Future Groundwater Depletion May Exceed Long-Term Sustainability Goals set by SGMA in the Central Valley, California, USA (2020 – 2070)

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Our WATER's Future: Challenges & Next Steps
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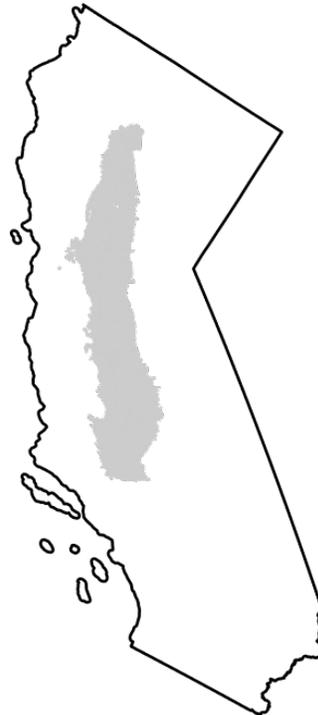# Introduction
Sustainable Groundwater Management Act

- Sustainable Groundwater Management Act of 2014 set a framework to protect our groundwater resources.

- There are multiple undesirable results of sustainability that SGMA is trying to avoid but we are interested in:
  - Lowering groundwater levels.
  - Reduction in groundwater storage.

- These undesirable results are measured at key indicator wells via measurable objectives and minimum thresholds.
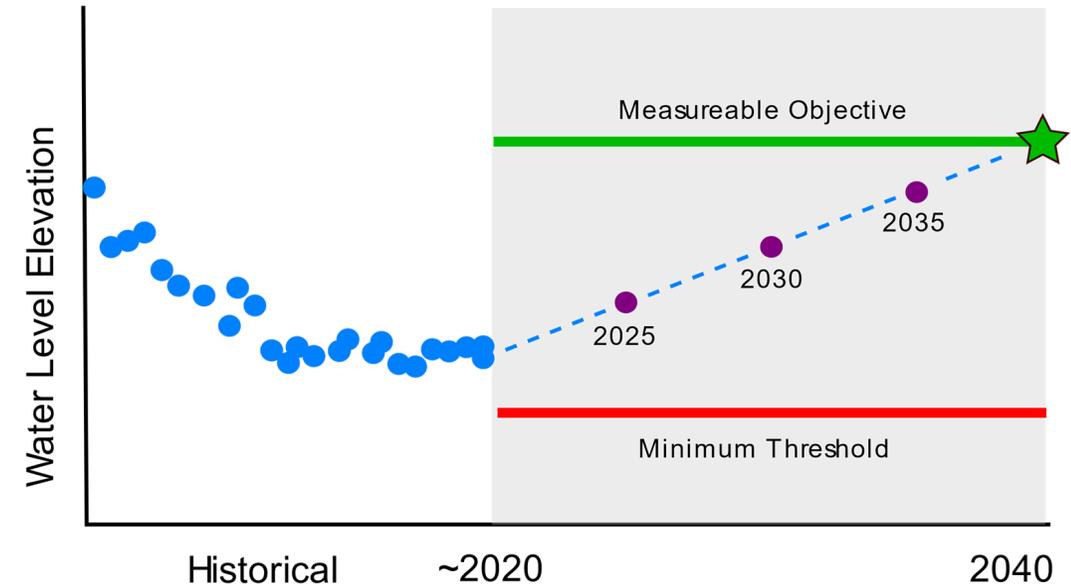
Lowering GW Levels

