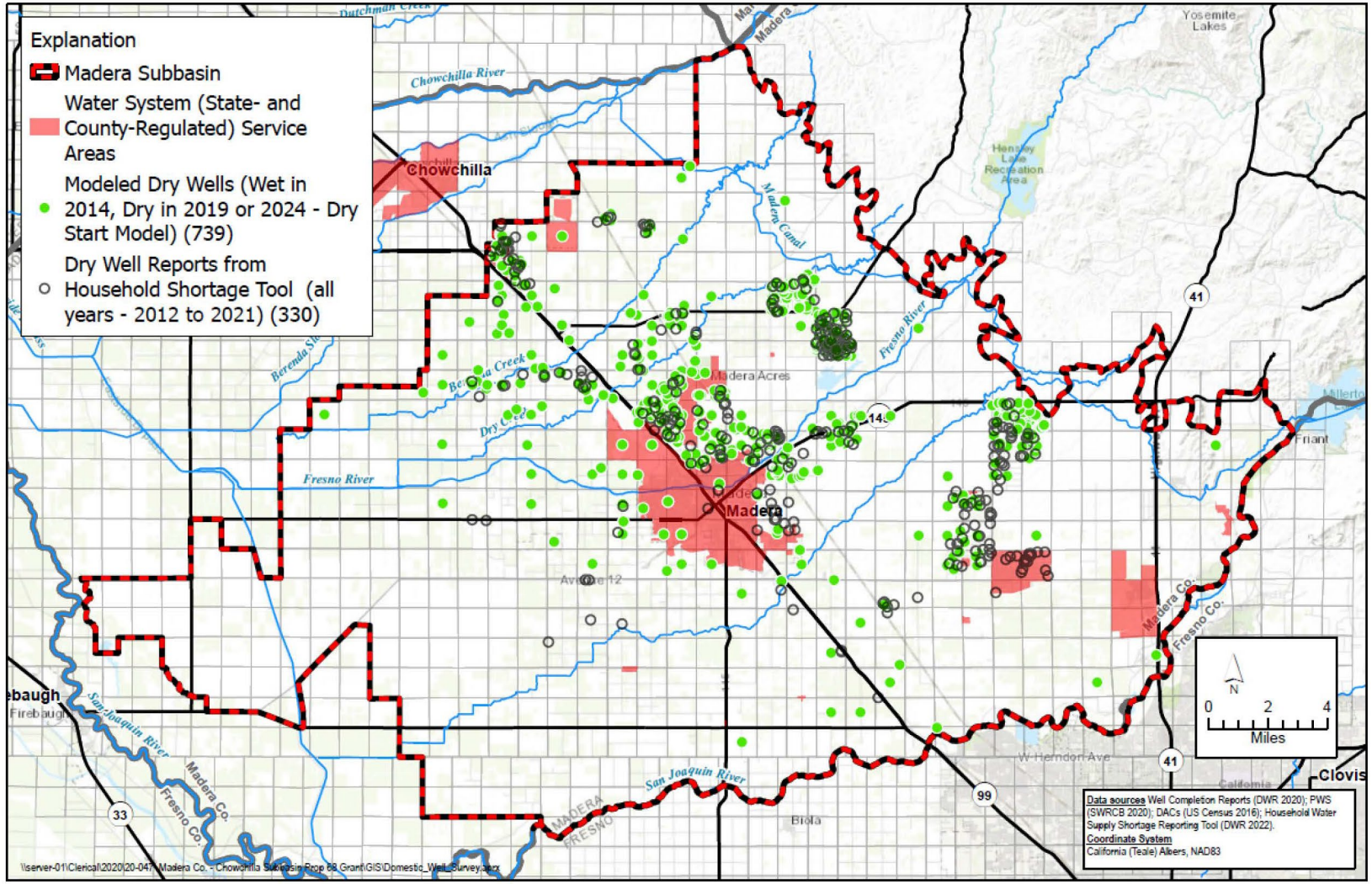


Figure 1. Chart of Household Water Supply Shortage Report Records in Madera Subbasin



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Comparison of DWR Dry Well Reports with Modeled Dry Wells Between 2015 and 2024
Madera Subbasin
Groundwater Sustainability Planning

