# Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin

*December 13, 2016*
*Napa County Board of Supervisors*

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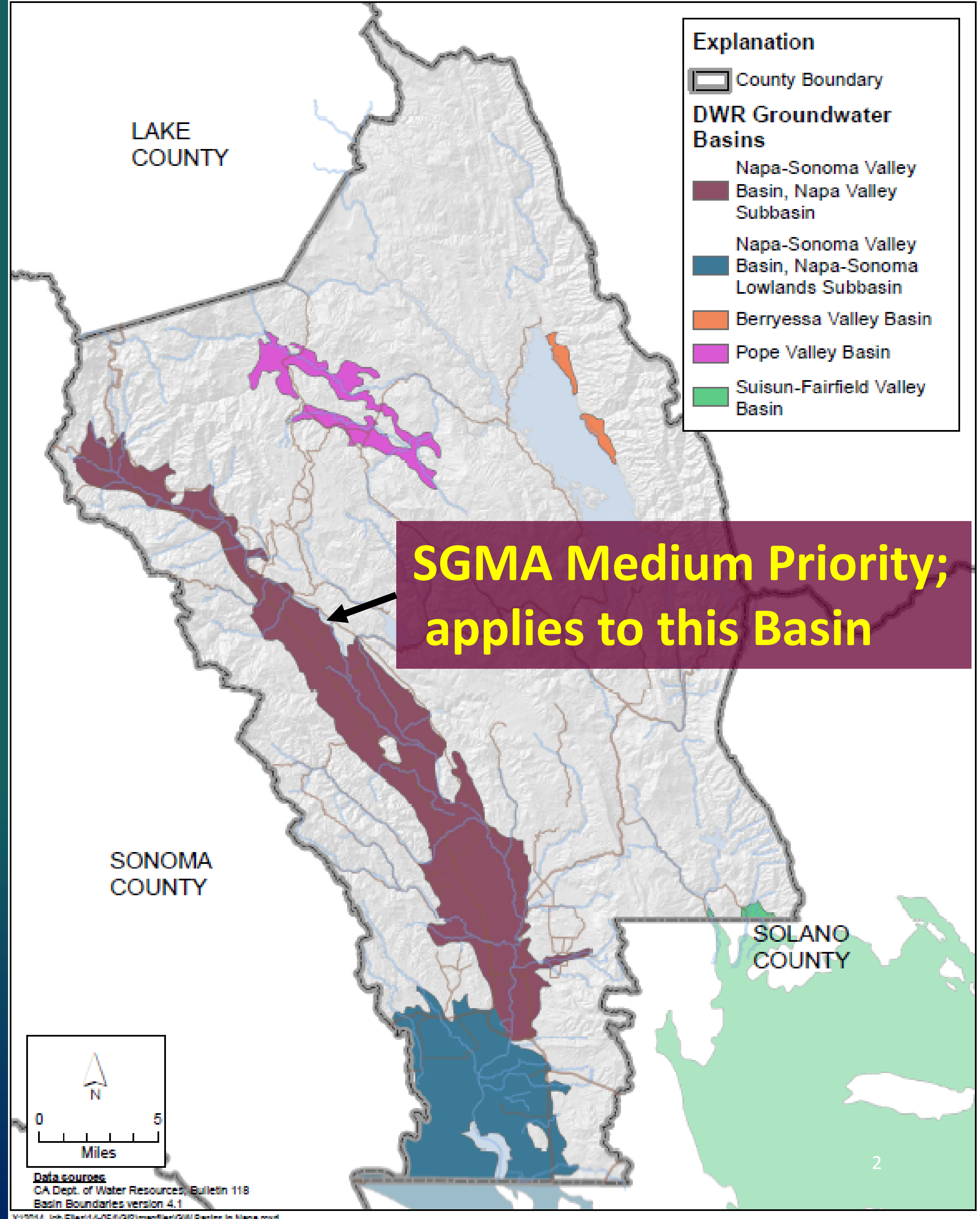
# Basin Analysis Report: Napa Valley Subbasin

- Napa Sonoma Valley Basin
    - **Napa Valley Subbasin**
    - Napa-Sonoma Lowlands Subbasin




**SGMA Medium Priority; applies to this Basin**

# Basin Analysis Report Contents

* Presentation Highlights

1. Introduction
2. Physical Setting and Hydrogeology
3. Monitoring Network and Program
4. Groundwater and Surface Water Conditions*
5. Historical, Current and Projected Water Supply*
6. Sustainable Yield Analysis*
7. Napa Valley Subbasin Sustainability Goals*
8. Monitoring Data Management and Reporting
9. Sustainable Groundwater Management*
10. Findings and Recommendations*

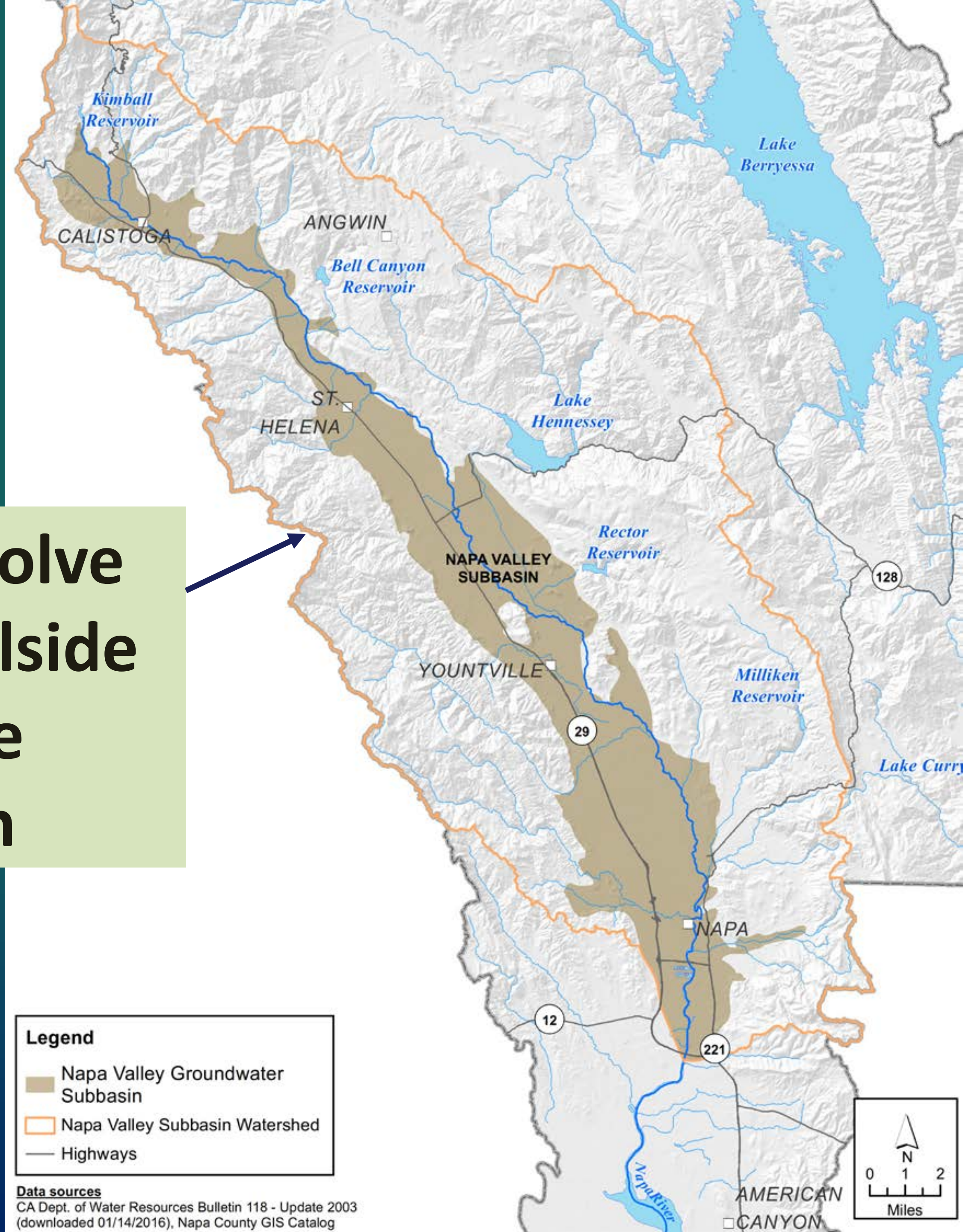
Appendices

# SGMA Basin Analysis Report

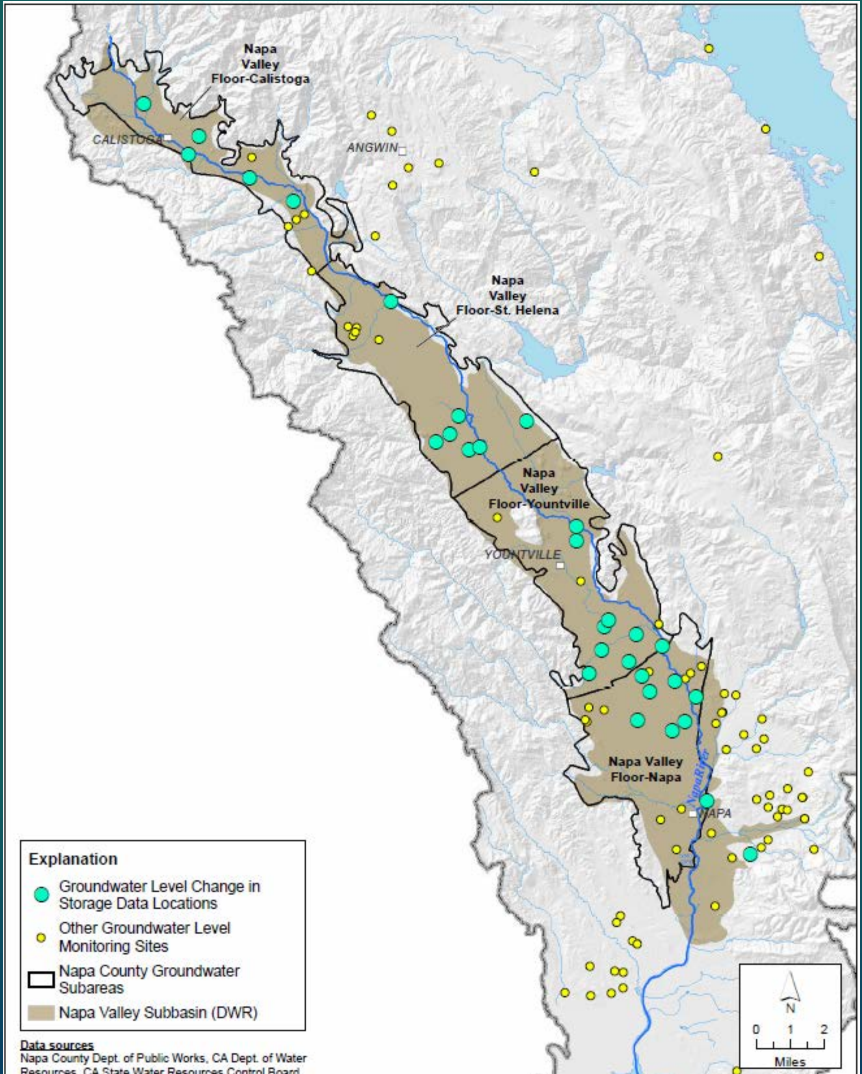
- **What it is:**
  - Functionally equivalent to a Groundwater Sustainability Plan
    - Report Table 1-2 shows comparison
  - For basins operated sustainably for at least 10 years
  - Covers the whole DWR-designated Subbasin
    - Water budget for Subbasin includes hydrologic components for the watershed
  - Conditions typical throughout the basin

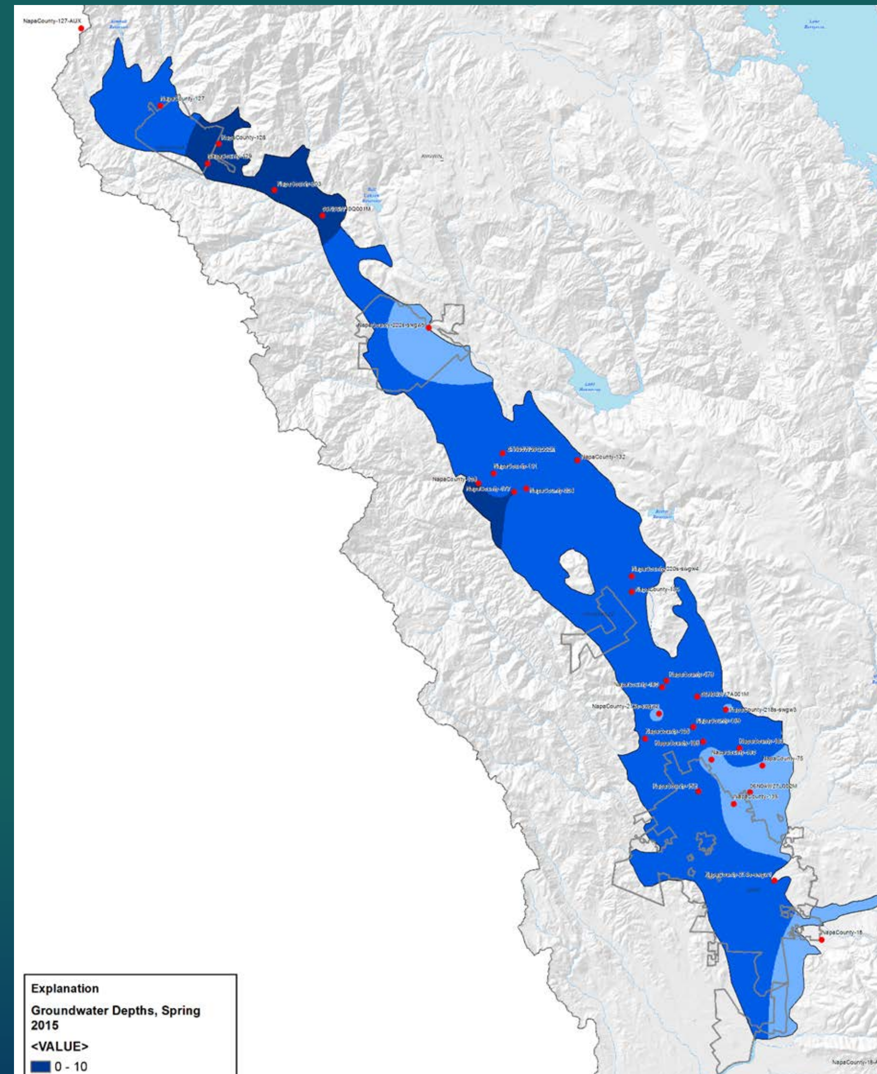
# Water Budget Area: Napa Valley Subbasin

