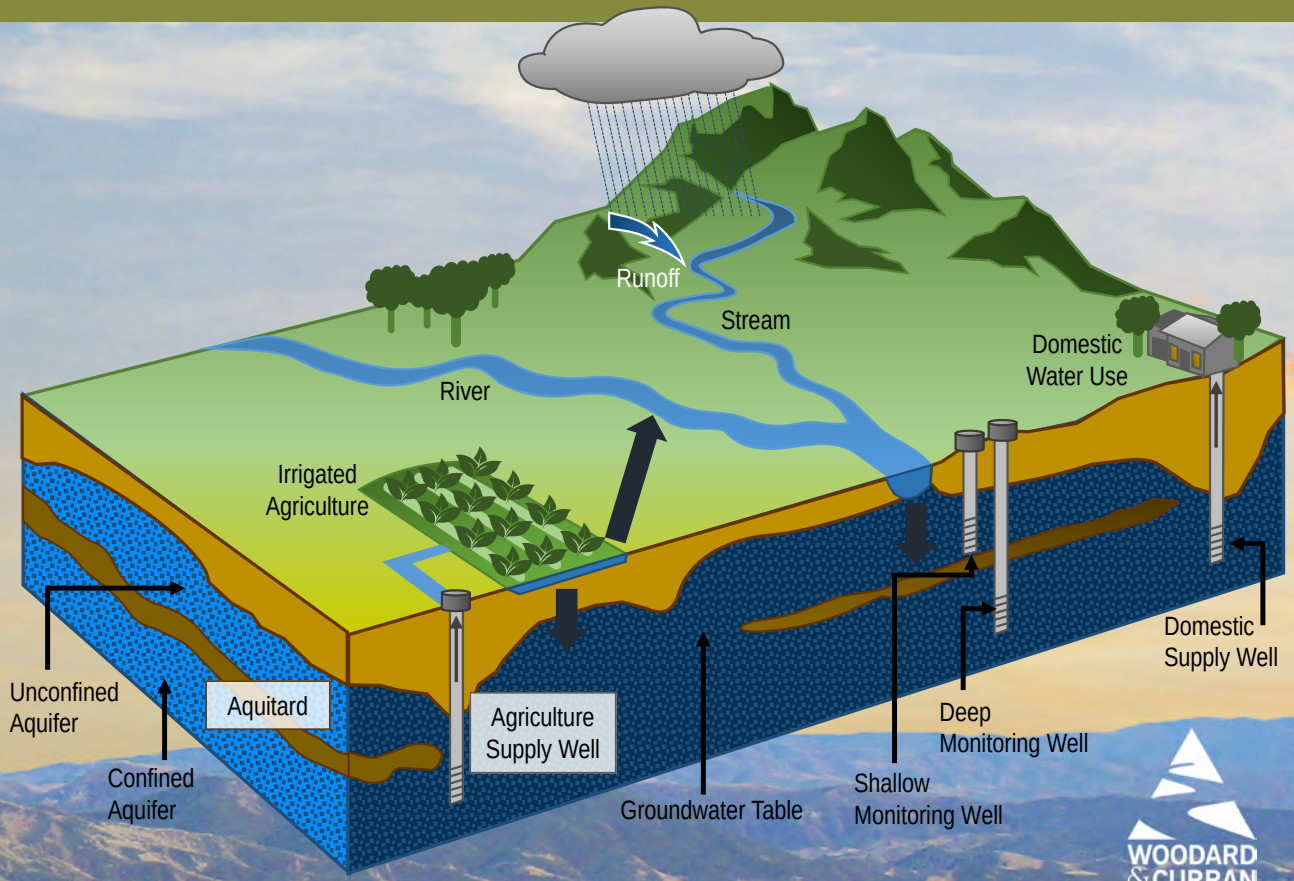
Cuyama Basin Groundwater Sustainability Agency

Update on Cuyama Basin Groundwater Modeling

December 3, 2018

Approach for Cuyama Basin Model Development

- Develop a Robust and Defensible Integrated Water Resources Model
  - Robust Model Grid
  - Agricultural and Domestic Water Demands
  - Include physical features affecting movement of surface and groundwater
  - Consider interaction between groundwater and surface water systems



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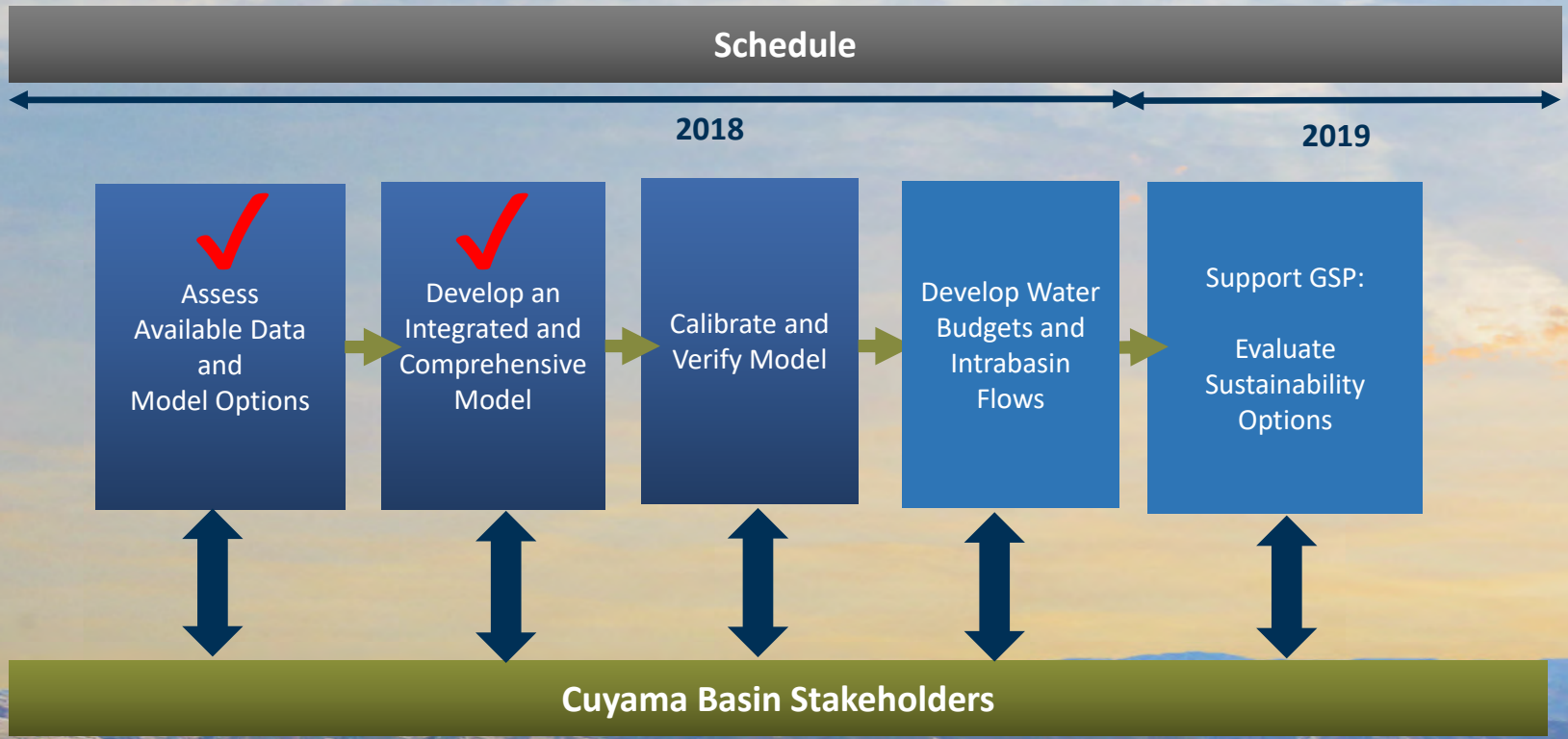
Cuyama Basin Integrated Water Resources Model Development



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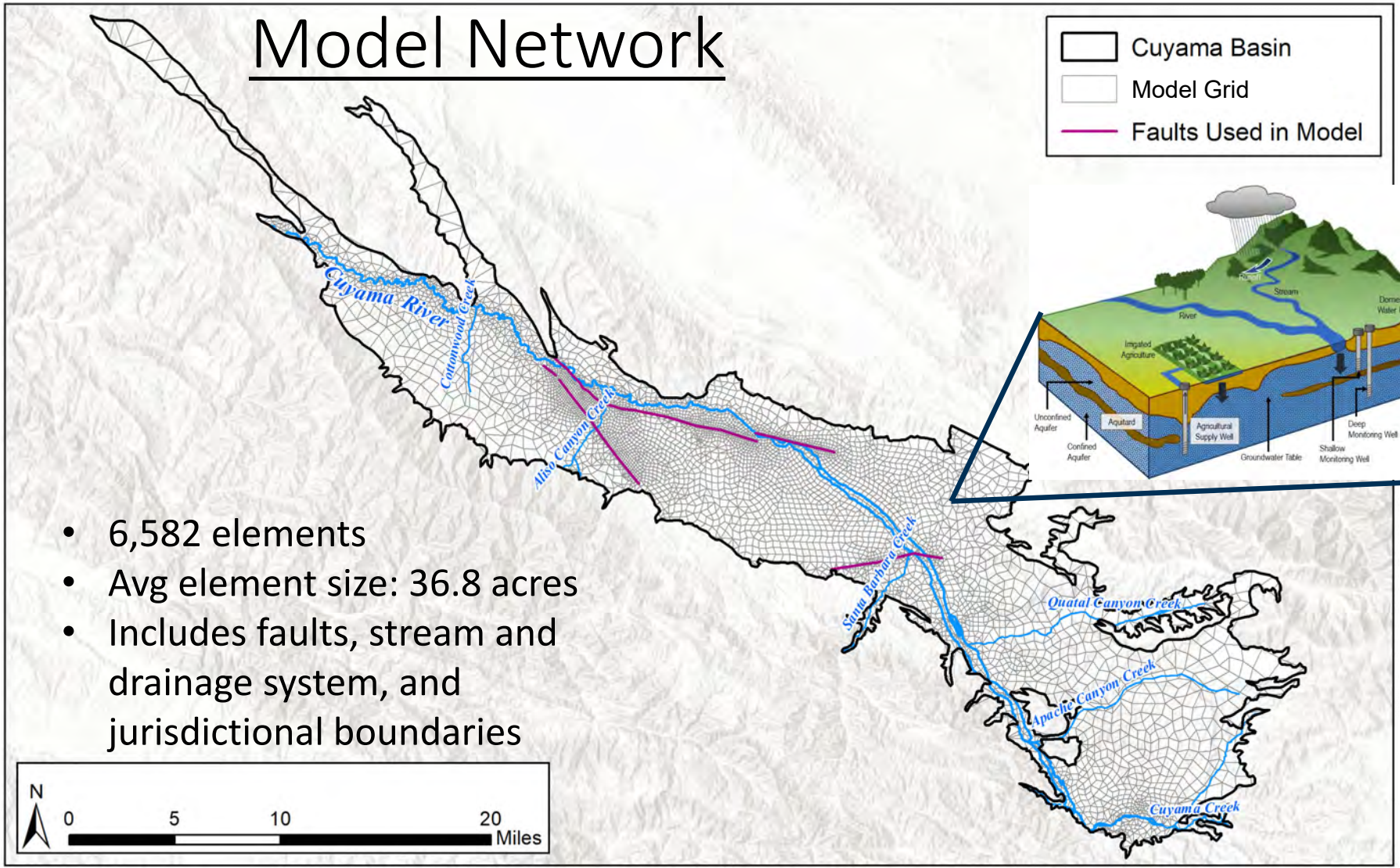
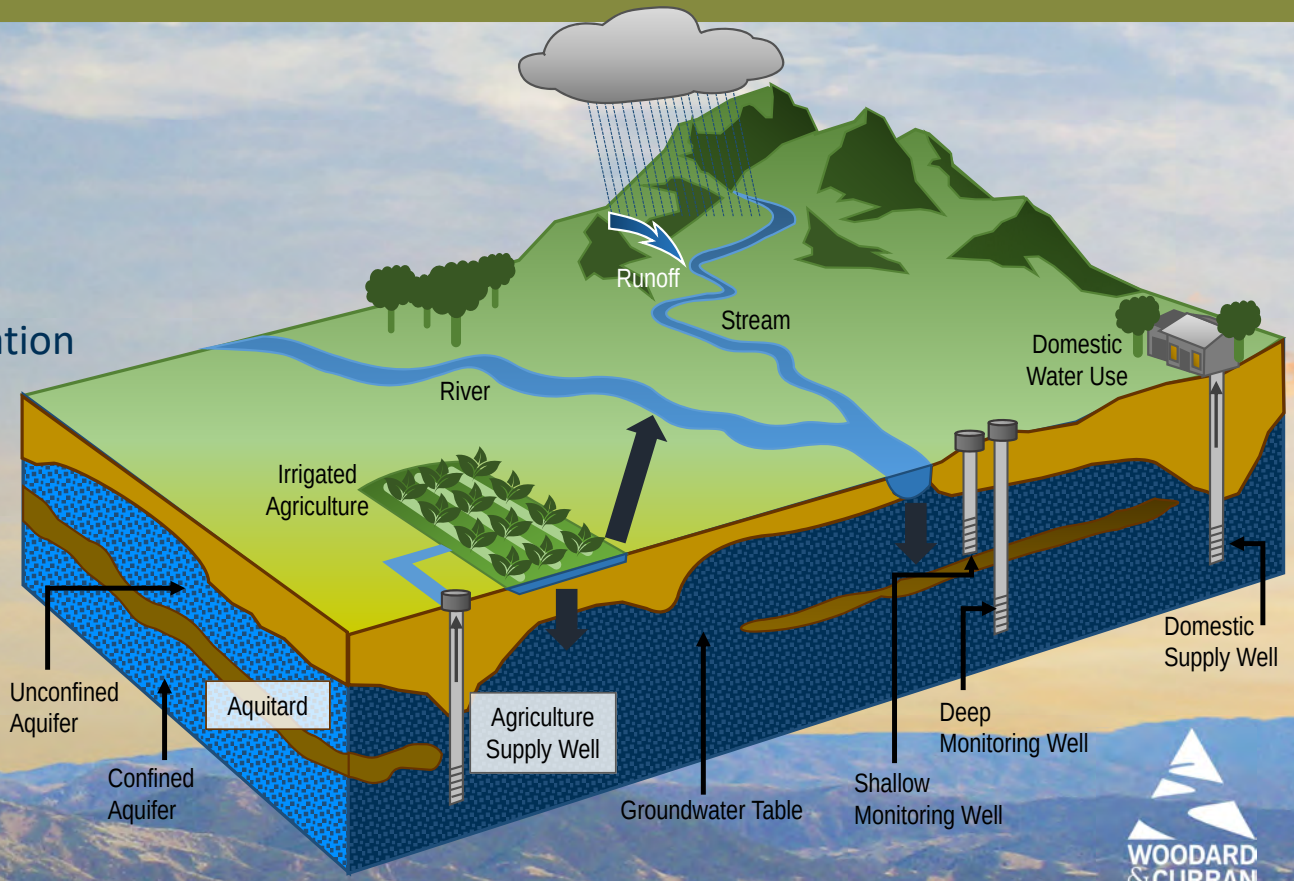
Model Network



- 6,582 elements
- Avg element size: 36.8 acres
- Includes faults, stream and drainage system, and jurisdictional boundaries

Data Used in the Model

- Model Period: 1967-2017
- Calibration Period: 1995-2015
- Daily Rainfall
- Daily Streamflow Reconstruction
- Geologic & Hydrogeologic Characterization
- Land Use and Cropping Patterns
- Soil Conditions
- Population and Domestic Water Use
- Groundwater Wells
- Irrigation Practices
- Other Data as Needed



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Model Calibration

- Calibration Goals:
  - Develop water budgets to reasonably represent the conditions for each area
  - Match short and long-term model groundwater levels to observed groundwater levels at select target wells
  - Match model streamflows to observed (or reconstructed) stremflows
  - Minimize overall uncertainties between model results and reported and/or observed data

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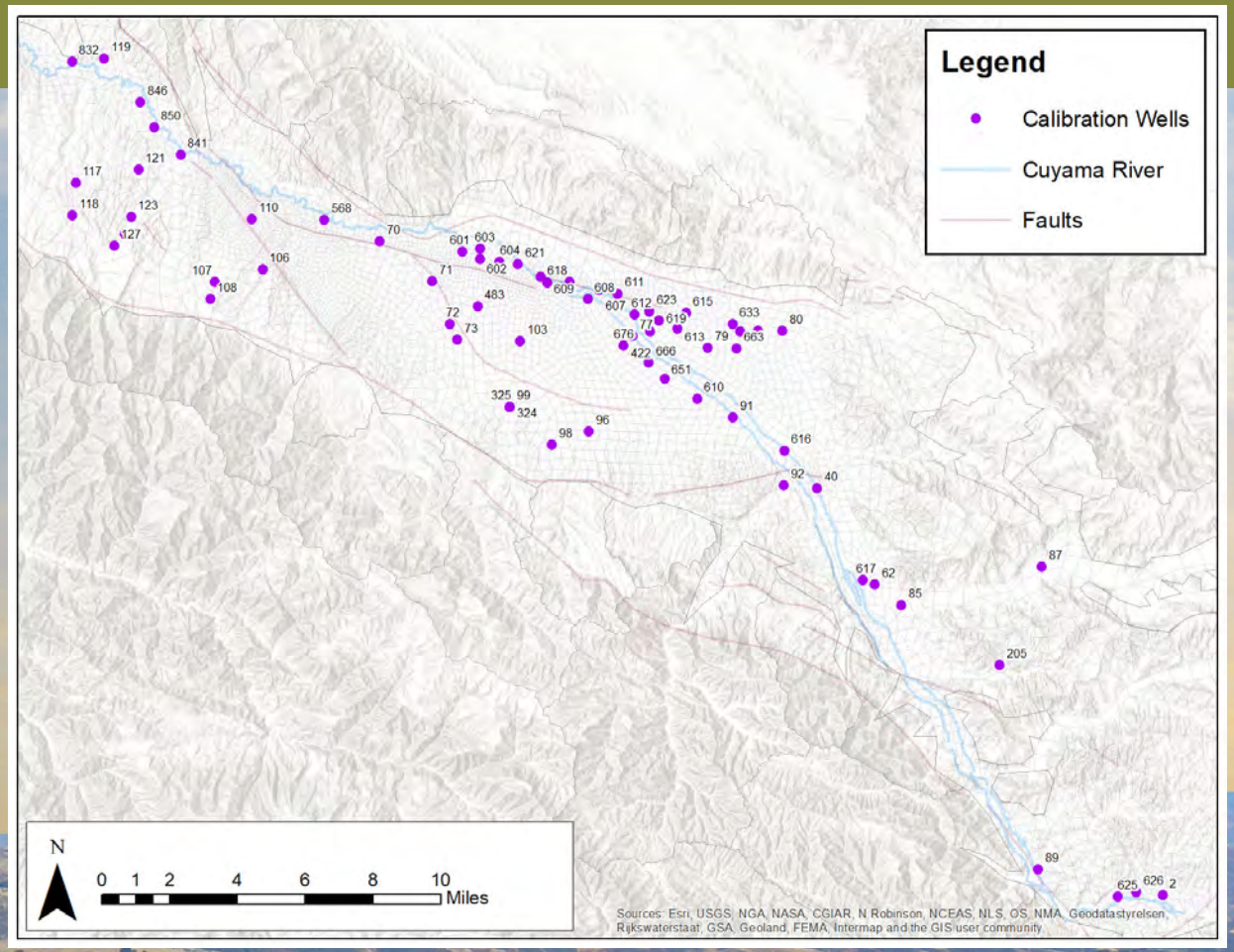
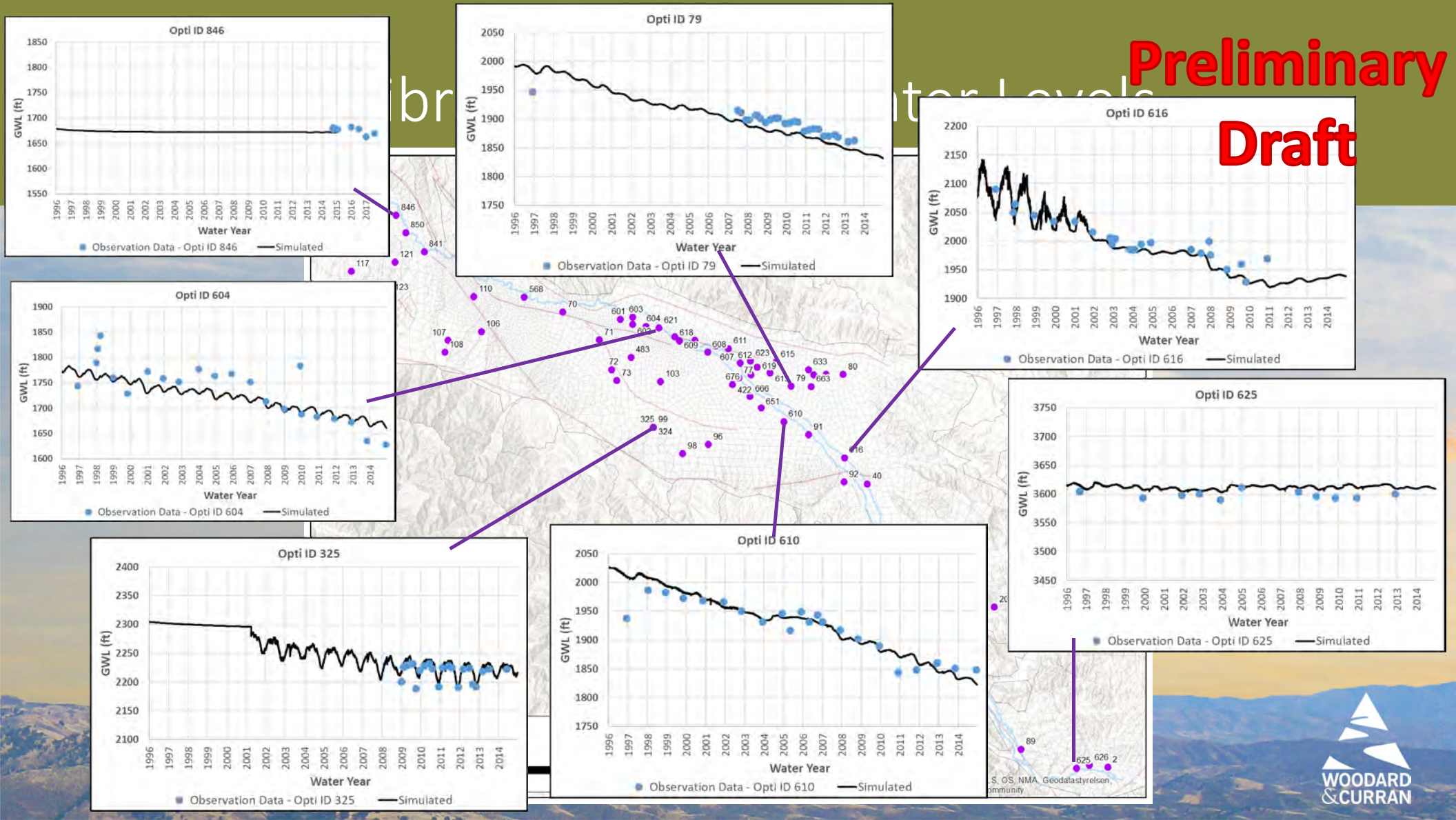
Model Calibration: Groundwater Levels

