Basin Planning Priorities Task 2 Workshop – Critical Analysis of Ambient Water Quality and Alternative Methods to Comply Pt. 1:

What Have We Learned in 17 years of SAR SNMP Implementation?

October 28, 2021

WEST YOST
Water. Engineered.

Workshop Approach

Date	Workshop Topic
August 2021	Overview of Recycled Water Policy – SNMP Monitoring and Analysis Requirements
October 2021	**Critical Analysis of SAR SNMP Ambient Water Quality and Alternative Methods to Comply Pt. 1: What Have We Learned in 17 years of Implementation?**
November 2021	Critical Analysis of SAR SNMP Ambient Water Quality and Alternative Methods to Comply Pt. 2: The Case for Prioritization and Levels of Analysis
January 2022	Critical Analysis of SAR SNMP Ambient Water Quality and Alternative Methods to Comply Pt. 3: Consideration of Alternative Methods
February 2022	Groundwater Monitoring for SNMP Compliance Pt. 1: Defining Key Wells, Data Gaps, and Responsible Parties
March 2022	Groundwater Monitoring for SNMP Compliance Pt 2: Database Management and Five-year Assessments
April 2022	Draft Work Plan Review
May 2022	Discuss Comments on Draft Work Plan
June 2022	Final Work Plan Review

Agenda

- Ambient water quality (AWQ) regulatory framework - Why we do it
- Methods to compute ambient water quality - How we do it
- Findings and adaptations since 2004 - What we have learned
- Questions for Consideration in Ongoing Methods and Data Collection
  - What questions do you have?

AWQ Regulatory Framework

Why are we required to compute ambient water quality?

AWQ Regulatory Framework: Basin Plan Implementation

- The Regional Board's principal means of achieving the water quality objectives and protecting the beneficial uses specified in the Basin Plan is the development, adoption, issuance, and enforcement of waste discharge requirements
- By regulating the quality of wastewaters discharged, and in other ways controlling the discharge of wastes which may impact surface and groundwater quality, the Regional Board works to protect the Region's water resources
- The Regional Board's regulatory tools include:
  - National Pollutant Discharge Elimination System permits
  - Waste Discharge Requirements
  - Water Reclamation Requirements
  - Water Quality Certification
  - Waste Discharge Prohibition

AWQ Regulatory Framework: Salt and Nutrient Management

- TDS and nitrogen management in the Santa Ana Region involves both regulatory actions by the Regional Board and actions by other agencies to control and remediate salt problems
- Regulatory actions include:
  - adoption of appropriate TDS and nitrogen limitations in requirements issued for waste disposal and municipal wastewater recycling
  - adoption of waste discharge prohibitions
- Actions by other agencies include projects to:
  - improve water supply quality
  - construction of groundwater desalters and brine lines to remove highly saline wastes from the watershed

AWQ Regulatory Framework: Salt and Nutrient Management

- The principal TDS and nitrogen regulatory tool employed by the Regional Board is the issuance of appropriate discharge requirements for the discharge, reuse, and recharge of recycled water (and other high-TDS/N discharges, as appropriate)
- Waste discharge requirements must specify limitations that, when met, will assure that Basin Plan water quality objectives will be achieved
- Where the quality of the water receiving the discharge is better than the established objectives (e.g. the receiving water has assimilative capacity for degradation), the Board must assure that the discharge is consistent with the state's antidegradation policy (State Board Order 68-16)

AWQ Regulatory Framework: Assimilative Capacity

- Some waters in the Region have assimilative capacity for addition of TDS and/or nitrogen discharges that exceed AWQ or BPOs:
  - wastewaters with higher TDS/nitrogen concentrations than the receiving waters are diluted sufficiently by natural processes, including rainfall or recharge, such that the TDS and nitrogen objectives of the receiving waters are met.
- The amount of assimilative capacity in a GMZ, if any, varies depending on the individual characteristics and must be reevaluated over time

AWQ Regulatory Framework: Assimilative Capacity

- To compute assimilative capacity in each groundwater management zone (GMZ), current TDS and nitrate water quality (e.g. AWQ) are compared to water quality objectives
- If the ***current AWQ is better than the water quality objectives***, then a GMZ ***has assimilative capacity***. The difference between the objectives and current quality is the amount of assimilative capacity available
- If the ***current AWQ is the same as or poorer than the water quality objectives***, then a GMZ ***does not have assimilative capacity***
- For groundwater management zones, current AWQ and available assimilative capacity must be determined every three years

AWQ Regulatory Framework: Regulatory Actions based on AWQ & AC

- If there is assimilative capacity in the receiving waters:
  - A waste discharge may be of poorer TDS/N quality than the Basin Plan objectives for the receiving waters, if Antidegradation demonstration is prepared by project proponent to show:
    - the discharge does not cause violation of the objectives
    - antidegradation requirements (68-16) are met, such as:
      - Beneficial use protection
      - Economic and socioeconomic considerations
      - Maximum benefit demonstration
  - A waste discharge with a constituent concentration that is at or below (i.e., better than) the current ambient TDS and/or nitrogen water quality, then the discharge will not be expected to result in the lowering of water quality, and no antidegradation analysis is required
    - *Note: Regional Board always retains discretion to request antidegradation analysis in any case*

AWQ Regulatory Framework: Regulatory Actions based on AWQ & AC

- If there is no assimilative capacity in the receiving waters:
  - the numerical limits in discharge requirements cannot exceed the receiving water objectives
- In some cases, compliance with TDS or N objectives for discharges to waters without assimilative capacity may be difficult to achieve (e.g. high TDS source water supplies).
- In such cases dischargers may:
  - participate in TDS offset programs, such as the use of desalters, in lieu of compliance with numerical TDS limits, subject to certain conditions incorporated into WDRs
  - Propose a maximum-benefit based salt and nutrient management plan that includes revised TDS and/or N objectives and long-term commitment to a program of water quality management actions

AWQ Regulatory Framework: Elsinore GMZ Example

Elsinore GMZ

- TDS Objective

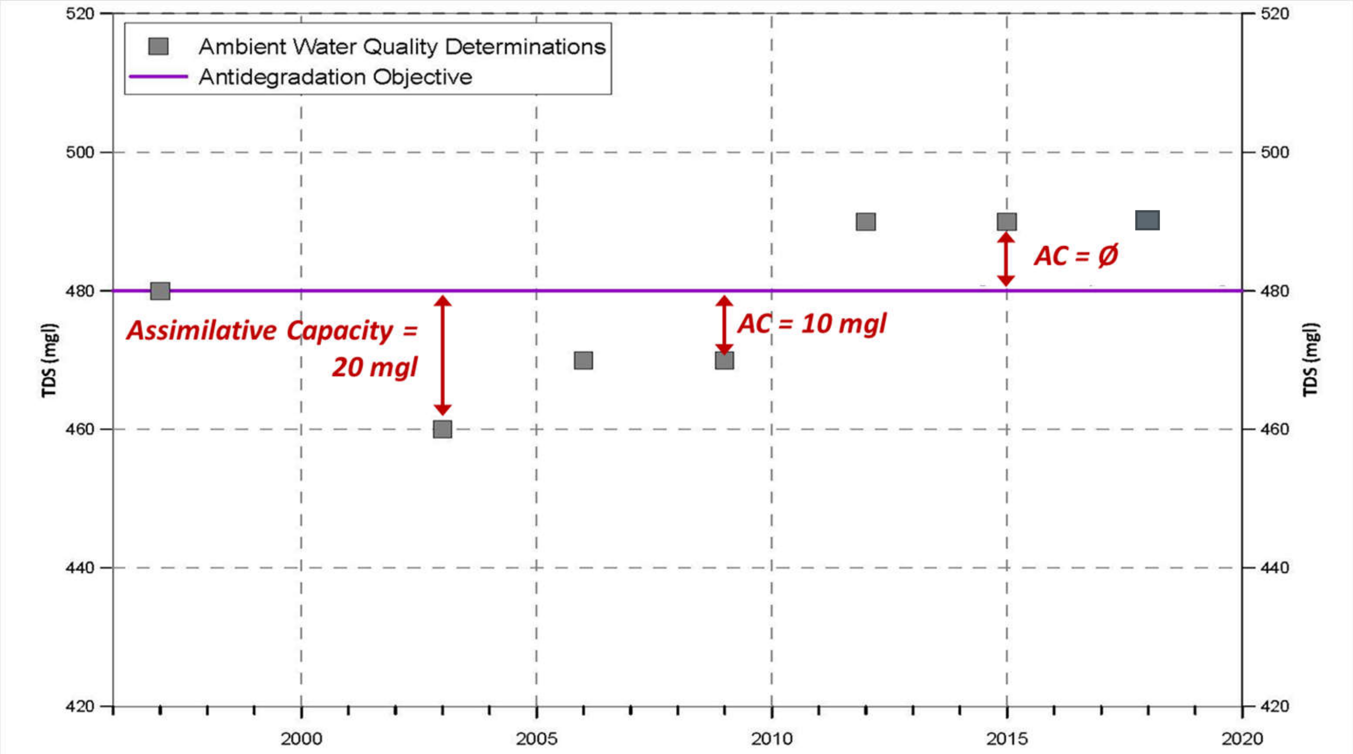
  = 480 mgl

- Waste Discharge Limit

  = 700 mgl

- Solution:

  Maximum Benefit SNMP
  (pending final approval)