**Water budgets involve the watershed (hillside inputs) not just the groundwater basin**



# Scale of Analysis: Napa Valley Subbasin




Sustainable Yield Analysis Addresses **Subbasin Scale**

Not Well or Parcel Scale

# SGMA Basin Analysis Report

- **What it is not:**
  - Not the whole County
    - *However, the County GW Monitoring efforts extend beyond the Subbasin*
  - Not the upper watershed, MST, or Carneros areas
  - Does not require return to pre-development conditions
  - Does not focus on very local groundwater problems (like well interference)

# Basin Analysis Report - Background

- Builds on technical work underway **since 2008** (from Table 1-1)
  - Napa County General Plan Update (2008)
  - Napa County Groundwater Conditions and Groundwater Monitoring Recommendations (2011)
  - Updated Hydrogeologic Conceptualization and Characterization of Conditions (2013)
  - Napa County Groundwater Monitoring Plan (2013)
- Technical equivalence to the elements of a SGMA Groundwater Sustainability Plan

# Comments Received to Date

- Comments received through November 21
- Comment topics have included:
  - Scope of monitoring efforts
  - Concerns about groundwater level declines and changes in summer baseflow conditions
  - Influence of hillside development on the Subbasin watershed, including water budget considerations such as surface water runoff and recharge
- Revisions to Draft Report in response to comments
  - Detailed Response to Comments table

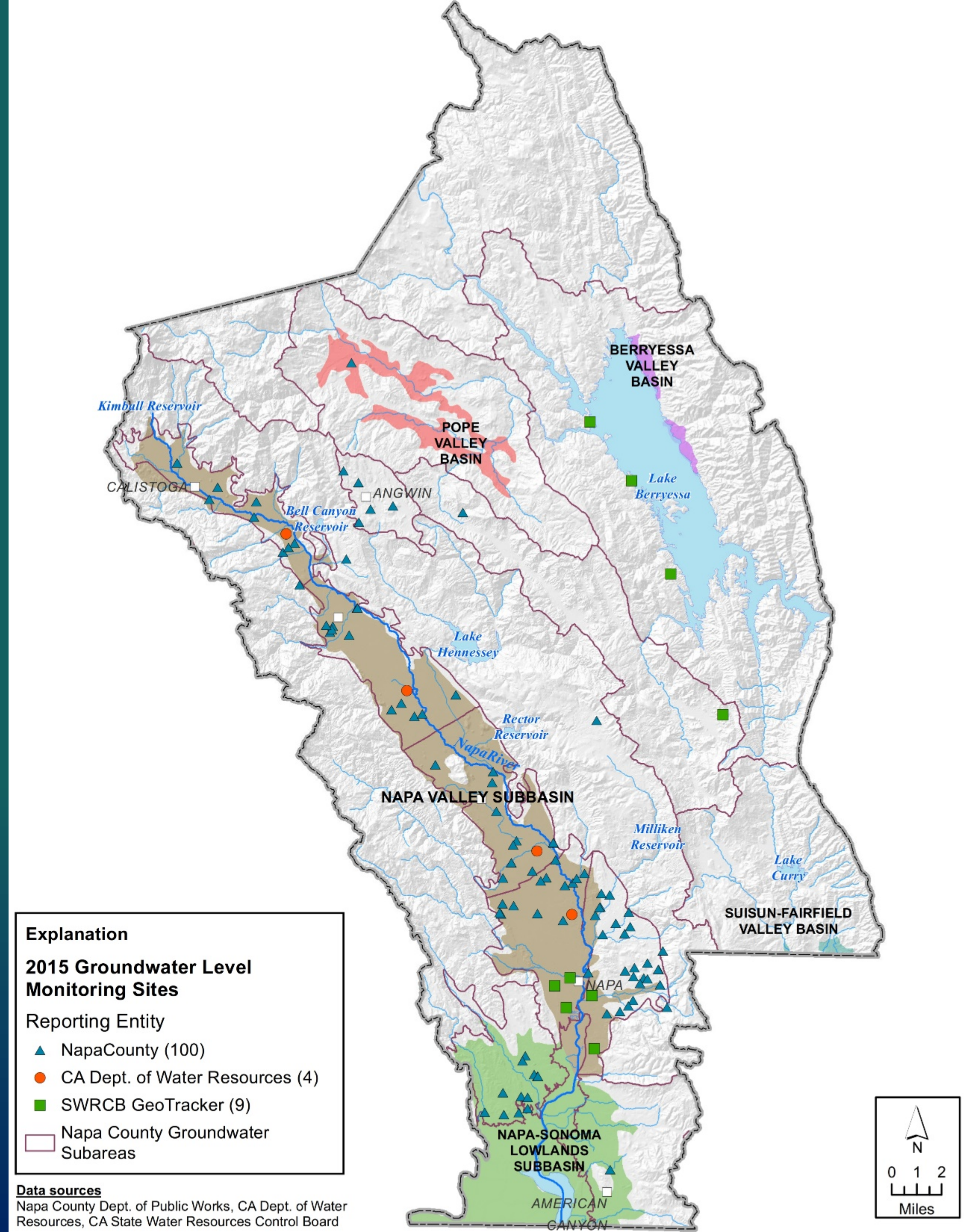
# Groundwater and Surface Water Conditions (Ch. 4)

# Groundwater Level Monitoring

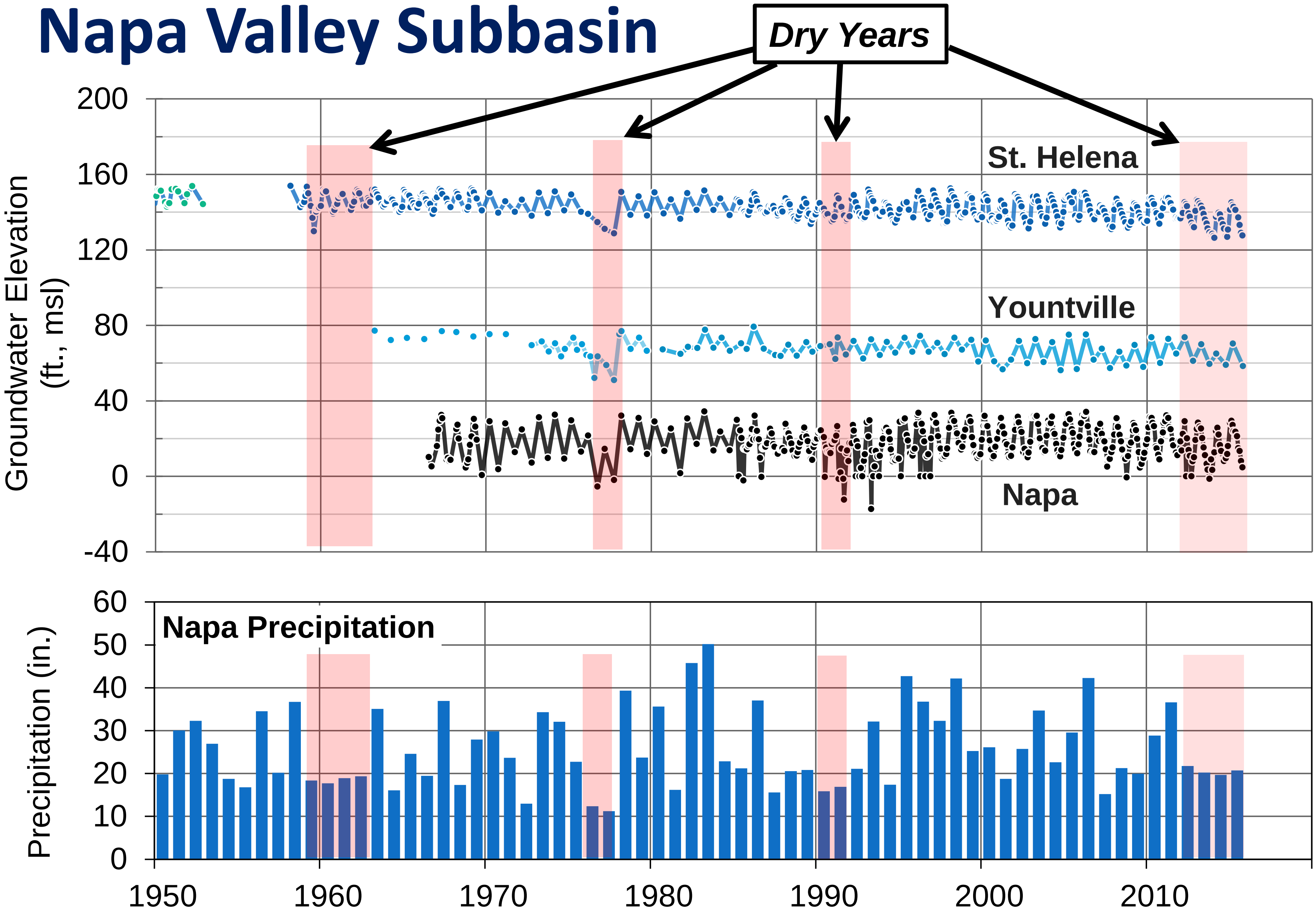
- Napa Co., 100 (includes 48 volun., 10 SW/GW)
- DWR, 4
- GeoTracker, 9