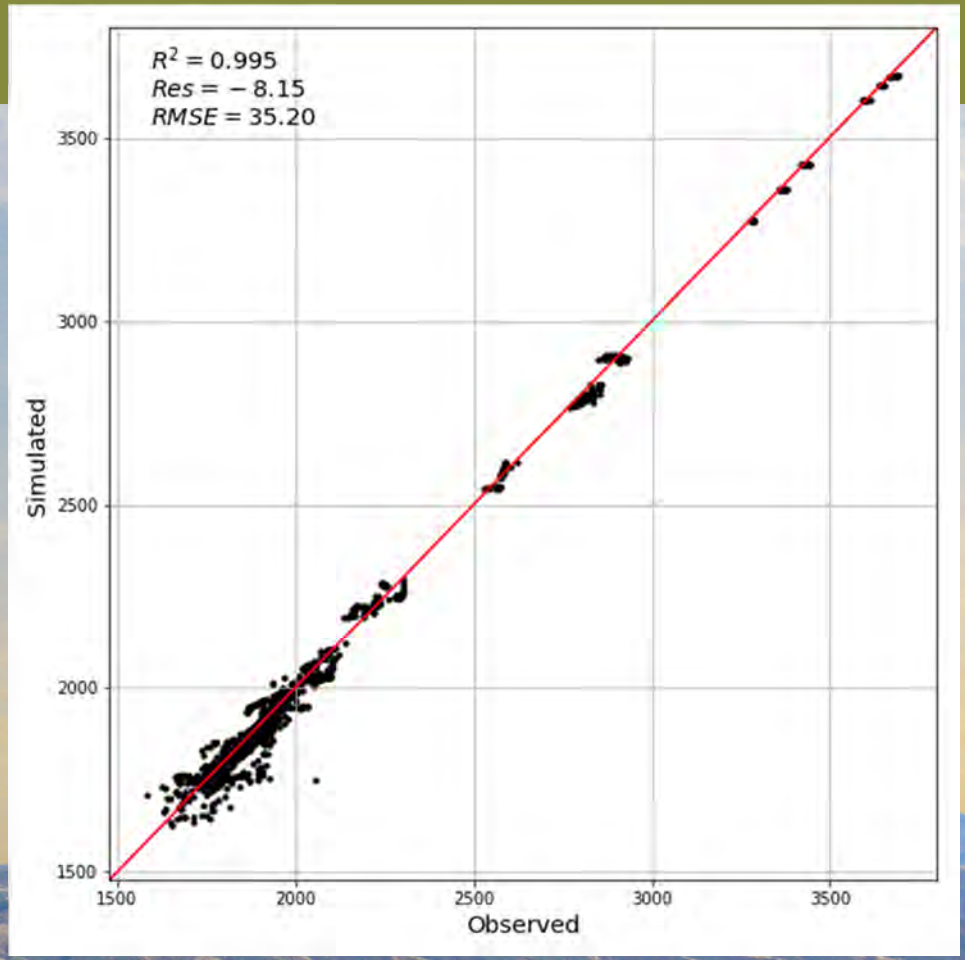


Preliminary

Draft



Model Calibration Statistics – Basin Wide



Water Budgets - Time Frames

Historical Conditions

Historical hydrology, land use and population (1995-2015)

Current Conditions

2017 land use and population

1967 - 2017 historical hydrology

Future Conditions

Year 2040 land use and population

- Assumed to be the same as Current Conditions

1967- 2017 historical hydrology

With and without climate change

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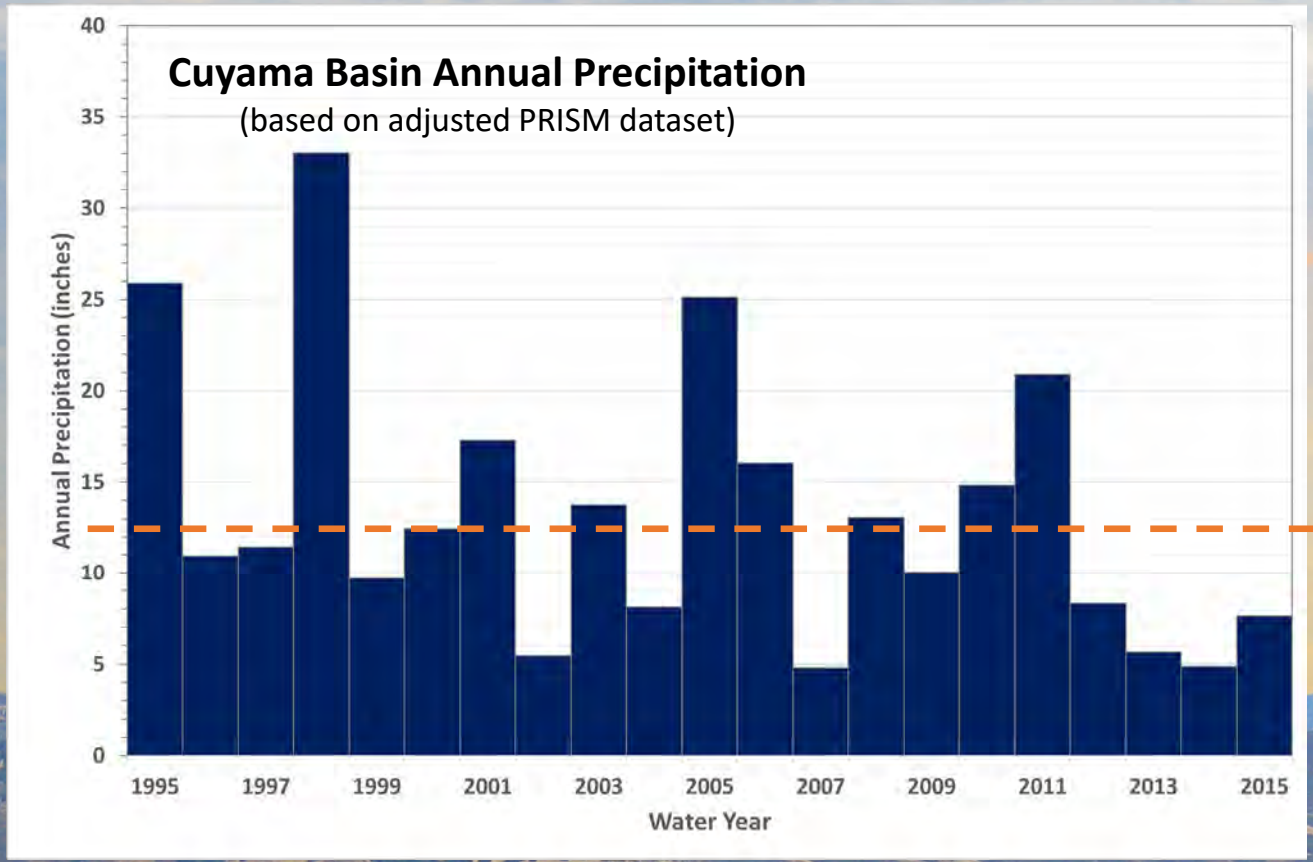
Cuyama Basin – Adjusted PRISM Precipitation



Average Annual Precipitation:

- Entire Basin: 12.6 inches
- Valley Floor: 11.0 inches
- Foothills: 14.2 inches

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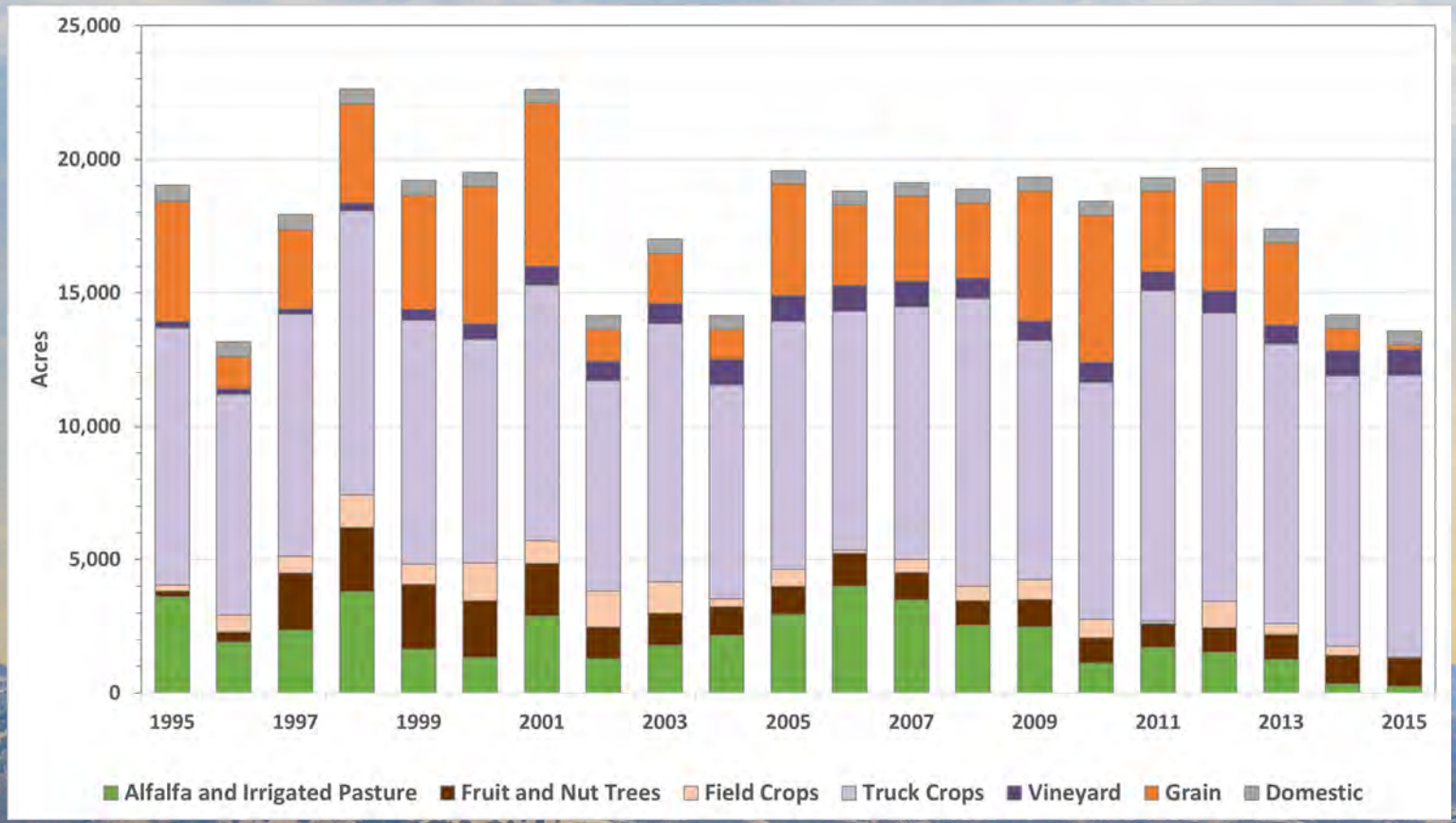
Cuyama Basin Land Use



Land Use under Historical Conditions

- Irrigated: 17,400 acres
- Domestic: 520 acres
- Population: 1,072
- Unit Water Use: 170 GPCD

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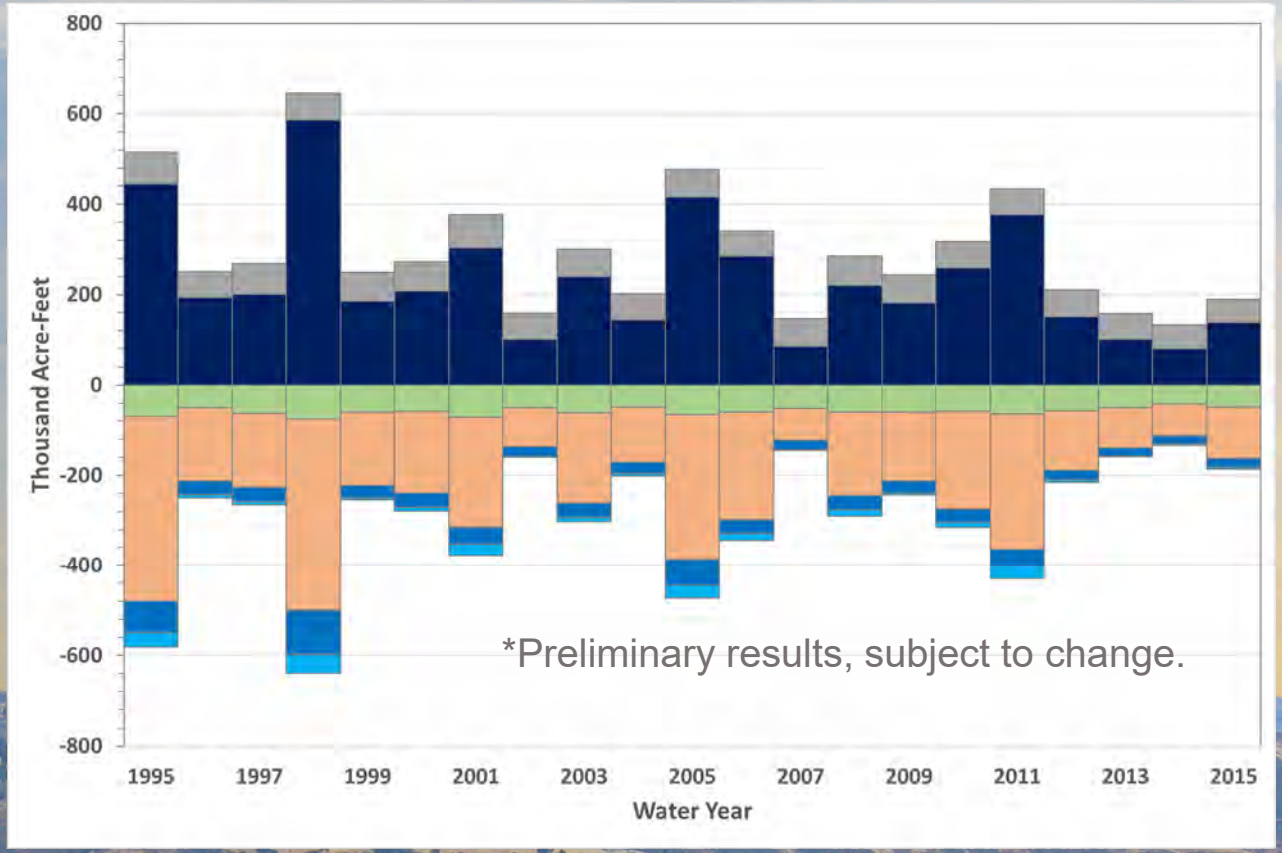
Draft Land Surface Water Budget: Basin-Wide

Preliminary Draft



Average Annual (20 years)

Inflows

- Precipitation 223 TAF (~11 in)
- Applied Water 60 TAF

Outflows

- Ag. Actual ET 58 TAF
- Native Veg. Actual ET 182 TAF
- Domestic Actual ET <0.1 TAF
- Deep Perc. 32 TAF
- Runoff 11 TAF

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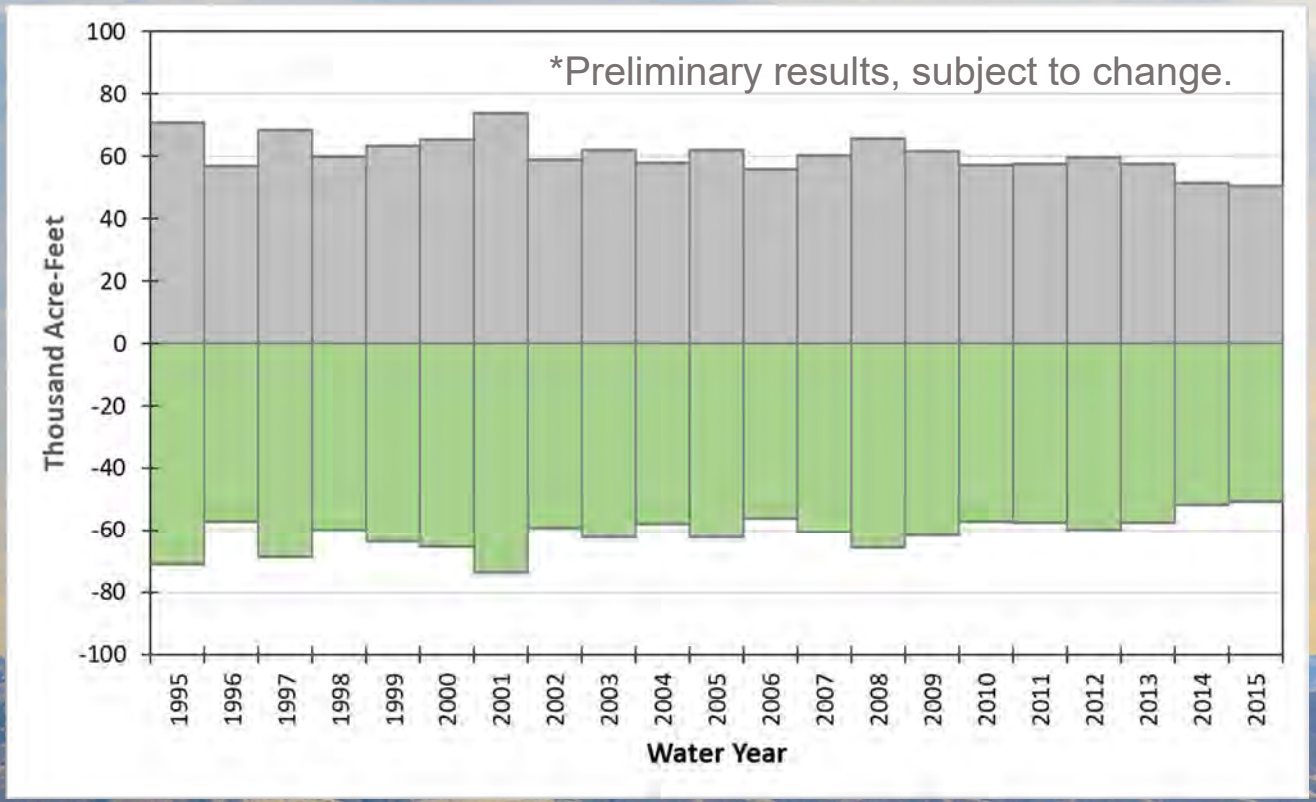
Draft Land & Water Use Budget: Basin-Wide

Preliminary Draft



Average Annual (20 years)

- Ag. Pumping: 60 TAF
- Ag. Demand: 60 TAF
- Domestic Pumping: 0.2 TAF
- Domestic Demand: 0.2 TAF

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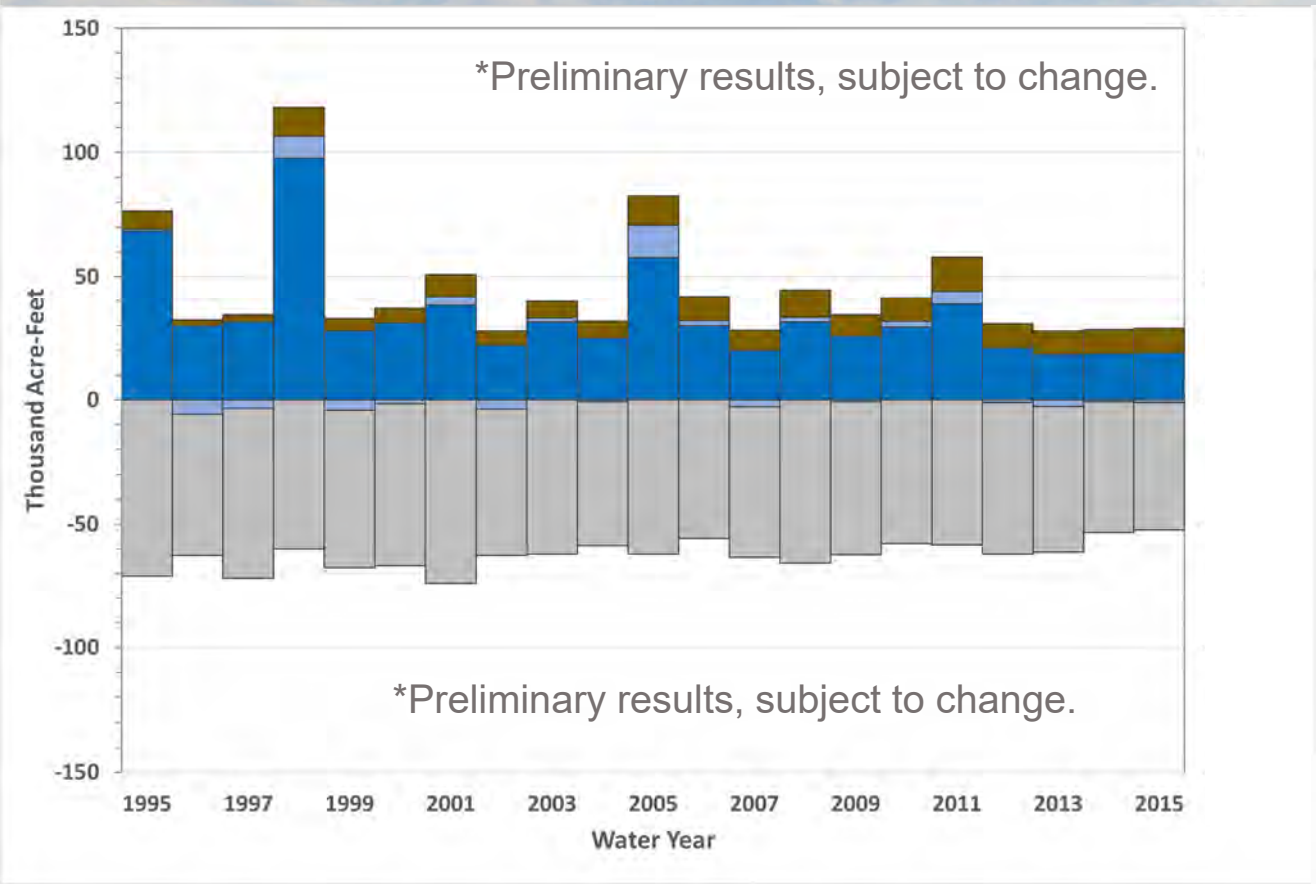
Draft Groundwater Budget: Basin-Wide

Preliminary Draft



Average Annual (20 years)

- **Inflows:**
  - Deep Perc.
  - Stream Seepage
  - Boundary Flow
- **Outflows:**
  - GW Pumping

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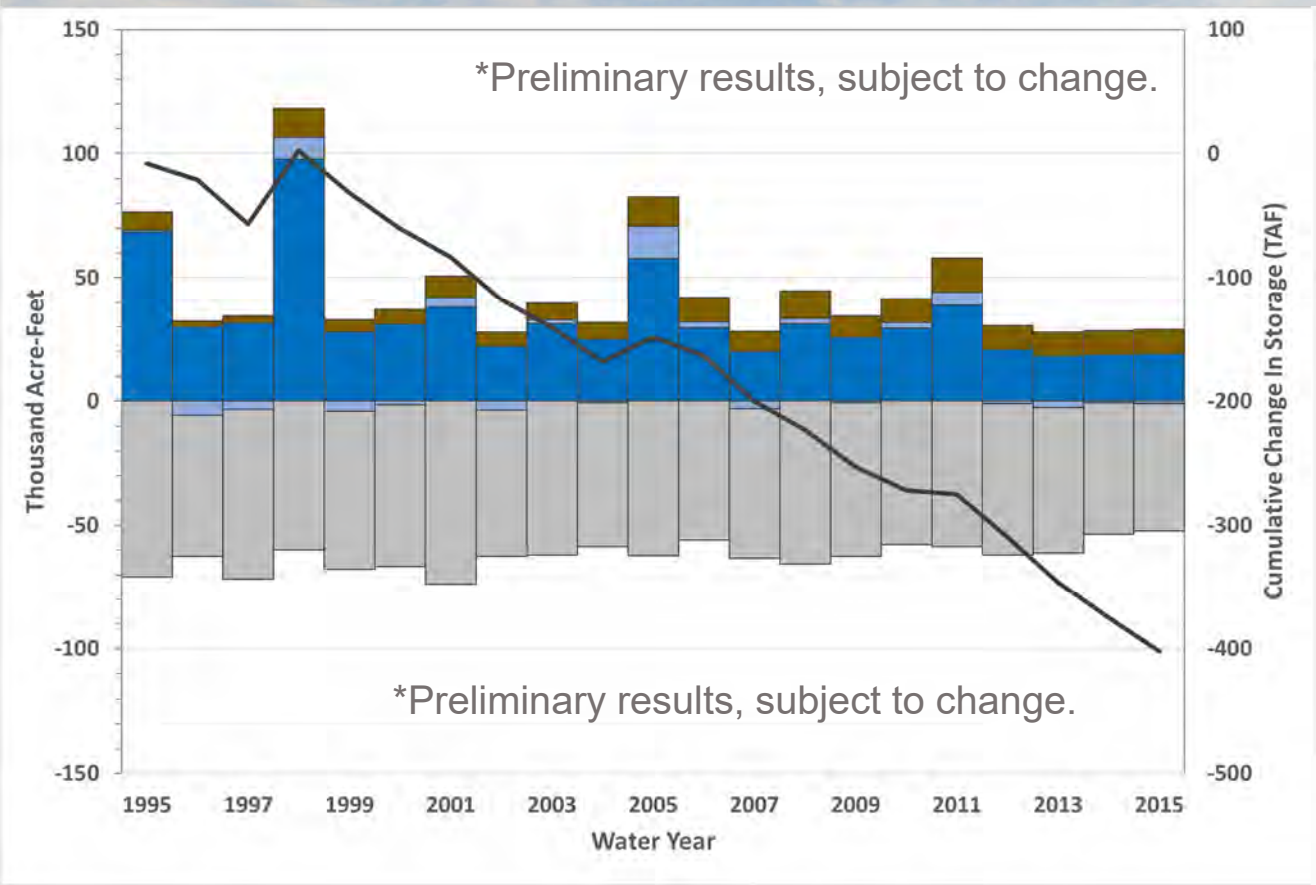
Draft Groundwater Budget: Basin-Wide

