Salinas Valley Basin GSA

Forebay Aquifer Subbasin GSP Overview

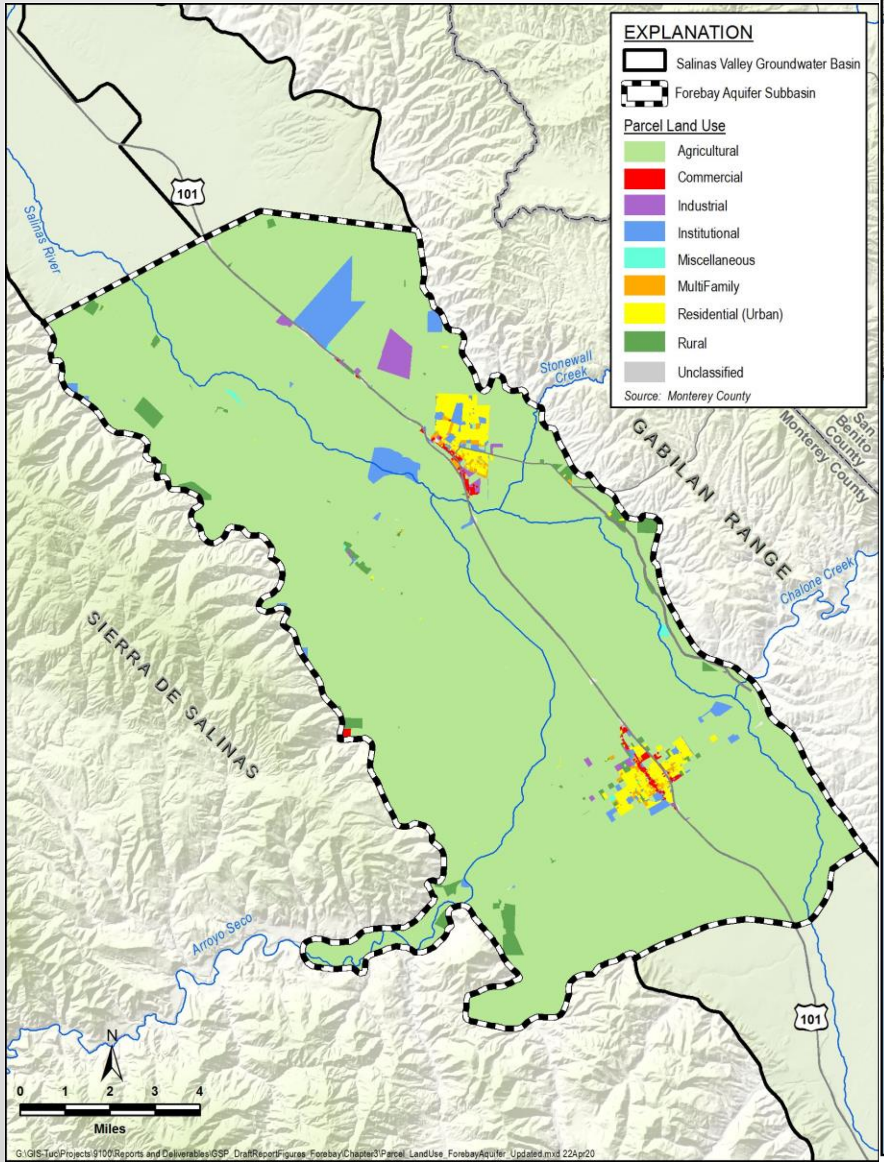
Presented to SVBGSA Advisory Committee
June 17, 2021