Total Wells = 113 Sites

**Ongoing network enhancements.**



# Groundwater Conditions: Napa Valley Subbasin

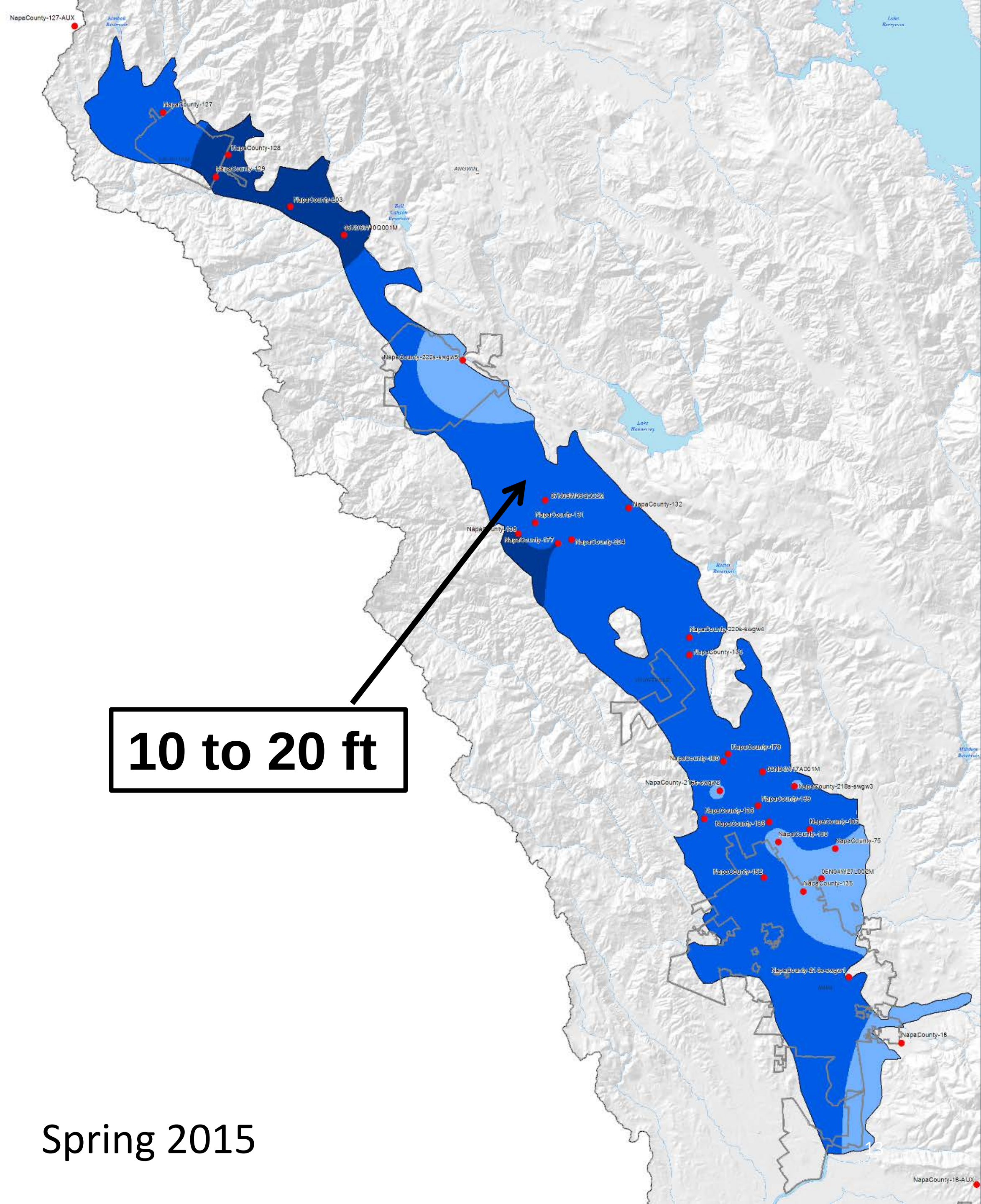


# Depth to Groundwater

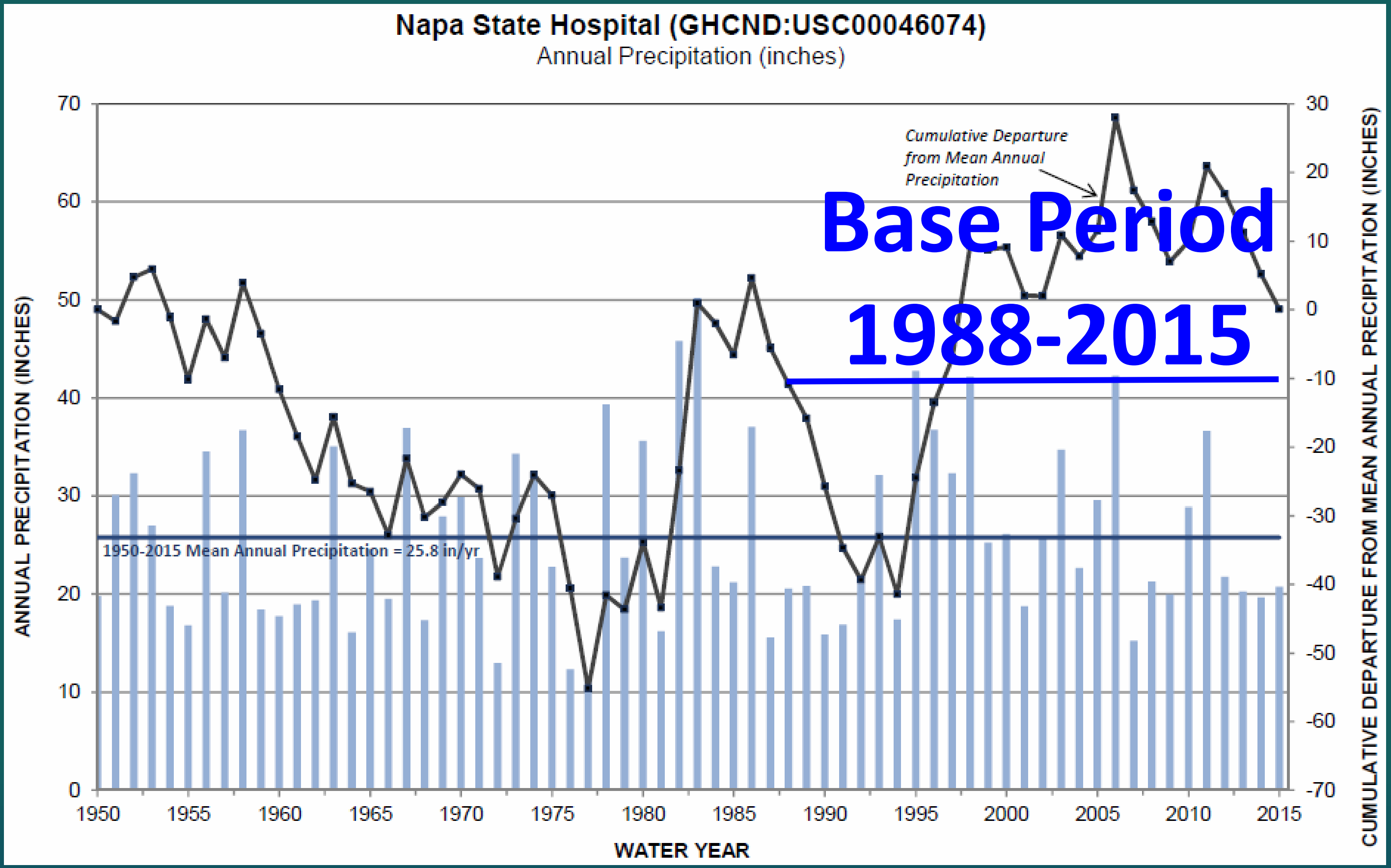
Feet below ground surface

- 0 - 10
- 10.01 - 20
- 20.01 - 30

***Water table (Valley Floor) generally very shallow; basin quite "full"***



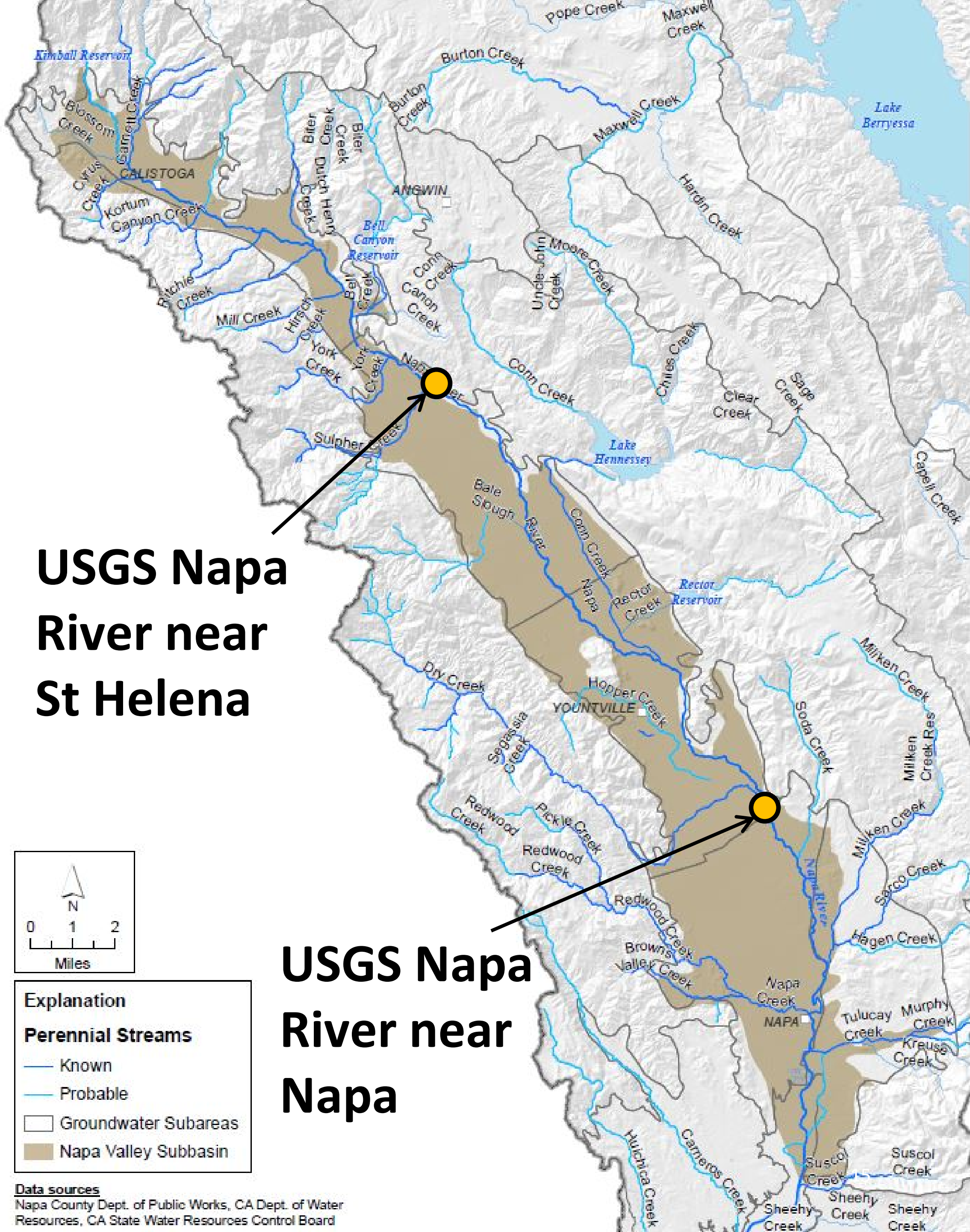
# Hydrologic Base Period (Study Period): 1988-2015




- Antecedent Dry Conditions
- Stable Cultural Conditions (Water Supply Sources; Land Use)
- Mix of Wet and Dry Water Year Types
- Similar Water Year Types at Start and End

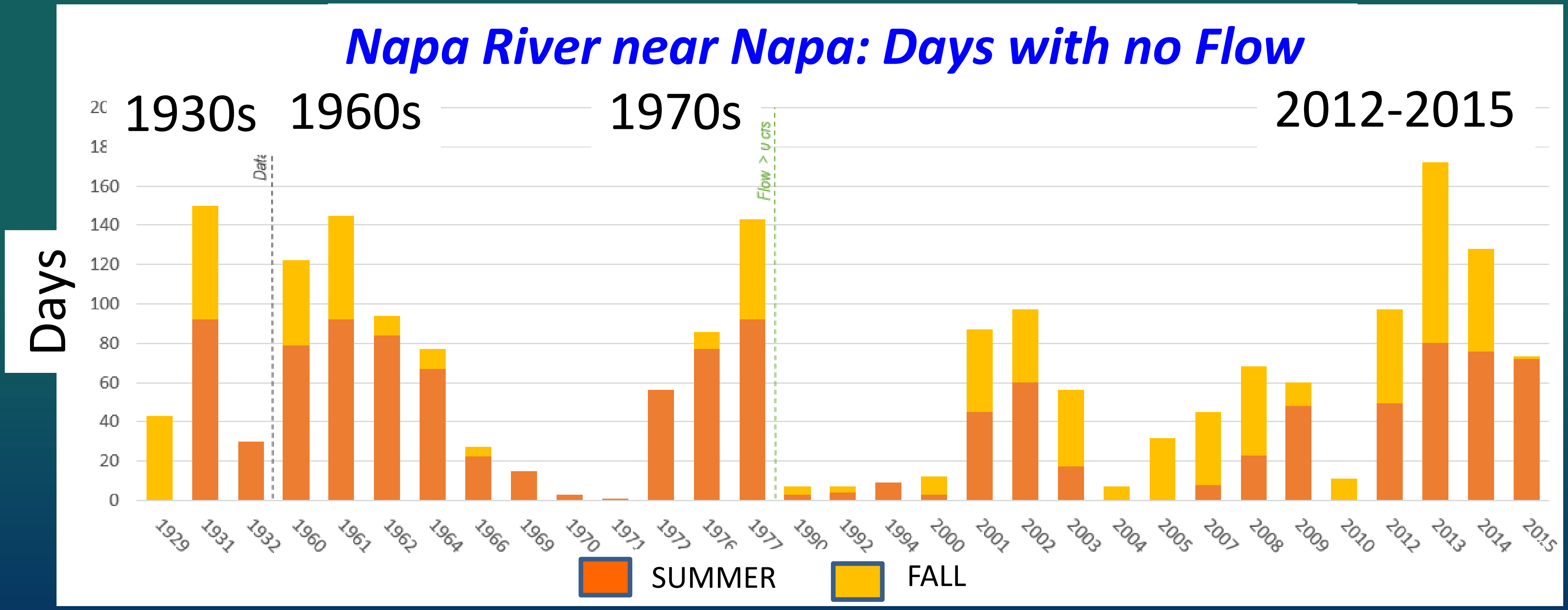
# Groundwater Interactions with Surface Water

- Perennial Streams Recharge the Napa Valley Subbasin
- Groundwater contributes to stream baseflow; varies temporally & spatially



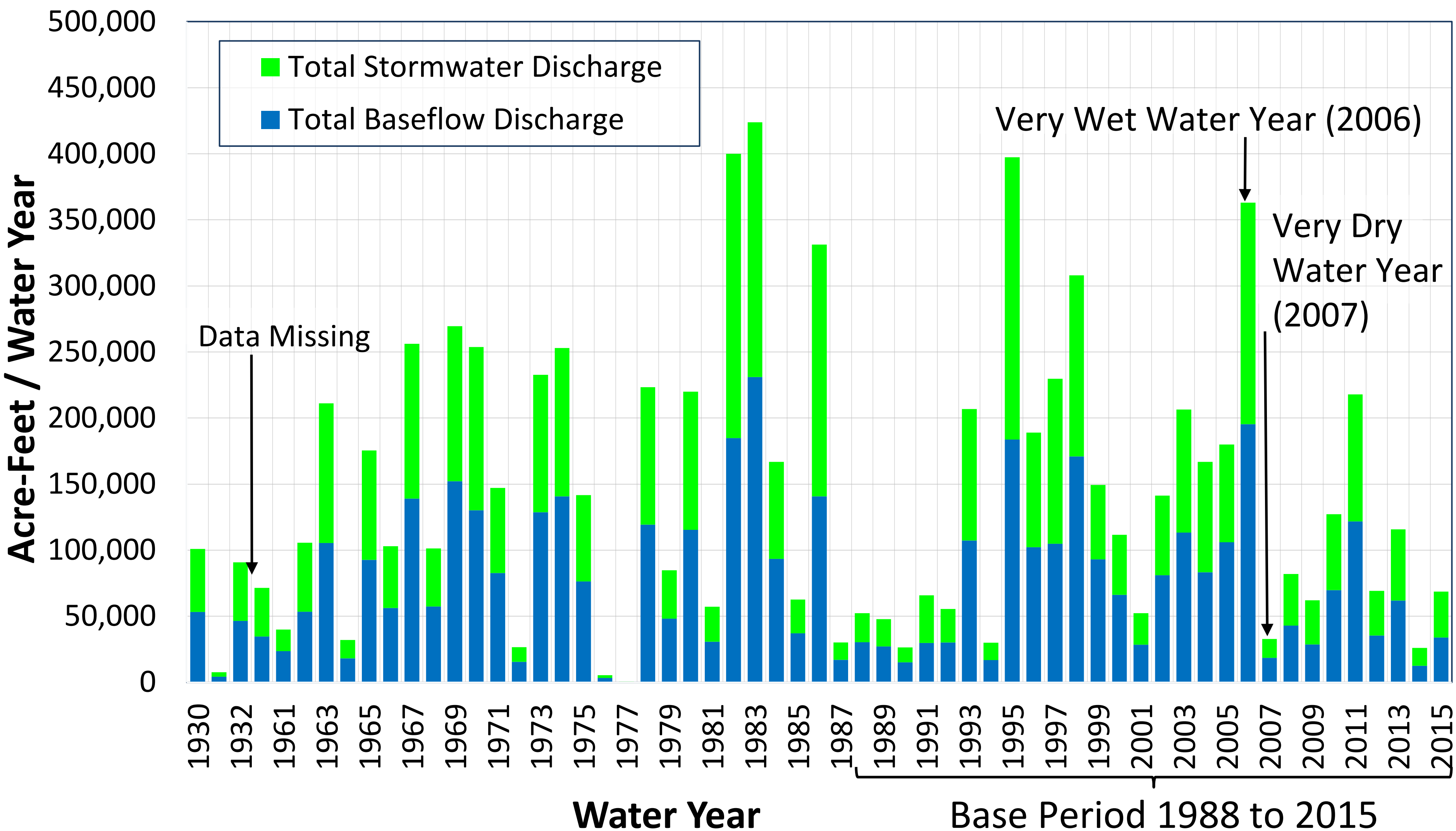
# Historical to Current Streamflow Observations

