MoundBasin

GROUNDWATER SUSTAINABILITY AGENCY

GROUNDWATER SUSTAINABILITY PLAN WORKSHOP NO. 2

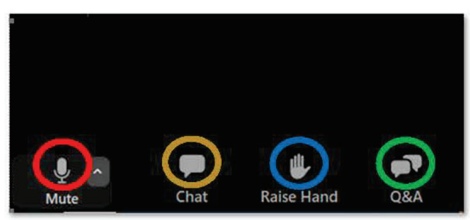
MARCH 4, 2021
6 PM

United Water CONSERVATION DISTRICT

VENTURA WATER

WEBINAR FEATURES

- Workshop is being recorded and will be posted to **moundbasingsa.org** along with the presentations
- Attendees are muted
- Questions and comments:
  - Use "Raise Hand" to ask a question verbally
  - Use "Q&A" to type a question and/or comment to the panelists
  - Use "Chat" to type a question and/or comment to the panelists



WORKSHOP AGENDA

No.	Time	Topic
1	6:00 – 6:05 pm	Meeting Call to Order, Roll Call, and Public Comments
2	6:05 – 6:10 pm	Welcome, Overview Webinar Features, and Agenda Review
3	6:10 – 6:15 pm	Get to Know the Audience • Attendee Poll Questions
4	6:15 – 6:30 pm	Introduction to Sustainable Management Criteria • Presentation • Q&A
5	6:30 – 6:55 pm	Groundwater Modeling and Water Budgets • Presentation • Q&A
6	6:55 – 7:00 pm	Break
7	7:00 – 7:40 pm	Proposed Sustainable Management Criteria • Presentation • Q&A
8	7:40 – 8:00 pm	• Stakeholder Questions and Feedback • Attendee Poll Questions
9	8:00 – 8:10 pm	Mound Basin GSA Director Comments
10	8:10 – 8:15 pm	Wrap-up

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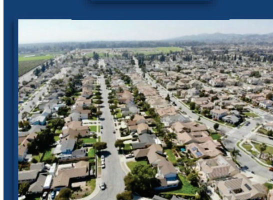
ATTENDEE POLL NOS. 1 - 3



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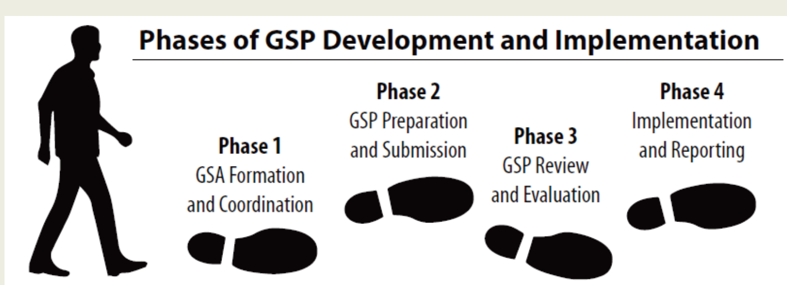
INTRODUCTION TO SUSTAINABLE MANAGEMENT CRITERIA

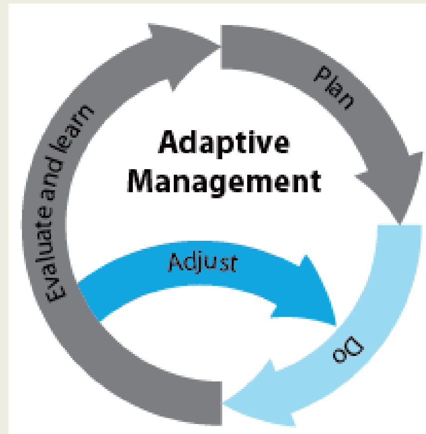
SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA) REQUIREMENTS

1. Form a Groundwater Sustainability Agency (GSA)
2. Adopt a Groundwater Sustainability Plan (GSP)
   - Due January 31, 2022
3. Achieve Sustainable Groundwater Management
   - 20 years following GSP adoption



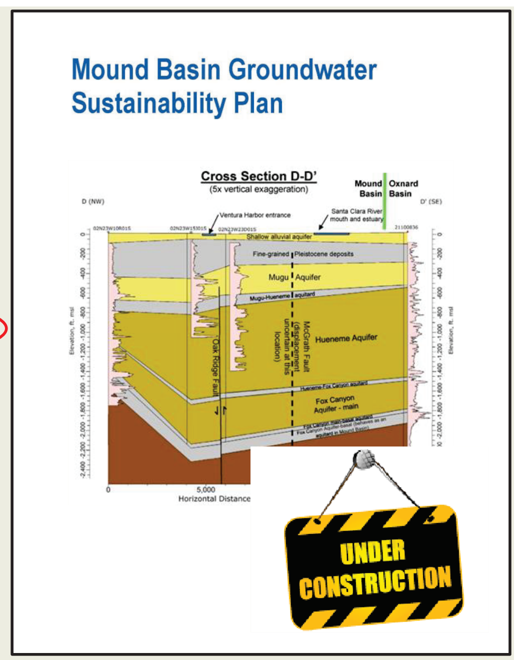
WHAT IS A GSP?

The GSP is a <u>flexible road map</u> for how a groundwater basin will achieve long term sustainability by <u>avoiding undesirable results</u> through <u>data-driven adaptive management</u>



WHAT MUST A GSP INCLUDE?

- GSP Contents
  - Administrative Information
  - Basin Setting
  - Sustainable Management Criteria
  - Monitoring Networks
  - Projects and Management Actions
  - Implementation



****** *Draft Basin Setting Available On MBGSA Website* ******

SUSTAINABLE MANAGEMENT CRITERIA

- Overarching goal of SGMA is to avoid undesirable results for each of the six SGMA sustainability indicators:

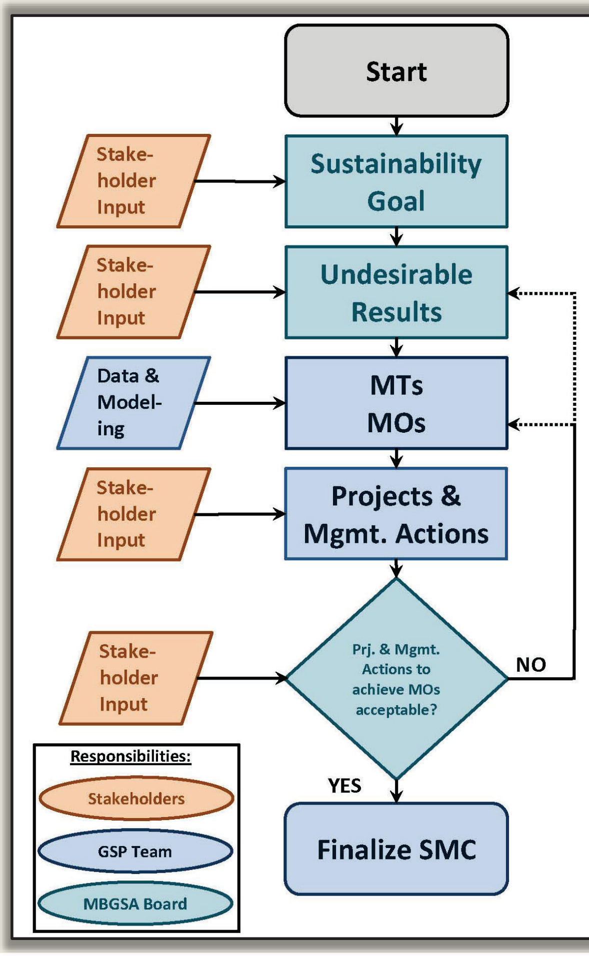
- Undesirable results and actions to prevent them are defined at the local level by the GSA

SUSTAINABLE MANAGEMENT CRITERIA

- Sustainability Goal
- Undesirable Results
  - Significant and unreasonable effects for sustainability indicators caused by groundwater conditions occurring throughout the basin
- Minimum Thresholds
  - Quantitative metrics indicating significant and unreasonable effect likely exist
- Measureable Objectives
  - Quantitative metrics that reflect basin desired conditions

SUSTAINABLE MANAGEMENT CRITERIA DEVELOPMENT PROCESS

SMC will be the central focus of the GSP



SUSTAINABILITY GOAL

- High-level policy framework to guide development of Sustainable Management Criteria & Plan Actions
- Adopted on September 17
- Available on-line

Sustainability Goal
Adopted September 17, 2020

The goal of this Groundwater Sustainability Plan (GSP) is to sustainably manage the groundwater resources of the Mound Basin for the benefit of current and anticipated future beneficial users of groundwater and the welfare of the general public who rely directly or indirectly on groundwater. Sustainable groundwater management will ensure the long-term reliability of the Mound Basin groundwater resources by avoiding undesirable results pursuant to the Sustainable Groundwater Management Act (SGMA) no later than 20 years from GSP adoption through implementation of a data-driven and performance-based adaptive management framework. It is the express goal of this GSP to develop sustainable management criteria and plan implementation measures to avoid undesirable results for the applicable SGMA sustainability indicators by:

1. *Using best available science and information, including consideration of uncertainty in the basin setting and groundwater conditions;*
2. *Conducting active and meaningful stakeholder engagement;*
3. *Considering potential impacts on the management of adjacent basins and, where necessary coordinating with adjacent basins; and*
4. *Balancing economic, social, and environmental impacts and benefits associated with the all current and anticipated future beneficial users of groundwater, by considering:*
   a. *Water supply reliability for agriculture and municipal and industrial users;*
   b. *Availability of alternative water sources for domestic groundwater beneficial users;*
   c. *Identifying and considering potential impacts to groundwater dependent ecosystems;*
   d. *State, federal, or local standards relevant to applicable sustainability indicators;*
   e. *Feasibility of projects and management actions necessary to achieve proposed measureable objectives; and*
   f. *Economic impact of projects and management actions necessary to achieve proposed measureable objectives on all beneficial users, with special consideration of disadvantage communities and agricultural landowners lacking alternative land use options.*

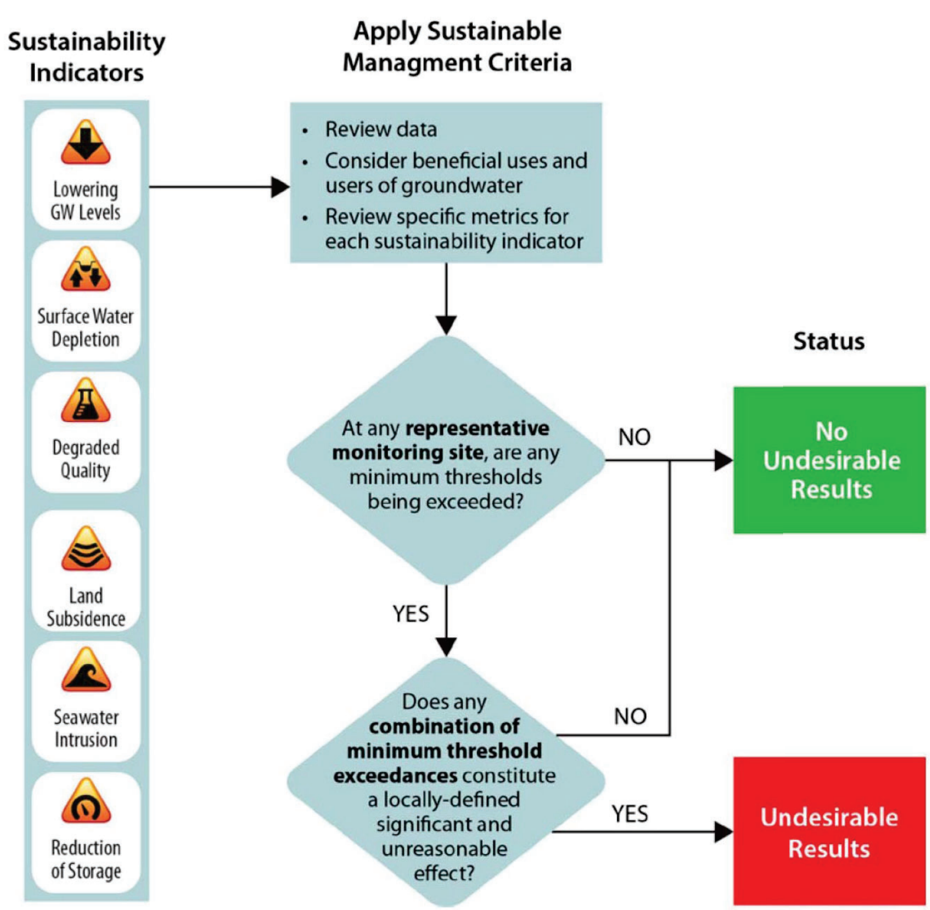
UNDESIRABLE RESULTS

"Significant and unreasonable effects for sustainability indicators caused by groundwater conditions occurring throughout the basin.

1. Significant and Unreasonable Effects: Undesirable results are significant and unreasonable effects related to a sustainability indicator. For example, seawater intrusion that impacts beneficial uses of groundwater.

2. Caused by Groundwater Conditions: The significant and unreasonable effects must be caused by managed groundwater conditions (i.e., pumping or GSP projects).

3. Throughout the Basin: The significant and unreasonable effects must occur or be caused by conditions throughout a large portion of the basin.



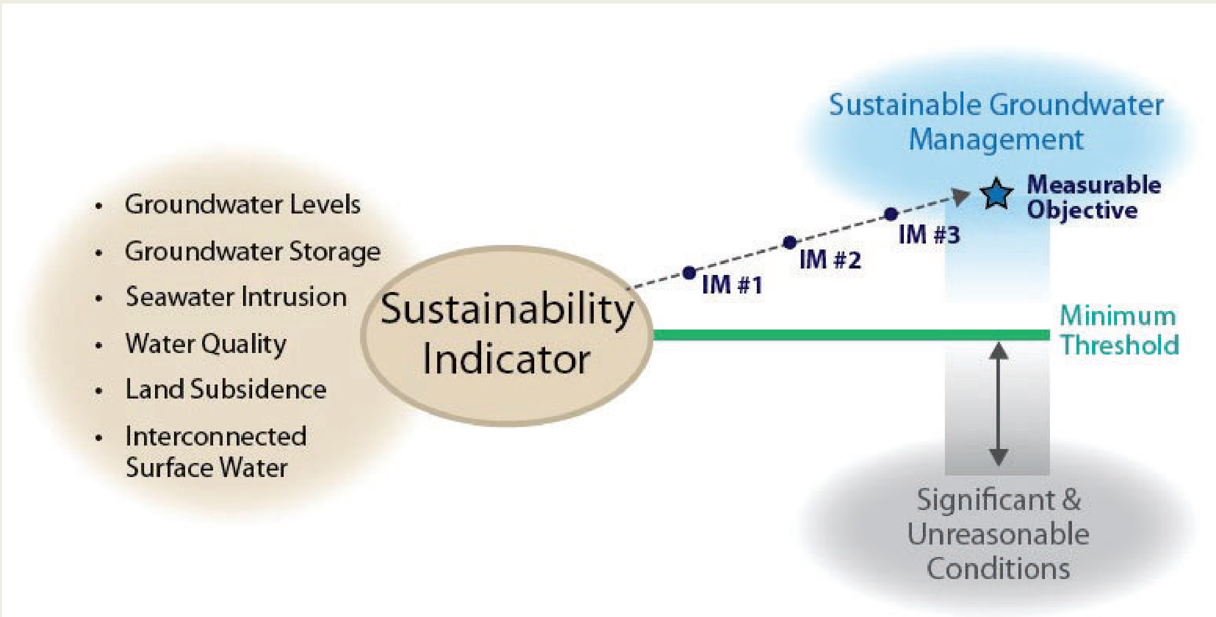
UR PROCESS

Minimum Thresholds:
Quantitative measures that indicate significant and unreasonable effects in a particular area

Undesirable Results:
Combination of minimum thresholds exceedances that defines undesirable results

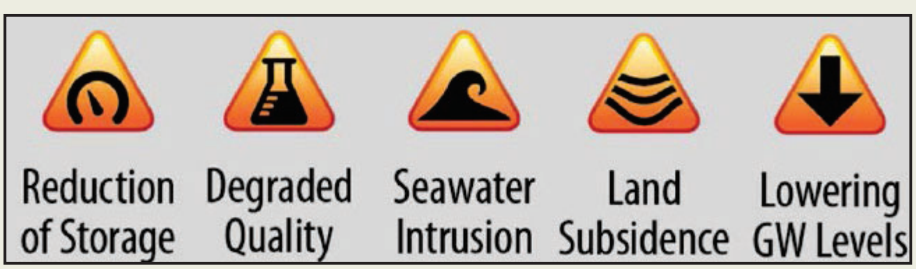
SUSTAINABLE MANAGEMENT CRITERIA

The overarching goal of SGMA is to avoid undesirable results



SUSTAINABLE MANAGEMENT CRITERION STATUS

Surface Water Depletion is not an applicable sustainability indicator. Surface water is not materially connected to principal aquifers (not affected by pumping).

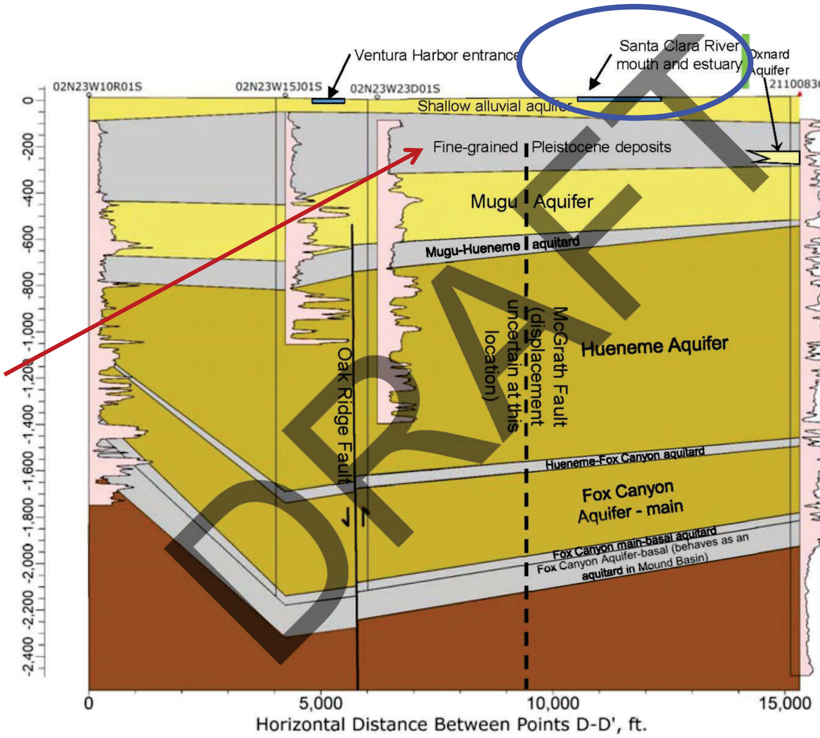


Proposed SMC to be discussed during third presentation

INTERCONNECTED SURFACE WATER

- *Shallow GW likely interconnected with river, however, there is no pumping from shallow aquifer.*

- *Surface water is separated from principal aquifers by thick aquitards. Pumping in principal aquifers is not believed to materially affect surface water.*



QUESTIONS?