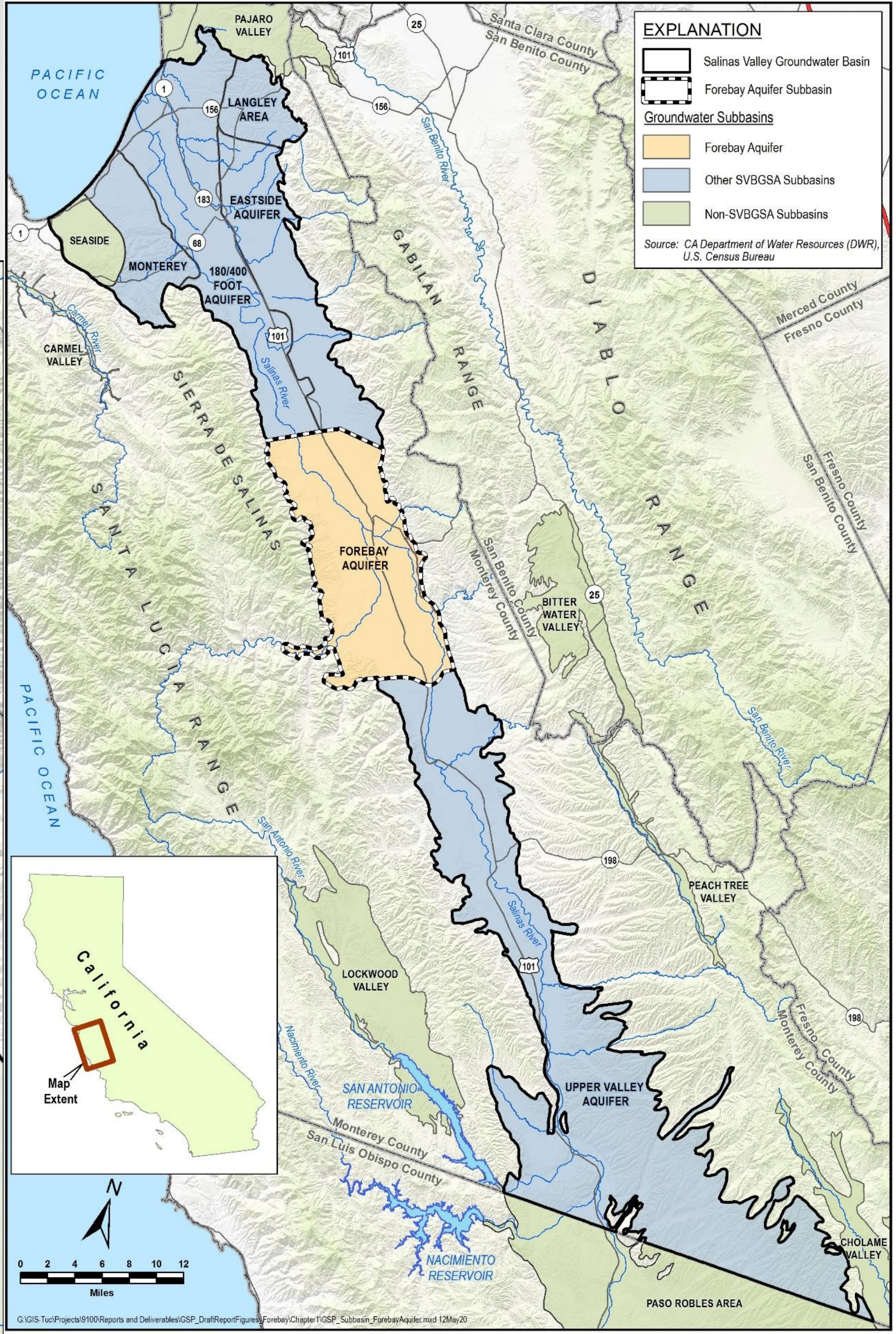
Prepared by

MONTGOMERY & ASSOCIATES

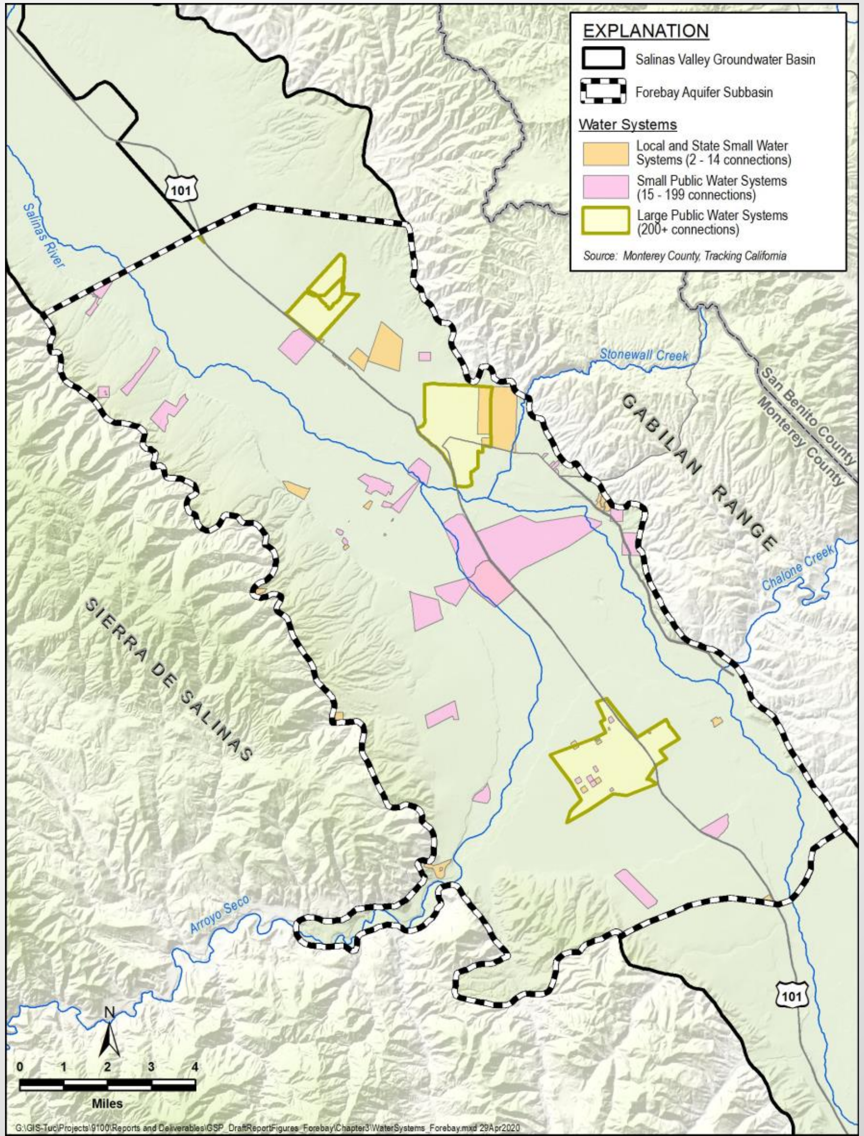
Forebay Aquifer Subbasin

- 94,000 acres
- Most land designated agricultural



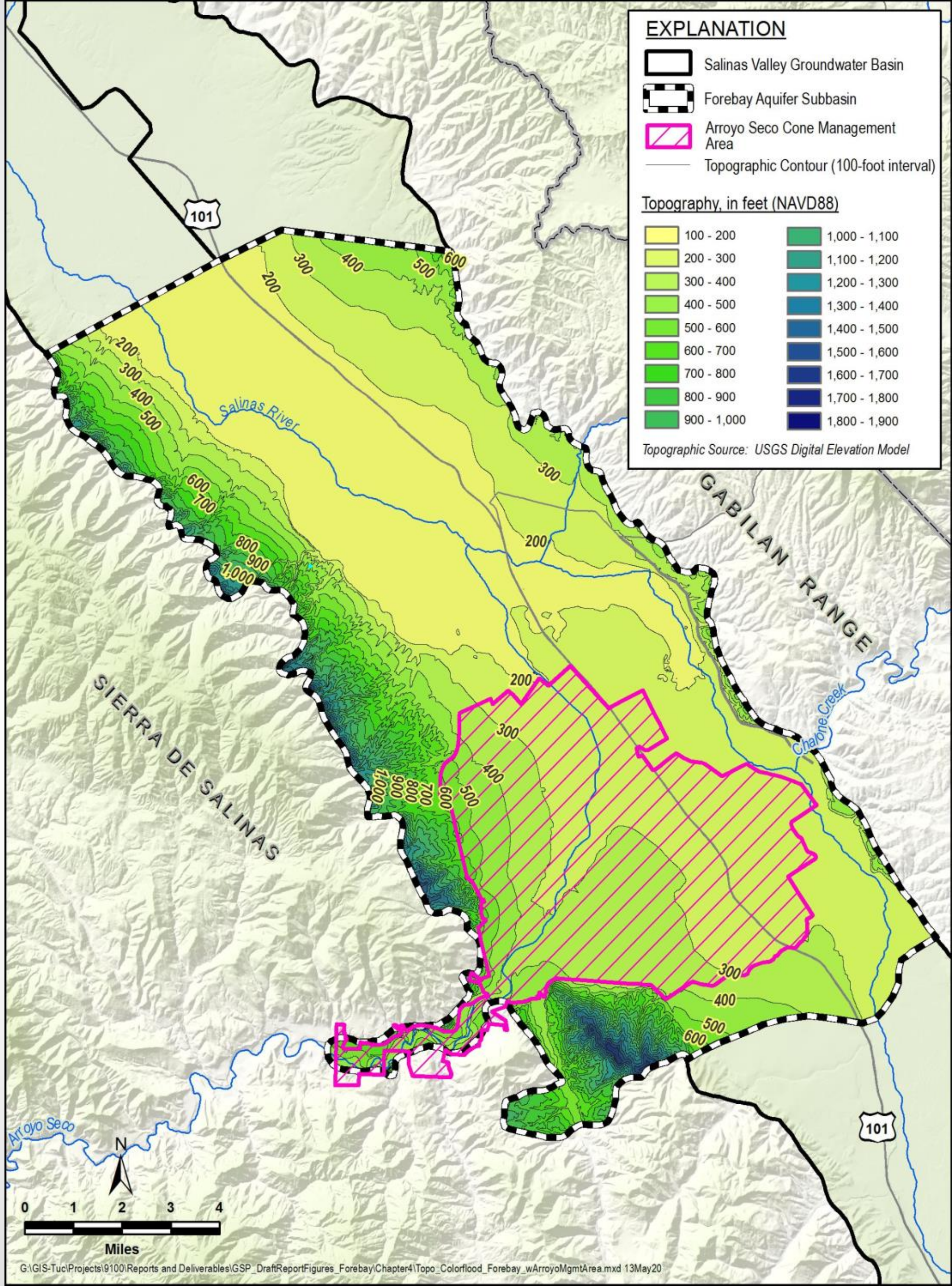


Communities Dependent on Groundwater

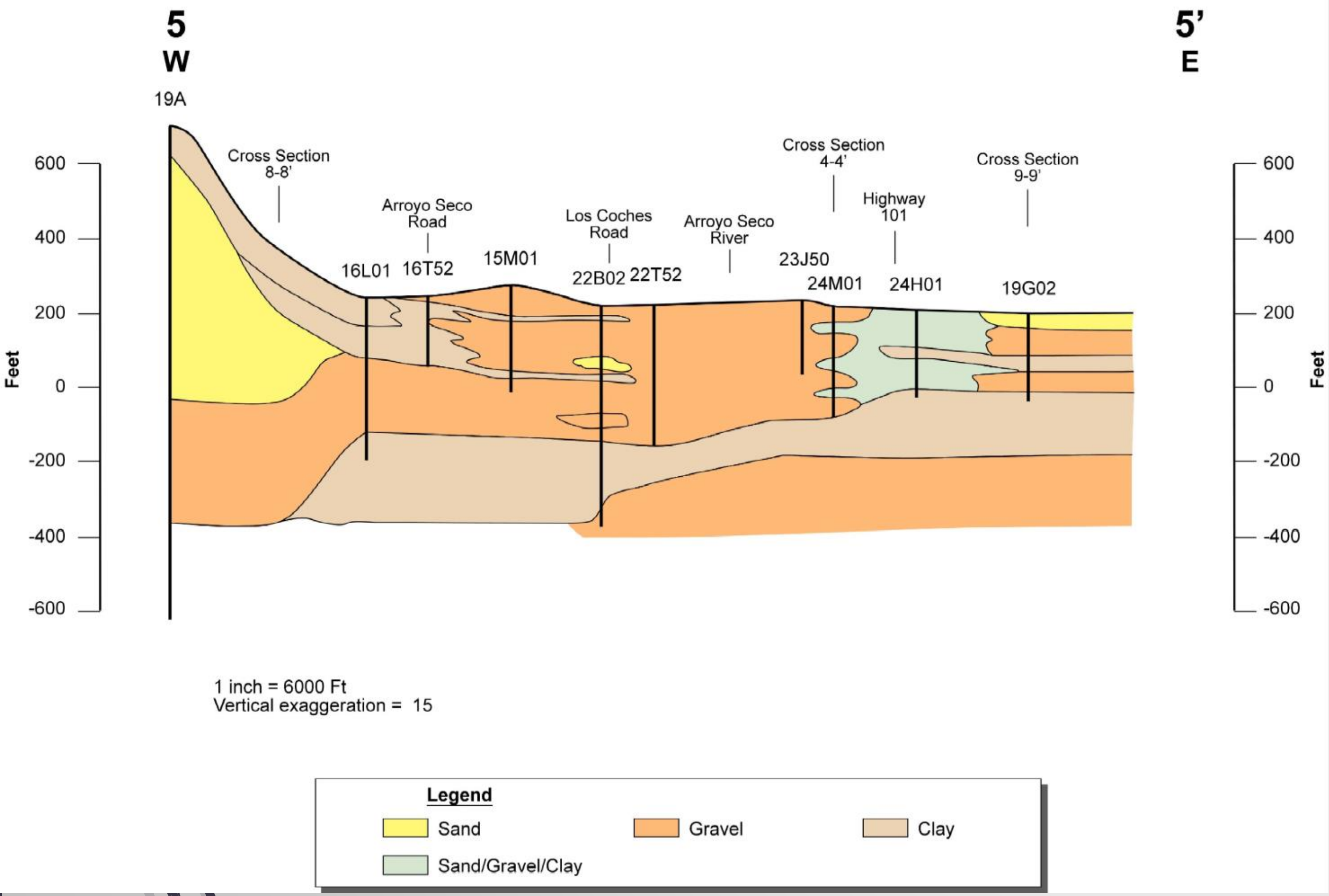


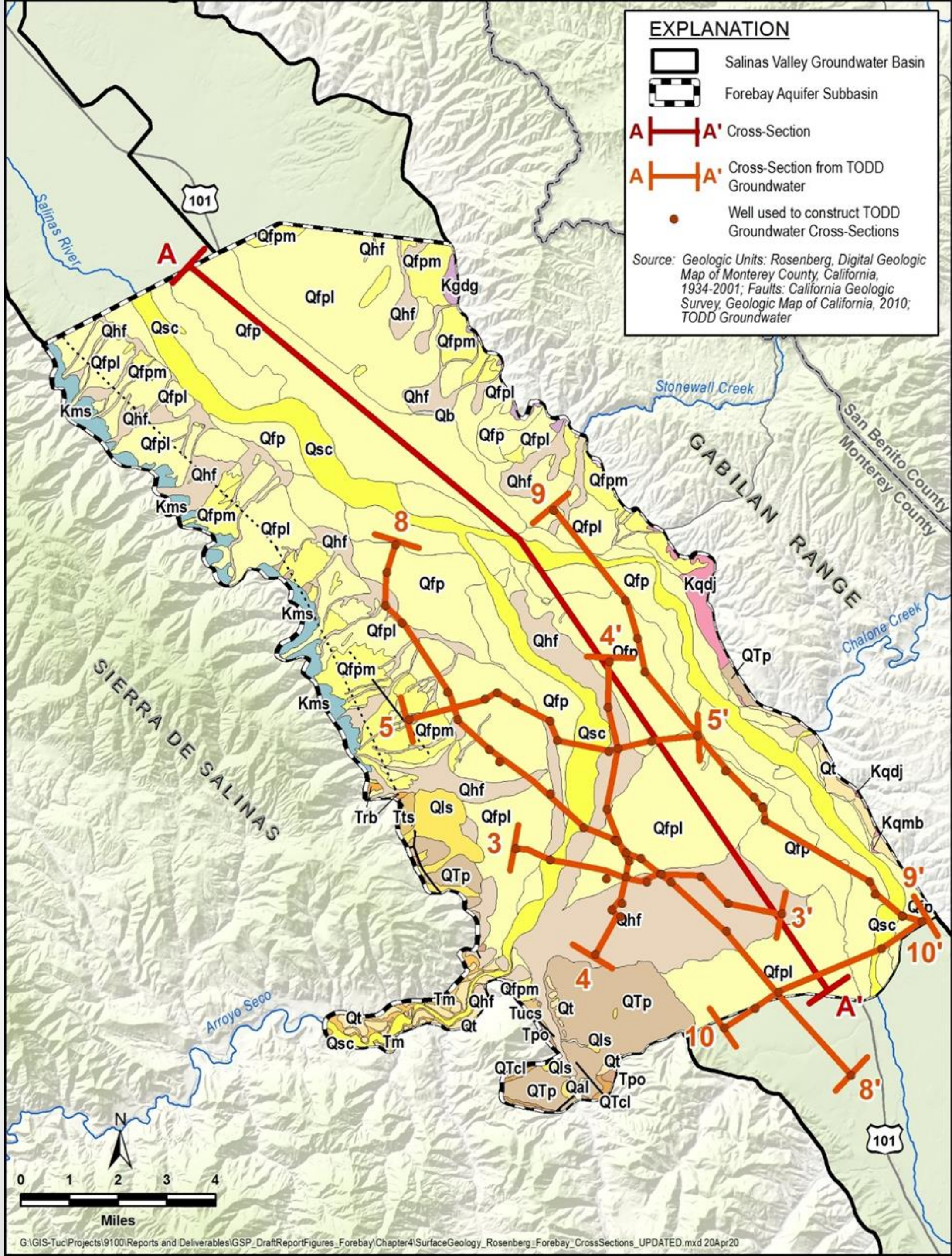
Basin Setting - Topography

- Arroyo Seco Cone
  - Alluvial fan
  - Coarser material than greater Forebay Subbasin
- Arroyo Seco Cone Management Area is outlined in pink