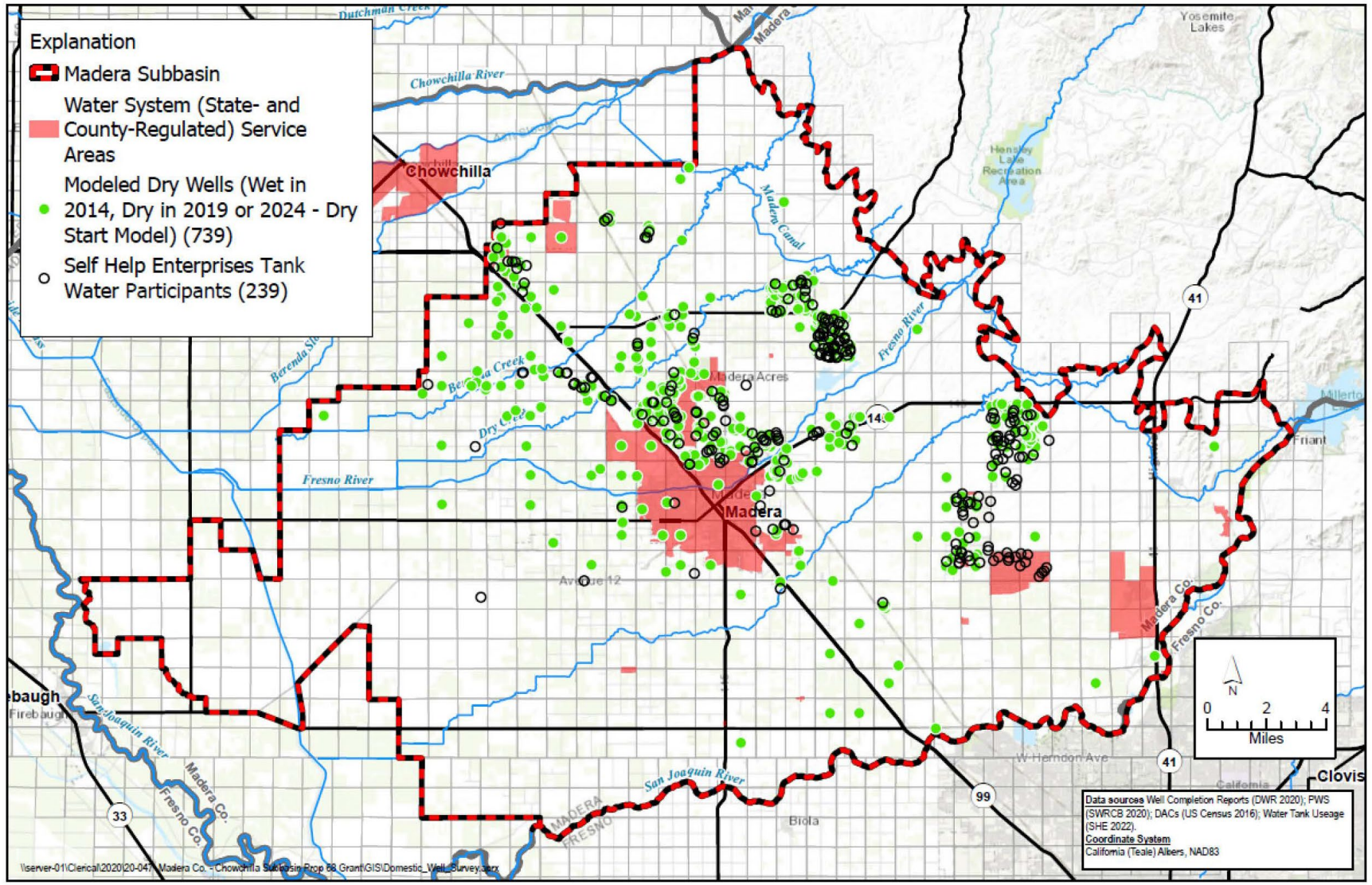

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Figure 7
Comparison of SHE Tank Water Participants with Modeled Dry Wells Between 2015 and 2024
Madera Subbasin
Groundwater Sustainability Planning

Economic Analysis of Potential Domestic Well Mitigation Program

- Purpose is to compare costs associated with domestic wells affected by groundwater decline
- Two cases compared
  - Costs to replace affected domestic wells during the planned GSP implementation period
  - Costs of avoiding well impacts by implementing GSP projects and management actions immediately
- Note that in both cases, sustainable GW conditions are achieved – the difference is when (i.e., by 2040 versus immediately)

What Costs Were Compared?