Reduction of Storage

Form GSA — June 2017

Submit GSP — ~2020

Implement GSP — 2020-2040

Achieve Sustainability — 2040

Maintain Sustainability — 2070

SGMA Indicator Well

Measureable Objective

Water Level Elevation

2025

2030

2035

Minimum Threshold

Historical   ~2020   2040

Motivation
Study Questions

1. Where are the areas of greatest long-term sustainability concern within the critically overdrafted aquifers?

2. How will the political boundaries conflict across the larger aquifer and potentially produce inter-agency depletion?

3. How drastic is groundwater depletion expected to be in poorly monitored SGMA regions?
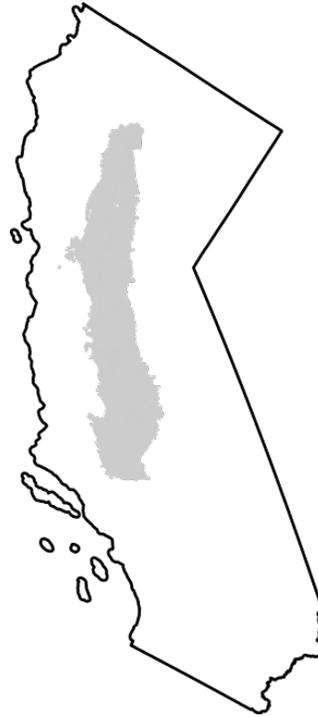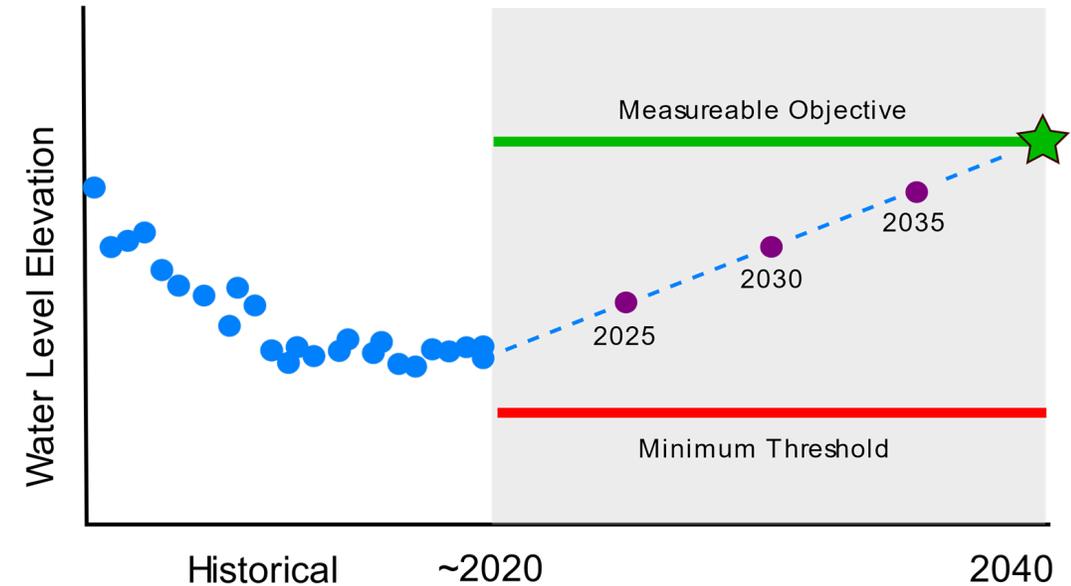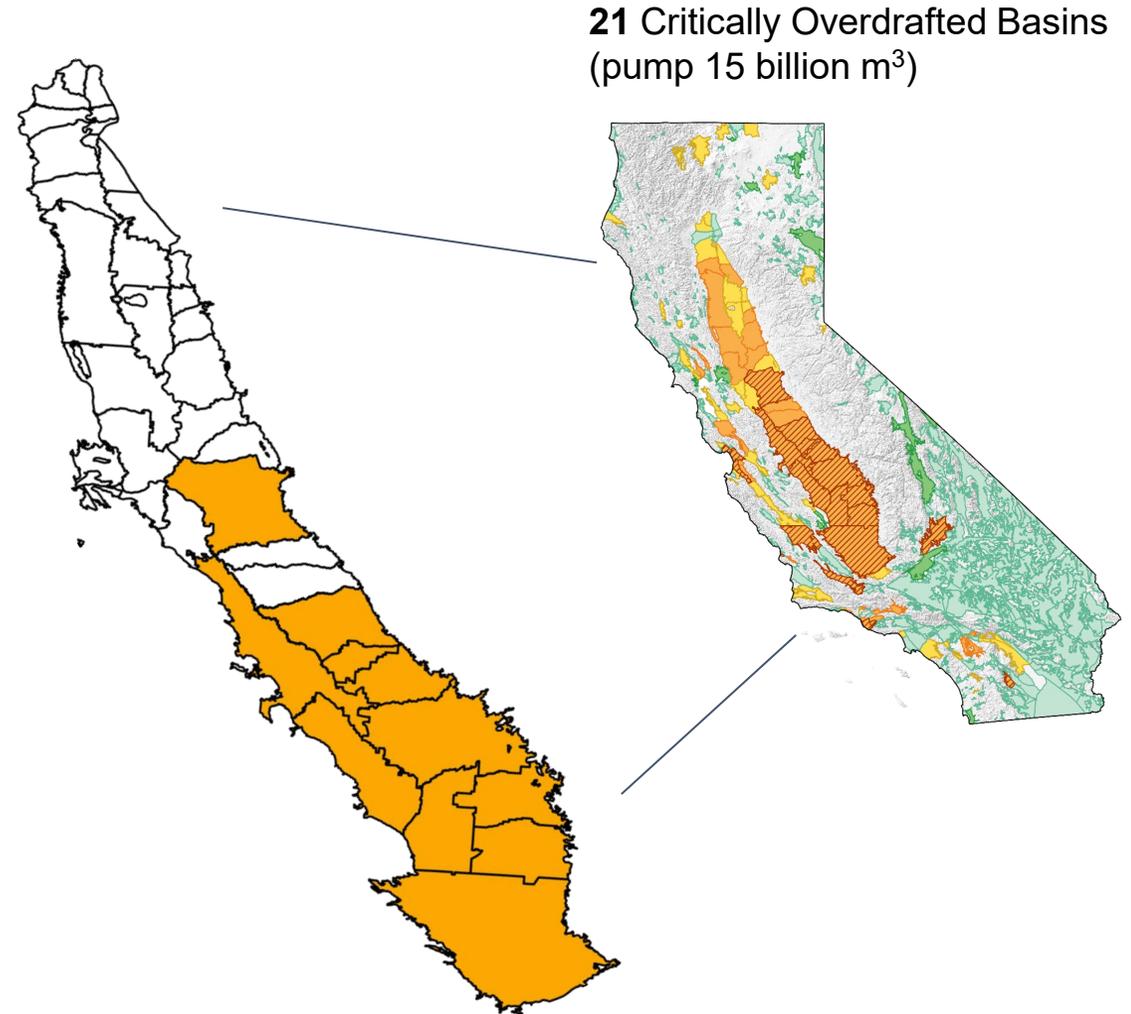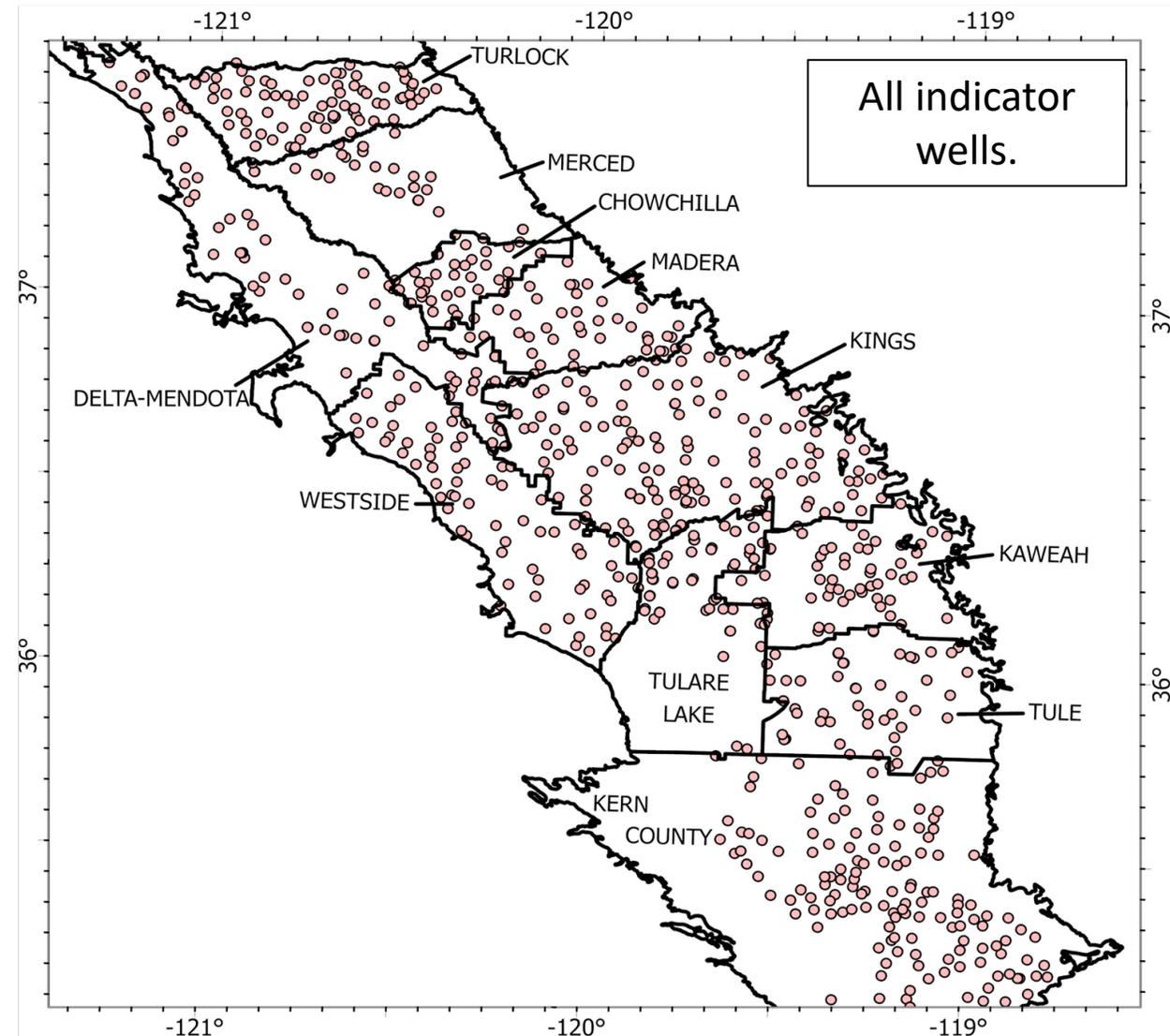
Motivation
Tasks

1. **Compile and evaluate a database of SGMA sustainability indicator wells across southern Central Valley for its spatial coverage and completeness.**

2. Model future groundwater pumping from that are reflective of both wet and dry conditions.

3. Use the modeled scenarios to determine where groundwater depletion is most severe.

**21** Critically Overdrafted Basins (pump 15 billion m^3)

Results
Sustainability Criteria Database

- Approximately 1000 indicator wells in our database with location information.

- Half of these are missing at least one piece of relevant information.

- Majority of remaining wells need screen perforated interval and screen depth data.

All indicator wells.