AWQ Regulatory Framework: Lakeview/Hemet-North GMZ Example

LVHN GMZ

- TDS Objective

  = 520 mgl

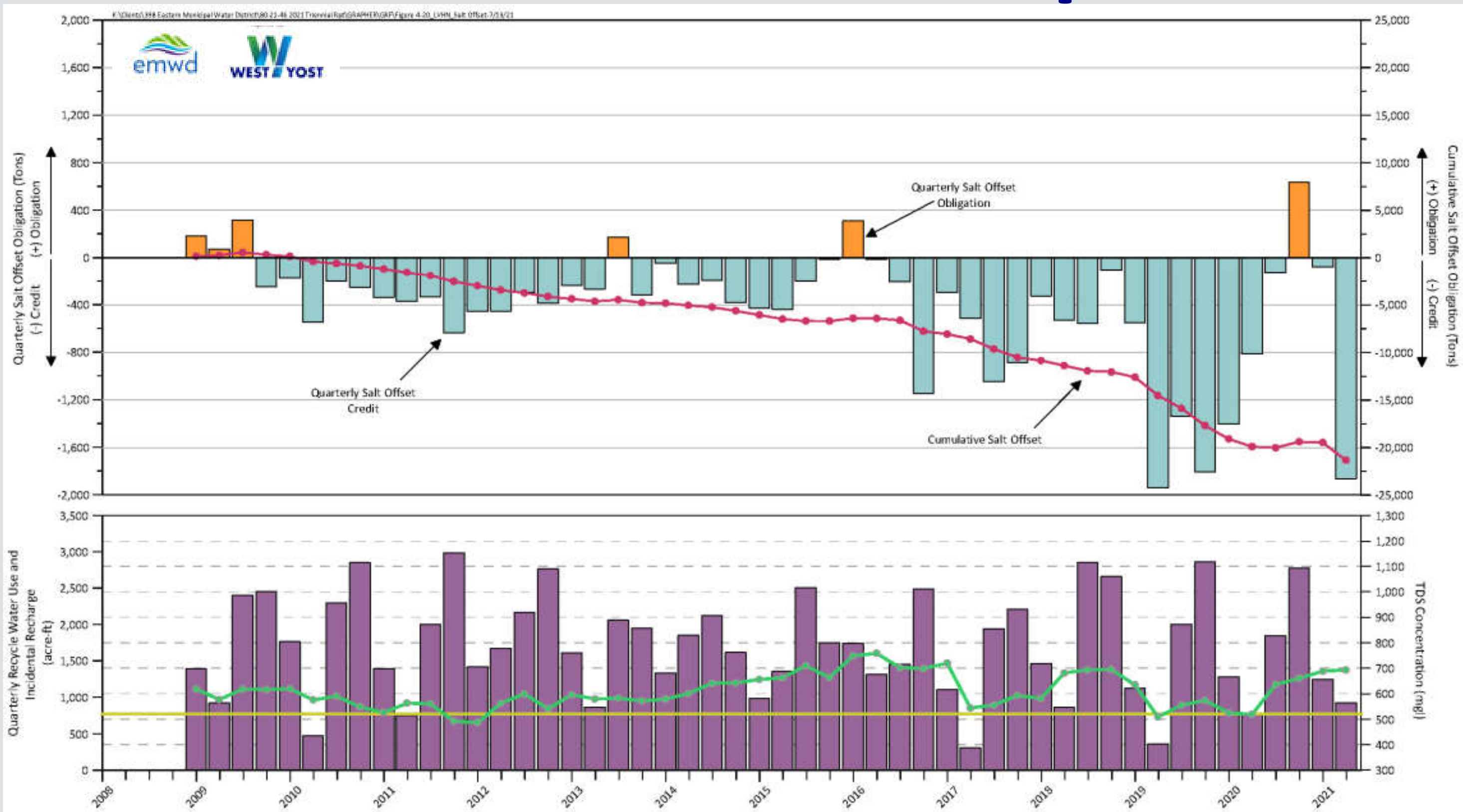
- TDS AWQ

  = 850

- Recycled Water TDS

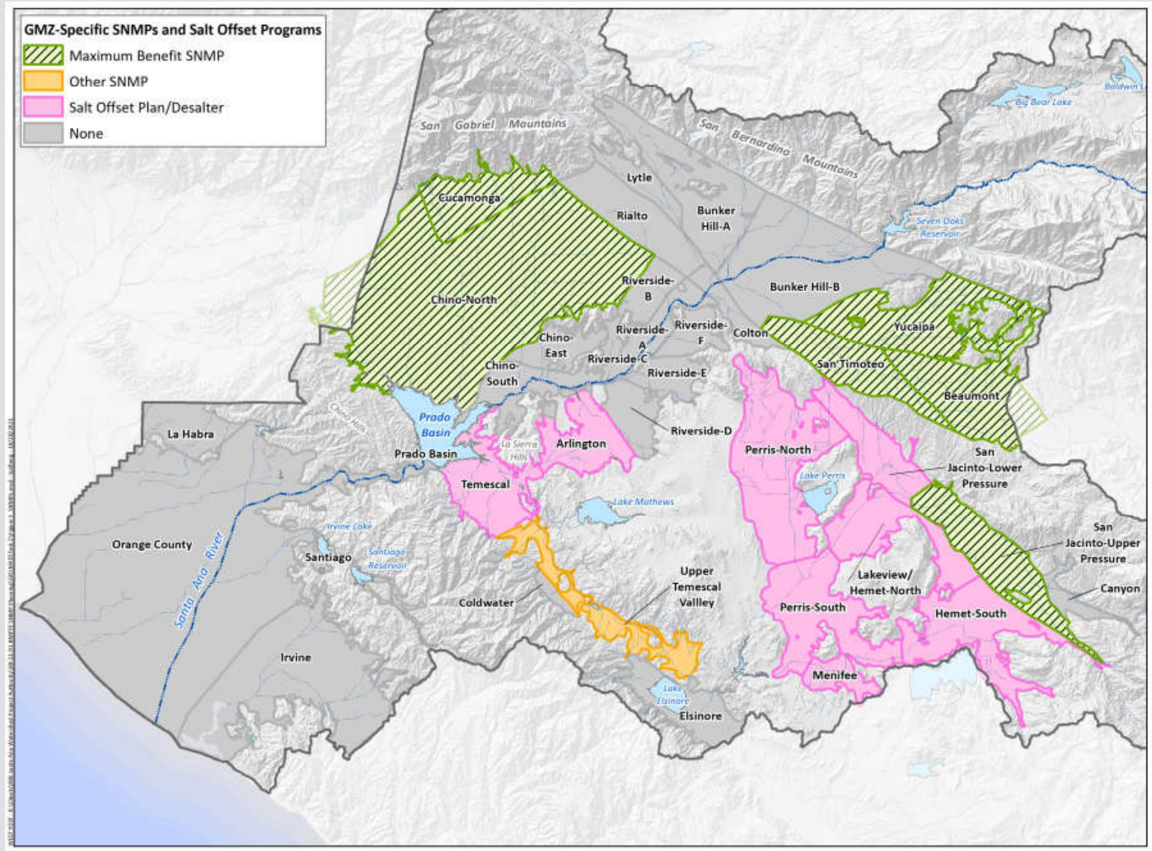
  = 500-800 mgl

- Salt Offset with Perris Desalter



GMZ-Specific SNMPs or Salt Offsets

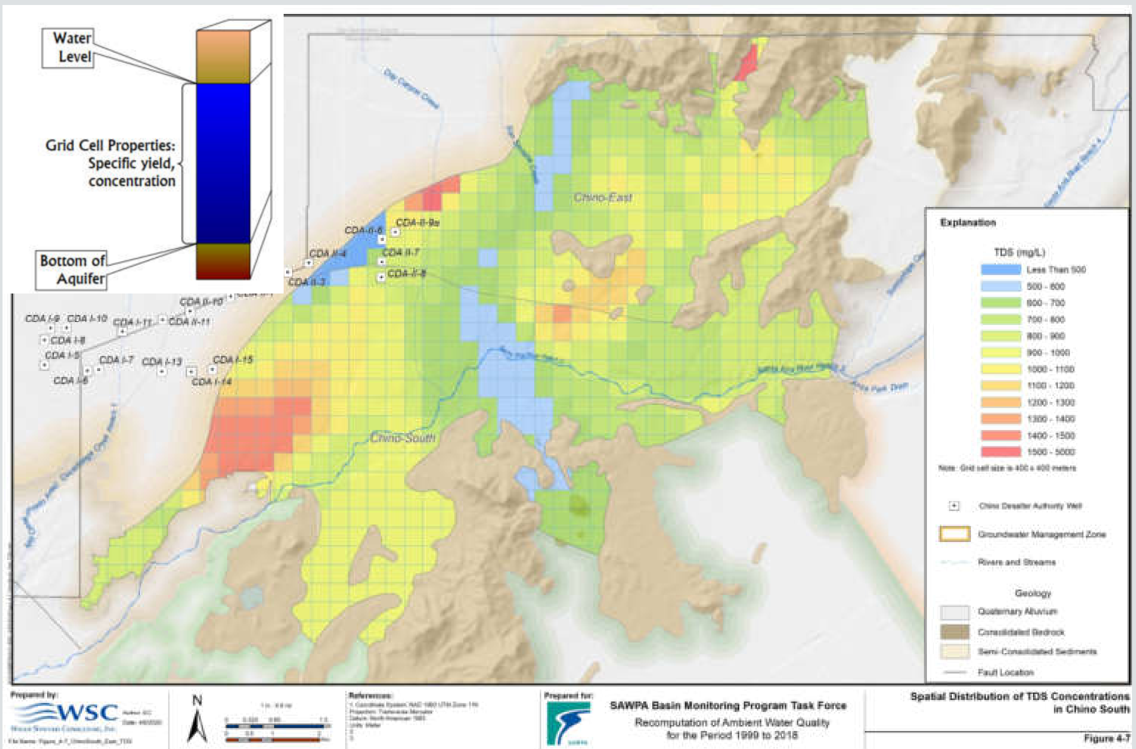
- Six GMZs with Maximum Benefit SNMPs
  - Plus Elsinore GMZ, expected in 2022
- One GMZ with an SNMP to address salt loading
- Eight GMZs with Salt Offset projects as part of WDRs



Ambient Water Quality Methods

How is AWQ calculated?

AWQ Methods: GMZ volume-weighted concentration



$$V = \sum_{i=1}^{n} A_i \cdot (GWE_i - BOA_i) \cdot SY_i$$

- V = volume of groundwater in the GMZ
- A_i = area of the i^{th} grid cell
- GWE_i = groundwater elevation (feet above mean sea level [feet msl])
- BOA_i = bottom of the aquifer of the i^{th} grid cell (feet msl)
- SY = specific yield of the i^{th} grid cell
- n = number of grid cells

$$C_{avg} = \frac{\sum_{i=1}^{n} C_i \cdot V_i}{\sum_{i=1}^{n} V_i}$$

- C_{avg} = the volume-weighted current ambient concentration in a GMZ
- C_i = the current ambient concentration of groundwater in the ith grid cell
- V_i = the volume of groundwater in the ith grid cell
- n = number of grid cells

AWQ Methods: Development of TDS and N Statistics

- Raw data from wells
- Time history review
- QA/QC checks
- Annualized averages for time period
- Statistical test for normality and rejection of outliers
- Compute AWQ "Statistic" for wells with qualified data
- Compute average and median values for wells where data was disqualified during statistical test

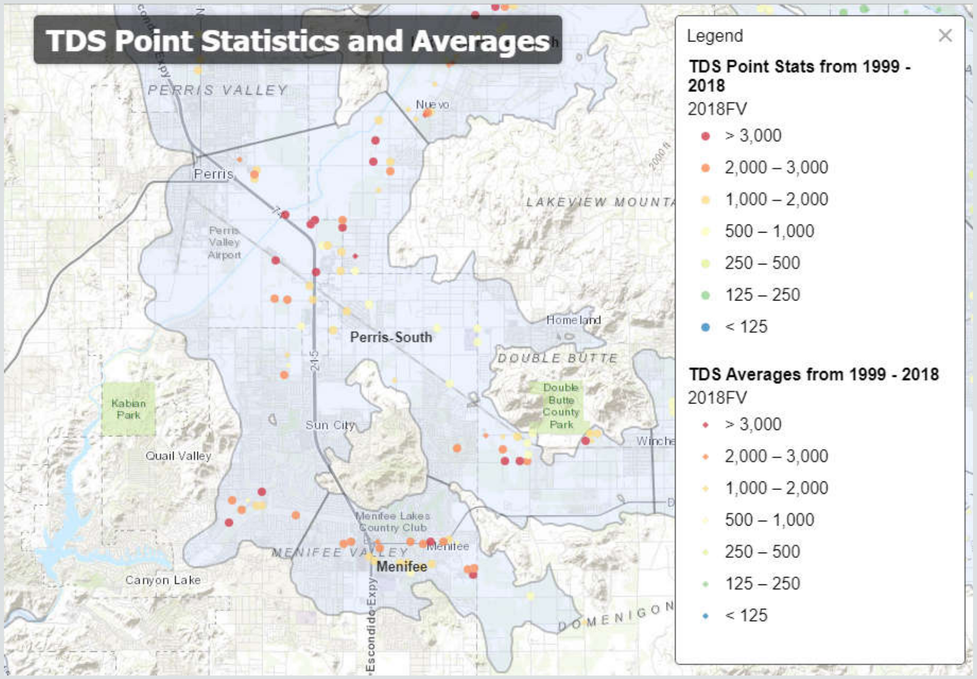


Image Source: WSC ArcGIS Online AWQ Data Explorer

AWQ Methods: Water Level, TDS/N Contours

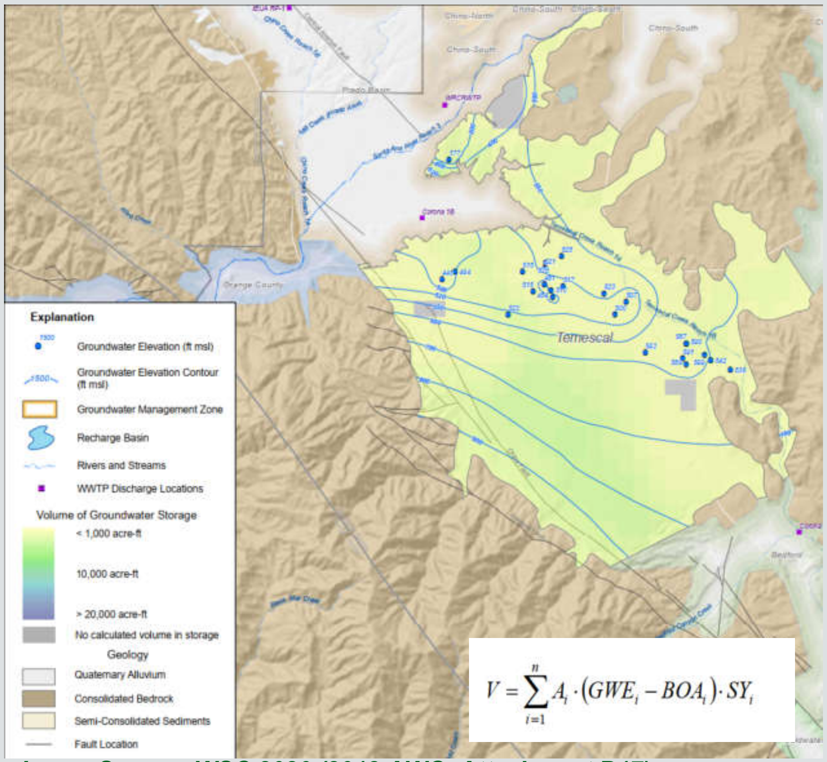


Image Source: WSC 2020 (2018 AWQ, Attachment B17)

