



*Borrego Springs Watermaster*

# Technical Advisory Committee Meeting

December 18, 2023

# Today's Agenda

1. Roll Call
2. TAC Meeting Guidelines
3. Public Comment
4. Final TM: Task 3 – *Correct Errors Identified in the 2021 BVHM*
5. Discuss Task 4 – *Model Recalibration*
6. Discuss potential methods for Task 5 – *Determine the Sustainable Yield*
7. Process and Report Outline for the 5-Year Assessment of the GMP
8. Status Update: Expansion of the Groundwater Monitoring Program (*time permitting*)
9. Public Comment

# TAC Meeting Guidelines

- Public comments reserved for start and end of meetings (Agenda Items III and IX)
- Discussion throughout TAC meeting reserved for TAC members

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# Redetermine the Sustainable Yield by 2025

**Task 1. Compare FMP-Estimated Pumping to Actual Pumping for WY 2022**

**Task 2. Update Water-Use Factors in the FMP**

**Task 3. Correct Errors Identified in 2021 BVHM**

**Task 4. Model Recalibration**

**Task 5. Determine the Sustainable Yield**

## Redetermine the Sustainable Yield by 2025

The Borrego Valley Hydrologic Model (BVHM) and its supporting tools, the Basin Characterization Model (BCM) and MODFLOW-OWHM with the Farm Process (FMP), were used to characterize the water budget and Sustainable Yield for the Borrego Springs Subbasin. Section II.E of the [Judgment](#) established the initial Sustainable Yield at 5,700 acre-feet per year (afy) and requires it to be redetermined by January 1, 2025, and every five years thereafter through 2035.

The TAC identified understanding the ability of the BVHM to accurately estimate historical and future pumping as the top priority issue to address in the 2025 redetermination of the Sustainable Yield. The TAC recommended to the Watermaster Board a technical scope-of-work and budget for water years (WYs) 2023 and 2024 to update the BVHM and Redetermine the Sustainable Yield by 2025. This [scope of work](#) was approved by the Watermaster Board at its meeting on February 9, 2023. The work planned for WYs 2022, 2023 and 2024 was included in a Sustainable Groundwater Management (SGM) grant application that has been awarded by the DWR.

The [scope of work](#) is listed below, along with memos documenting each completed task:

- *Task 1 – Compare FMP-Estimated Pumping to Actual Pumping for WY 2022*
- *Task 2 – Update Water-Use Factors in the FMP*
- *Task 3 – Correct Errors Identified in the 2021 BVHM*
- *Task 4 – Perform Model Recalibration*
- *Task 5 – Determine the Sustainable Yield*

# Task 3 TM – *Correct Errors in 2021 BVHM*

- **November 16, 2023** - Draft Task 3 TM sent to TAC for review
- **December 7, 2023** – TAC comments due
- **December 11, 2023** – Task 3 TM finalized
- Objectives of today's presentation:
  - Summary of Task 3 TM
  - Review TAC comments on Task 3

# Errors Identified in the 2021 BVHM

- Streamflow routing (SFR) package
- Flow and head boundary (FHB) package
- Multi-Node Well (MNW2) package
- Farm Process (FMP) package



# Approach to Making Corrections

1. Begin approach with 2022 BVHM
2. Correct the identified errors in one model package
3. Run BVHM through WY 2022
4. Compare water budget from *corrected* BVHM to water budget from *uncorrected* BVHM
5. Repeat steps #1-3 for each individual error
6. Run *final corrected* BVHM (all model packages corrected) through WY 2022 and compare water budget to *uncorrected* BVHM

# Corrections to All Packages - *Final Corrected BVHM*

- 14% increase in total inflows
  - Increased subsurface inflow
- 2% increase in total outflows
  - Increased pumping and ET
- 11% less change in storage