Preliminary Draft



Average Annual (20 years)

- **Inflows:**
  - Deep Perc.
  - Stream Seepage
  - Boundary Flow
- **Outflows:**
  - GW Pumping

GW Storage Change

-20 TAF /Yr

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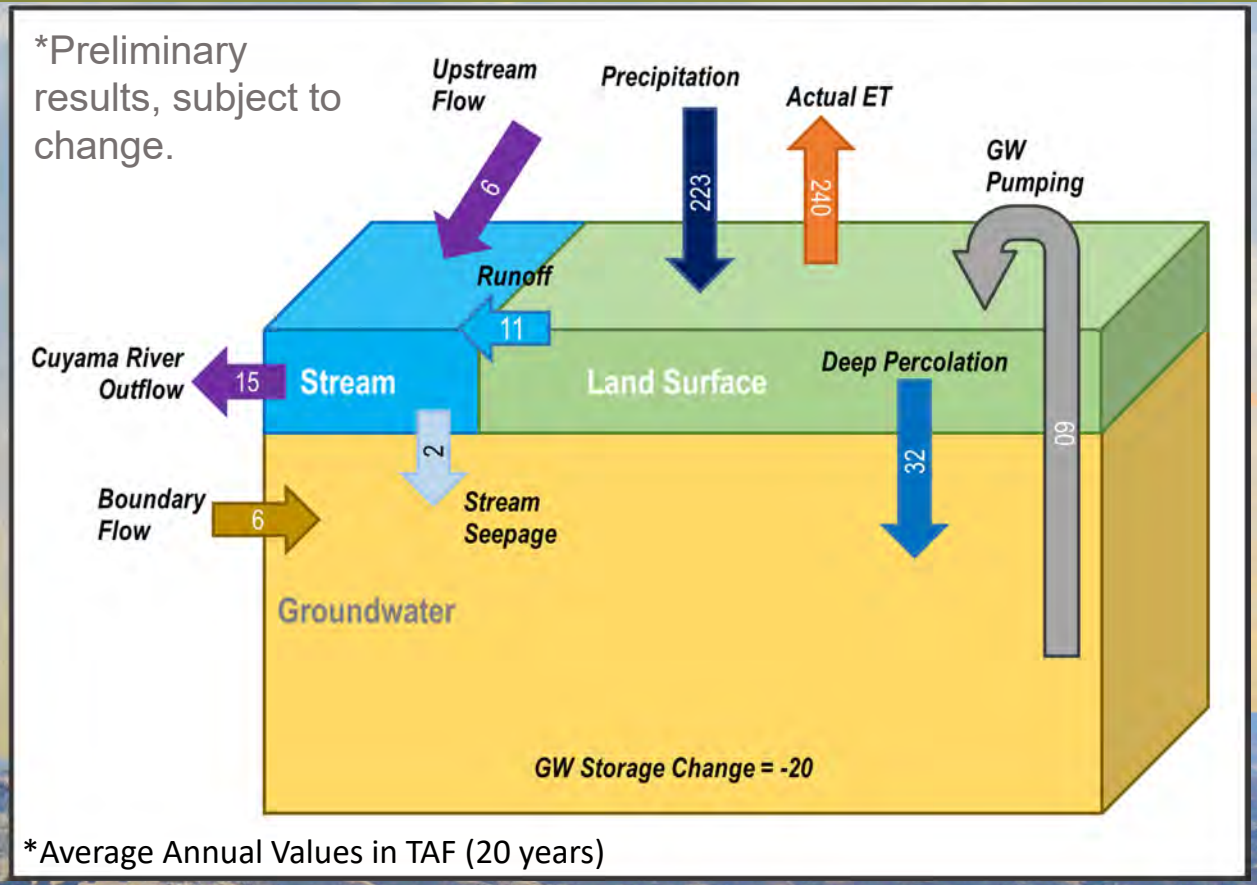
Draft Overall Water Budget: Basin-Wide

Preliminary Draft



*Average Annual Values in TAF (20 years)

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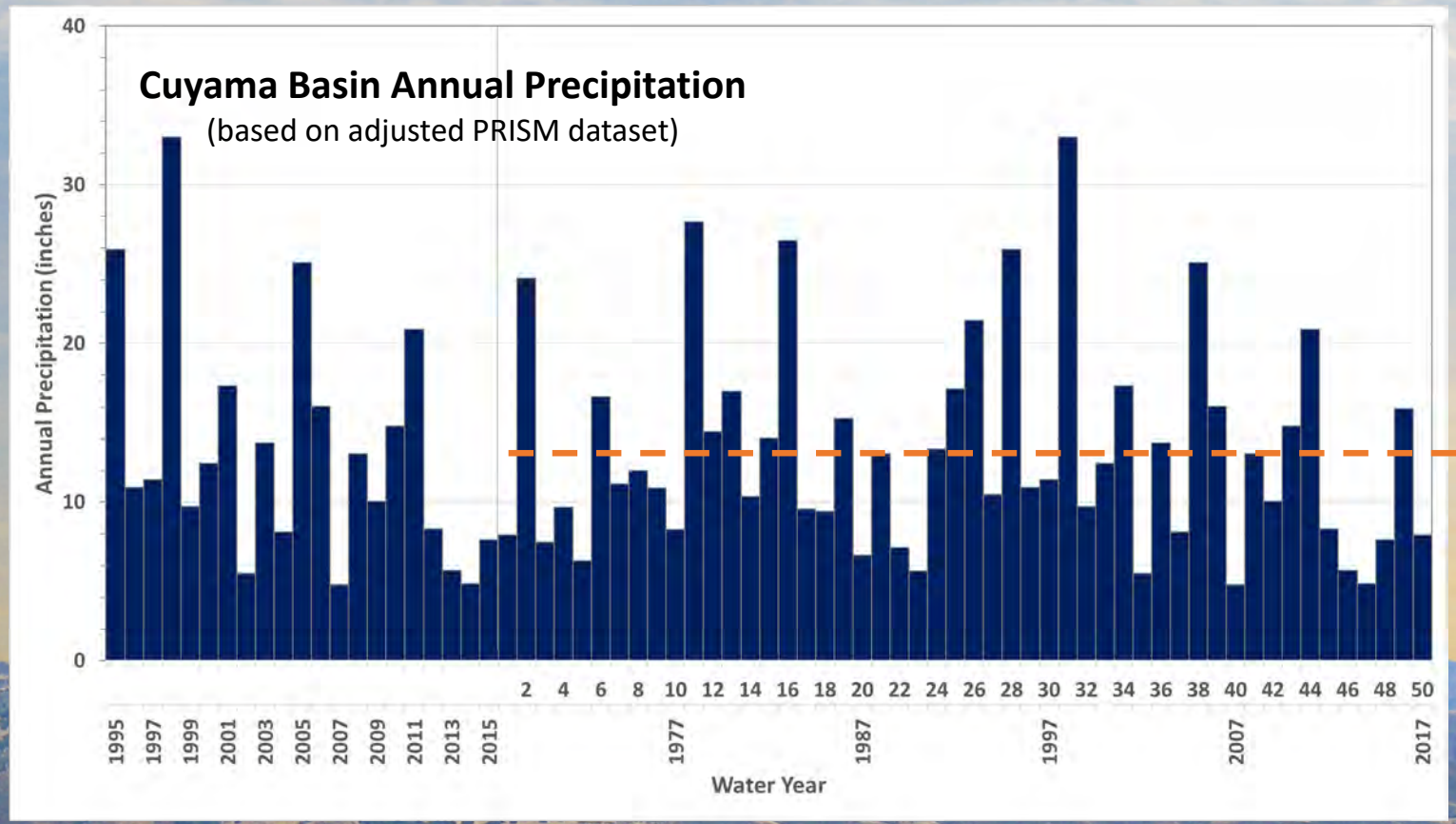
Future Conditions
Cuyama Basin Adjusted PRISM Precipitation



Average Annual Precipitation (50 years)

- Entire Basin: 13.1 inches
- Valley Floor: 11.5 inches
- Foothills: 14.8 inches

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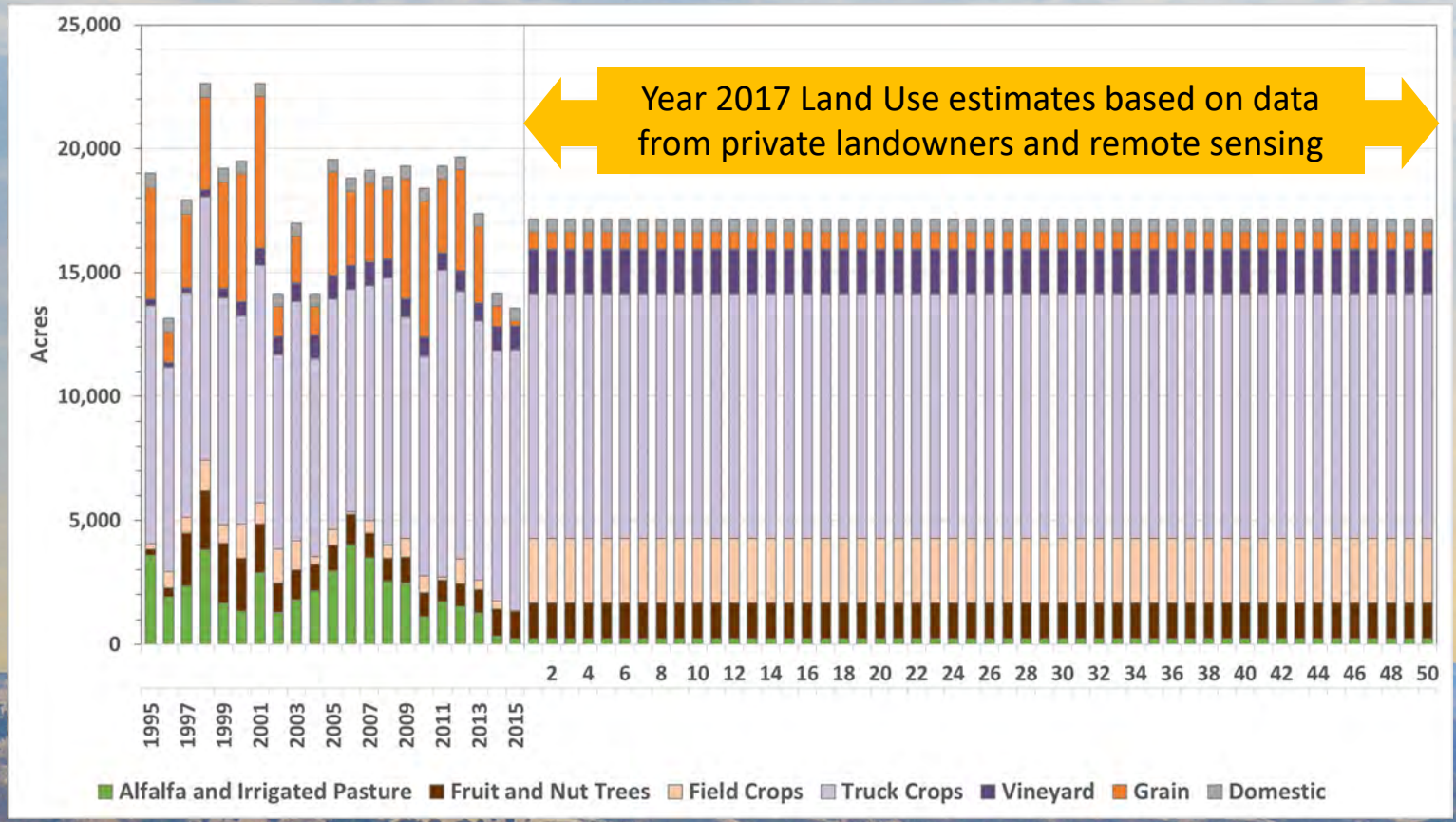
Future Conditions
Cuyama Basin Land Use



Land Use under Future Conditions

- **Irrigated: 16,700 acres**
- **Domestic: 800 acres**
- **Population: 1,072**
- **Unit Water Use: 170 GPCD**

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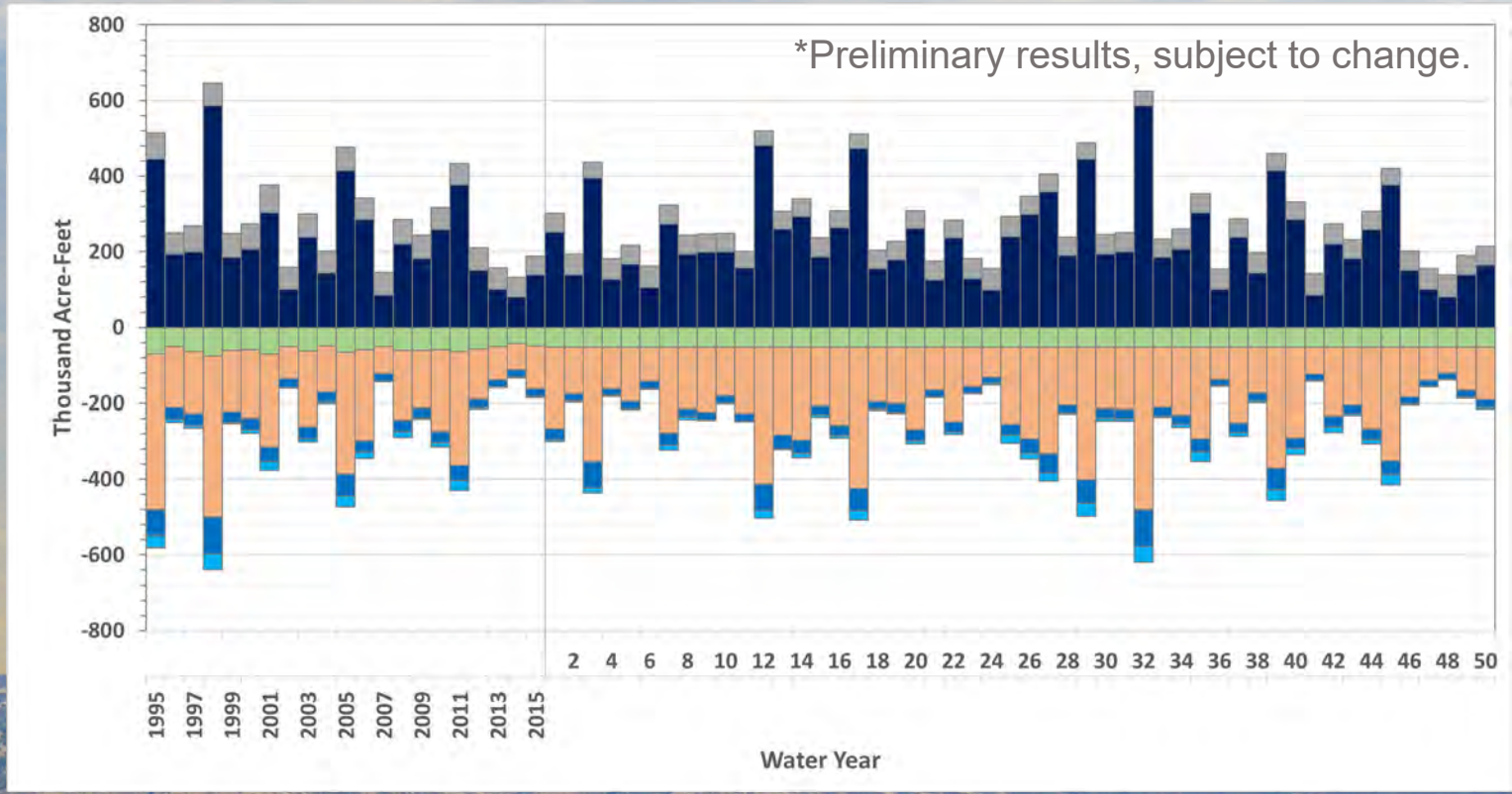
Future Conditions Land Surface Water Budget: Basin-Wide

Preliminary Draft



Average Annual (50 years)

Inflows

- Precipitation: 230 TAF (~11.4 in)
- Applied Water 49 TAF

Outflows

- Ag. Actual ET 52 TAF
- NV Actual ET 188 TAF
- Dom. Act. ET <0.1 TAF
- Deep Perc. 29 TAF
- Runoff 10 TAF

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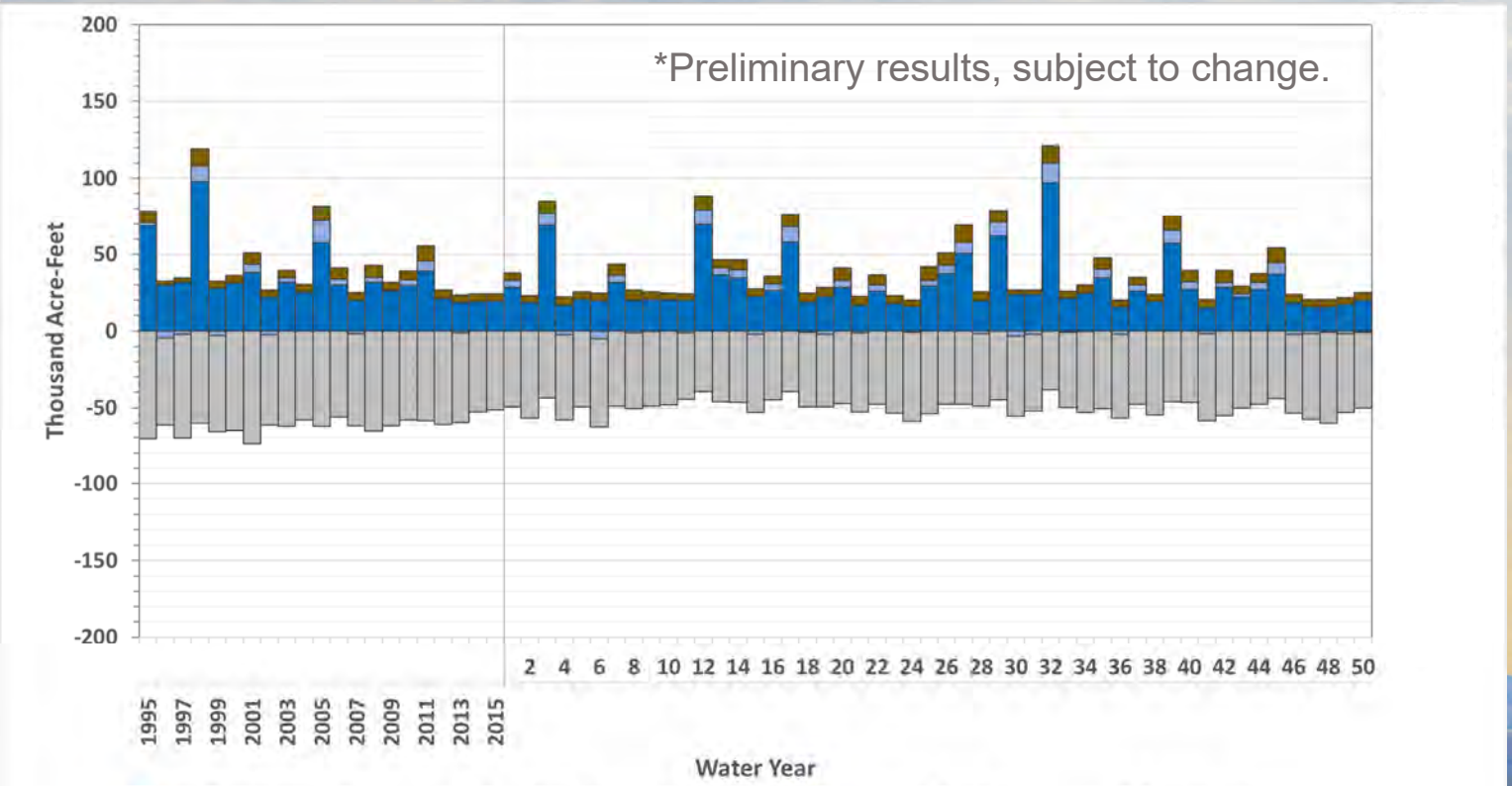
Future Conditions Groundwater Budget: Basin-Wide

Preliminary Draft



Average Annual (50 years)

Inflows:

- Deep Percolation
- Stream Seepage
- Boundary Flow

Outflows:

- GW Pumping

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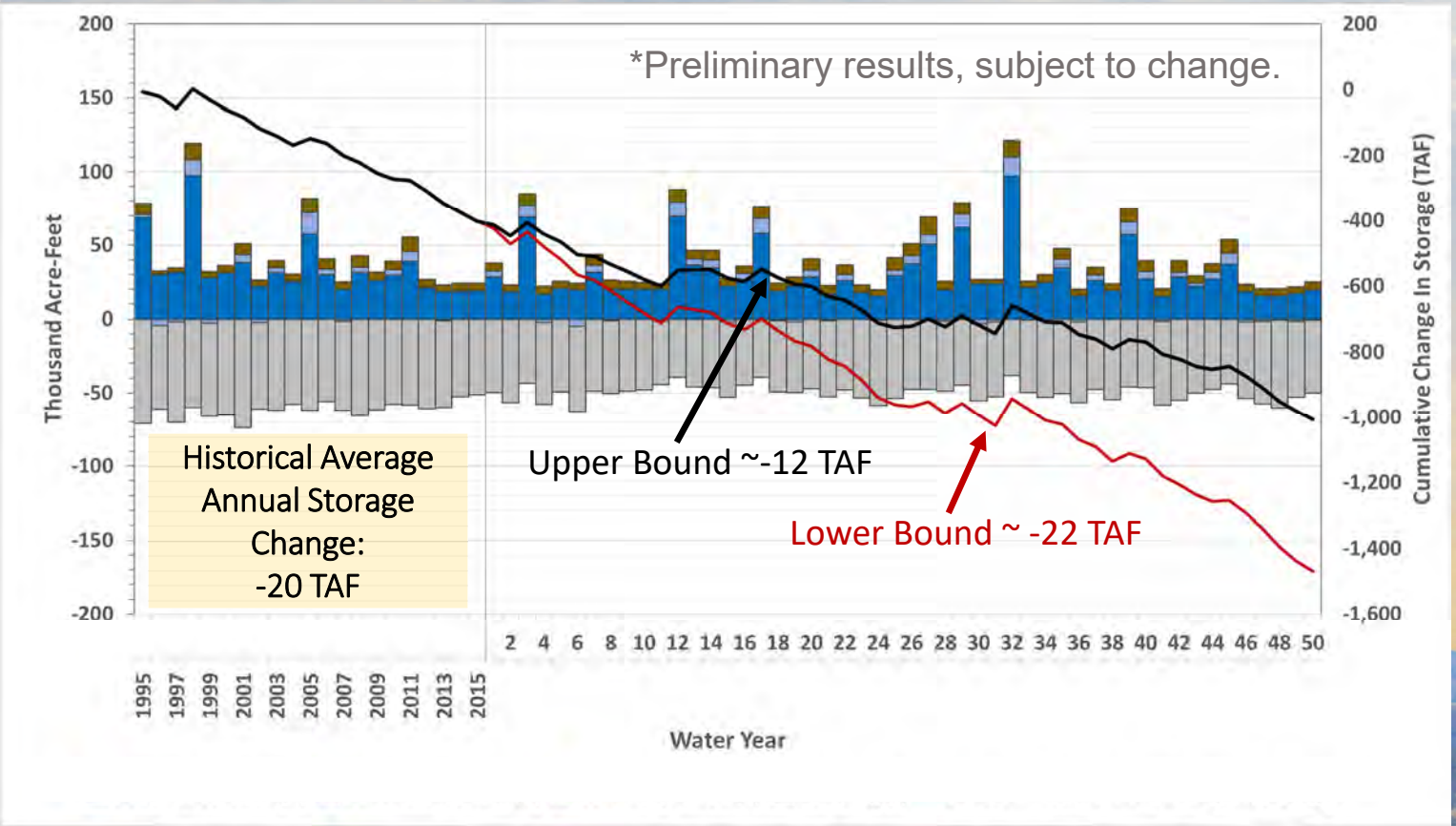
Future Conditions Groundwater Budget: Basin-Wide

