WMA

Santa Ynez River Valley Groundwater Basin
Western Management Area
Groundwater Sustainability Agency

January 2021

Stakeholder Workshop

STETSON ENGINEERS INC.

DUDEK

Geosyntec consultants
engineers | scientists | innovators

Housekeeping

- Recording the meeting for the purpose of capturing public feedback
- Recording can be made available upon request
- Opportunities for public feedback and questions throughout the workshop
- Public comments on the GCTM should be submitted to the website:

www.santaynezwater.org

- Slide numbers in lower right

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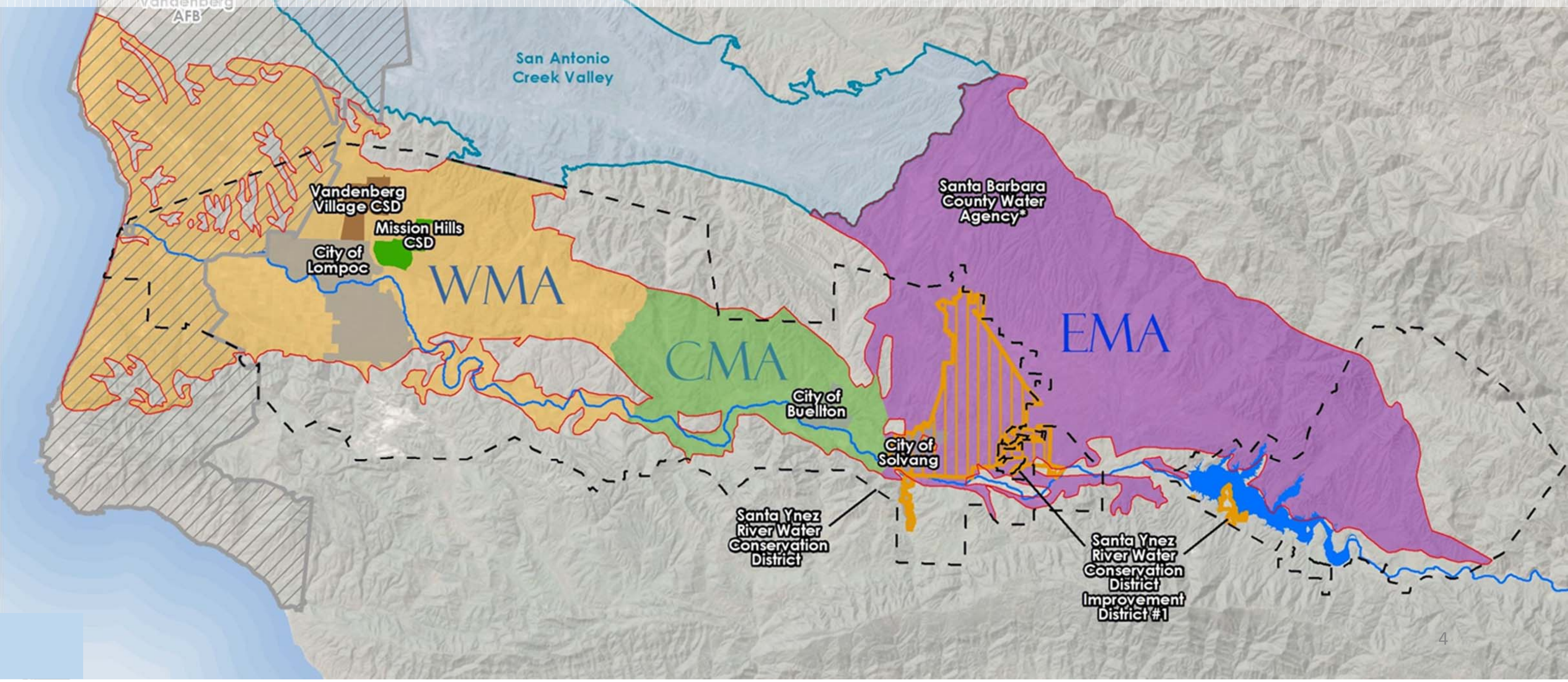
Agenda

1. Groundwater Conditions Tech Memo
2. Water Budget Technical Memo
3. Groundwater Model Update
4. Sustainable Management Criteria – Example Thresholds
5. The Way Ahead
6. Schedule

Basin, Management Areas, & Adjacent Basin



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Groundwater Conditions Technical Memo

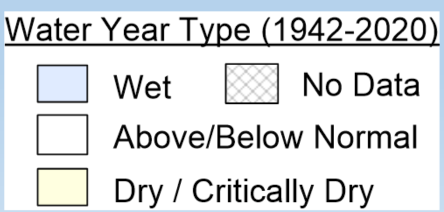
Describes the current groundwater conditions within the WMA.

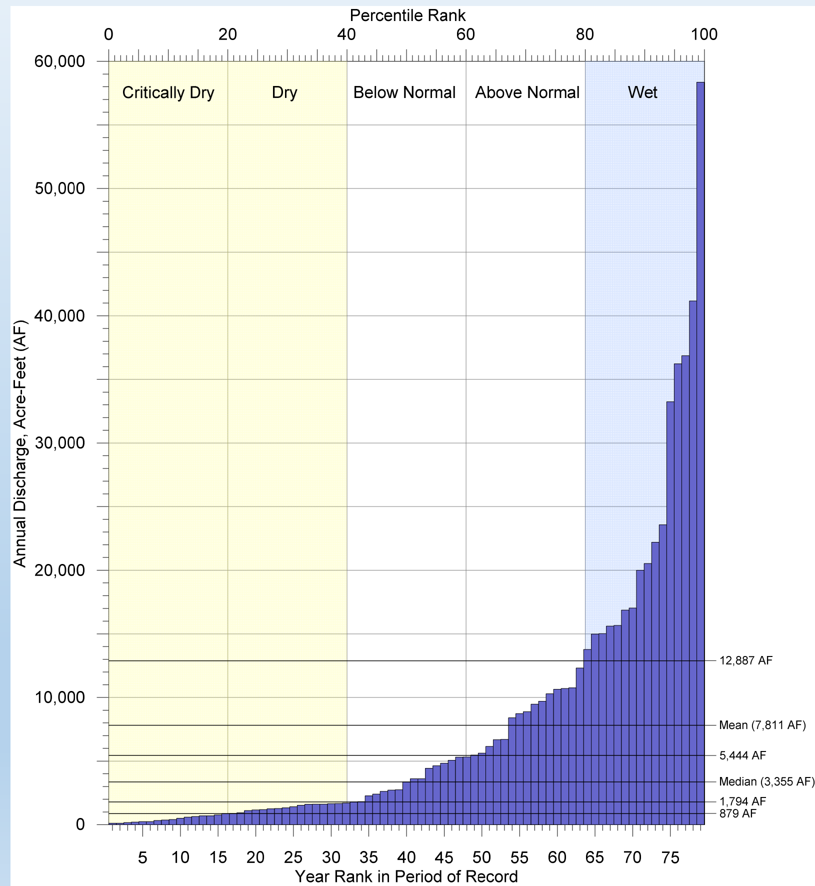
Chapters describe:

- Groundwater Elevations and Hydrographs
- Groundwater Storage
- Groundwater Quality
- Seawater Intrusion
- Land Subsidence
- Interconnected Surface Water and Groundwater Dependent Ecosystems

New GCTM Content

- New Water Year Classification
- Additional water quality analysis to supplement SGMA requirements





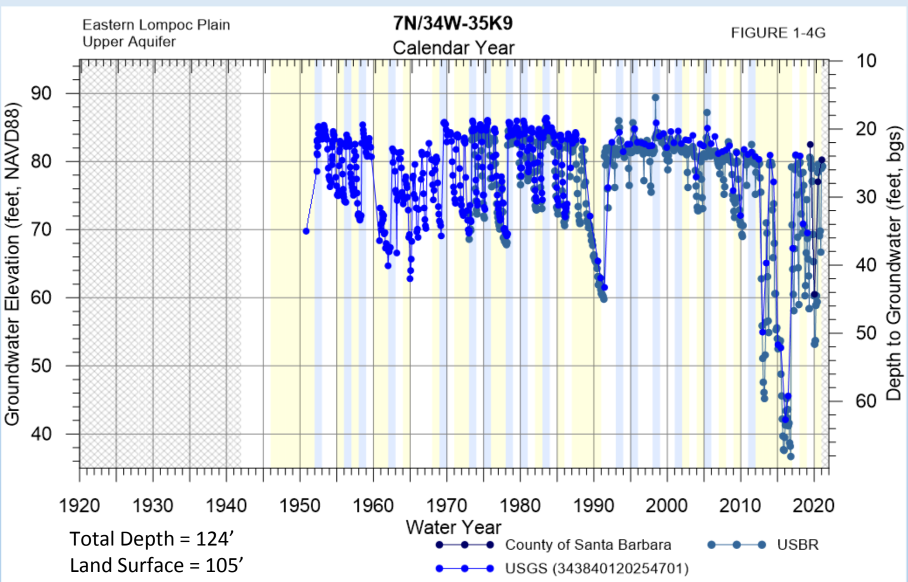
Water Year Ranking

Groundwater Elevations

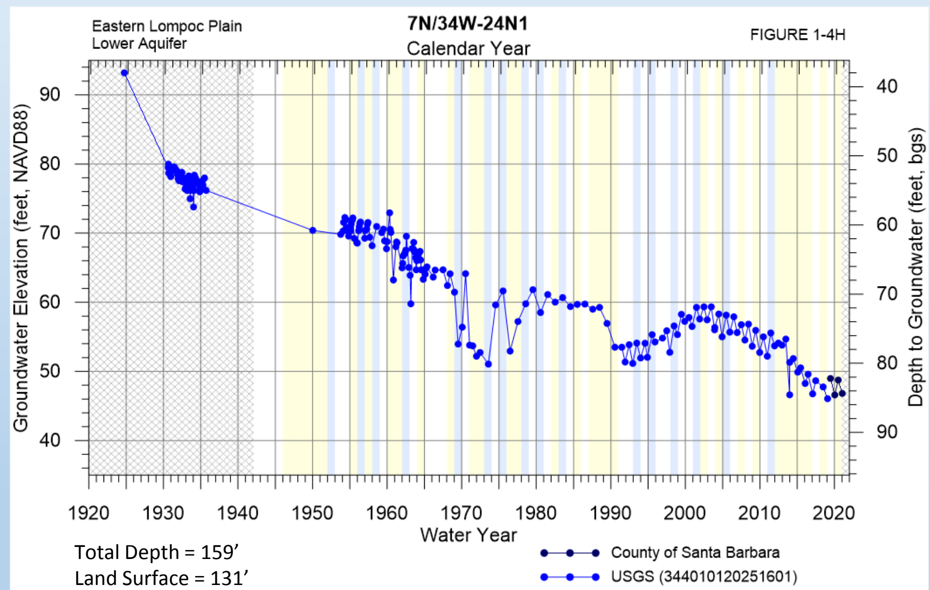
Water Year Type (1942-2020)