- For Current GSP plan - all PMAs implemented as planned with estimated GW use and levels):
  - Costs of replacing domestic wells affected
- For alternative, immediate PMA implementation
  - Loss of crop net return starts immediately (the largest cost)
  - Costs to build/operate projects start sooner (not included but would make conclusion stronger)
  - GW pumping costs are lower for all users (a benefit)

Economic Analysis Summary of Results

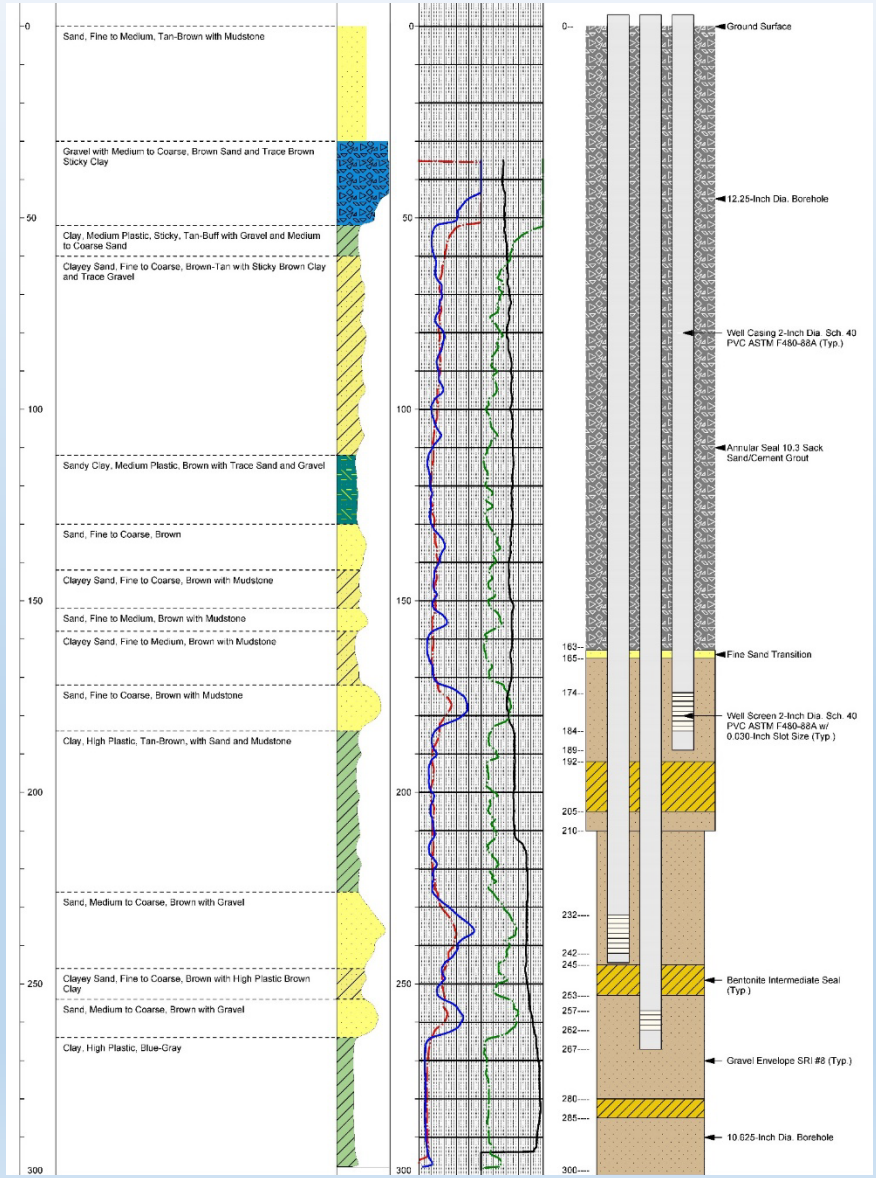
- Madera Subbasin costs (all in present value 2021 $):
  - Cost of well replacement = $39 million
  - Cost of immediate demand reduction = $252 million
  - Pumping cost savings due to immediate demand reduction = $92 million
  - ***Net cost advantage of well replacement = $121 million***
- Chowchilla Subbasin costs
  - Cost of well replacement = $5 million
  - Cost of immediate demand reduction = $123 million
  - Pumping cost savings due to immediate demand reduction = $82 million
  - ***Net cost advantage of well replacement = $36 million***