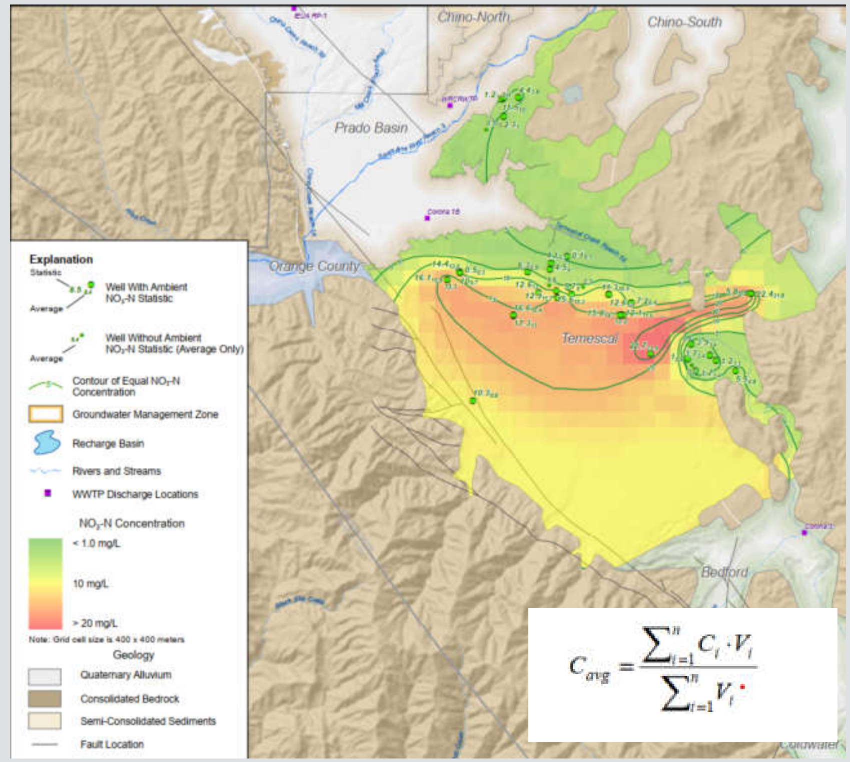
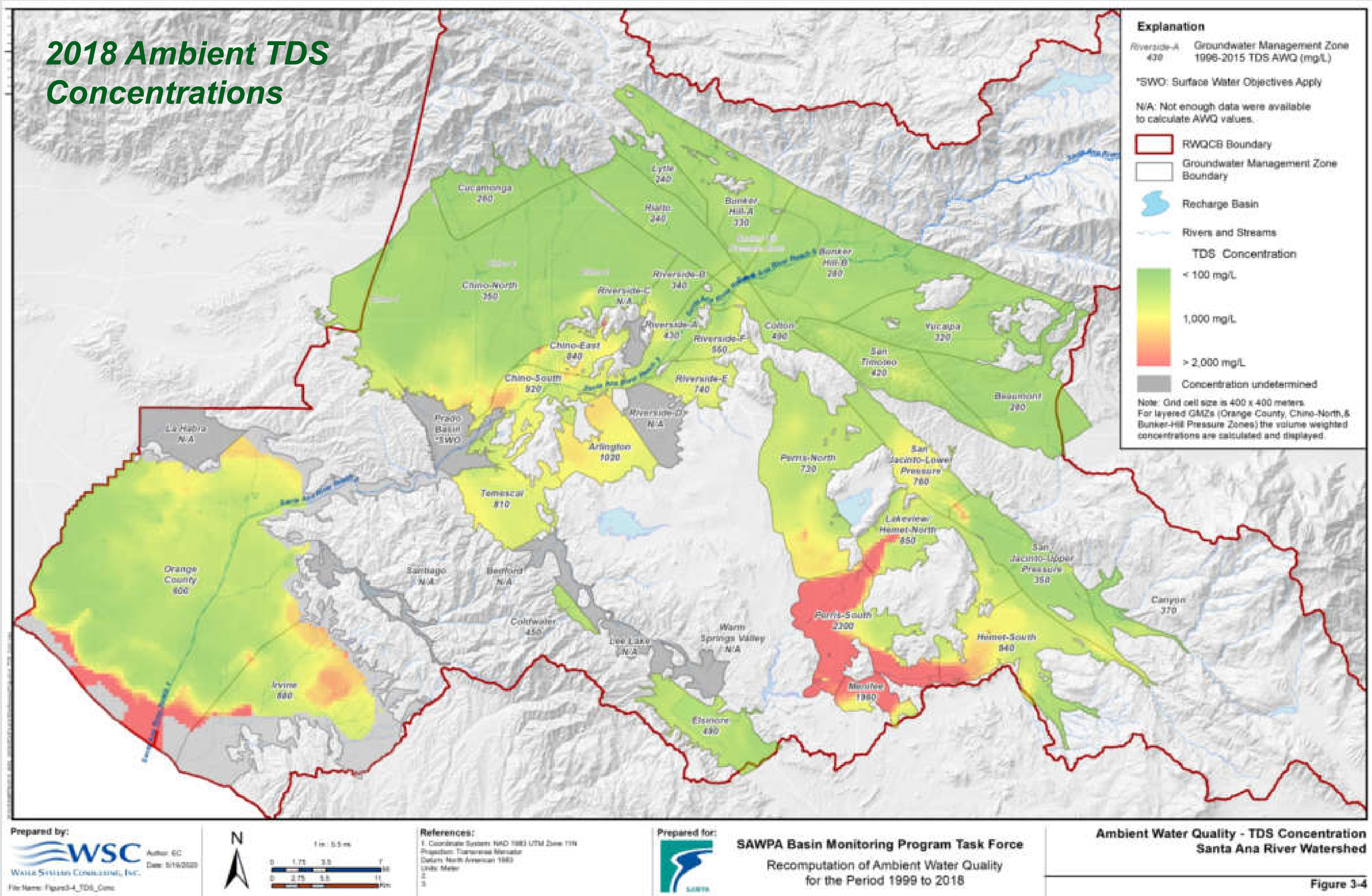
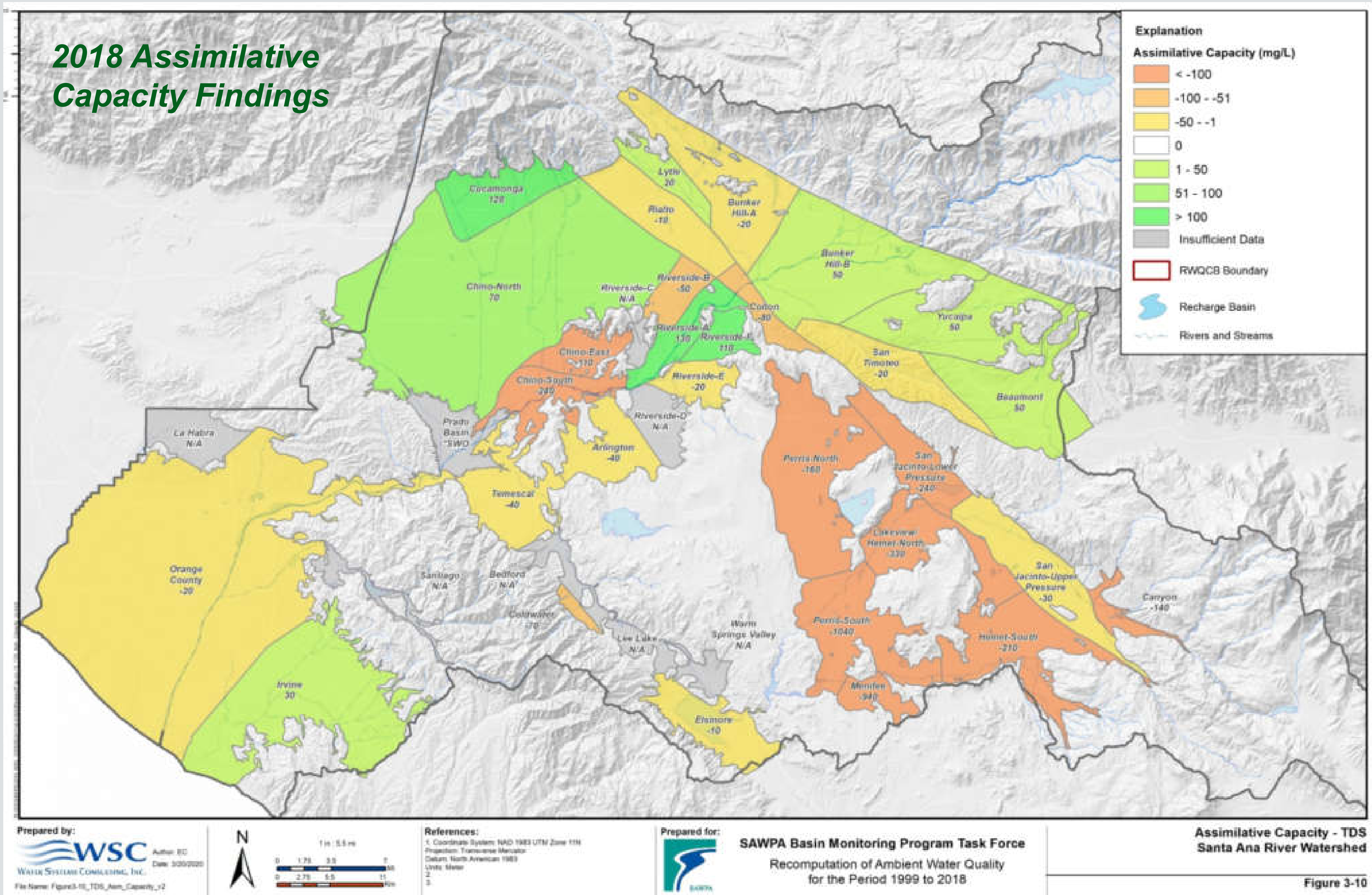


Image Source: WSC 2020 (2018 AWQ, Attachment B17)


2018 Ambient TDS Concentrations
Explanation
Groundwater Management Zone 1996-2015 TDS AWQ (mg/L)
*SWO: Surface Water Objectives Apply
N/A: Not enough data were available to calculate AWQ values.
RWQCB Boundary
Groundwater Management Zone Boundary
Recharge Basin
Rivers and Streams
TDS Concentration
< 100 mg/L
1,000 mg/L
> 2,000 mg/L
Concentration undetermined
Prepared by:
WSC
Prepared for:
SAWPA Basin Monitoring Program Task Force
Recomputation of Ambient Water Quality for the Period 1999 to 2018
Ambient Water Quality - TDS Concentration
Santa Ana River Watershed
Figure 3-4

2018 Assimilative Capacity Findings



Key Features of AWQ Methods Defined by TIN/TDS Task Force

- "Current" AWQ: the most recent 20-year historical record used to compute TDS/N statistics
  - 2018 AWQ Period of Record = January 1, 1999 through December 31, 2018
- Minimum of three years of data within the 20-year period is required to qualify for TDS/N statistic generation
- TDS/N statistics favored in contouring, average/median values are primarily for reference
- All statistics equally weighted in contouring, regardless of time period of available data within the 20-year computation period
- In areas with limited or no data, historical interpretations honored

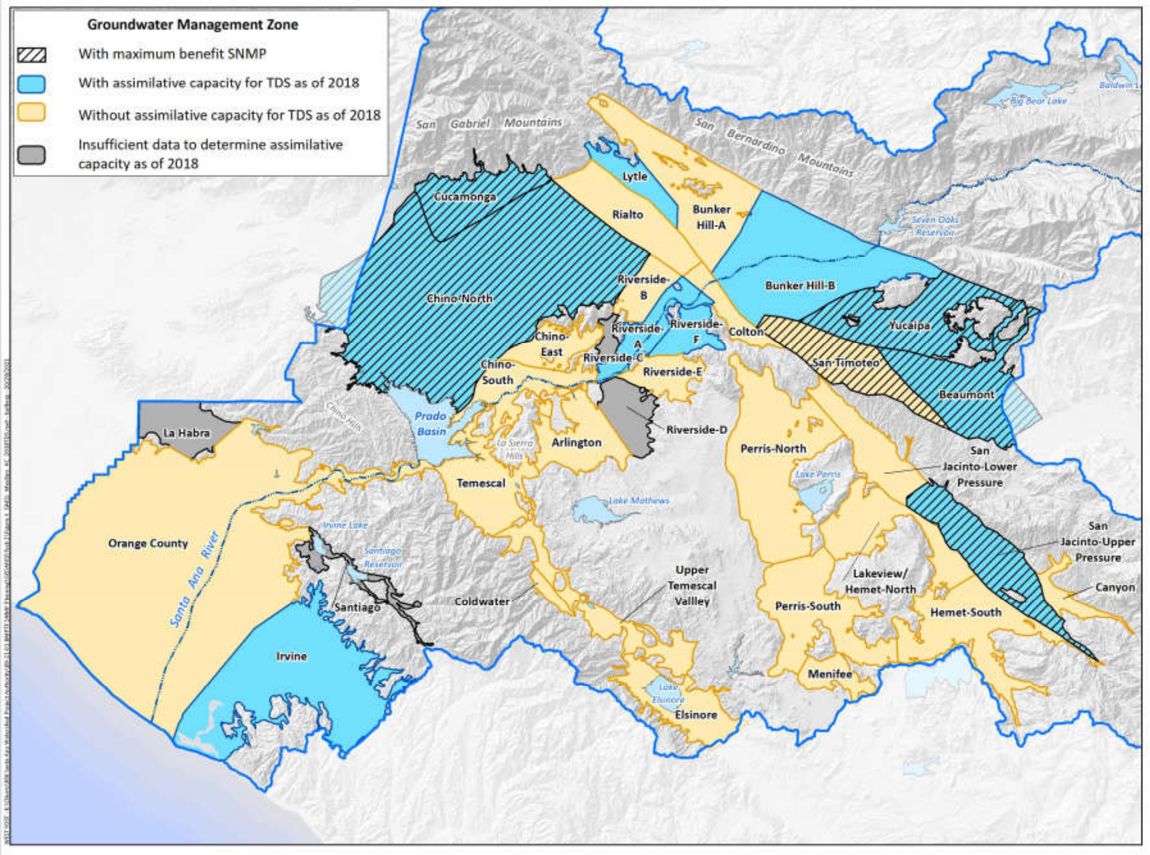
AWQ Findings and Adaptations

What we have learned since 2004?