Preliminary Draft



Average Annual (50 years)

Inflows:

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Outflows:

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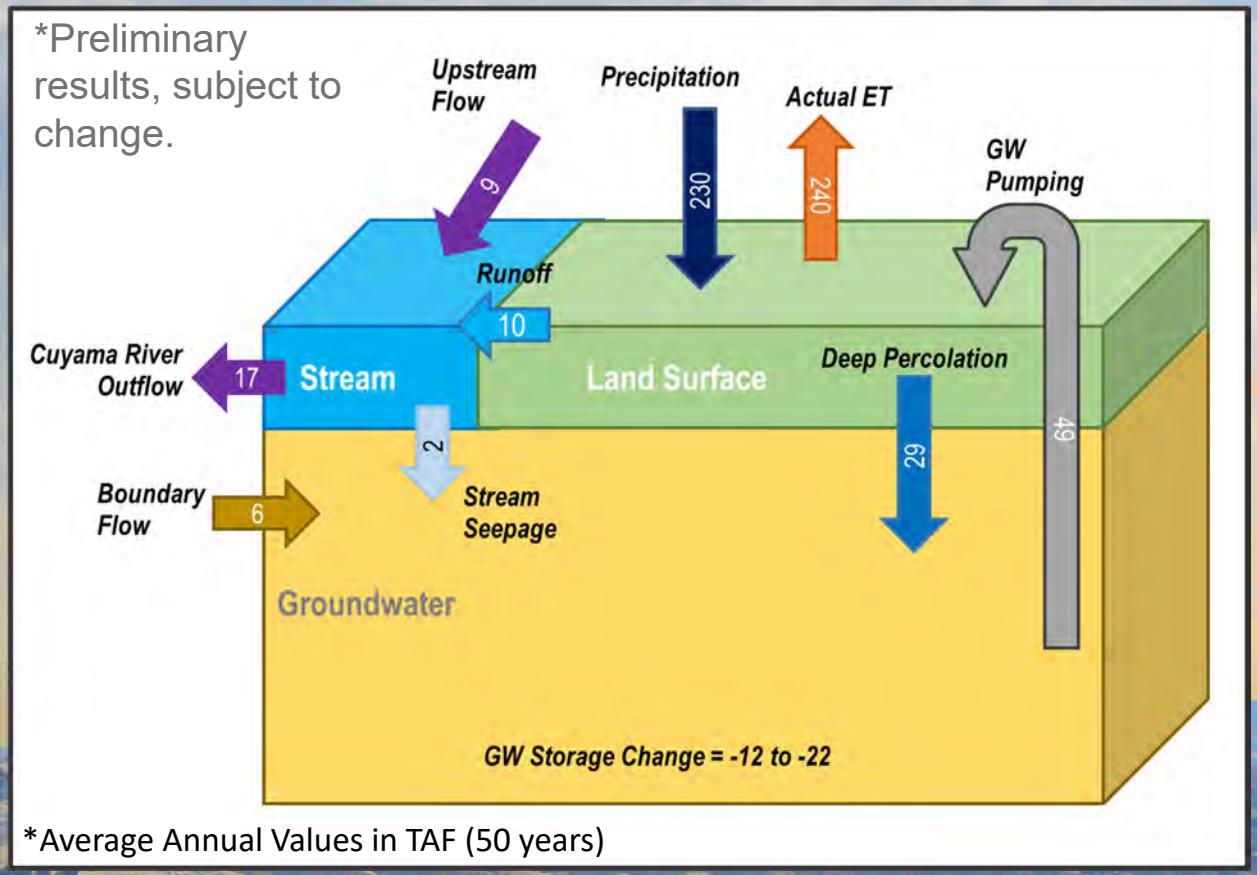
Future Conditions Overall Water Budget: Basin-Wide

Preliminary Draft



*Average Annual Values in TAF (50 years)

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Projects and Actions to Close the Gap Between Water Supplies and Demands

- Demand Reduction Actions
  - Pumping restrictions/allocations
    - Water accounting
    - Water metering
  - Water market
- Supply Enhancement Projects
  - Storm and flood water capture
  - Water supply imports/exchanges

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Questions and Discussion – Groundwater Modeling

- Clarifying Questions?
  - How the model works
  - Historical conditions and trends
  - Water budgets under current and future conditions

- In addition to what has been presented, what other information from the model would help you understand water resources in the Cuyama Valley?

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Cuyama Basin Groundwater Sustainability Agency

Review of Preliminary Thresholds

December 3, 2018

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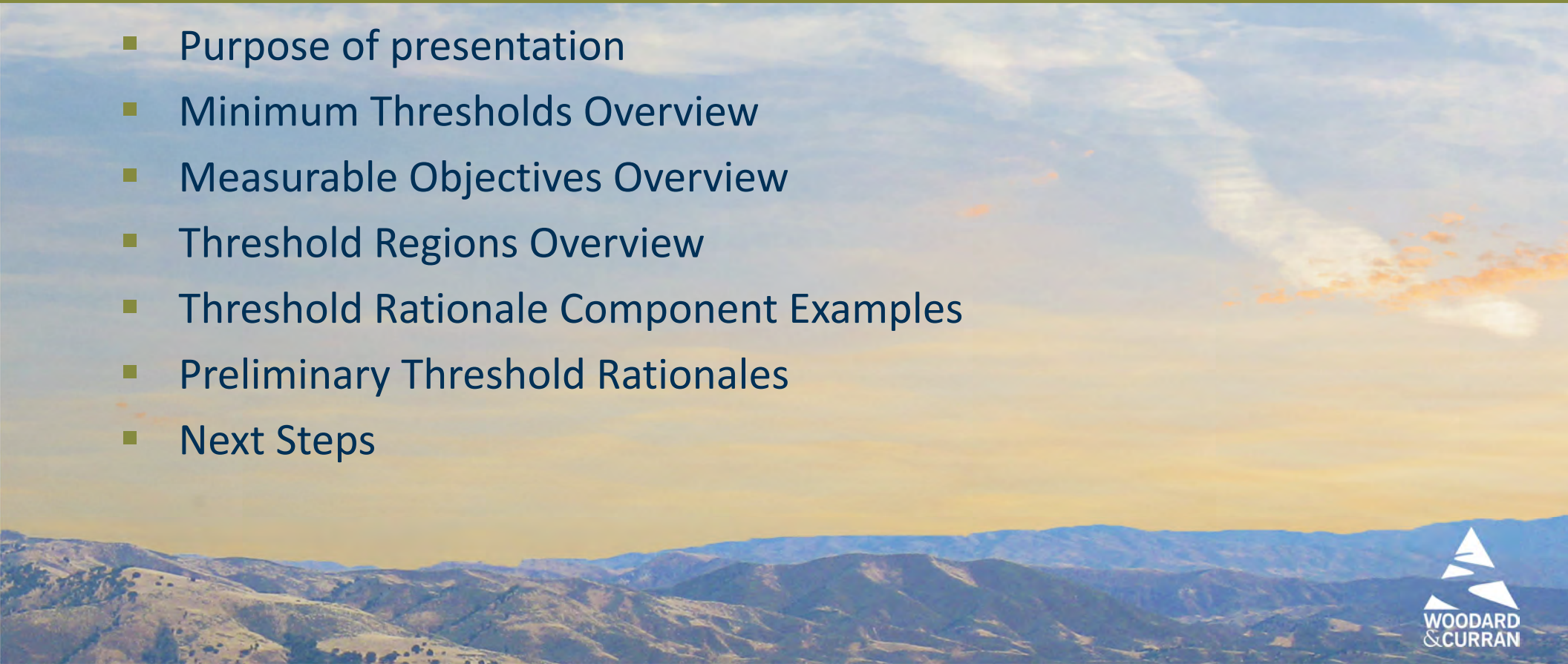
Preliminary Thresholds Presentation Overview

- Purpose of presentation
- Minimum Thresholds Overview
- Measurable Objectives Overview
- Threshold Regions Overview
- Threshold Rationale Component Examples
- Preliminary Threshold Rationales
- Next Steps



Purposes of Presentation

- Present preliminary threshold rationales for threshold regions
- Gain consensus on recommended threshold rationales
- Gain clarification on threshold rationales in regions without a recommendation
  - Some regions have differing perspectives on appropriate threshold rationale
  - Threshold rationale options present today meet technical/regulatory requirements
  - Local control via CBGSA Board allows board to select appropriate thresholds

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Why Minimum Thresholds?

- Required by SGMA
- Establish Range of Operation in Groundwater Basin
- Protect other Groundwater Pumpers

- <u>For Example:</u>

  Keep Groundwater Levels High Enough to:

  1. Ensure adjacent pumpers have access to groundwater
  2. Protect access to groundwater in Community Services District well

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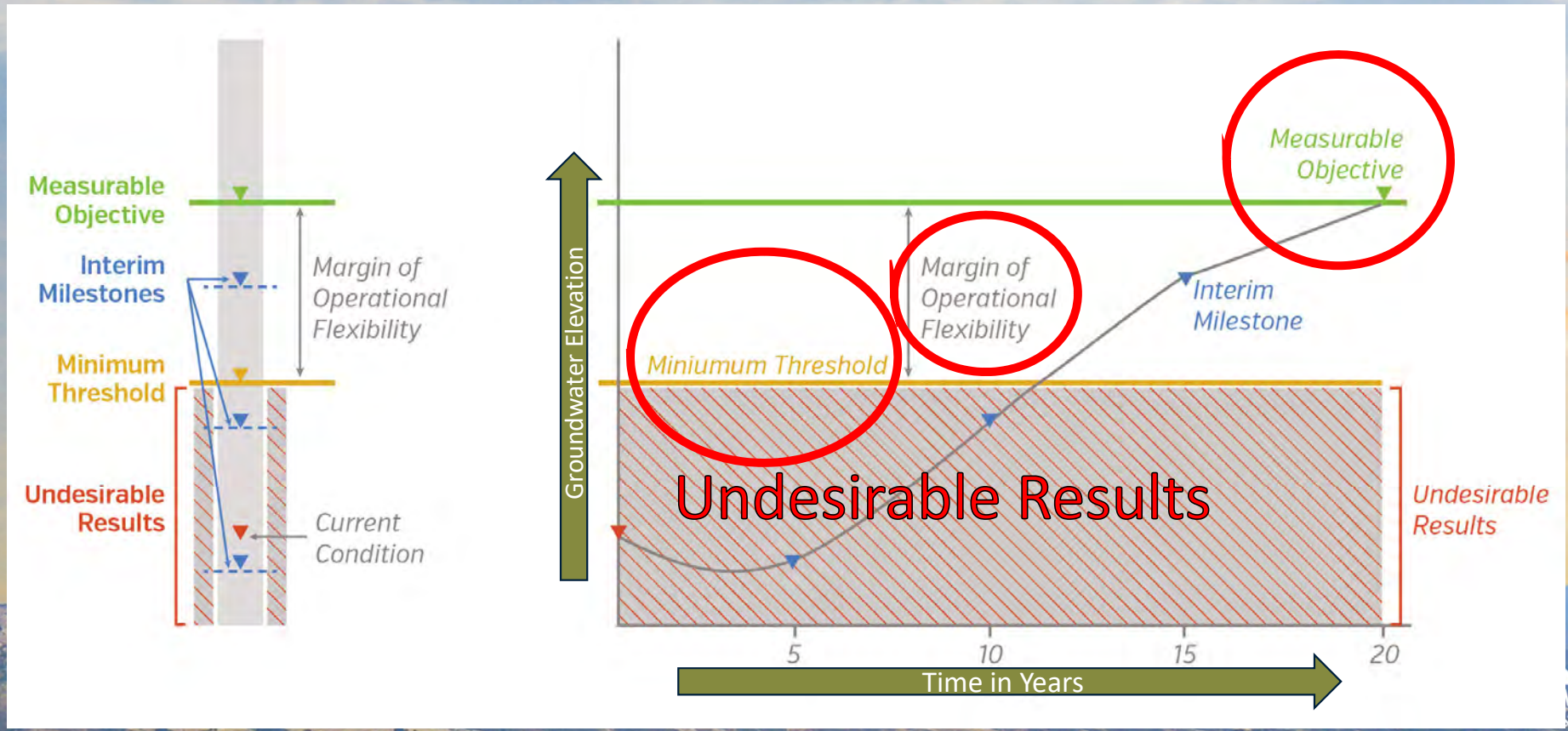
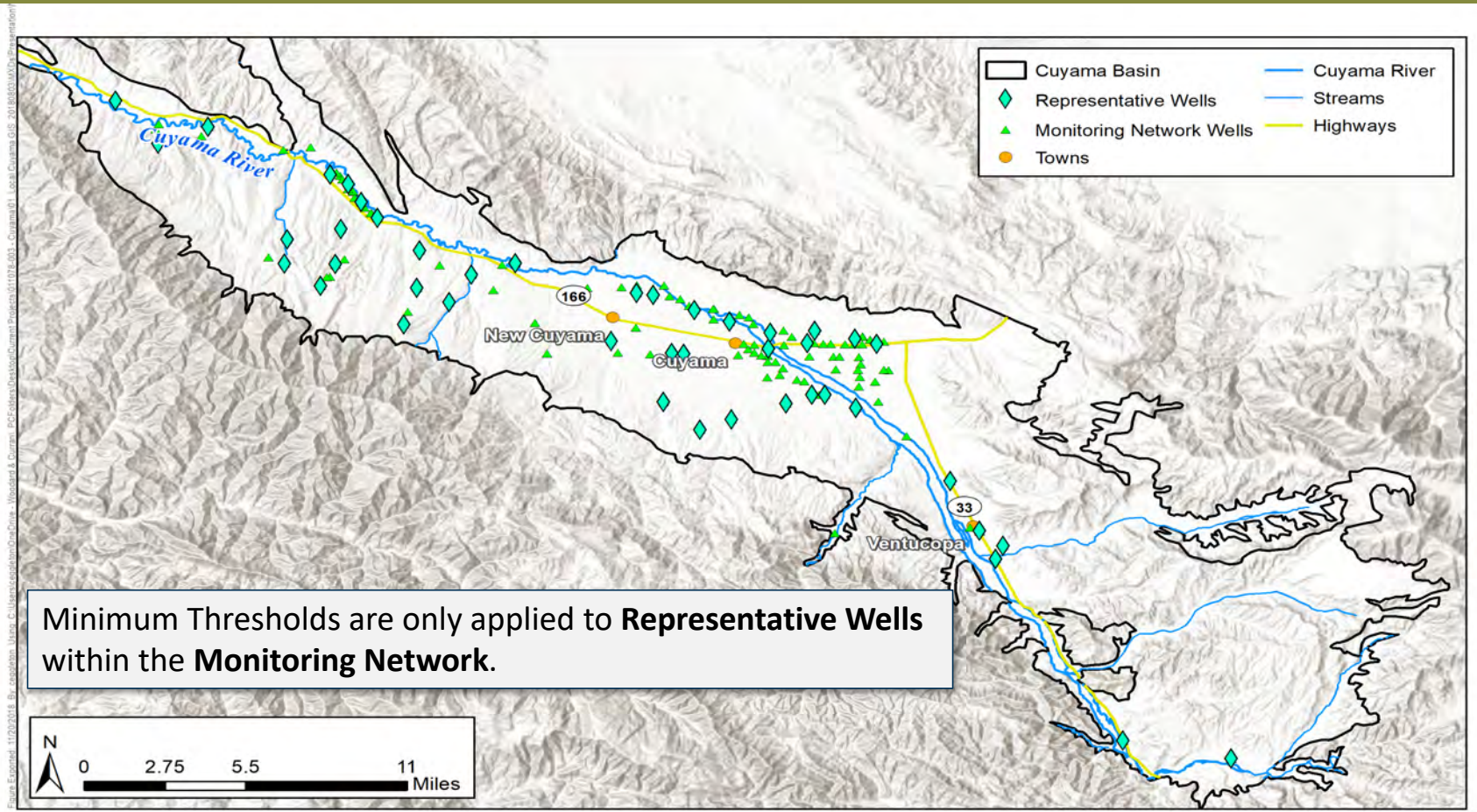
Minimum Thresholds and Measurable Objectives Example

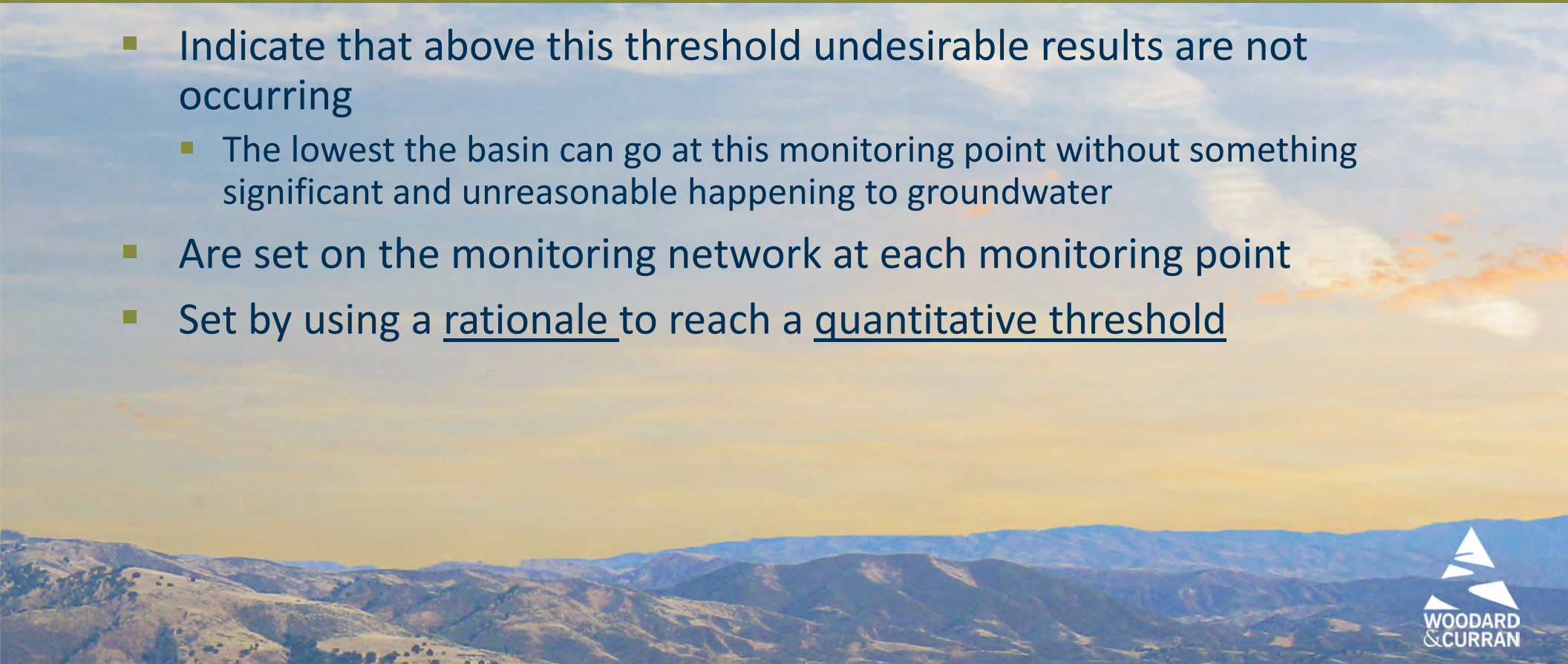


Where are Thresholds Applied?



Minimum Thresholds

- Indicate that above this threshold undesirable results are not occurring
  - The lowest the basin can go at this monitoring point without something significant and unreasonable happening to groundwater
- Are set on the monitoring network at each monitoring point
- Set by using a rationale to reach a quantitative threshold



Measurable Objectives (MOs) Overview

- MOs are quantitative goals that are set to create a useful Margin of Operational Flexibility (MoOF).
- The MoOF is an amount of groundwater above the MT that should accommodate droughts, climate change, conjunctive use operations, or GSP implementation activities.
- The MoOF should be used to provide a buffer in groundwater levels so that the basin can be managed without reaching minimum thresholds during drought periods

What if Thresholds are Not Met During GSP Implementation?