Results
Unconfined vs. Confined Aquifer Monitoring
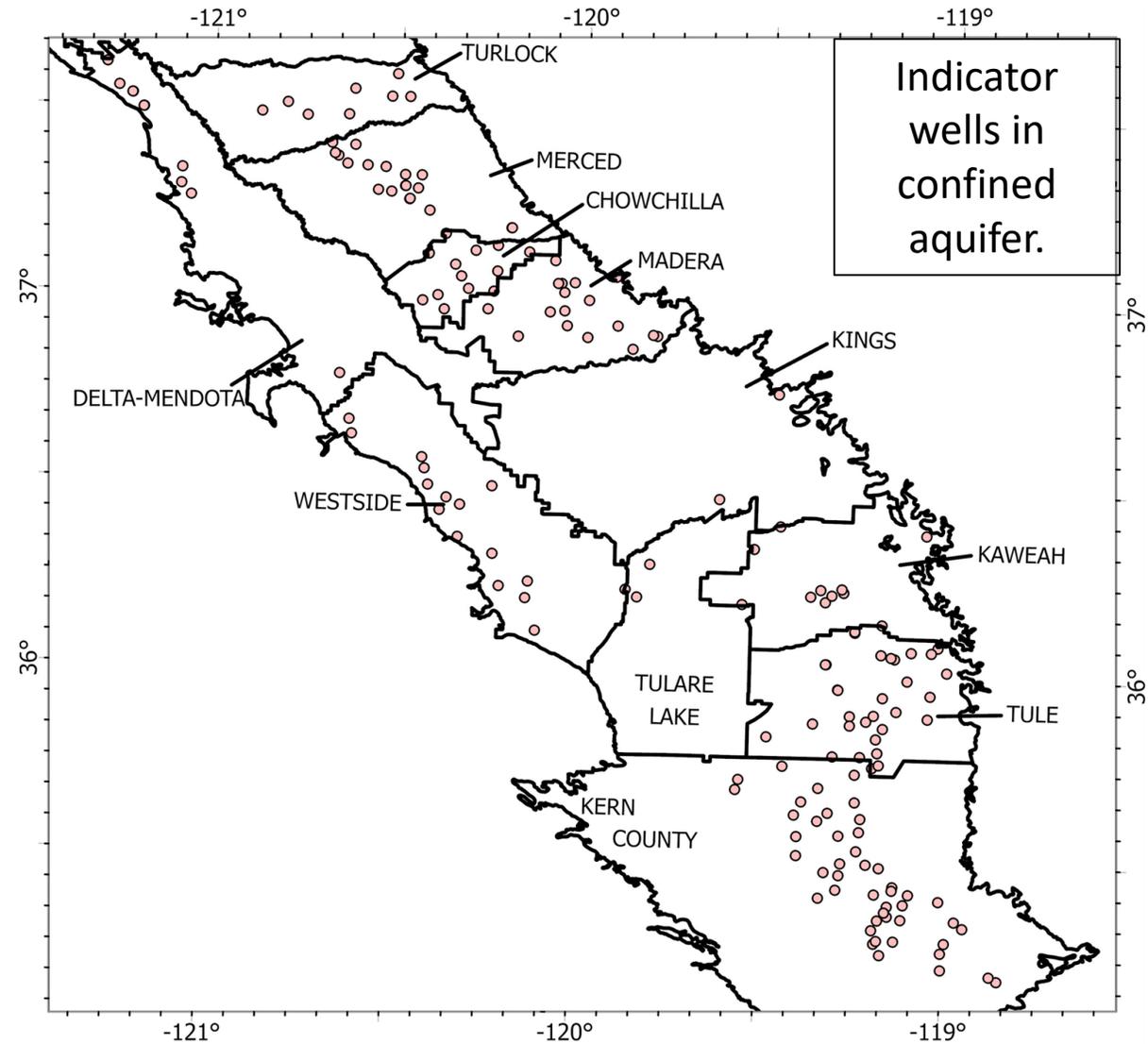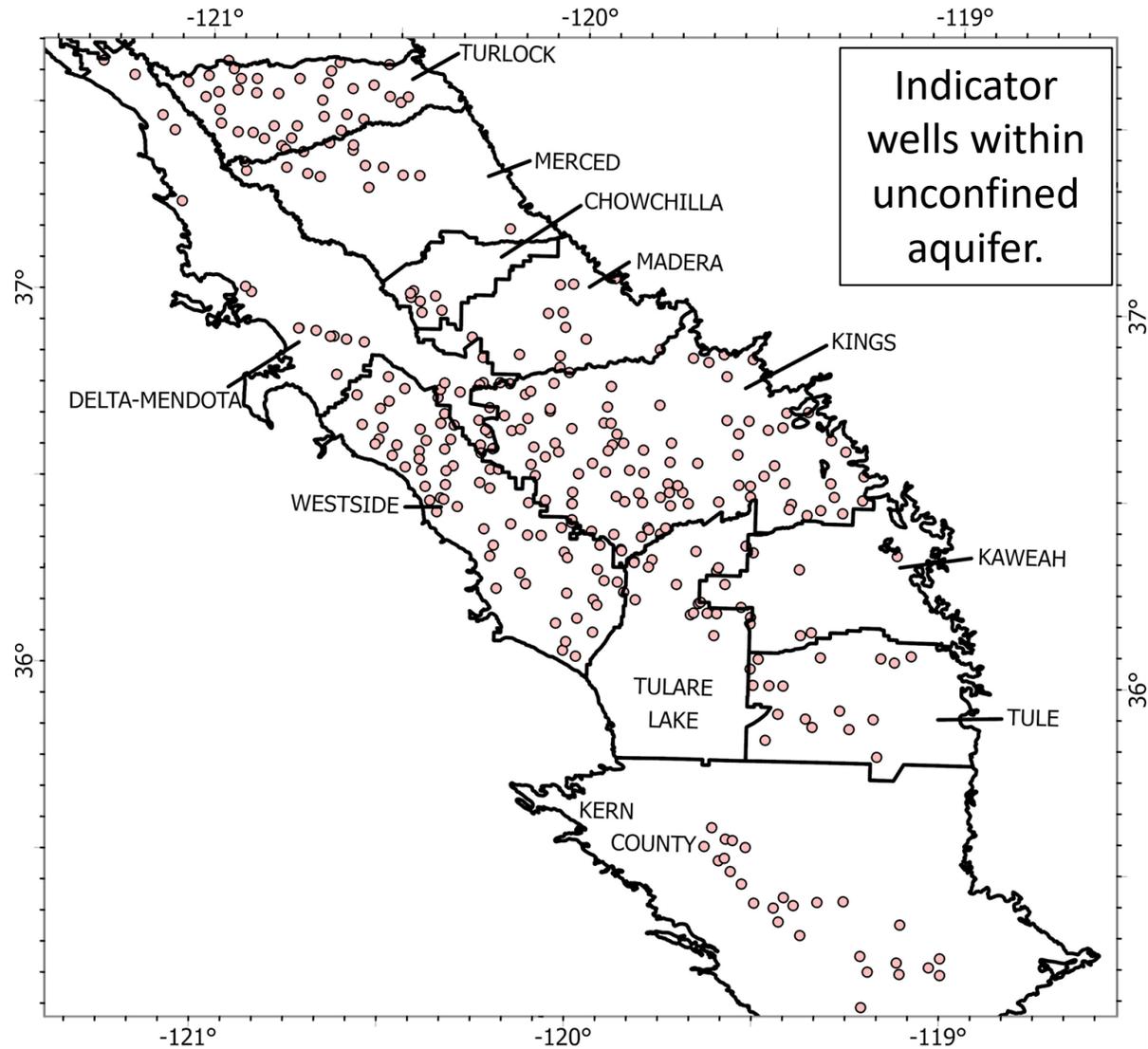
Indicator wells within unconfined aquifer.