Assimilative Capacity for TDS As of 2018 AWQ

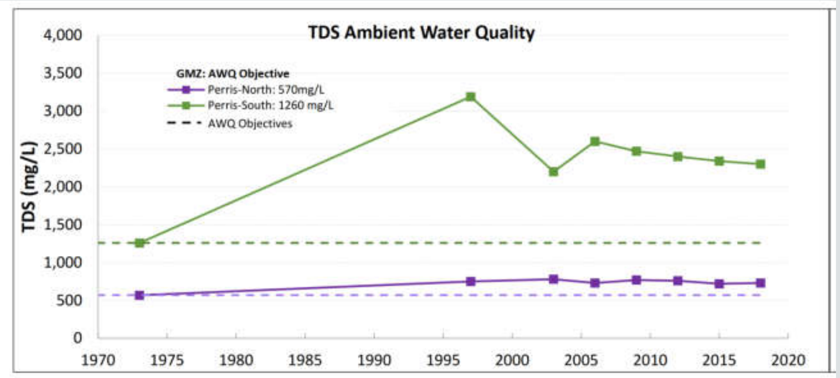
- 35 GMZs Total
- 10 GMZs with Assimilative Capacity
    - 5 are Maximum Benefit GMZs
- 21 with ***<u>NO</u>*** Assimilative Capacity
- 4 with no AWQ findings

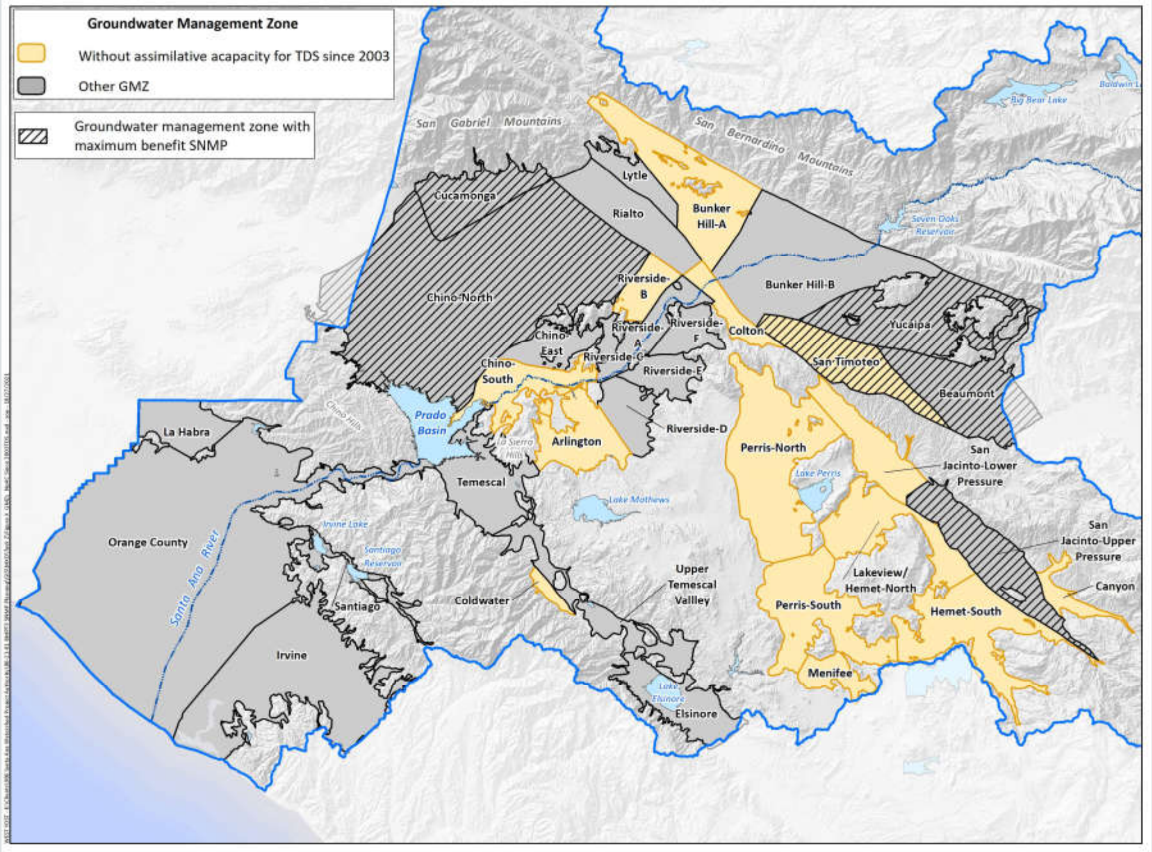
- *Note: AWQ in Upper Temescal Valley GMZ computed in separate process with unique methods per approved GMZ-specific SNMP*



Assimilative Capacity for TDS Since 2004

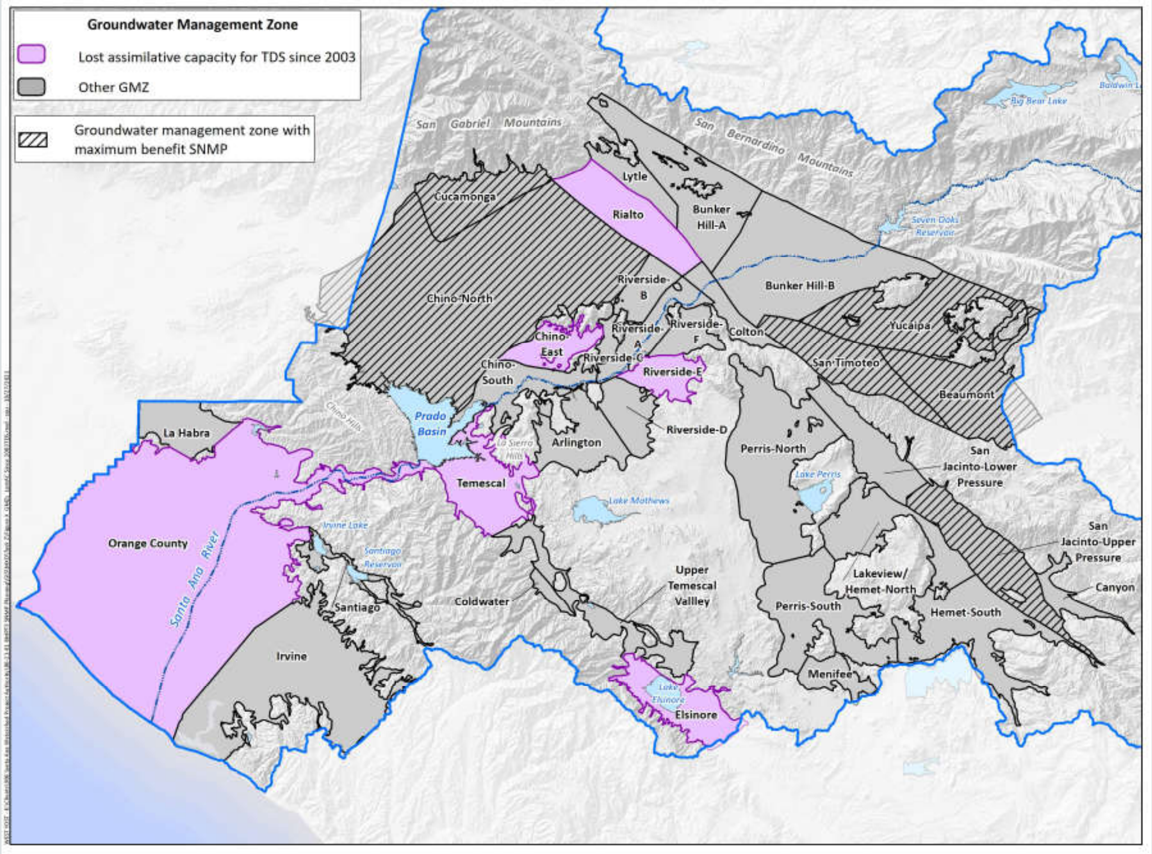
- 14 GMZs have had ***NO*** Assimilative Capacity since 2003 AWQ recomputation





Assimilative Capacity for TDS Since 2004

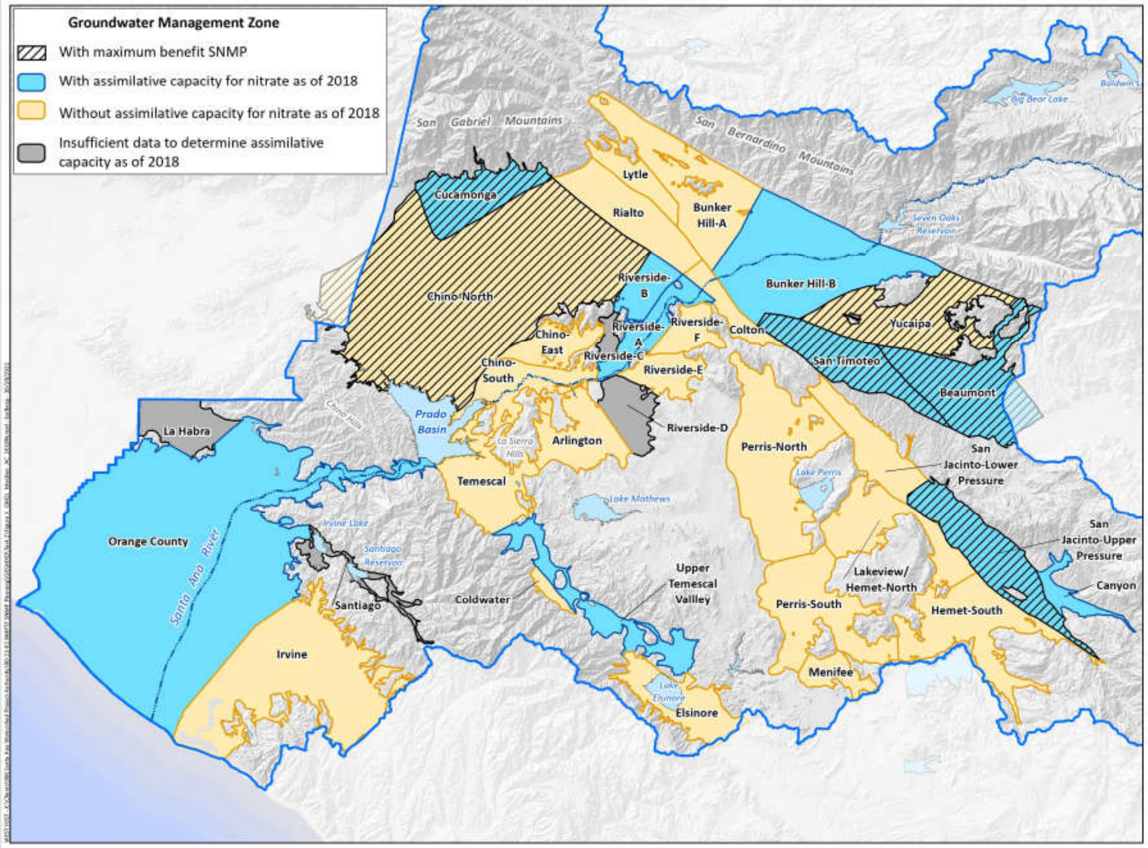
- Six GMZs lost assimilative capacity for TDS since 2003
  - Rialto
  - Riverside-E
  - Chino East
  - Temescal
  - Elsinore
  - Orange County