View looking north from Olivas Park Drive

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GROUNDWATER MODELING AND WATER BUDGETS

SGMA REQUIREMENTS

- SGMA requires minimum 50-yr future projections of groundwater conditions, including water budget for the basin
- Must use >= 50 yrs. of *historical* hydrology
- Must use most recent conditions for baseline estimate of future water demands
- Must evaluate potential effects on water demand due to:
  - Land Use Change
  - Population Change
  - Climate Change

FUTURE CONDITIONS KEY ASSUMPTIONS

- Discussed with Board on 9/17/2020
- Hydrology
  - 1943 – 2019 (77 yrs.) is proxy for future conditions
    - Wide range of conditions during this period
- Groundwater Pumping
  - Agricultural – per MBAWG
    - Ranges from 2,873 AFY in wet yrs. to 3,548 AFY in dry yrs.
  - City of Ventura planned pumping = 4,000 AFY
  - Two industrial wells – same as recent historical pumping

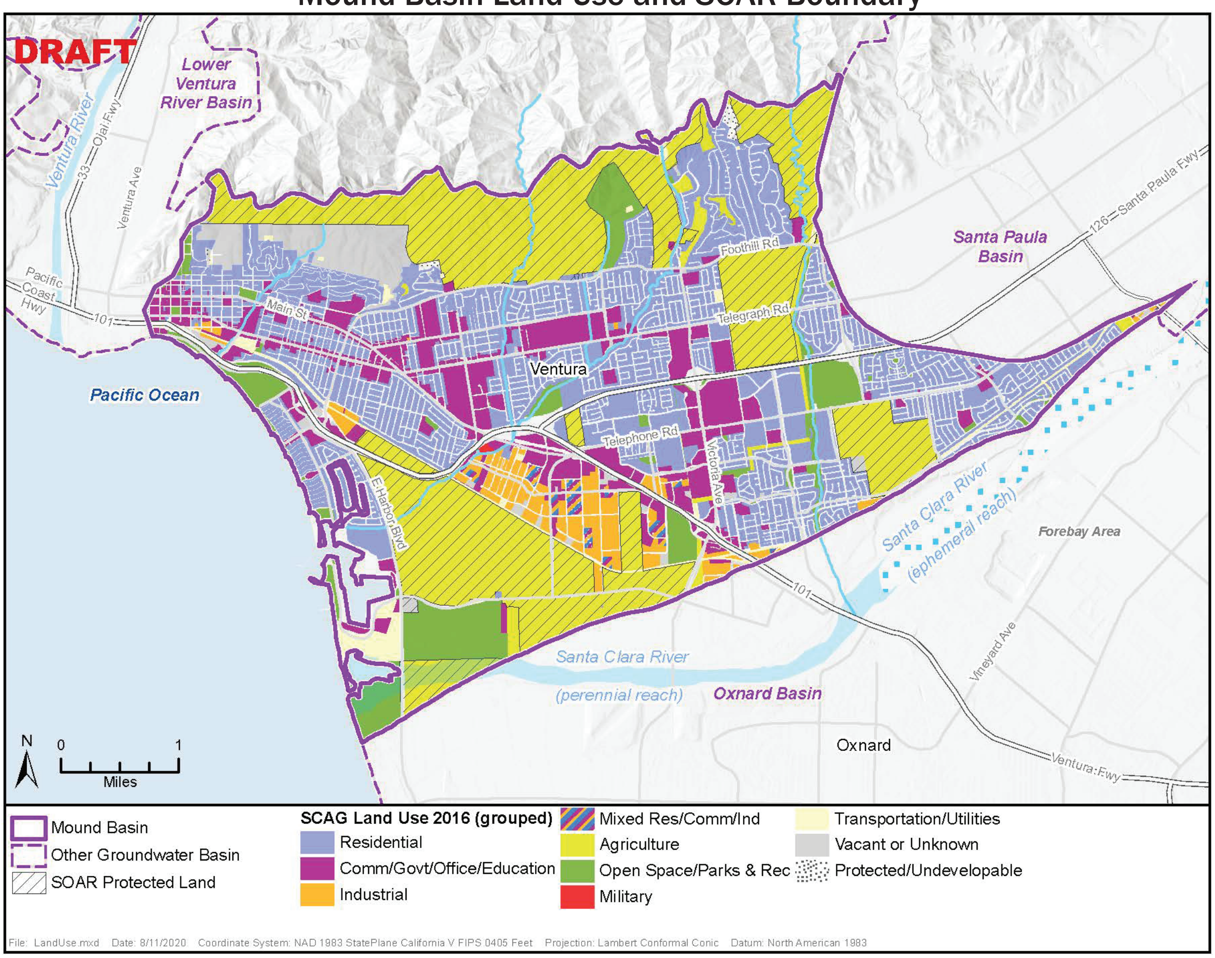
FUTURE CONDITIONS KEY ASSUMPTIONS (CON'T)

- Adjacent Basins
  - Santa Paula – assume future pumping consistent with recent pumping (adjudicated)
  - Oxnard Basin – used FCGMA "Reduction with Projects Scenario from GSP per FCGMA staff recommendation
    - Adjustments made to reduce unrealistically high groundwater levels in Oxnard Basin Forebay (GW levels above land surface)
- Artificial Recharge (UWCD)
  - Existing Freeman Diversion operations + planned expansion project per UWCD staff

SGMA REQUIRED ANALYSIS

- **Land Use Impact**
  - Assume no material change due to SOAR voter initiatives approved through 2050.
  - City has net zero policy for development
- **Population Change**
  - Same as above.
- **Climate Change**
  - Evaluated climate change using DWR change factors for 2030 and 2070 climate change conditions
  - Sea level rise 15 cm (2030) and 45 cm (2070)

Mound Basin Land Use and SOAR Boundary



MODEL SCENARIOS

- Historical: 1985-2019 (calibration/verification model)
- Baseline: This simulation employs the future assumptions described above.
- 2030 Climate Change: Baseline inputs modified using DWR 2030 “climate change factors”
- 2070 Climate Change: Baseline inputs modified using DWR 2070 “climate change factors”
- 2070 Climate Change without Freeman Diversion Expansion Project: Same as “2070 Climate Change” scenario, but w/o expansion project.
- Particle tracking to evaluate seawater intrusion risk

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UWCD SLIDES

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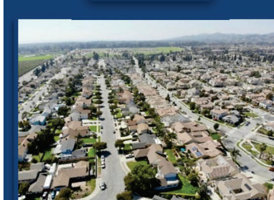

GROUNDWATER MODEL AND WATER BUDGET QUESTIONS

View looking southeast from Grant Park

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5 MINUTE BREAK

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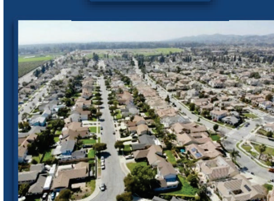

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VENTURA WATER

PROPOSED SUSTAINABLE MANAGEMENT CRITERIA

DRAFT WATER QUALITY SMC

Degraded Quality

- Current water quality supports beneficial uses (currently no undesirable results)
- Nexus between URs and groundwater conditions
  - Pumping could increase downward movement of poor quality water
- Potential Effects on Beneficial Users
  - Increased costs for treatment, decreased crop yield, increased water demand for leaching, etc.

DRAFT WATER QUALITY MINIMUM THRESHOLDS

Degraded Quality

- Criteria for Minimum Threshold Development
  - Maximum Contaminant Levels (MCLs)
  - RWQCB Water Quality Objectives (WQOs)
  - Agricultural Toxicity Thresholds
  - Existing Water Quality
- MTs based on significant and unreasonable effects consistent with sustainability goal
  - RWQCB WQOs used except in one case where existing water quality does not meet WQO (Hueneme Aquifer – TDS)

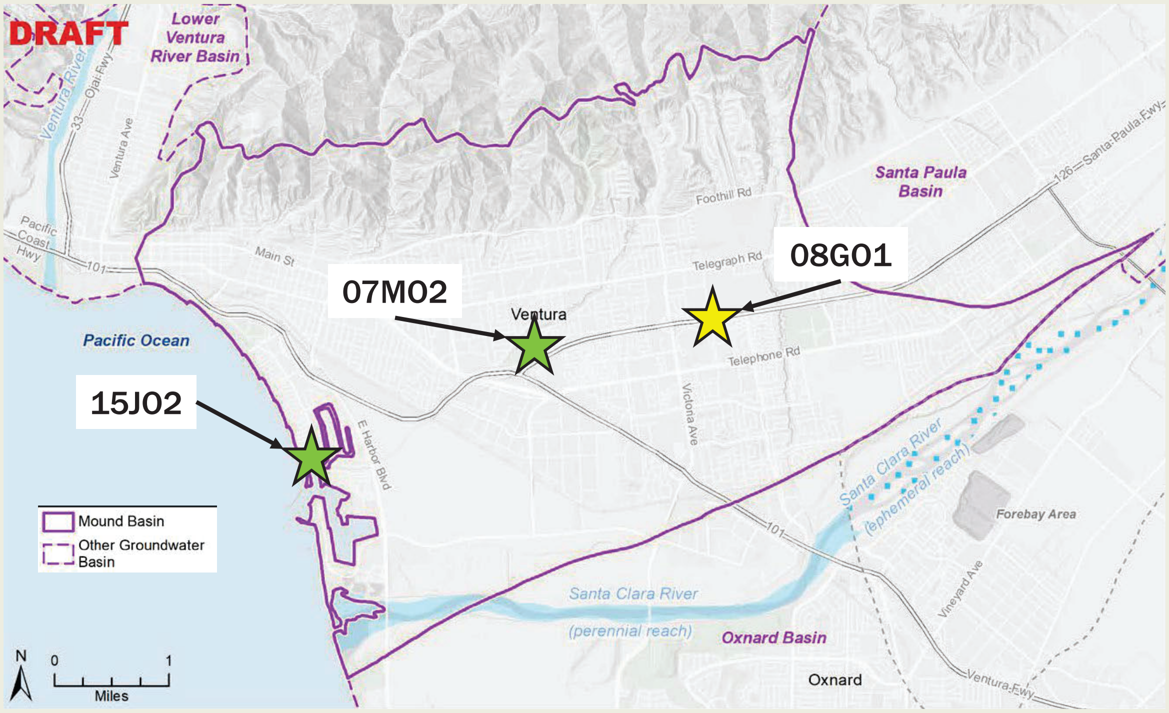
DRAFT WATER QUALITY UNDESIRABLE RESULTS

Degraded Quality

- Criteria for Undesirable Results:
  - SGMA undesirable results are considered to be occurring when all representative wells in a principal aquifer (Mugu or Hueneme) exceed a minimum threshold concentration continuously for two years and MBGSA determines that the exceedances are caused by groundwater pumping.

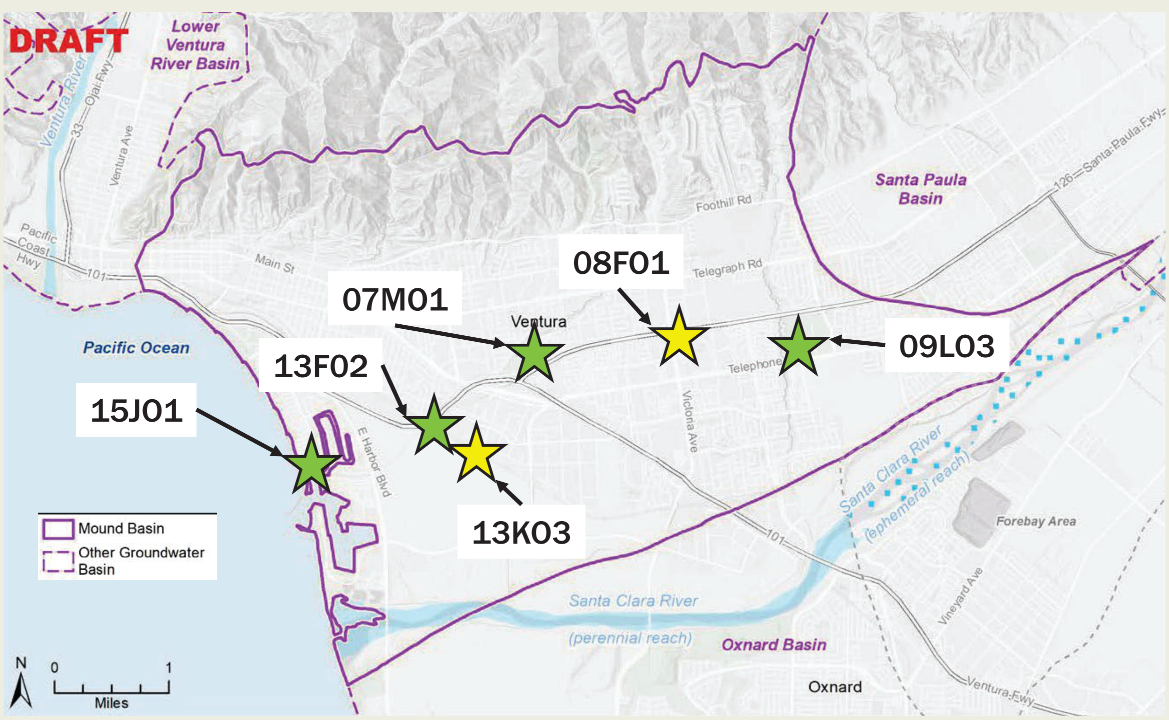
WATER QUALITY MONITORING LOCATIONS – MUGU AQUIFER

Degraded Quality



WATER QUALITY MONITORING LOCATIONS – HUENEME AQUIFER

Degraded Quality



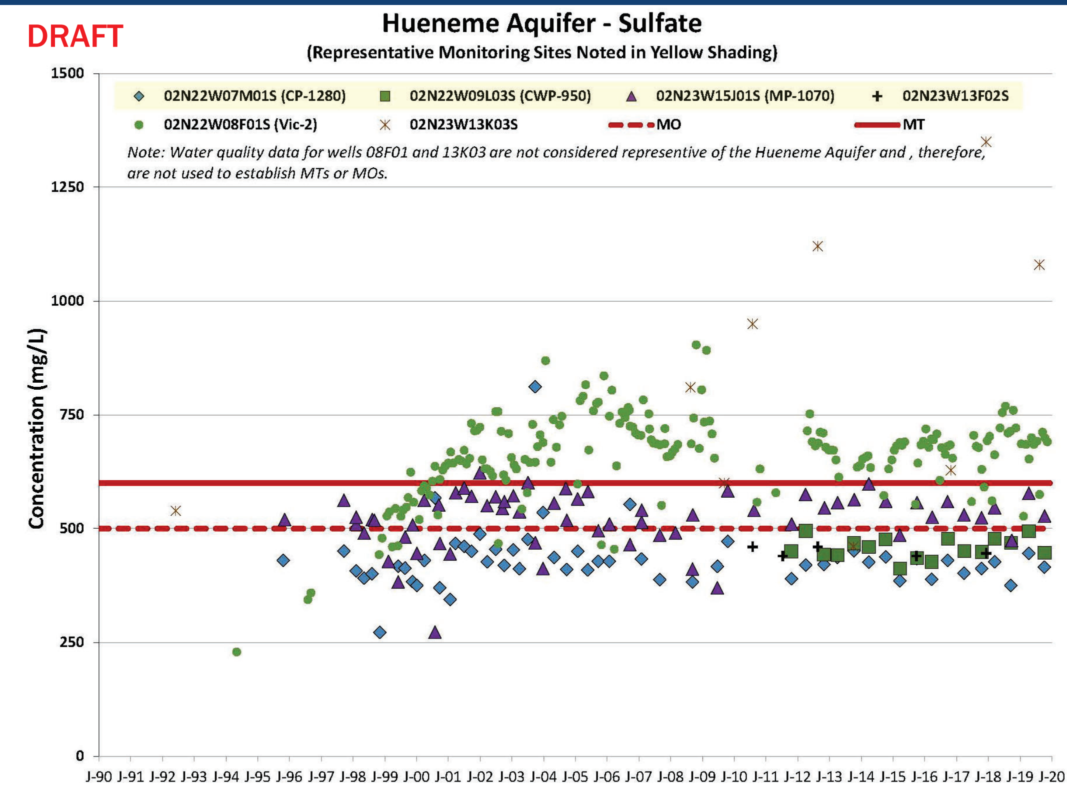
DRAFT WATER QUALITY MEASURABLE OBJECTIVES

Degraded Quality

- Goal is to preserve existing water quality
- MOs are based recent historical water quality

EXAMPLE WQ SMC CHART

Degraded Quality



DRAFT WATER QUALITY SMC

Degraded Quality

Constituent	MCL (mg/L)	Sec. MCL (R/U/ST) (mg/L)	RWQCB WQO (mg/L)	Average Conc. Representative Monitoring Wells Last 10 Years (mg/l)	Proposed MT (mg/L)	MT Rationale	Proposed MO (mg/L)	MO Rationale
Mugu Aquifer								
Nitrate	45	N/A	45	Non-Detect	45	Protect water quality for potable uses.	5	Preserve existing water quality for potable uses.
TDS	N/A	500/1,000/1,500	1,200	902	1,200	Protect agricultural, municipal, and industrial beneficial uses consistent with RWQCB WQOs.	1,000	Preserve existing water quality for agricultural, municipal, and industrial beneficial uses. MO is set at Upper Consumer Acceptance Level to support potable uses.
Sulfate	N/A	250/500/600	600	350	600	Protect municipal beneficial use consistent with RWQCB WQOs and prevent exceedances of Short-Term Consumer Acceptance Level.	500	Preserve existing water quality for municipal beneficial use. MO is set at Upper Consumer Acceptance Level to support potable uses.
Chloride	N/A	250/500/600	150	50	150	Protect agricultural beneficial use consistent with RWQCB WQOs.	75	Preserve existing water quality for agricultural beneficial use. MO is selected to preserve existing water quality.
Boron	N/A	N/A	1	0.47	1	Protect agricultural beneficial use consistent with RWQCB WQOs.	0.75	Preserve existing water quality for agricultural beneficial use. MO is selected to preserve existing water quality.
Hueneme Aquifer								
Nitrate	45	N/A	45	Non-Detect	45	Protect water quality for potable uses.	5	Preserve existing water quality for potable uses.
TDS	N/A	500/1,000/1,500	1,200	1,171	1,400	Protect agricultural, municipal, and industrial beneficial uses. MT is 200 mg/L higher than RWQCB WQO based on current and historical data at representative monitoring wells (set at upper range of data from past ten years).	1,200	Preserve existing water quality for agricultural, municipal, and industrial beneficial uses.
Sulfate	N/A	250/500/600	600	488	600	Protect municipal beneficial use consistent with RWQCB WQOs and prevent exceedances of Short-Term Consumer Acceptance Level.	500	Preserve existing water quality for municipal beneficial use. MO is set at Upper Consumer Acceptance Level to support potable uses.
Chloride	N/A	250/500/600	150	76	150	Protect agricultural beneficial use consistent with RWQCB WQOs.	100	Preserve existing water quality for agricultural beneficial use. MO is selected to preserve existing water quality.
Boron	N/A	N/A	1	0.62	1	Protect agricultural beneficial use consistent with RWQCB WQOs.	0.75	Preserve existing water quality for agricultural beneficial use. MO is selected to preserve existing water quality.

[1] Consumer Acceptance Levels, where R = Recommended, U = Upper, and ST = Short Term

[2] Undesirable results are considered to occur when all representative monitoring wells in a principal aquifer exceed the minimum threshold concentration for a constituent for two consecutive years.

[3] Sustainability Goal for degraded water quality for a given constituent is considered to be met when the two-year running average concentration for at least one representative monitoring well is below the measurable objective.

OTHER SUSTAINABILITY INDICATORS

Reduction of Storage | Seawater Intrusion | Land Subsidence | Lowering GW Levels

- **The remaining sustainability indicators are related to groundwater levels.**
- **Model simulations of future conditions used to evaluate these sustainability indicators**

SIMULATED FUTURE GROUNDWATER LEVELS

1. Future groundwater levels are predicted to be higher than historical levels due to anticipated increases in Oxnard Basin groundwater levels.
2. The impact of climate change on groundwater levels is typically less than approximately 5 ft.
3. The impact of the Freeman Diversion expansion project is almost undetectable.