Indicator wells in confined aquifer.
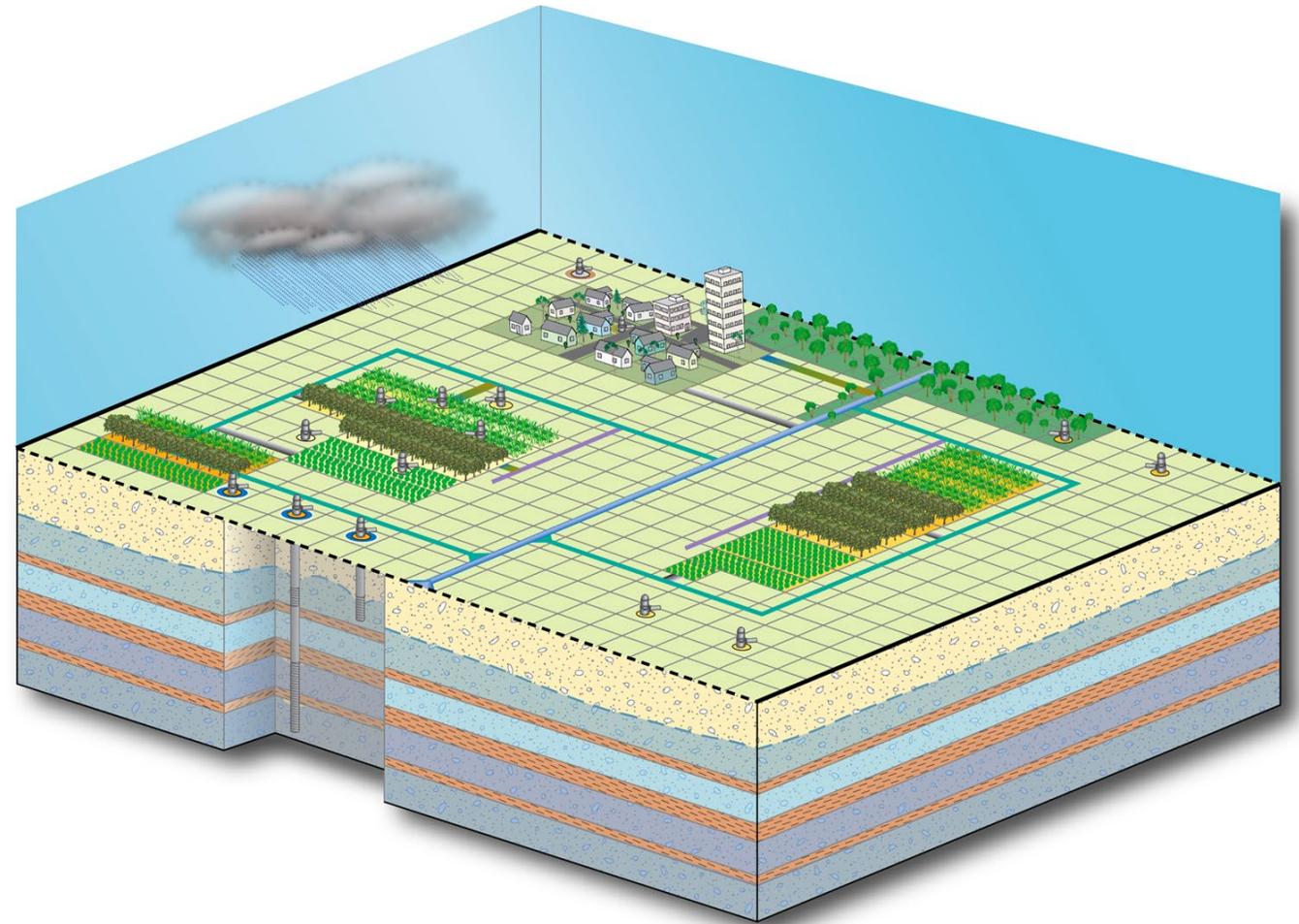
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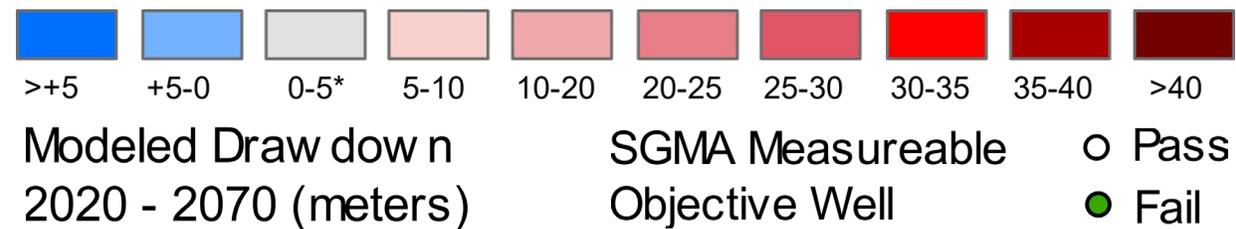**21** Critically Overdrafted Basins (pump 15 billion m^3)
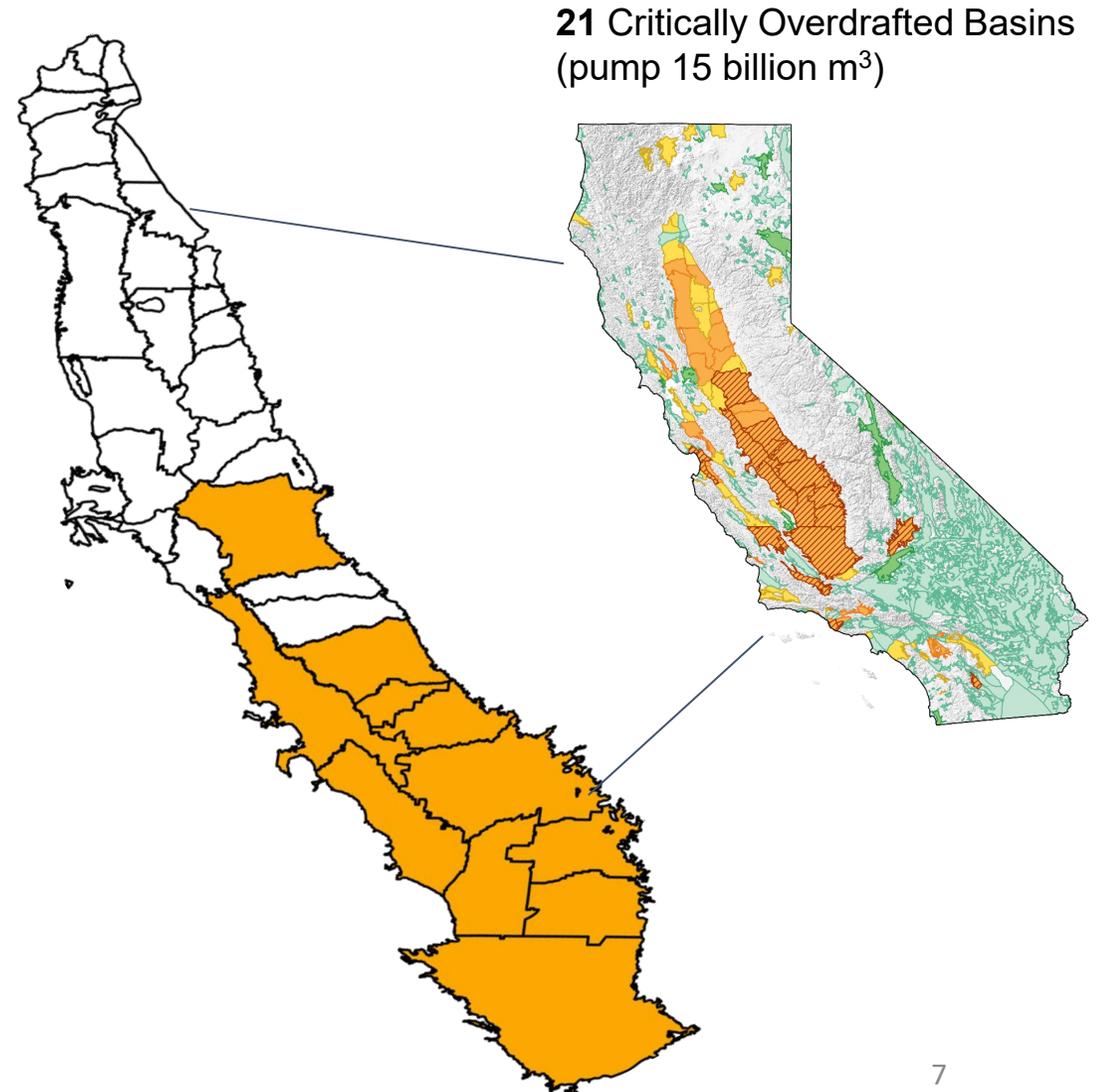
Modeling
Central Valley Hydrologic Model

- Simulating monthly water budgets between 1961 and 2020

- Six sets of data constrain model parameters.
  - Lithologic
  - Hydrologic
  - Subsidence
  - Water consumption
  - Land use (agricultural and urban)
  - Surface water inflows