- Wet
- No Data
- Above/Below Normal
- Dry / Critically Dry

WMA Groundwater Elevation Hydrographs for the WMA Lompoc Plain



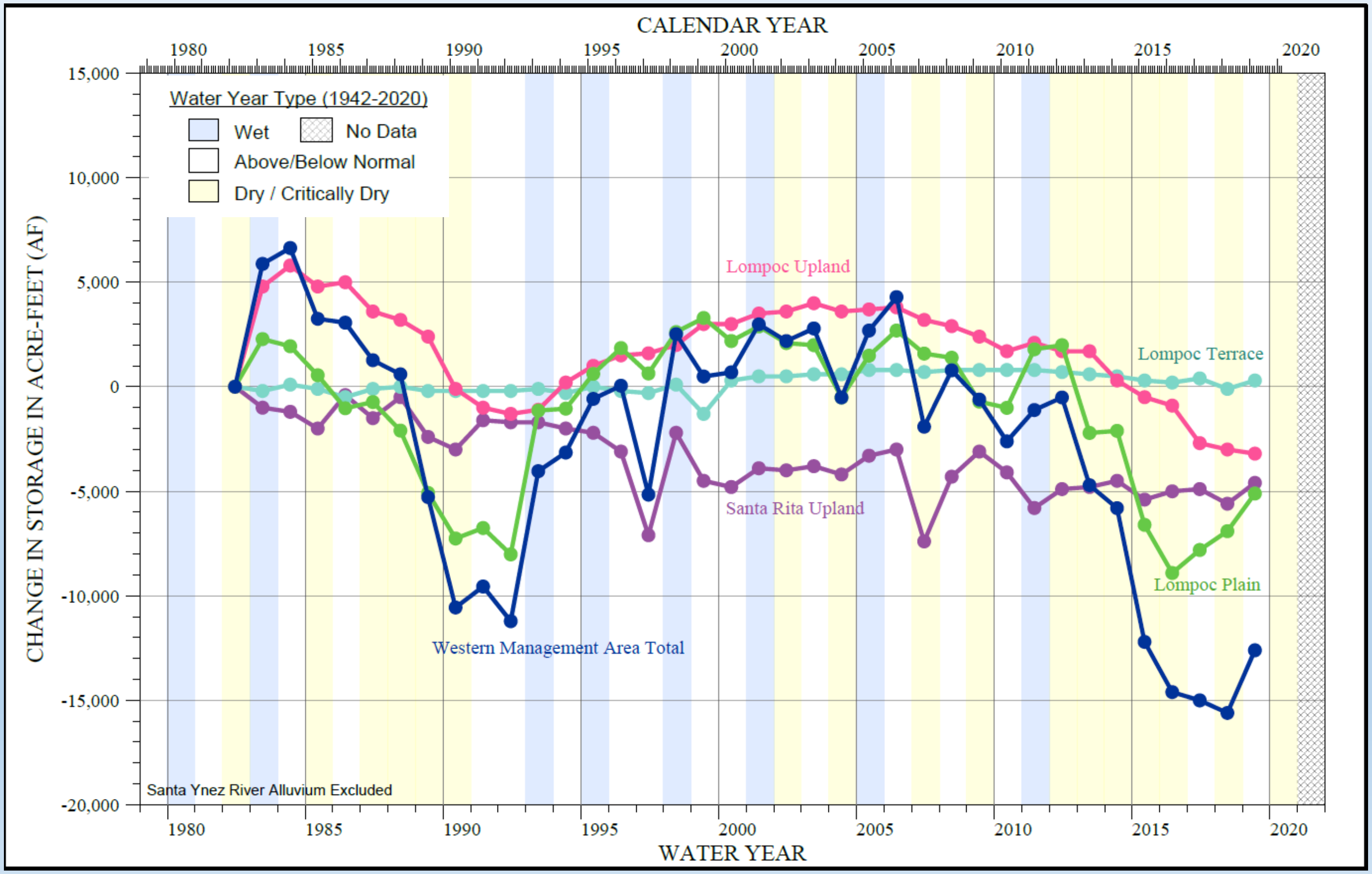
Example of relatively stable groundwater elevations



Example of declining groundwater elevations

Change in Groundwater in Storage

Cumulative Change in Groundwater in Storage Since March 1982



Groundwater Quality in the WMA

In accordance with SGMA....

- GW Quality data is provided for reference, in terms of various beneficial uses in the WMA. Baseline conditions are provided as a snapshot, and the goal of the WMA will be not to create an undesirable result under the GSP (will be discussed further under Sustainable Management Criteria, SMCs).

- Managing GW quality in an effort to meet basin plan objectives is the responsibility of other agencies.

- Future GW management actions in the WMA will not adversely affect GW quality, nor will they interfere with other agencies objectives or responsibility to manage, maintain or improve GW quality.

Central Coast 2019 Basin Plan

Water Quality Objectives

Central Coast Regional Water Quality Control Board

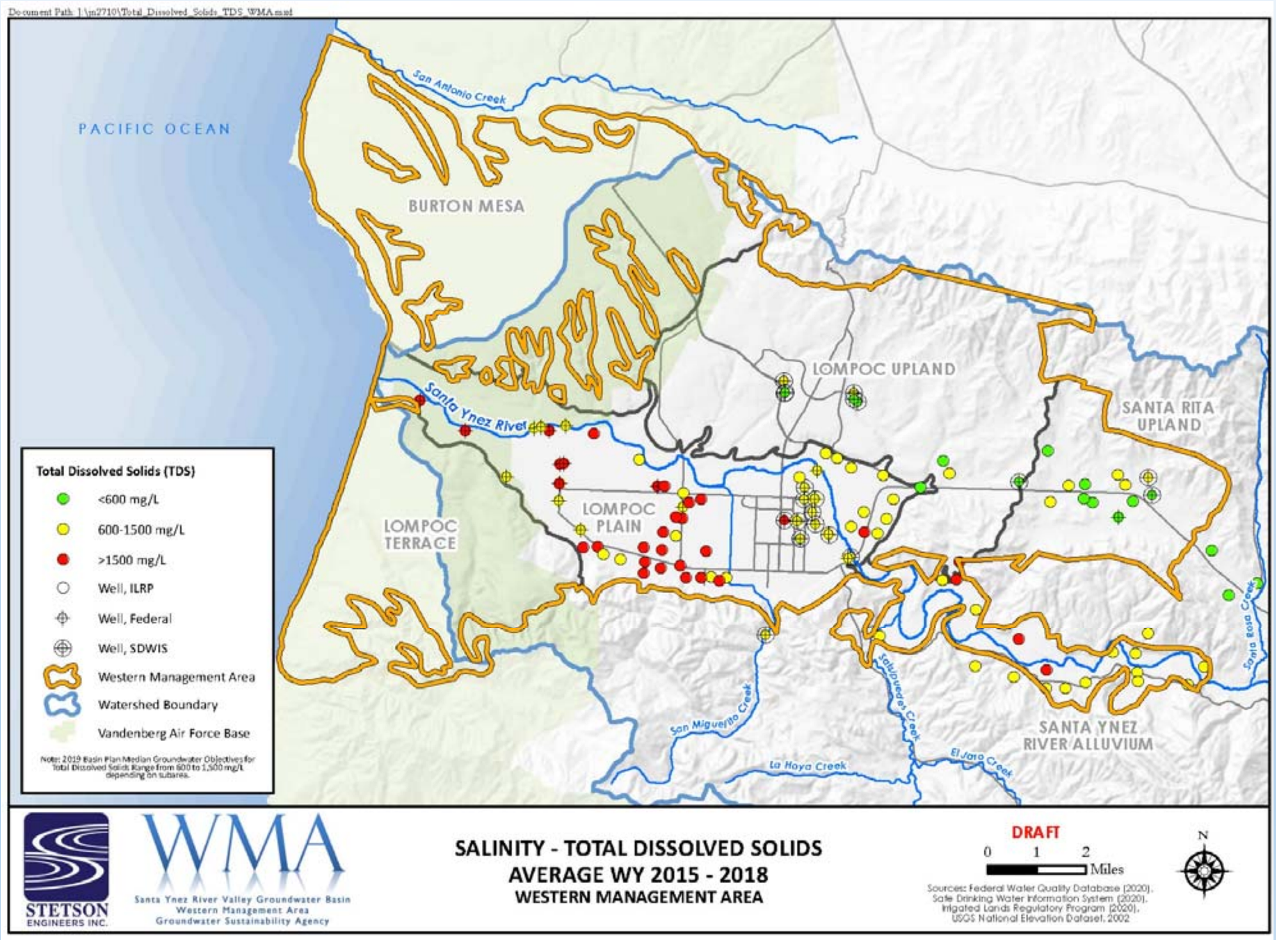
Table 3-6. Median Groundwater Objectives, mg/L[a]

Basin/Sub-Area	TDS	Cl	SO_4	B	Na	N[b]
Big Basin						
Near Felton	100	20	10	0.2	10	1
Near Boulder Creek	250	30	50	0.2	20	5
Pajaro Valley						
Hollister	1200	150	250	1.0	200	5
Tres Pinos	1000	150	250	1.0	150	5
Llagas	300	20	50	0.2	20	5
Salinas Valley						
Upper Valley[f]	600	150	150	0.5	70	5
Upper Forebay[f]	800	100	250	0.5	100	5
Lower Forebay[f]	1500	250	850	0.5	150	8
180 foot Aquifer[f]	1500	250	600	0.5	250	1
400 foot Aquifer[f]	400	50	100	0.2	50	1
Paso Robles Area[g]						
Central Basin[f]	400	60	45	0.3	80	3.4
San Miguel[f]	750	100	175	0.5	105	4.5
Paso Robles[f]	1050	270	200	2.0	225	2.3
Templeton[f]	730	100	120	0.3	75	2.7
Atascadero[f]	550	70	85	0.3	65	2.3
Estrella[f]	925	130	240	0.75	170	3.2
Shandon	1390	430	1025[h]	2.8	730	2.3
Estero Bay						
Santa Rosa	700	100	80	0.2	50	5
Chorro	1000	250	100	0.2	50	5
San Luis Obispo	900	200	100	0.2	50	5
Arroyo Grande	800	100	200	0.2	50	10
Carrizo Plain	[e]	[e]	[e]	[e]	[e]	[e]
Santa Maria River Valley[c]						
Upper Guadalupe[f]	1000[d]	165	500[d]	0.5	230	1.4[e]
Lower Guadalupe[f]	1000[d]	85	500[d]	0.2	90	2.0[e]
Lower Nipomo Mesa[f]	710	95	250	0.15	90	5.7[e]
Orcutt[f]	740	65	300	0.1	65	2.3[e]
Santa Maria[f]	1000[d]	90	510	0.2	105	8.0[e]
Cuyama Valley	1500	80	--	0.4	--	5
San Antonio Creek Valley	600	150	150	0.2	100	5
Santa Ynez River Valley						
Santa Ynez	600	50	10	0.5	20	1
→ Santa Rita	1500	150	700	0.5	100	1
→ Lompoc Plain[f]	1250	250	500	0.5	250	2
→ Lompoc Upland[f]	600	150	100	0.5	100	2
→ Lompoc Terrace[f]	750	210	100	0.3	130	1

Groundwater Quality

This graphic shows Total Dissolved Solids (TDS) concentrations in milligrams per liter (mg/L), for groundwater samples collected from wells within the WMA.