Assimilative Capacity for Nitrate As of 2018 AWQ

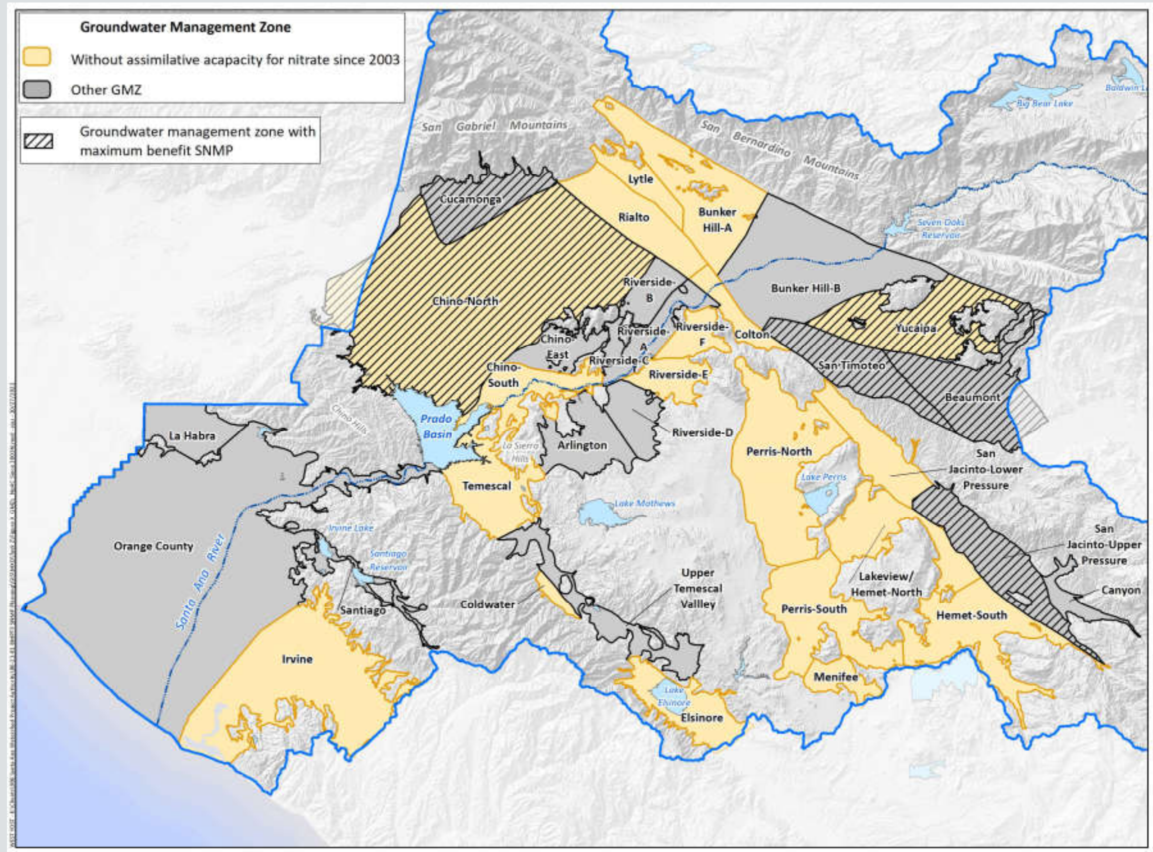
- 35 GMZs Total
- 10 with Assimilative Capacity
    - 4 are Maximum Benefit GMZs
- 21 with ***NO*** Assimilative Capacity
- 4 with no AWQ findings

- *Note: AWQ in Upper Temescal Valley GMZ computed in separate process with unique methods per approved GMZ-specific SNMP*



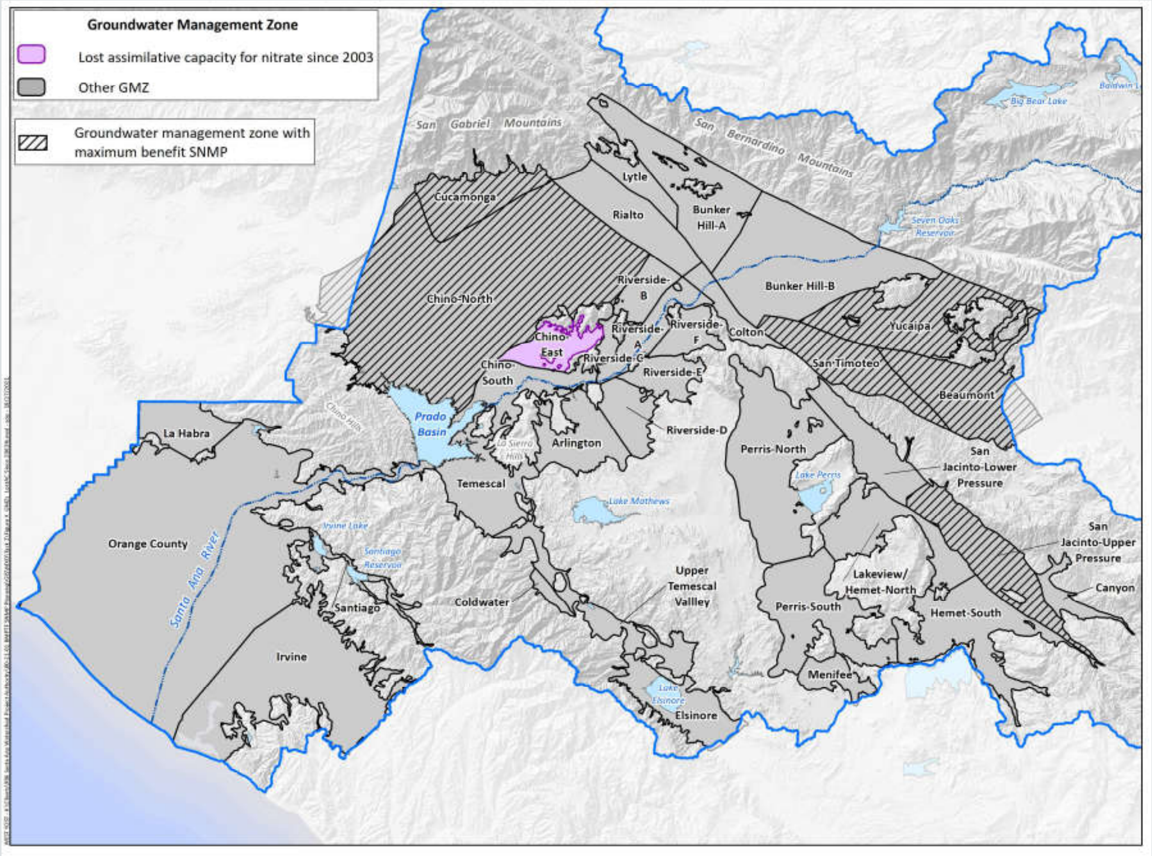
Assimilative Capacity for Nitrate Since 2004

- 19 GMZs have had ***NO*** Assimilative Capacity since 2003 AWQ recomputation



Assimilative Capacity for Nitrate Since 2004

- One GMZ lost assimilative capacity for nitrate since 2003
  - Chino East GMZ
  - Methodological



Overview of Key Findings and Adaptations since 2004

Key Findings

- Changes in AWQ over time are driven by systemic (physical) processes *and* analytical methodologies
- Collection, QA/QC, and management of data is time consuming and expensive
- Aquifer properties are outdated in some GMZs
- Many GMZs have very limited data
- The statistics procedure eliminates a lot of data that could/should be used
- Method does not address “hot spots”
- AWQ is not suitable initial condition for forward-projections of TDS/N conc.

Key Adaptations

- Interpretive tools
  - Change maps
  - Key wells and trends
  - Well attrition analysis
- Exploratory tasks to address:
  - how revision of aquifer properties could change AWQ results
  - filling data gaps
- Refined statistical procedures
- Web tools for exploring data
- ***Next Up: AWQ specific monitoring program***

Interpretive Tools
What drives changes in AWQ over time?

Table 4-1. Systemic and Methodological Factors Affecting Groundwater Quality.

Category	Factor
Systemic Change	The movement of solutes from the vadose zone to the saturated zone.
Systemic Change	Changes in water levels that affect groundwater storage in a GMZ
Systemic Change	Revised understanding of hydrogeologic physical models, which may change aquifer geometry and aquifer properties.
Systemic Change	Pumping/recharge stresses and/or groundwater flow within or between GMZs that can add, remove, and/or transport TDS and nitrate constituents in groundwater.
Methodological Change	The addition or loss of wells within GMZs.
Methodological Change	The geographic distribution of added or lost wells within GMZs.
Methodological Change	Differences in the techniques employed to contour and interpolate water quality data.
Methodological Change	The elimination of three years of data from the analysis (1996 to 1998).
Methodological Change	The addition of three years of data to the analysis (2016 to 2018).

Image Source: WSC 2020 (Table 4-1, page 48)

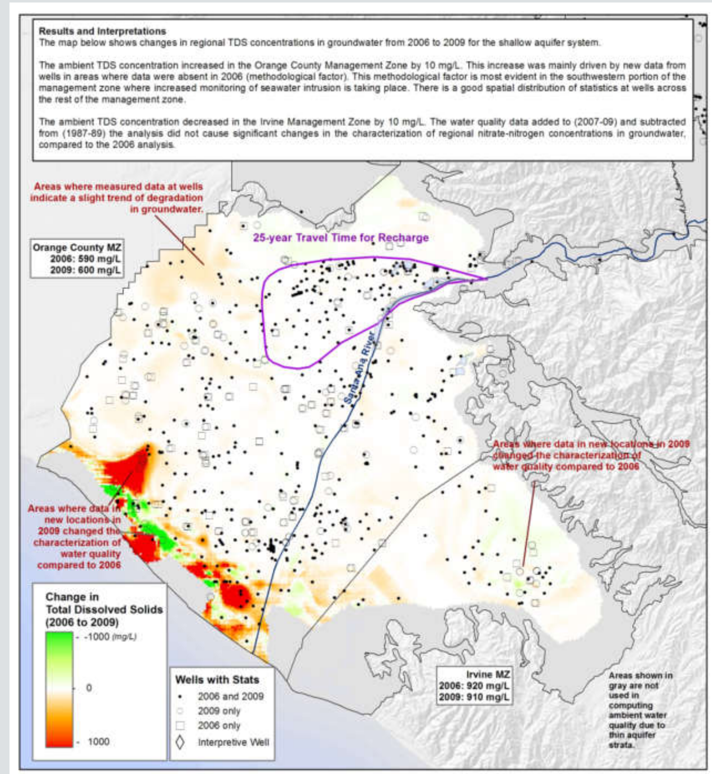


Image Source: WEI, 2011 Figure 4-10

Interpretive Tools
Key Well Trends

- 1st Generation:
  - Selected for 2009 AWQ
  - Selected based on:
    - location
    - groundwater flow paths
    - construction
    - proximity to recharge facilities or SAR recharge
    - representativeness of basin trends
  - Qualitative interpretations of time history charts
- Advancements:
  - Mann Kendall statistical trend analysis
    - Expanded to all wells

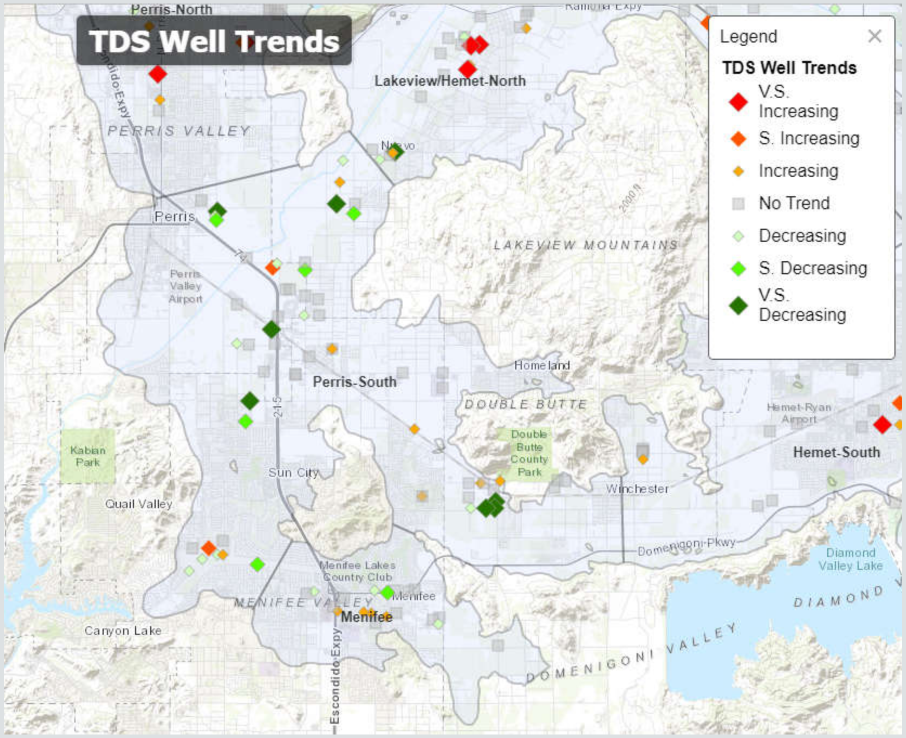


Image Source: WSC ArcGIS Online AWQ Data Explorer

Interpretive Tools
Well Attrition

- If wells are no longer sampled, they fall out of the analysis, and, if not replaced:
  - Can alter interpretation and interpolation of water quality statistics
  - Reduces understanding of how basin is changing
- 1st generation:
  - Identify wells lost if not sampled in next three-year period
- Advancements:
  - Identify wells lost if not sampled in next six-year period
  - Attempts to address data gaps