Water Budget Component	Annual Average WY 1945 - 2022		
	<i>Uncorrected</i> BVHM	<i>Final Corrected</i> BVHM	
	<i>afy</i>	<i>afy</i>	<i>% difference</i>
<b>Total Inflows</b>	<b>6,633</b>	<b>7,632</b>	<b>14%</b>
Streambed Recharge	3,775	3,888	3%
Unsaturated Zone Recharge	1,490	1,622	8%
Subsurface Inflow	1,367	2,121	43%
<b>Total Outflows</b>	<b>13,796</b>	<b>14,057</b>	<b>2%</b>
Groundwater Pumping	10,630	10,693	1%
Non-FMP Wells	2,226	2,300	3%
FMP Wells	8,404	8,394	0%
Evapotranspiration	2,644	2,841	7%
Subsurface Outflow	521	523	0%
<b>Total Change in Storage</b>	<b>-7,163</b>	<b>-6,425</b>	<b>11%</b>

# TAC Comments on Task 3 TM

- Comments received from John Peterson and Tom Watson
- Comment - Requested confirmation that Watermaster reviewed the BVHM for additional unit errors in the BVHM
  - Watermaster Staff reviewed the model when first inherited → unit errors in the SFR were discovered. No additional errors have since been identified.
  - Following the completion of Task 3, the units in the BVHM are consistent and correct.

# Next Steps

- Final Task 3 TM published
- Begin work on Task 4 – *Model Recalibration*
  - Recommendation to use the *Final Corrected BVHM*

## Reports available on the Watermaster's website:

### Redetermine the Sustainable Yield by 2025

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- [Task 3 – Correct Errors Identified in the 2021 BVHM](#)
- [Task 4 – Perform Model Recalibration](#)
- [Task 5 – Determine the Sustainable Yield](#)



# Schedule to Redetermine the Sustainable Yield

Task 1. Compare FMP-Estimated Pumping to Actual Pumping for WY 2022

Task 2. Update Water-Use Factors in the FMP

Task 3. Correct Errors Identified in 2021 BVHM

## **Task 4. Model Recalibration** – *December 2023 through May 2024*

- April 2024 – Distribute and discuss draft TM at TAC meeting
- May 2024 – Publish Final TM

## **Task 5. Determine the Sustainable Yield** – *May 2024 through September 2024*

- April 2024 - TAC meeting to discuss projection scenarios and methods to redetermine SY
- September 2024 - Distribute and discuss draft TM at TAC meeting
- October 2024 – present final TM and TAC recommendation report to Board
- December 2024 – present to Board for approval

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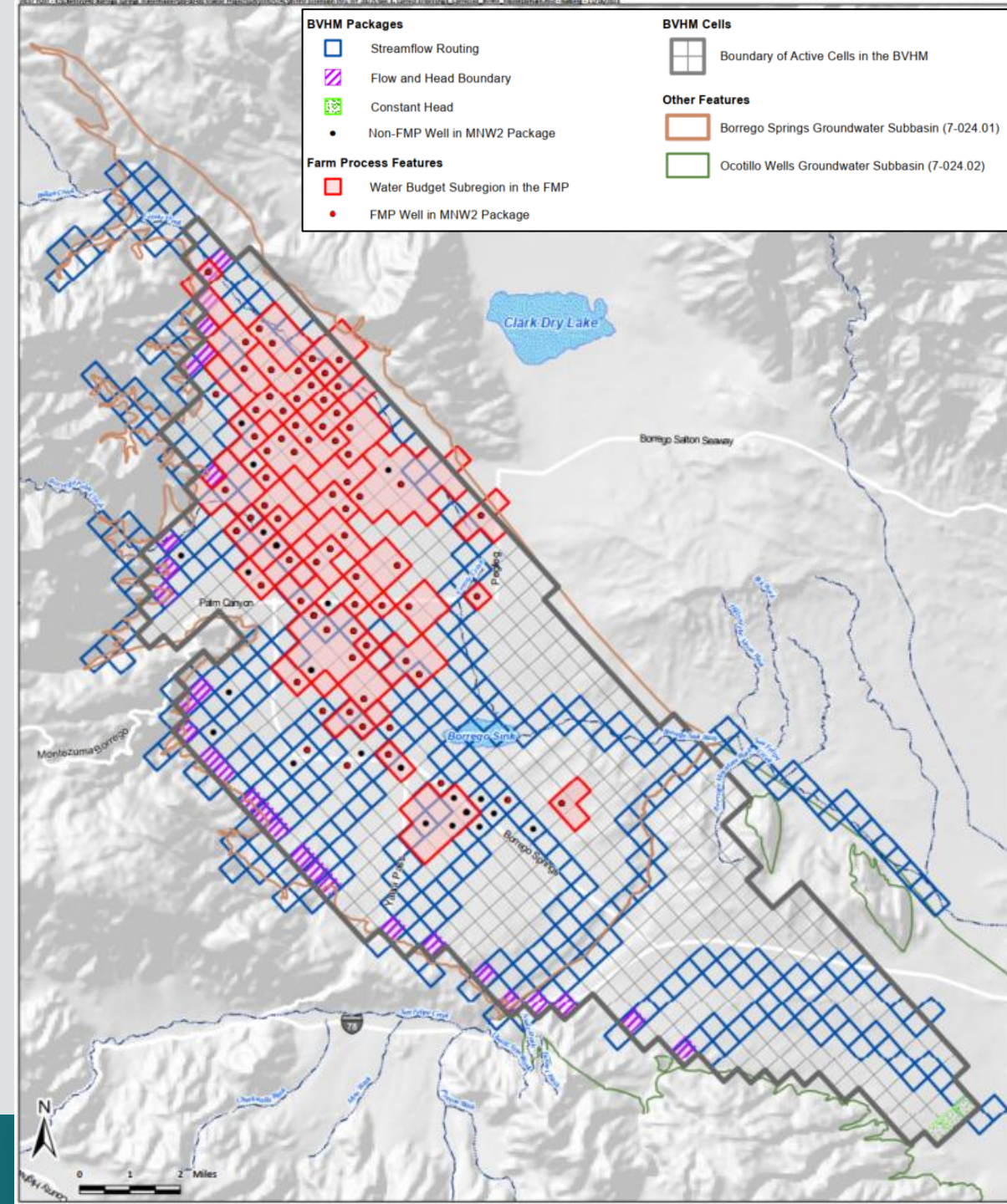
# Objective of Task 4 – Model Recalibration