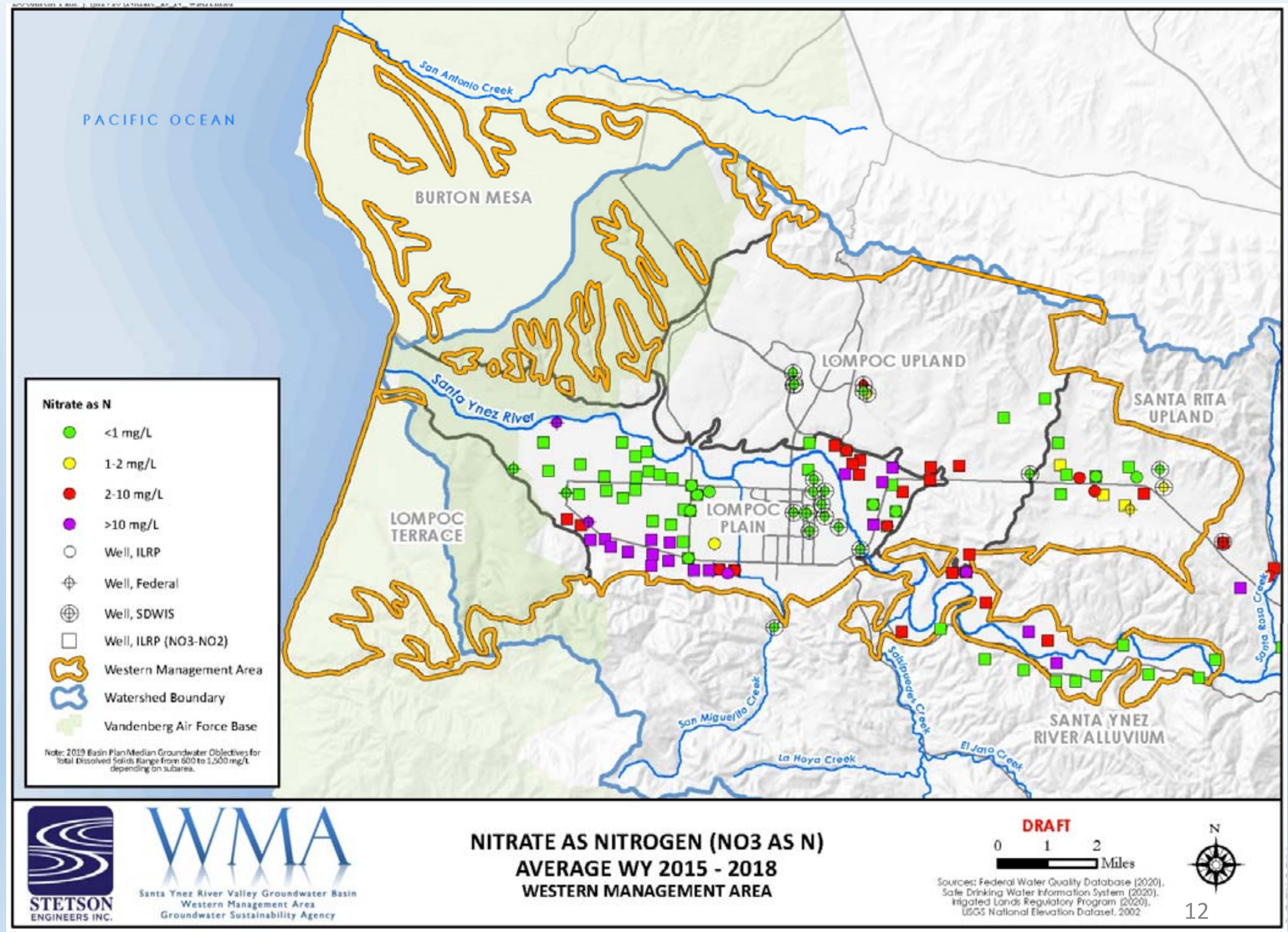
The colors relate to the TDS concentrations observed. Water quality objective (2019) is 600-1500 mg/L.



Groundwater Quality in the WMA

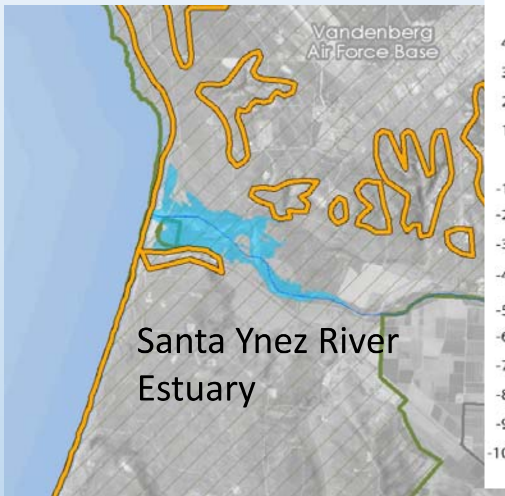
This graphic shows Nitrate concentrations in milligrams per liter (mg/L), for groundwater samples collected from wells within the WMA.

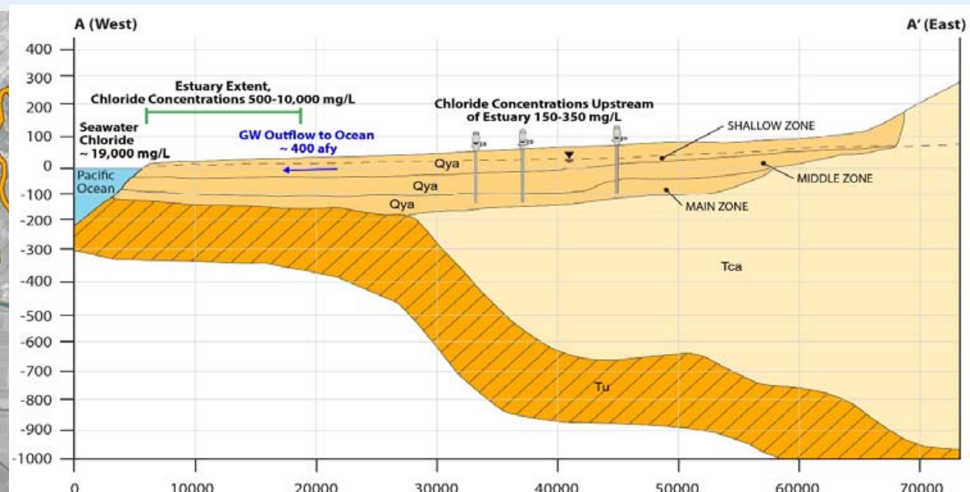
The colors relate to the nitrate concentrations observed. Water quality objective (2019) is 1-2 mg/L.

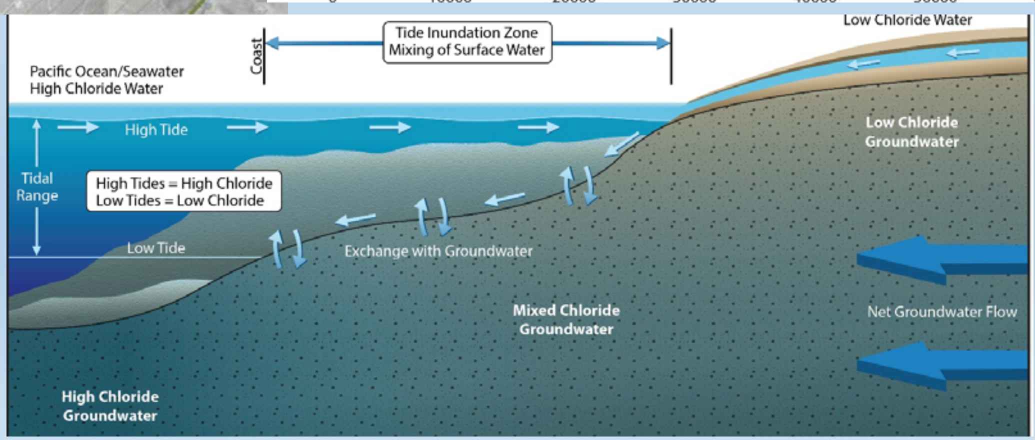


Cross Section of Western WMA

Seawater Intrusion Discussion







This cross section shows chloride concentrations observed for:

- Ocean water ~19,000 mg/L
- Santa Ynez River Estuary ~500 – 10,000 mg/L
- Wells screened in the Upper Aquifer ~150-350 mg/L (inland from the Estuary)

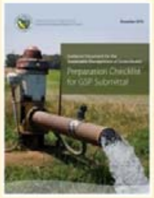
GCTM Requirements

SGMA Regulations, Six SGMA indicators, and document align.

DWR Checklist Requirements for GC

2.2.2 Current and Historical Groundwater Conditions *(Reg. § 354.16)*

- Groundwater elevation data
- Estimate of groundwater storage
- Seawater intrusion conditions
- Groundwater quality issues
- Land subsidence conditions
- Identification of interconnected surface water systems
- Identification of groundwater-dependent ecosystems
  - Including potentially related factors such as instream flow requirements, threatened and endangered species, and critical habitat.



DWR (2016) Groundwater Sustainability Plan (GSP) Annotated Outline.
Guidance Document for the Sustainable Management of Groundwater.

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The DWR Checklist is a summary of some key requirements for the GCTM, as written in the SGMA regulations.

These are the SGMA regulations which describe the full list of requirements for preparing the GCTM.

SGMA Regulations

§ 354.16. Groundwater Conditions

Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:

(1) Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.

(2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.

(b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.

(c) Seawater intrusion conditions in the basin, including maps and cross-sections of the seawater intrusion front for each principal aquifer.

(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.

(e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

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Groundwater Conditions Technical Memo

Questions?

Water Budget Technical Memo

Accounts for the water inflows (water supply) and outflows (water demand) within the WMA.

Presents historical changes to water supply and water demand, according to WMA hydrology, population, land use, and climatic conditions.

Water Budget Analysis Time Period (W.Y. 1982 – W.Y. 2018)

Water Budget Keys

Basic Equation for Groundwater Storage:

Inflows – Outflows = Change in Storage

More inflow than outflow:

Groundwater levels and Storage increase

More outflow than inflow:

Groundwater levels and Storage decrease

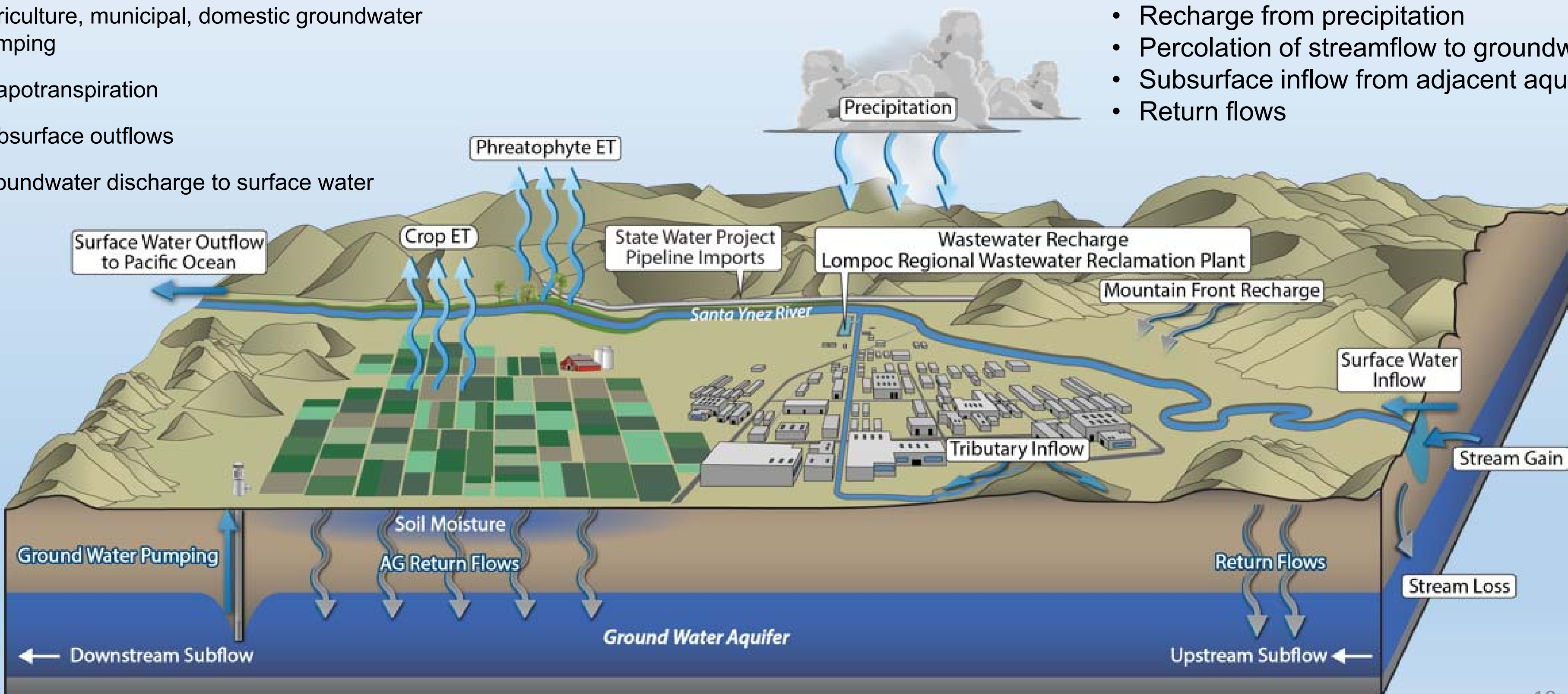
Water Budget will address variability:

- Hydrologic- Droughts 1987-1991, 2012-2018; Floods i.e. 1998
- Changes in Land Use/Demands, quantity and timing
- Climate Change, quantity and timing

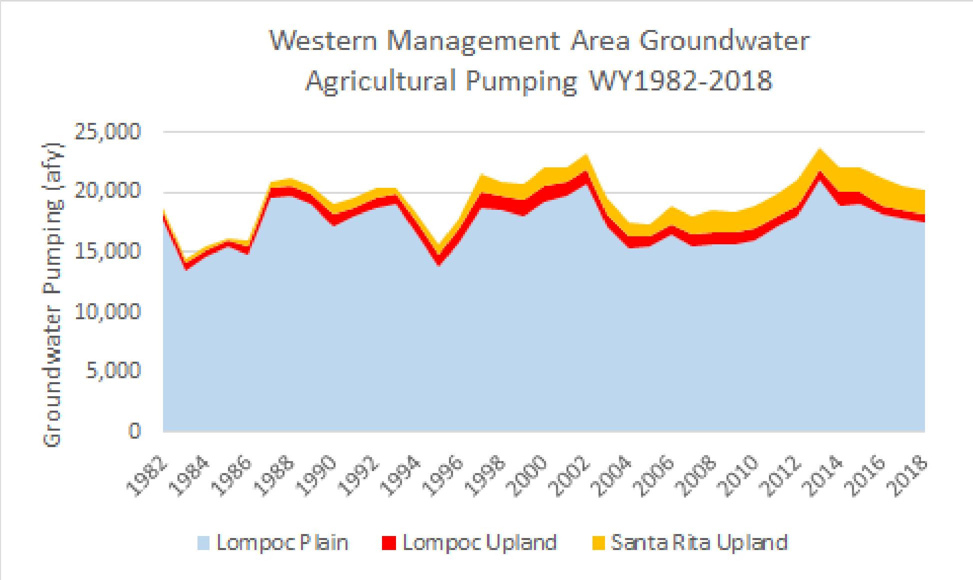
WMA Inflows and Outflows

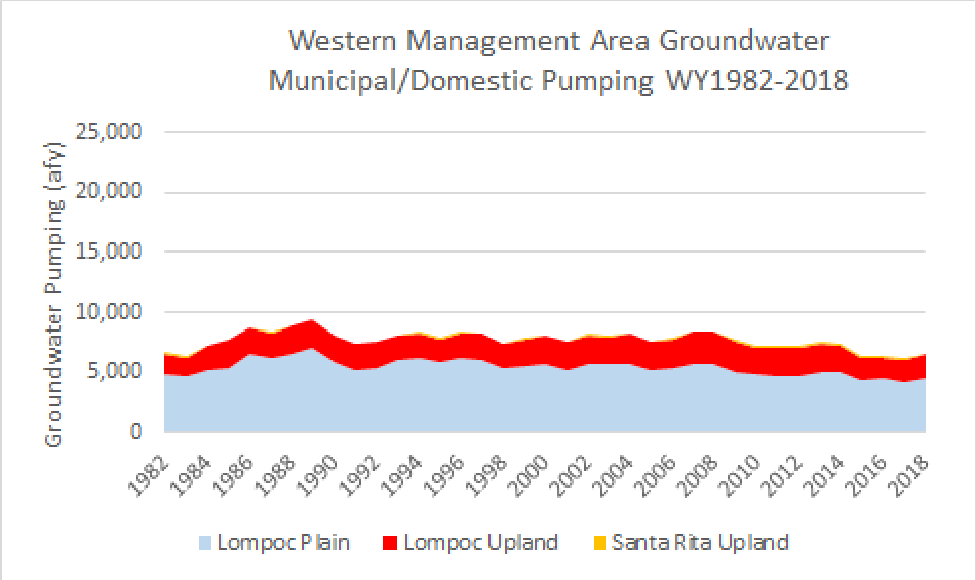
- Percolation of streamflow to groundwater
- Evaporation
- Santa Ynez River outflows
- Agriculture, municipal, domestic groundwater pumping
- Evapotranspiration
- Subsurface outflows
- Groundwater discharge to surface water

- Santa Ynez River
- Tributaries
- Groundwater discharge to surface water
- State Water Project
- Recharge from precipitation
- Percolation of streamflow to groundwater
- Subsurface inflow from adjacent aquifers
- Return flows



WMA Groundwater Pumping





Example of stable to increasing pumping trend.

Example of stable to declining pumping trend.

Water Budget Requirements

SGMA Regulations, Six SGMA indicators, and document align.

These are the SGMA regulations which describe the full list of requirements for preparing the Water Budget.

DWR Checklist Requirements for Water Budget

2.2.3 **Water Budget Information** ***(Reg. § 354.18)***

- Description of inflows, outflows, and change in storage
- Quantification of overdraft
- Estimate of sustainable yield
- Quantification of current, historical, and projected water budgets

DWR (2016) Groundwater Sustainability Plan (GSP) Annotated Outline. Guidance Document for the Sustainable Management of Groundwater.

The DWR Checklist is a summary of some key requirements for the Water Budget, as written in the SGMA regulations

SGMA Regulations

§ 354.18. Water Budget

(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.

(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:

(1) Total surface water entering and leaving a basin by water source type.

(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.

(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

(4) The change in the annual volume of groundwater in storage between seasonal high conditions.

(5) If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.

(6) The water year type associated with the annual supply, demand, and change in groundwater stored.

(7) An estimate of sustainable yield for the basin.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.

(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:

(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.

(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.

(C) A description of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability of the Agency to operate the basin within sustainable yield. Basin hydrology may be characterized and evaluated using water year type.

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.

(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.

(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.

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Water Budget Technical Memo

Questions?

Groundwater Model Update

How will it help us comply with SGMA?

Using "best available science to quantify the water budget and to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface" § 354.20.E

Entire Santa Ynez River Valley Groundwater Basin using MODFLOW – USG (Unstructured Grid) Model Software

- public domain open source software

What is it used for?

Planning tool

Model currently being calibrated for Historical Conditions Water Years 1982-2018 (37 years)
Model will be used to simulate Future Projected Conditions Water Years 2018-2072 (55 years).

Groundwater Model Update

Groundwater Model Uses and SGMA:

- Quantitative estimate of groundwater inflows and outflows to the WMA (informs the Water Budget),
- Considerations for seasonality and temporal changes to groundwater availability and recharge,
- Quantitative framework to estimate future potential scenarios, and
- Guide development of SMC thresholds.

Groundwater Modeling Steps:

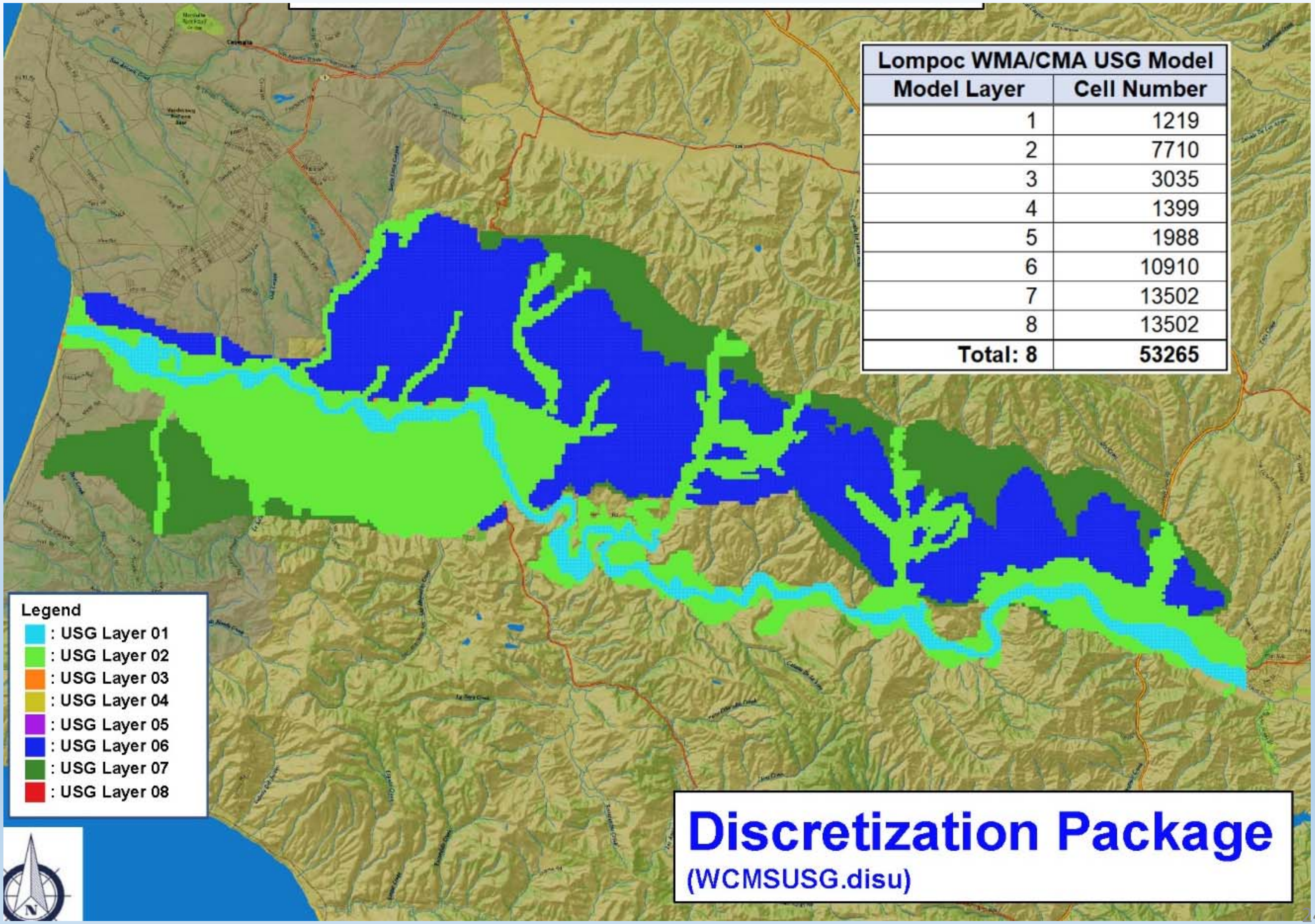
- Build
- Calibrate
- Run Scenarios

Model Grid

Model cells are 4 acres.