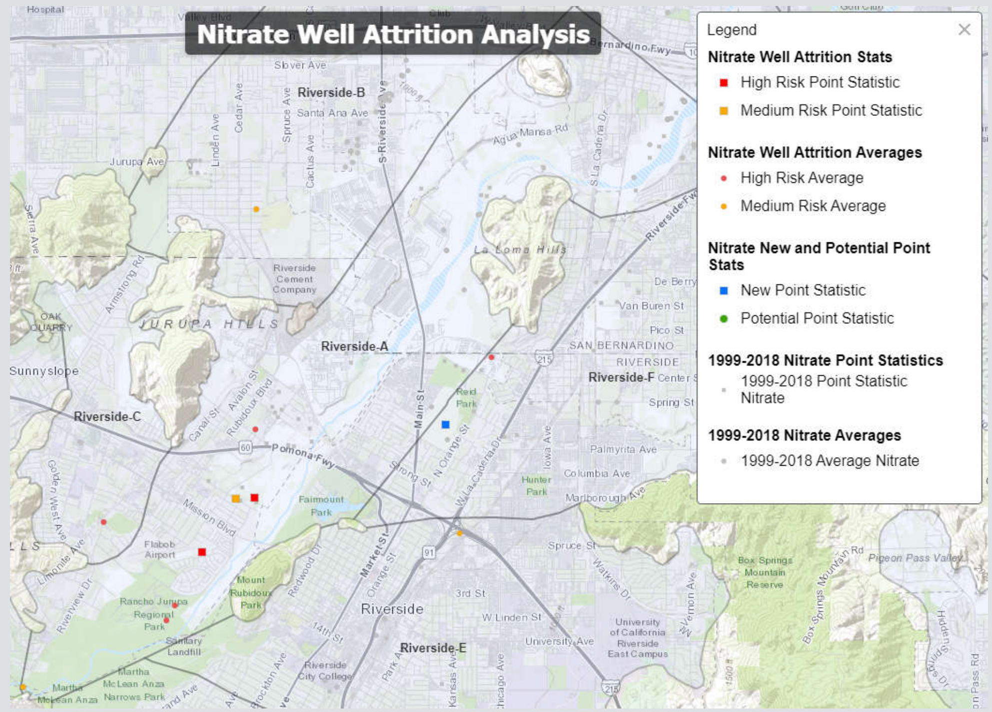
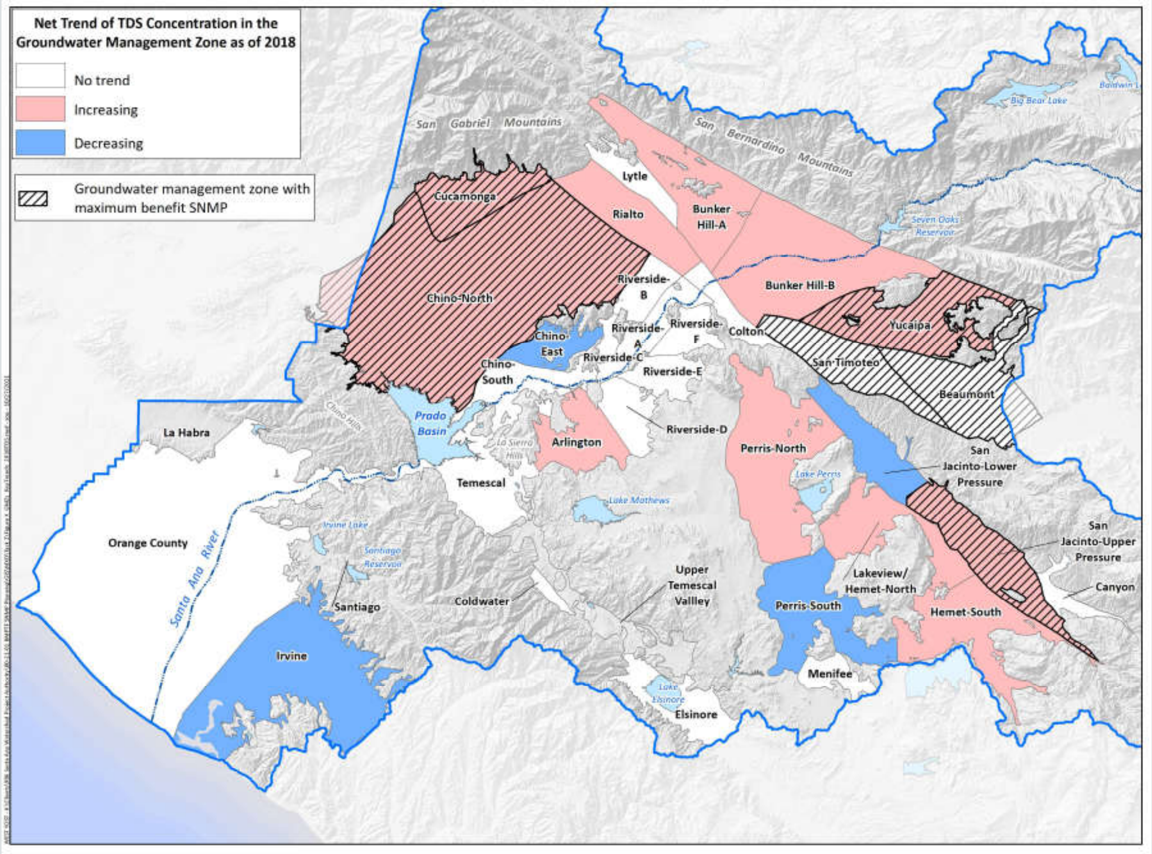


Image Source: WSC ArcGIS Online AWQ Data Explorer

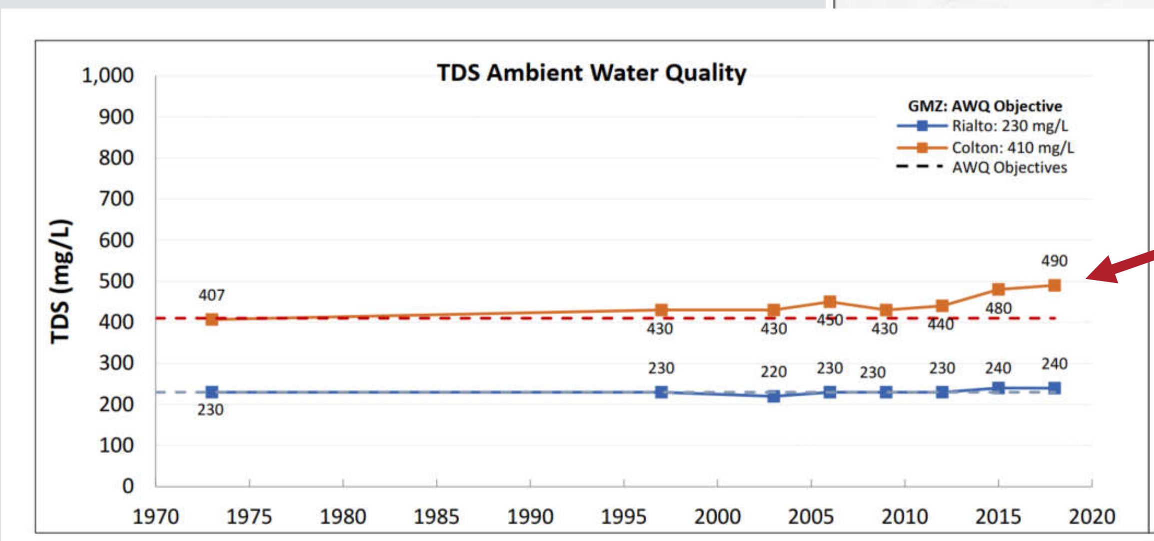
Challenges with Data and Statistics

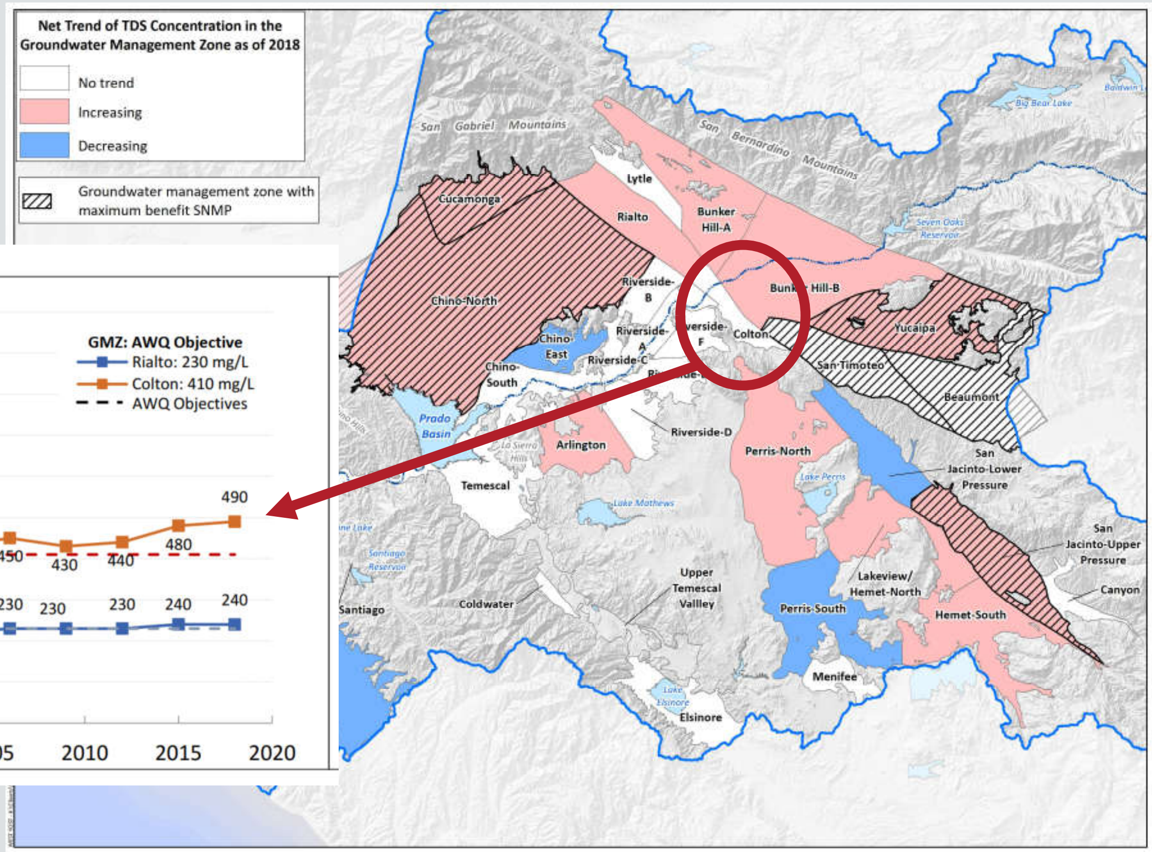
Trend Analysis

- Only considers the 20-year period of analysis, not longer term trends
- When only looking at key wells, sometimes well trend don't match AWQ trends