- Improve the ability of the BVHM to estimate *historical* and *future*:
  - Groundwater Elevations
  - Water Budget → Used to estimate the Sustainable Yield
    - Inflows
    - Outflows
    - Change in Storage



# Version of BVHM to Re-calibrate

- Use the geometry/layering and spatial/temporal resolution from *Initial BVHM*
- Use corrected model packages from *Task 3*
- Updated KC and OFE water-use factors in the FMP from *Task 2*, which includes:
  - Initial KC values (entire model simulation period)
  - Initial OFE values (recent years)
  - Adjusted OFE values to reflect the evolution of irrigation methods used in the Basin since WY 1946 (historical period)





# Calibration Methods

## 1. Select adjustable model parameters

- Hydraulic and storage properties of the aquifer-system sediments (by model layer)
- Vertical hydraulic conductivity of the unsaturated zone
- Hydraulic conductivity of the streambed channels
- Subsurface inflows to the model domain
- Stream runoff to the model domain

## 2. Select calibration methods to adjust model parameters

- Use “Pilot Points” for hydraulic and storage properties
- Use “scalar multipliers” for all other parameters
- Adjust via PEST (automated) and manually

## 3. Select calibration period → 1945-2022

# Calibration Methods (cont.)

## 4. Select calibration targets/data

- Groundwater-elevations – select data with even spatial and temporal distribution
- Surface-water discharge – identify very wet years where surface water discharge from the Basin likely occurred

## 5. Configure PEST settings and prepare input files for PEST

- Initial parameter values based on:
  - Initial BVHM
  - Results of Tasks 1-3
  - New data (e.g., pump test results from Rams Hill; information on historical OFE)

## 6. Perform model calibration with PEST

# Calibration Methods (cont.)

## 7. Review calibration results

- Map and table of final model parameters
- Table of calibration statistics
- Map of mean residual by well
- Table and time-series chart of the annual water budget
- Scatter plots and time-series charts that compare simulated vs. observed groundwater elevations at wells
- Time-series chart of simulated surface-water discharge vs. precipitation