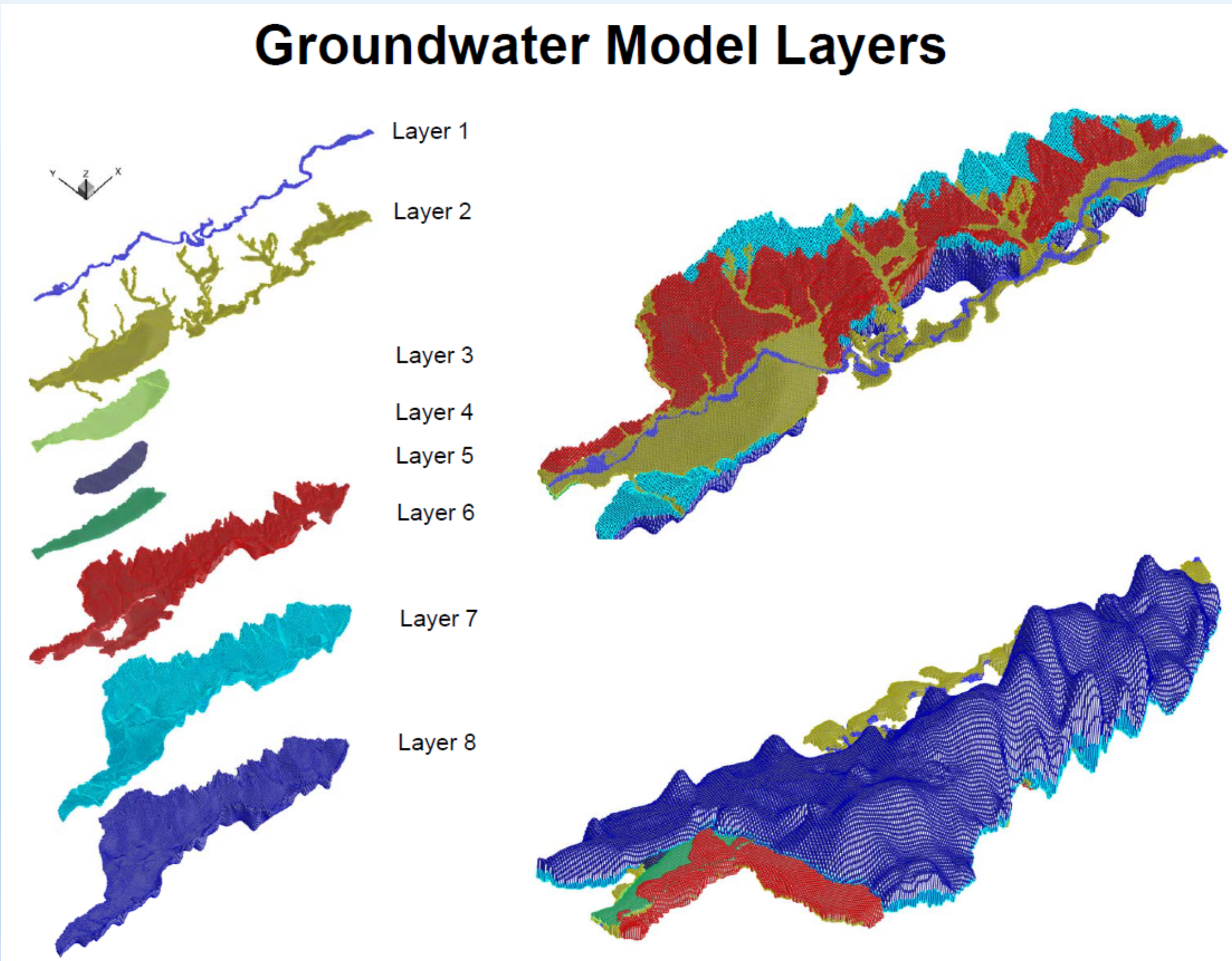
Monthly timestep.

Solvang to Pacific Ocean



Lompoc WMA/CMA USG Model	
Model Layer	Cell Number
1	1219
2	7710
3	3035
4	1399
5	1988
6	10910
7	13502
8	13502
Total: 8	**53265**

Groundwater Model Update



The 3D subsurface geologic model was used to export the various groundwater model layers.

Each layer correlates to a different geologic formation (or unit) and identified Principal Aquifer.

These layers are used as the basis for the groundwater model.

The model estimates groundwater flow velocities, recharge rates, and model scenarios to predict future groundwater supply and demand based on current groundwater uses.

Groundwater Model Update

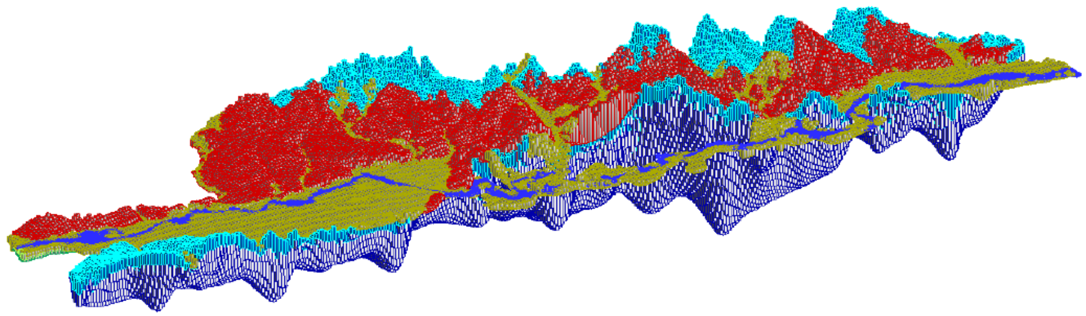
View of all Groundwater Model Layers stacked together

Layer Property Flow Package

(WCMSUSG.lpf)

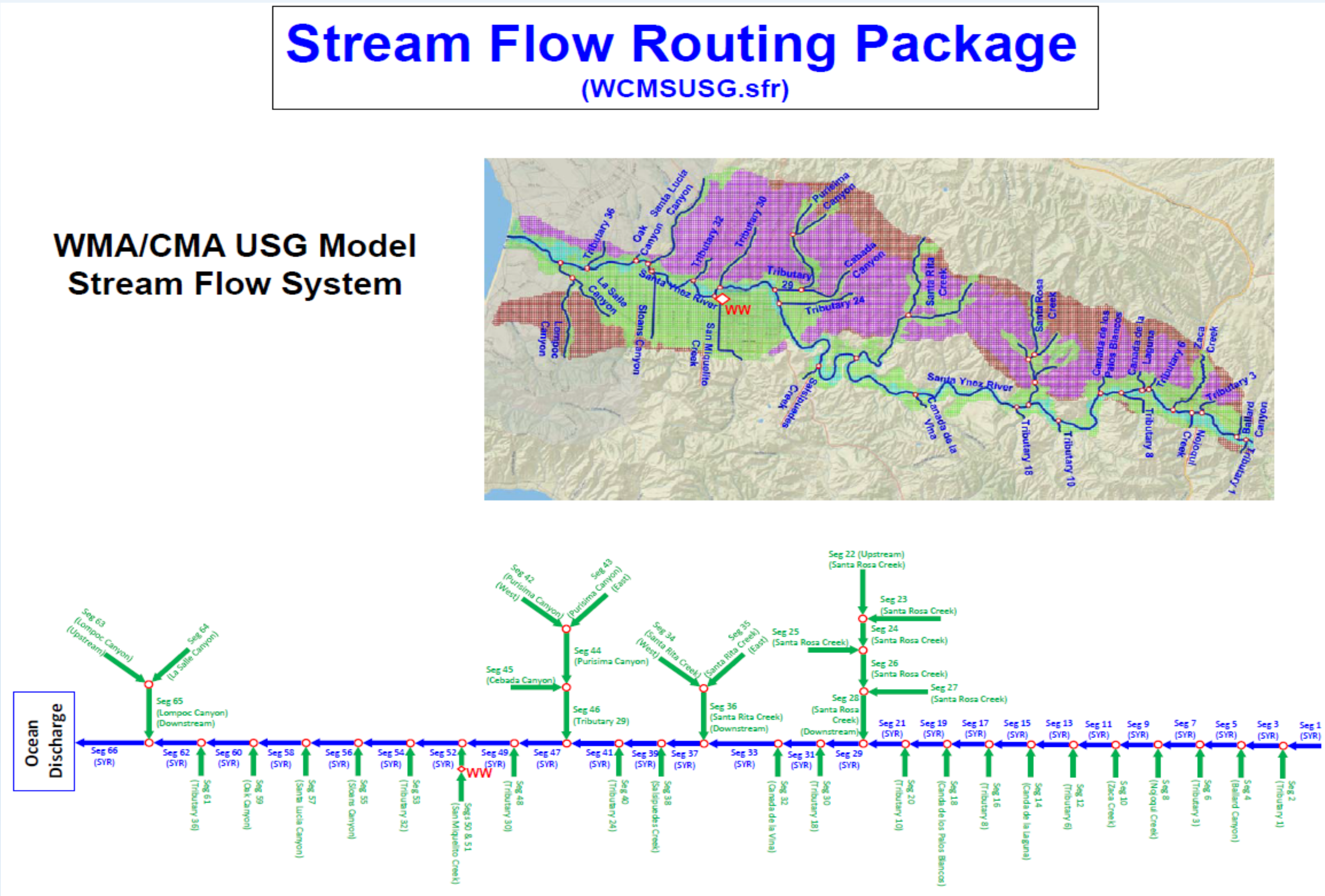
Model Aquifer Properties

Model Layer	Kx = Ky (ft/day)	Kz (ft/day)	Ss (ft^{-1})	Sy	Remark
1	240	0.24	0.0001	0.1	Stream Deposits
2	55	0.055	0.0001	0.1	Upper Alluvium
3	35.5	0.0355	0.0001	0.1	Lower Alluvium
4	2.2	0.0022	0.0001	0.1	Silt
5	300	0.3	0.0001	0.1	Main Water Bearing Zone
6	15	0.015	0.0001	0.1	Older Alluvium
7	50	0.05	0.0001	0.1	Upper Careaga
8	10	0.01	0.0001	0.1	Lower Careaga



Aquifer properties for each model cells will be adjusted based on model cell locations during model calibration