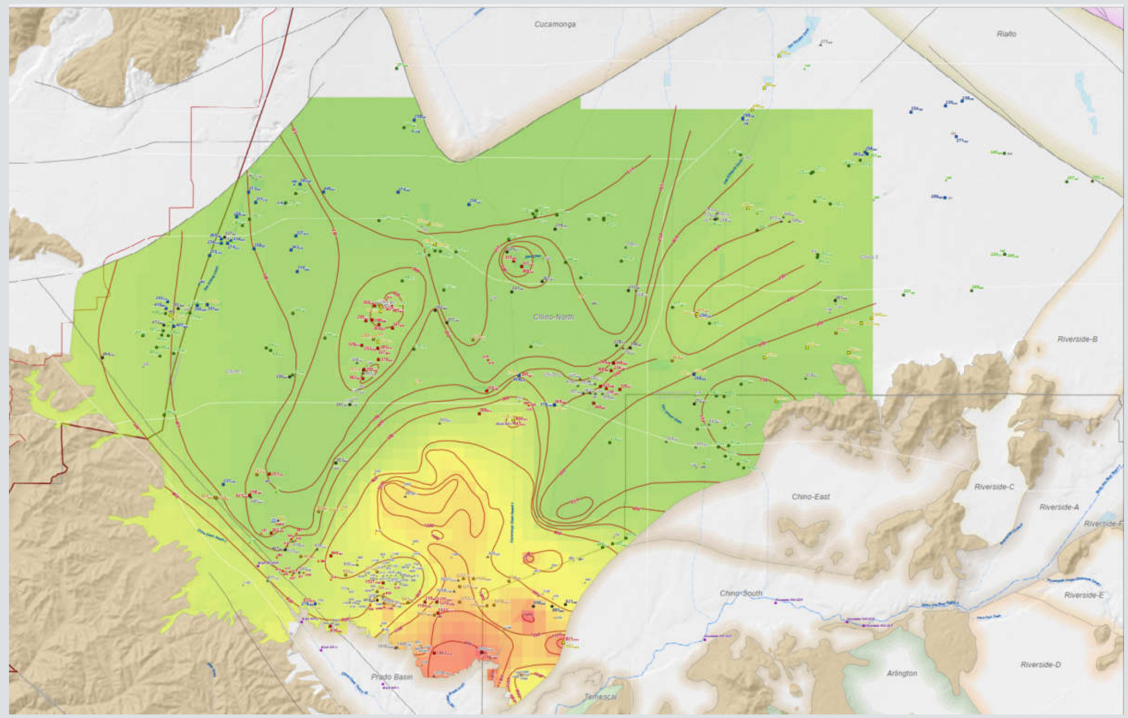
Challenges with Data and Statistics





Challenges with Data and Statistics

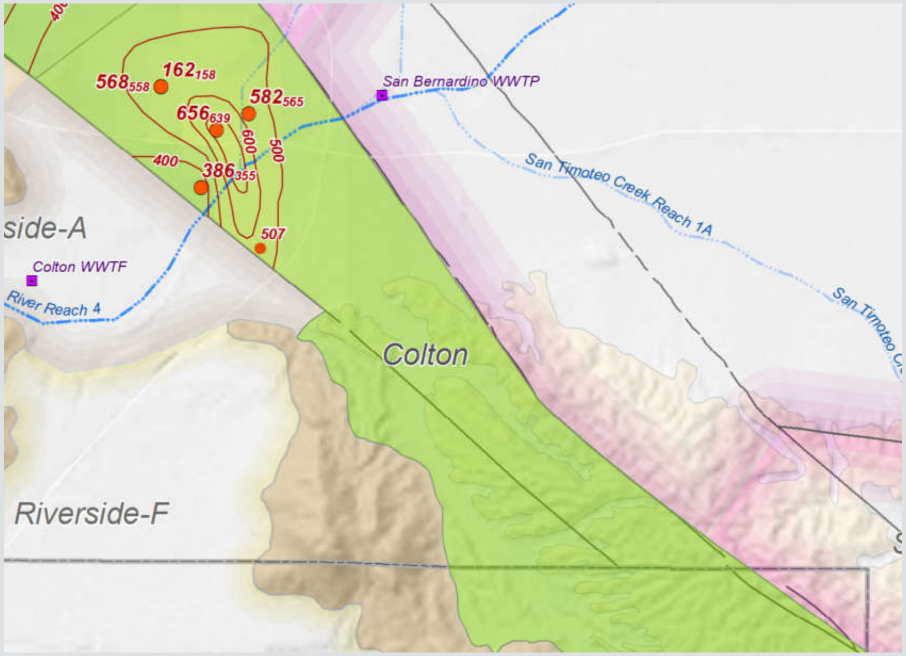
- There is ***a LOT*** of data
  - Difficult to standardize contouring approach
  - No attribution to new vs old data
  - Prioritization of old statistics vs recent data with averages only
  - Default assumption to honor contours in areas where wells lost
  - Mistakes are more likely
    - Examples



Source: WSC, 2020 (Attachment B)

Challenges with Data and Statistics

- In some places there is ***very little*** data, same problems?
  - Difficult to standardize contouring approach
  - No attribution to new vs old data
  - Prioritization of old statistics vs recent data with averages only
  - Default assumption to honor contours in areas where wells lost

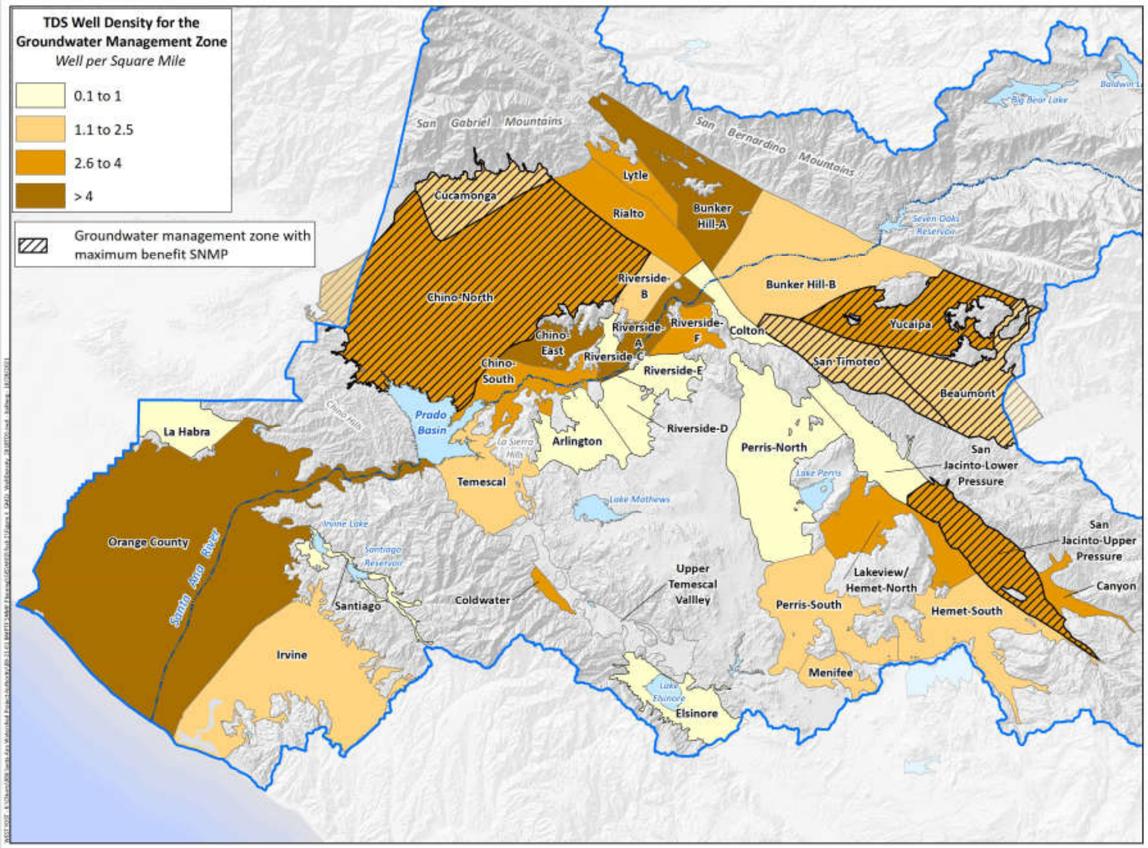


Source: WSC, 2020 (Attachment B)

Challenges with Data and Statistics

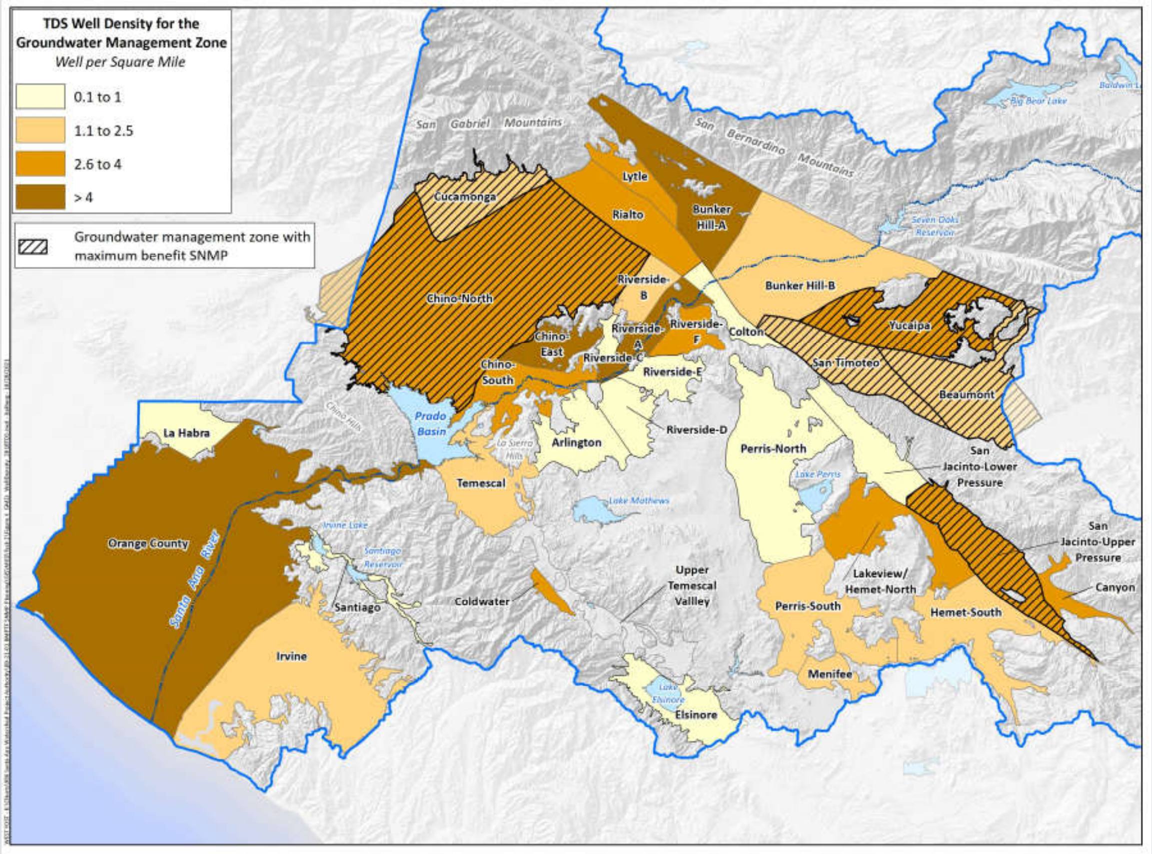
- The data we have…

  is what we have
- Well attrition analysis alone has not successfully yielded increase in monitoring needed
- Basin Plan requirement to prepare monitoring program



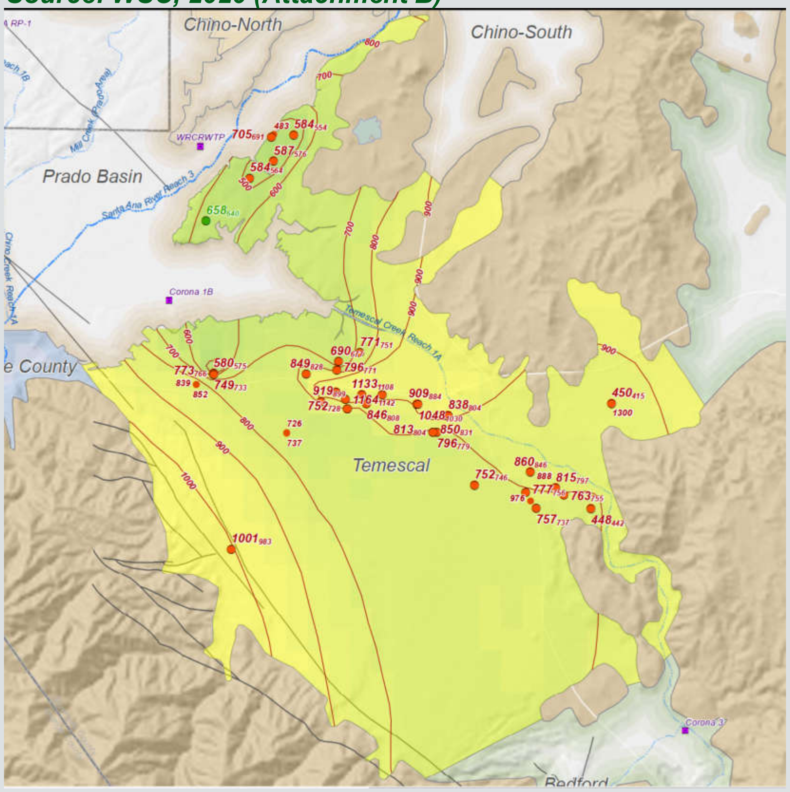
Challenges with Data and Statistics

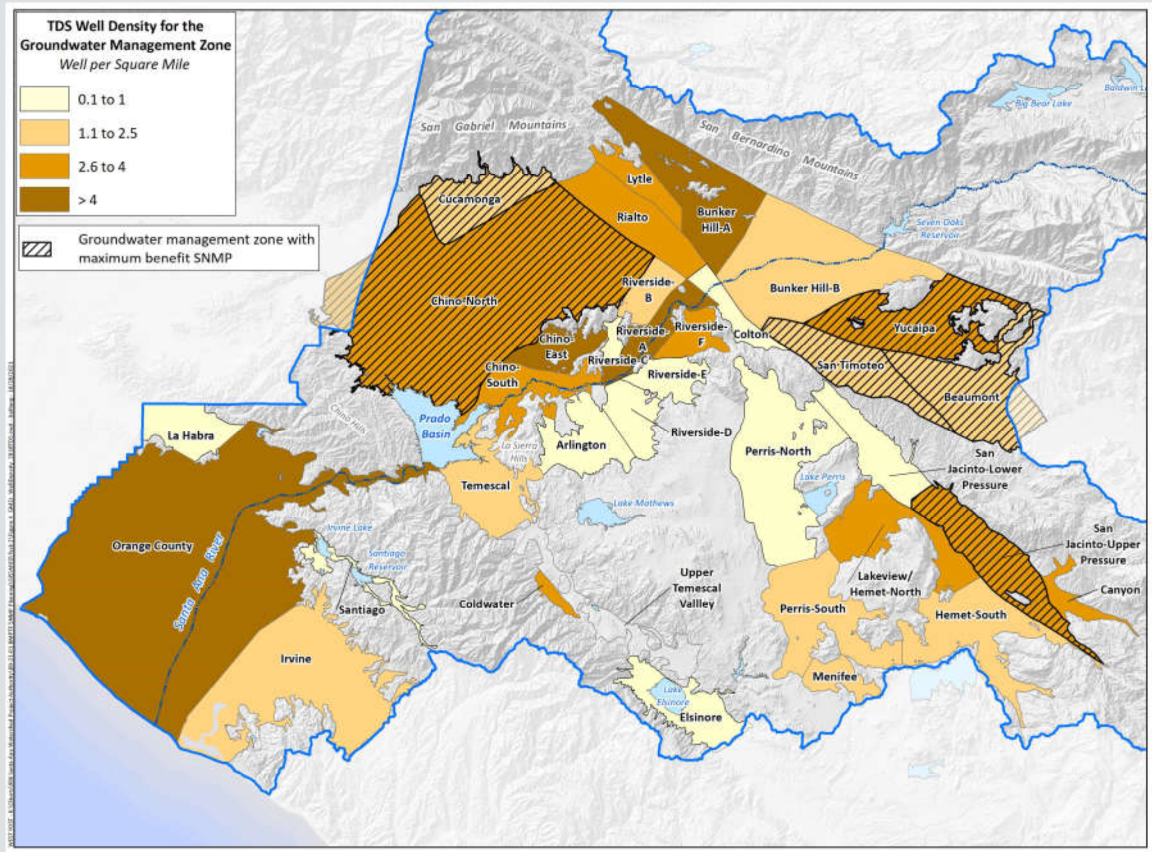
- What is the right density of data?