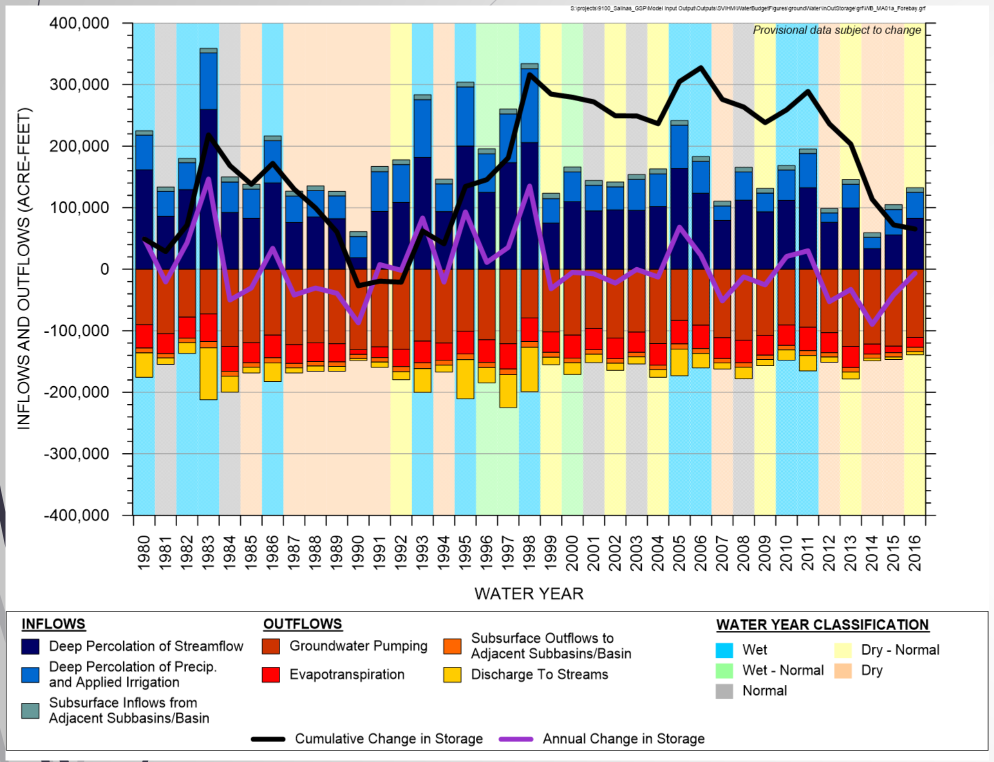
Hydrogeologic Conceptual Model





Groundwater Budget

Updated Water Budget

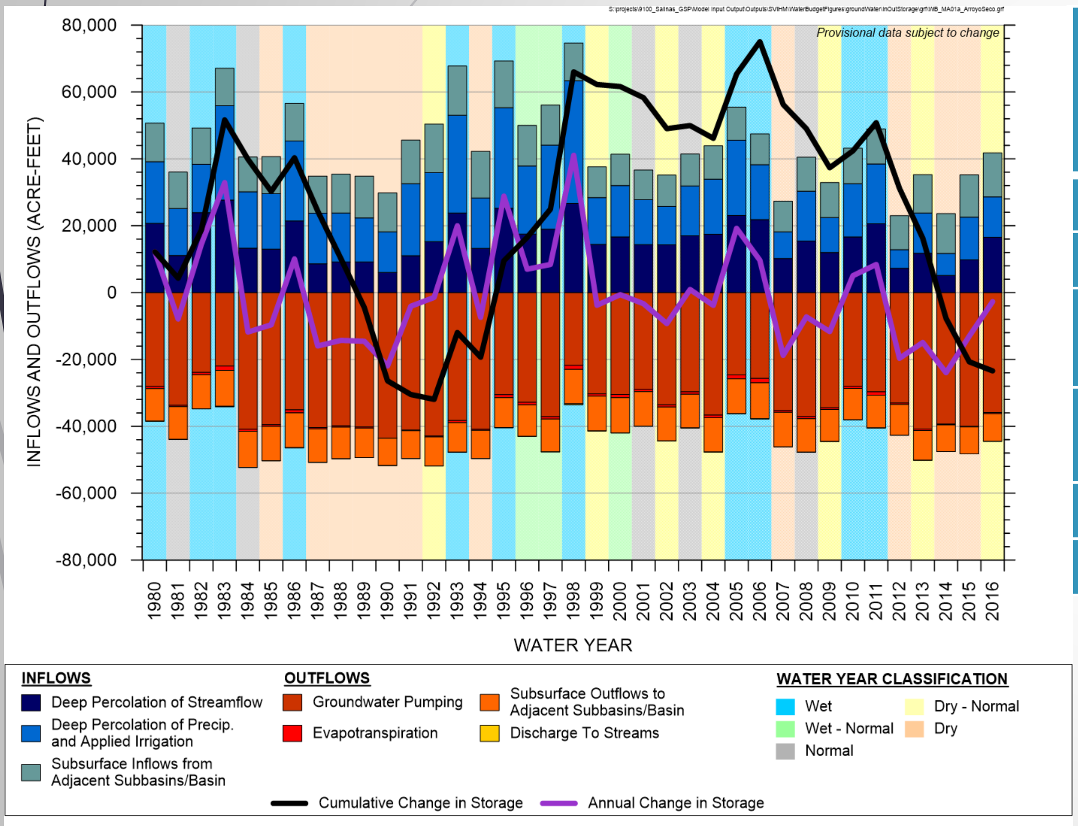


	Historical Average (WY 1980-2016)	2030	2070
Groundwater Pumping	-108,655	-111,500	-117,800
Net Stream Exchange	90,316	103,200	105,700
Deep Percolation of Precipitation & Applied Irrigation	52,197	53,100	57,500
Net flow from Adjacent Subbasins/Basin	-26	-500	0
Groundwater Evapotranspiration	-32,060	-33,900	-35,100
Net Storage Gain (+) or Loss (-)	1,772	9,900	9,600

Provisional data subject to change.
Units are acre-feet per year.
Negative values indicate a loss of groundwater.

Groundwater Budget for Arroyo Seco Cone Management Area

Updated Water Budget



	Historical Average (WY 1980-2016)	2030	2070
Groundwater Pumping	-34,200	-34,900	-37,100
Net Stream Exchange	15,600	23,800	23,800
Deep Percolation of Precipitation & Applied Irrigation	16,900	15,300	16,600
Net flow from Adjacent Subbasins/Basin	1,600	-2,100	-1,500
Groundwater Evapotranspiration	-600	-1,500	-1,500
Net Storage Gain (+) or Loss (-)	-600	1,700	1,600

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Units are acre-feet per year.
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Sustainable Yield = pumping + change in storage

Updated Water Budget

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Units are acre-feet per year.
Negative values indicate a loss of groundwater.

Model results

	Historical Sustainable Yield	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield
Groundwater Pumping	108,700	111,500	117,800
Change in Storage	1,800	9,900	9,600
Projected Sustainable Yield	110,400	121,400	127,400
% Pumping Change	2% increase	9% increase	8% increase

Model results adjusted based on pumping data

	Historical Sustainable Yield Range	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield
Groundwater Pumping	151,106 to 174,452	169,500	179,200
Change in Storage	0	0	0
Projected Sustainable Yield	151,106 to 174,452	169,500	179,200

Sustainable Yield for Arroyo Seco Cone Management Area

Updated Water Budget

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Negative values indicate a loss of groundwater.