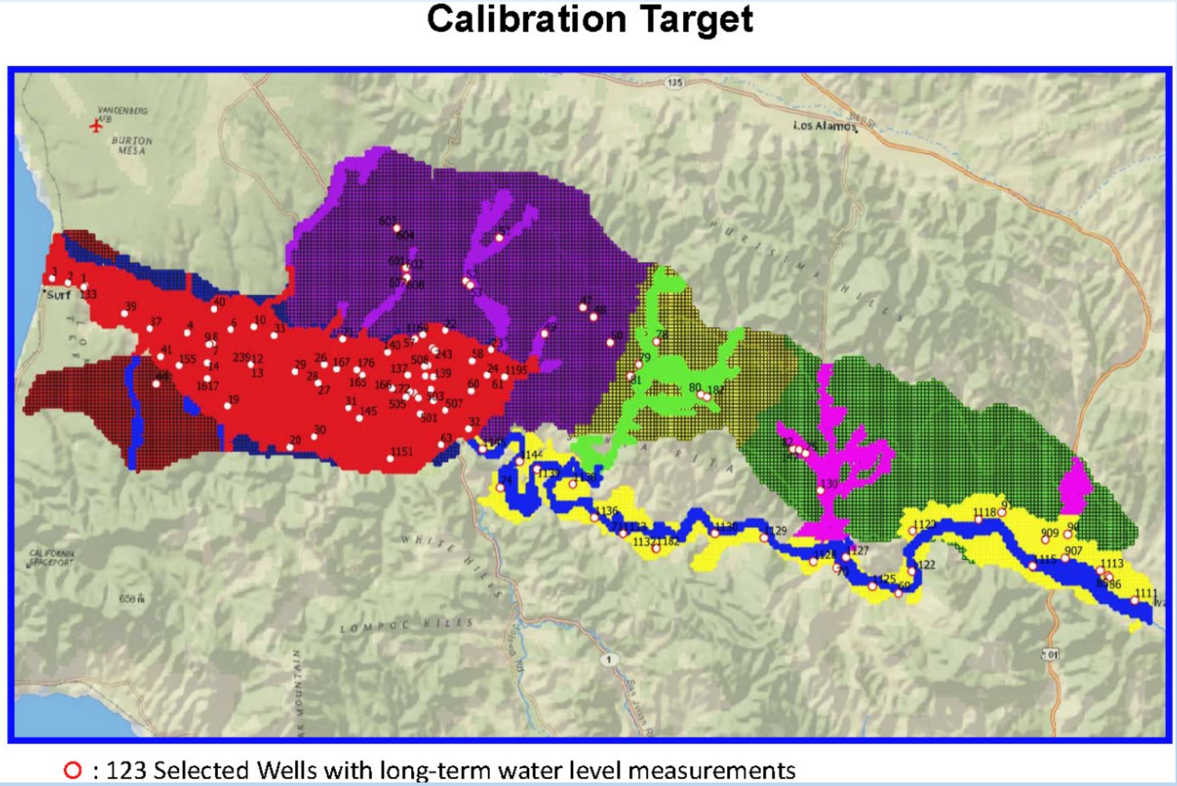
Groundwater Model Update



Visual representation of how stream flows are considered and integrated into the groundwater model.

Stream flows contribute to recharge of the identified Principal Aquifers.

Groundwater Model Update



Water Budgets developed per subareas. For WMA: Santa Rita Upland, Lompoc Upland, Lompoc Terrace, Lompoc Plain, and Santa Ynez River Alluvium subareas

Calibration time period
WY 1982-2018

Calibrated to Measured:
-Groundwater Levels/Contours
-Streamflow gages
-Intra/Inter Annual Variability

Groundwater Model Update

Questions?

Sustainable Management Criteria (SMC)

Management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

Undesirable results categorized by six sustainability indicators.

- Lowering Groundwater Levels
- Reduced Groundwater Storage
- Land Subsidence
- Degraded Water Quality
- Surface Water Depletion
- Seawater Intrusion

Avoidance of undesirable results is critical to the success of a GSP.

Need to establish undesirable results thresholds. How do we do that???

SMC Development Steps

1. Basin Conditions	2. Sustainability Goal	3. Undesirable Results	4. Minimum Thresholds	5. Measurable Objectives
Gather a good **understanding** of basin conditions. Select representative wells.	**Qualitative statement** that guides threshold setting process.	**Quantitative set of conditions** related to minimum thresholds that cause significant and unreasonable conditions.	Numeric **values for each sustainability indicator** used to define undesirable results and sustainability.	Quantifiable goals for the **maintenance or improvement** of specified groundwater conditions over 20 years.

Examples of Undesirable Results

- Lowering Groundwater Levels
  - Water levels continue to decline due to pumping rather than climatic conditions.
- Reduced Groundwater Storage
  - Water level declines reducing the volume of groundwater in storage such that there is insufficient supply to support pumping during drought conditions without causing undesirable results.
- Land Subsidence
  - Groundwater pumping practices causing ground surface elevation changes as land subsidence.

Examples of Undesirable Results

- Degraded Water Quality
  - Groundwater pumping practices that cause:
    - Migration of impaired water resulting in impairment of water supplies.
    - Concentrations exceed regulatory levels.
- Surface Water Depletion
  - Groundwater pumping practices causing depletion of interconnected surface water.
- Seawater Intrusion
  - Groundwater pumping practices causing migration of seawater into groundwater supplies.