## 8. Repeat Steps #1-7 until calibration results are satisfactory

## 9. Document calibration process and results in TM

# TAC Comments

- Comments from Bob Wagner (AAWARE):
  - **Recharge to the Basin and the Sustainable Yield are likely higher than the current Sustainable Yield.** Using the difference between the change in storage calculation and annual groundwater extraction, the Sustainable Yield can be roughly estimated. Based on WY 2022 and WY 2023, the Sustainable Yield is estimated as ranging from 7,200 to 8,700 afy (greater than the current 5,700 afy). Note that this method does not include losses from ET and outflow from the Basin (approx. 800 afy).
  - **FMP estimates of pumping are more representative of consumptive use than actual pumping.** This is evident by i) the FMP significantly underestimates actual groundwater pumping, and ii) FMP-estimated pumping is close to OpenET-estimated ET. This indicates the FMP is also underestimating return flows.
  - FMP was developed to estimate pumping in cases where pumping data is unavailable; metered pumping data is now available in the Basin.
  - The differences in recharge and FMP-estimated pumping should be addressed prior to performing Task 4.

# Next Steps

- **January 8, 2024** – TAC Comments Due
- **April 2024** – Publish draft TM on results of Task 4

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# Sustainable Yield

- The Judgment defines the **Sustainable Yield** as:  
*"The maximum quantity of water, calculated over a base period representative of long-term conditions in the Basin, that can be cumulatively pumped on an annual basis from the Basin without causing an Undesirable Result."*
- Current Sustainable Yield = 5,700 afy
  - Estimated by the BVHM
  - Based on historical, long-term, average annual **net recharge**
- Sustainable Yield must be redetermined by 2025

# TAC Comments on Calculation of Recharge

- A. Long-term annual average recharge, or
- B. Long-term annual average recharge minus discharge
- The Sustainable Yield should be based on long-term average *net* recharge (inflows – outflows)
  - Consistent with method described in the GMP

Water Budget Components	Acre-Feet/Year
<b>INFLOWS (Model Update 1945- 2016)</b>	
Stream Recharge	3,905
Unsaturated Zone Recharge	1,497
Underflow (Inflow from Adjacent Basins)	1,367
<b>Total Inflows</b>	<b>6,770</b>
<b>OUTFLOWS BESIDES PUMPING (Most Recent 10 Years, 2007-2016)</b>	
Evapotranspiration	498
Underflow (Flow out of Southern End)	523
<b>Total Outflows</b>	<b>1,021</b>

Inflows – Outflows = Sustainable Yield = 5,700 afy



# TAC Comments on the Time Period to Estimate the Sustainable Yield

## A. Historical calibration period of the BVHM (e.g., 1945-2022)

- Entire calibration period (1945-2022) should be used to estimate inflows
- More recent historical period (2007-2022) should be used to estimate outflows, since this is more representative of current and future conditions

## B. Future BVHM projection that accounts for climate change and future land/water uses that could affect natural recharge

# TAC Comments on Model Area to Estimate the Water Budget

- A. Use entire BVHM domain, including Ocotillo Wells Groundwater Subbasin (as done by USGS and Dudek)
- B. Only the BVHM domain that covers the Basin**
  - Model domain overlying Borrego Springs Subbasin should be used
  - Model domain overlying the Ocotillo Wells Subbasin should be excluded

# Proposed Methods to Redetermine the Sustainable Yield

1. Compute the water budget of the Basin using recalibrated BVHM (Task 4)
2. Estimate the long-term average annual ***net recharge*** to the Basin to establish a Preliminary Sustainable Yield
3. Develop a future groundwater pumping scenario to simulate the Rampdown of pumping to the Preliminary Sustainable Yield by 2040 and beyond
4. Perform uncertainty analysis for future climate change and climate variability
5. Analyze the BVHM results from the future scenario(s)
6. Adjust the Sustainable Yield based on the analysis of the future scenarios, if necessary

# Proposed Methods to Redetermine the Sustainable Yield

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# Develop Future Pumping Scenario

- Pumping scenario will be used in BVHM projections for 2023-2070
- Options to assign future pumping:
  - a. Rampdown pumping to ***Preliminary Sustainable Yield*** by 2040 using a linear reduction of pumping at all active wells, or
  - b. Rampdown is based on future land use and water supply plans of the BPA holders
    - More labor-intensive, but will likely result in a more probable scenario of future pumping
- Options for use of the FMP:
  - a. Use the FMP to estimate future agricultural pumping → This would likely require an iterative process to simulate the Rampdown.
  - b. Do not use the FMP (assign pumping to wells) → Can still simulate irrigation return flows