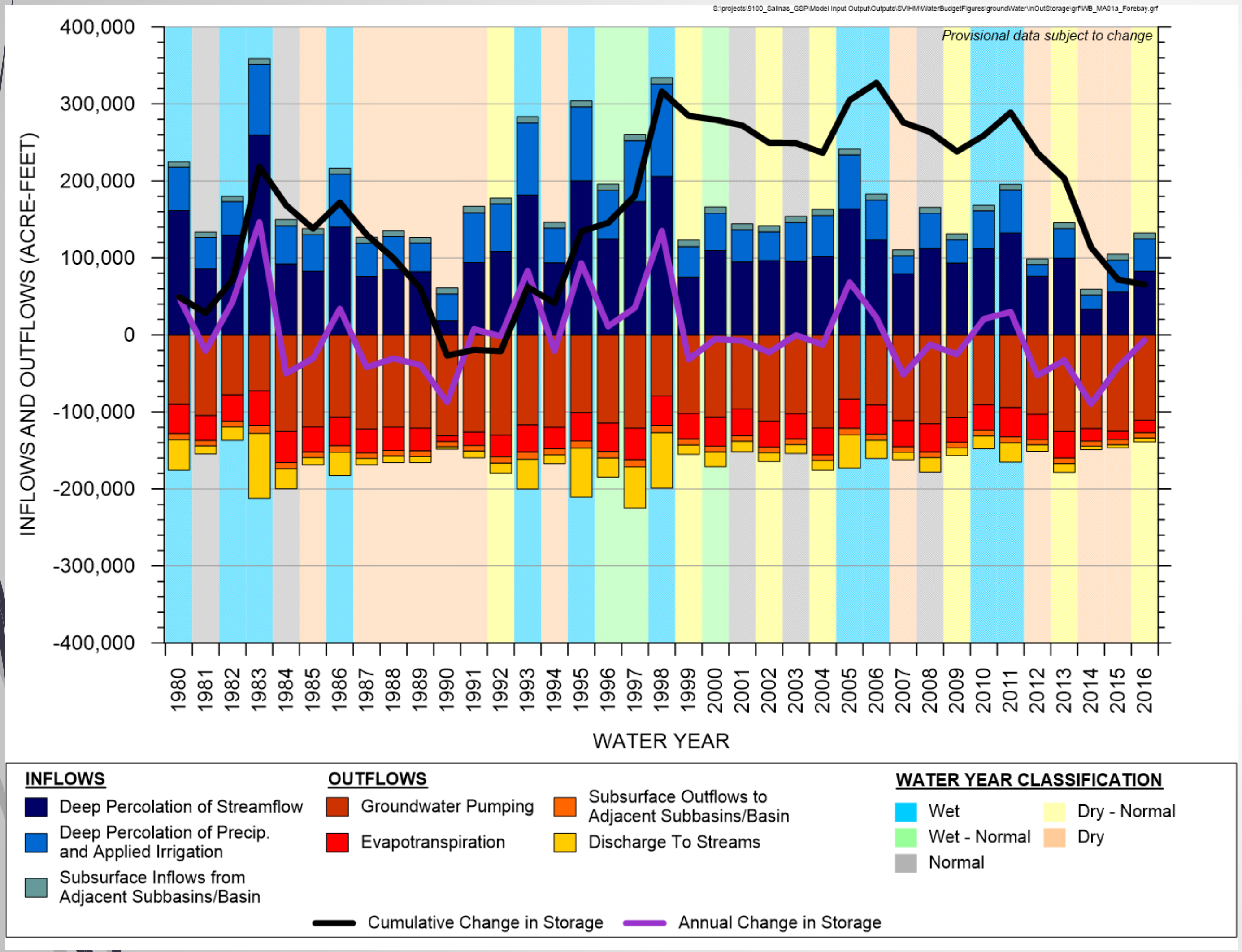
Model results

	Historical Sustainable Yield	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield
Groundwater Pumping	34,200	34,900	37,100
Change in Storage	-600	1,700	1,600
Projected Sustainable Yield	33,600	36,600	38,700
% Pumping Change	2% decrease	5% increase	4% increase

Model results adjusted based on pumping data

	Historical Sustainable Yield Range	2030 Projected Sustainable Yield	2070 Projected Sustainable Yield
Groundwater Pumping	44,400 to 53,000	52,100	55,400
Change in Storage	0	0	0
Projected Sustainable Yield	44,400 to 53,000	52,100	55,400

Groundwater Budget Summary



- Overall – there is no chronic decline in water levels and Forebay is in balance
- Historical and future water budgets are both averages of many years/hydrologic periods
- Current is a snapshot and does not tell us much since it only views change from one year to the next
- Future water budget incorporates average climate change, but does not represent short-term climate change effects

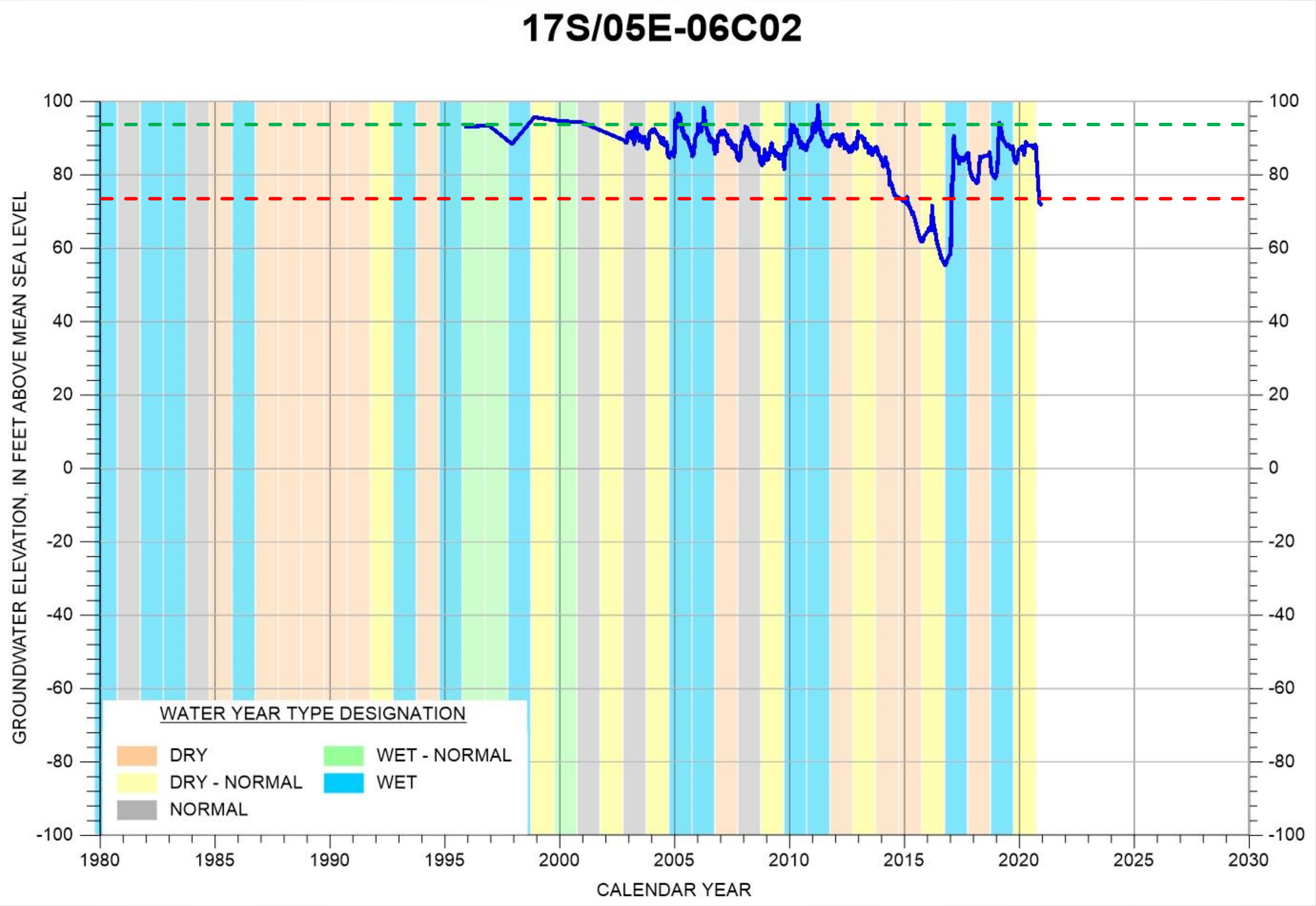
Groundwater conditions/SMC – **Groundwater Levels**

1. Chronic lowering of groundwater levels SMC

Measurable Objective (MO):
2015 groundwater elevations + 75% of difference between 2015 and 1998

Minimum Threshold (MT):
Set to December 2015 groundwater elevations

Undesirable Result:
Over the course of any one year, more than 15% of groundwater elevation minimum thresholds are exceeded.



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Minimum Threshold – 2015 elevation

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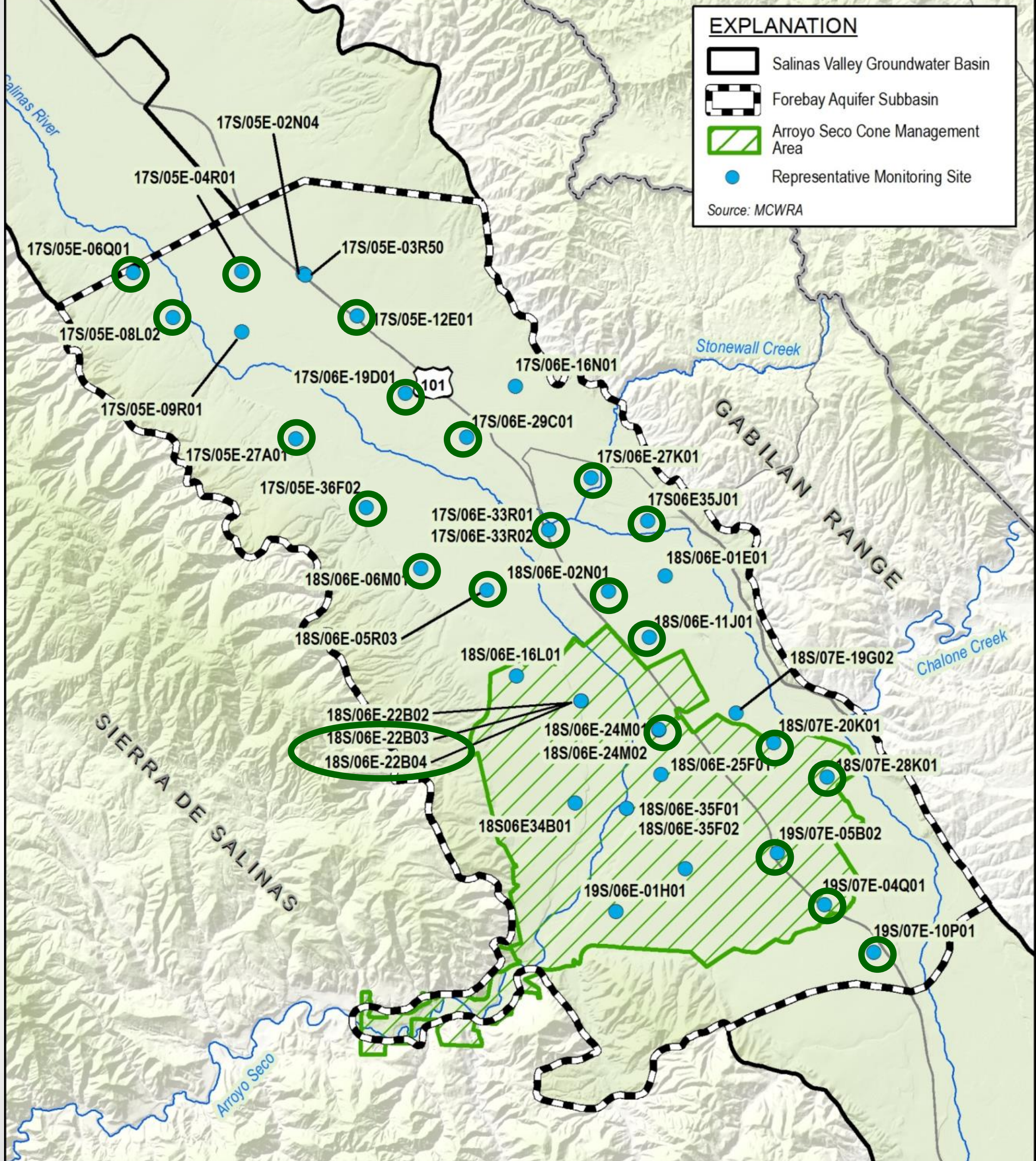
No wells were below the MT in 2019