WMA Example SMC Thresholds

Groundwater Elevations

EXAMPLE FOR DISCUSSION

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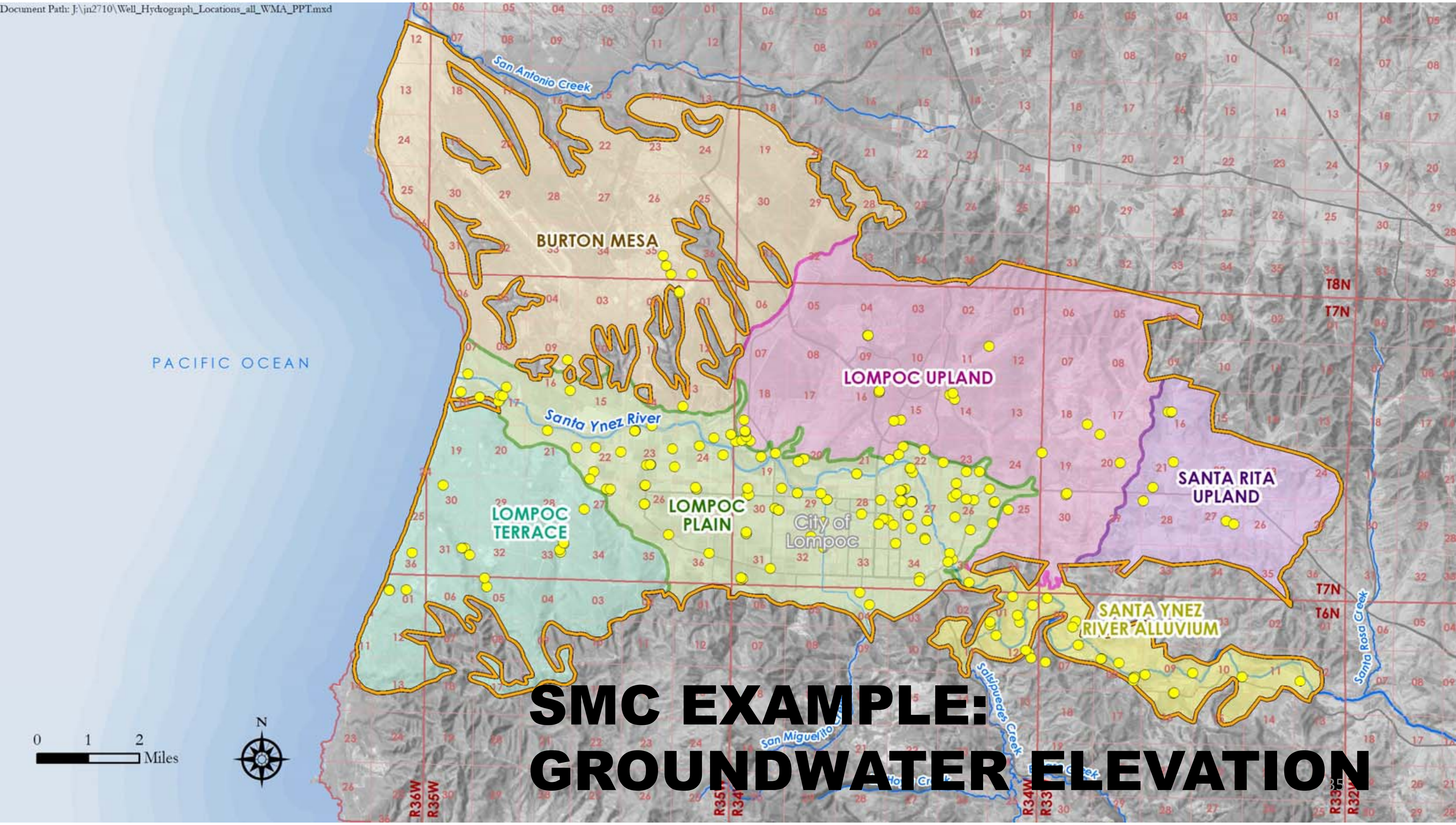
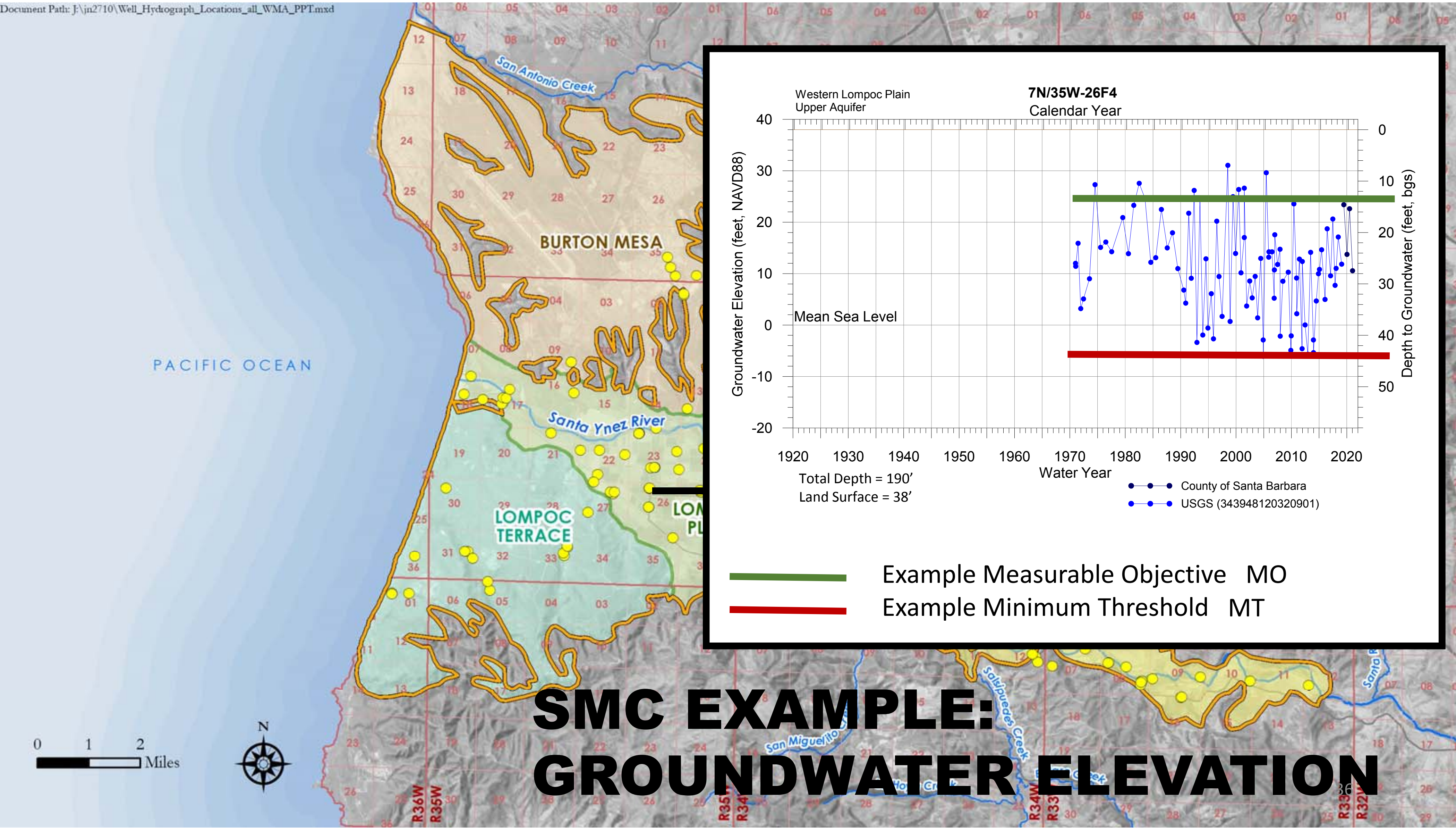
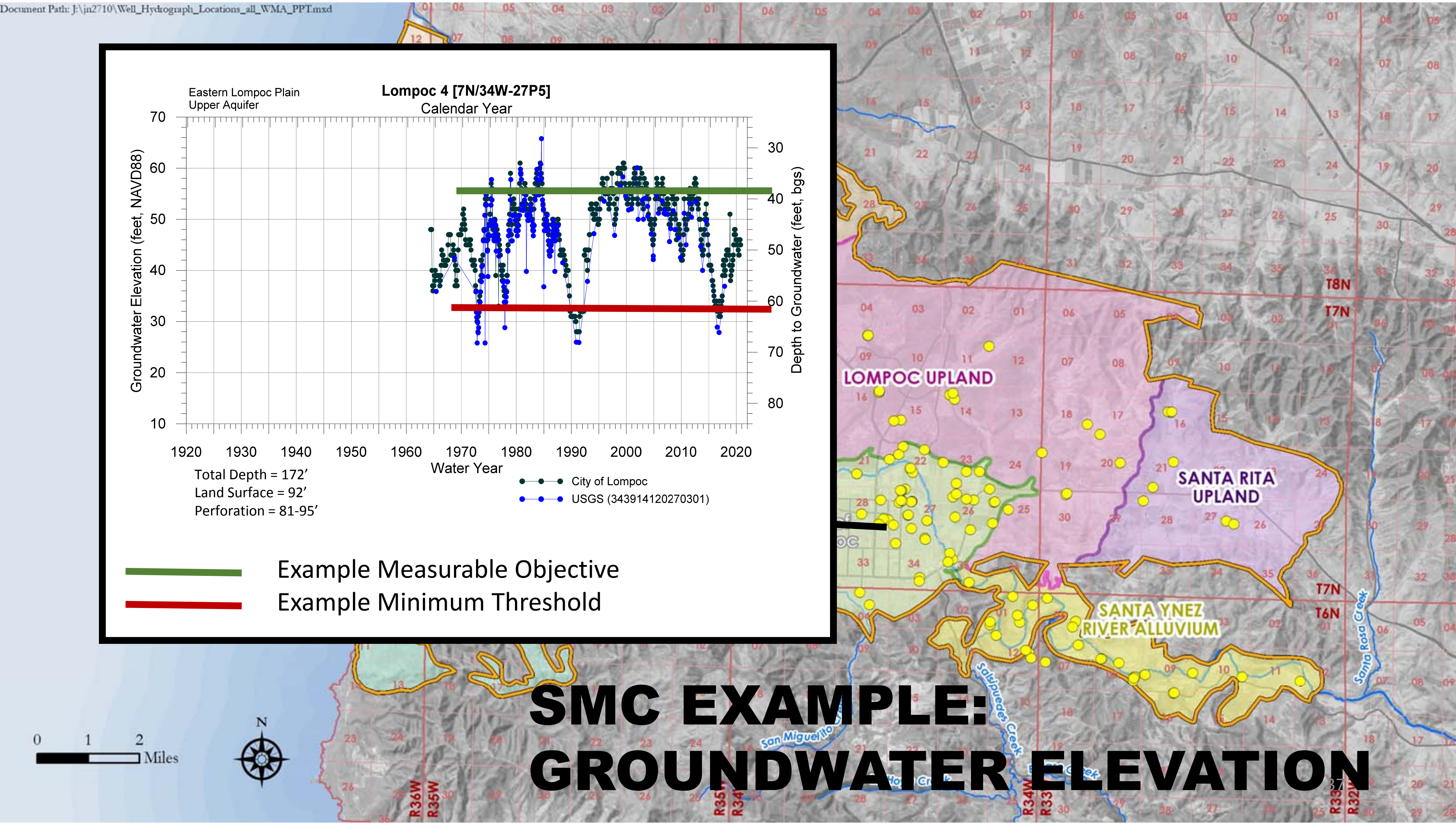
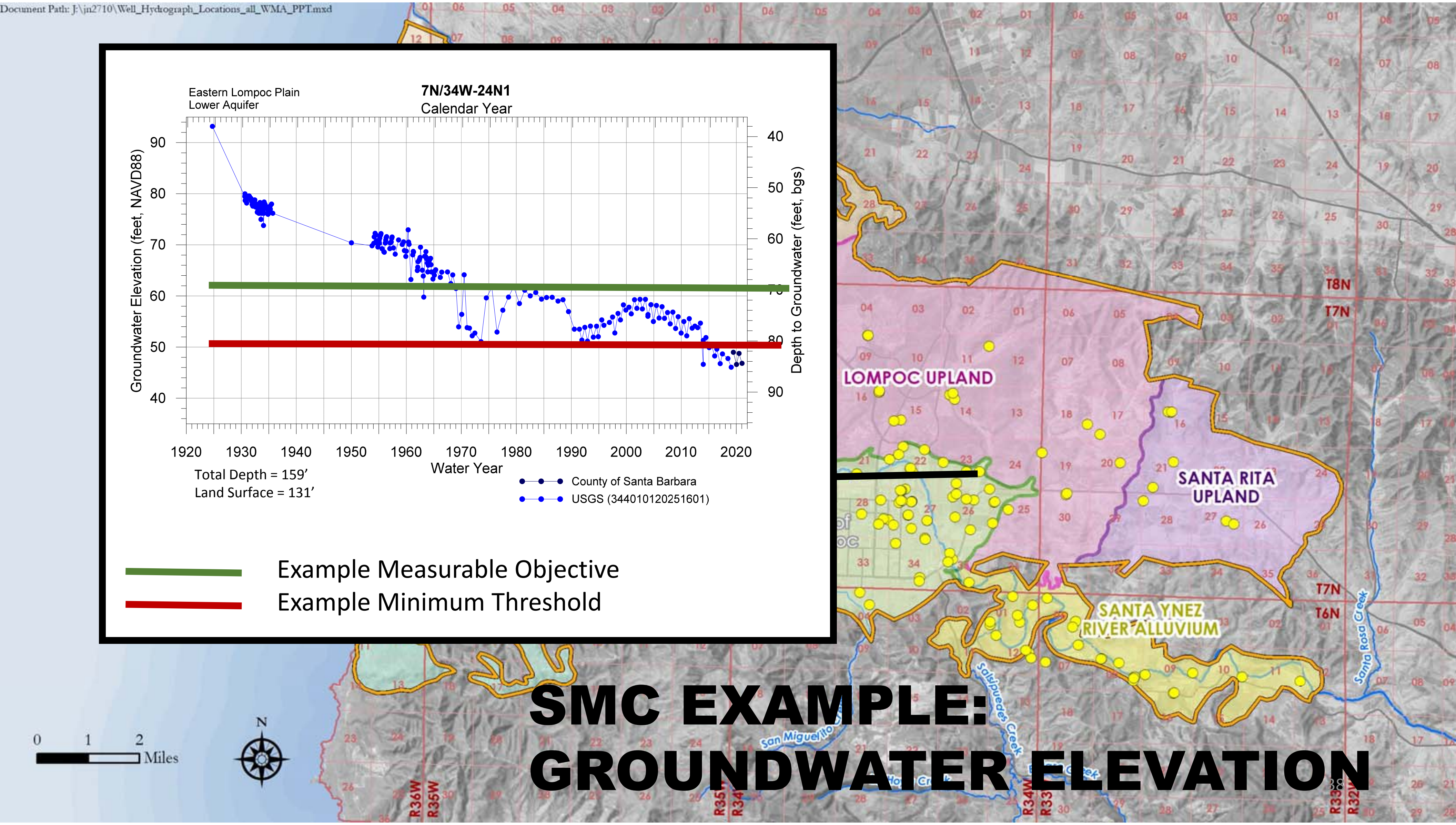
SMC EXAMPLE: GROUNDWATER ELEVATION




Document Path: J:\jn2710\Well_Hydrograph_Locations_all_WMA_PPT.mxd
PACIFIC OCEAN
BURTON MESA
LOMPOC TERRACE
Santa Ynez River
San Antonio Creek
Salsipuedes Creek
San Miguelito
0 1 2 Miles
N
Western Lompoc Plain
Upper Aquifer
7N/35W-26F4
Calendar Year
Groundwater Elevation (feet, NAVD88)
Depth to Groundwater (feet, bgs)
Mean Sea Level
Water Year
Total Depth = 190'
Land Surface = 38'
County of Santa Barbara
USGS (343948120320901)
Example Measurable Objective MO
Example Minimum Threshold MT
SMC EXAMPLE:
GROUNDWATER ELEVATION


Document Path: J:\jn2710\Well_Hydrograph_Locations_all_WMA_PPT.mxd
Eastern Lompoc Plain
Upper Aquifer
Lompoc 4 [7N/34W-27P5]
Calendar Year
Groundwater Elevation (feet, NAVD88)
Depth to Groundwater (feet, bgs)
Water Year
Total Depth = 172’
Land Surface = 92’
Perforation = 81-95’
City of Lompoc
USGS (343914120270301)
Example Measurable Objective
Example Minimum Threshold
LOMPOC UPLAND
SANTA RITA
UPLAND
SANTA YNEZ
RIVER ALLUVIUM
T8N
T7N
T6N
Salsipuedes Creek
San Miguelito
Santa Rosa Creek
Miles
N
SMC EXAMPLE:
GROUNDWATER ELEVATION