- GSP regulations and BMPs do not encourage management of discrete portions of the basin as they relate to individual monitoring wells
- For each individual monitoring well:
  - When a minimum threshold is unexpectedly reached, the GSA should investigate why, and evaluate whether the threshold is reasonable or not, given current conditions compared to conditions when the GSP was adopted.
  - Will be discussed in Management Actions Section of GSP

- As thresholds relate to the entire basin:
  - The Undesirable Result is considered to occur during GSP i
    XX% of representative monitoring wells (XX of 49) f
    minimum groundwater elevation threshold

This is when Regulators like SWRCB can get involved

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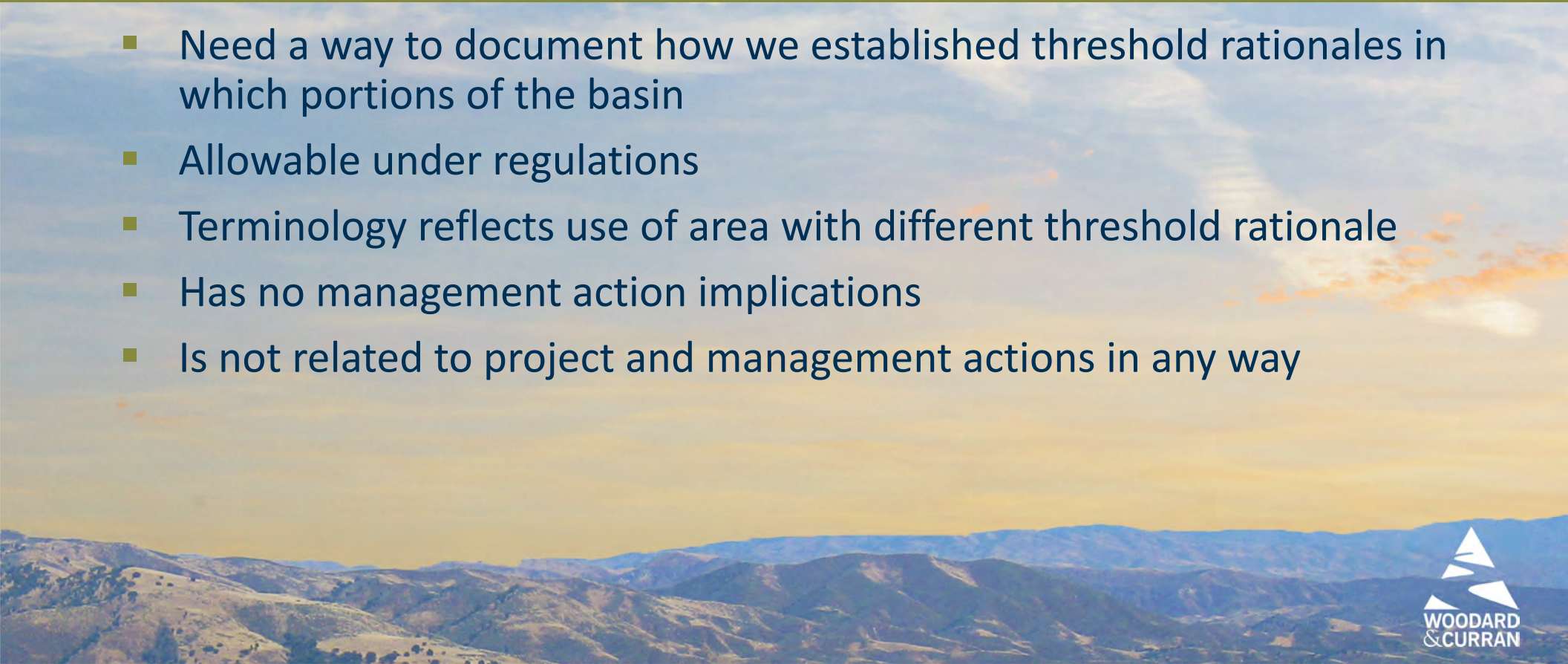
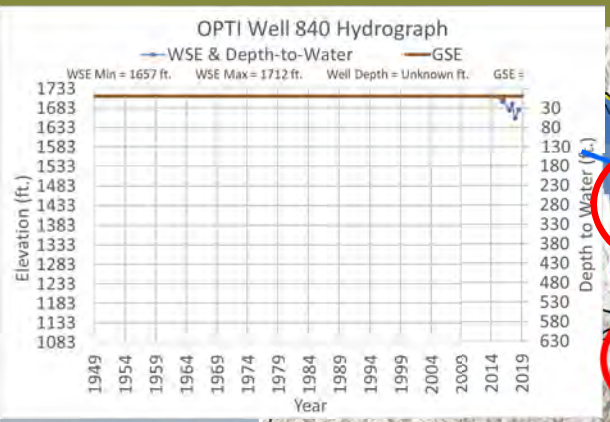
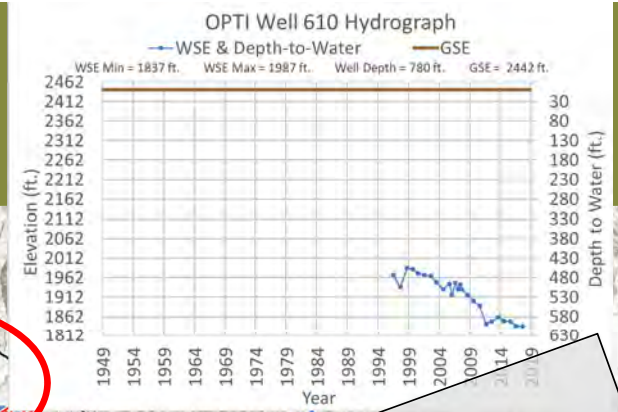
Threshold Regions – a way to describe which areas use which threshod rationales

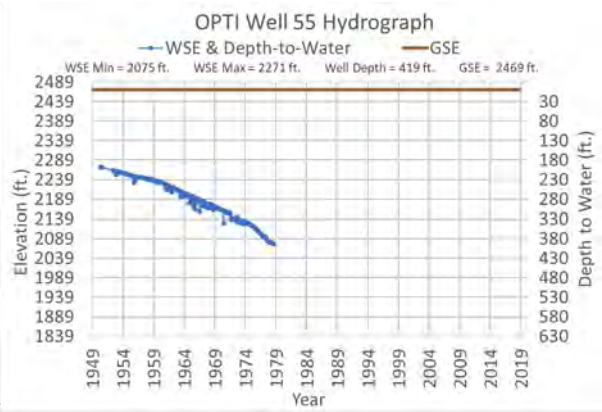
- Need a way to document how we established threshold rationales in which portions of the basin
- Allowable under regulations
- Terminology reflects use of area with different threshold rationale
- Has no management action implications
- Is not related to project and management actions in any way

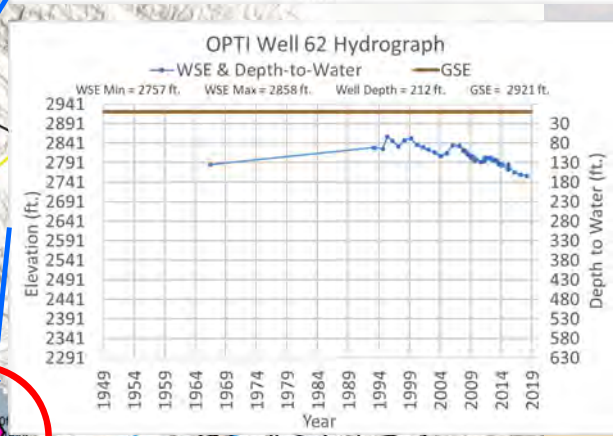


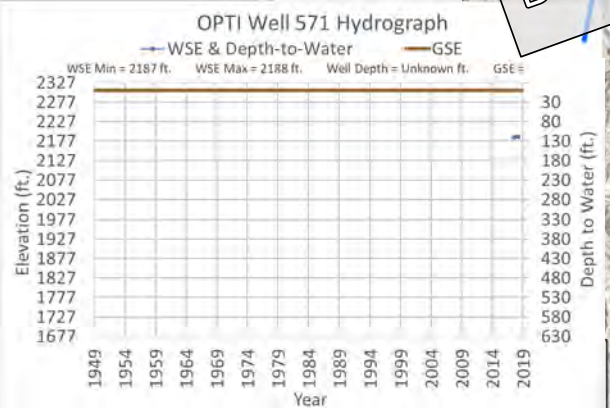
Why Threshold Regions?

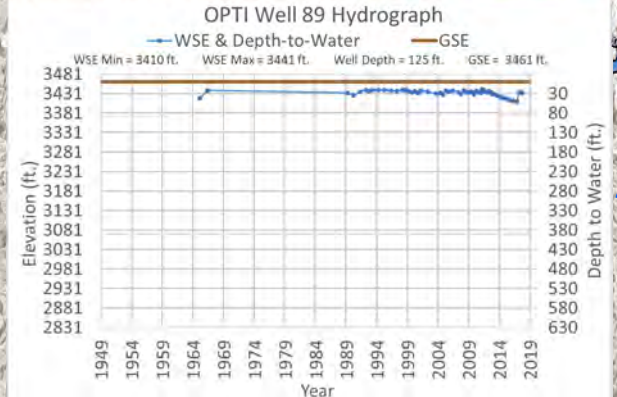










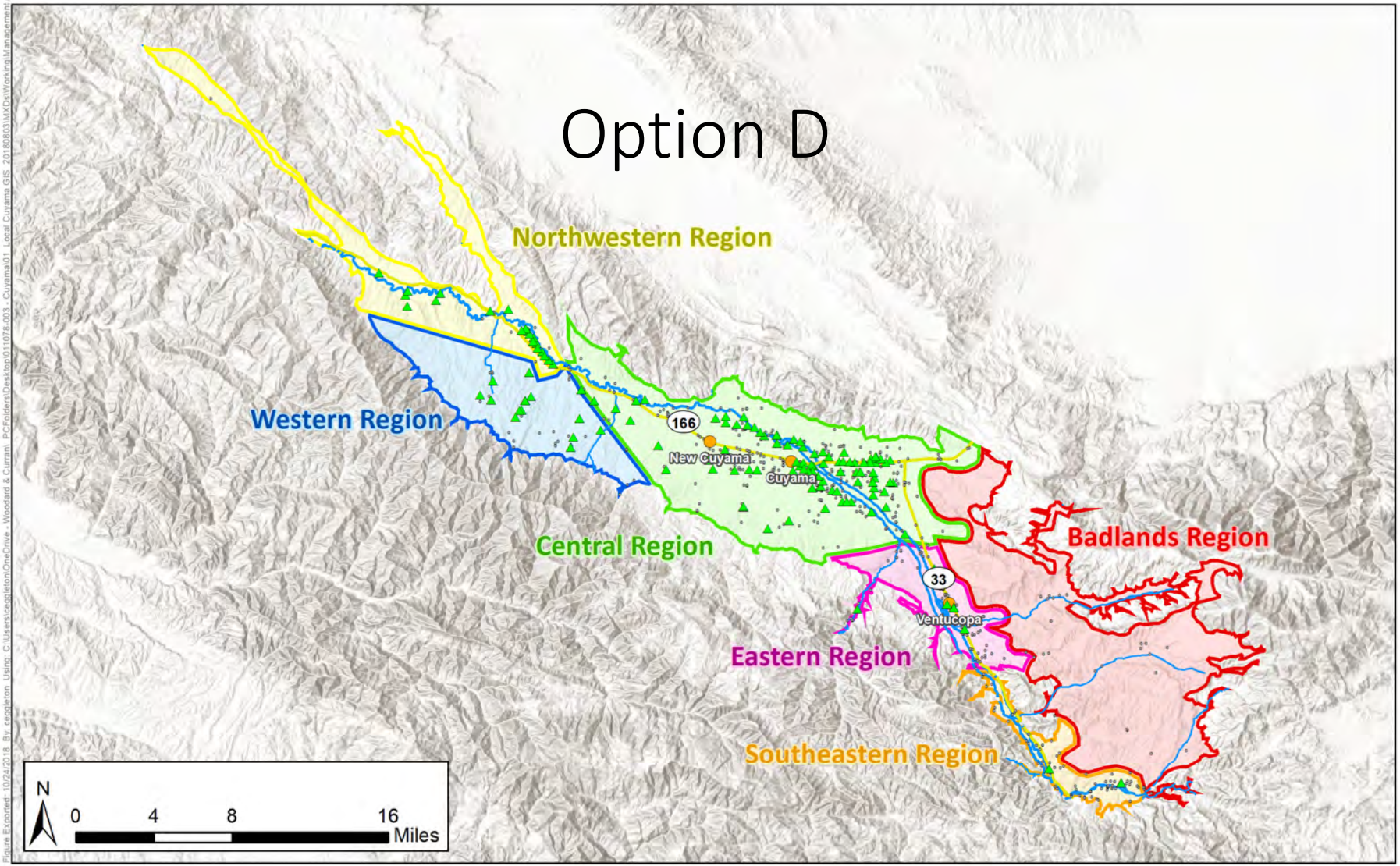


Board Direction on Minimum Thresholds

Approved Motion from November 7, 2018 Board Meeting

Direct Woodard & Curran to use Option D to develop preliminary threshold numbers.

Option D


Northwestern Region
Western Region
Central Region
Badlands Region
Eastern Region
Southeastern Region
166
New Cuyama
Cuyama
33
Ventucopa
N
0
4
8
16
Miles

Schedule for Thresholds Discussion

- Tech Forum – Oct 23
- SAC – Nov 1
- Board – Nov 7

Input and Discussion

- Tech Forum – Nov 28
- SAC – Nov 29
- Board – Dec 3
- Public Workshop – Dec 3

Initial Recommendations

- **Board Direction on Sustainability Thresholds – Jan 9**
- **Release Thresholds GSP Section – Jan 18**
- SAC – Jan 31

Discussion on Draft GSP Section

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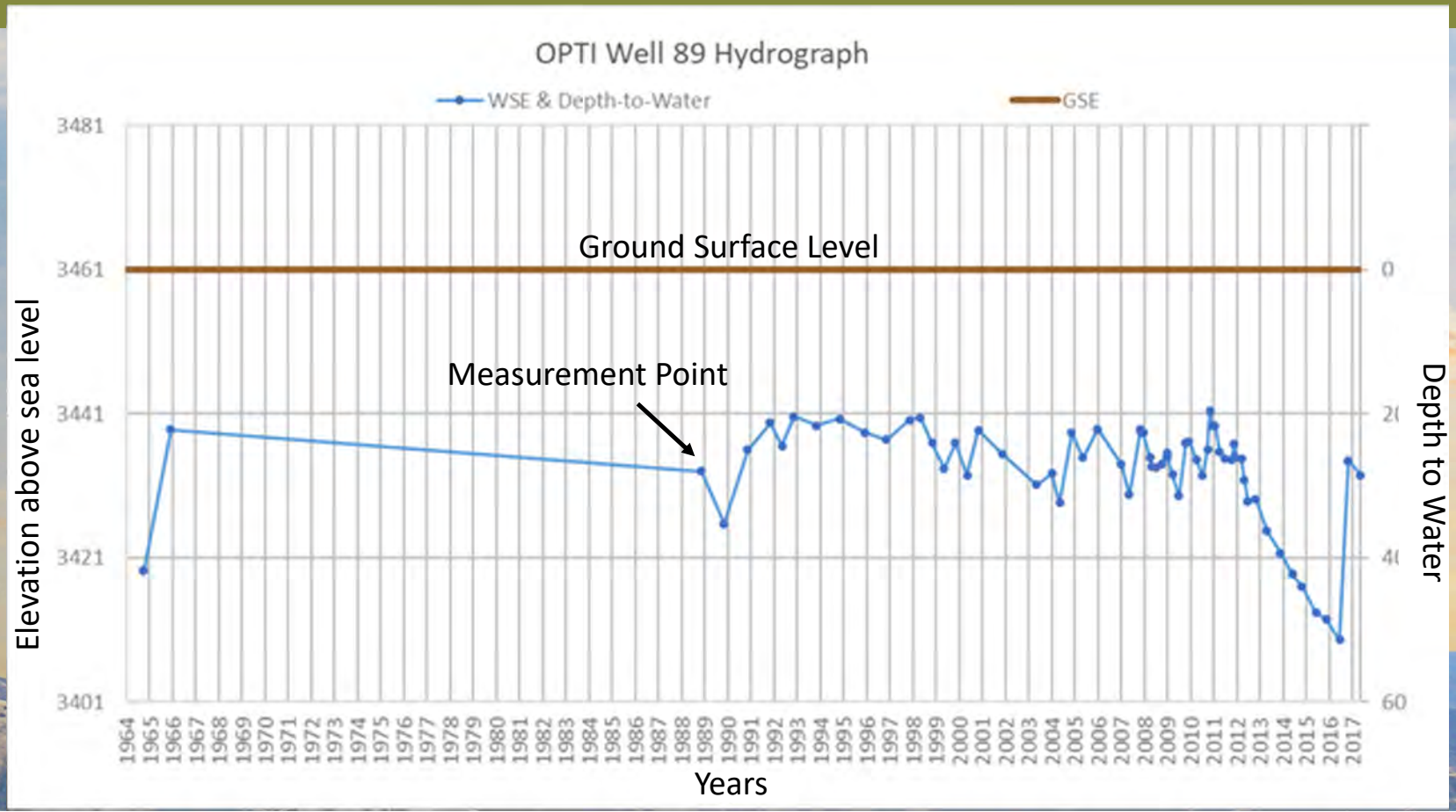
Threshold Rationale Components Example Hydrograph Refresher



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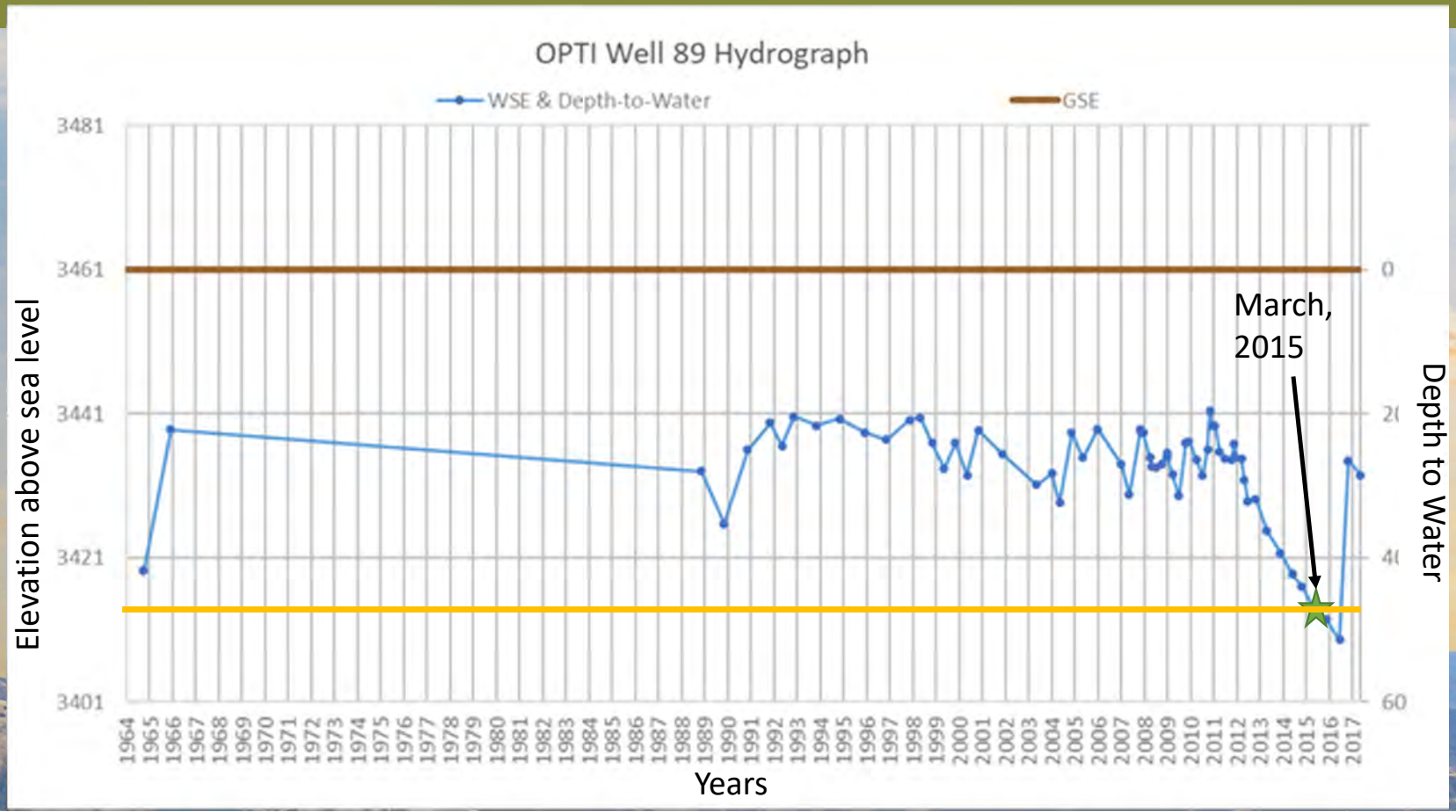
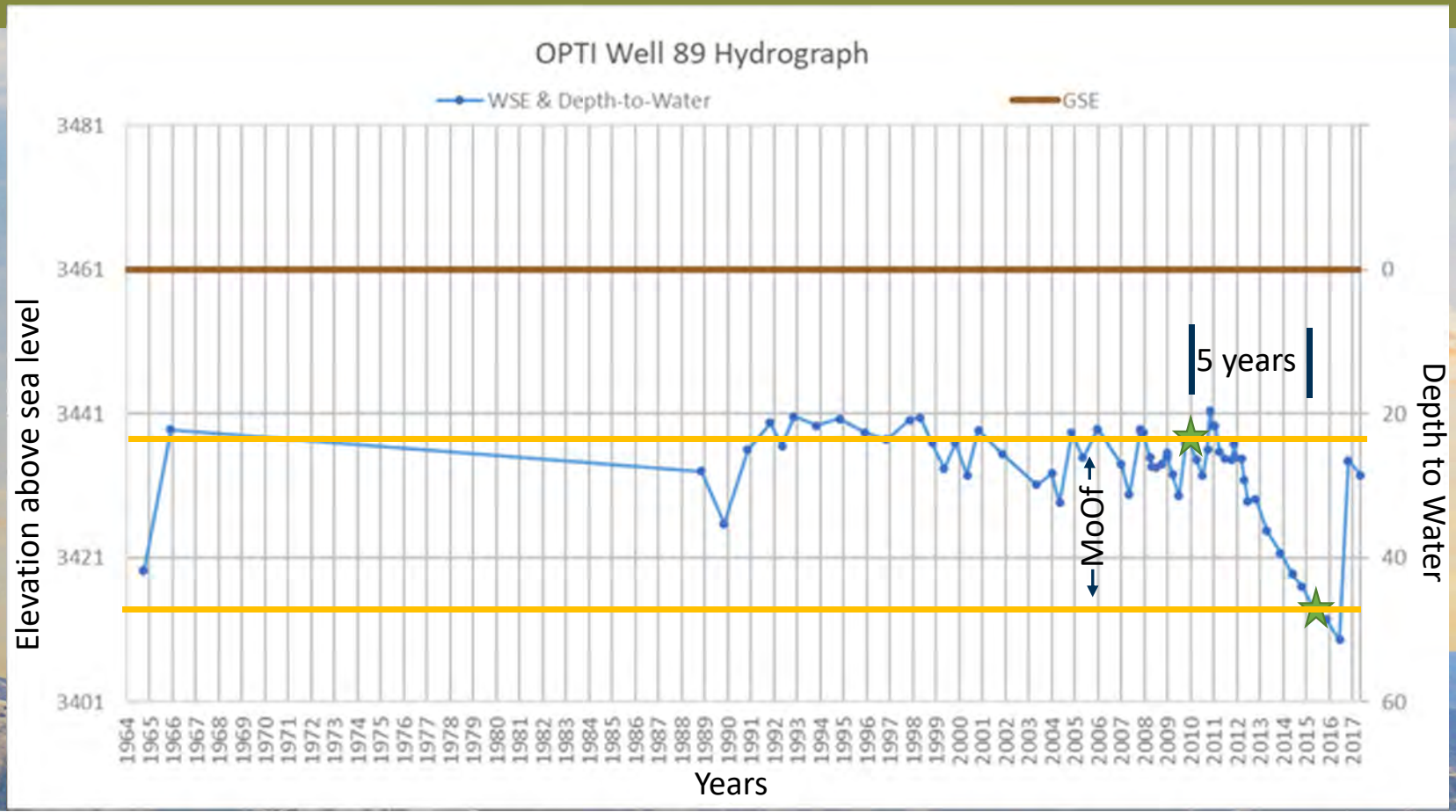
Threshold Rationale Components Example
Nearest to January 1, 2015