Wells circled in green were above the MO in 2019



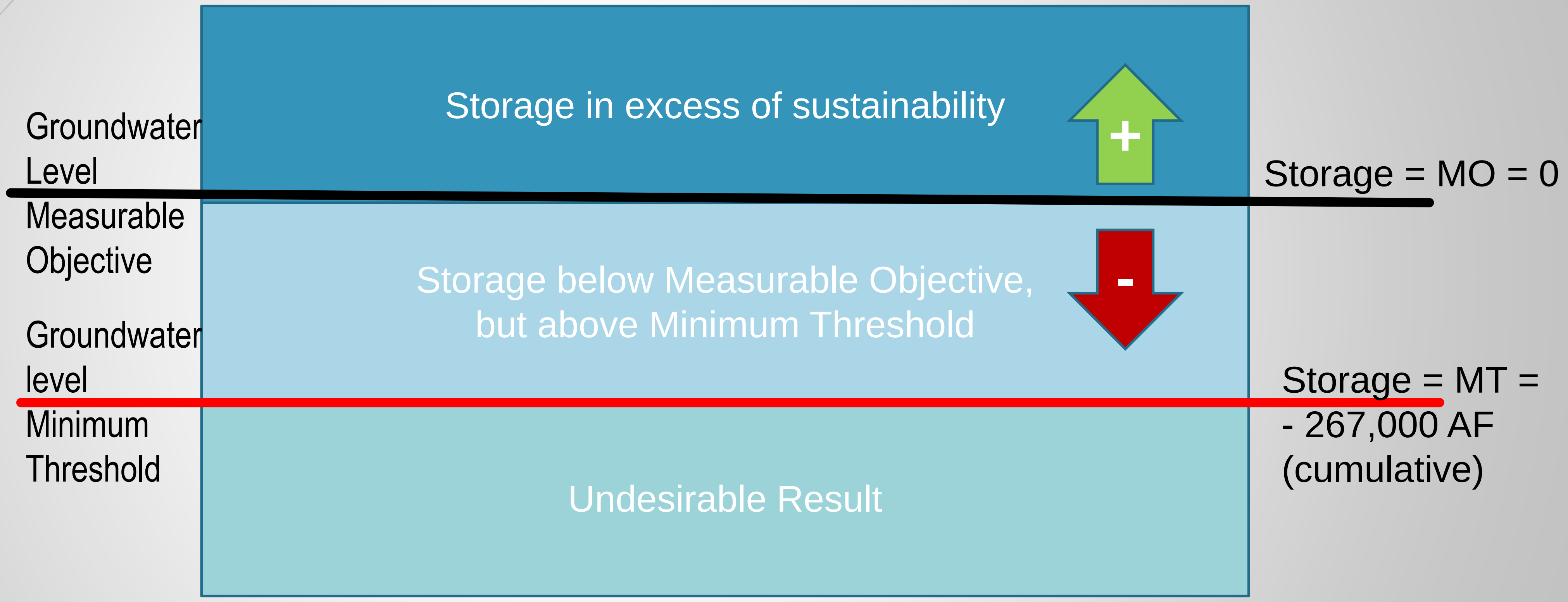
Groundwater conditions/SMC – **Groundwater Storage**

2. Reduction of groundwater storage

Measurable Objective (MO):
Set to zero when the groundwater elevations are held at the groundwater level measurable objectives.

Minimum Threshold (MT):
Set to -267,000 acre-feet below the measurable objective. This reduction is based on the groundwater level minimum thresholds.

Undesirable Result:
There is an exceedance of the minimum threshold.



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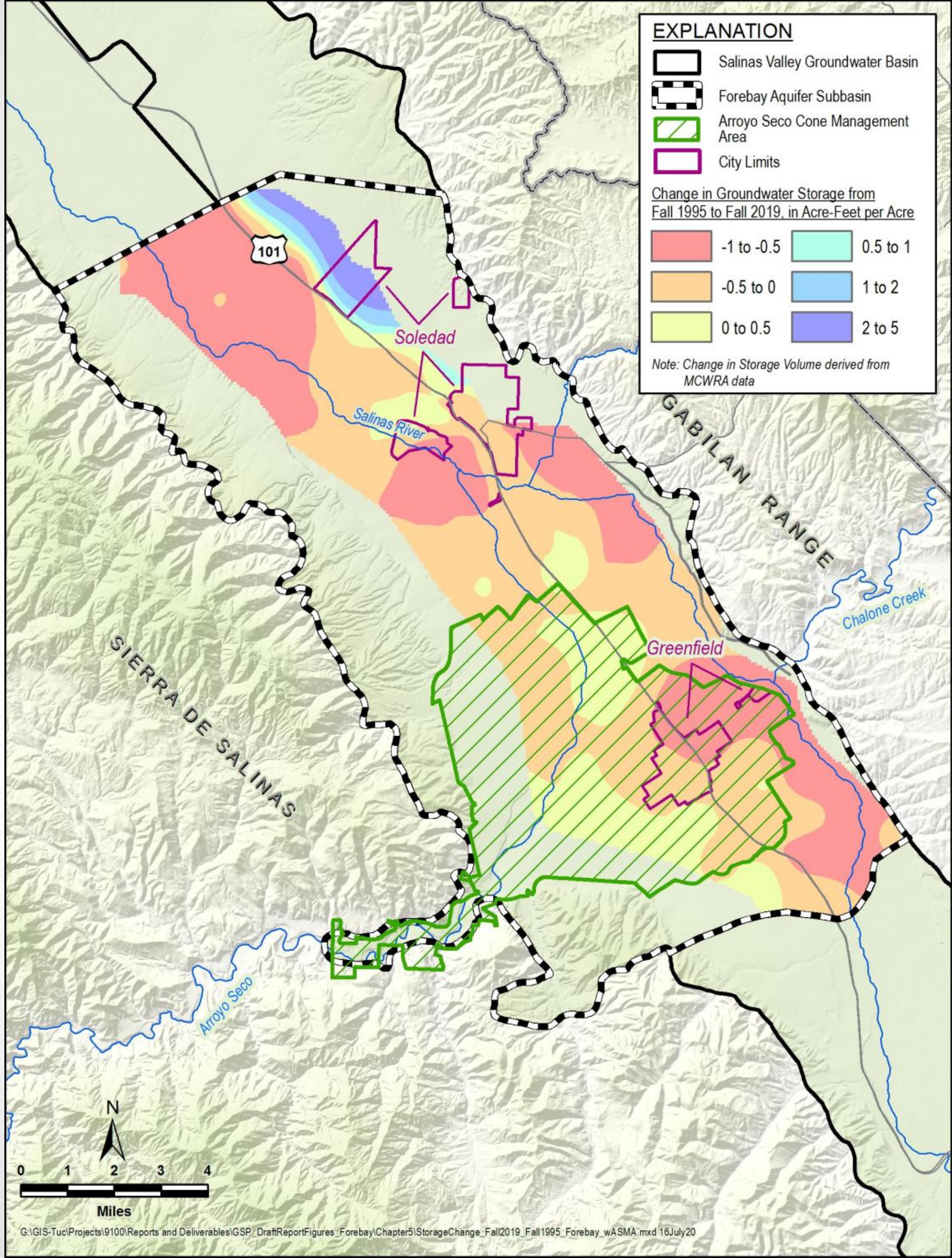


Groundwater conditions/ SMC – **Water Quality**

3. Degraded Groundwater Quality

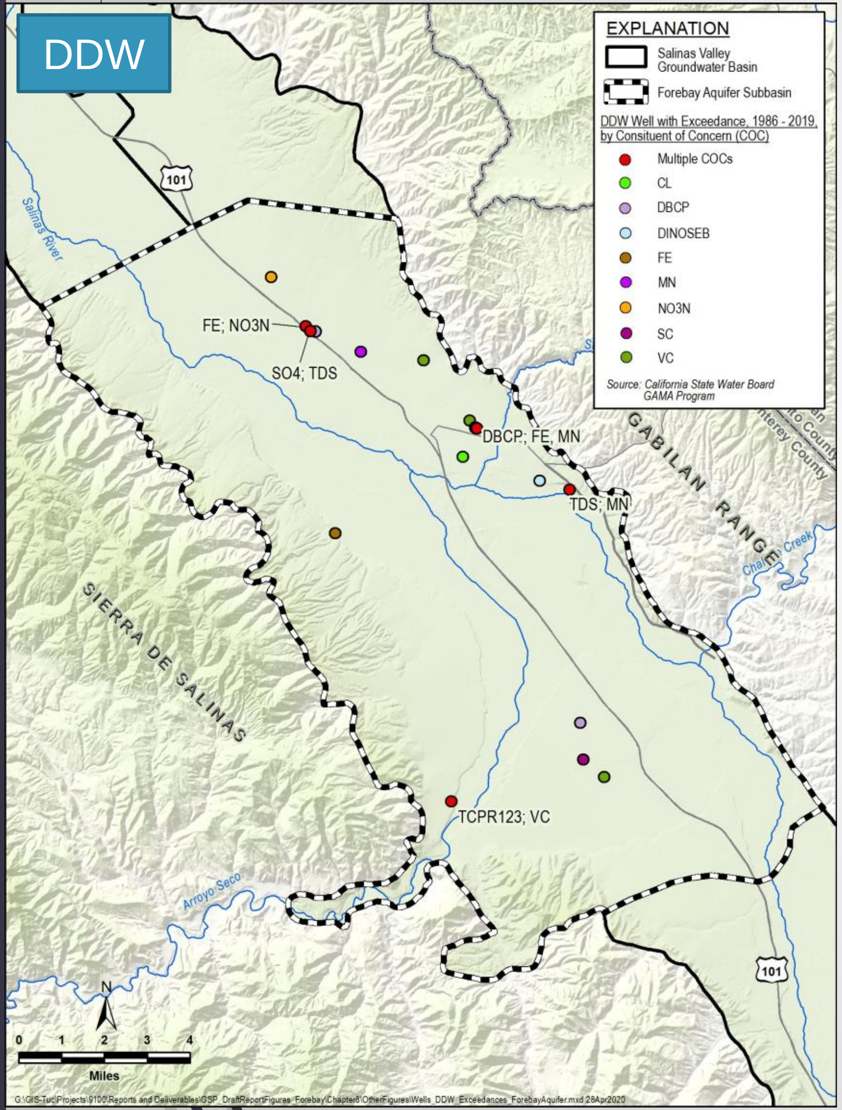
Measurable Objective (MO)
Zero additional exceedances of either the regulatory drinking water standards (potable supply wells) or the Basin Plan objectives (irrigation supply wells) beyond those observed in 2019 for groundwater quality constituents of concern.