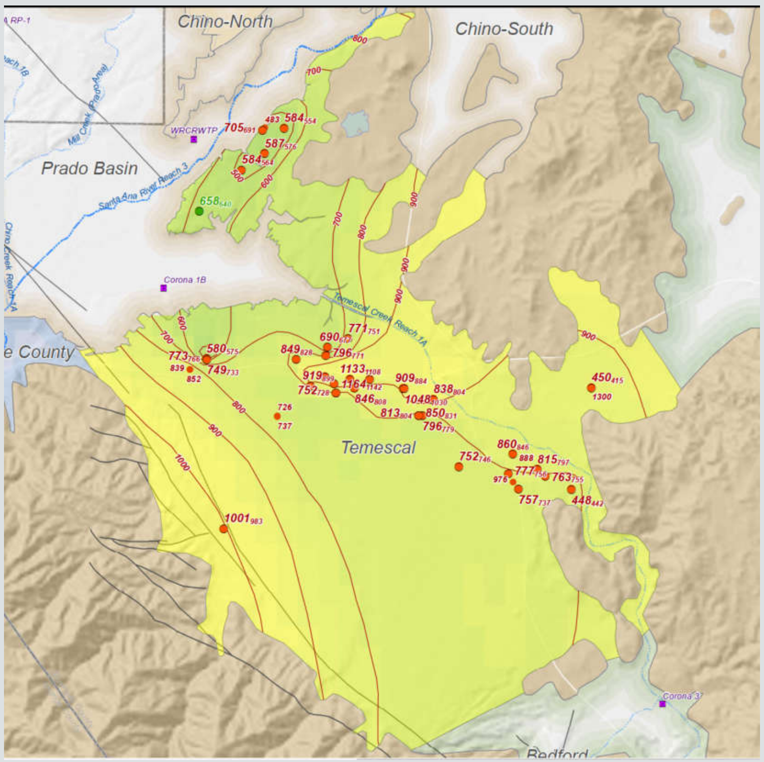
Challenges with Data and Statistics

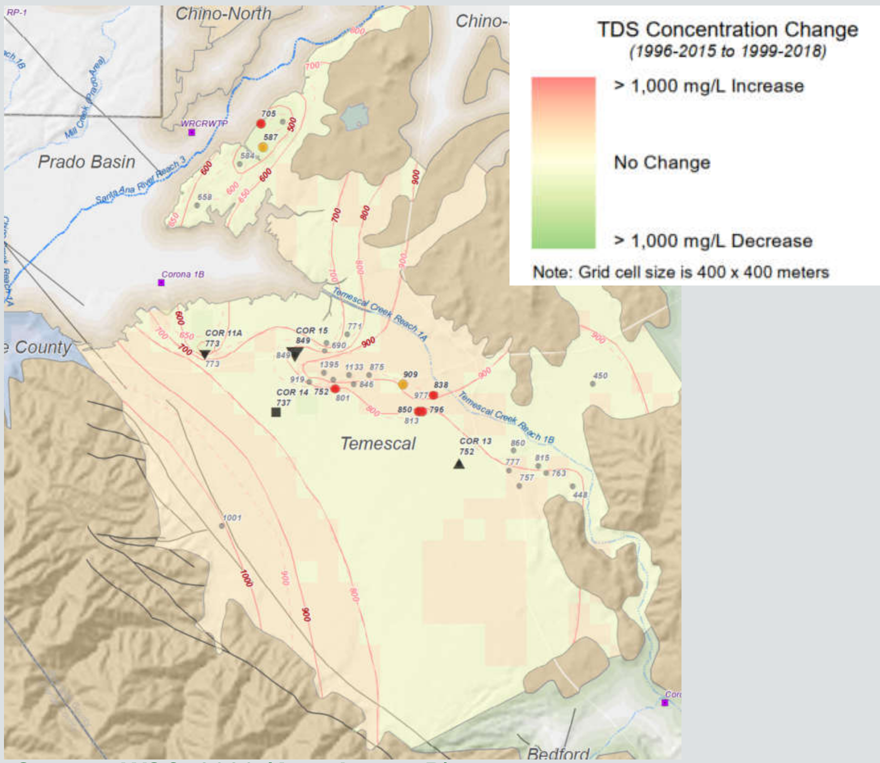
Source: WSC, 2020 (Attachment B)





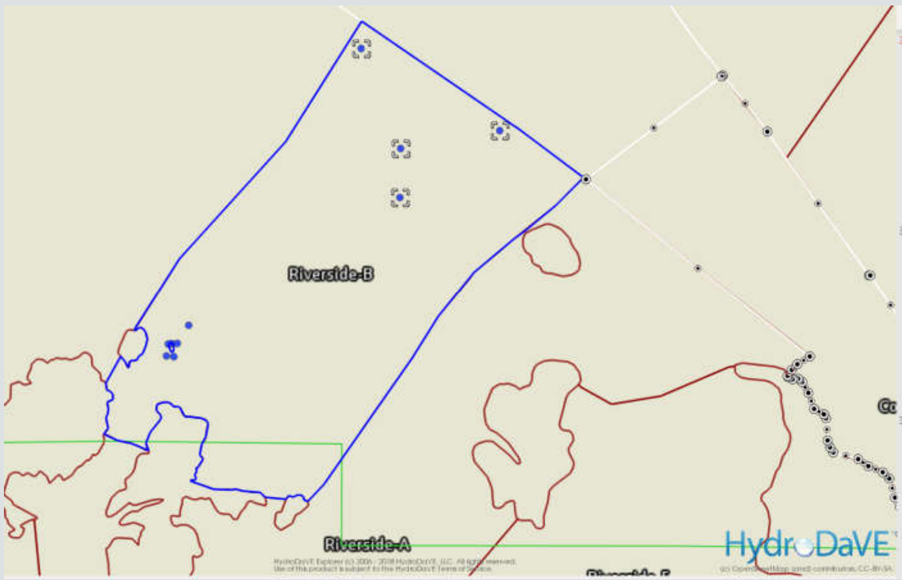
Challenges with Data and Statistics Interpretation in areas with no data





Source: WSC, 2020 (Attachment B)

Challenges with Data and Statistics Interpretation in areas with limited data



- 10 wells with TDS statistics
- But…
  - Six are landfill wells in small cluster
  - 2 may no longer be actively sampled
- How to fill these data gaps?

Questions for Consideration in Ongoing Methods and Data Collection

- Is all data good data?
  - Should we reduce the analysis to a set of key wells that MUST be monitored?
  - Should we include landfill monitoring wells? If so, which ones?
- How do we prioritize addressing data gaps?
- Should the high TDS concentrations along the Pacific Coast of Orange County GMZ be included in the ambient concentration – especially in light of regional groundwater management actions to address seawater intrusion?
- Should we continue to rely on a 20-year period of record? If so, what improvements could be considered:
  - Should we prioritize wells with recent data (over any data within analysis period)

What Questions do you have?

- ???

Next Presentation

Date	Workshop Topic
August 2021	Overview of Recycled Water Policy – SNMP Monitoring and Analysis Requirements
October 2021	Critical Analysis of SAR SNMP Ambient Water Quality and Alternative Methods to Comply Pt. 1: What Have We Learned in 17 years of Implementation?
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June 2022	Final Work Plan Review

THANK YOU

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WE SUPPORT OUR COMMUNITIES

WE ARE WATER FOCUSED

WE TAKE PRIDE IN WHAT WE DO

WE DO WHAT'S RIGHT

WE STRIVE TO BECOME OUR BEST

WE BELIEVE IN QUALITY

WE LISTEN

WE SOLVE HARD PROBLEMS

WE SEE THE BIGGER PICTURE

WE TAKE OWNERSHIP

WE COLLABORATE

WE HAVE FUN

WE ARE WEST YOST

WEST YOST
Water. Engineered.

New Basin Plan Requirement (Draft)

- Groundwater Monitoring Program

  No later than August 1, 2022 ... [the Task Force Members] … shall submit to the Regional Board for approval, an updated watershed-wide TDS and nitrogen monitoring program that will provide the data necessary to implement the TDS/nitrogen management plan. Data to be collected and analyzed shall address a minimum

  (1) determination of current ambient quality in groundwater management zones;

  (2) determination of compliance with TDS and nitrate-nitrogen objectives for the management zones;

  (3) evaluation of assimilative capacity findings for groundwater management zones;

  (4) assessment of the effects of recharge of surface water POTW discharges on the quality of affected groundwater management zones; and

  (5) ***any other requirements specified in the State Water Board's Recycled Water Policy*** (Resolution No. 2018-0057)

New Basin Plan Requirement (Draft)

- Ambient Water Quality

  The determination of current ambient quality can be accomplished using the method consistent with that employed by the N/TDS Task Force (20-yr running average) to develop the TDS and nitrogen water quality objectives included in the Basin Plan***, or an alternative method approved by the Executive Officer of the Regional Board***. The determination of current ambient groundwater quality throughout the watershed must be reported by October 1, 2023, and, at a minimum, ***every five years thereafter*** unless the Regional Board revises this schedule.

Purpose of the Ask

- Monitoring program hasn't been updated since 2005
- Past recommendations to revise ambient water quality methods
- 2019 Recycled Water Policy (Policy) Amendments
    - Requires the Regional Board and Task Force to address more than just the monitoring program and ambient water quality methods
    - Monitoring program and ambient water quality are elements program identified as an early target for the RB in complying with the 2019 Policy amendments

Objectives and Approach

Our objective is to develop monitoring and reporting specifications that:

- Create compliance with applicable regulations
  (Basin Plan objectives; Recycled Water Policy)
- Leverage regulations to create flexibility in assessment methods
- Leverage regulations to reduce frequency and cost of future assessments
- Are clear and actionable, with a time-certain schedule to perform compliance actions

Our approach is to start with the end in mind →compliance with 2019 Recycled Water Policy

Five-Year Assessments

Section 6.2.6 of Policy

The regional water boards, in consultation with stakeholders, shall assess and review monitoring data generated from [the SNMP] every five years, unless an alternate timeline has been established in a basin plan amendment. The assessment shall include an evaluation of:

1. Observed trends in groundwater salinity with the predicted trends from the SNMP
2. The ability of the monitoring network to adequately characterize groundwater quality in each GMZ and
3. Potential new data gaps
4. The ability of any relied-upon models to adequately simulate groundwater quality
5. Available assimilative capacity based on observed trends and the most recent water quality data
6. The impact of new projects that are reasonably foreseeable at the time of the assessment

SNMP Monitoring Plan Requirements

Section 6.2.4.1 of Policy

- The monitoring plan must be designed to effectively evaluate water quality in the basin. The monitoring plan must focus on:
  - water supply wells,
  - areas proximate to
    - large water recycling projects, particularly groundwater recharge projects, and
    - other potential sources of salt and nutrients identified in the salt and nutrient management plan.
  - Also, monitoring locations shall, where appropriate, target groundwater and surface waters where groundwater has connectivity with adjacent surface waters.

Five-Year Assessments: Do we have the information and protocols needed?

		Triennial AWQ	Maximum Benefit SNMPS	Cooperative Agreement Modeling	WDR Salt Offset Programs
1	Compare observed trends in groundwater salinity with the ***predicted trends*** from the SNMP		✓	✓	
2	The ability of the monitoring network to adequately characterize groundwater quality in each GMZ	✔			
3	Potential new data gaps	✔			
4	The ability of any relied-upon models to adequately simulate groundwater quality		✓	✓	
5	Available assimilative capacity based on observed trends and the most recent water quality data	✔	✓		
6	The impact of new projects that are reasonably foreseeable at the time of the assessment		✓	✓	

Advancements to Consider

- Mapping of loading factors
- Selection of key wells rather than all wells available
- Applying tiered AWQ analysis approach to focus higher-cost efforts in most critical areas and simplify in other areas
- Five-year reporting