SELECTED MODEL OUTPUT LOCATIONS

Figure 1a. Historical and Projected Groundwater Levels, Mugu Aquifer at Marina Park

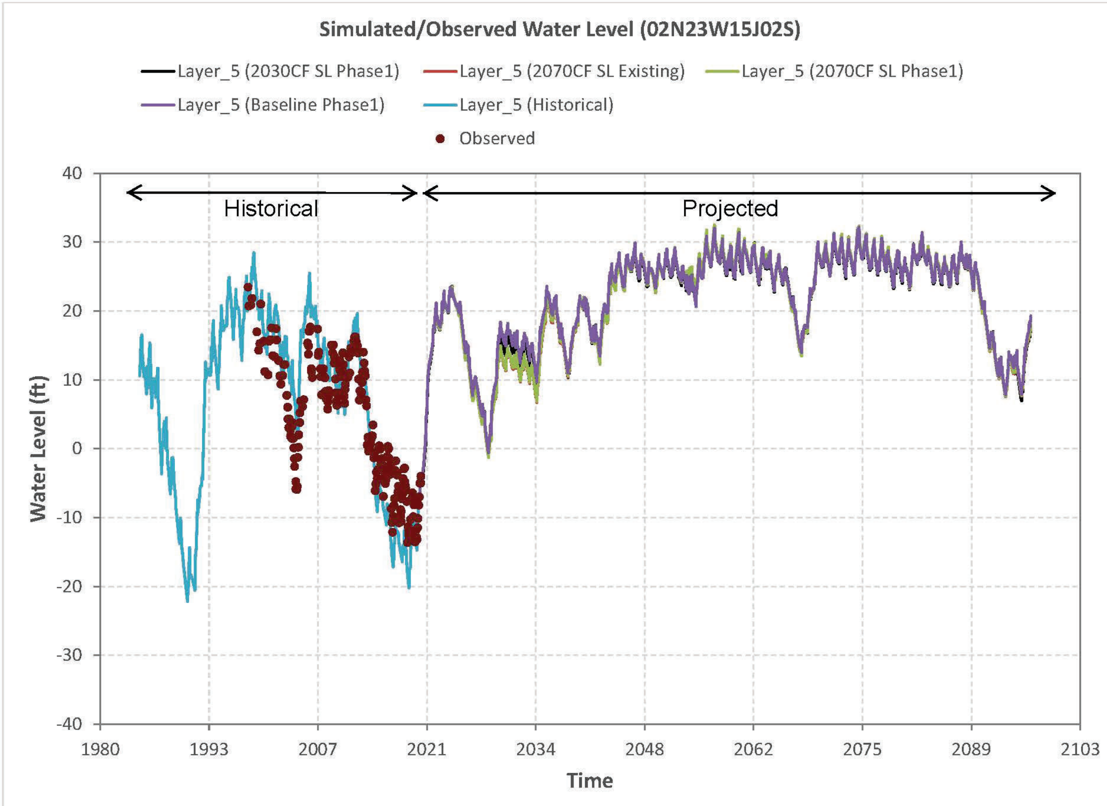


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Figure 1c. Historical and Projected Groundwater Levels, Mugu Aquifer at Camino Real Park

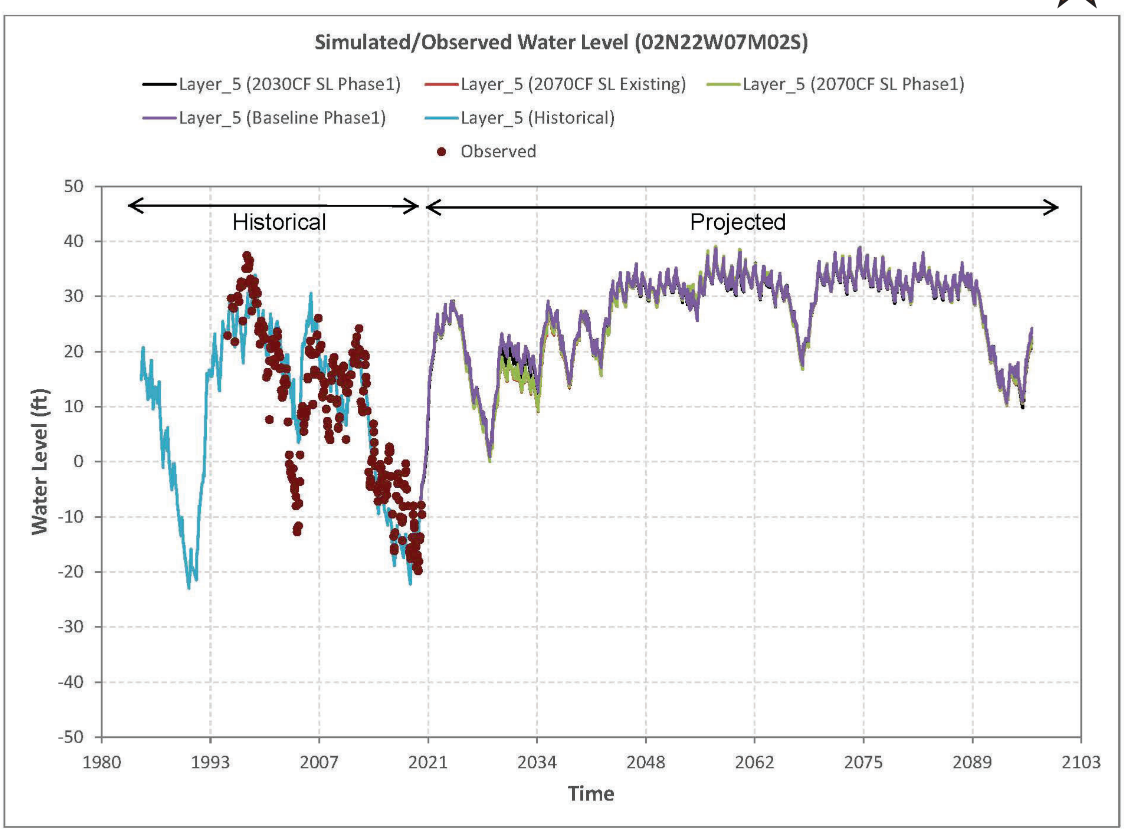

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Figure 1b. Historical and Projected Groundwater Levels, Hueneme Aquifer at Marina Park

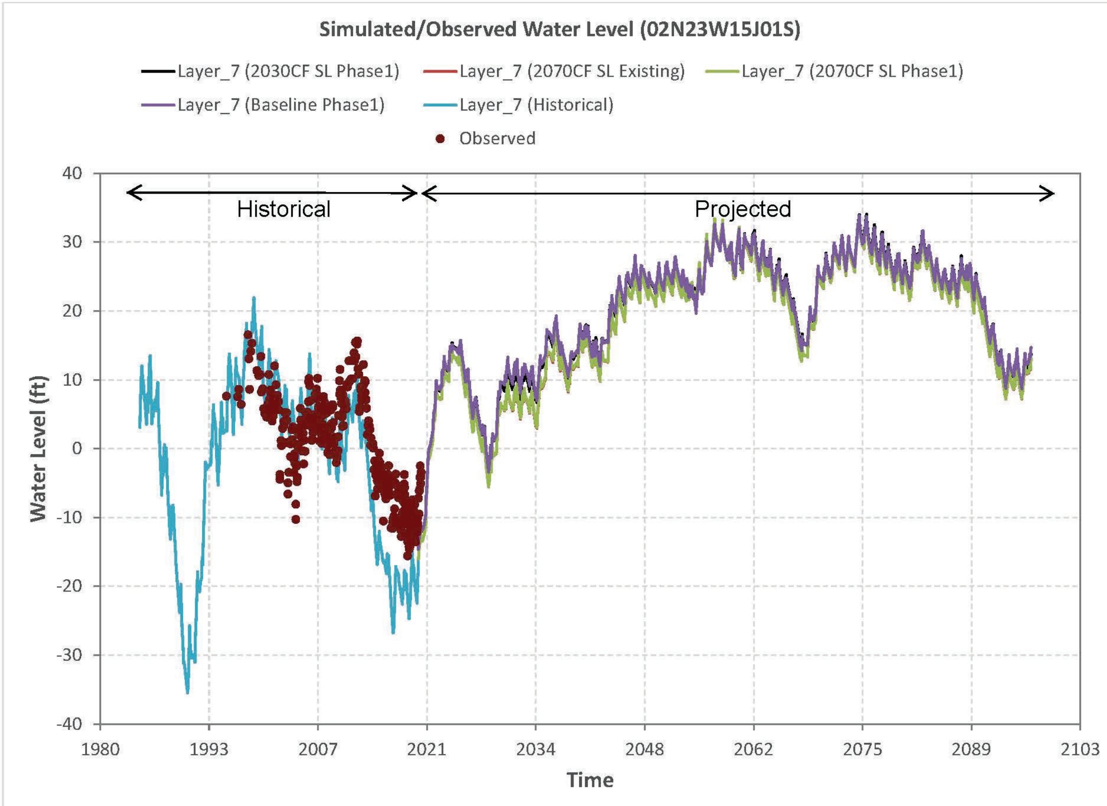

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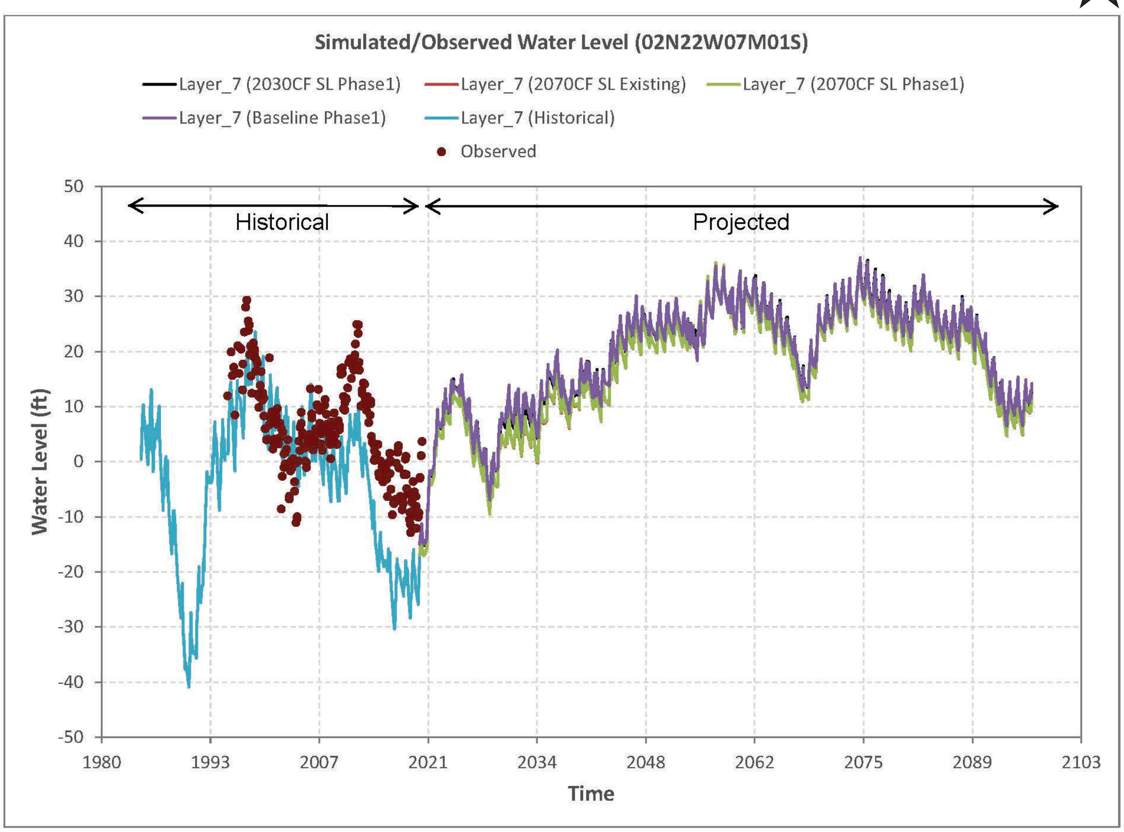
Figure 1d. Historical and Projected Groundwater Levels, Hueneme Aquifer at Camino Real Park



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SEAWATER INTRUSION RISK EVALUATION

- Aquifers are exposed to seawater at subcrop approximately 10.5 miles offshore.
- Between subcrop and shoreline, aquifers are believed to be protected from seawater by thick sequence of fine-grained deposits (aquitard)
- Historical movement of seawater from subcrop toward shoreline was estimated using historical model using particle tracking
  - No landward movement of seawater in Mugu Aquifer
  - Approximately 0.5 miles of average landward movement in Hueneme Aquifer over last century*

**Migration rates in the most permeable zones of the aquifer would be considerably (many times) higher.*

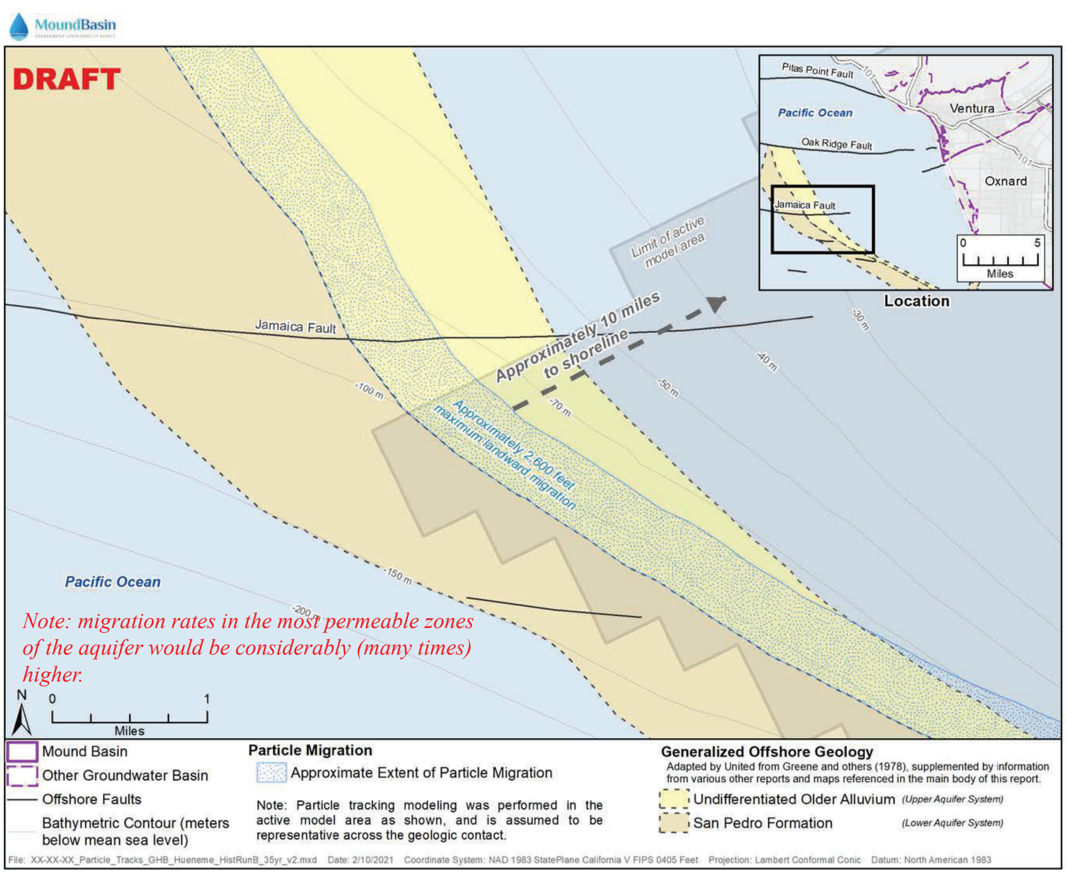


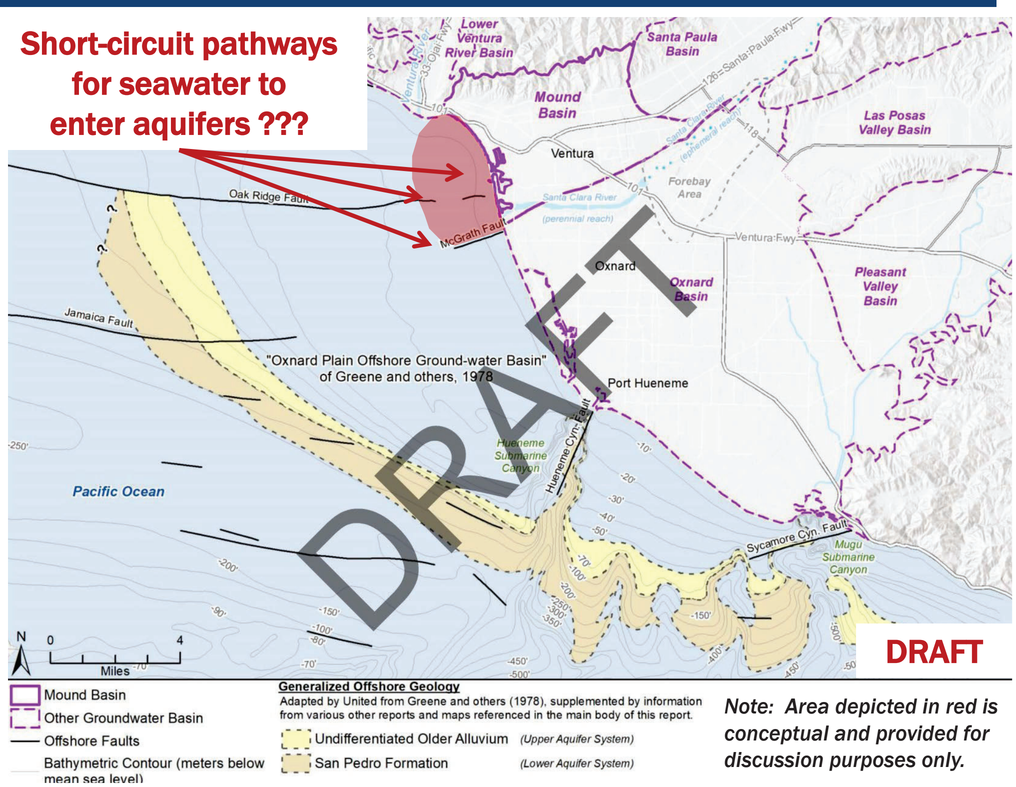
Figure 3 Estimated Historical Extent of Landward Seawater Movement in the Hueneme Aquifer.

SEAWATER INTRUSION RISK EVALUATION (CON'T)

- Conclusions:
  - Seawater is not migrating landward in Mugu Aquifer
  - Timeframe for seawater to migrate from current estimated location in Hueneme Aquifer to shore is longer than SGMA planning horizon
- <u>However</u>, if a short circuit pathway for seawater migration into aquifers exists nearshore (possible along faults or "stratigraphic windows"), onshore flow of seawater could occur much sooner.

SEAWATER INTRUSION POTENTIAL VIA SHORT-CIRCUIT PATHWAYS?

Potential gaps in the confining layer above the aquifers and/or faulting could possible provide short-circuit pathways for seawater intrusion near the shoreline. If such short-circuit pathways exist, seawater could reach the shoreline within the GSP implementation period.



Note: Area depicted in red is conceptual and provided for discussion purposes only.

SEAWATER INTRUSION RISK EVALUATION (CON'T)

- Particle tracking of groundwater flow directions and flow rates along the shoreline was performed to evaluate risk of onshore migration via a near shore short-circuit pathway.