- Historical streamflows in Napa Valley varied considerably season-to-season & year-to-year (USGS WRI 13-73, 1973)
- Historical data show no to low flow days dating back to the 1930s



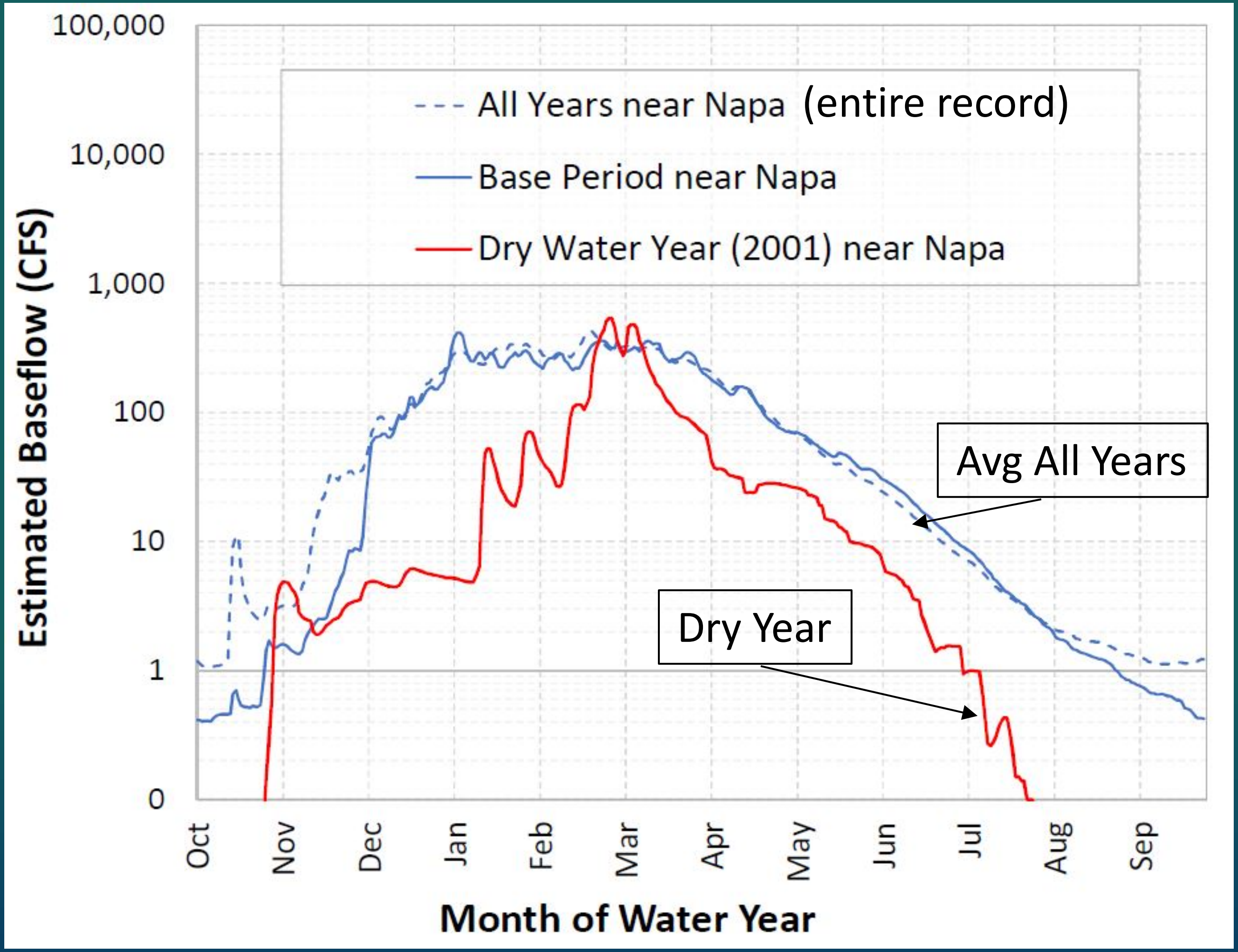
# Total Baseflow (GW) & Stormflow

## (Napa River Near Napa)



# Average Napa River Baseflow

## (Napa River near Napa)




**Baseflow estimate is calculated from stream gage data. Historical seasonal variations in flow are typical.**

# Statistical Analyses Related to Baseflow

## Relationships between:

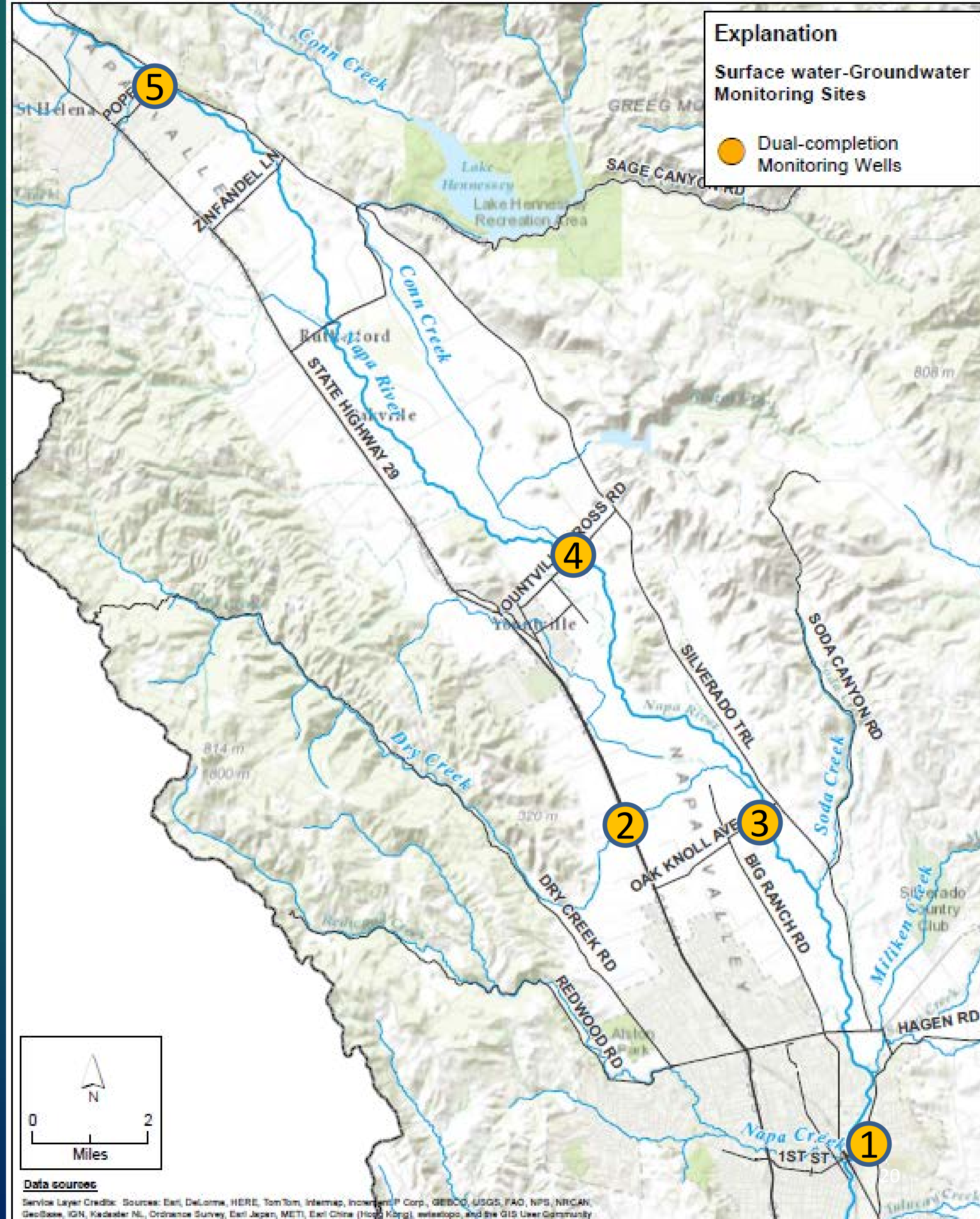
## Baseflow — Precipitation — GW Levels — Pumping

- Long precipitation and GW level records compared to periods of little to no flow in the River
  - Flow conditions historically and recently continue to correlate with annual precipitation and GW levels near the River
- Relationship also occurs between pumping and baseflow during 1988-2015; similar results for 1995-2015
- Multiple regression analysis performed to assess degree to which precipitation and pumping together correlate with low baseflow
  - Precipitation influence: 79%
  - Pumping influence: 21%

# Surface Water/ Groundwater

## Monitoring at 5 Sites

- Shallow MWs each site
  - Levels & quality
- Stream gauge each site
  - Stream level & quality



# GW Monitoring Wells Near River

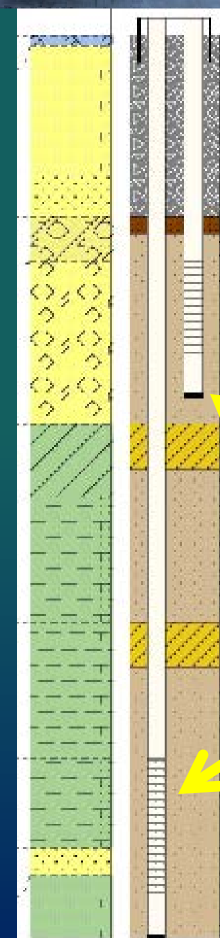
**Above Ground**

Locked Protection

Below Ground

"Nested"

Monitoring Wells

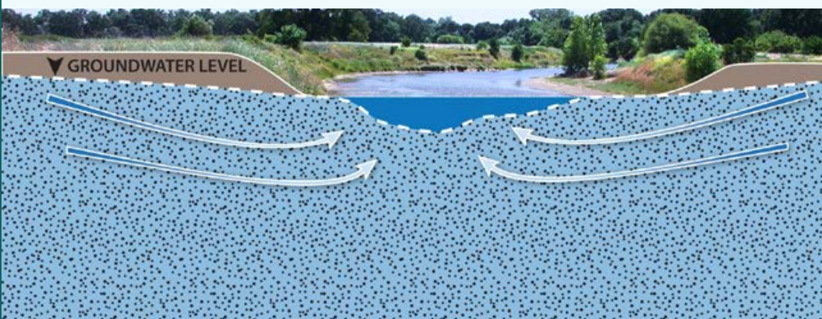



Looking Down at MWs

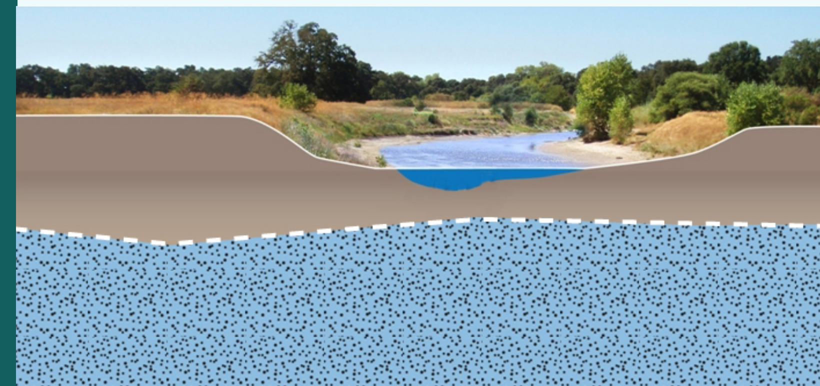

*Not to Scale*

# SW/GW Interaction

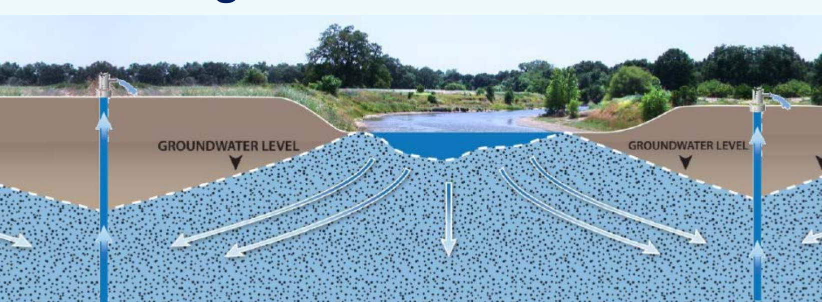
## Direct Connection
## Maintains/Discharges to Stream (Groundwater Baseflow)