Threshold Rationale Components Example
5 Years of Storage - 5 years before 2015



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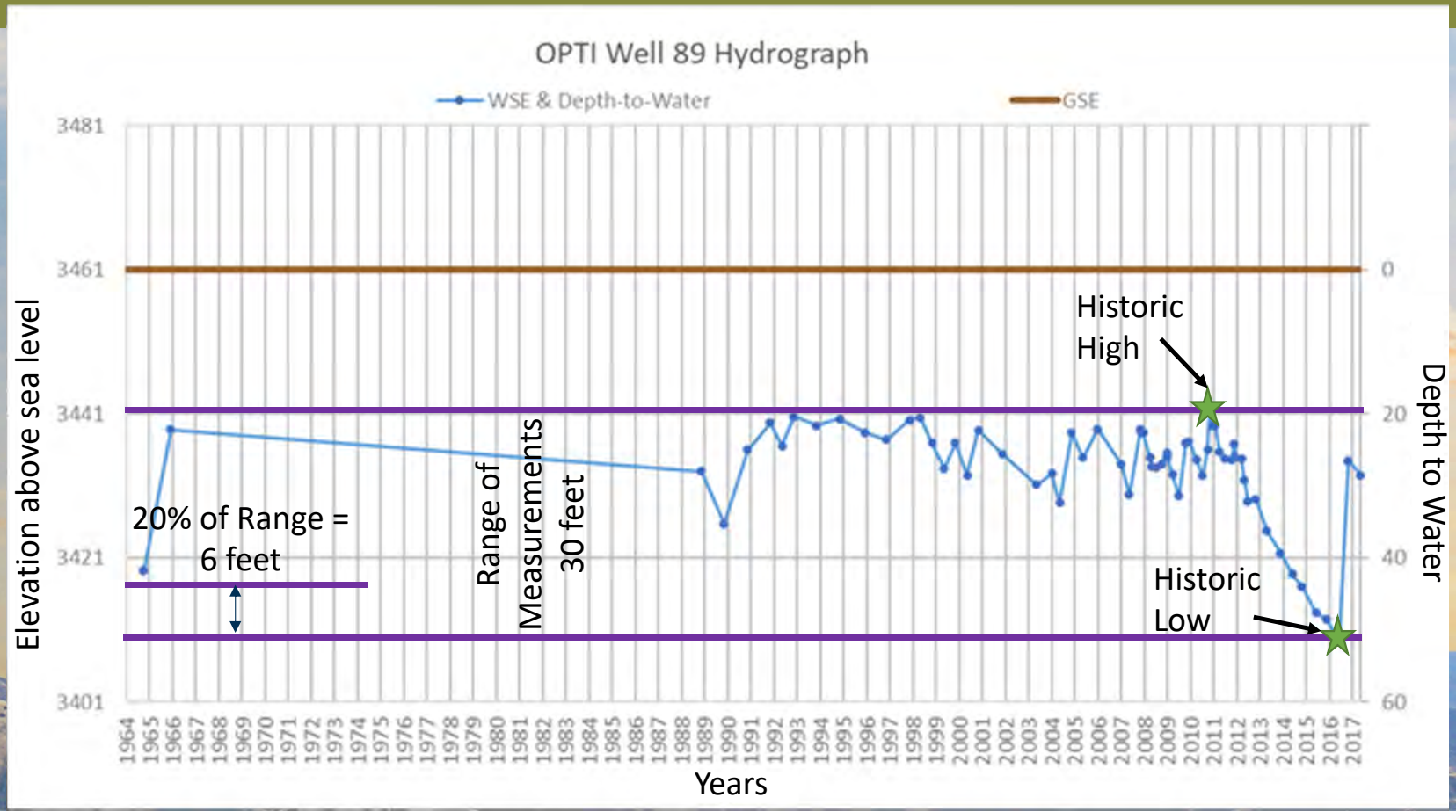
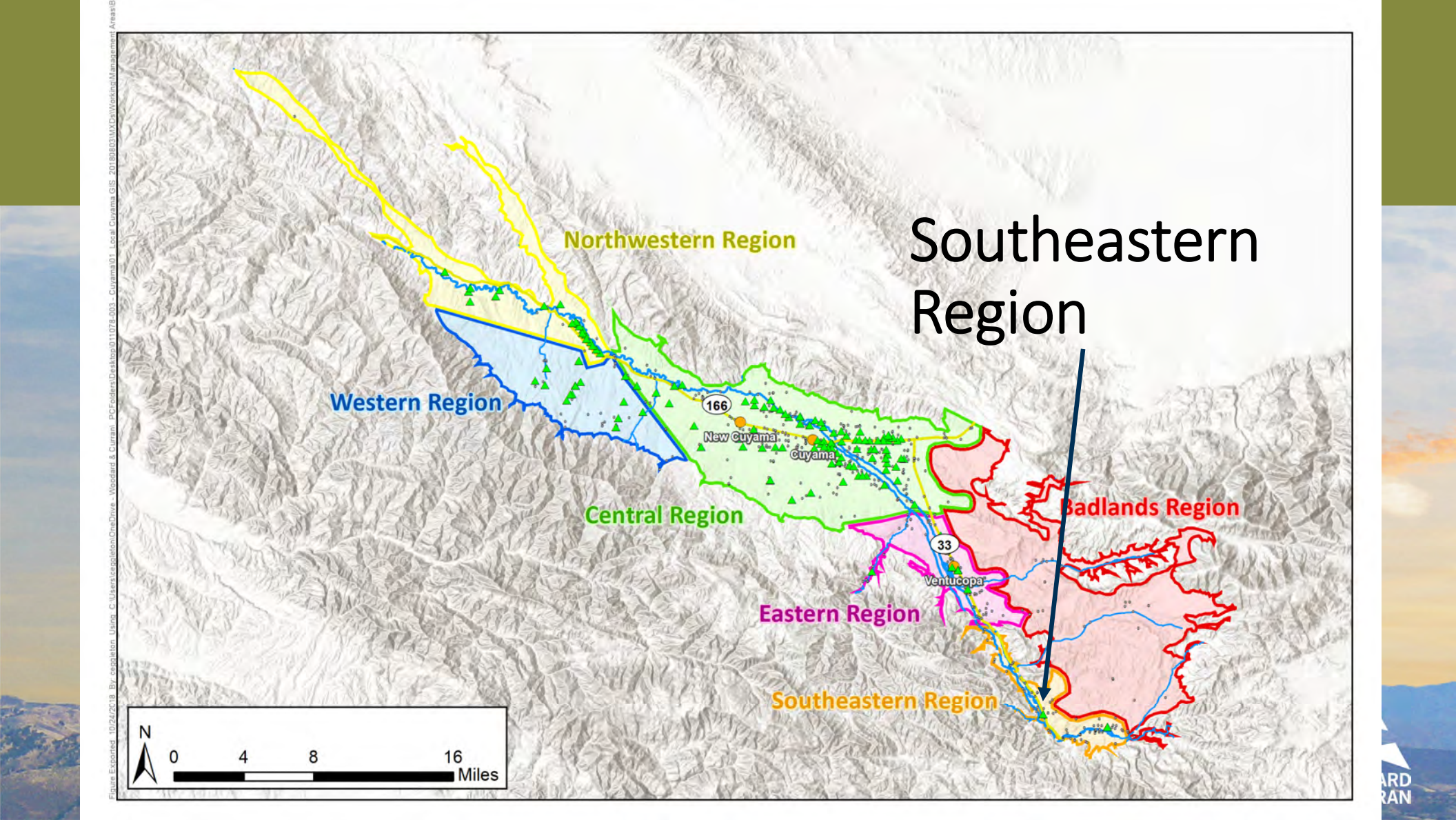
Threshold Rationale Components Example
20% of Range



Measurable Objectives (MOs) & Minimum Thresholds (MTs) Key Thoughts

- Thresholds in the 2020 Cuyama GSP are a *Starting Point* to identify what is sustainable in the basin
- No single rationale or method works across the entire basin
- Limited periods of record in monitoring in some wells cause uncertainty in defining thresholds and will require updates as more data is collected over time
- Thresholds will be updated in GSP update in 2025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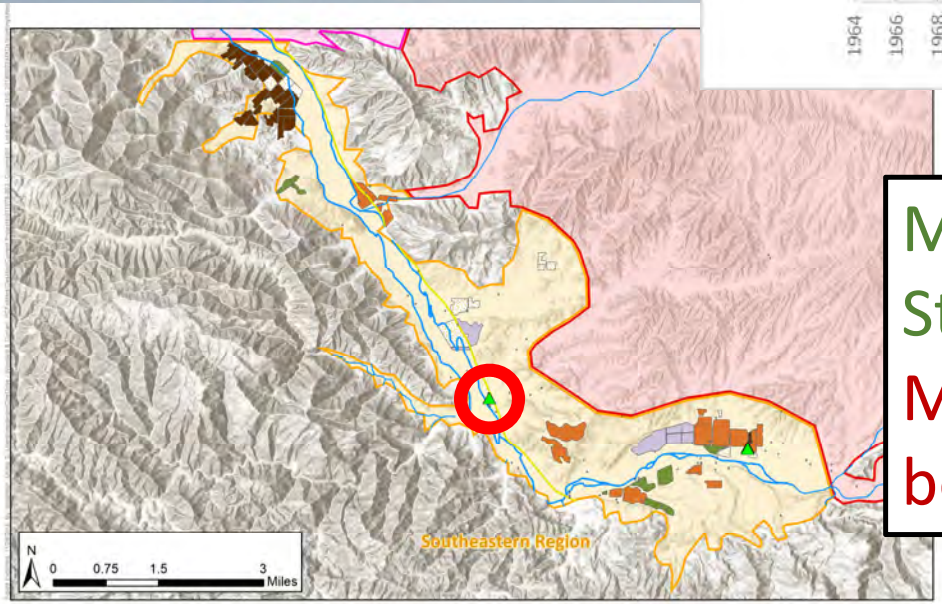
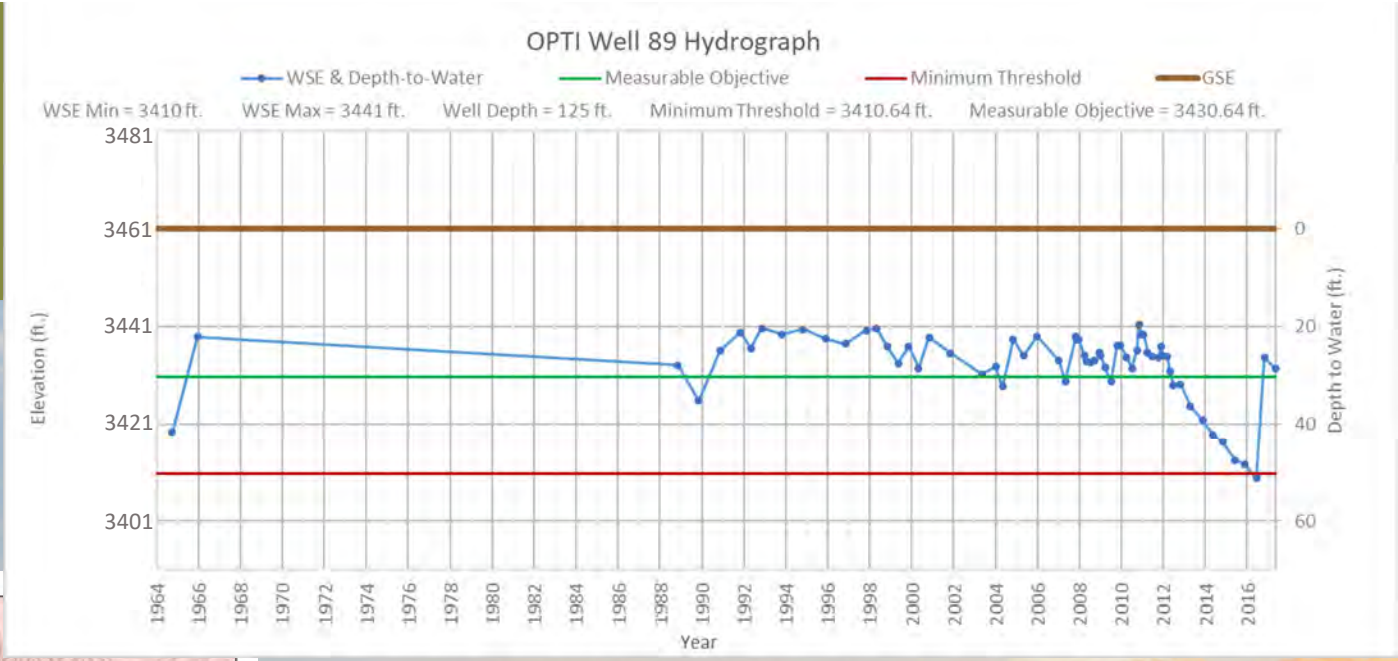
Southeastern Region

Propose 20% of Range





Measurable Objective – 5-years of Storage

Minimum Threshold – 20% of Range below 1/1/2015 Measurement

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Southeastern Region - Advantages/ Disadvantages 20% of Range as Basis for Minimum Thresholds

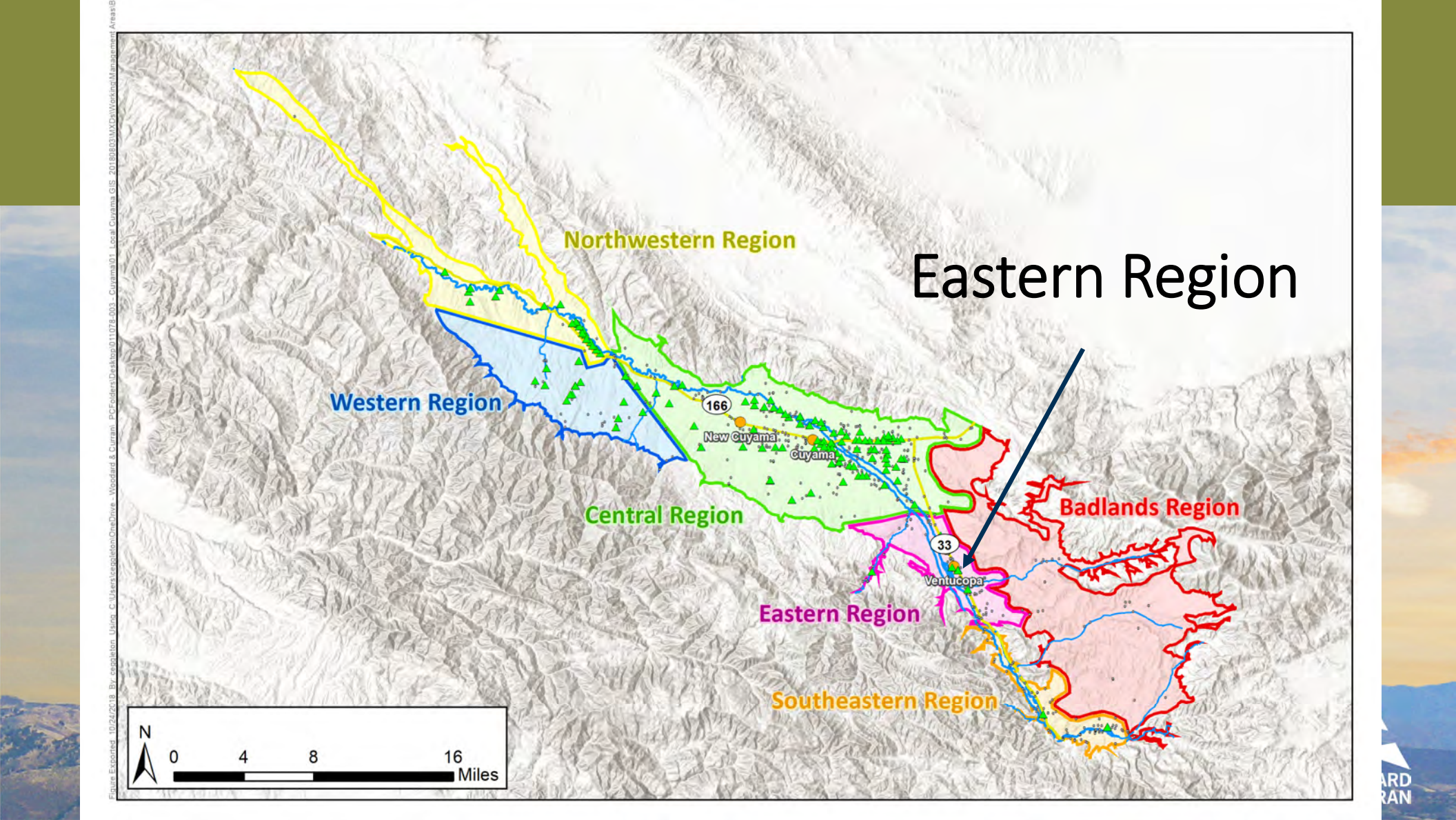
Advantages

- Maintains 5 years of storage between minimum threshold and measurable objective
- Maintains groundwater elevations 6 feet below 2015 levels

Disadvantages

- Maintains groundwater elevations 6 feet below 2015 levels

WOODARD &CURRAN


Eastern Region
Northwestern Region
Western Region
Central Region
Badlands Region
Eastern Region
Southeastern Region
166
New Cuyama
Cuyama
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Ventucopa
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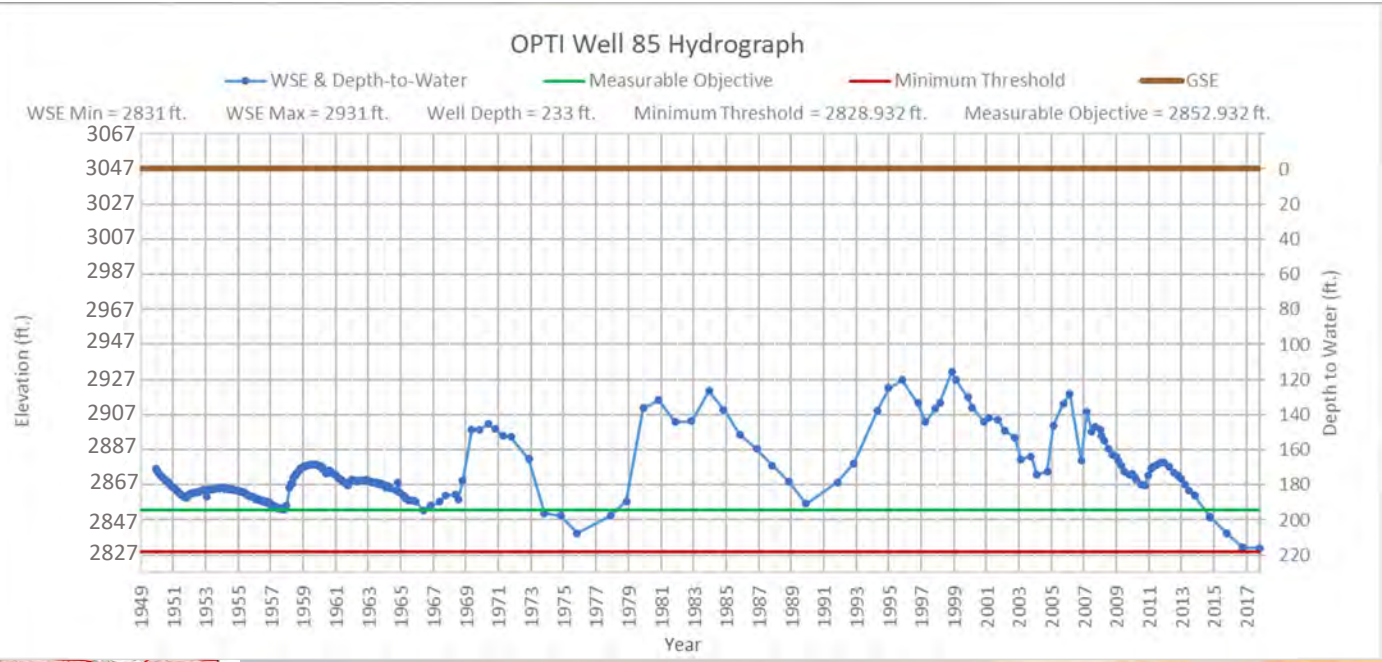
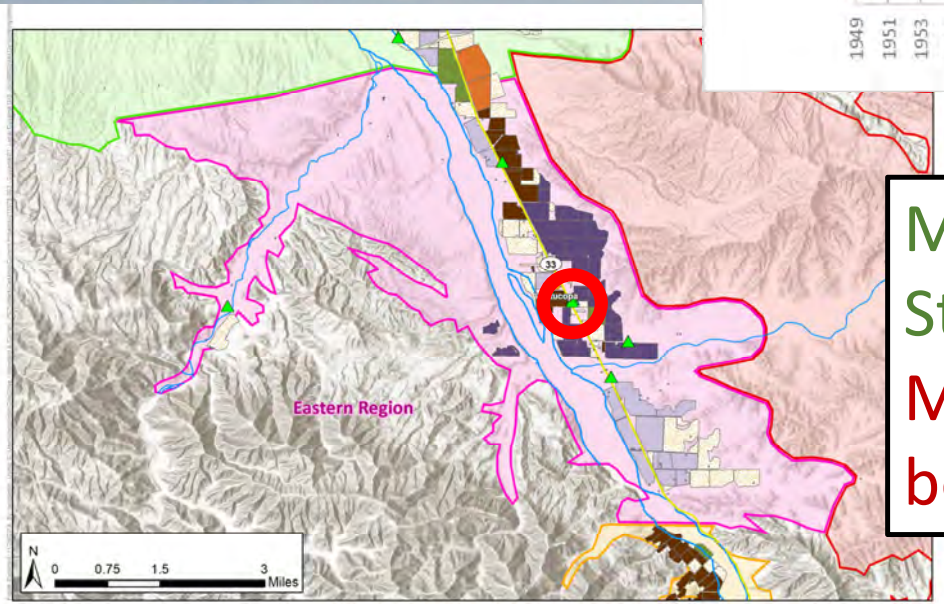
Miles

Eastern Region

Propose 20% of Range





Measurable Objective – 5-years of Storage

Minimum Threshold – 20% of Range below 1/1/2015 Measurement

WOODARD &CURRAN

Eastern Region - Advantages/ Disadvantages 20% of Range as Basis for Minimum Thresholds

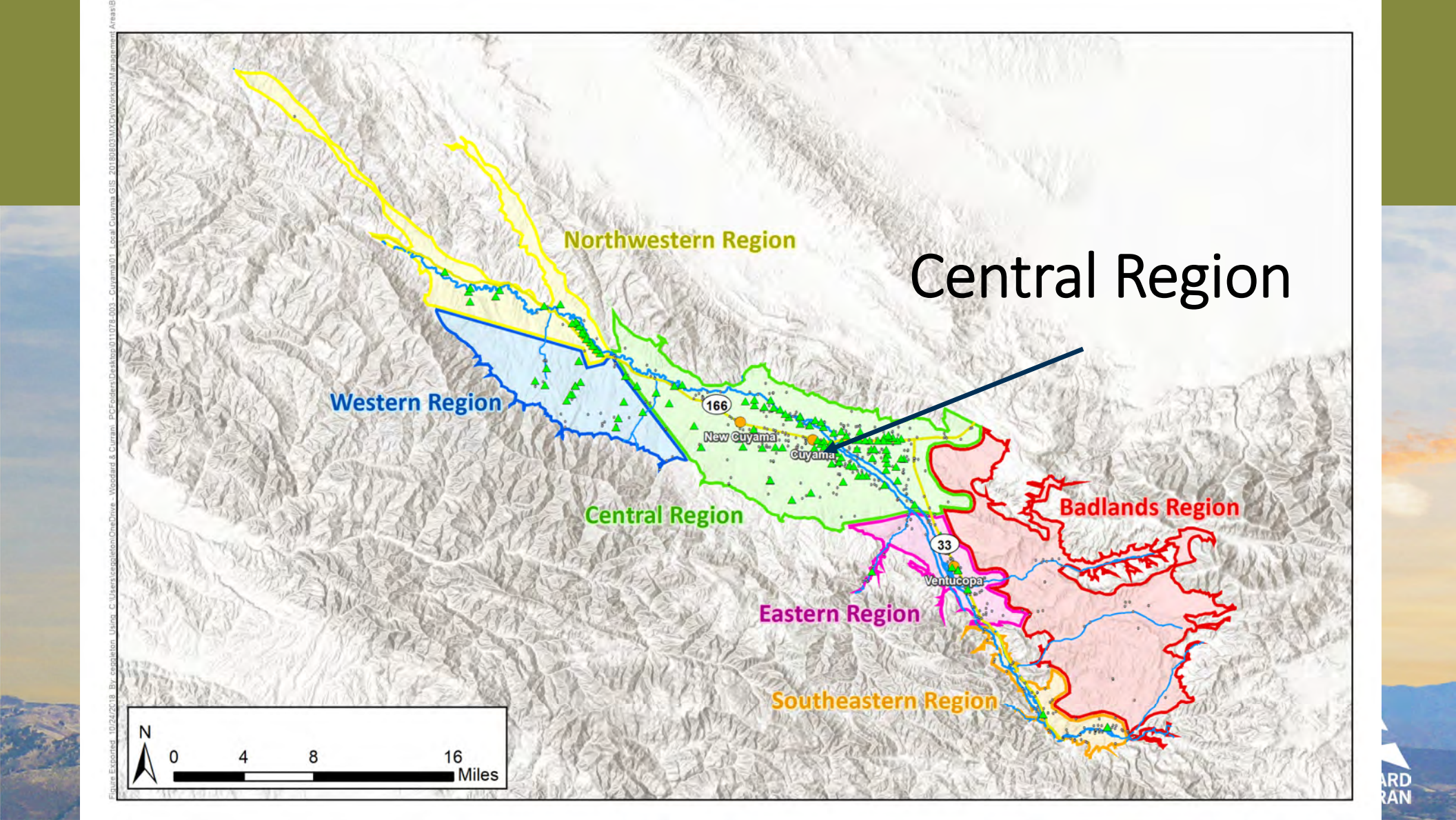
Advantages

- Maintains 5 years of storage between minimum threshold and measurable objective
- Maintains groundwater elevations at 2017 levels