# Perform Uncertainty Analysis of Future Climate Change and Climate Variability

Two approaches for performing uncertainty analysis to evaluate the potential for Undesirable Results:

- a. Use the same procedures used to establish the current Sustainable Yield:
  - i. Repeat historical climate for 2023-2070
  - ii. Apply DWR change factors for 2030 and 2070 to historical climate
  - iii. Use a Monte Carlo Simulation to characterize uncertainty in climatic variability
- b. Use different procedures and/or datasets. Examples of climate projections for downscaled precipitation and temperature include:
  - NASA Earth Exchange (NEX) Downscaled Climate Projections (NEX-DCP30)
  - NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6)
  - CMIP6 Downscaling Using the Weather Research and Forecasting model (WRF-CMIP6)

# Analyze BVHM Results and Adjust Sustainable Yield (if necessary)

- Compare BVHM results to Sustainable Management Criteria:
  - Minimum Thresholds for groundwater elevations at Representative Monitoring Wells
  - Minimum Thresholds for groundwater storage
- If the BVHM results of the future scenario(s) show that Minimum Thresholds are projected to be exceeded, then the Preliminary Sustainable Yield would be reduced, and steps 3-5 would be repeated until the Minimum Thresholds are not exceeded → Sustainable Yield redetermined for 2025-2030
- Alternatively, the Sustainable Management Criteria could be adjusted
  - Relationship to GMP Update process

# Next Steps

- **January 29, 2024** – TAC Comments due. The TAC is specifically requested to address:
  - Development of future groundwater pumping scenarios
  - Future climate change and climate change variability (uncertainty analysis)
- **February 8, 2024** – Present preliminary methodology to perform Task 5 and TAC comments at the Watermaster Board meeting



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# Five-Year Assessment of GMP

- The Judgment and GMP are the Physical Solution for the Basin to achieve its Sustainability Goal by 2040
- Title 23 § 356.4 of CCR require an assessment of GSPs every five years
  - **5-Year Assessment Report**
- The redetermination of the Sustainable Yield and the 5-Year Assessment Report may necessitate updates to the GMP
- DWR comments on the Judgment/GMP are forthcoming, and hence, may require additional (unknown) updates to the GMP
- Board has requested TAC input on the appropriate **scope of work and schedule** for the 5-year Assessment Report using the available Proposition 68 grant funding

# Objectives

1. Prepare 5-year Assessment Report:
  - Evaluate if implementation of the Judgment/GMP is progressing towards meeting the Sustainability Goal of the Basin by 2040
  - Identify/recommend updates to the GMP
2. Update GMP based on recommendations from 5-Year Assessment Report
3. Schedule:
  - DWR has indicated that the 5-year Assessment Report and Final Updated GMP are due by June 2026
  - Maximize amount of work funded by Prop 68 grant (end date: March 31, 2025)

# 5-Year Assessment Report Outline

The outline is based on DWR guidance (attached to memo):

Section 1. Background & Objectives

Section 2. Status of Projects and Management Actions

Section 3. Administrative, Legal, and Coordination Activities

Section 4. New Information

Section 5. Current Groundwater Conditions vs. Sustainable Management Criteria

Section 6. Monitoring Program

Section 7. Basin Setting based on New Information

Section 8. Corrective Actions

Section 9. Summary of Completed or Proposed Plan Updates

# Process – 5-Year Assessment Report

1. Staff prepares draft sections of the Report
2. TAC meeting to review draft sections
3. TAC reviews draft sections and submits written comments and suggested edits  
→ 3-week comment period
4. Staff incorporates TAC feedback into draft sections
5. Repeat Steps #1-4 for all Report sections
6. Staff prepares draft-final 5-Year Assessment Report
7. TAC reviews and comments on draft-final 5-Year Assessment Report to develop a TAC Recommendation to the Board on recommended GMP updates
8. Board is presented with TAC Recommendation and the final 5-Year Assessment Report for review and approval