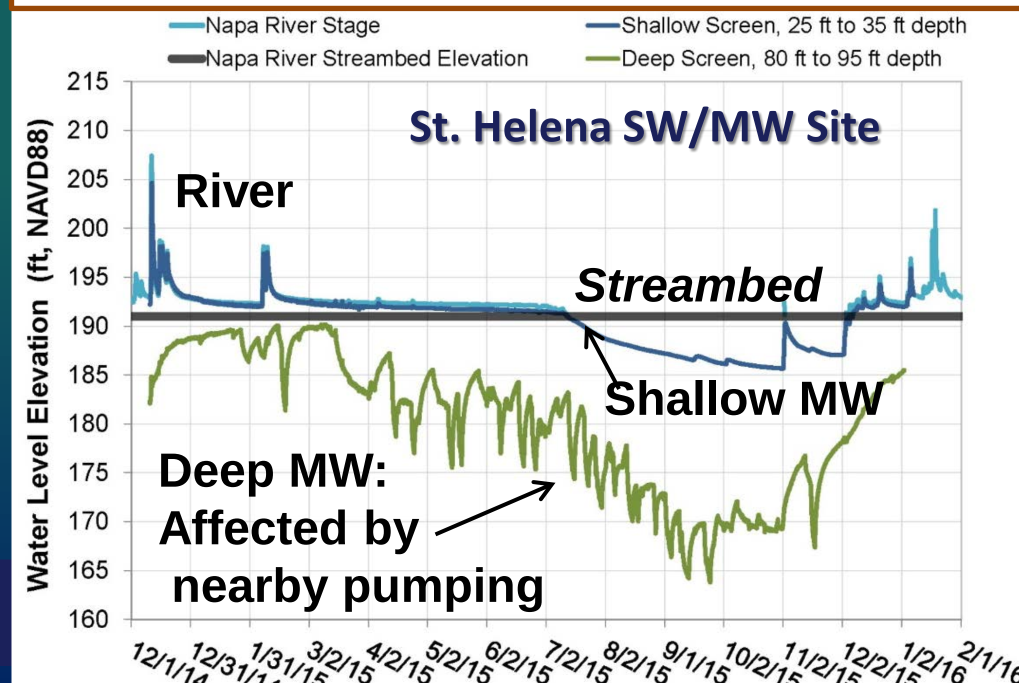

## Indirect Connection
## Stream Seepage Independent of GW Levels



## Groundwater Pumping
## Stream Loses Water/ Recharge to GW




River and Shallow MW not exhibiting short- term pumping effects

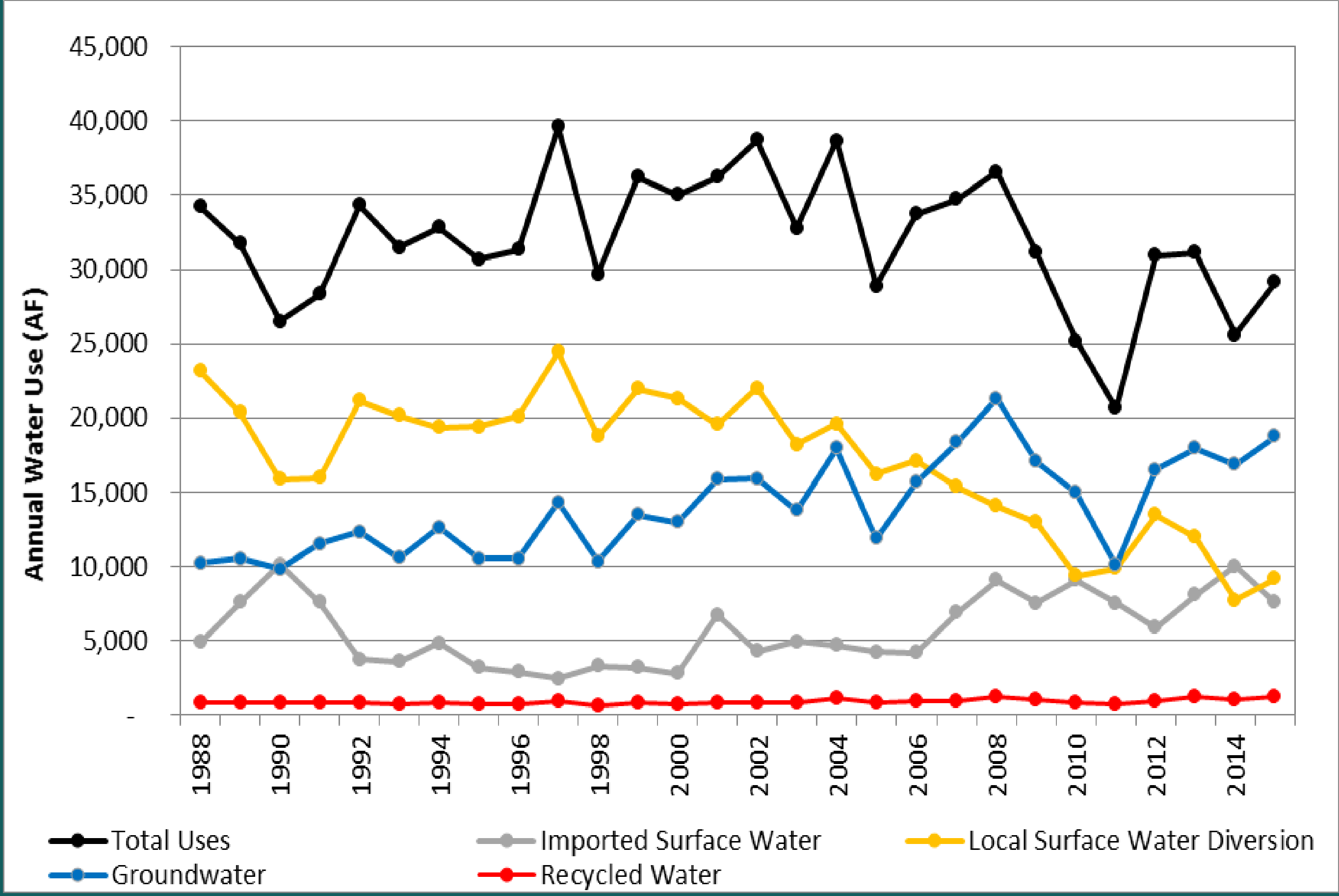



*Courtesy TNC*

# Groundwater/Surface Water Summary

- Overall, groundwater conditions stable
- Shallow depth to groundwater in the Valley Floor; the basin is quite “full”
- Historical streamflows varied considerably season-to-season and year-to-year
- Groundwater (baseflow) contributes to the total volume of streamflow
- Average annual recharge approx. 4X > pumping
- Napa River system is hydrogeologically sensitive to climatic and seasonal variations and other factors that change the water balance

# Total Subbasin Water Use (In Ch 5)




- Total water use generally stable 1988-2015.
- GW use has increased.
- Use of SW diverted from within the Subbasin or by muni reservoirs in the Subbasin watershed has decreased by ~ half from 1988-2015.

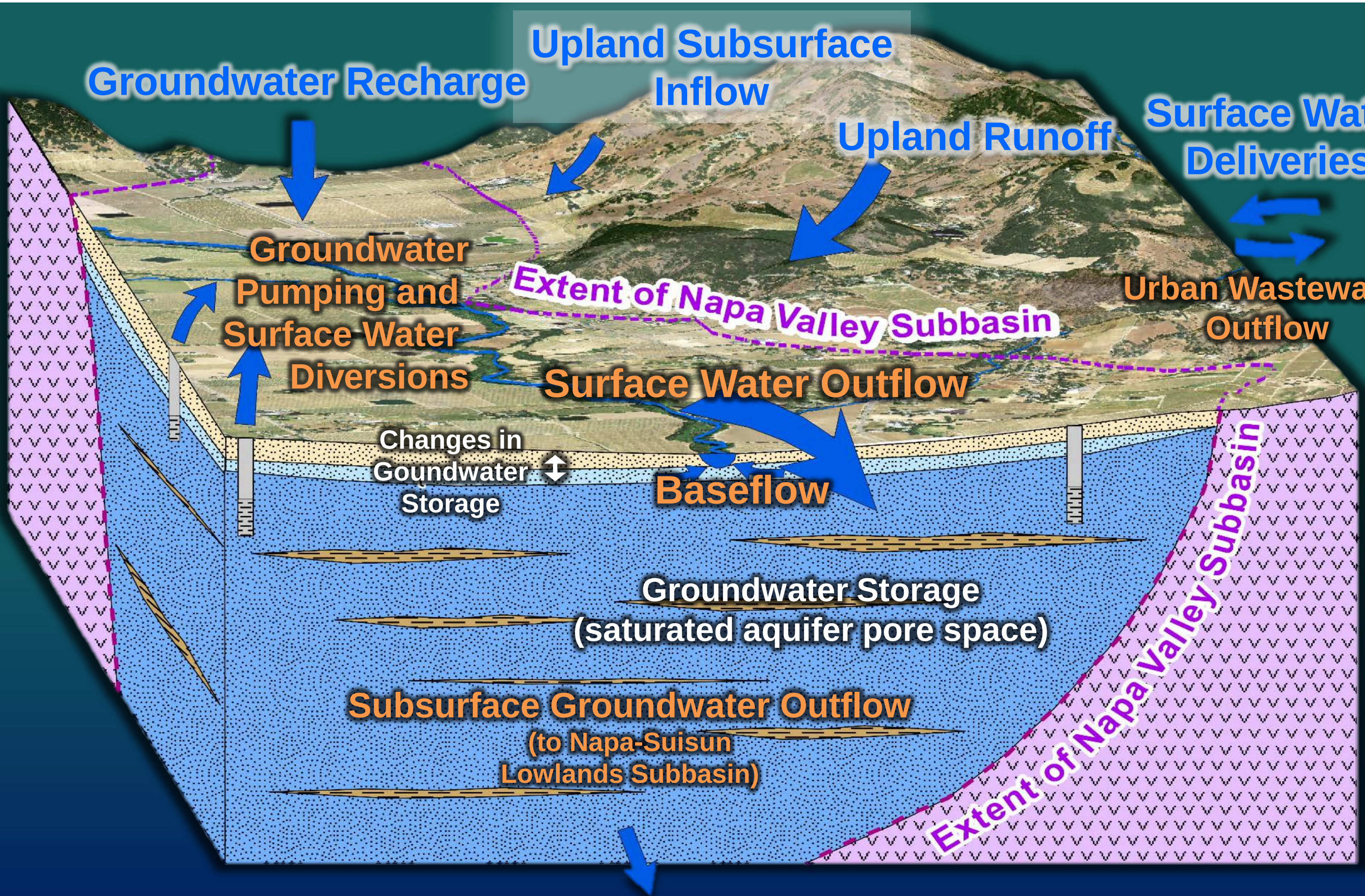
*Data sources: Basin Analysis Report Root Zone Model, City of Calistoga, City of Napa, City of St. Helena, Town of Yountville, NCFCWCD, and Napa San. Dist., with additional calculations based on U.S. Census Bureau population data and Napa County Winery Permit records.*

# Sustainable Yield Analysis (Ch. 6)

(Two Independent Methods of Analysis)

# Water Budget:
# Core Element of Groundwater Sustainability

***Inflows* – *Outflows* = $\triangle$*S* *Change in GW Storage***



# Sustainable Yield

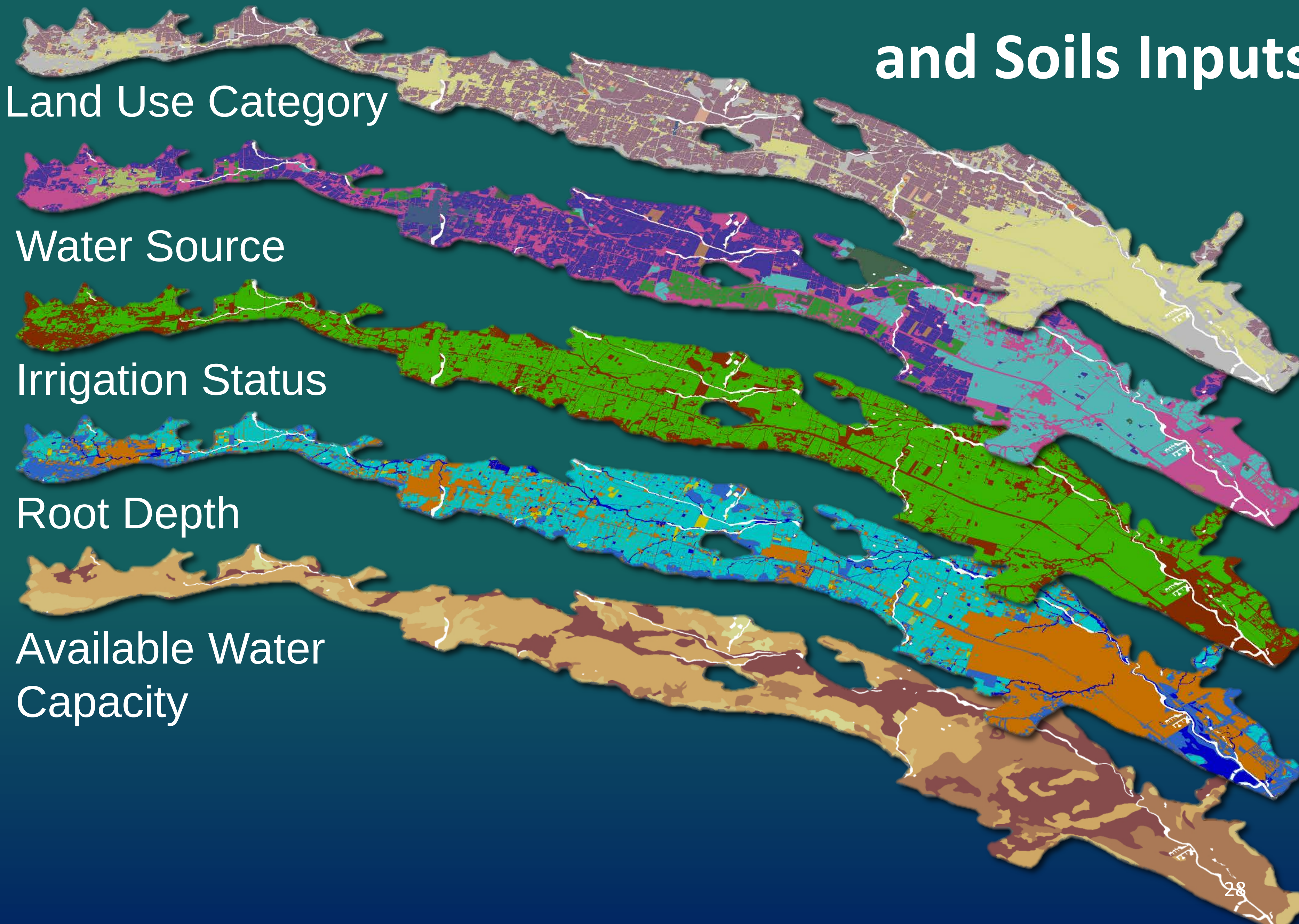
Sustainable Yield (Definition; Water Code Section 10721(v)):

*"Maximum quantity of water, calculated over a* ***base period representative of long-term conditions*** *in the basin and including any temporary surplus, that can be withdrawn annually without causing an undesirable result."*