Disadvantages

- May not restore groundwater levels to 2015 conditions
- Maintains groundwater elevations at 2017 levels

WOODARD &CURRAN


Central Region
Northwestern Region
Western Region
Central Region
Badlands Region
Eastern Region
Southeastern Region
166
New Cuyama
Cuyama
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Ventucopa
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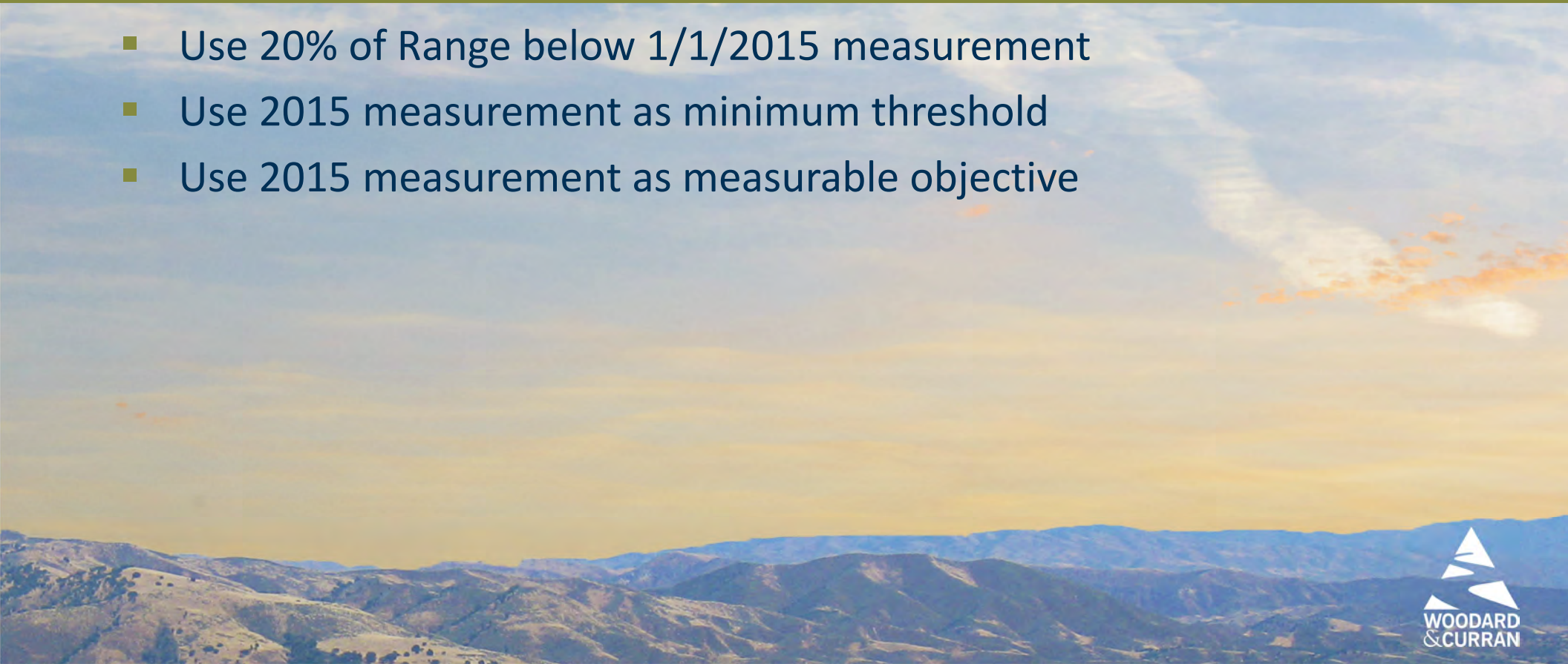
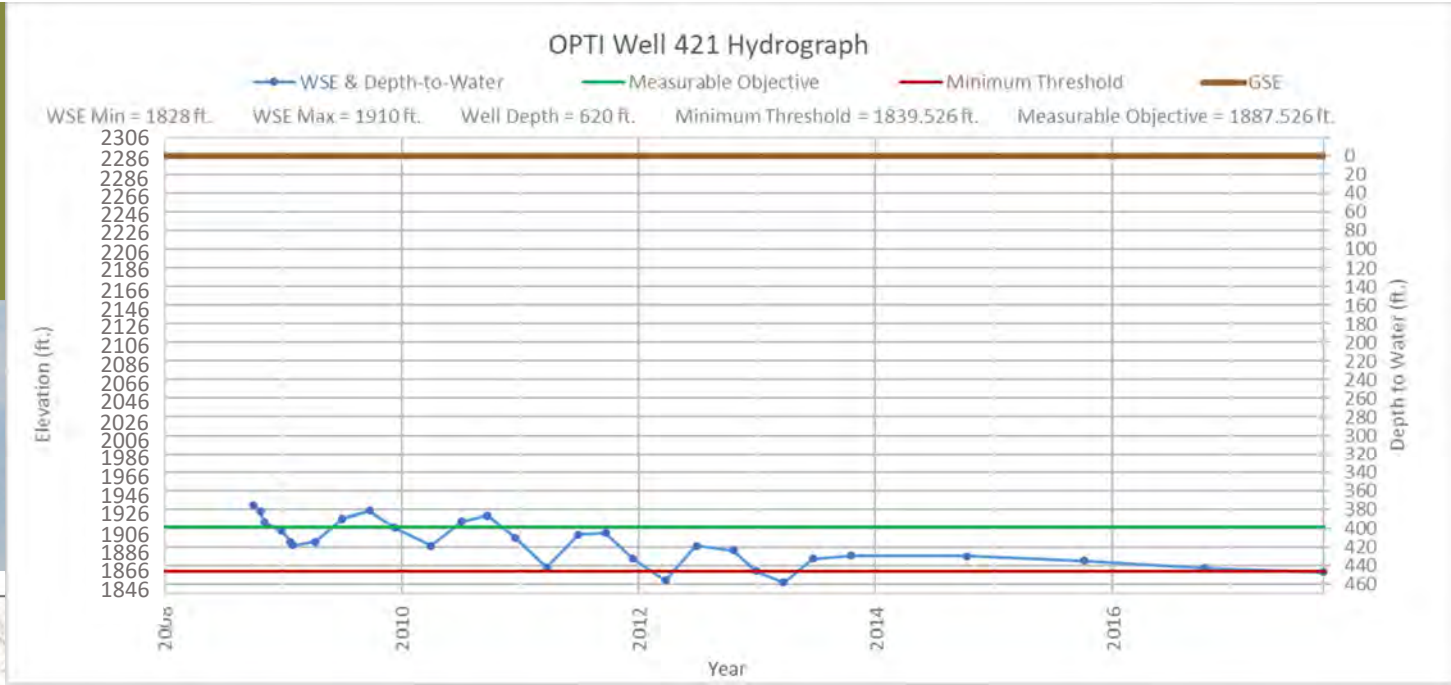
Three Minimum Threshold Options for Central Region

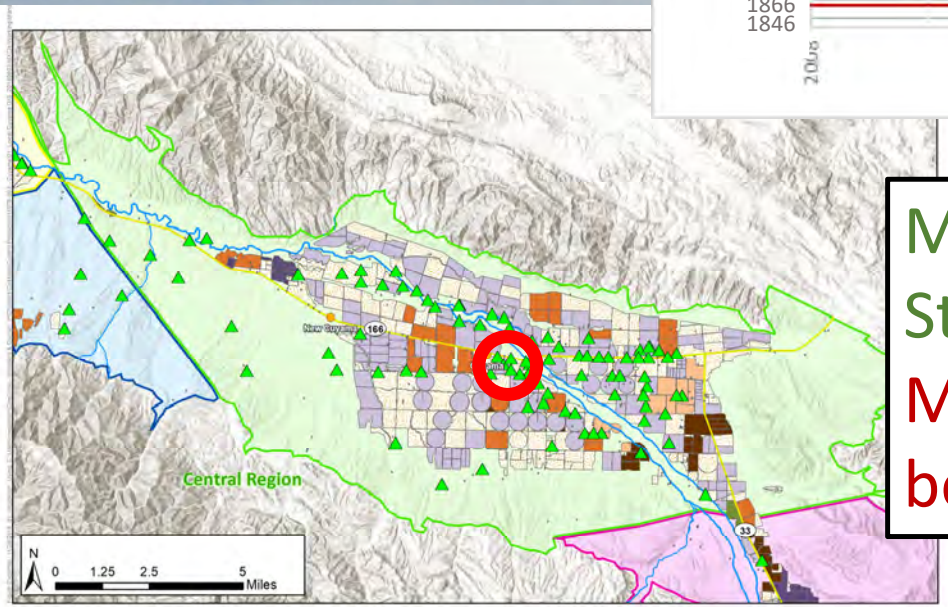
- Use 20% of Range below 1/1/2015 measurement
- Use 2015 measurement as minimum threshold
- Use 2015 measurement as measurable objective



Central Region

20% of Range





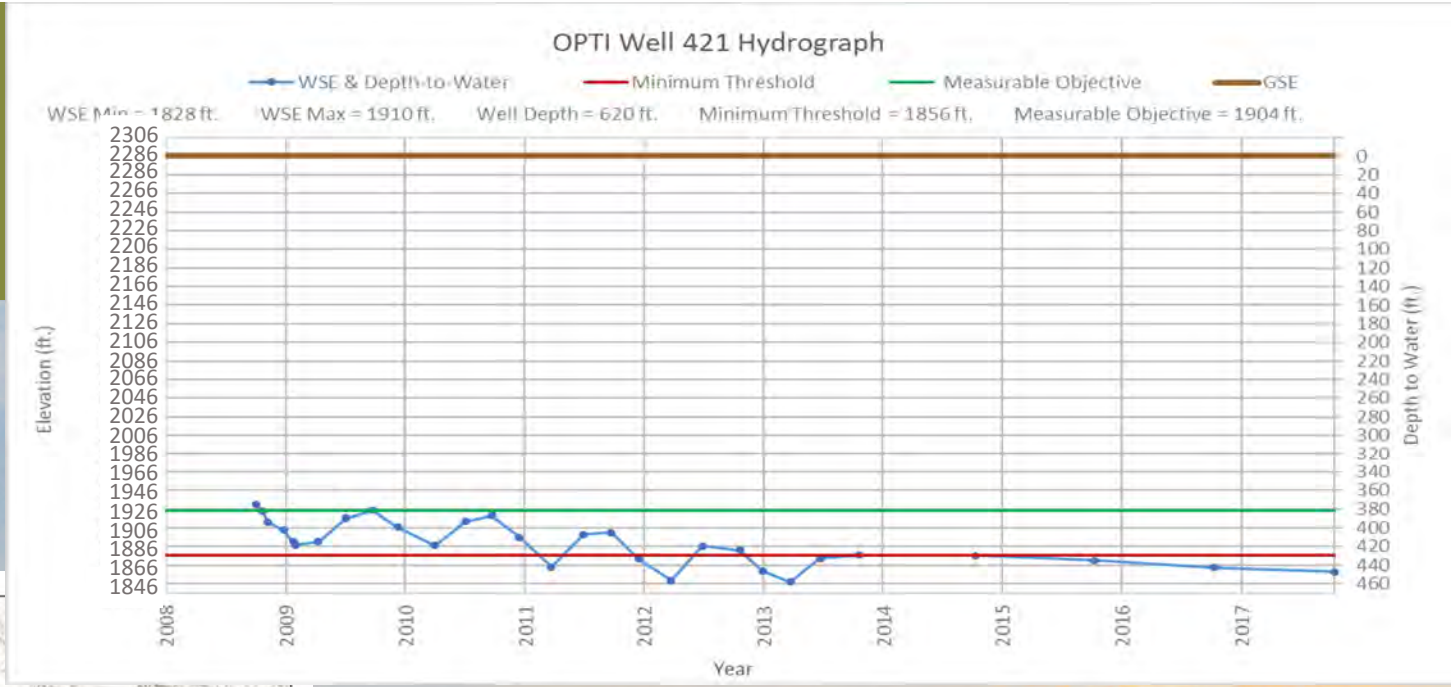
Measurable Objective – 5-years of Storage

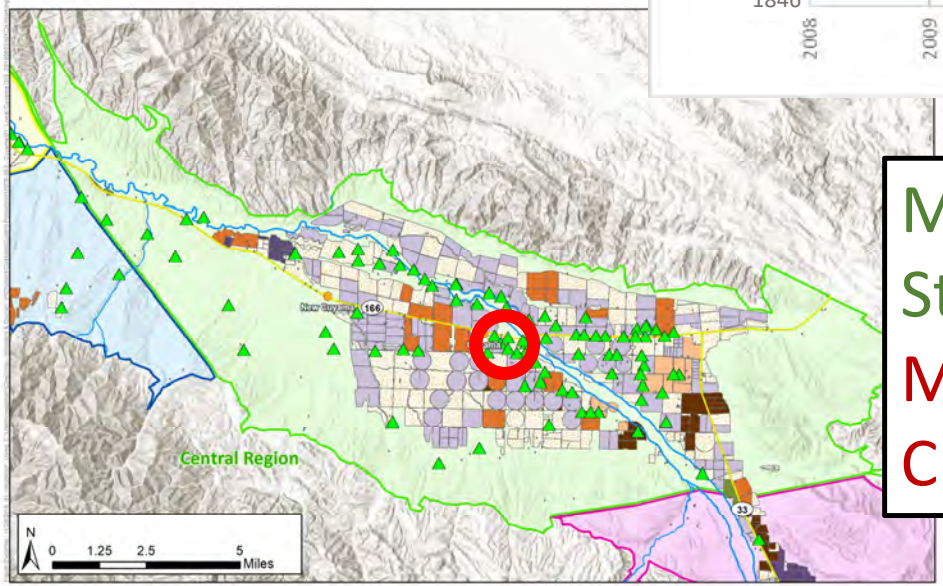
Minimum Threshold – 20% of Range below 1/1/2015 Measurement

WOODARD &CURRAN

Central Region

2015 as MT





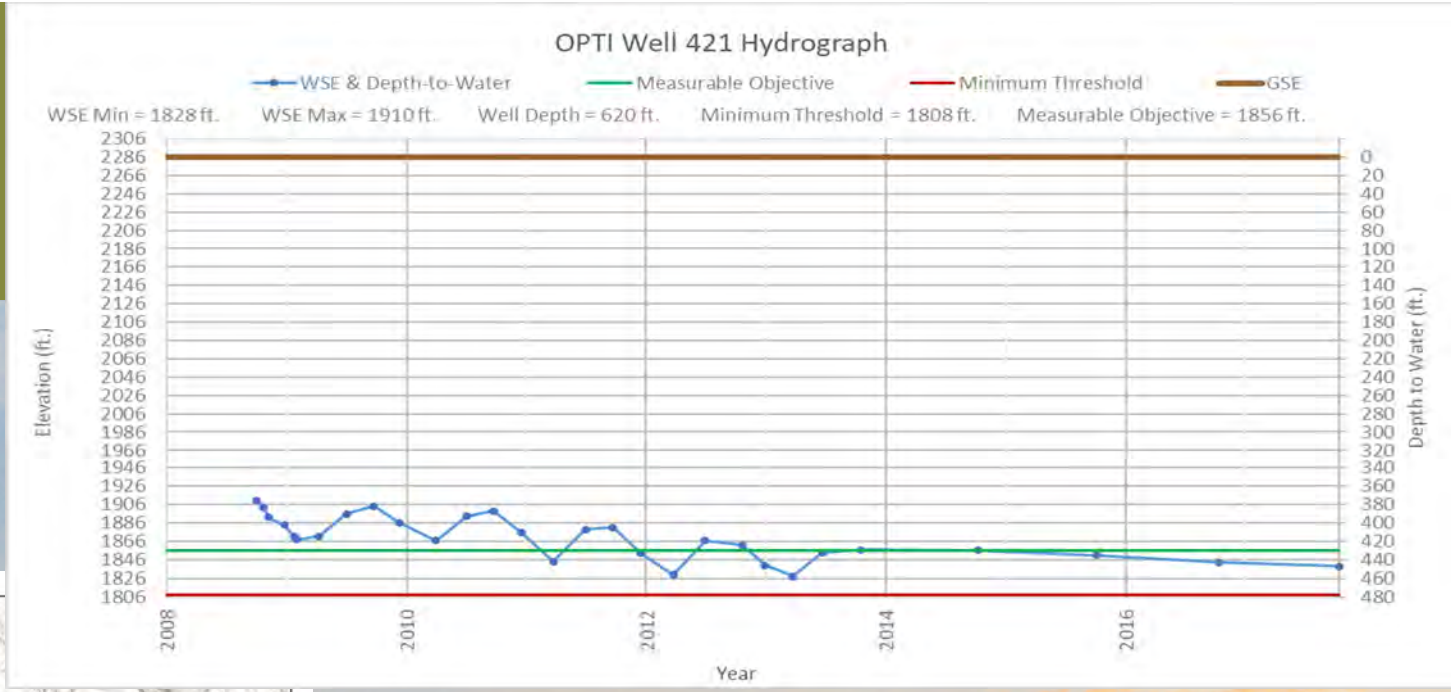
Measurable Objective – 5-years of Storage

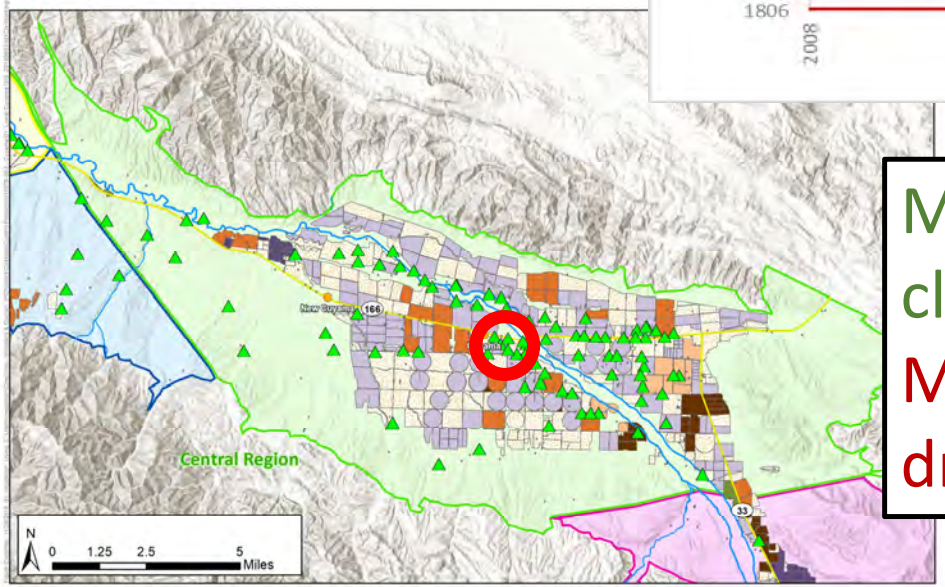
Minimum Threshold – Measurement Closest to (but after) January 1, 2015

WOODARD &CURRAN

Central Region

2015 as MO





Measurable Objective – 1/1/2015 (or closest Measurement, or calculated)

Minimum Threshold – 5-years of drought storage

WOODARD &CURRAN

Central Region - Advantages/ Disadvantages of Three Options for Minimum Thresholds