# Process – Update GMP

1. Based on the TAC Recommendation on the 5-Year Assessment Report, Staff prepares draft Updated GMP
2. TAC meeting to review draft Updated GMP
3. TAC reviews draft Updated GMP and submits written comments and suggested edits  
→ 3-week comment period
4. Staff incorporates TAC comments into final Updated GMP
5. TAC meeting to develop TAC Recommendation to the Board
6. Bring Final Updated GMP and TAC Recommendation to Board for approval
7. Submit final Updated GMP and 5-Year Assessment Report to DWR

# Schedule – WY 2024

## Objective: Prepare 5-Year Assessment Report

### TAC Milestones:

#### **April 2024** – TAC meeting to discuss sections:

- Section 1. Background & Objectives
- Section 2. Status of Projects and Management Actions
- Section 3. Administrative, Legal, and Coordination Activities
- Section 4. New Information

#### **June 2024** - TAC meeting to discuss sections:

- Section 5 – Current Groundwater Conditions vs. Sustainable Management Criteria
- Section 8 – Corrective Actions

#### **August 2024** - TAC meeting to discuss sections:

- Section 6 – Monitoring Program
- Section 7 – Basin Setting based on New Information
- Section 9 – Summary of Completed or Proposed Plan Updates

# Schedule – WY 2025

## Objectives:

- Finalize 5-Year Assessment Report
- Prepare Updated GMP

## TAC Milestones:

**October 2024** – TAC meeting to discuss:

- Draft Final 5-Year Assessment Report
- TAC-Recommendation to Board on recommended updates to the GMP

**January 2025** – TAC meeting to review the Draft Updated GMP

**March 2025** – TAC meeting to finalize TAC Recommendation to the Board to adopt the final Updated GMP

**March 31, 2025** – Prop 68 Grant Funding expires



# Schedule – WY 2026

## Objectives:

- Finalize Updated GMP
- Submit Assessment Report and Updated GMP to DWR

## TAC Milestones:

**June 2026** – DWR deadline for:

- 5-Year Assessment Report
- Final Updated GMP

# TAC Comments

- Reassess Minimum Thresholds for Chronic Lowering of Groundwater Levels
  - Minimum Thresholds for Representative Monitoring Sites will be evaluated and revised (if applicable)
  - Data gaps in the GMP and Groundwater Monitoring Plan will be updated, where possible
- Update discussion of monitoring and management programs
  - New/changed/updated programs will be described in the Assessment Report, such as San Diego County programs
- Reduce reliance on the BVHM
  - BVHM will be used to redetermine the Sustainable Yield, at the Board's direction
  - Groundwater quality, groundwater level, and groundwater pumping data will be described and analyzed in the Assessment Report
- Follow the DWR's Suggested Periodic Evaluation Annotated Outline for outline of Assessment Report
  - DWR's Suggested Periodic Evaluation Annotated Outline was used to develop draft outline

# Next Steps

- **January 8, 2024** – TAC Comments Due on 5-Year Assessment of GMP memo
- Begin work on Sections 1-4 of Assessment Report

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# Status Update:

## Expansion of the Groundwater Monitoring Program

- Canvassed 17 wells on November 14, 2023 and assessed the following:
  - Site access
  - Current condition of the well
  - Any repair or rehabilitation required to convert the well to a monitoring well
  - If low-flow sampling or a different method could collect a groundwater-quality sample
  - If a sounder and/or transducer can be placed down the well
- Collected 3 groundwater-level measurements
- Collected 3 groundwater-quality samples
- Obtained well completion reports/well construction information for Bauer and Seley wells

- Well Canvass was performed in Nov. 2023
- Next Steps:
  - Entry Permits
  - Data Confidentiality Agreements
  - Well Conversion Plans