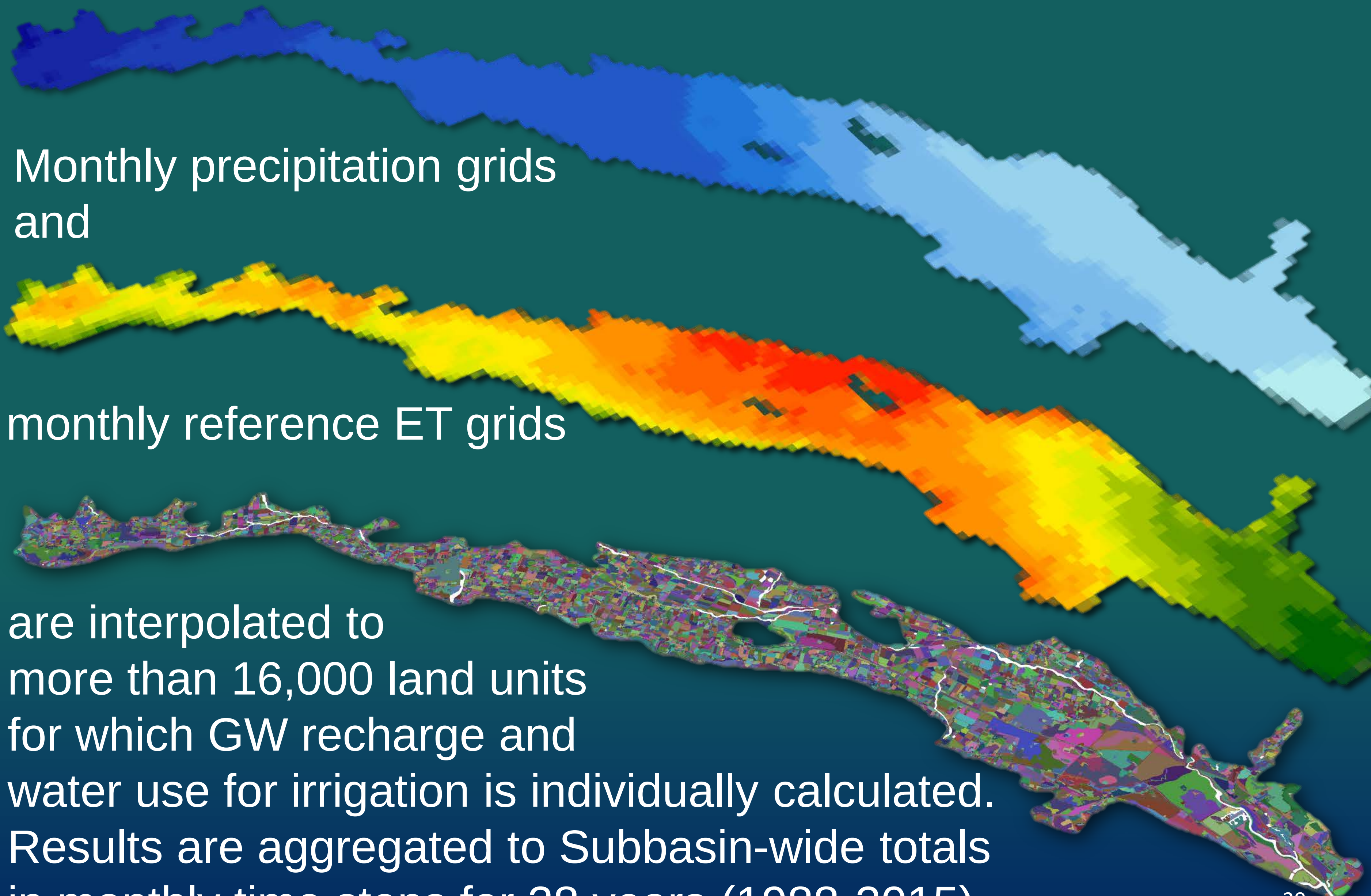
**Analyses for Hydrologic Base Period:**

**28-Year Period from 1988-2015**

# Root Zone Model Land Use and Soils Inputs



# Root Zone Model Monthly Hydrologic Inputs



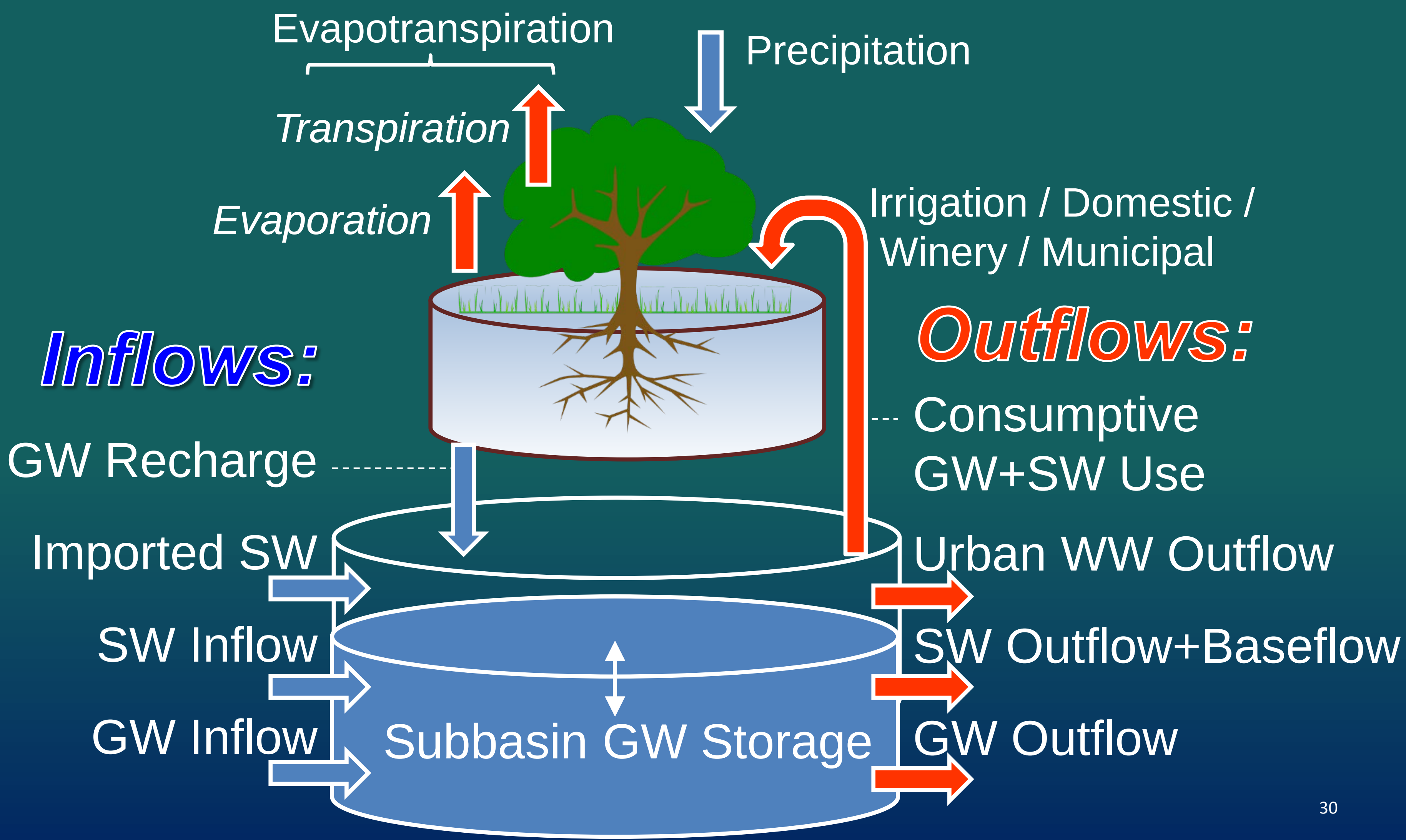
Monthly precipitation grids
and

monthly reference ET grids

are interpolated to
more than 16,000 land units
for which GW recharge and
water use for irrigation is individually calculated.
Results are aggregated to Subbasin-wide totals
in monthly time steps for 28 years (1988-2015).

# Subbasin Water Budget Components

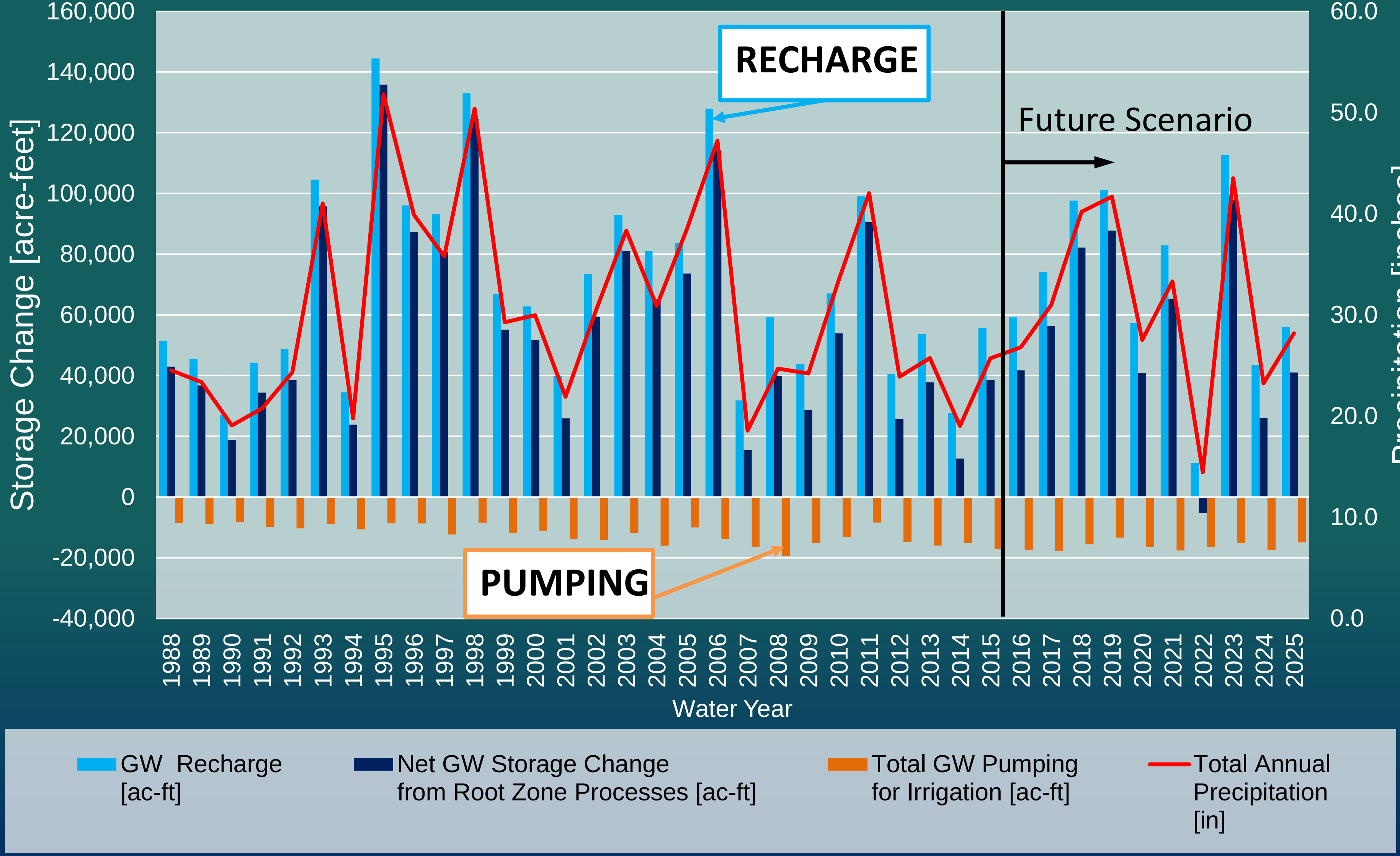
***Inflows* – *Outflows* = $\Delta$ *S Change in GW Storage***



# Future Scenario

- Future climate is simulated for 2016–2025 based on climate model outputs for Napa Valley (USGS Basin Characterization Model; Flint & Flint, 2013).
- Future water demands increase each year based on pending vineyard and winery permits and the winery expansion rate from 2011–2015.
- Imported surface water deliveries held constant at 2011–2015 average, reflecting potential continuation of recent drought conditions and an average State Water Project allocation of 42%.
- Conservatively, recycled water use was held constant for the future scenario; however, actual expanded recycled water use will be beneficial.