- Future scenarios use historical climate from 1992 - 2014

- Models pumping with the Farm Process Package – modulate pumping using crop coefficient changes

Boyce and others, 2020

Results
Baseline Model

Year 2040

Indicator Well #82

- Baseline Model
- Measurable Objective
- Minimum Threshold
- 2040 Goal Sustinablity Year

Elevation (m)

Modeled Draw down 2020 - 2070 (meters)

| >+5 | +5-0 | 0-5* | 5-10 | 10-20 | 20-25 | 25-30 | 30-35 | 35-40 | >40 |
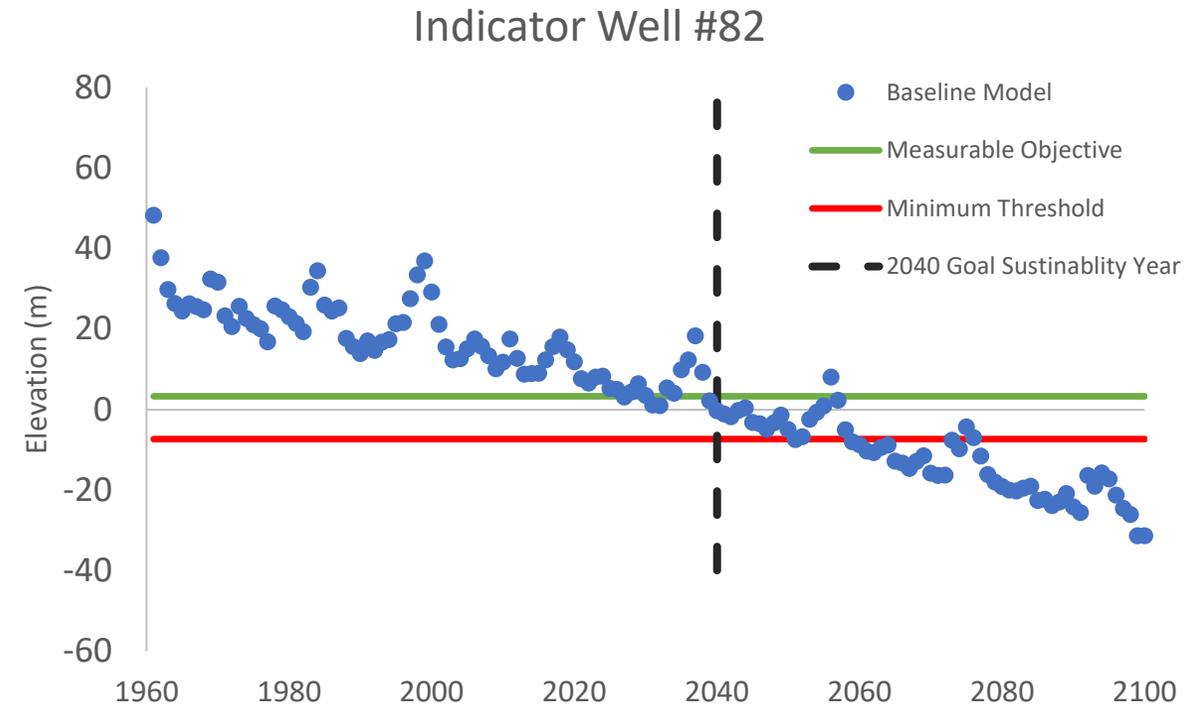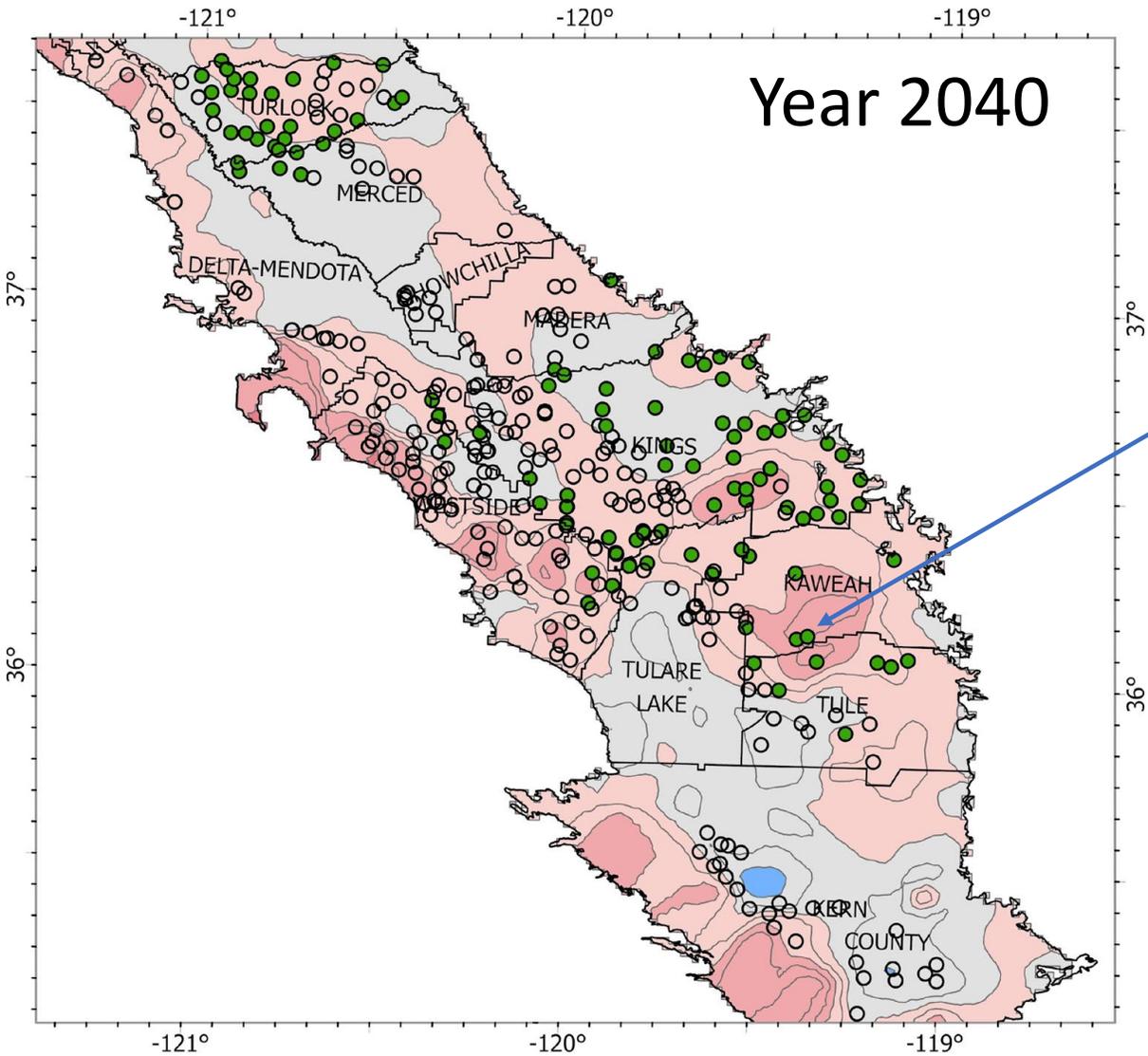
SGMA Measureable Objective Well