Advantages

20% of Range

- Recognizes current conditions

2015 as Minimum Threshold

- Attempts to regain 2015 groundwater levels

2015 as Measurable Objective

- Provides flexibility to adjust land and water use practices

Disadvantages

20% of Range

- Lower long-term groundwater levels

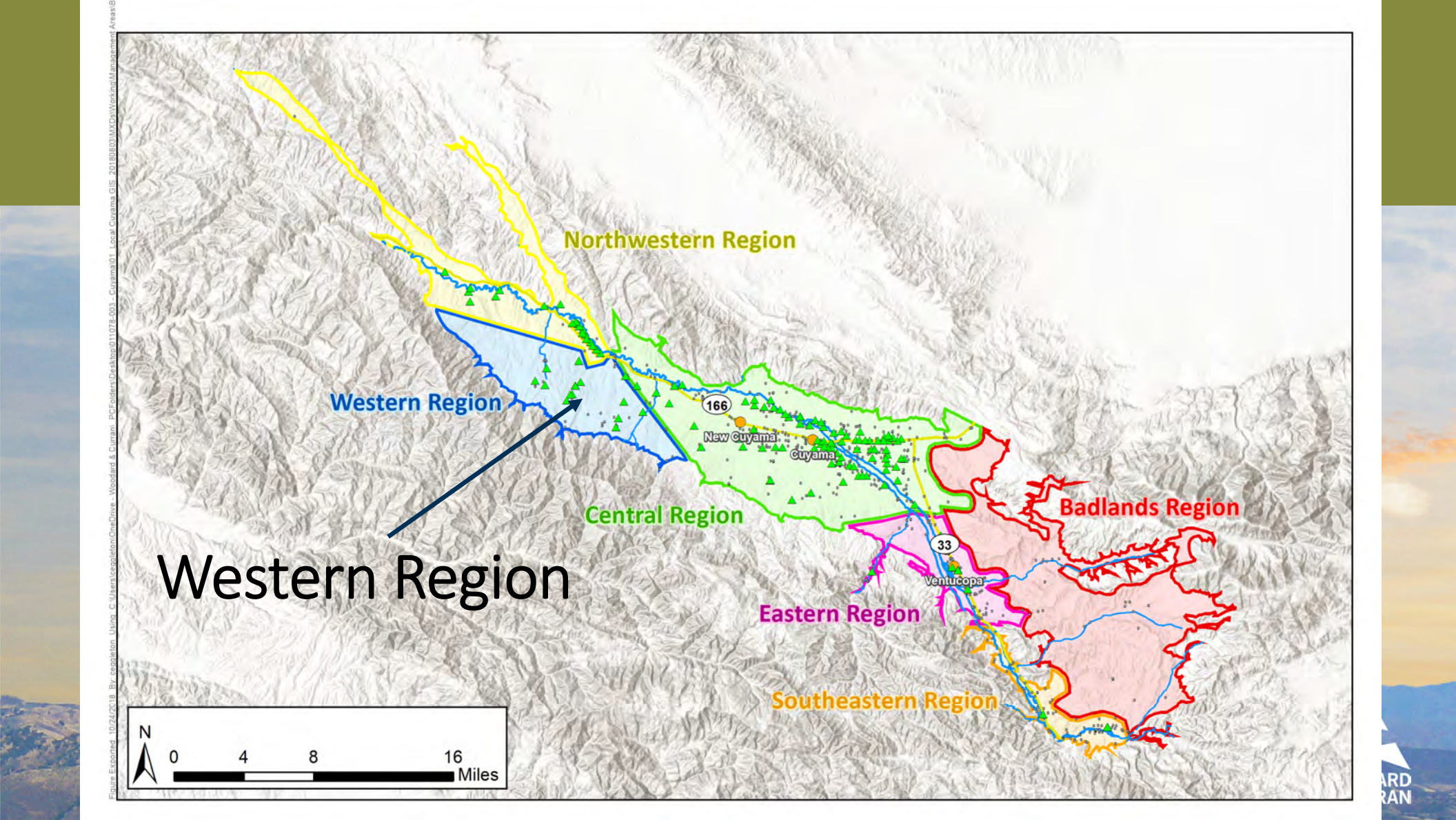
2015 as Minimum Threshold

- Current levels are below minimum threshold

2015 as Measurable Objective

- Lower long-term groundwater levels

WOODARD &CURRAN


Northwestern Region
Western Region
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Badlands Region
Eastern Region
Southeastern Region
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New Cuyama
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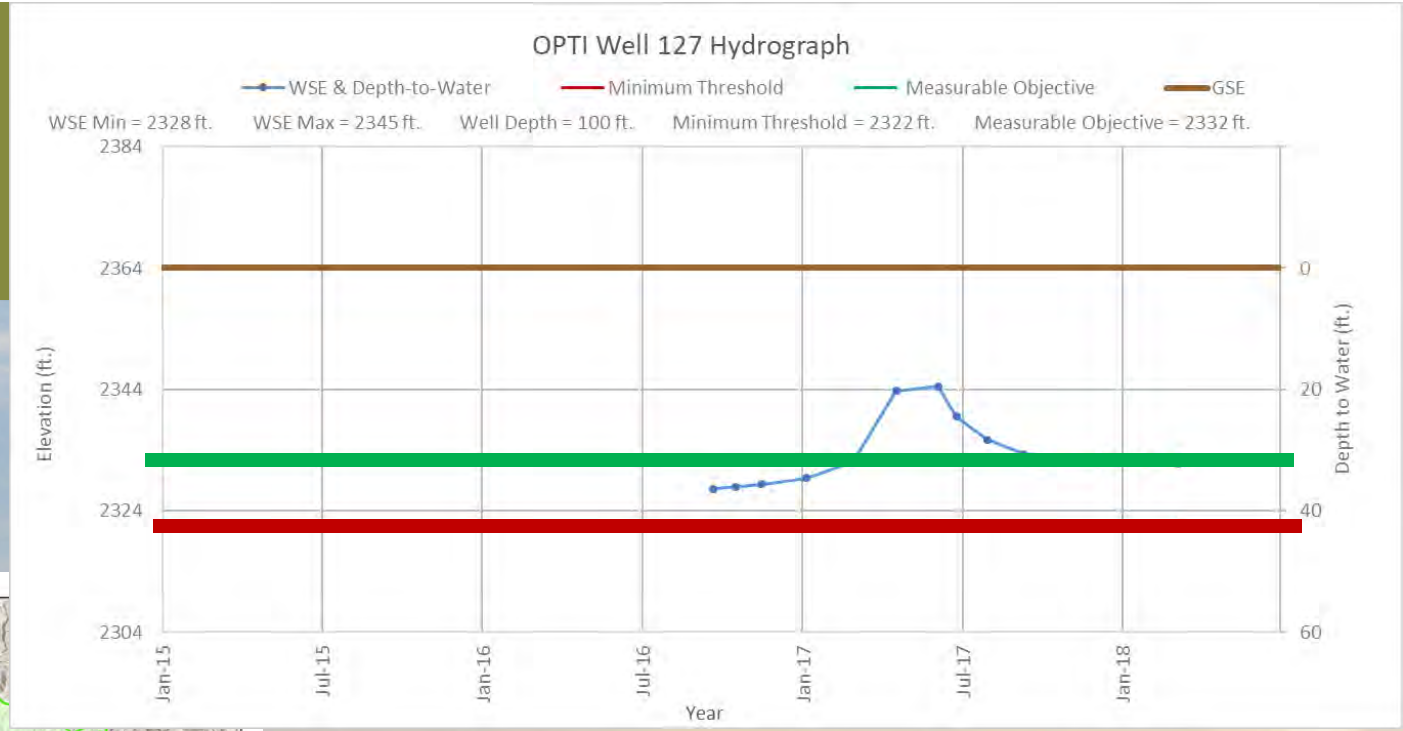
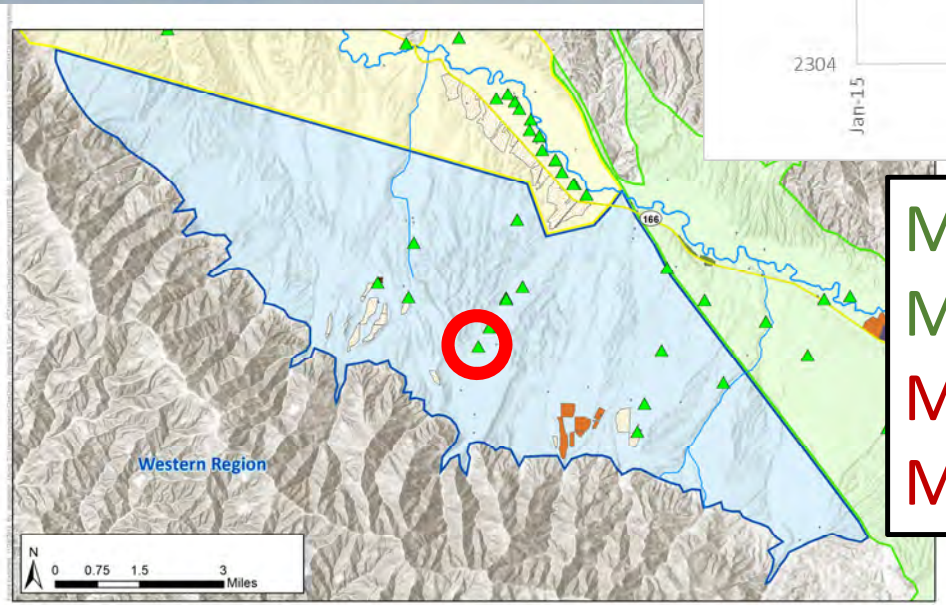
Western Region

2018 as MO, – 10 feet as MT





Measurable Objective – 2/1/2018 Measurement

Minimum Threshold – 10 feet below Measurable Objective

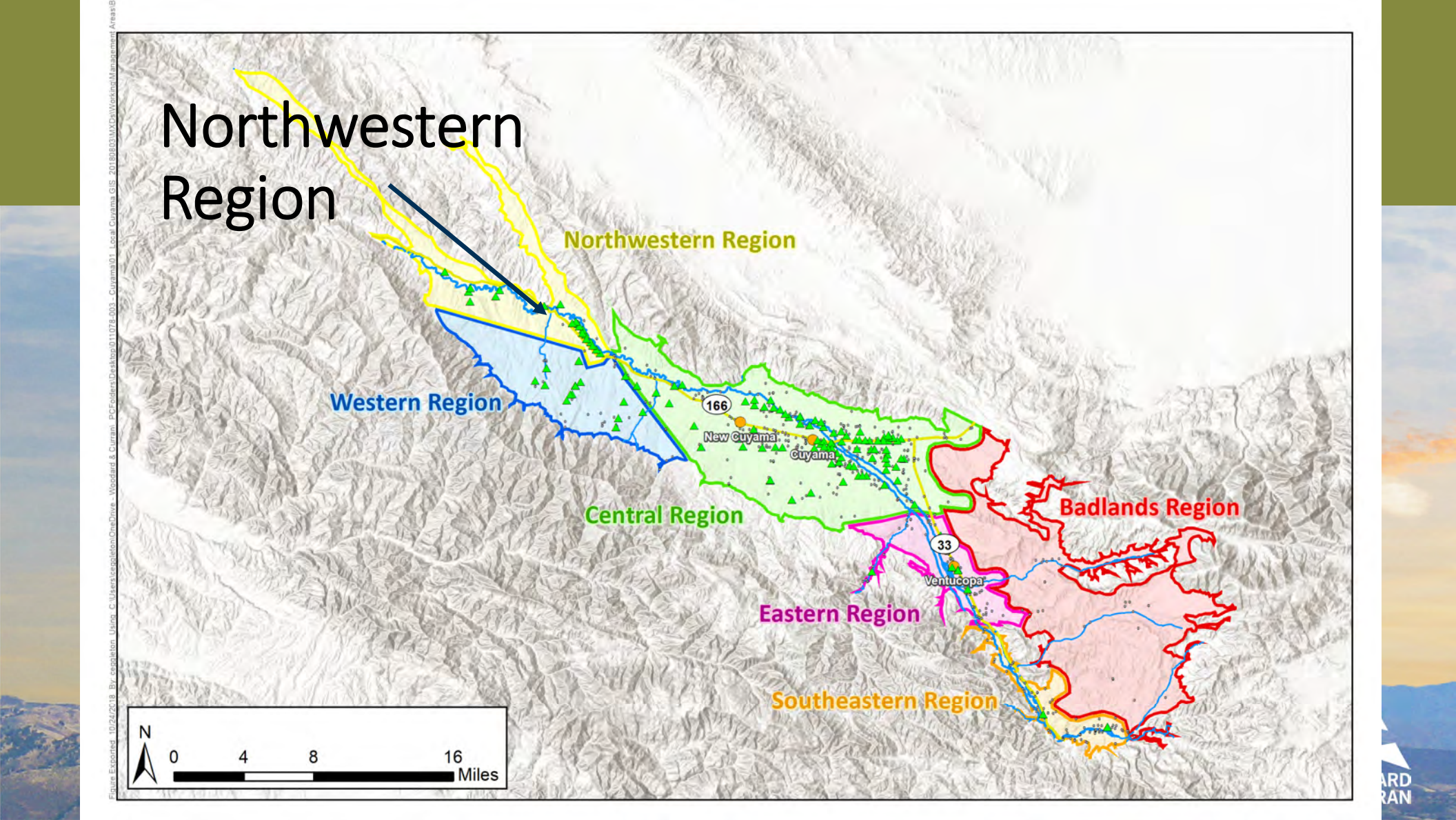
WOODARD &CURRAN

Western Region - Advantages/ Disadvantages of Using 2018 for Measurable Objective

Advantages

- Recognizes lack of historic data
- Provides flexibility for moving forward, can adjust as needed
- Maintains estimated 5 years of storage between minimum threshold and measurable objective

Disadvantages


Northwestern Region
Northwestern Region
Western Region
Central Region
Eastern Region
Badlands Region
Southeastern Region
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New Cuyama
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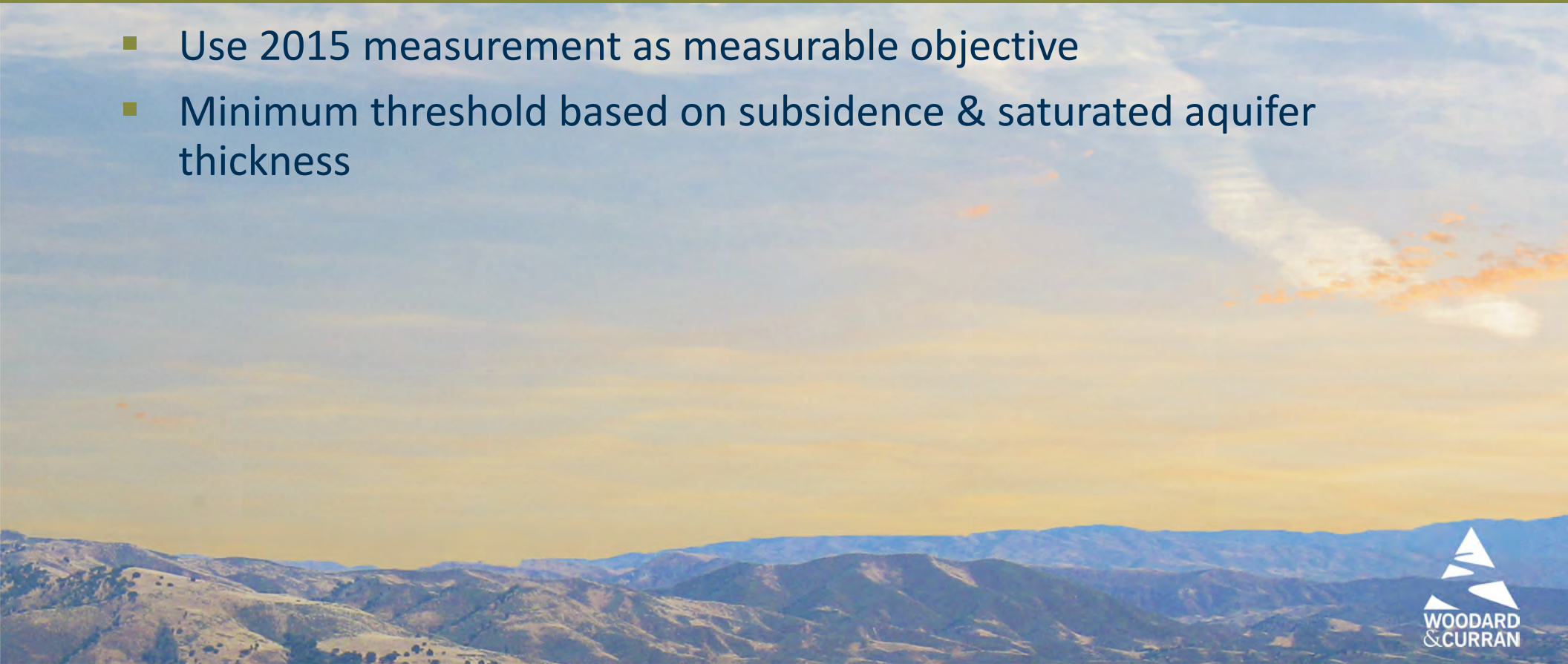
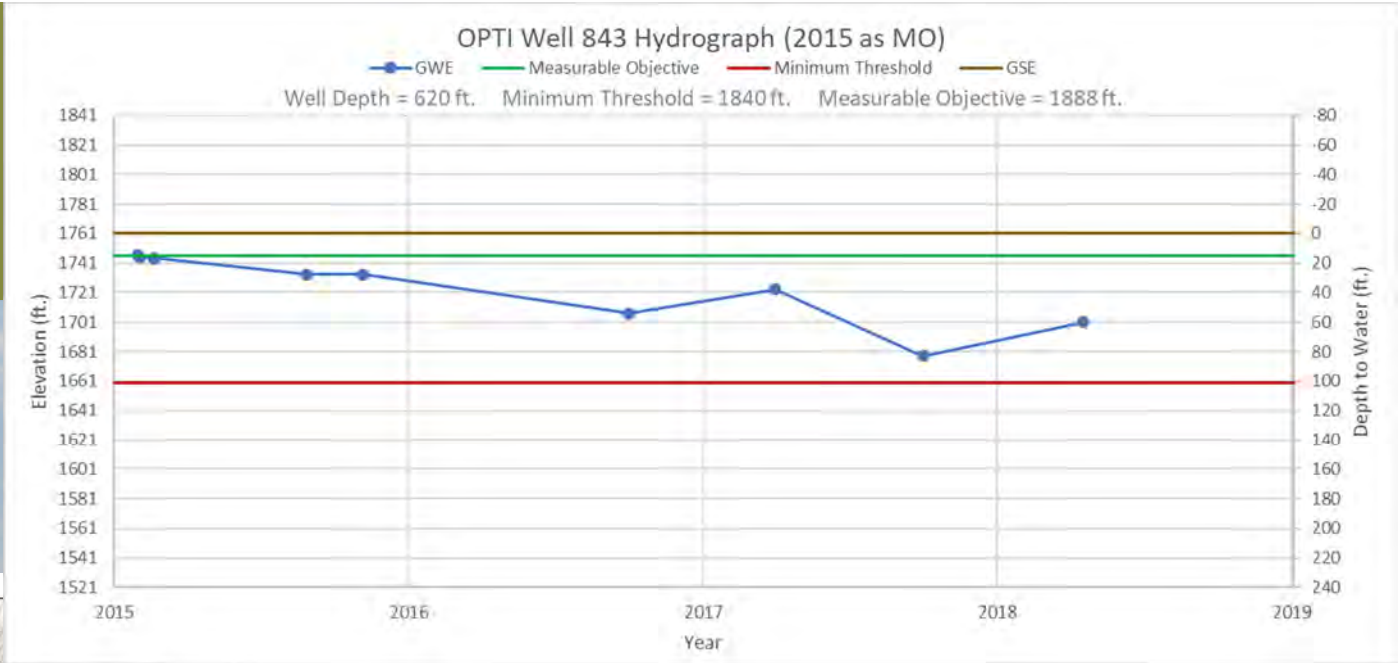
Three Minimum Threshold Options for Northwestern Region

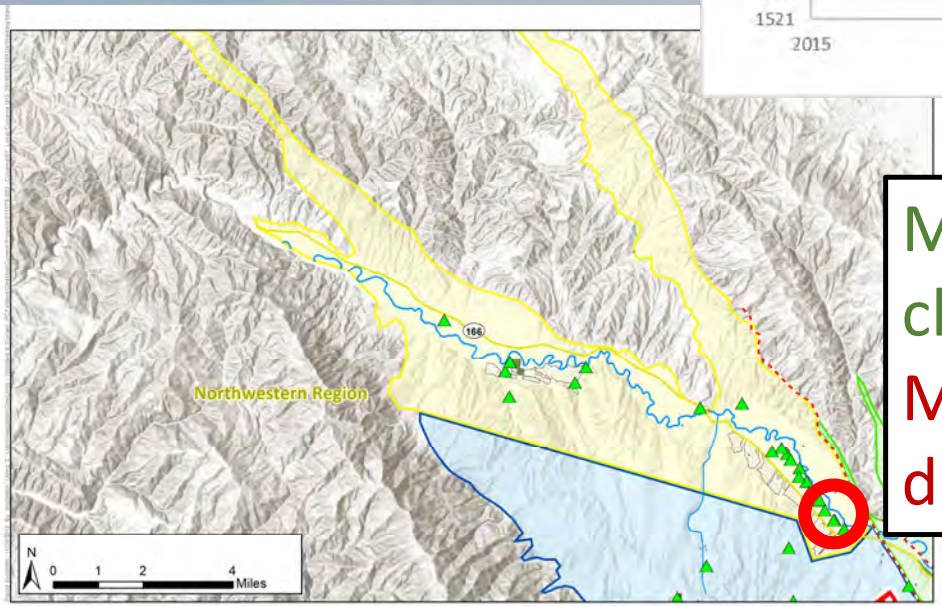
- Use 2015 measurement as measurable objective
- Minimum threshold based on subsidence & saturated aquifer thickness



Northwestern Region

Use 2015 as MO





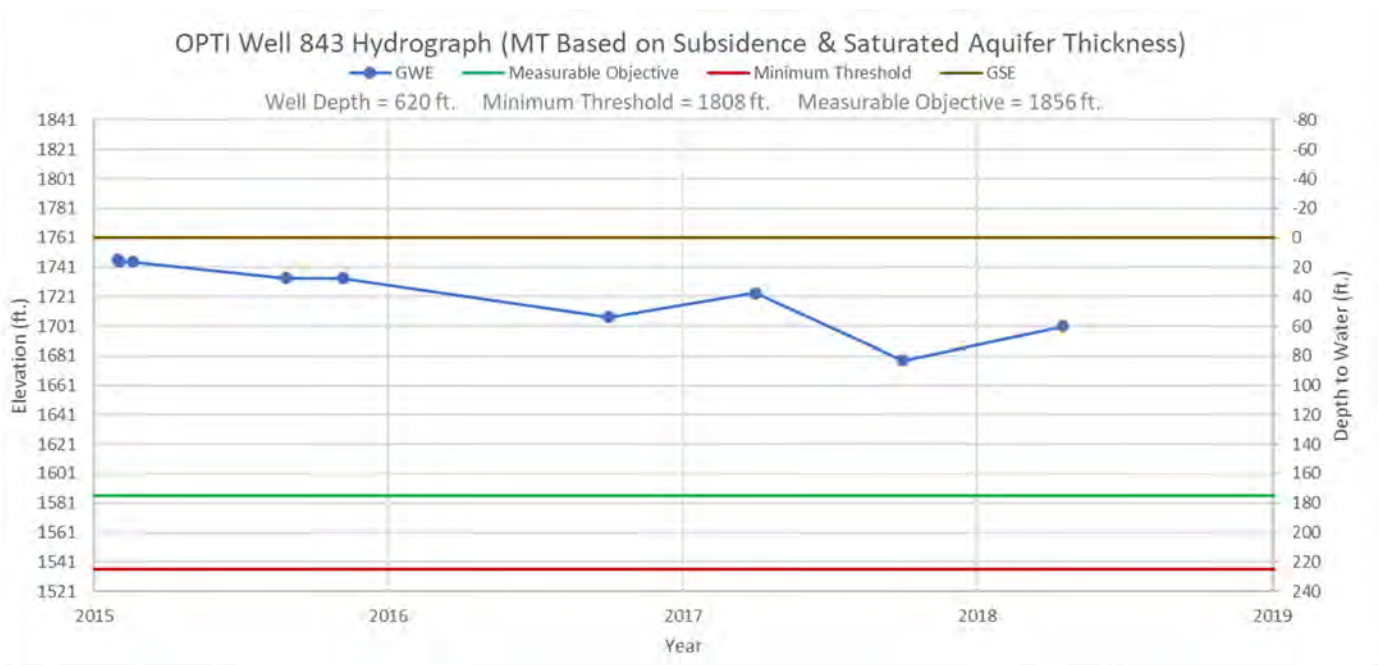
Measurable Objective – 1/1/2015 (or closest Measurement, or calculated)

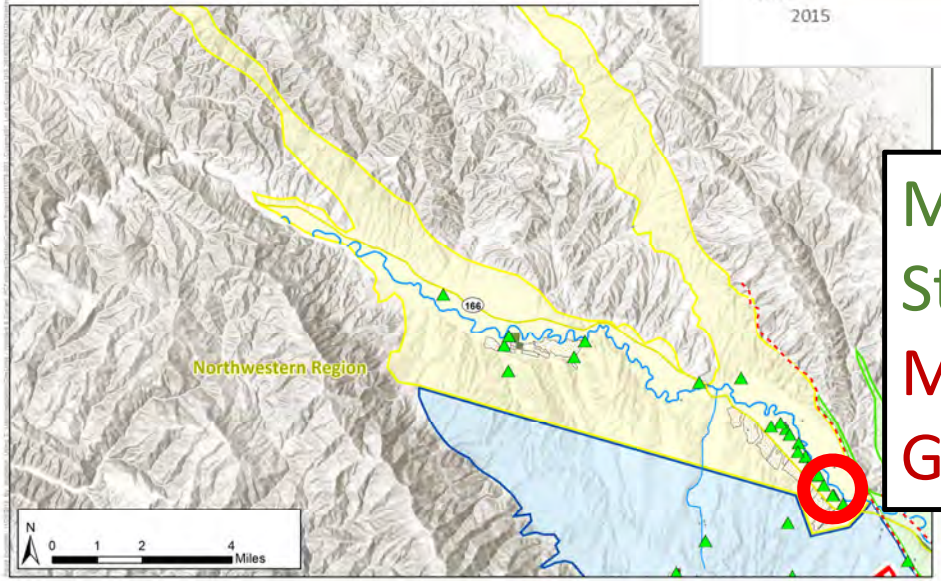
Minimum Threshold – 5-years of drought storage

WOODARD &CURRAN

Northwestern Region

MT based on subsidence & saturated aquifer thickness





Measurable Objective – 5-years of Storage

Minimum Threshold – 225 ft. below Ground Surface Elevation

WOODARD &CURRAN

Northwestern Region - Advantages/ Disadvantages of Three Options for Minimum Thresholds

Advantages

2015 as Measurable Objective

- Provides flexibility to adjust land and water use practices

Based on subsidence & saturated aquifer thickness

- Provides more flexibility for operations

Disadvantages

2015 as Measurable Objective

- Lower long-term groundwater levels

Based on subsidence & saturated aquifer thickness

- Lowest long-term groundwater levels

WOODARD &CURRAN

Next Steps/Public Involvement

- Prepare thresholds for wells in Representative Monitoring Network for review by Standing Advisory Committee meeting and consideration by the Board in January 2019
  - Check CGBSA website (cuyamabasin.org) for meeting dates
  - Members of the public are encouraged to attend the Standing Advisory Committee and Board meetings to provide input
- Prepare draft Thresholds GSP Section