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20 years of Flow Migration in Hueneme Aquifer from Shoreline *

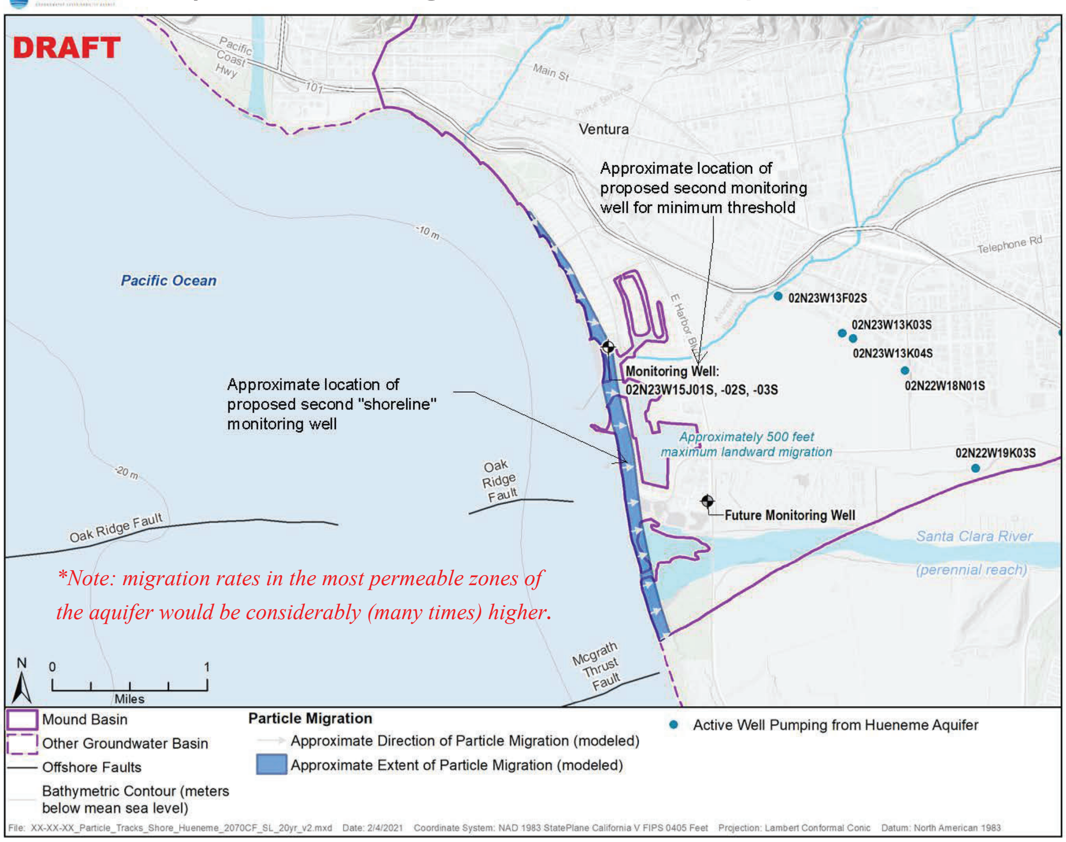


Figure 2a Estimated Landward Movement of Groundwater During 20-Year GSP Implementation Period (with 2070 Climate Change and Sea Level Rise).

Mound Basin Groundwater Sustainability Agency Groundwater Sustainability Plan   Page 3

50 years of Flow Migration in Hueneme Aquifer from Shoreline *

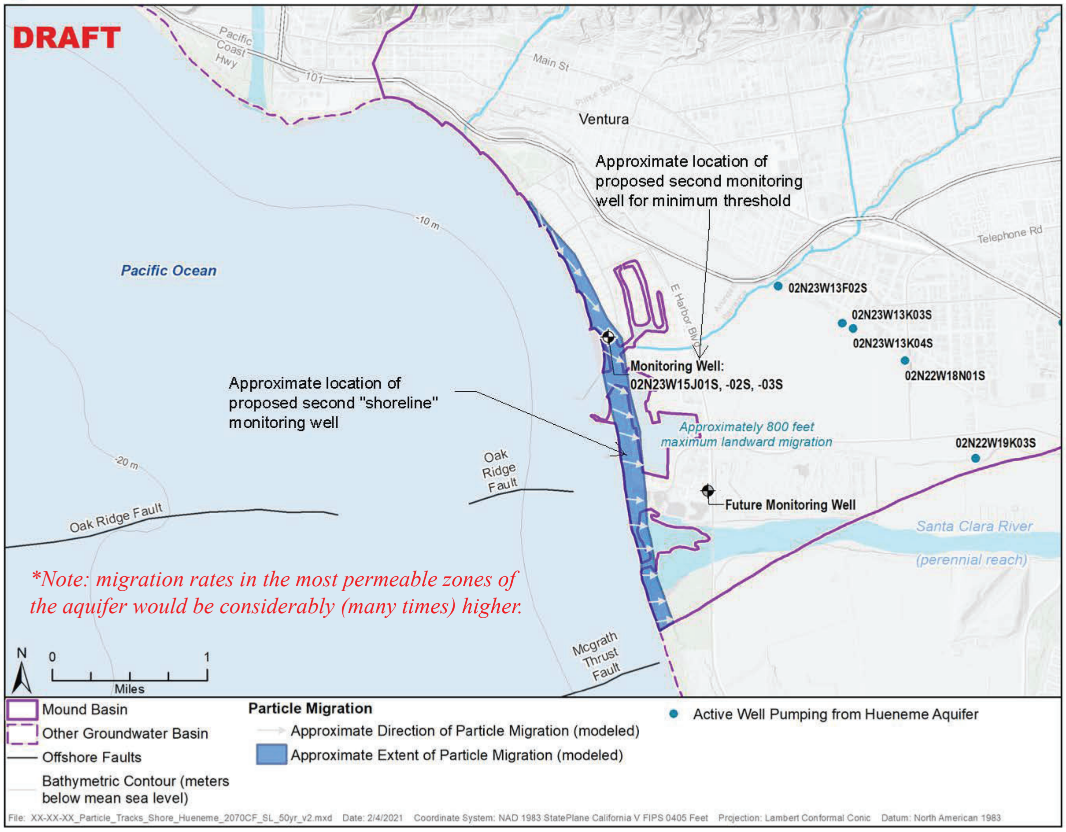


Figure 2b **Estimated Landward Movement of Groundwater During 50-Year SGMA Planning Period (with 2070 Climate Change and Sea Level Rise).**

Mound Basin Groundwater Sustainability Agency Groundwater Sustainability Plan Page 4

KEY RESULTS OF SHORELINE FLOW EVALUATION

1. Particle tracking results suggest that groundwater will flow offshore in the Mugu Aquifer.
2. Particle tracking results suggest that groundwater will flow onshore in the Hueneme Aquifer at an average rate of approximately 1/8 of a mile per 20 years.
   - Note: Migration rates in the most permeable zones of the aquifer could be considerably (many times) higher.

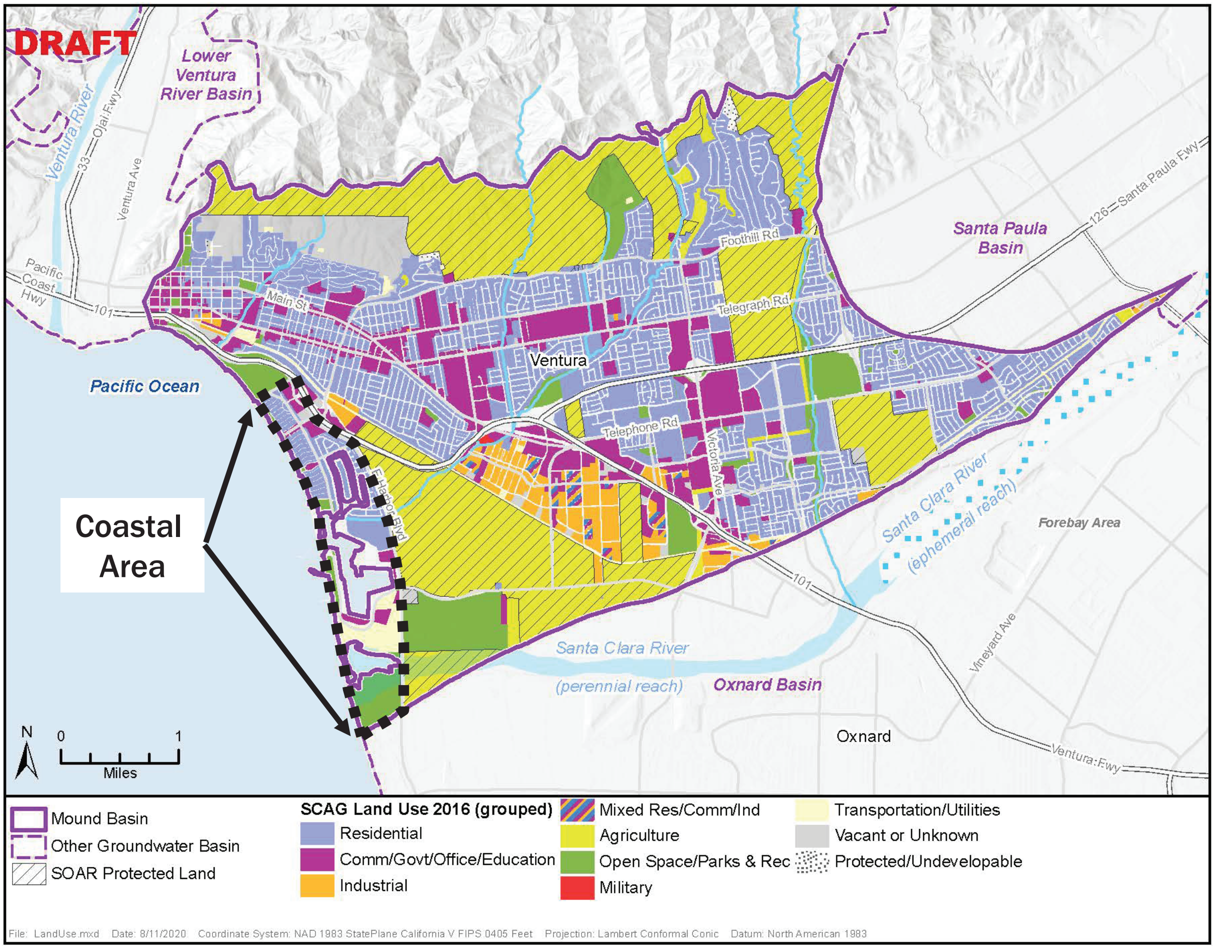
SUSTAINABLE MANAGEMENT IMPLICATION #1

- Seawater intrusion is not anticipated to be an issue for the Mound Basin during the 50-year SGMA planning horizon; <u>however</u>, a monitoring and contingency plan is warranted to address potential short-circuit pathways for seawater.

PROPOSED SEAWATER INTRUSION SMC

- Undesirable Result: Seawater intrusion east of Harbor Blvd.
  - No current or anticipated future beneficial uses of groundwater west of Harbor Blvd.
  - Protect existing beneficial uses east of Harbor Blvd.
- Minimum Threshold:
  - Seawater in monitoring wells near Harbor Blvd.
- Measurable Objective:
  - No indication of seawater in monitoring wells near Harbor Blvd.

Mound Basin Land Use



SEAWATER INTRUSION MONITORING RECOMMENDATIONS

- Construct one additional "shoreline monitoring well"
  - Shoreline monitoring wells provide early detection of seawater and provide time for GSA to implement contingency measures before seawater reaches Harbor Blvd.
- Construct one additional monitoring well along Harbor Blvd. for SMC monitoring
- Estimate cost ~$500,000 each
  - Pursue SGMA implementation grant

Proposed Monitoring Wells for Seawater Intrusion

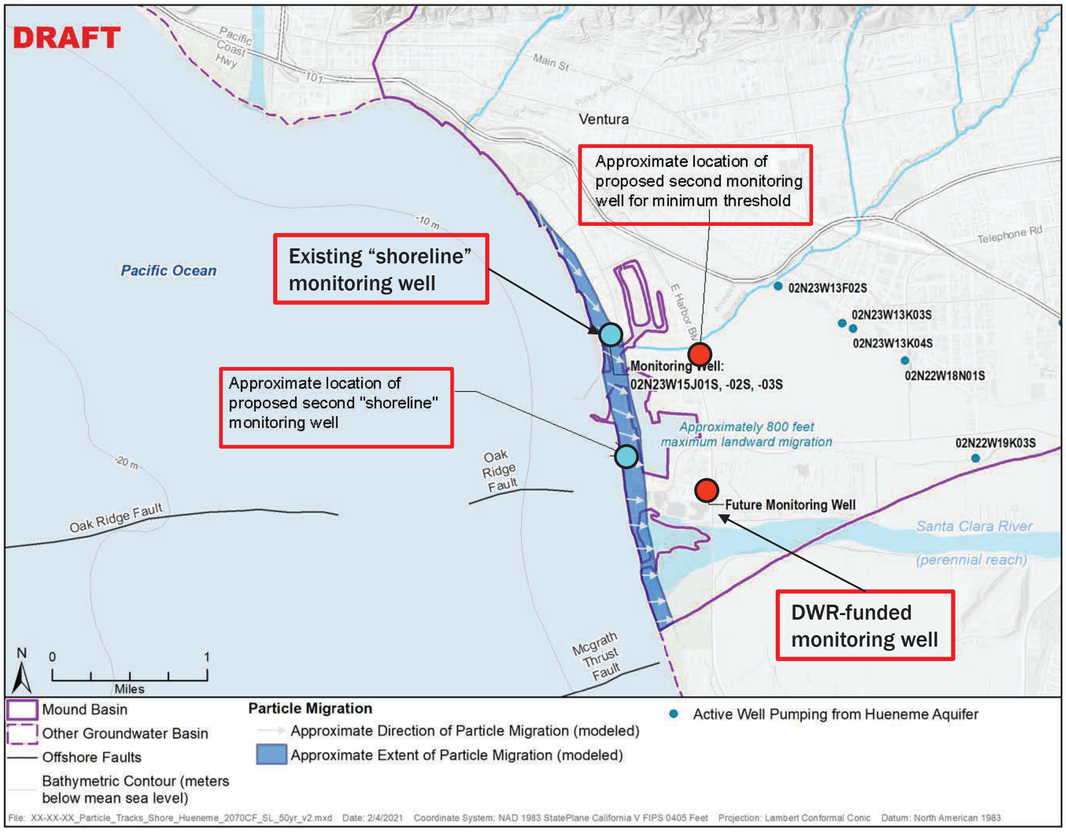


Figure 2b Estimated Landward Movement of Groundwater During 50-Year SGMA Planning Period (with 2070 Climate Change and Sea Level Rise).

Mound Basin Groundwater Sustainability Agency Groundwater Sustainability Plan Page 4

SUSTAINABLE MANAGEMENT IMPLICATION #2

- Subsidence is not anticipated because modeling results suggest that future groundwater levels will remain above historical low levels.

- Therefore, inelastic land subsidence is not anticipated to be an issue for the Mound Basin during the 50-year SGMA planning horizon.

PROPOSED SUBSIDENCE SMC

- Undesirable Result: Measurable inelastic subsidence due to groundwater pumping west of Harbor Blvd.
  - “Coastal Area” west of Harbor Blvd. is susceptible to land subsidence
    - City sewer main running along Harbor Blvd has low slope
    - Sea level rise impacts to Coastal Area predicted – subsidence would exacerbate sea level rise impacts
- Minimum Threshold:
  - Groundwater levels below historical low levels as a proxy for potential onset of subsidence
    - Note: areas east of Harbor Blvd. are less susceptible to effects of subsidence, but it is unlikely that groundwater levels could be sustained below historical lows east of Harbor Blvd. without causing groundwater levels to drop below historical lows in Coastal Area
- Measurable Objective:
  - GW levels during wet periods sufficient to prevent dropping below historical lows during droughts

Mound Basin Land Use

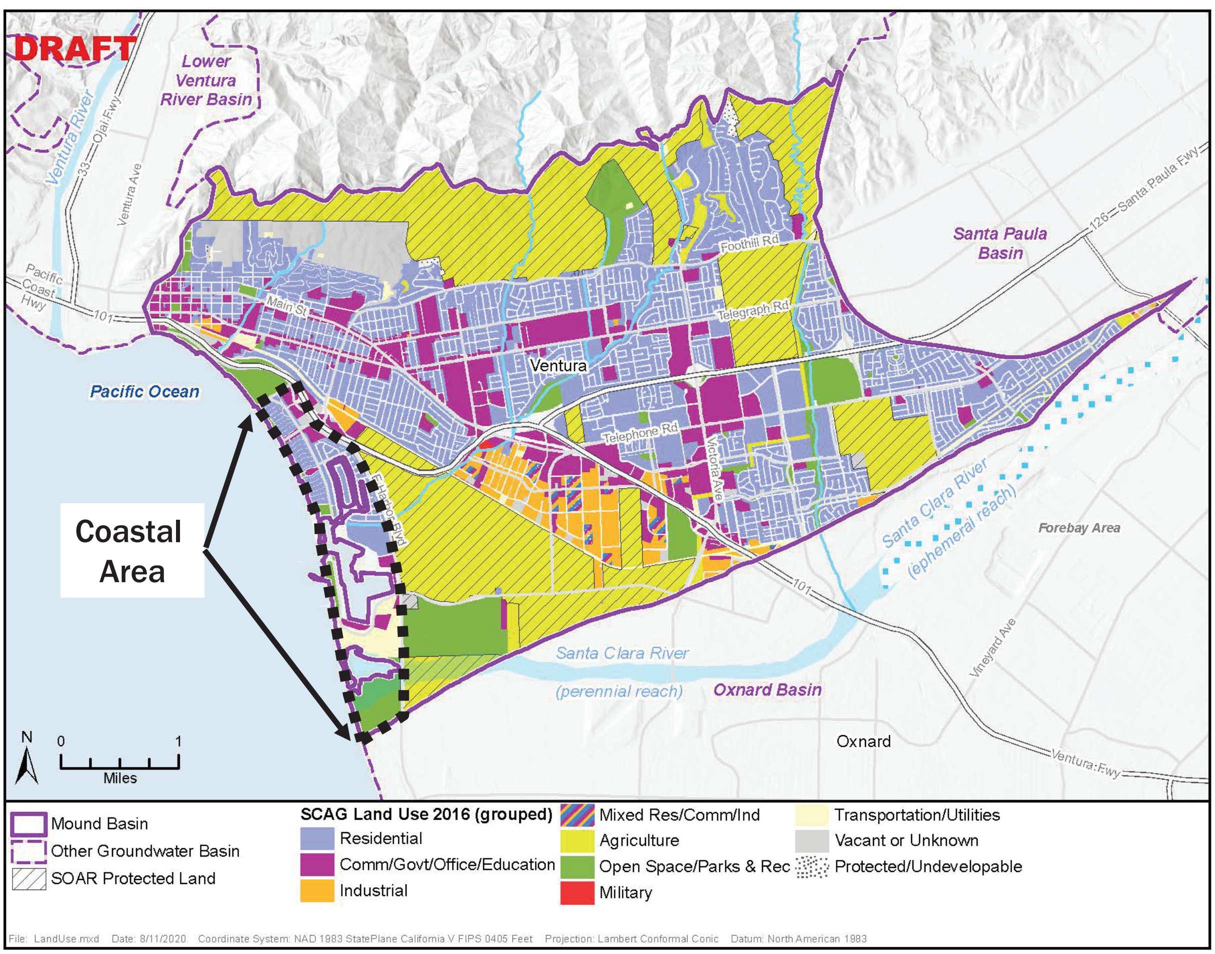
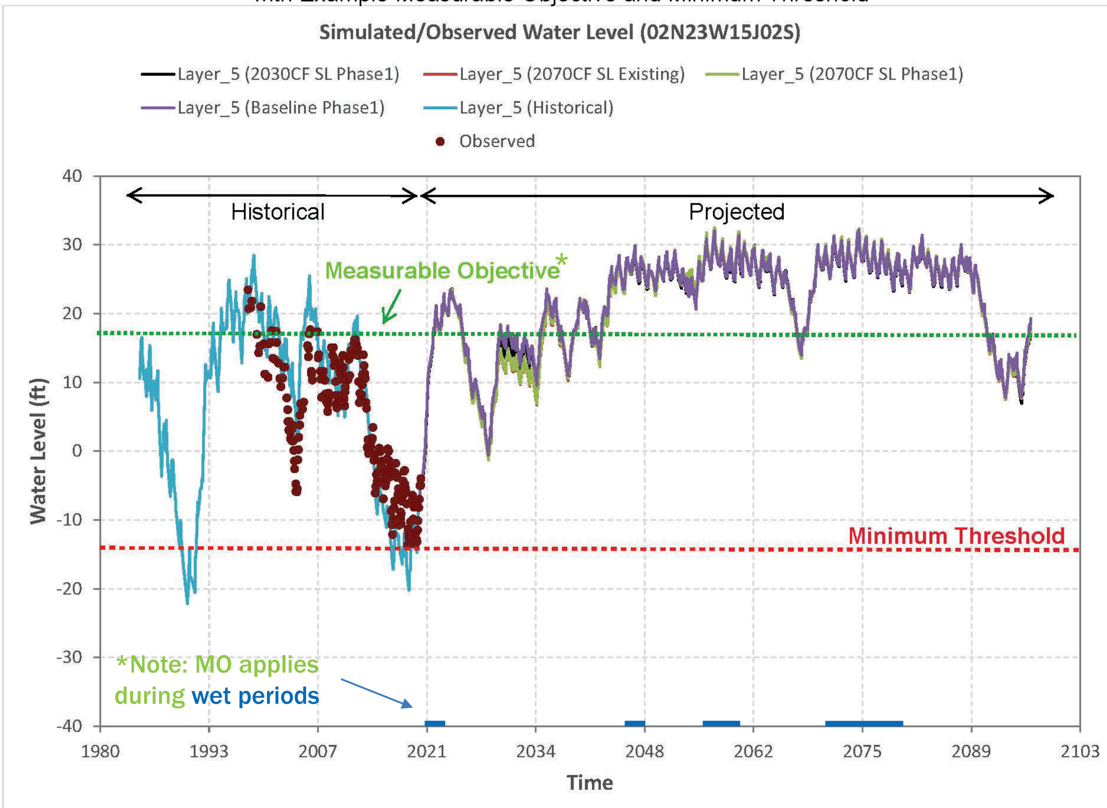
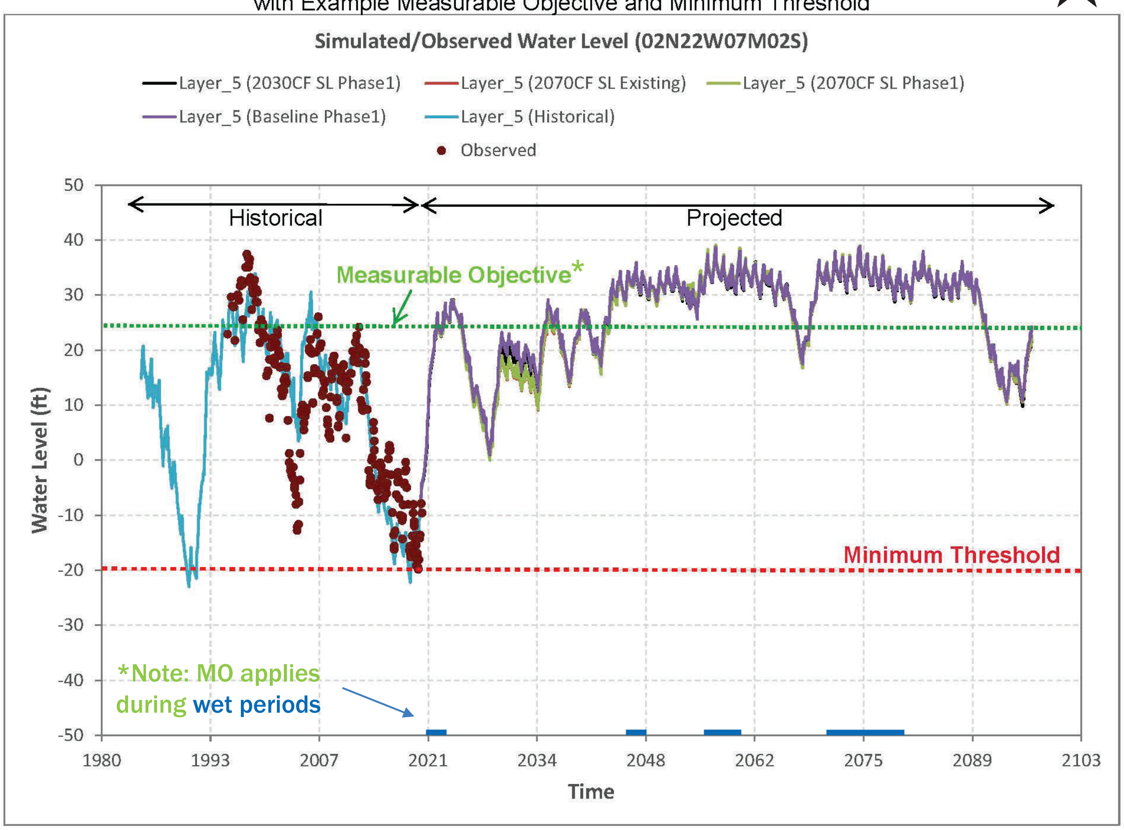