○ Pass
● Fail

Results
Baseline Model

Year 2070

Indicator Well #82
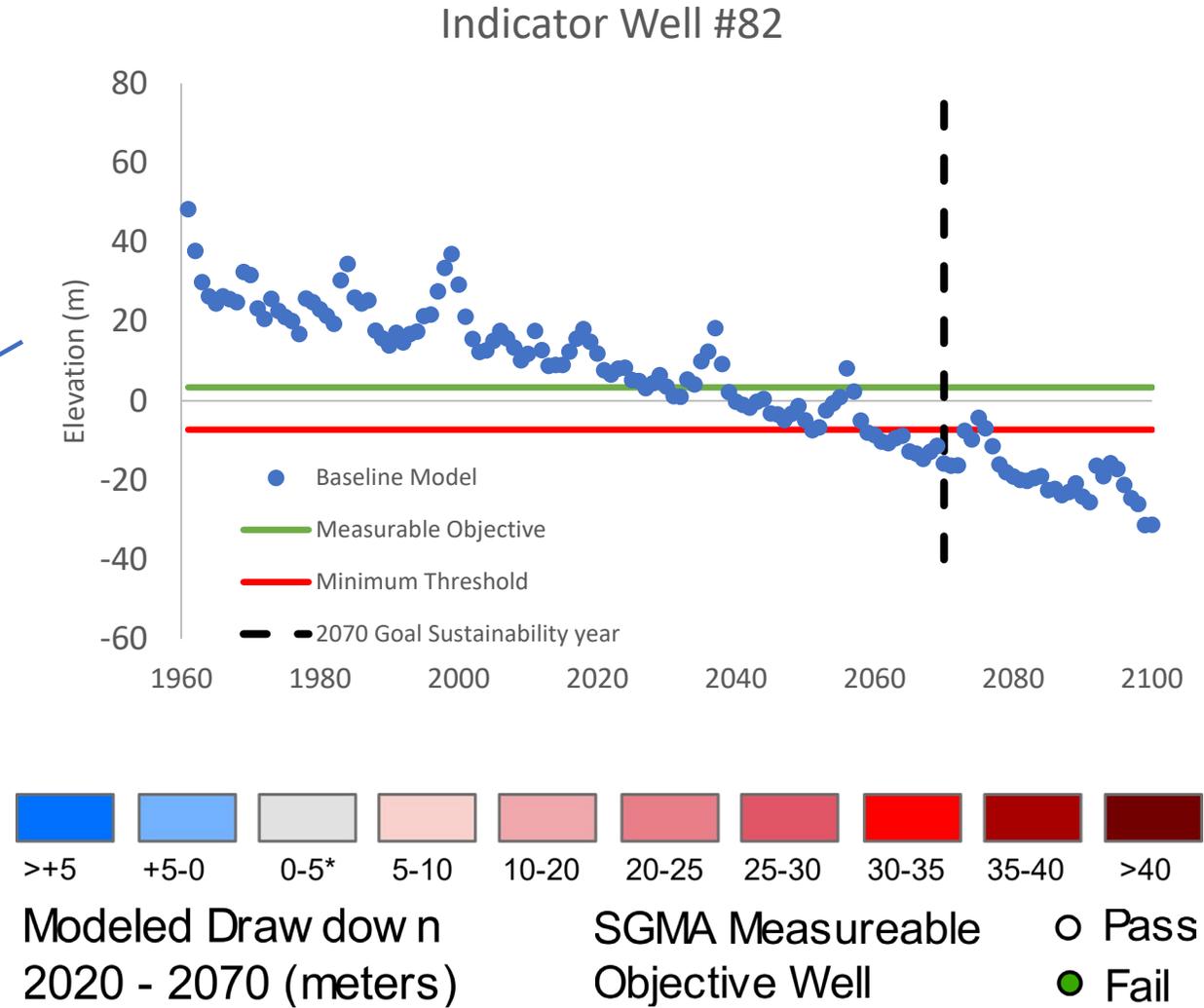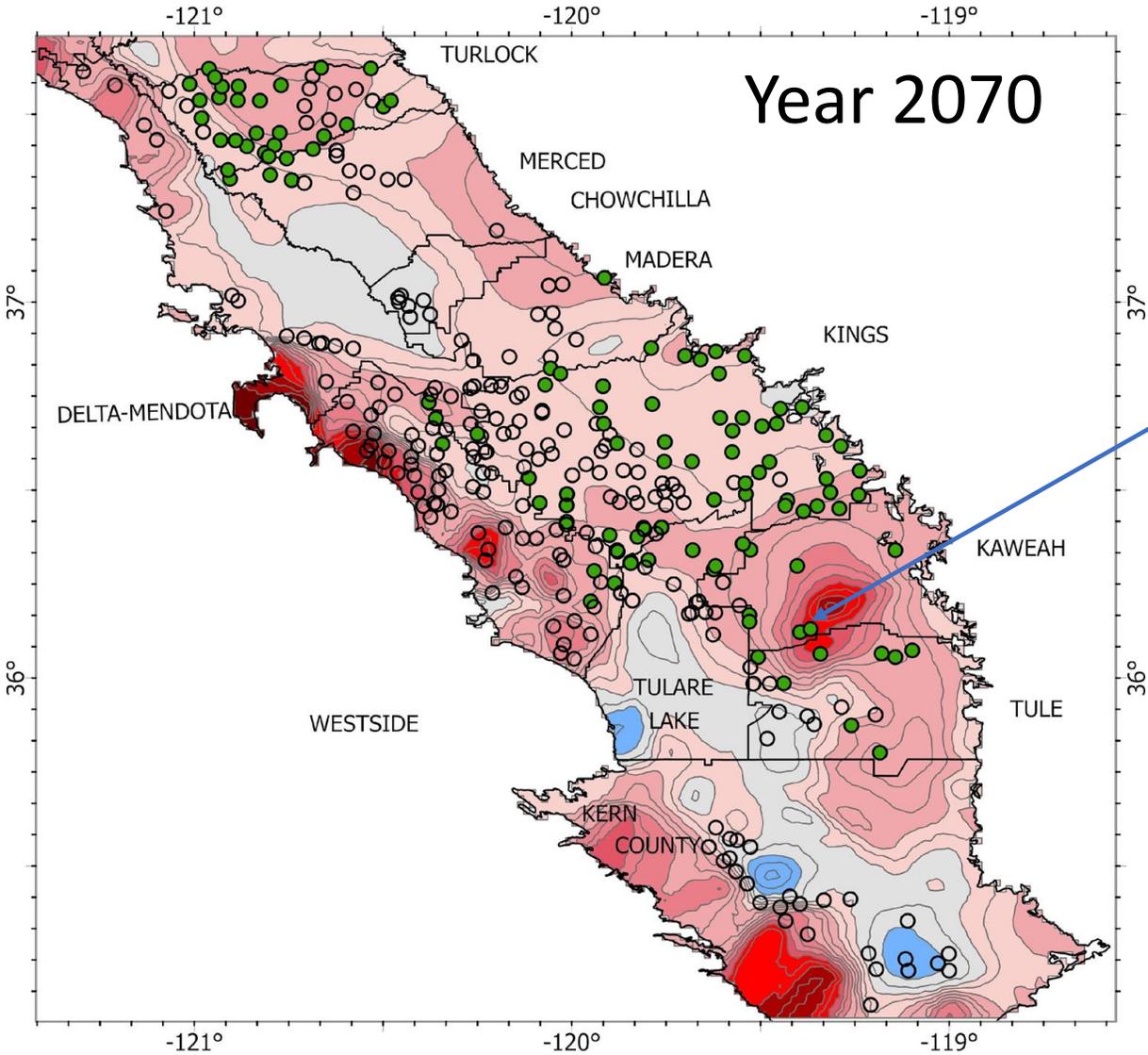
Results
Baseline vs. 25% pumping increase in 2040

SGMA Measureable Objective Well — ○ Pass — ● Fail — Modeled Draw down 2020 - 2070 (meters)