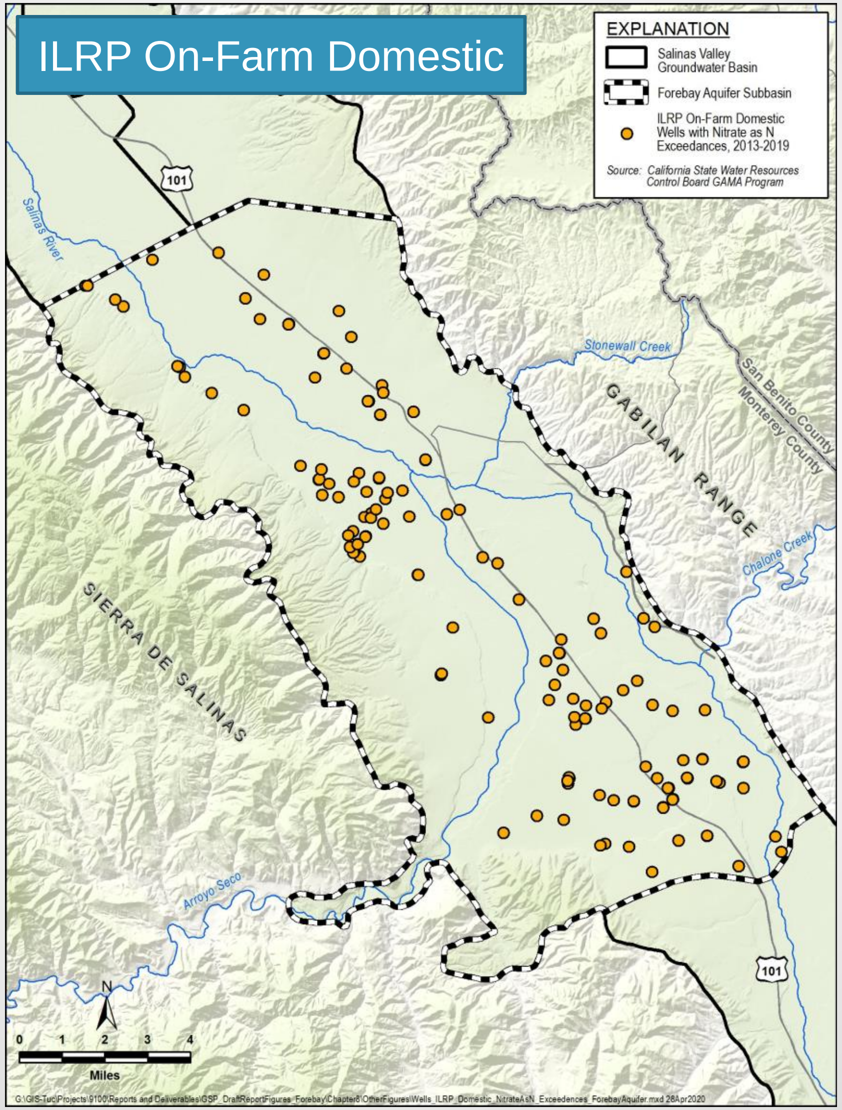
Minimum Threshold (MT)
Same as the measurable objective.

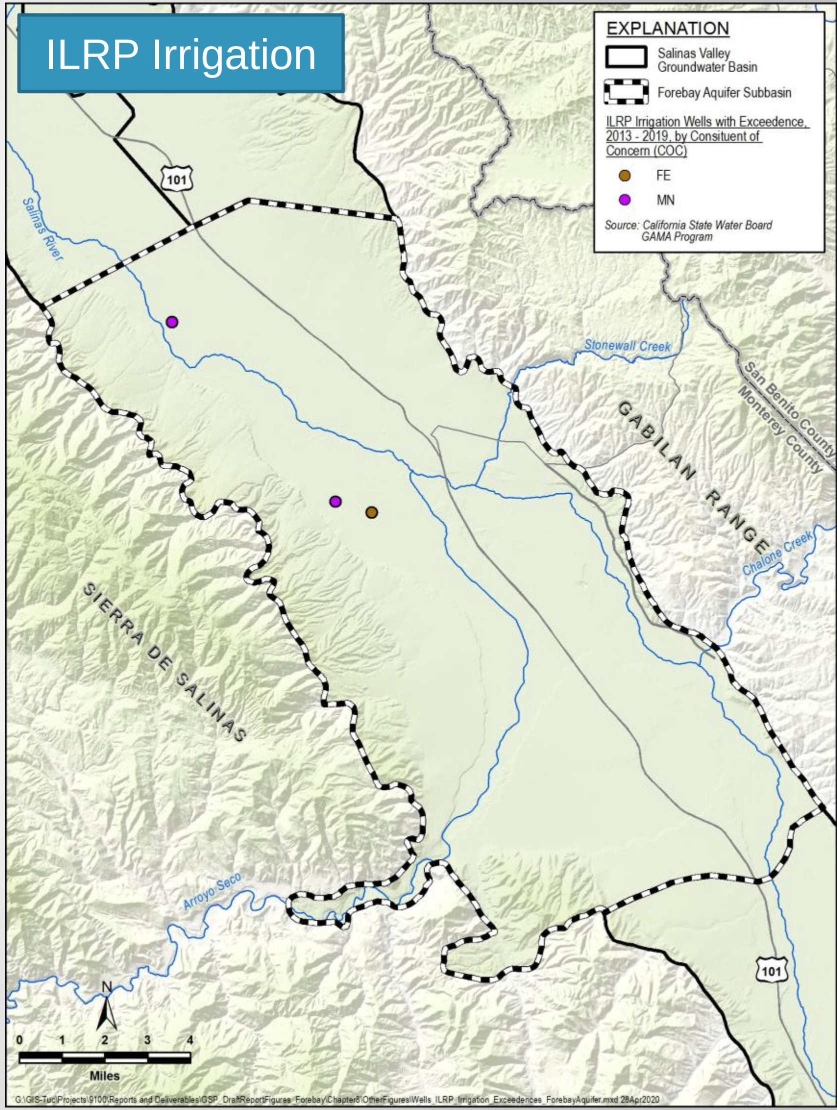
Undesirable Result:
The minimum threshold is exceeded as a direct result of projects or management actions taken as part of GSP implementation.

	Number of Wells Sampled for COC	Minimum Threshold/Measurable Objective – Number of Wells Exceeding Regulatory Standard from latest sample
DDW Wells		
1,2 Dibromo-3-chloropropane	24	3
1,2,3-Trichloropropane	36	2
Beryllium	35	1
Chloride	34	1
Di(2-ethylhexyl) phthalate	30	1
Dinoseb	34	3
Iron	32	6
Lindane	23	1
Manganese	32	4
Nitrate (as nitrogen)	42	5
Polychlorinated Biphenyls	19	1
Specific Conductance	36	1
Sulfate	33	1
Thallium	35	1
Total Dissolved Solids	33	4
Vinyl Chloride	36	4
ILRP On-Farm Domestic Wells		
Iron	38	8
Manganese	38	2
Nitrate (as nitrogen)	**251**	**162**
Nitrate + Nitrite (sum as nitrogen)	**111**	**62**
Nitrite	158	1
Specific Conductance	**261**	**71**
Sulfate	261	34
Total Dissolved Solids	**231**	**90**
ILRP Irrigation Wells		
Iron	48	1
Manganese	48	2

Groundwater conditions/SMC – Current Water Quality Exceedance Maps







Groundwater conditions/SMC – **Subsidence**

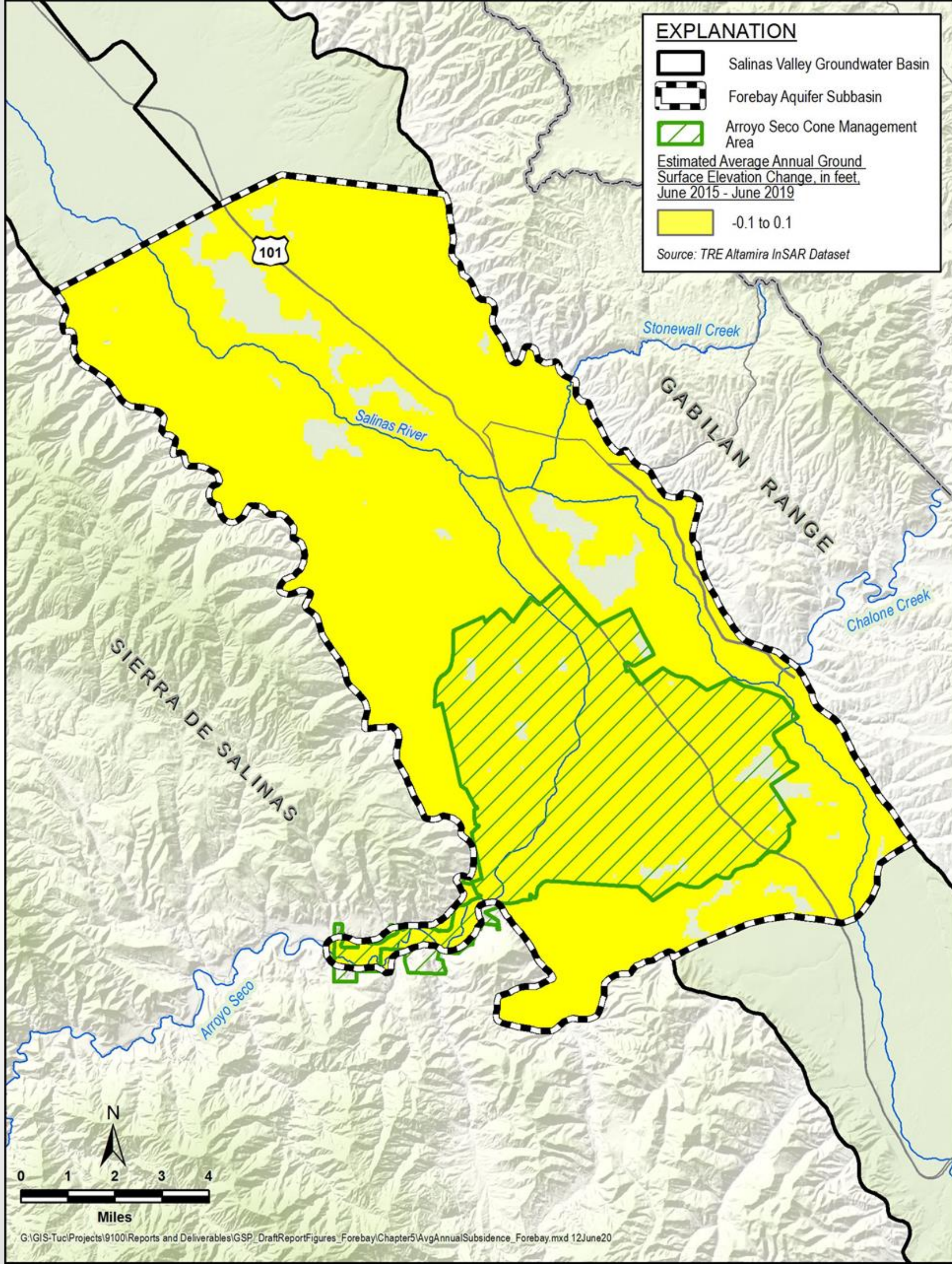
4. Subsidence

Measurable Objective (MO):
0.1 feet per year. This is a long-term rate of zero feet per year plus 0.1 feet per year of estimated land movement to account for InSAR measurement errors.