# Root Zone Model Output



# Groundwater Pumping Napa Valley Subbasin

| Groundwater Use | 2012 – 2015 Avg. Acre-Ft/Yr |
|---|---|
| Vineyard Irrigation | 12,263 |
| Other Ag Irrigation | 448 |
| Unincorporated Residential (indoor use) | 371 |
| Semi-Ag, Residential, and Commercial Unincorporated Areas, Irrigation | 2,885 |
| Unincorporated Wineries | 1,222 |
| Municipal | 317 |
| Total Average Groundwater Pumping 2012 - 2015 | 17,506 |

# Water Budget Results

| Est. Inflows (1988-2015) | Avg. Annual Ac-Ft/Yr |
|---|---|
| *Upland Runoff* | *145,000* |
| GW Recharge | 69,000 |
| Imported SW Deliveries | 17,000 |
| Uplands Subsurface Inflow | 5,000 |

−

| Est. Outflows (1988-2015) | Avg. Annual Ac-Ft/Yr |
|---|---|
| *SW Outflow and Baseflow* | *176,000* |
| Net GW Use<br>Net SW Use | 13,000<br>14,000 |
| GW Subsurface Outflow | 19,000 |
| Urban Waste-water Outflow | 8,000 |

=

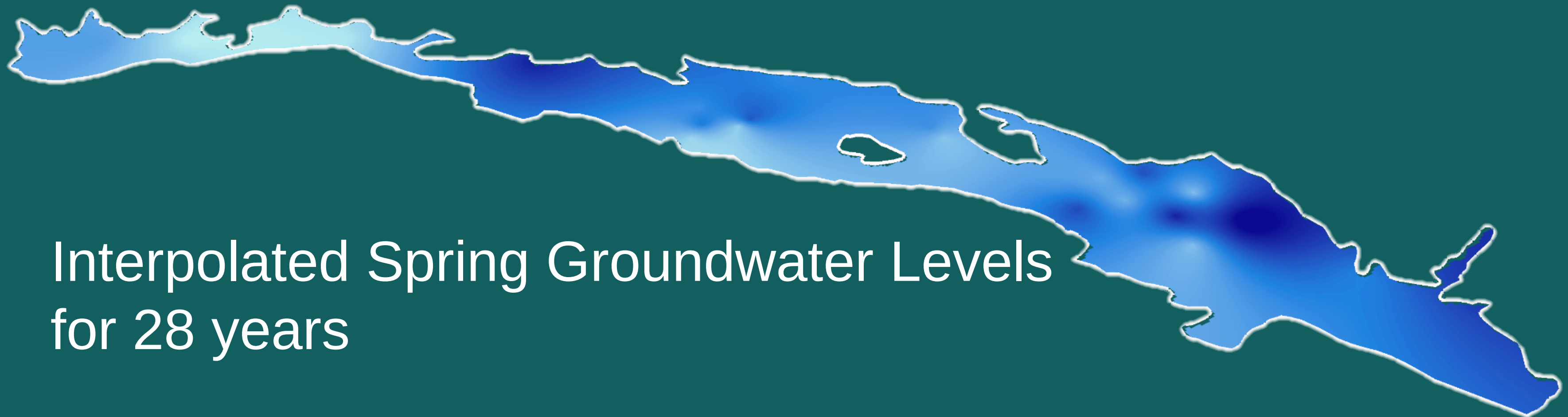
**Net Avg. Annual Change in Subbasin Storage ~ 6,000 Acre-Ft/Yr**

**(uncertainty in individual budget components;** *italicized more uncertain***)**

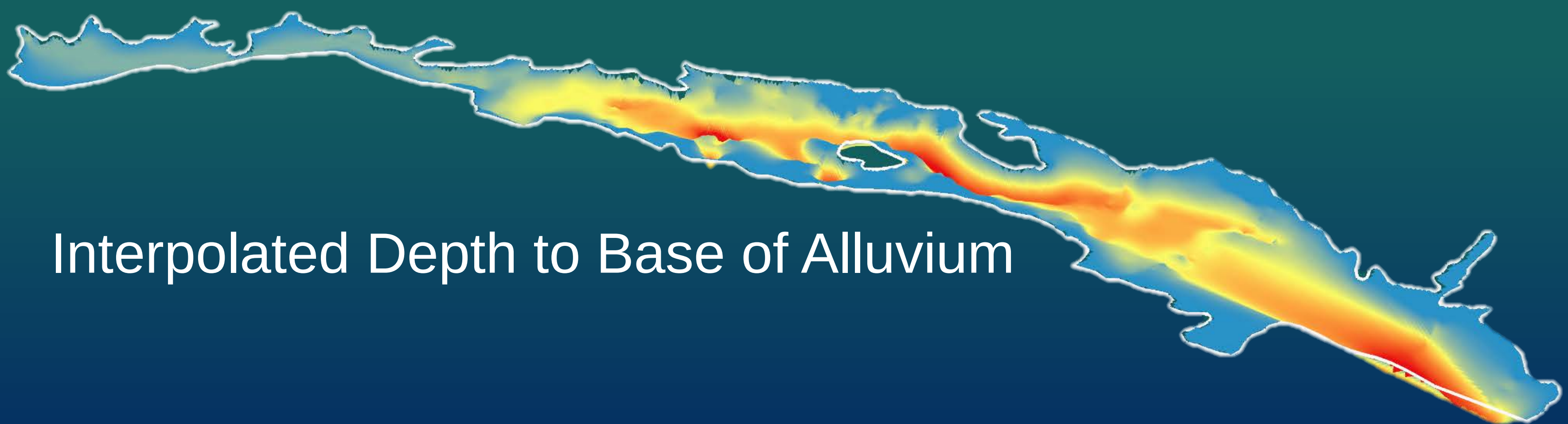
# Water Budget In Balance

- Annual variations in net Subbasin GW storage largely driven by precipitation and related fluctuations in uplands runoff & streamflow.
- Avg. net annual change in GW storage over the 1988-2015 base period (5,900 AFY) is consistent with the stable to slightly above average cumulative precipitation input for the period.
- Positive avg. net annual change in GW storage supports Subbasin monitoring showing stable trends; indicates current levels of pumping have not exceeded the sustainable yield.
- Projected water budget results (2016-2025) show avg. net annual changes in GW storage from 8,000 AFY (warm and moderate rainfall) to -14,300 AFY (hot and low rainfall); indicates importance of continued monitoring and responsive Subbasin management much like recent conservation efforts.

# Groundwater Level Change in Storage



Interpolated Spring Groundwater Levels for 28 years

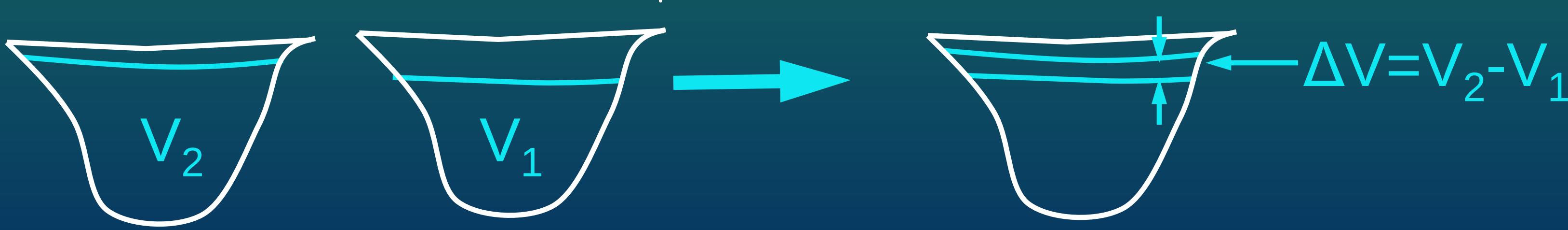


Interpolated Depth to Base of Alluvium

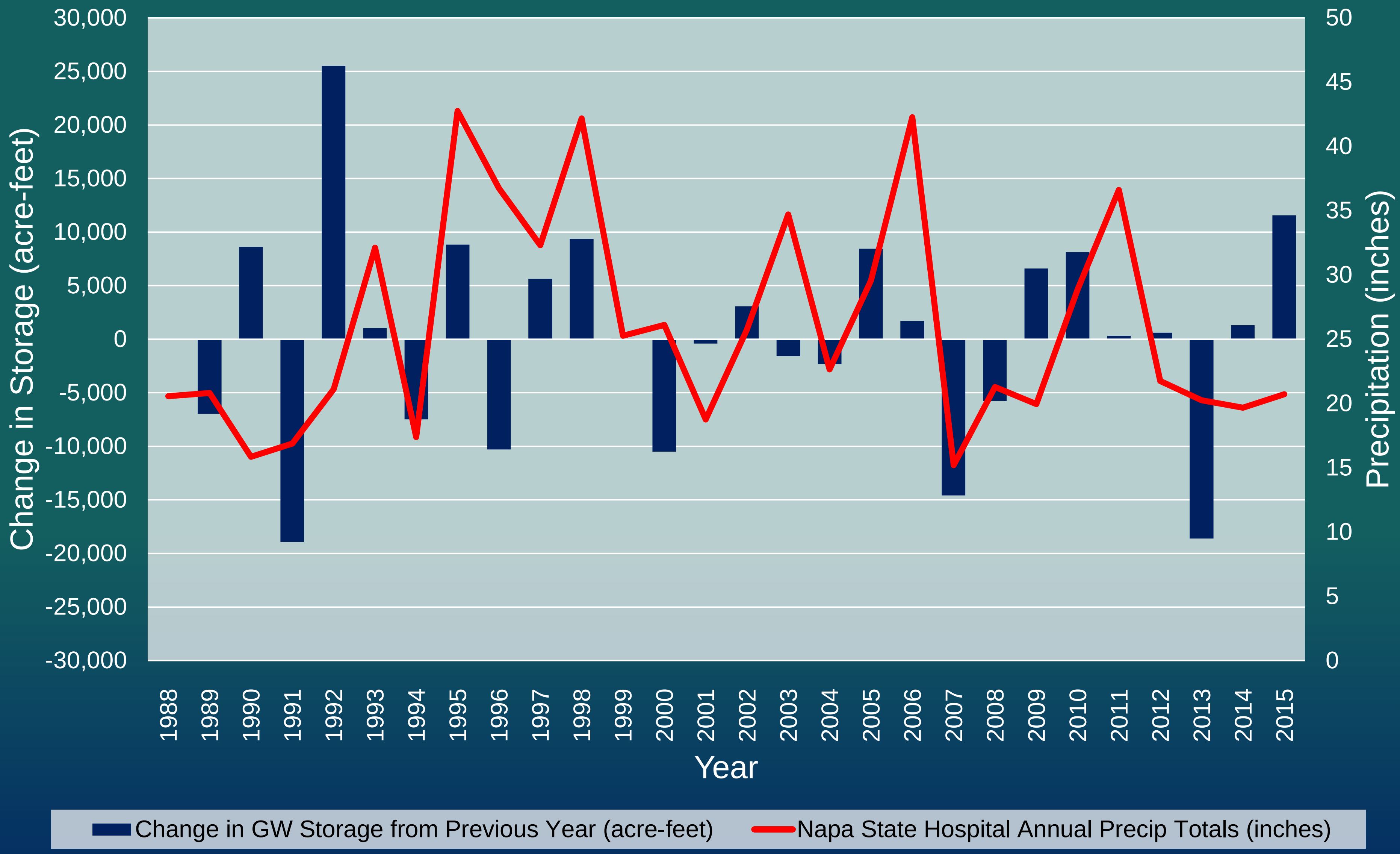
# Groundwater Level Change in Storage

- 3D GIS Models of Saturated Aquifer Volumes (V) are generated for 28 Years

- Change in Groundwater Storage =
  Change in Aquifer Volumes (ΔV) Between 2 yrs x Specific Yield



# Groundwater Level Change in Storage



# Sustainable Yield

- The Basin Analysis Report references GW conditions and recent GW pumping rates to estimate a base period sustainable yield.
- Results of Subbasin monitoring, water budget, and groundwater level change in storage each indicate that the sustainable yield was not exceeded during the base period from 1988-2015; estimated sustainable yield between 17,000—20,000 AFY.
- Sustainable yield is <u>not a fixed value</u> for a given basin or subbasin.

## Napa Valley Subbasin Sustainability Goal (Ch. 7)

(Sustainability Indicators and Monitoring)

# Sustainable Yield and Related Terms

Sustainable Yield (Definition; Water Code Section 10721(v)):

"*Maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually without causing an undesirable result*."

"Undesirable Result" – key term linked to accomplishing sustainability.

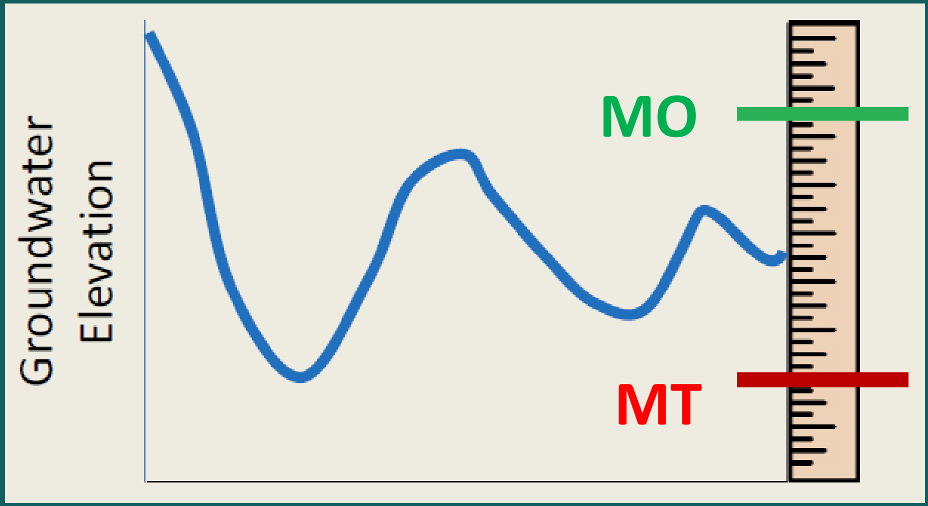
# Groundwater Sustainability Indicators

**Not Causing Undesirable Results:**
**Means Avoiding Significant and Unreasonable …**

| | | |
|---|---|---|
| Lowering of GW Levels | Reduction of GW Storage | Seawater Intrusion |
| Water Quality Degradation | Land Subsidence | Depletion of Surface Water |

Napa Valley Hydrogeologically Sensitive to this Indicator

# Minimum Thresholds and Measurable Objectives




(DWR, March 2016)