Figure 4a. Historical and Projected Groundwater Levels, Mugu Aquifer at Marina Park with Example Measurable Objective and Minimum Threshold



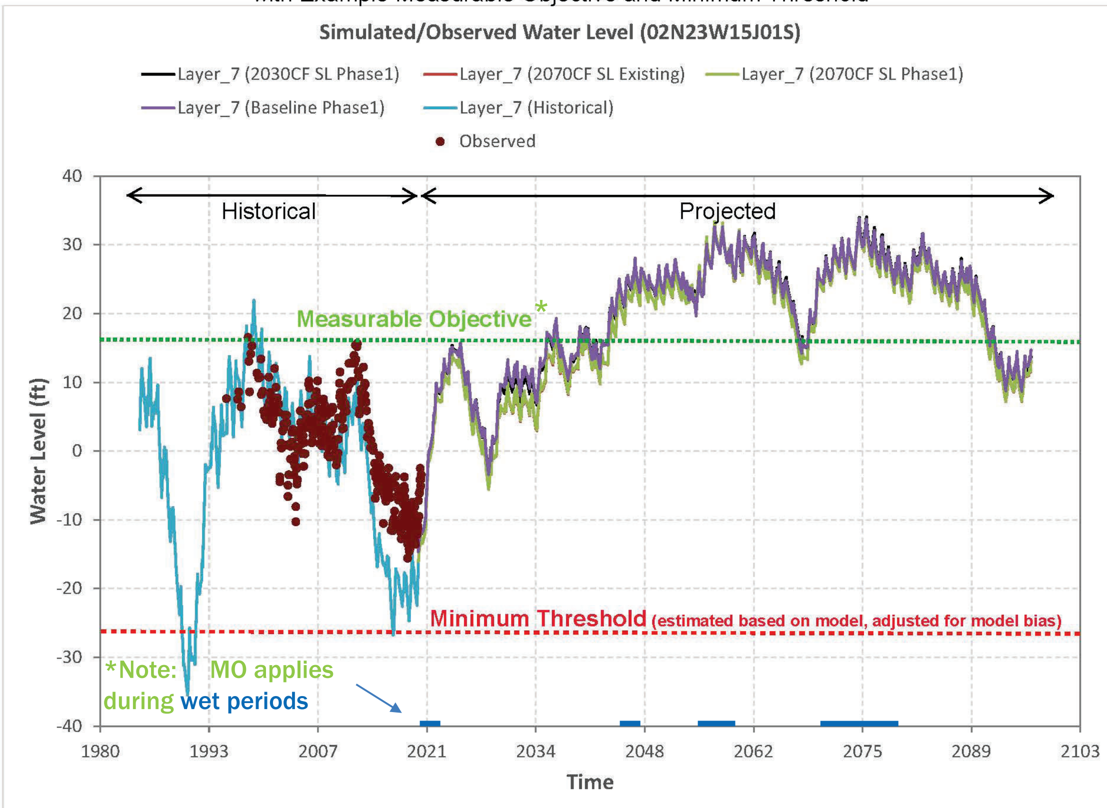
DRAFT

Figure 4c. Historical and Projected Groundwater Levels, Mugu Aquifer at Camino Real Park with Example Measurable Objective and Minimum Threshold



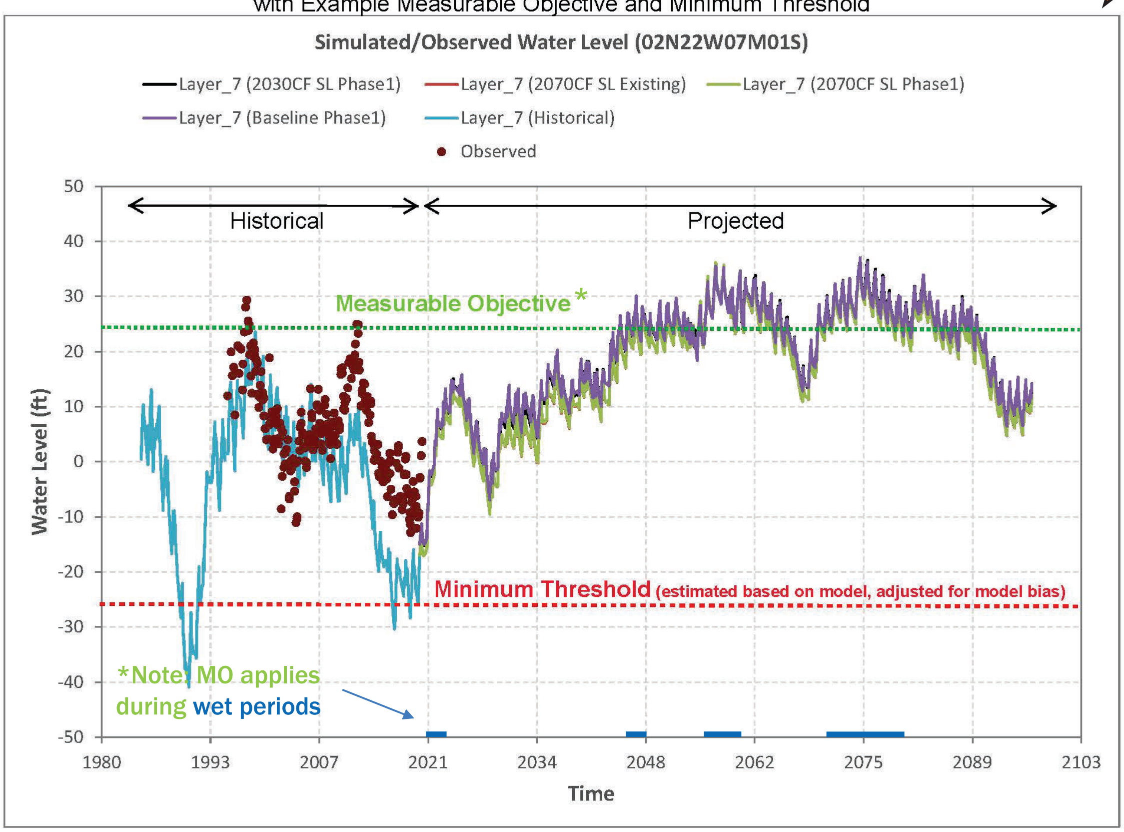
DRAFT

Figure 4b. Historical and Projected Groundwater Levels, Hueneme Aquifer at Marina Park with Example Measurable Objective and Minimum Threshold



DRAFT

Figure 4d. Historical and Projected Groundwater Levels, Hueneme Aquifer at Camino Real Park with Example Measurable Objective and Minimum Threshold



DRAFT

OTHER SUSTAINABLE MANAGEMENT IMPLICATIONS

- The chronic groundwater level decline and reduction of groundwater storage sustainability indicators will not be controlling factors for sustainable management.
- FCGMA's progress toward achieving its sustainability goal for the Oxnard Basin will be important to track. MBGSA will need to be prepared to adapt its GSP if FCGMA does not meet its sustainability goal or otherwise dramatically deviates from the plans set forth in its initial GSP.

NEXT STEPS

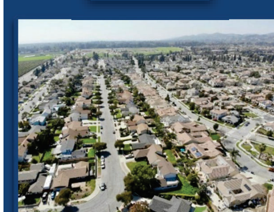
SUSTAINABLE MANAGEMENT CRITERIA QUESTIONS

MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

STAKEHOLDER Q&A & FEEDBACK

United Water
CONSERVATION DISTRICT

VENTURA WATER

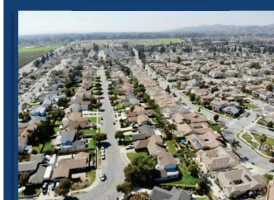


MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

ATTENDEE POLL NOS. 4 - 6

United Water
CONSERVATION DISTRICT

VENTURA WATER

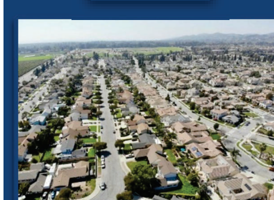


MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

MBGSA DIRECTOR COMMENTS

United Water
CONSERVATION DISTRICT

VENTURA WATER



PLEASE STAY ENGAGED!

- Track status at: https://www.moundbasingsa.org/
- Join the MBGSA Interested Parties List: https://www.moundbasingsa.org/contact-us/
- Email inquiries to: Jackie Lozano Jackiel@unitedwater.org

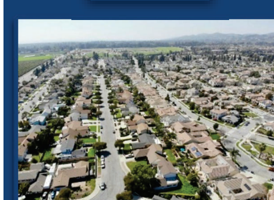
MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

THANK YOU FOR PARTICIPATING!

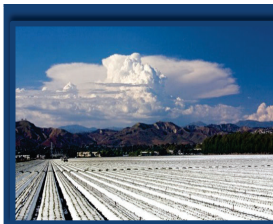
COUNTY OF VENTURA CALIFORNIA

United Water CONSERVATION DISTRICT

VENTURA WATER



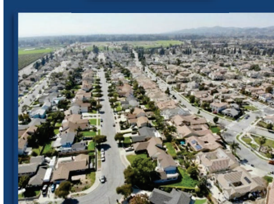
MoundBasin
GROUNDWATER SUSTAINABILITY AGENCY