Legend: >+5, +5-0, 0-5*, 5-10, 10-20, 20-25, 25-30, 30-35, 35-40, >40
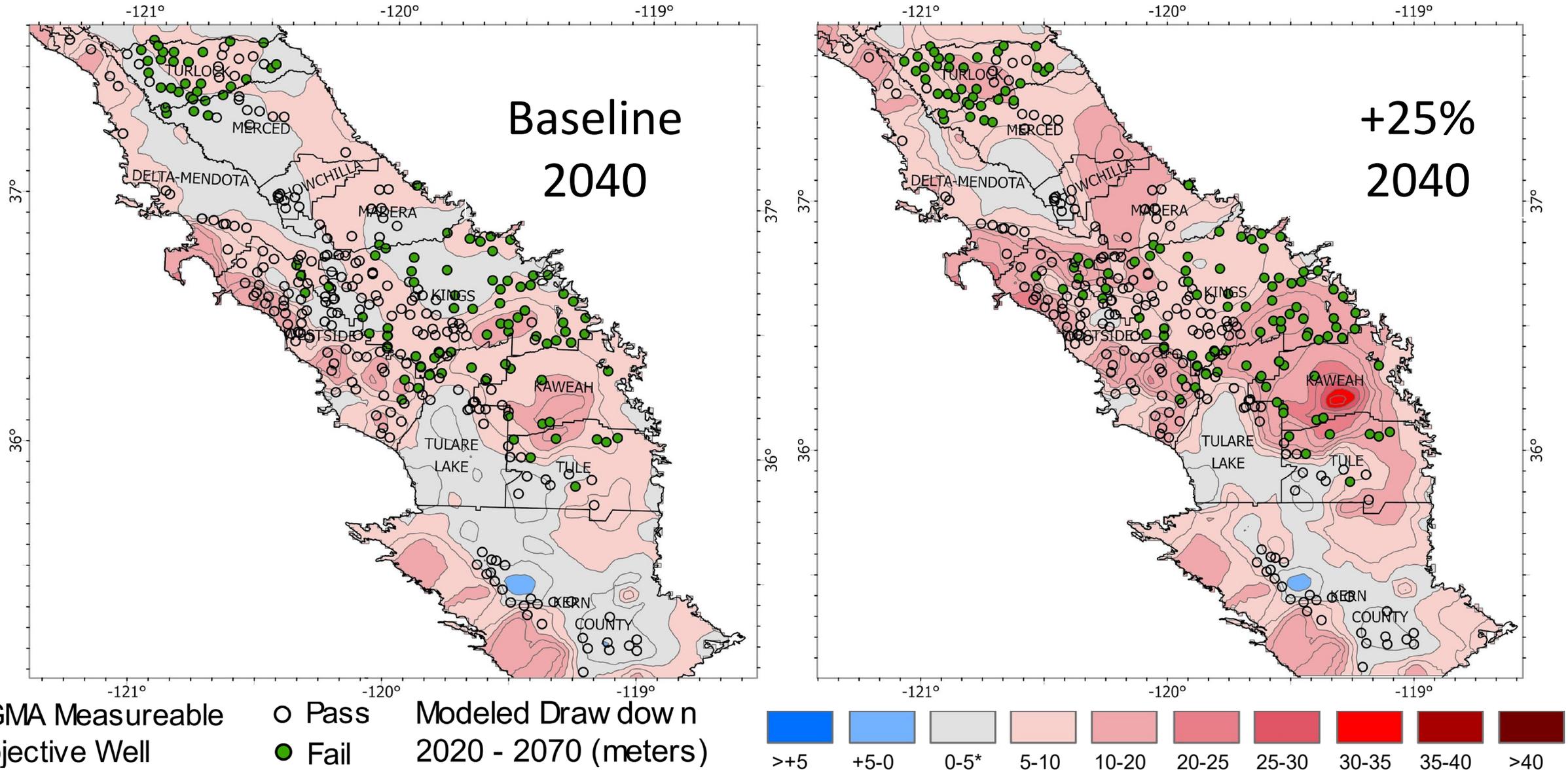
Results
Baseline vs. 50% pumping increase in 2040

Baseline
2040

+50%
2040

SGMA Measureable Objective Well
○ Pass
● Fail
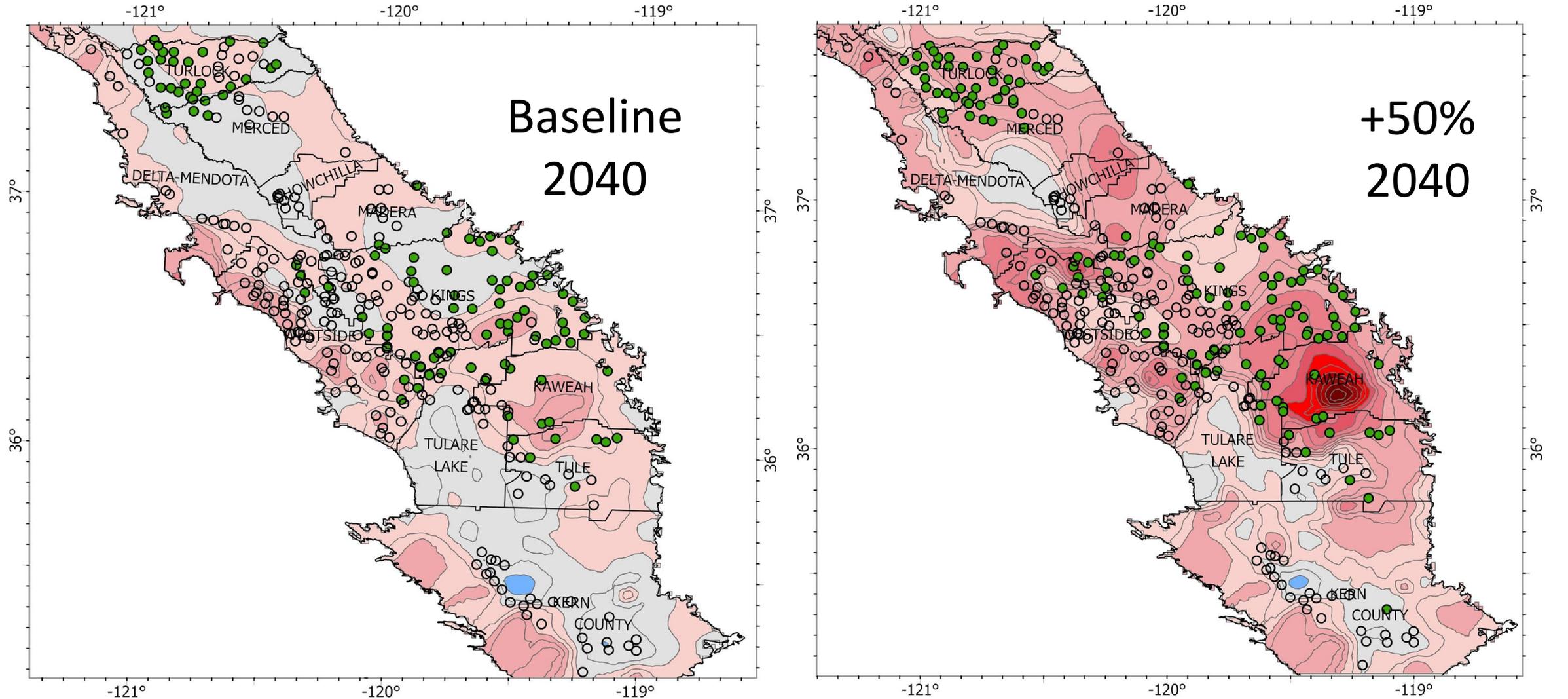Modeled Draw down 2020 - 2070 (meters)