Minimum Threshold (MT):
0.133 feet per year. This is the rate that results in less than one foot of cumulative subsidence over a 30-year implementation horizon, plus 0.1 feet per year of estimated land movement to account for InSAR measurement errors.

Undesirable Result:
There is no exceedance of minimum threshold for subsidence.

- Negligible current subsidence
- Future subsidence due to groundwater conditions is unlikely



Groundwater conditions/SMC – **Interconnected Surface Water**

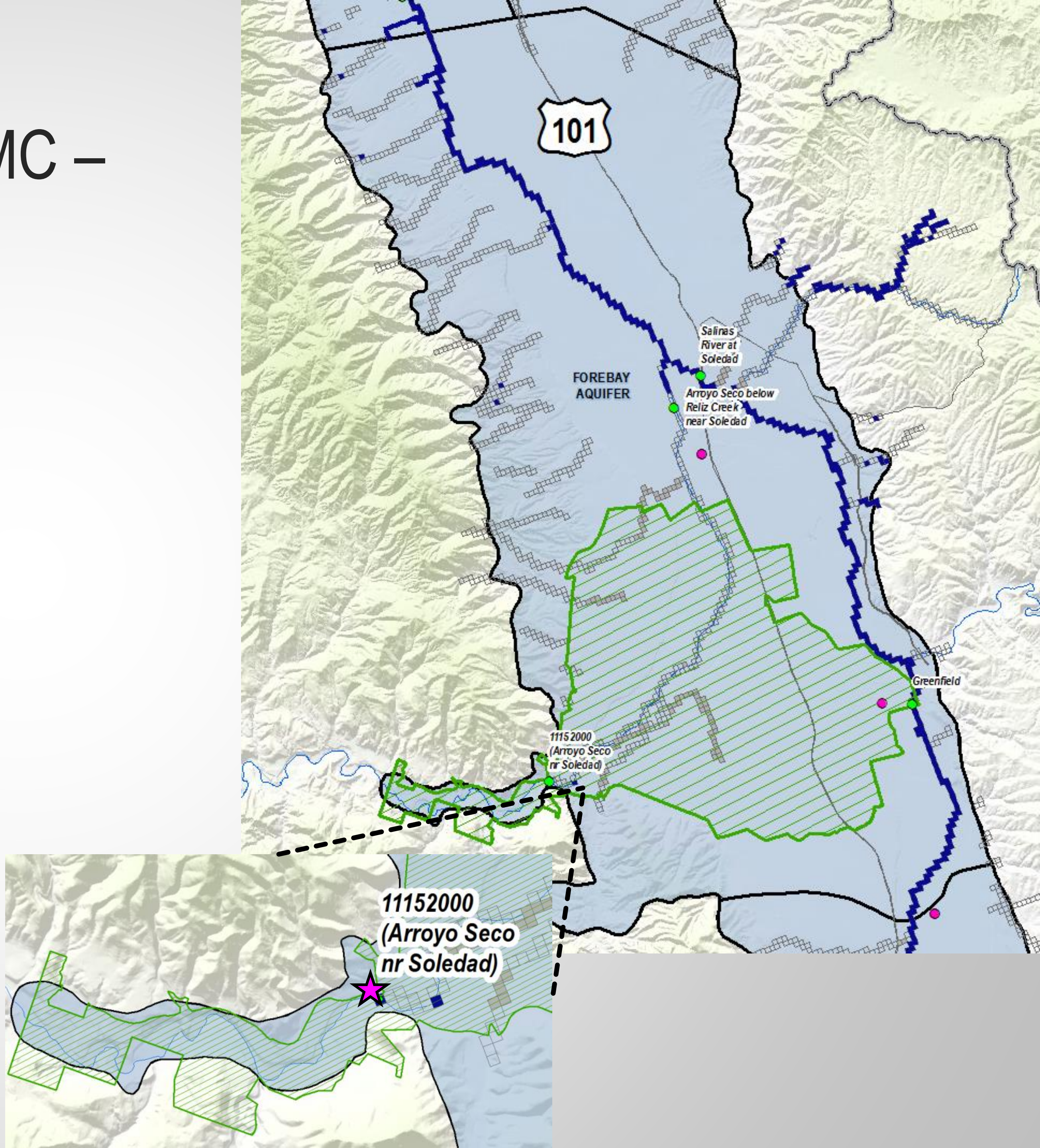
5. Depletion of Interconnected Surface Water (ISW)

Measurable Objective (MO):
Established by proxy using shallow groundwater elevations near locations of ISW, are set to 75% of the distance between 2015 and 1998 shallow groundwater elevations.

Minimum Threshold (MT):
Established by proxy using shallow groundwater elevations near locations of ISW, are set to groundwater elevations observed in December 2015.

Undesirable Result:
There is an exceedance of the minimum threshold in a shallow groundwater monitoring well used to monitor ISW.

- No interconnected surface water monitoring points yet
  - Green dots are USGS gauge and MCWRA River Series measurement site
  - Pink dots are existing wells that will be added to network
- One shallow well will be added on Arroyo Seco (pink star)



Summary of Current Conditions in Relation to SMC

- Forebay Aquifer Subbasin has not historically been in overdraft, nor experienced chronic lowering of groundwater levels
- From 1980 to 2016, the basin was in overdraft during only 3 years
- Given that the Subbasin’s extraction is currently close to the sustainable yield, this chapter includes a robust set of potential projects and management actions that could be undertaken if needed

Forebay Projects & Management Actions

Projects & Management Actions

RECHARGE PROJECTS

- Multi-benefit stream channel improvements
- MAR Overland Flow

PROJECTS THAT RESULT IN REOPERATIN OF THE RESERVOIRS

- Winter releases with ASR in the 180/400-Foot Aquifer Subbasin
- Interlake Tunnel & Spillway Modification
- Drought Reoperation

MANAGEMENT ACTIONS

- Conservation and agricultural BMPs
- Fallowing, Fallow Bank, and Agricultural Land Retirement
- Forebay Pumping Restrictions TAC

IMPLEMENTATION ACTIONS

- Well Registration
- GEMS Expansion
- Dry Well Notification System
- Water Quality Partnership

Multi-benefit Stream Channel Improvements

Vegetation Management

Non-native Vegetation Removal

Sediment Management

Floodplain Enhancement & Recharge

Component 1. Stream Maintenance

Component 2. Invasive Species Removal

Component 3. Floodplain Enhancement and Recharge

Project Benefits	Quantification of Project Benefits	Cost
Groundwater recharge, flood risk reduction, returns streams to a natural state of dynamic equilibrium	Component 1: Multi-subbasin benefits not quantified Component 2: Multi-subbasin benefits of 2,790 to 20,880 AF/yr. of increased recharge Component 3: Forebay direct benefits of 400 AF/yr. from 4 recharge basins	<u>Component 1</u> Multi-subbasin Cost: $150,000 for annual administration and $95,000 for occasional certification; $780,000 for the first year of treatment on 650 acres, and $455,000 for annual retreatment of all acres <u>Component 2</u> Multi-subbasin Cost Range: $14,536,943 to $18,871,239 Unit Cost: $60 to $740/AF <u>Component 3</u> Forebay Cost: $4,464,000 Unit Cost: $930/AF

Managed Aquifer Recharge (MAR) of Overland Flow

Construction of basins for managed aquifer recharge of overland flow before it reaches streams

- Increased groundwater recharge
- Highly dependent on site and precipitation
- Enhance sustainable yield and groundwater elevations
- Enhance soil moisture, which also helps erosion protection and near-surface temperature regulation

Quantification of Project Benefits	Cost
400 AF/yr. in increased recharge	Capital Cost: $4,128,000 Unit Cost: $870/AF

Projects that Result in Reoperation of the Reservoirs

Winter Release with Aquifer Storage and Recovery in the 180/400

- Shift reservoir releases to winter months and inject winter releases into the 180/400-Foot Aquifer Subbasin for Aquifer Storage and Recovery to provide summer irrigation water to CSIP
- More regular winter reservoir releases, greater groundwater recharge in the Forebay Subbasin, and help reducing spread of Arundo; additional benefits for other subbasins

- Multi-subbasin capital cost: $172,141,000
- Unit cost for 12,900 AF/yr. ASR: $1,450/AF

MCWRA Inter-lake Tunnel and Spillway Modification

- Tunnel to transfer excess water from Nacimiento to San Antonio Reservoir
- Multi-subbasin benefit: 30,500 AF/yr. of increased groundwater recharge from the Salinas River throughout the Salinas River Valley
- Greater surface water stored in reservoirs; more groundwater recharge

- Multi-subbasin capital cost: $118,503,000
- Unit Cost: $393/AF

MCWRA Drought Reoperation

- Establishment of the Drought Technical Advisory Committee (D-TAC) to develop a plan for how to manage reservoir releases during drought conditions
- More regular winter reservoir releases; drought resilience
- Unable to quantify benefits since drought operations have yet to be triggered

- Minimal SVBGSA staffing costs for participation; No additional MCWRA costs since already formed