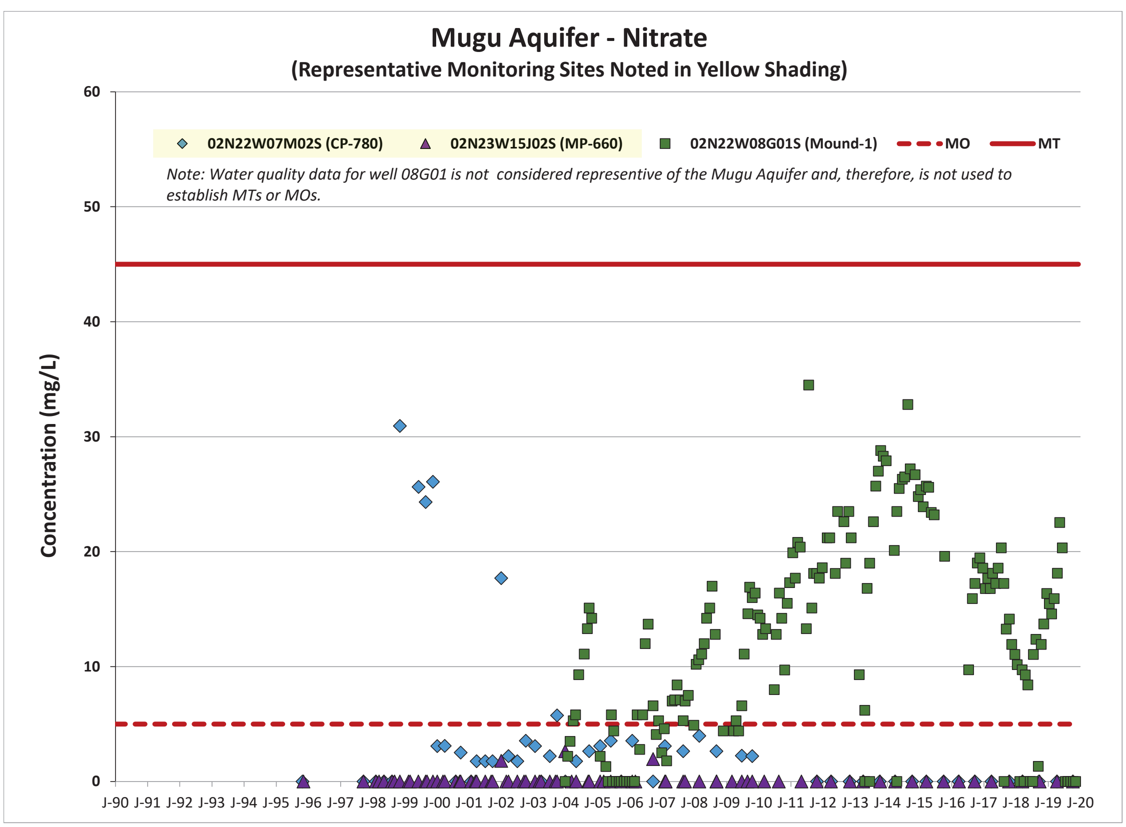


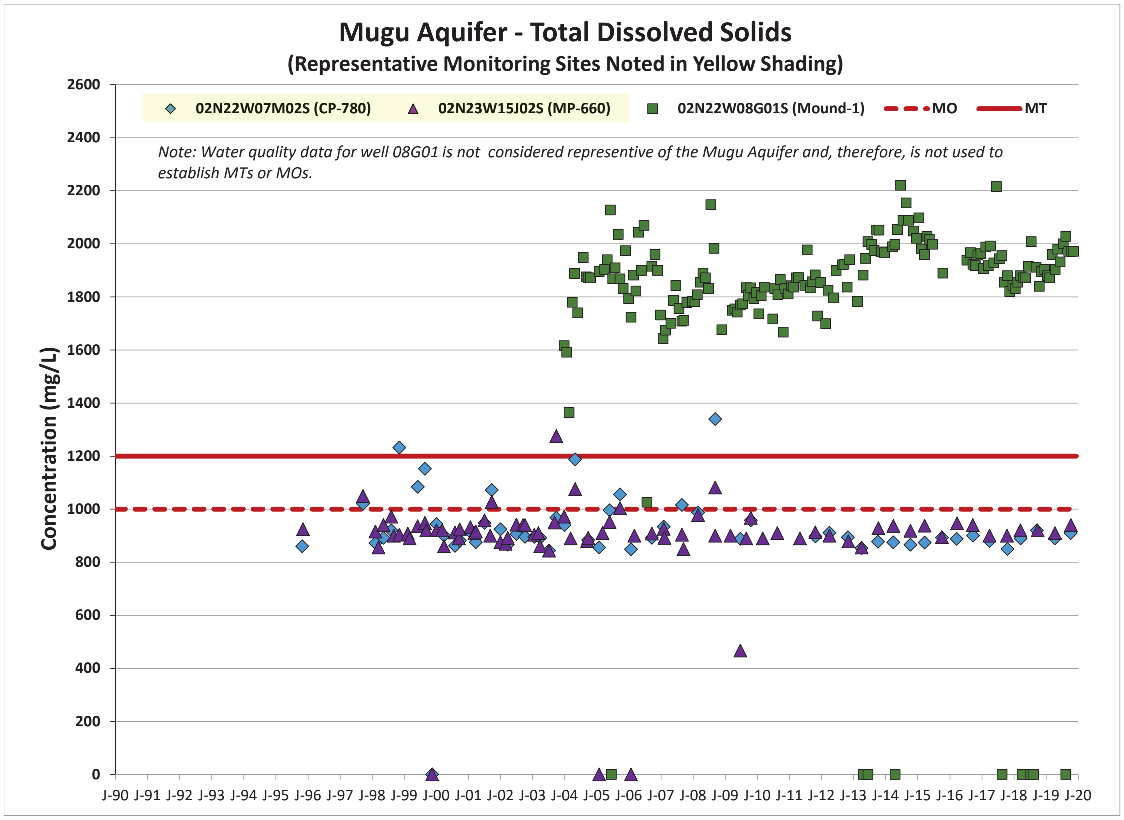
EXTRA SLIDES

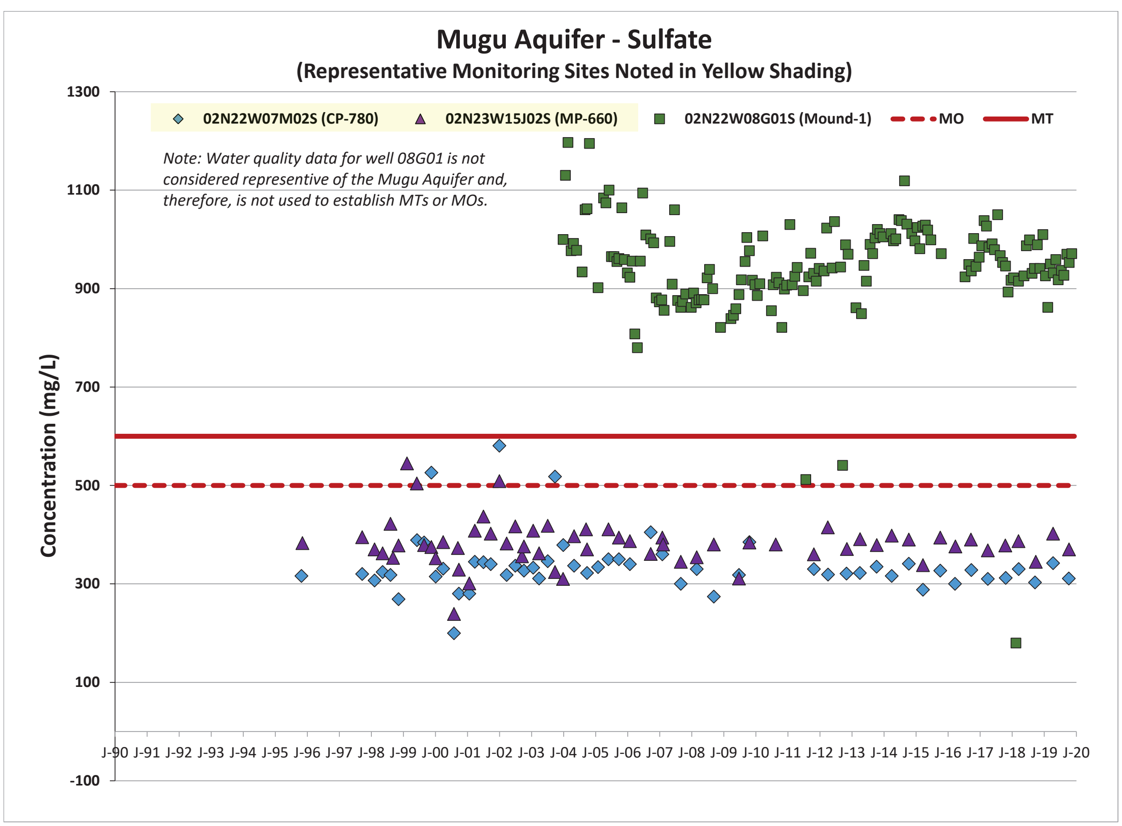
United Water
CONSERVATION DISTRICT

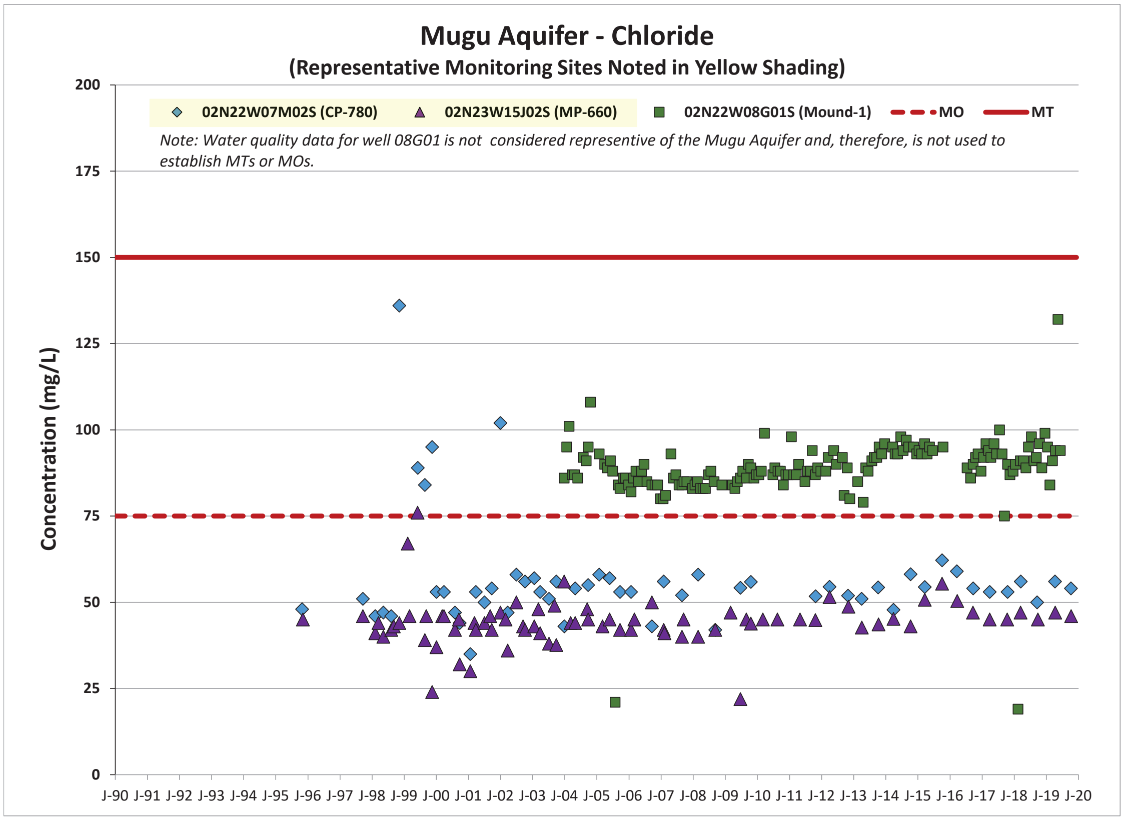
VENTURA WATER



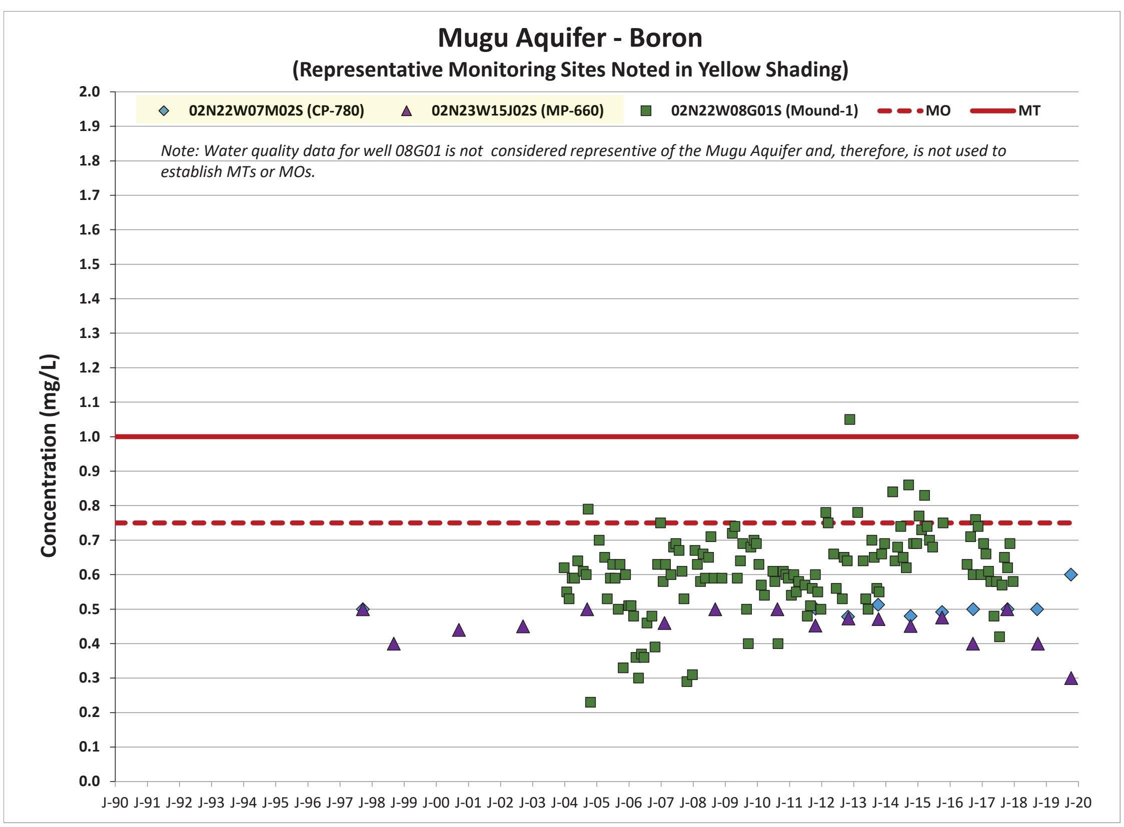



Mugu Aquifer - Total Dissolved Solids
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MO
MT
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

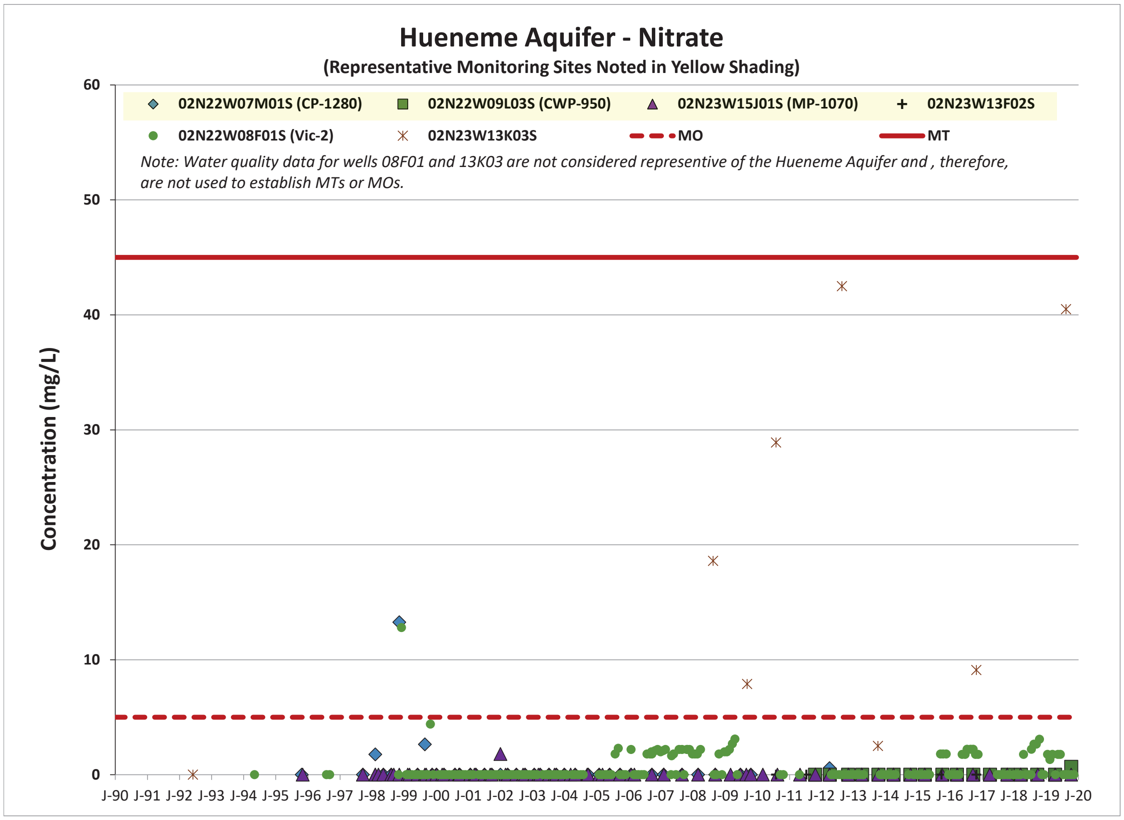

Mugu Aquifer - Sulfate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MO
MT
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
1300
1100
900
700
500
300
100
-100
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20



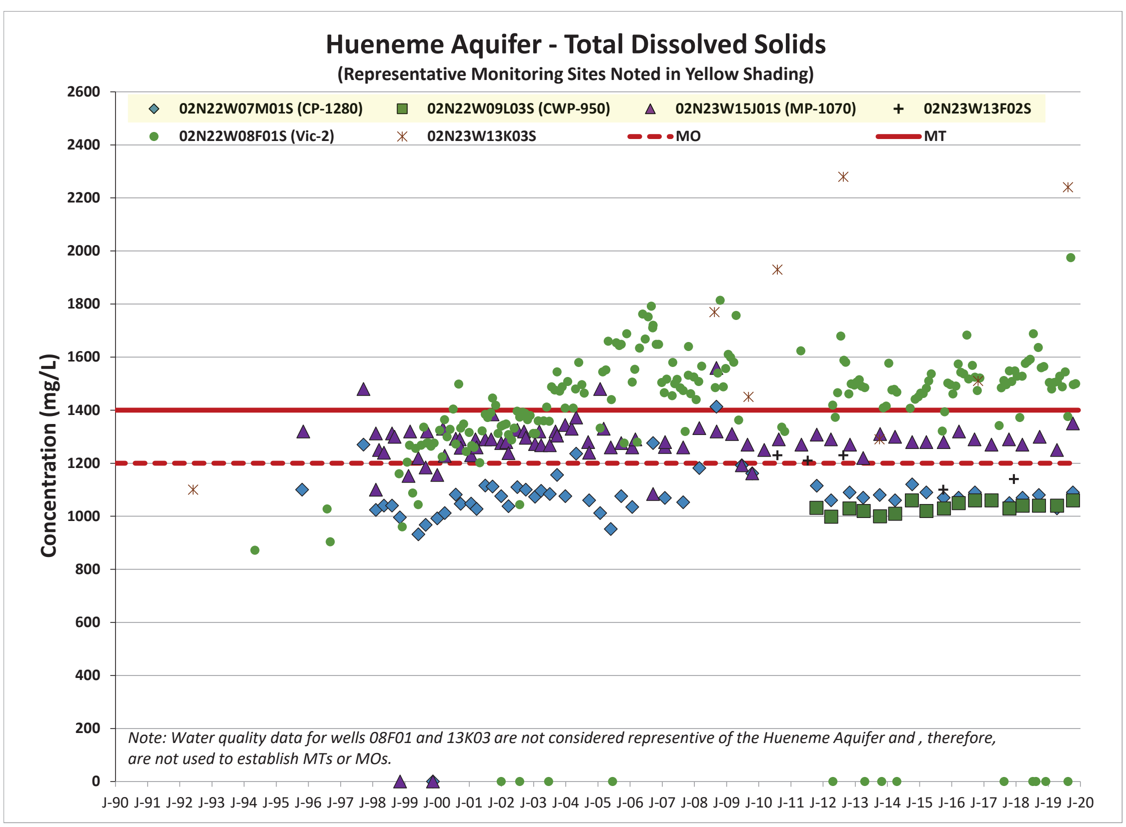
Mugu Aquifer - Chloride
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MO
MT
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
200
175
150
125
100
75
50
25
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20



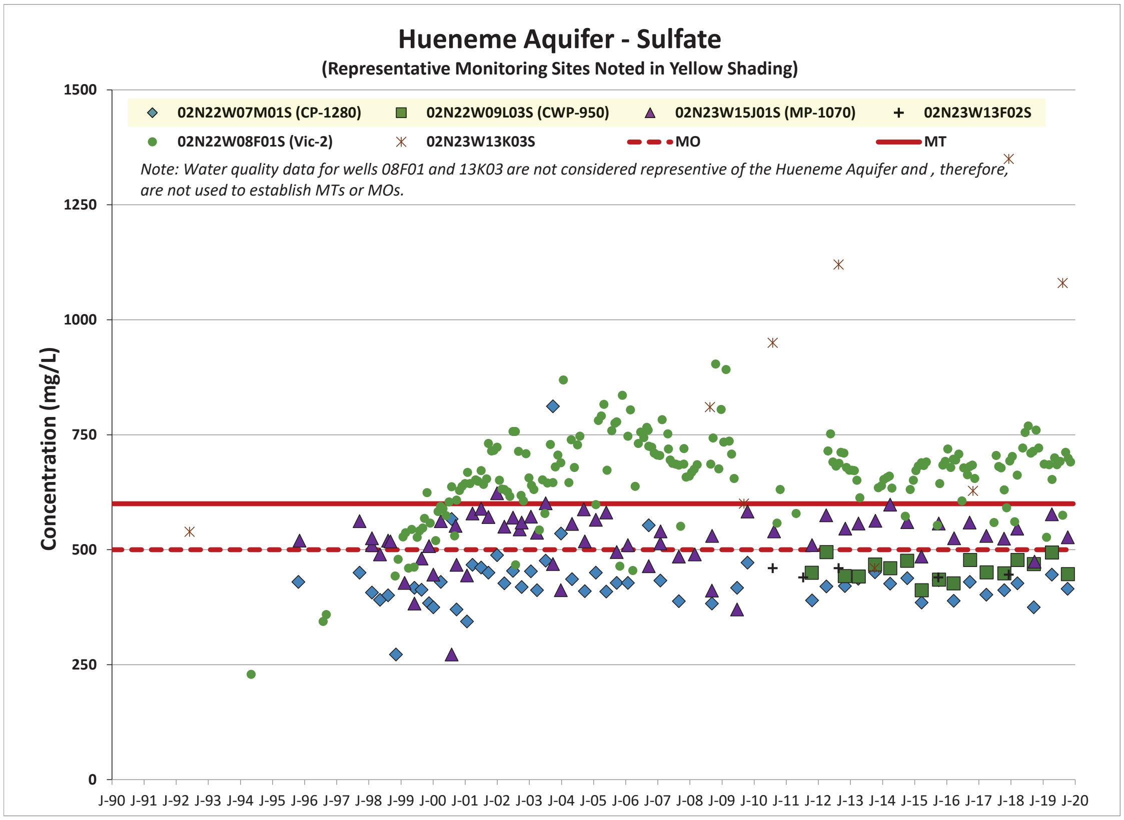
Mugu Aquifer - Boron
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M02S (CP-780)
02N23W15J02S (MP-660)
02N22W08G01S (Mound-1)
MO
MT
Note: Water quality data for well 08G01 is not considered representative of the Mugu Aquifer and, therefore, is not used to establish MTs or MOs.
Concentration (mg/L)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20