>+5 | +5-0 | 0-5* | 5-10 | 10-20 | 20-25 | 25-30 | 30-35 | 35-40 | >40

Results
Model Scenario Outputs – 50% pumping increase

SGMA Measureable Objective Well ○ Pass ● Fail Modeled Draw down 2020 - 2070 (meters)
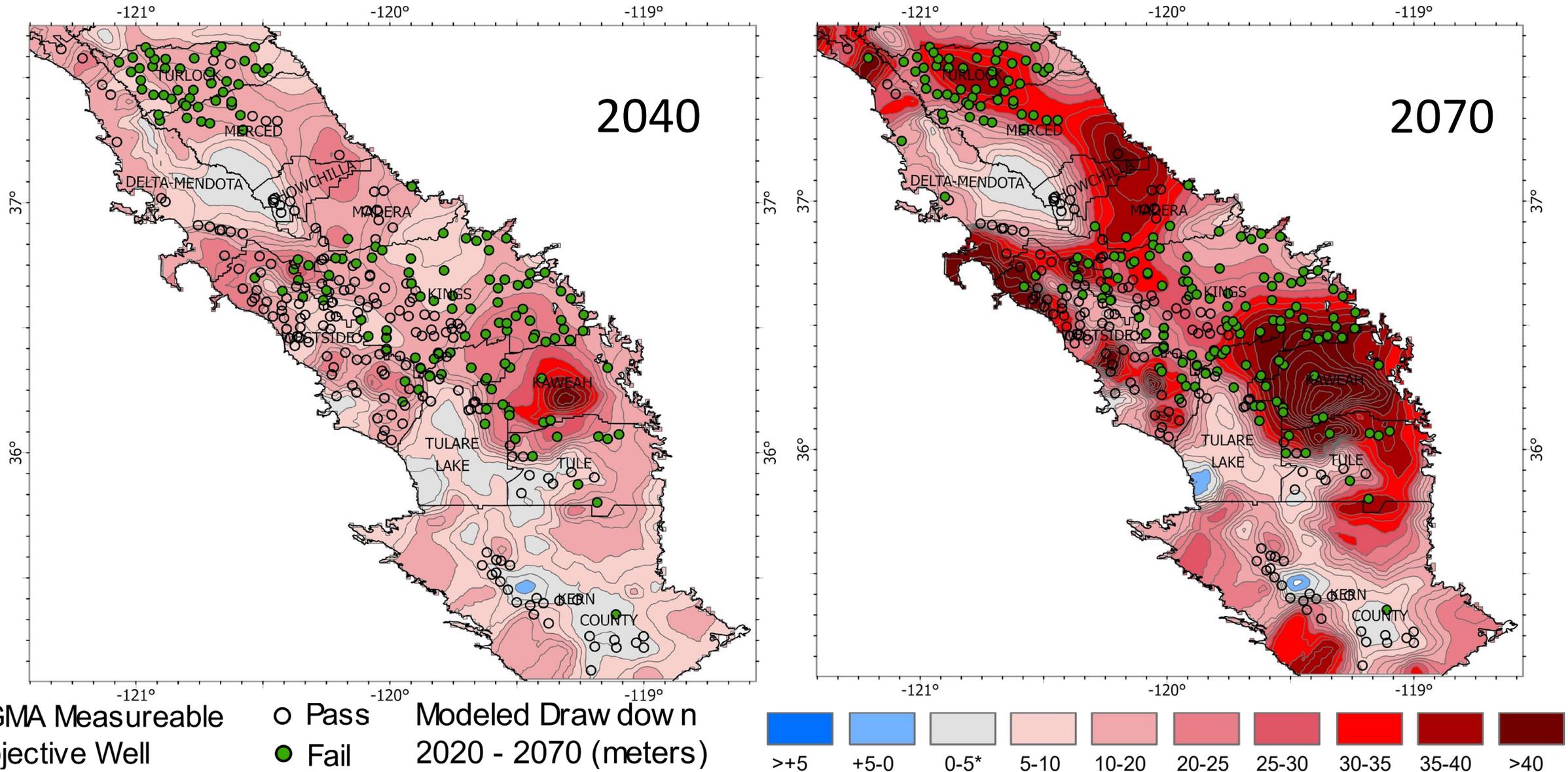
Results
Model Scenarios- Well Failures: Measurable Objectives
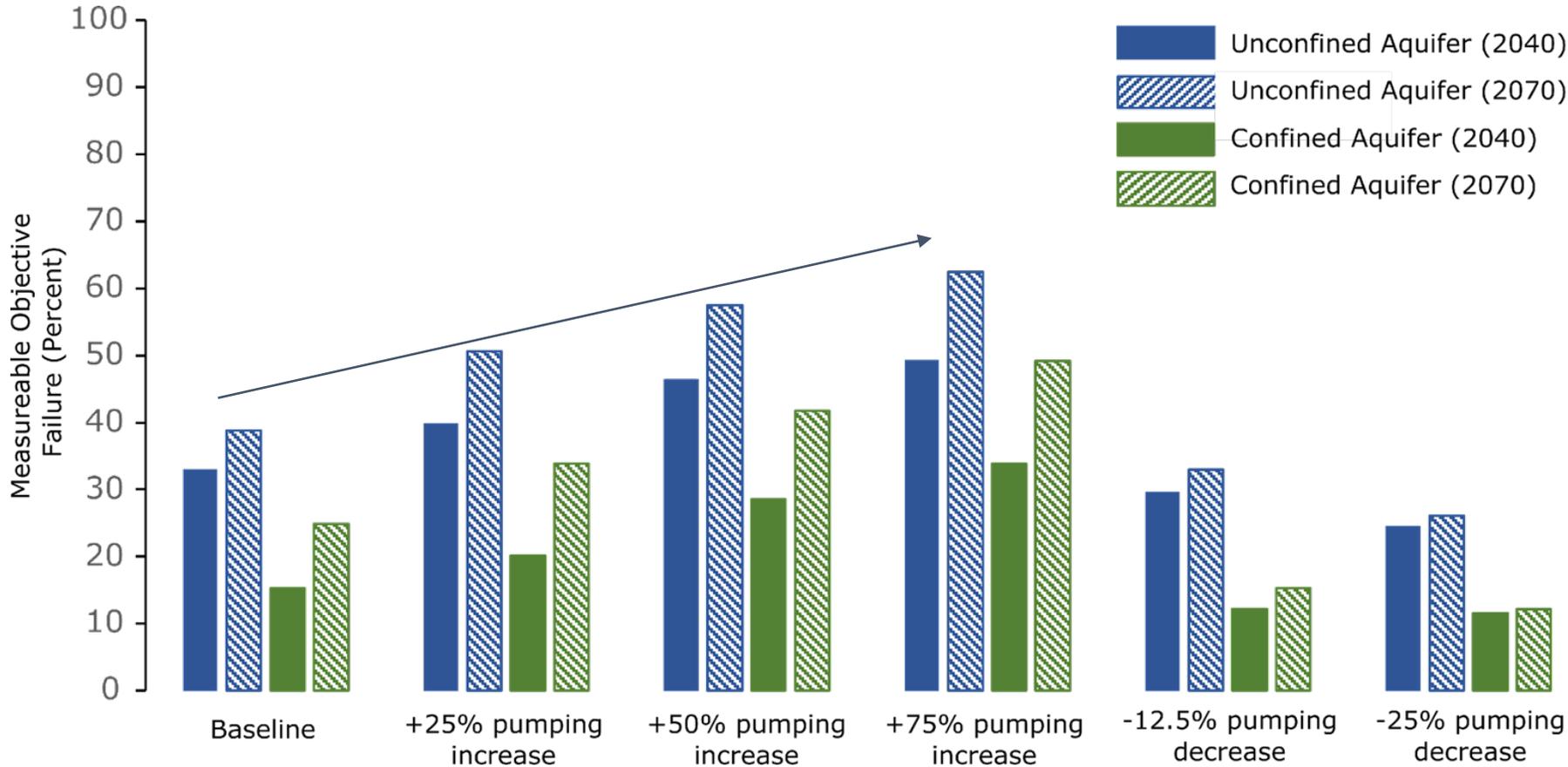
- Unconfined aquifer:
  - 2040: 20% - 50% failure
  - 2070: 25% - 60% failure

- Confined aquifer:
  - 2040: 10% - 30% failure
  - 2070: 10% - 50% failure

Preliminary Conclusions
SGMA Sustainability Goals

SGMA Measureable Objectives

Legend:
- Unconfined Aquifer (2040)
- Unconfined Aquifer (2070)
- Confined Aquifer (2040)
- Confined Aquifer (2070)

Categories: Baseline, +25% pumping increase, +50% pumping increase, +75% pumping increase, -12.5% pumping decrease, -25% pumping decrease

Baseline model
+25% pumping increase
+50% pumping increase
+75% pumping increase

Contour Interval 3m

Modeled Drawdown 2020 – 2070 (meters): >+5, +5-0, 0-5*, 5-10, 10-20, 20-25, 25-30, 30-35, 35-40, >40

SGMA Measureable Objective Well: ○ Pass ● Fail

*note: Gray regions indicate minor drawdown

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