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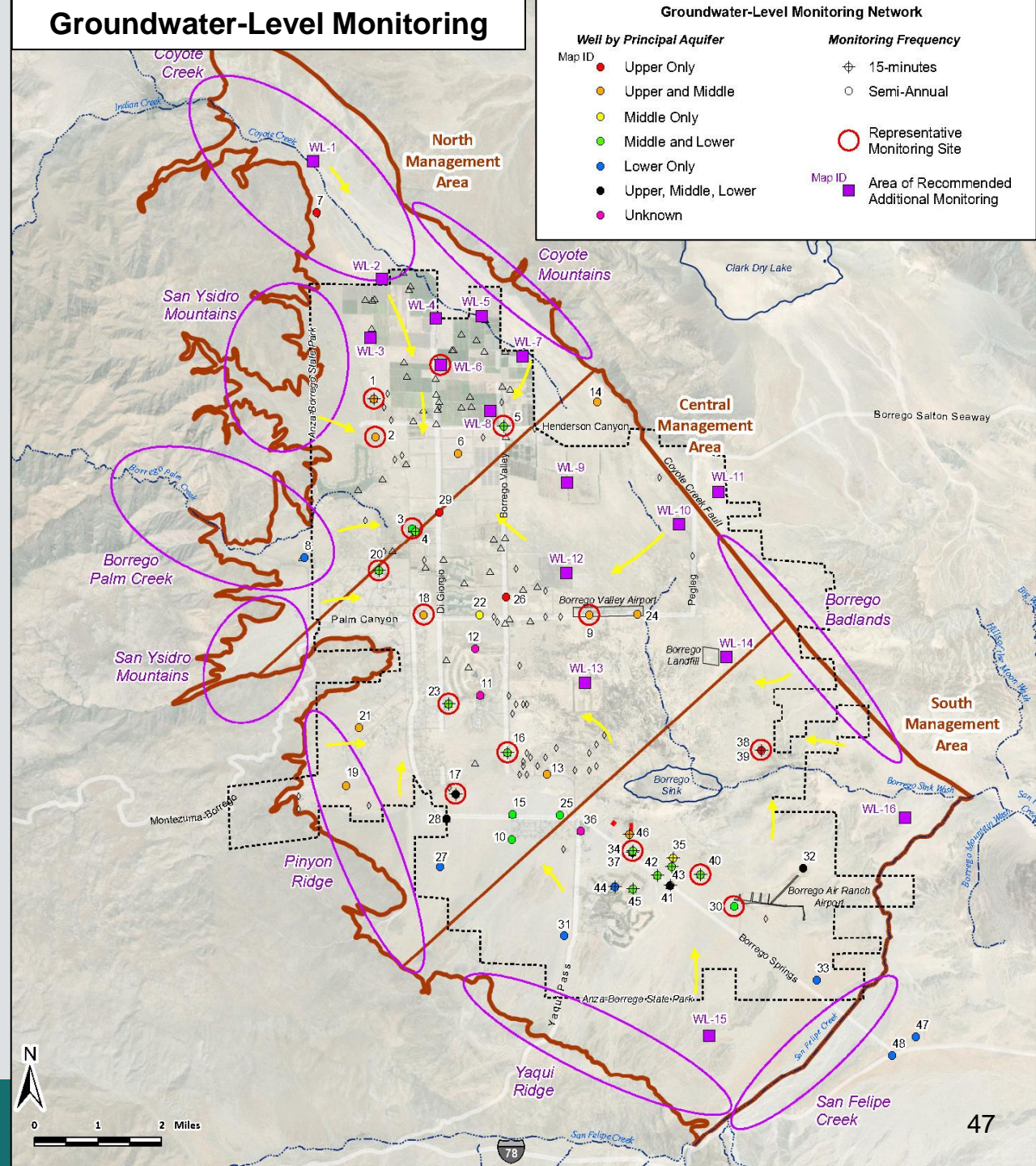
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# Expansion of the Groundwater Monitoring Program

- Well Canvass was performed in Nov. 2023
- Next Steps:
  - Entry Permits
  - Data Confidentiality Agreements
  - Well Conversion Plans

## Groundwater-Level Monitoring



# Next Steps

- Prepare work plan and cost estimate for monitoring well conversions
- Select the wells best suited to be added to the monitoring networks and update the TAC/Board
- Execute work plan



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# Future Meetings

- Next TAC meeting: April 2024
- Draft Agenda:
  - Review draft TM on Task 4 – *Model Recalibration*
  - Discuss projection scenarios and methods for Task 5 – *Determine the Sustainable Yield*
  - Review Sections 1-4 of 5-Year GMP Assessment Report

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**Thank You!**