Conclusions of Economic Comparison

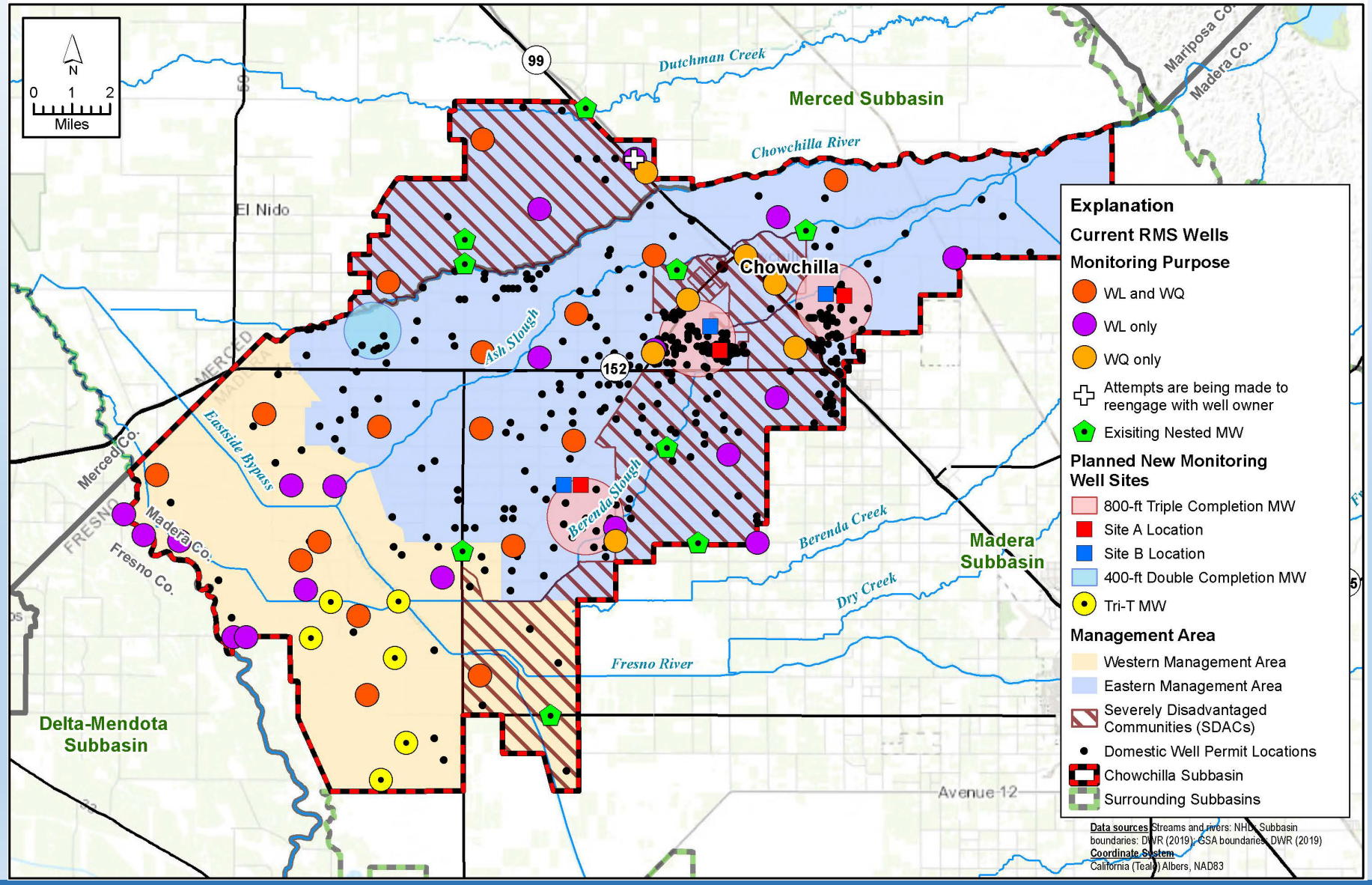
- Costs of replacing domestic wells as needed during GSP's planned implementation is ***cheaper than*** immediately implementing projects and full demand management
- Conclusion holds for both Madera and Chowchilla subbasins
- Conclusion would still hold within a reasonable range of well replacement costs