Summary of Projects & Management Actions - Recharge Projects

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
A1	Multi-benefit Stream Channel Improvements	Prune native vegetation and remove non-native vegetation, manage sediment, and enhance floodplains for recharge. Includes 3 components: 1. Stream Maintenance Program 2. Invasive Species Eradication 3. Floodplain Enhancement and Recharge	Groundwater recharge, flood risk reduction, returns streams to a natural state of dynamic equilibrium	Component 1: benefits not quantified Component 2: 2,790 to 20,880 AF/yr. of increased recharge Component 3: 400 AF/yr. from 4 recharge basins	<u>Component 1</u> Cost: $150,000 for annual administration and $95,000 for occasional certification <u>Component 2</u> Average Cost: $16,500,000 Unit Cost: $60 to $740/AF <u>Component 3</u> Cost: $4,464,000 Unit Cost: $930/AF
A2	Managed Aquifer Recharge with Overland Flow	Constructs basins for managed aquifer recharge of overland flow before it reaches streams	Groundwater recharge, less stormwater and erosion, more regular surface temperature	400 AF/yr. in increased recharge	Capital Cost: $4,128,000 Unit Cost: $870/AF

Summary of Projects & Management Actions - Reservoir Reoperation

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
B1	Winter Releases with Aquifer Storage and Recovery	Shift reservoir releases to winter months and inject winter releases into the 180/400-Foot Aquifer Subbasin for Aquifer Storage and Recovery to provide summer irrigation water to CSIP	More regular winter reservoir releases, greater groundwater recharge in the Forebay Subbasin, and help reducing spread of Arundo; additional benefits for other subbasins	Analysis underway	Multi-subbasin Capital Cost: $172,141,000 Unit Cost for 12,900 AF/yr. for ASR: $1,450/AF *(distribution of benefits throughout Valley will be determined through a benefits assessment)*
B2	Interlake Tunnel and Spillway Modification	Tunnel to transfer excess water from Nacimiento to San Antonio Reservoir	Greater surface water stored in reservoirs; more groundwater recharge	30,500 AF/yr. of increased groundwater recharge from the Salinas River throughout the Salinas Valley	Multi-subbasin Capital Cost: $118,503,000 Unit Cost: $393/AF *(distribution of benefits throughout Valley will be determined through a benefits assessment)*
B3	Drought Reoperation	Establishment of the Drought Technical Advisory Committee (D-TAC) to develop a plan for how to manage reservoir releases during drought conditions	More regular winter reservoir releases; drought resilience	Unable to quantify benefits since decisions have yet to be made	Minimal SVBGSA staffing costs for participation; No additional MCWRA costs since already formed

Summary of Projects & Management Actions - Demand Management

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
C1	Conservation and Agricultural BMPs	Promote agricultural best management practices and support use of evapotranspiration data as an irrigation management tool for growers	Better tools assist growers to use water more efficiently; decreased groundwater extraction	Unable to quantify benefits until specific BMPs are identified and promoted	Approximately $100,000 for four workshops, grant writing, and demonstration trials. Cost could be reduced if shared between subbasins.
C2	Fallowing, Fallow Bank, and Agricultural Land Retirement	Includes voluntary fallowing, a fallow bank whereby anybody fallowing land could draw against the bank to offset lost profit from fallowing, and retirement of agricultural land	Decreased groundwater extraction for irrigated agriculture	Dependent on program participation	$195-$395/AF if land is fallowed $810-$2,000/AF if land is retired
C3	Forebay Pumping Technical Advisory Committee (TAC)	Establish TAC to convene if triggered by groundwater levels declines, groundwater storage loss, or low Arroyo Seco flows to determine potential pumping restrictions	Decreased groundwater extraction when pumping restrictions enacted	Dependent on specific pumping restrictions implemented	Staffing costs plus $10,000 per year (if TAC is triggered)

Summary of Implementation Actions

Project/ Management Action #	Name	Description	Project Benefits	Quantification of Project Benefits	Cost
D1	Groundwater Elevation Management System (GEMS) Expansion	Update current GEMS program, by collecting groundwater elevation data from wells in areas not currently covered by GEMS and enhance data collection	Better informed decisions	N/A – Implementation Action	Not estimated at this time
D2	Water Quality Partnership	Form a working group for different agencies to coordinate on domestic water issues	Better access to quality water	N/A – Implementation Action	Not estimated at this time
D3	Dry Well Notification System	Develop a system for well owners to notify the GSA if their wells go dry. Refer those owners to resources to assess and improve their water supplies. Form a working group if concerning patterns emerge.	Support affected well owners with analysis of groundwater elevation decline	N/A – Implementation Action	Not estimated at this time
D4	Well Registration	Register all production wells. Monitor flowmeters on all non-*de minimis* wells.	Better informed decisions, more management options	N/A – Implementation Action	Not estimated at this time

Projects & Management Actions: General Timeline

January 2022

> Assess existing data and define data gaps
> Initial prioritization of projects
> Define future role of Subbasin Committees
> Establishment of Implementation Committee

Year 1

> Complete data analysis needed for project prioritization and initial project selection
> Engage key stakeholders, partners and permitting agencies
> Develop start up budget for monitoring, project planning, grant opportunity assessment
> Establish Forebay Pumping Restrictions TAC

Adapt & pursue other projects as needed

Year 2

> Establish expanded monitoring programs (GEMS)
> Well registration

> Continued stakeholder outreach and feedback on projects and management actions

Project planning:
> feasibility studies; funding
> Preliminary project specific data collection
> Project design

Convene Forebay Pumping Restrictions TAC when triggered

Year 3-5

> Use data to continually inform project decision making (and Annual Report/ 5 year GSP update)

Develop funding mechanisms → Apply for grant funding

Further refine designs / prototype if needed

Year 6-10

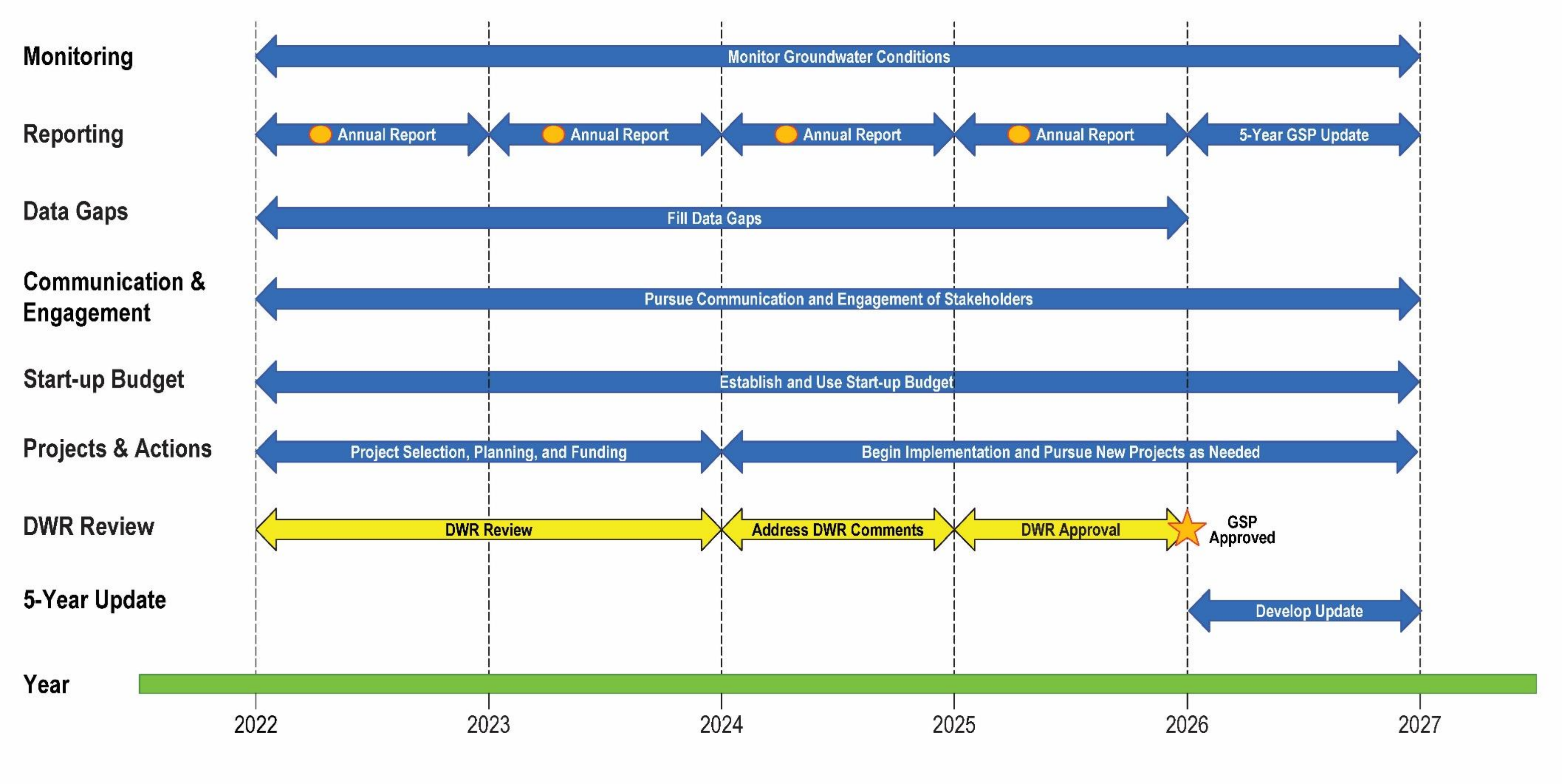
> Ultimately use data to document sustainability and tell the story

Implement → Monitor → Report

Forebay Projects & Management Actions Road Map

Years	Data/ Implementation Actions	Forebay Pumping Restrictions TAC	Multi-benefit Stream Channel Improvements	Projects that result in Reservoir Reoperation	Other projects (Overland Flow, Ag BMPs)
Year 1-2	Develop well registration program, GEMS expansion ordinance, and Dry Well Notification System	Establish Forebay TAC (membership, guiding principles, decision-making procedures)	Continue administration of SMP and Arundo removal with RCD; Apply for grant funding for SMP and Arundo removal	Evaluate benefits to Forebay and compare projects; D-TAC will meet when triggered	.
Year 3-4	Implement well registration, GEMS expansion, and Dry Well Notification System Establish Water Quality Partnership	Meet annually, develop pumping restrictions if triggered	Review permits and relation between components	Evaluate reservoir reoperation rules	If other subbasins move forward with these projects, consider implementing in Forebay
Year 5-6+		Cont.	Identify floodplain enhancement opportunities	Develop funding mechanism	.

Implementation Schedule



Adaptive Management

Image source: https://reefresilience.org/management-strategies/marine-protected-areas/adaptive-management

Questions