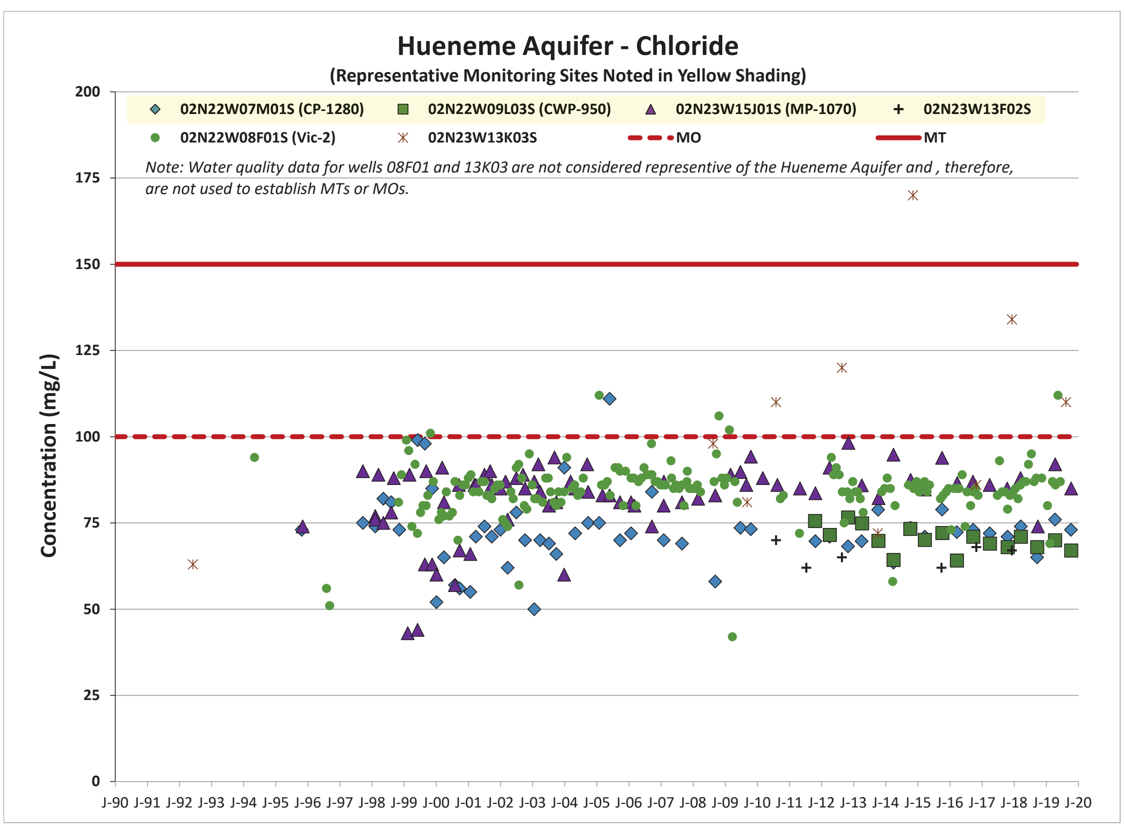


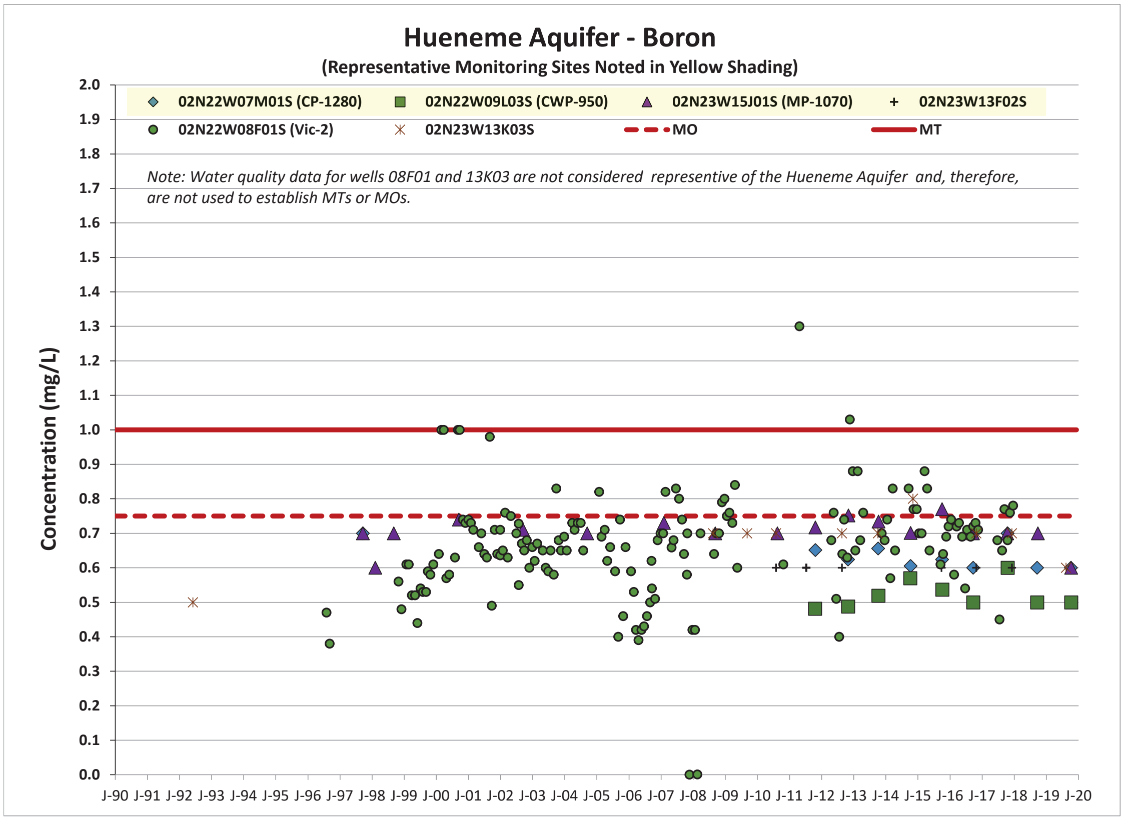
Hueneme Aquifer - Nitrate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MO
MT
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
60
50
40
30
20
10
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20



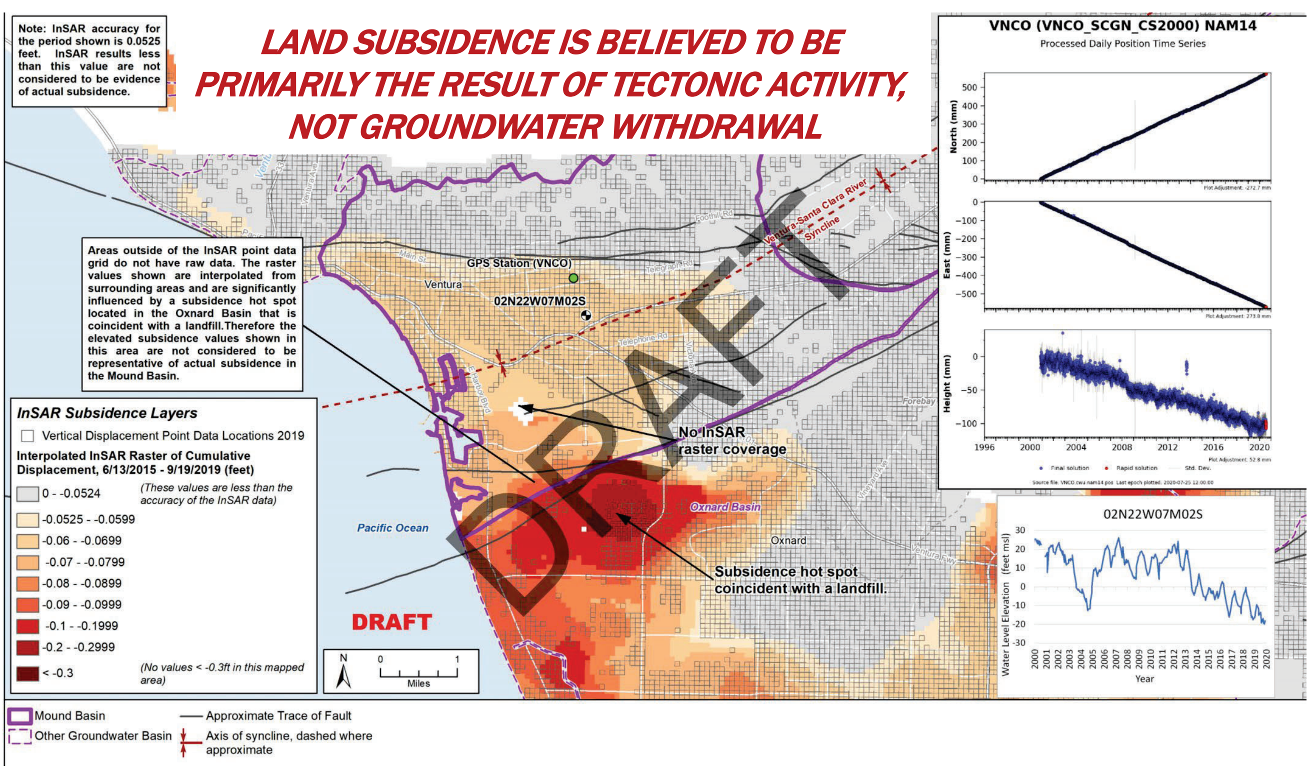
Hueneme Aquifer - Total Dissolved Solids
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MO
MT
Concentration (mg/L)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20


Hueneme Aquifer - Sulfate
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MO
MT
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
1500
1250
1000
750
500
250
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20


Hueneme Aquifer - Chloride
(Representative Monitoring Sites Noted in Yellow Shading)
02N22W07M01S (CP-1280)
02N22W09L03S (CWP-950)
02N23W15J01S (MP-1070)
02N23W13F02S
02N22W08F01S (Vic-2)
02N23W13K03S
MO
MT
Note: Water quality data for wells 08F01 and 13K03 are not considered representative of the Hueneme Aquifer and , therefore, are not used to establish MTs or MOs.
Concentration (mg/L)
200
175
150
125
100
75
50
25
0
J-90 J-91 J-92 J-93 J-94 J-95 J-96 J-97 J-98 J-99 J-00 J-01 J-02 J-03 J-04 J-05 J-06 J-07 J-08 J-09 J-10 J-11 J-12 J-13 J-14 J-15 J-16 J-17 J-18 J-19 J-20



LAND SUBSIDENCE



Mound Basin

GROUNDWATER SUSTAINABILITY AGENCY

Recap of Groundwater Flow Model and Summary of Water Budgets

Mound Basin GSA
Workshop No. 2

John Lindquist
Senior Hydrogeologist
March 4, 2020

United Water
CONSERVATION DISTRICT

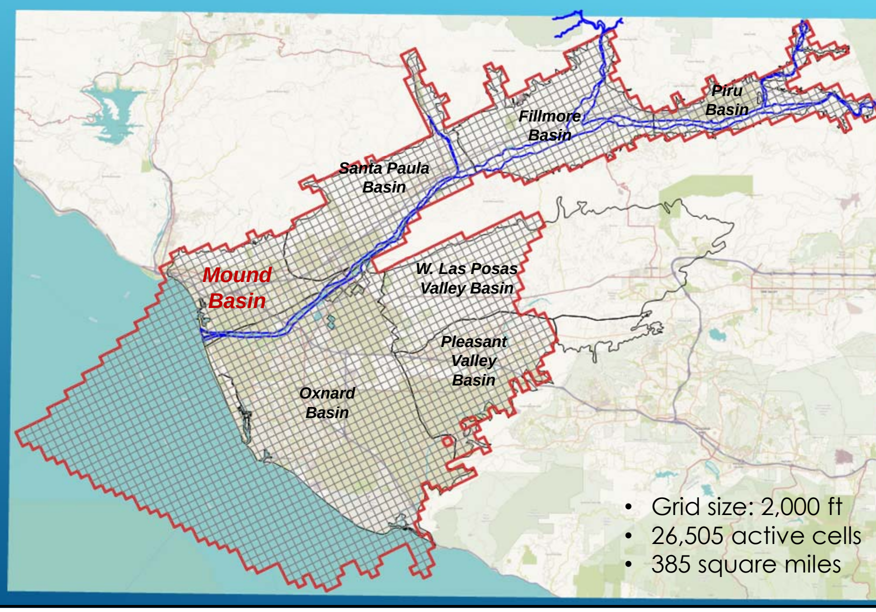
1

OUTLINE:

1. Recap of United's groundwater flow model
2. Quick review of groundwater conditions in Mound Basin that affect water budgets
3. Historical and current water budgets
4. Projected water budgets

2

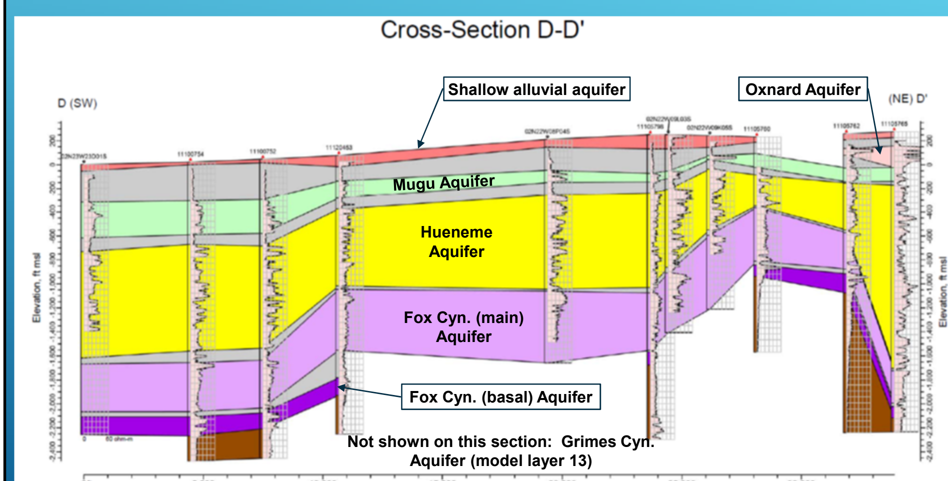
UNITED WCD'S 2020 GROUNDWATER FLOW MODEL—AREAL EXTENT



- Grid size: 2,000 ft
- 26,505 active cells
- 385 square miles

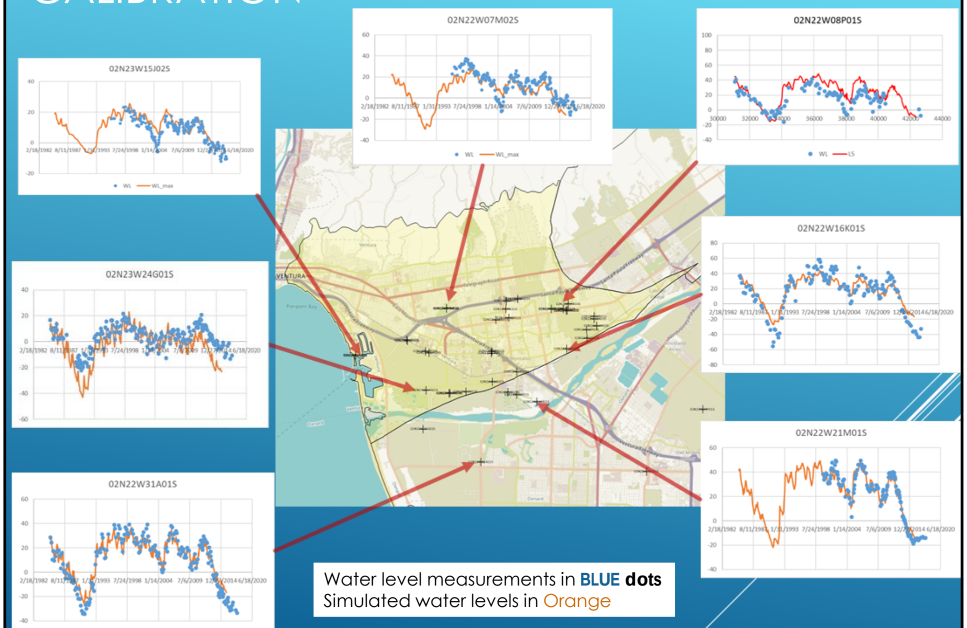
3

13 MODEL LAYERS REPRESENT REGIONAL AQUIFERS AND AQUITARDS



4

CALIBRATION



5

WATER BUDGETS:
DEFINITIONS AND ACRONYMS

"**Water budget**"—an accounting of how much water flows into or out of a groundwater basin, including:

- recharge
- discharge
- underflow
- change in storage

*"**Water balance**" might be a more accurate term*

"**Ag**"—agriculture

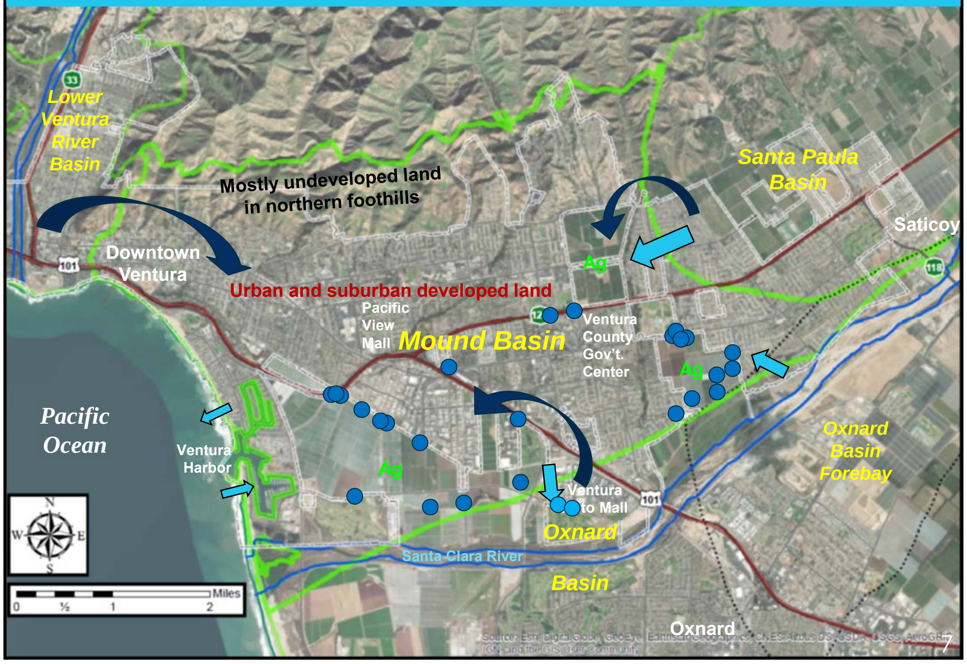
"**M&I**"—municipal and industrial

"**AFY**"—acre-feet per year

- 1 acre x 1 foot deep = ~326,000 gallons

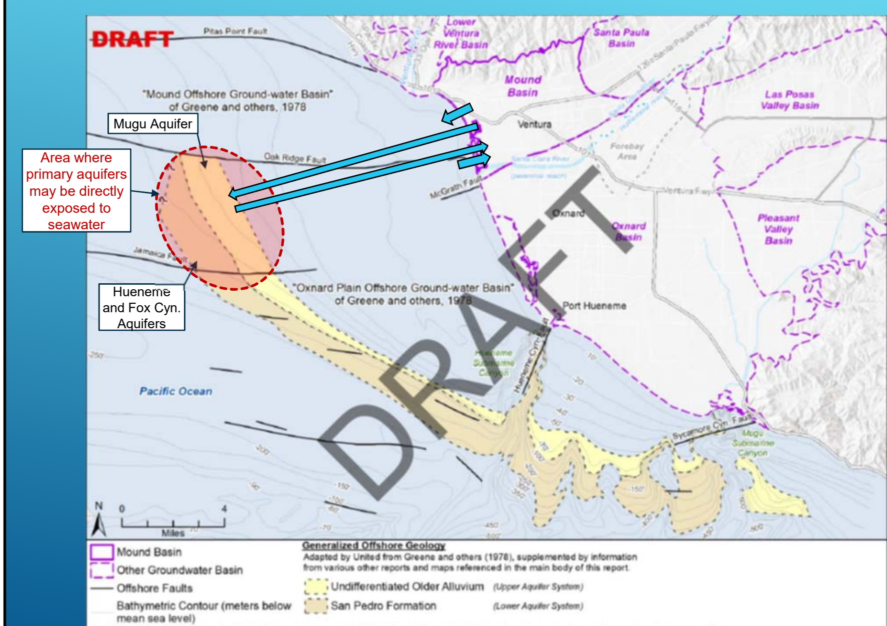
6

CONCEPTUAL MODEL FOR MOUND BASIN



7

OFFSHORE OUTCROPS OF AQUIFERS



8

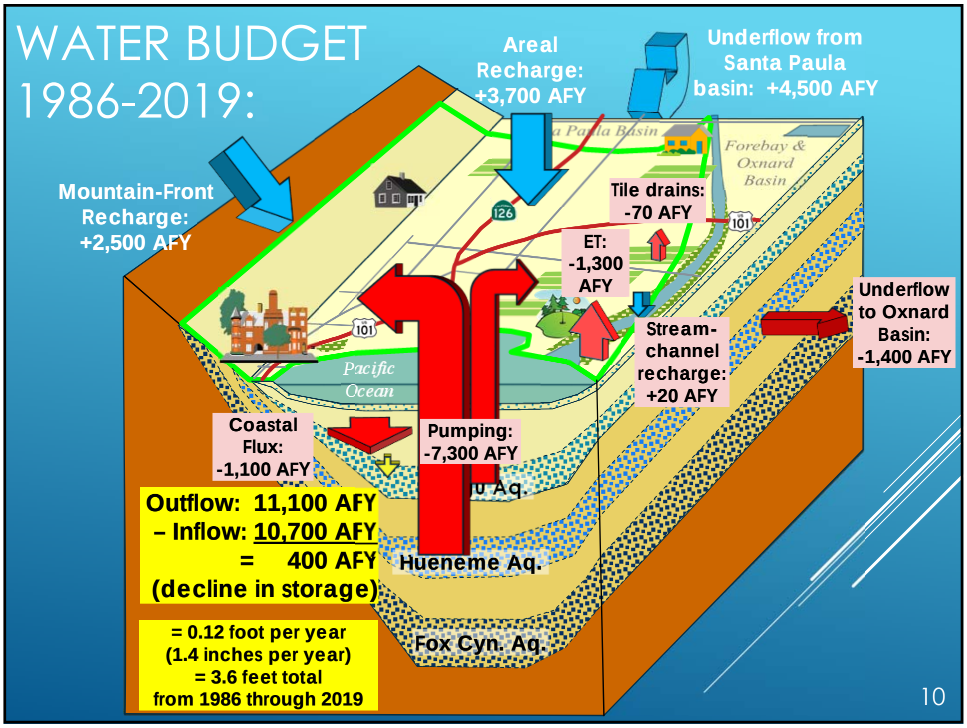
HISTORICAL/CURRENT WATER BUDGET ESTIMATION METHODS:

- Relied largely on United's regional groundwater flow model

What we know	What can be estimated	What the model can calculate best
Groundwater pumping	Recharge (infiltration) of rainfall	Groundwater underflows to/from Mound Basin
Surface-water imports	Mountain-front recharge	Surface-water/groundwater interaction
Groundwater imports	Return flows (Ag and M&I)	Evapotranspiration from shallow groundwater
Rainfall	Surface flows in the Santa Clara River watershed	Change in storage
		Discharge to tile drains

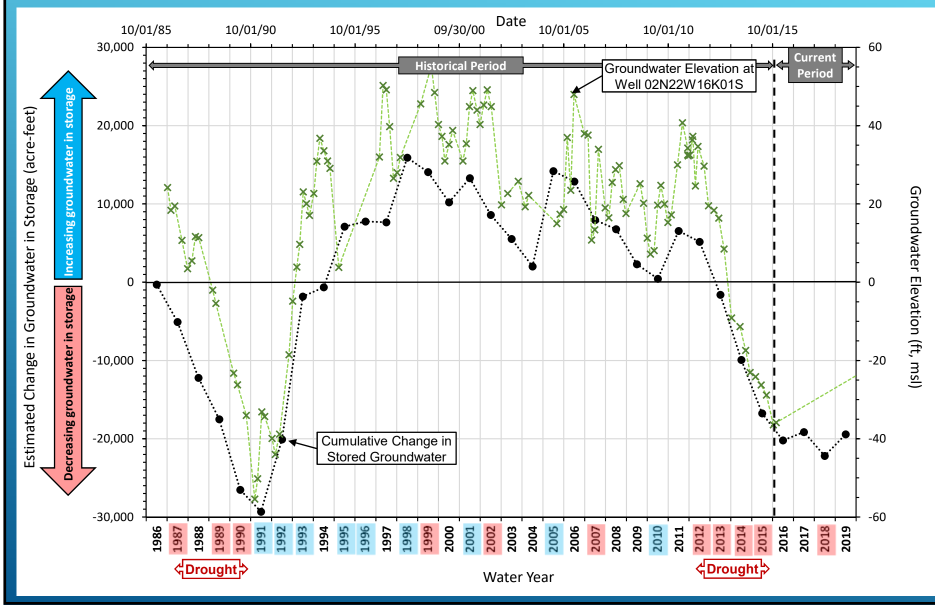
9

WATER BUDGET 1986-2019:



10

HISTORICAL CHANGES IN GROUNDWATER IN STORAGE, TOTAL FOR BASIN

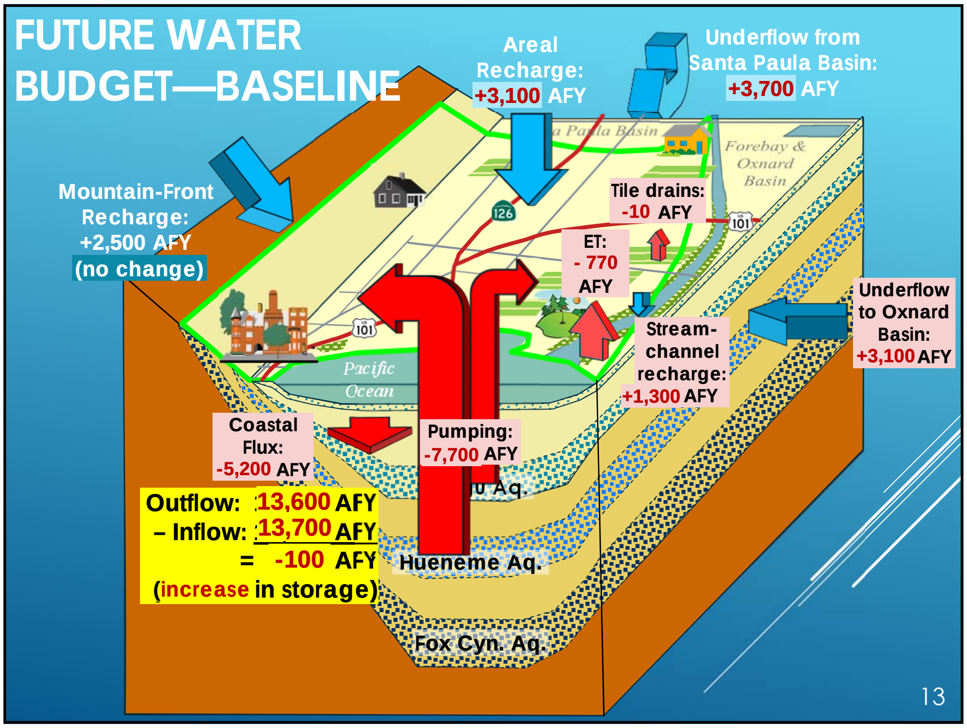


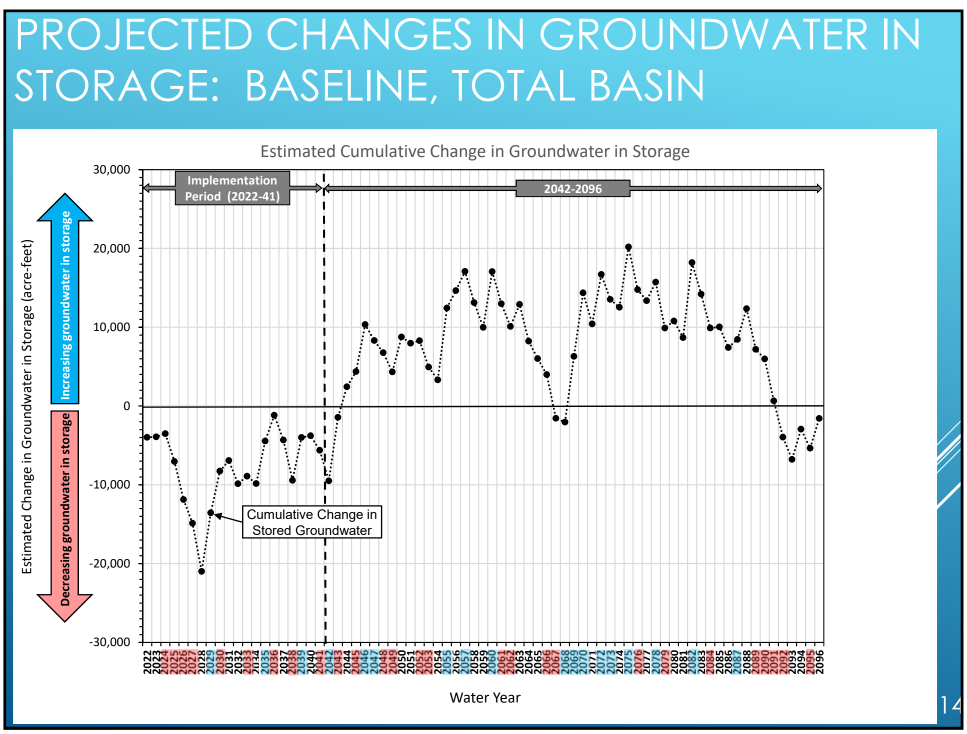
11

FUTURE WATER BUDGET ESTIMATION METHODS: FUTURE BASELINE

- WY 2022 through 2096, assuming:
  - Repeat of 1943-2019 rainfall, but use modern watershed hydrology (e.g., cities, dams & pipelines)
  - No climate change or sea-level rise
  - ***Oxnard Basin achieves its GSP sustainability goals***

12


FUTURE WATER
BUDGET—BASELINE
Areal
Recharge:
+3,100 AFY
Underflow from
Santa Paula Basin:
+3,700 AFY
Mountain-Front
Recharge:
+2,500 AFY
(no change)
Forebay &
Oxnard
Basin
Tile drains:
-10 AFY
ET:
- 770
AFY
Underflow
to Oxnard
Basin:
+3,100 AFY
Stream-
channel
recharge:
+1,300 AFY
Pacific
Ocean
Coastal
Flux:
-5,200 AFY
Pumping:
-7,700 AFY
Outflow: 13,600 AFY
– Inflow: 13,700 AFY
= -100 AFY
(increase in storage)
Hueneme Aq.
Fox Cyn. Aq.
13

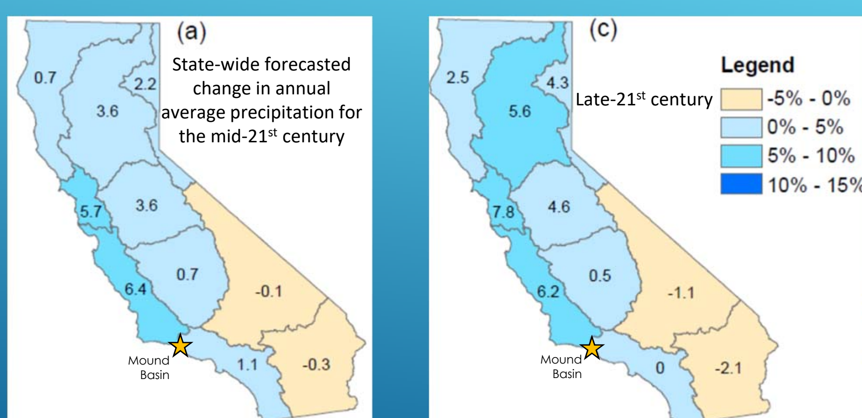

PROJECTED CHANGES IN GROUNDWATER IN
STORAGE: BASELINE, TOTAL BASIN
Estimated Cumulative Change in Groundwater in Storage
Implementation
Period (2022-41)
2042-2096
Estimated Change in Groundwater in Storage (acre-feet)
Increasing groundwater in storage
Decreasing groundwater in storage
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
Cumulative Change in
Stored Groundwater
Water Year
14

FUTURE WATER BUDGET ESTIMATION METHODS: CLIMATE-CHANGE SCENARIOS

- Applied DWR's 2030 & 2070 climate-change factors
  - Increased rainfall variability, evapotranspiration (ET), and pumping
  - 15 to 45 cm of sea-level rise

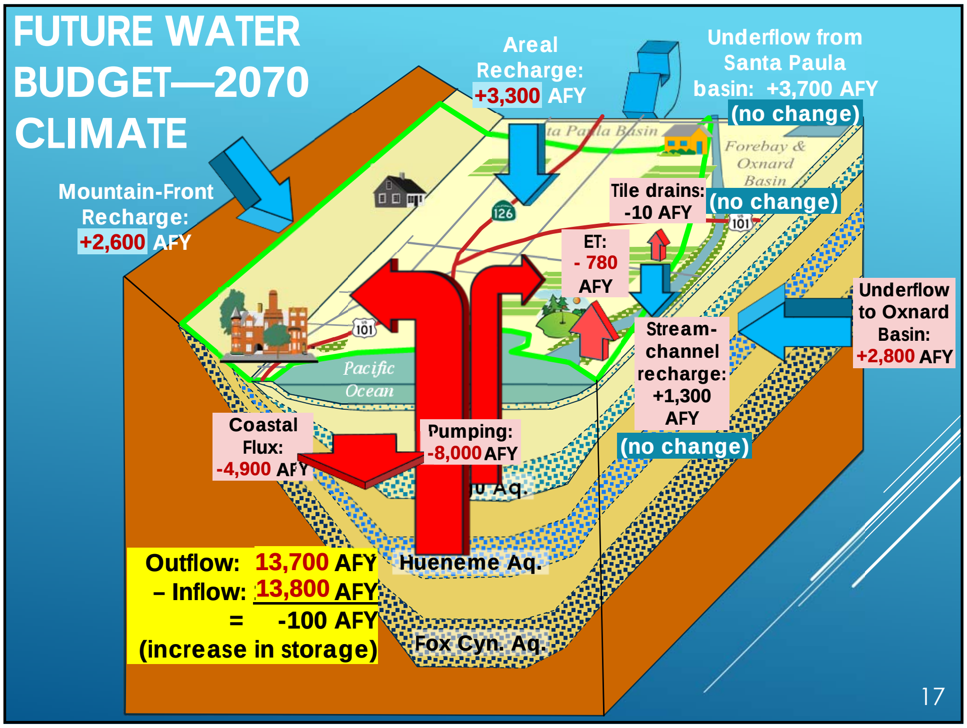
15

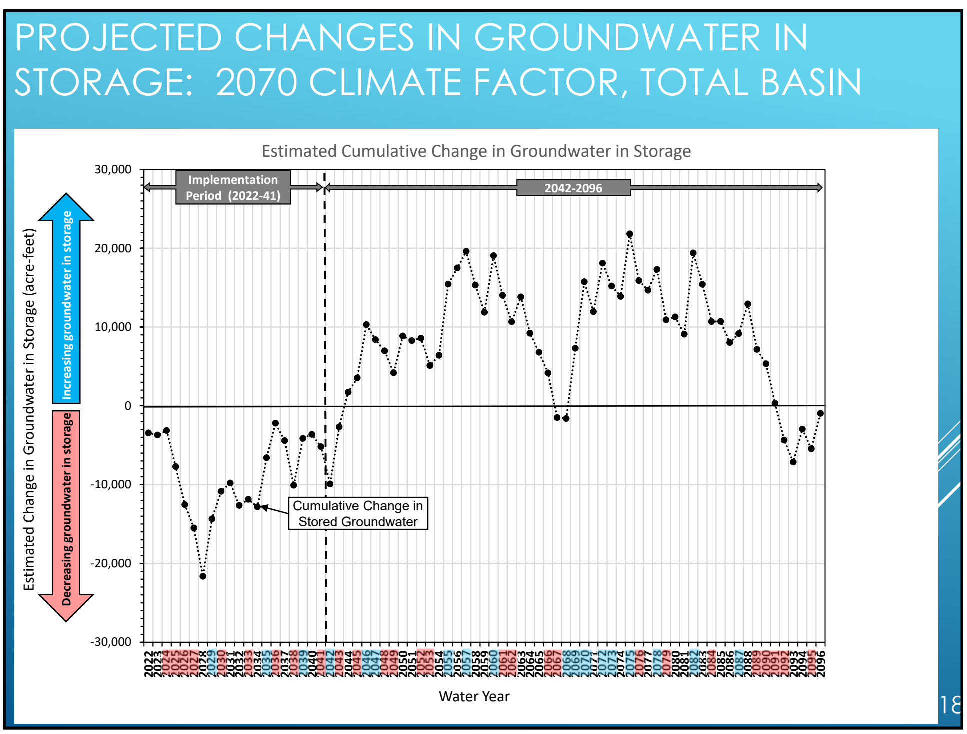
CLIMATE-CHANGE EFFECTS ON PROJECTED FUTURE WATER BUDGET



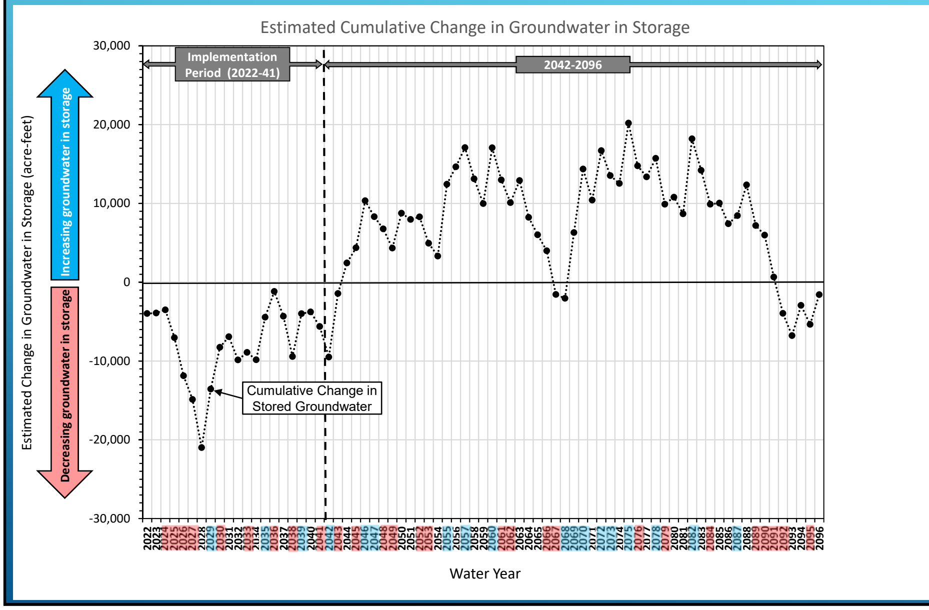
From "California's Fourth Climate Change Assessment" (He and others, 2018)

16


FUTURE WATER BUDGET—2070 CLIMATE
Areal Recharge: +3,300 AFY
Underflow from Santa Paula basin: +3,700 AFY
(no change)
Forebay & Oxnard Basin
Mountain-Front Recharge: +2,600 AFY
Tile drains: -10 AFY
(no change)
ET: - 780 AFY
Underflow to Oxnard Basin: +2,800 AFY
Pacific Ocean
Stream-channel recharge: +1,300 AFY
(no change)
Coastal Flux: -4,900 AFY
Pumping: -8,000 AFY
Outflow: 13,700 AFY
– Inflow: 13,800 AFY
= -100 AFY
(increase in storage)
Hueneme Aq.
Fox Cyn. Aq.
17


PROJECTED CHANGES IN GROUNDWATER IN STORAGE: 2070 CLIMATE FACTOR, TOTAL BASIN
Estimated Cumulative Change in Groundwater in Storage
Estimated Change in Groundwater in Storage (acre-feet)
Increasing groundwater in storage
Decreasing groundwater in storage
30,000
20,000
10,000
0
-10,000
-20,000
-30,000
Implementation Period (2022-41)
2042-2096
Cumulative Change in Stored Groundwater
Water Year
18

PROJECTED CHANGES IN GROUNDWATER IN STORAGE: BASELINE, TOTAL BASIN



19

QUESTIONS?

"The goal of science is to create the best narratives that we can from the evidence at hand,

…but to be willing to rewrite those narratives in an instant if and when superior evidence becomes available."

— D.R. Yesner and others, 2004, in "Peopling of the Americas and continental colonization: A millennial perspective"

20