Monitoring Well Construction and Instrumentation

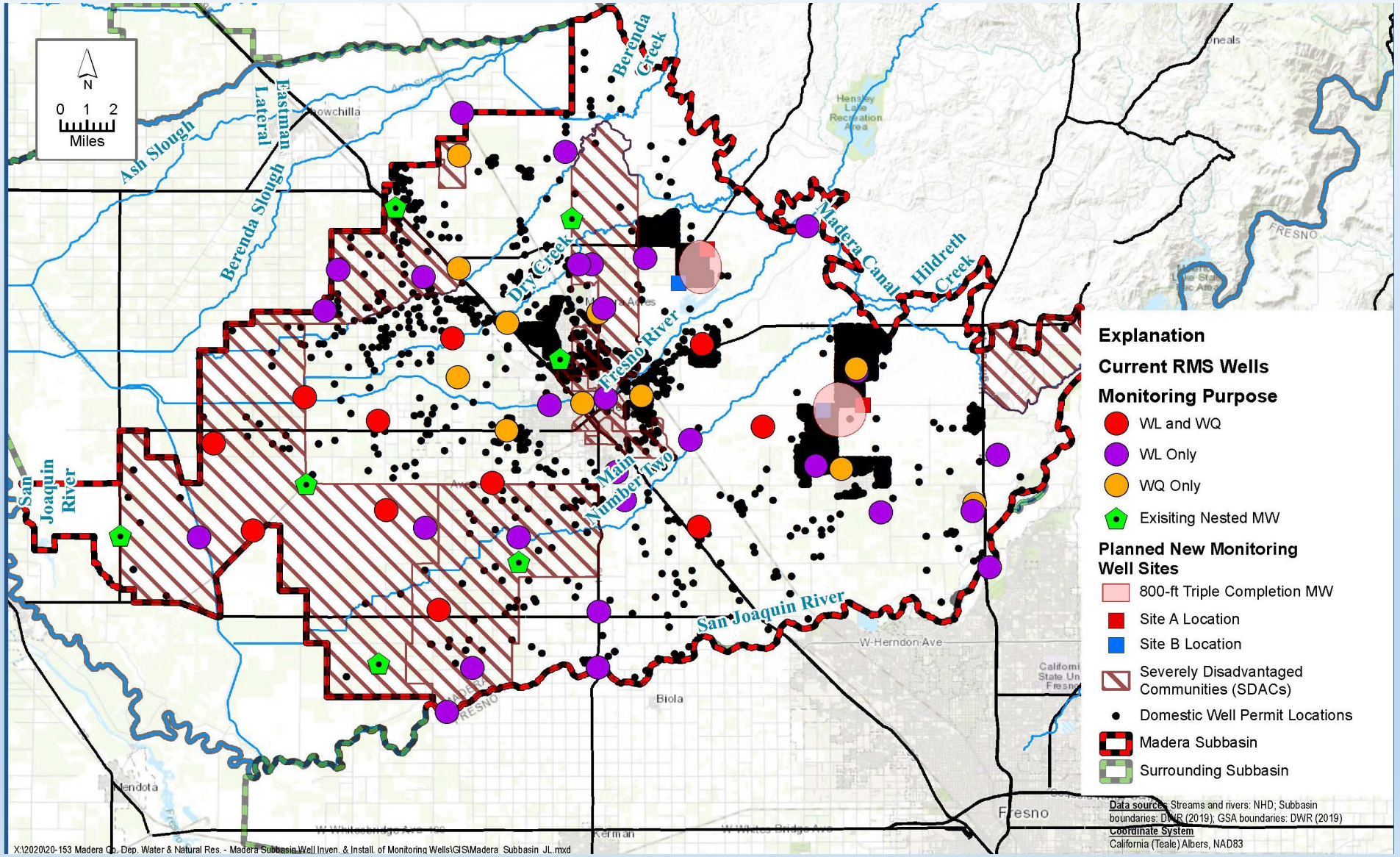
- Test hole drilling to 800 feet at three locations in Chowchilla Subbasin and two locations in Madera Subbasin
- Lithologic and geophysical logging of each test hole
- Construction of up to three wells at each location screened in different depth zones
- Measurement of groundwater levels and collection of groundwater quality samples from each well
- Install instrumentation for long-term water level monitoring; surveying



Monitoring Well Construction and Instrumentation – Chowchilla Subbasin



Monitoring Well Construction and Instrumentation – Madera Subbasin



Next Steps for Domestic Well Inventory

- Finalize Domestic Well Inventory Reports (in progress)
- Confirm proposed nested monitoring well locations (in progress)
- Drill/install new nested monitoring wells (Summer/Fall 2022)
- Install transducers and collect GW quality samples (Fall 2022)
- Prepare Well Installation Reports (Fall 2022)

Discussion