Preliminary DRAFT Screening Matrix of Proposed Technical Alternatives

Item No.	PROPOSED TECHNICAL ALTERNATIVE	Relative Cost	Readiness to Proceed	Feasibility/Implementability	Leveraging Opportunity	Community & Political Support	Multi-Objective/Supports Watershed Health	Effective Addressing GW Depletion Areas	Address Impacts/Unintended Consequences	Notes
	Stormwater Capture & Recharge									
1	Option 1 - Medium to large scale project(s) 40 to 100 acres total, 20-50 acres each	$$	L	?	H	?	H	M	?	Technical Feasibility and Locations TBD
2	Option 2 - Agricultural distributed stormwater capture and recharge - ¼ to ½ acre each	$	M	M	M	H	?	L	?	Technical Feasibility and Locations TBD
3	Option 3 - Domestic distributed stormwater capture and recharge (LID approach)	$$	M	M	H	H	H	L	L	
	Stormwater Capture and Storage									
4	Option 1 - Small surface storage ponds (No. acre/storage volume) - ¼ to ½ acre each	$	H	H	M	H	H	L	L	
5	Option 2 - Large surface storage ponds (No. acre/storage volume) 40 to 100 acres total, 20-50 acres each	$$	L	?	M	?	M	M	M	
	Groundwater Banking									
6	Option 1 - Contractor Facilities - One to two wells each for City of Sonoma and Valley for the Moon Water District	$	M	M	M	M	M	L/M	L	Technical Feasibility TBD
7	Option 2 - Facilities outside Water Contractor areas - One to two wells each for both of the depleted areas	$$$	L	L	L	L	M	H	?	Technical Feasibility TBD/Requires Institutional changes
	Increase Recycled Water Use to Reduce Groundwater Demand									
8	Option 1 - Agricultural irrigation and commercial landscape irrigation	$$/$ $$	M	H	M	M/H	M	M/H	L	Needs to be split into Phases
	Increase Conservation to Reduce Groundwater Demand									
9	Option 1 - Increase Rural Area Domestic Conservation	$	H	H	M	H	M	M	L	
10	Option 2 - Increase Rural Area Agricultural Conservation	$	M	M	M	H	M	M	L	
	In Lieu Surface Water Substitution for Groundwater									
11	Option 1 - Rural agricultural and domestic wells replacement with imported surface water	$$$	L	L	M	?	M	H	M	Technical Feasibility TBD/Requires institutional changes/storage
	Pumping Redistribution									
12	Option 1 - Rural agricultural and domestic pumpage redistributed from groundwater depletion areas	$$$	L	L	M	L	M	H	H	Technical Feasibility TBD/Requires institutional changes
	Salinity Intrusion Mitigation									
13	Option 1 - Replace groundwater wells with imported surface water along southern valley	$$$	L	L	M	?	M	M	H	Requires institutional changes
14	Option 2 - Injection wells along southern valley – recycled water and/or imported water	$$$	L	L	M	?	M	M	M	Technical Feasibility TBD/Requires significant water quality permitting
	Desalination									
15	Desalination plant with intake at San Pablo Bay or tidal marshlands area	$$$$	L	L	M	L	L	L	H	Technical Feasibility TBD

? Unknown or Significant Uncertainty

Potential Yield in Acre-Feet
20-Year Roll-Out

ALTERNATIVE/YEARS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Increase Conservation & Efficiency - *Rural Domestic*																				
Pursue funding/Ramp up	-	-	-	-																
Implementation		10	50	100	150	200	250	300	400	500	500	500	500	500	500	500	500	500	500	500
Increase Conservation & Efficiency - *Agriculture*																				
Pursue funding/Ramp up	-	-	-	-																
Implementation		50	75	100	150	250	400	500	500	500	500	500	500	500	500	500	500	500	500	500
Expanded Recycled Water Use - *Agricultural & Commercial Landscape Irrigation*																				
Pursue funding/buildout	-	-	-	-	-	-	-	-	-	-										
Implementation			300	300	300	300	300	300	300	300	500	700	900	1000	1000	1000	1000	1000	1000	1000
Stormwater Capture & Recharge - 2 *to 3 Medium to Large Projects*																				
Studies/EIR	-	-	-	-	-	-	-	-	-											
Implementation										500	500	500	500	500	500	500	500	500	500	500
Stormwater Capture & Recharge - *Agricultural Distributed Small Projects*																				
Pursue funding/Ramp up	-	-	-																	
Implementation				10	10	10	25	25	25	50	50	50	50	100	100	100	100	100	100	100
Stormwater Capture & Recharge - *LID Distributed Projects*																				
Pursue funding/Ramp up	-	-	-	2	2	2	5	5	5	5										
Implementation											10	10	10	10	10	10	10	10	10	10
Stormwater Capture & Storage - Agriculture - Small Ponds																				
Ramp up	-	-	-	10	10	20	20	30	30											
Implementation										50	50	50	50	50	50	50	50	50	50	50
Stormwater Capture & Storage - Agriculture - Medium to Large Ponds																				
Ramp up	-	-	-	10	10	20	20	30	30	50	50	50	50	50	50	50	50	50	50	50
Implementation																				
Groundwater Banking - Water Contractor Facilities																				
Pilot Testing	-	-	-	-	-	50	50	50	50	50										
Implementation											100	100	100	100	100	500	500	500	500	500