- **Minimum Threshold (MT)**

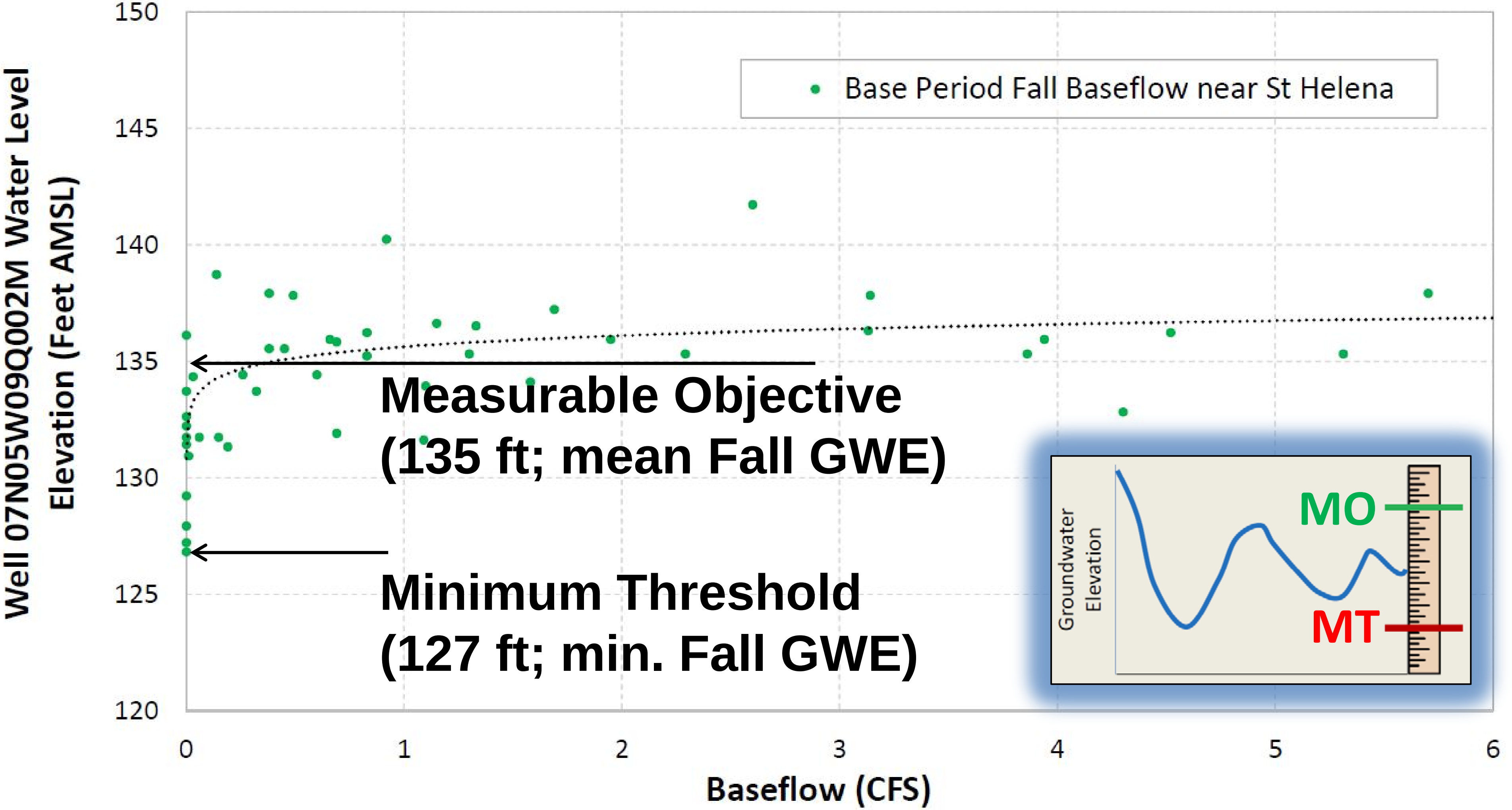
"a numeric value for each sustainability indicator used to define undesirable results" (Section 351)

- **Measurable Objective (MO)**

"specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions" (Section 351)

**Measurable objectives and minimum thresholds are established to ensure GW sustainability or improve GW conditions.**

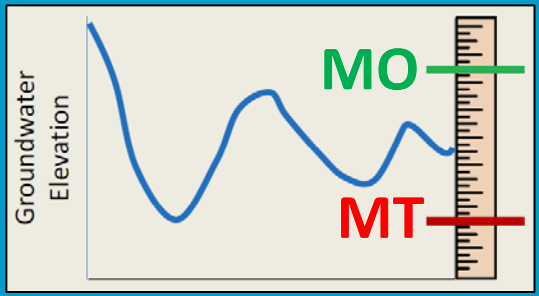
# Relationship Between Fall Groundwater Levels and Baseflow




- Analysis uses all historical baseflow data/groundwater data for GW & Stream Gage sites (not just the base period data)

# Groundwater Elevations to Avoid Streamflow Depletion Serve as Proxies for Other Indicators

- The streamflow Minimum Thresholds represent the lowest GW elevation (GWE) that has occurred historically in the Fall; below this GWE, additional streamflow depletion is likely to occur.
  - Prefer Fall GW levels approximate Measurable Objectives (MO)
  - Stay at or above Fall GW levels established as Minimum Threshold (MT)
  - Avoid GW Levels at Minimum Threshold on continuous basis; this would contribute to worsening of existing conditions

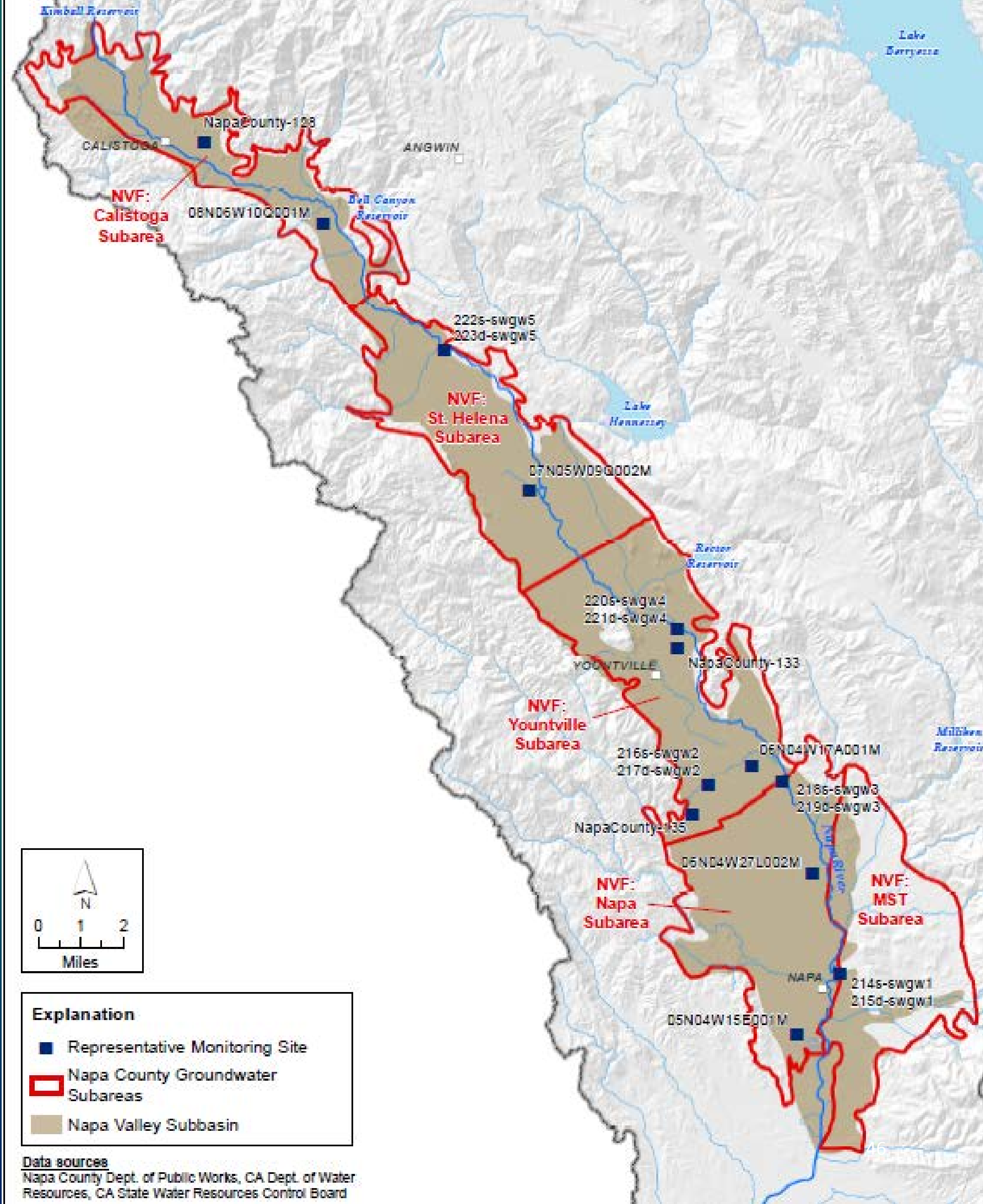



- These minimum thresholds also serve as proxies for other sustainability indicators.

# Representative Monitoring Sites

- Representative wells to ensure sustainability
- 18 locations
- Metrics for each sustainability indicator, as applicable

**Ongoing: Other Countywide GW Data (95+ wells) to be Analyzed, Updated, & Reported**



# Sustainable Groundwater Management (Ch. 9)

- **Napa County 2008 General Plan**
  - Includes 6 goals, 28 policies, and 10 water resources action items within the Conservation Element and related to water resources
- **Groundwater Ordinances**
  - Already in place to regulate groundwater usage and well development in the County
- **County Water Availability Analysis**
  - Developed new 2015 guidelines; help applicants comply with CEQA guidelines
- **Promote Education and Collaboration**
  - WICC, well owner outreach, self-directed well monitoring, and IRWMPs

# Sustainable Groundwater Management (Ch. 9)

- **Reports on GW Conditions/Subbasin Sustainability**
  - Annually and every 5 years
- **Best Management Practices**
  - Already in place for existing monitoring & reporting
  - Will be expanded with first 5-year Basin Analysis Report update
- **Implementation of Additional Management Actions**
  - Will be considered, in coordination with other municipal agencies and stakeholders, to ensure long-term sustainability of the Subbasin

# Findings and Recommendations (Ch. 10)

## Findings

- Subbasin has been operated within its sustainable yield from 1988-2015
- Simulated future conditions, from 2016-2025, show GW use remaining within the base period sustainable yield
- Sustainable yield may change due to variations in Subbasin inflows, management strategies (enhanced recharge), or evolving sustainability objectives

# Recommendations

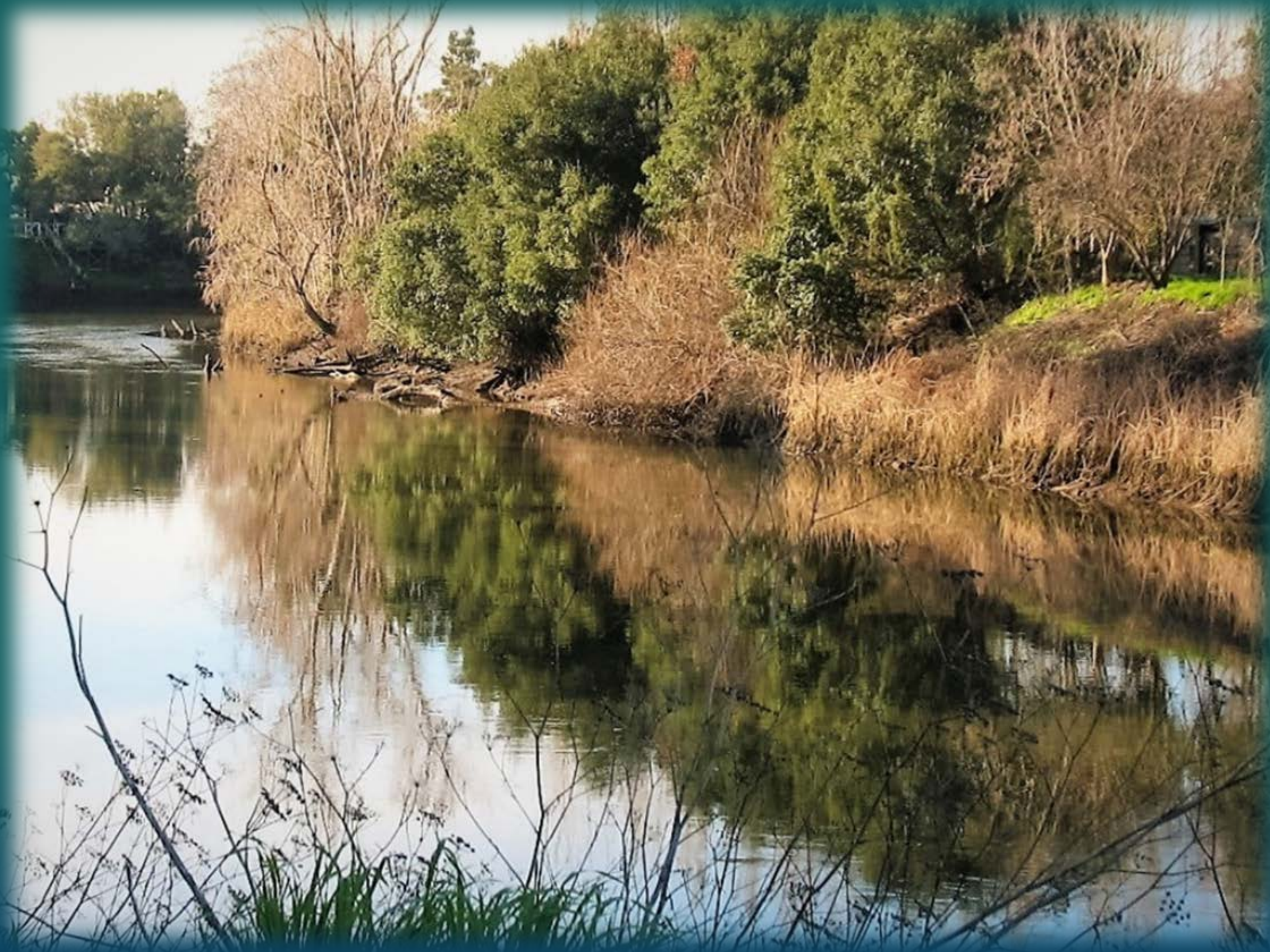
- Chapter 10 Table 10-1
  - Previous recommendations from 2011; 18 recommended actions, nearly all completed
    - Included prepare a workplan for a “Groundwater Sustainability Plan” and preparation of a “Groundwater Sustainability Plan”
  - Groundwater Resources Advisory Committee (Feb. 2014); 6 recommendations
    - Many implemented and ongoing
  - Basin Analysis Report; 13 recommendations
    - Example follows

# Recommendations Summary

| Summary | Time Frame | Relative Priority |
|---|---|---|
| Continue and improve GW and SW monitoring programs | Ongoing | 1 |
| Coordinate with Planning Dept. to improve data collection as part of existing and future discretionary permits | Ongoing | 1 |
| Evaluate and address uncertainties in water budget components, incl. water use and trends in the unincorp. areas | Near to Mid Term (by 2020) | 1-2 |

# Recommendations Summary (continued)

| Summary | Time Frame | Relative Priority |
|---|---|---|
| Evaluate opportunities for additional recharge and the distribution of GW Dependent Ecosystems | Near to Mid Term (by 2019) | 1 - 2 |
| Expand capacity to encourage GW stewardship | Near Term (by 2018) | 2 |
| Coordinate with BMPs published by DWR | Near Term (2017-2018) | 1 |



# Thank You