Document Path: J:\jn2710\Well_Hydrograph_Locations_all_WMA_PPT.mxd



SMC EXAMPLE: GROUNDWATER ELEVATION

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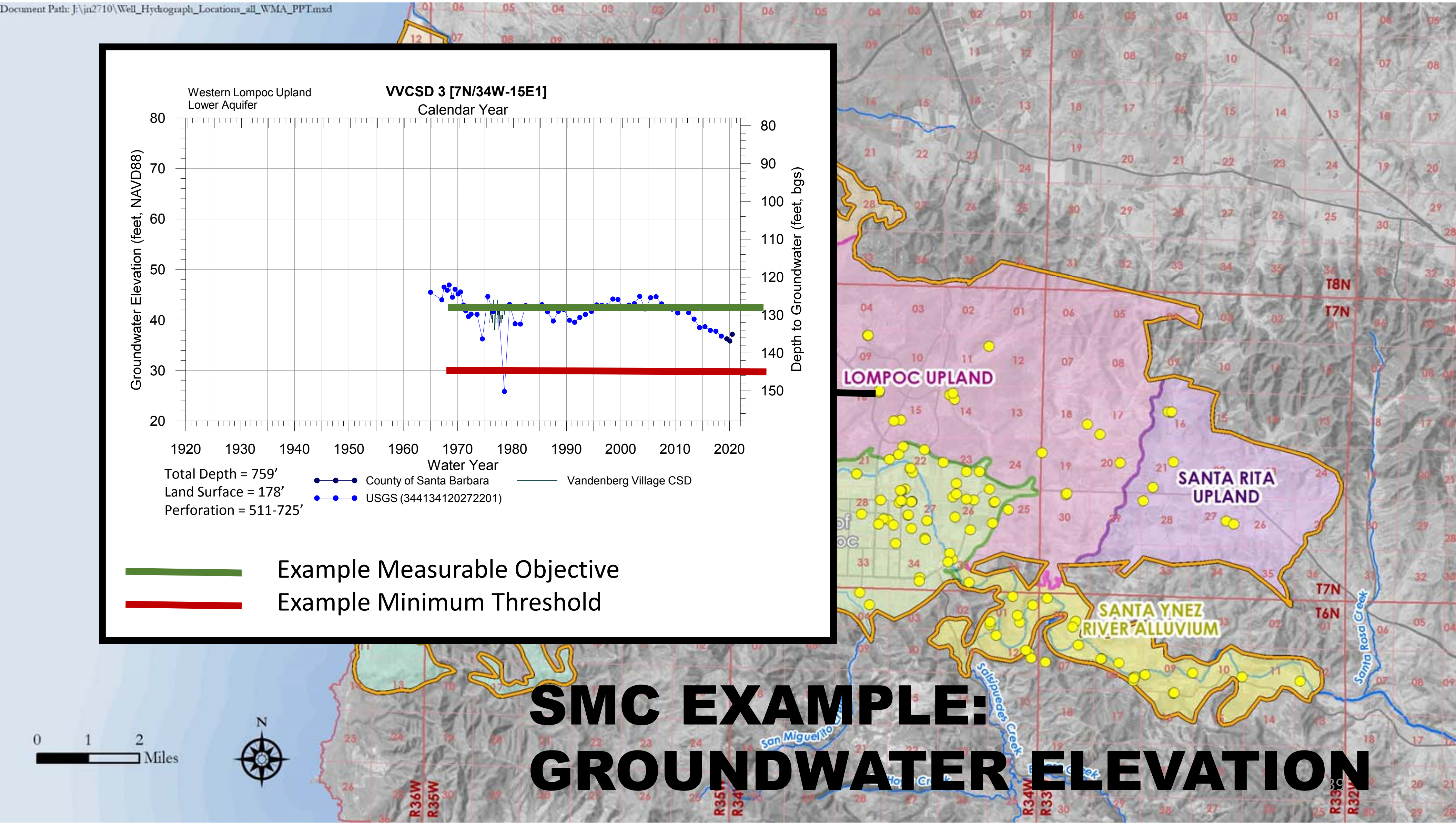
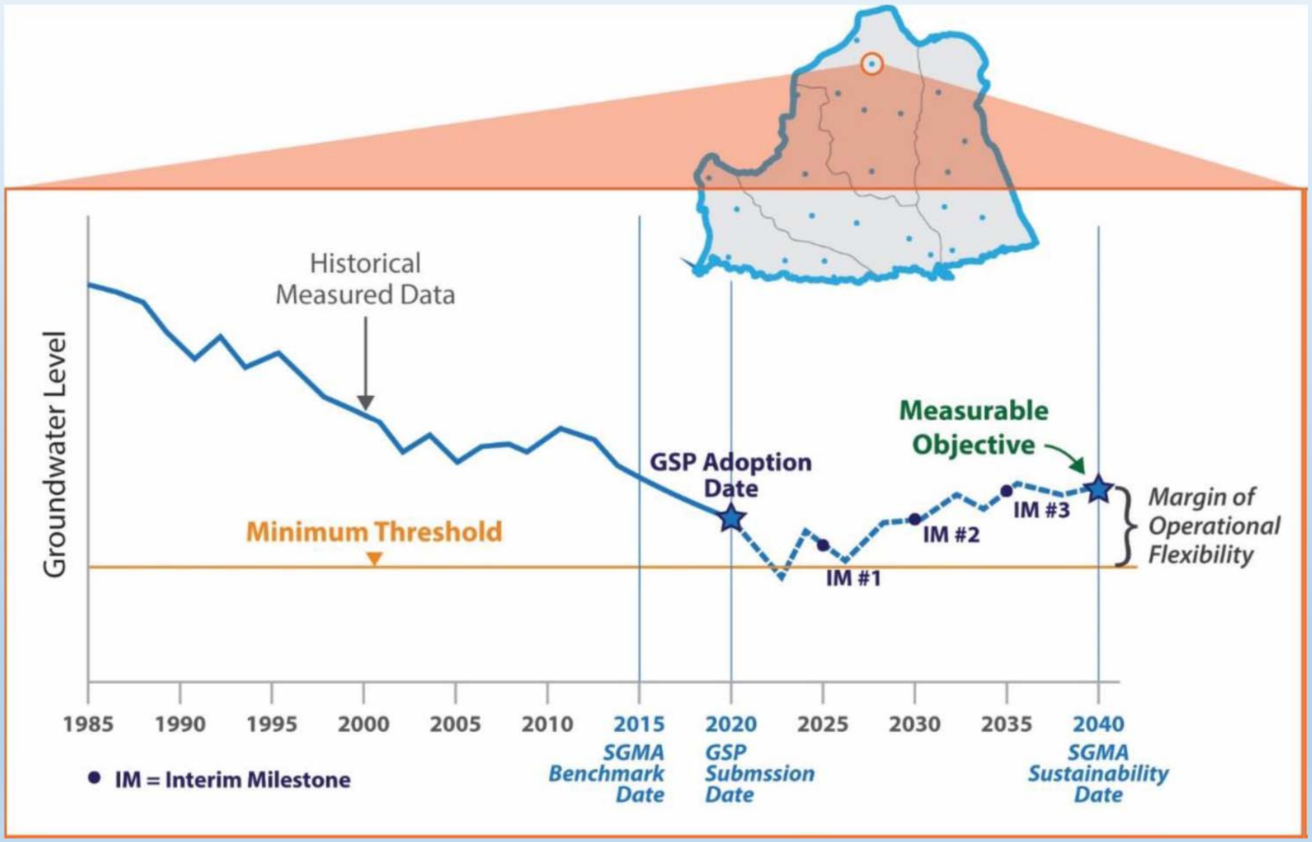
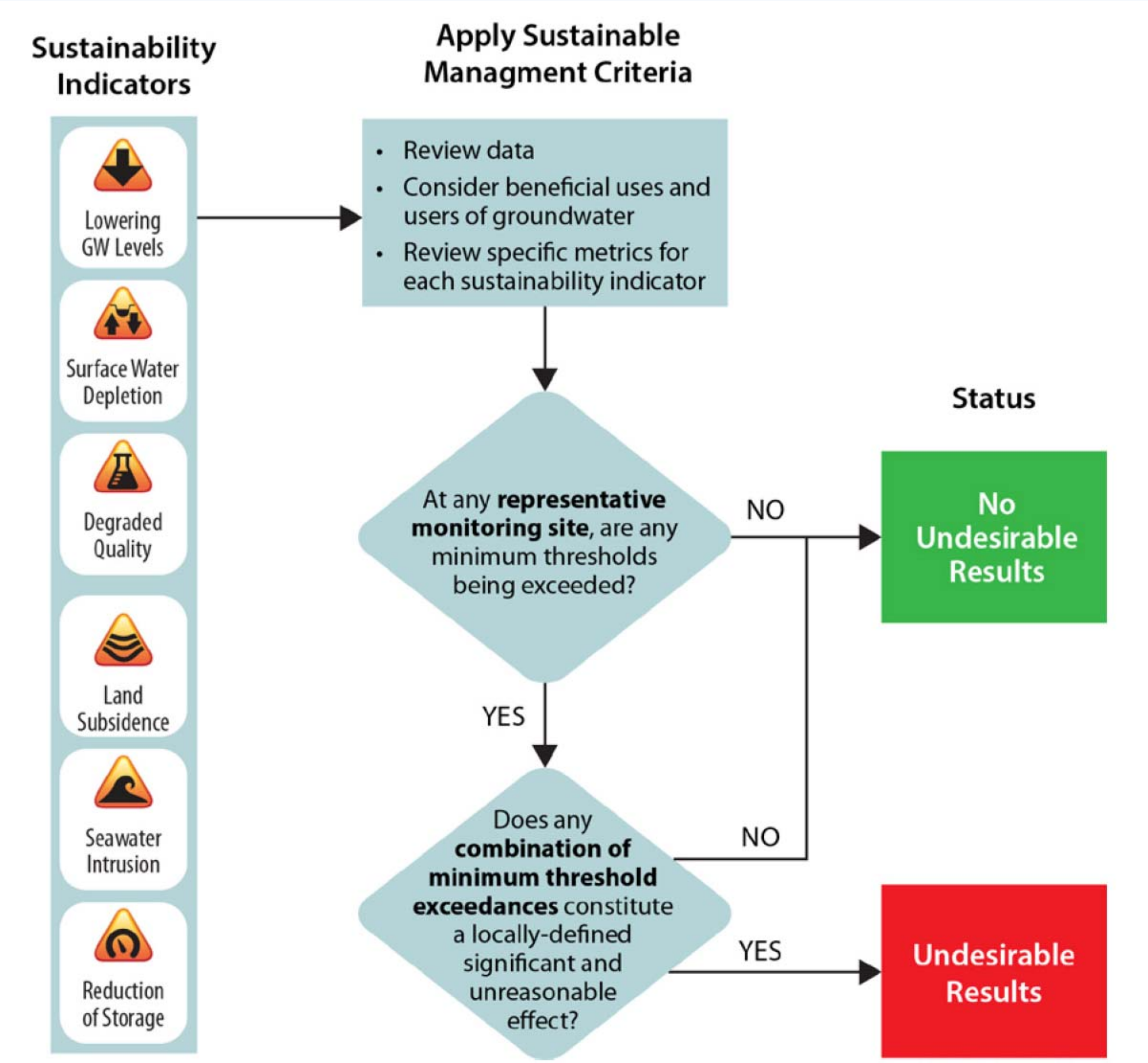


Minimum Thresholds and Planning Horizon under SGMA





Process for Determining Undesirable Results

- **Six indicators**
- **Review data and beneficial uses**
- **Locally-defined <u>significant</u> and <u>unreasonable</u> effects**
- **Minimum Thresholds**
- **Monitoring**

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Examples of SMCs for Other Indicators' Undesirable Results

Reduced Groundwater Storage

- Tied to MTs and MOs of water levels of representative wells

Land Subsidence

- MT = allowed subsidence at critical infrastructure without causing damage
- MO = no long-term reduction at monitoring locations

Degraded Water Quality

- Groundwater pumping practices that cause:
  - MT = drinking water quality standards (xx% of wells must exceed)
  - MO = natural baseline conditions

Seawater Intrusion

- MT = 500 mg/L Chloride Concentration front reaches VAFB boundary
- MO = Estuary salinity maintains current baseline salinity level

Surface Water Depletion

- Assess impacts to GDEs (not along the river)

SMC and Undesirable Results

Questions?

The Way Ahead

- Complete the Groundwater Conditions Tech Memo
- Complete the Water Budget
- Complete the Groundwater Model
- Establish Monitoring Network
- Establish Sustainable Management Criteria Thresholds
- Identify Projects and Management Actions
- Release DRAFT GSP

The Way Ahead

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Questions?

Comments can be submitted to the website:

www.santaynezwater.org