Potential Yield in Acre-Feet
20-Year Roll-Out

ASSUMPTIONS

Increase Conservation & Efficiency	
Rural Domestic	30% increase in conservation and efficiency possible - Pacific Institute & NRDC 2014 - 375 afy on 1250 afy demand
Agriculture	Assumes 25% reduction, participation 10-50% over a 20 year timeframe - max of 500 afy on current 4800 afy demand
Expand Recycled Water Use	
Agricultural & Commercial Landscape Irrigation	Expansion in process for completion 2016/2017 up to 300 afy
	Additional expansion in 2025 for up to additional 1,200 afy
Stormwater Capture & Recharge by Infiltration	
2 to 3 Medium to Large Scale Projects	Maximum yield projected at 500 afy
Stormwater Capture & Recharge by Infiltration	
Agricultural Distributed Small Projects	Maximum yield projected at 100 afy
Stormwater Capture & Recharge by Infiltration	
Urban and Rural Domestic - LID Distributed	Potentital yields of 10 afy
Stormwater Capture & Storage	
Agriculture - Small Ponds	Potentital yields of 50 afy
Stormwater Capture & Storage	
Agriculture - Medium to Large Ponds	Potentital yields of 50-100 afy
Groundwater Banking	
Contractor Facilities	Potentital yields of 500 afy

Possible Technical Alternatives to Address Groundwater Depletion

Possible Technical Approaches	
Stormwater Capture & Recharge by Infiltration Ponds	Assess how much stormwater is potentially available and could be captured and recharged, optimal recharge locations, and facilities needed. Include flood management, habitat enhancement, and recreation elements.
Option 1 Assumptions 4 events per year 2-3 ft recharge per event 8-12 feet recharge/yr Capture/Recharge ~~320 – 1200 AF/yr~~1,000 AFY	*Two to three medium to large scale project(s) 40-100 acres, 20-50 acres each?* Possible location(s) Cost range $4,000,000-$20,000,000 Land purchase/easement $20,000 to $100,000 per acre for purchase; $5,000 - $10,000 per year for easement Planning/Design $100,000-250,000 Construction $250,000-1,000,000 Operation & Maintenance $10,000 to $20,000 per year Timing – will require studies, site acquisition, design and environmental compliance; estimate 2 to 5 years to get project operational Cost/AF $25 – $200/AF for land purchase - $80 – 95/AF for easement Estimated over 20 year time
Option 2 Assumptions 4 events per year 2-3 ft recharge per event 8-12 feet per year Capture/Recharge 1-6 AF each, Times 20 = 20-120 AF Annual Recharge	*Agricultural distributed stormwater capture and recharge - ¼ to ½ acre each?* Distributed across alluvial basin 20 locations Recharge efficiency: unknown – location specific Cost range Design/Construct $10,000-20,000/location - $200,000 to $400,000 O&M $5,000/yr Timing – can be done with minimal design; assume 1 new site per year over 20 years starting in 2020. Cost/AF $170-$3,250/AF Estimated over 20 year time Assumes capture of sheetflow, upland flows and direct precipitation and not streamflow which would require SWRCB water rights permit
Option 3 Assumptions ~~2,000~~6,500 households *500 gallons per household* *Capture 10~~3~~AFY*	*Distributed stormwater capture~~, recharge and reuse (LID approach)~~ – urban and rural domestic* Techniques include elements such as rain gardens and bioretention; vegetated swales, buffers, and strips; aeration techniques for capture; rain barrels and cisterns; permeable pavers; impervious surface reduction and disconnection distributed across alluvial basin. Cost range $1,000 per household? $2M total over 20 yrs Timing – Will require incentives for broad application – grant funds could help; assume ~~2,000~~6,500 households added to program over 20 year period.

	Cost/AF +$30,000/AF Estimated over 20 year time
Stormwater Capture and Storage	Assess the potential for small and large surface water storage ponds as temporary storage to offset a portion of agricultural groundwater demands.
Option 1 *Assumptions* *8 feet height and volume*	Small surface storage ponds (No. acre/storage volume) - *¼ to ½ acre each* Number of acres of storage ponds 20-40 Distributed in rural areas in southern Sonoma Valley Capture volume 1-4 AF each, times 20 = 20-80 AF Cost range Design/Construct $10,000-20,000/location - $200,000 to $400,000 O&M $2,000- $5,000/year Timing – can be done with minimal design; assume 1 new storage pond per year over 20 years Cost/AF $375 - $600/AF Estimated over 20 year time Assumes capture of sheetflow, upland flows and direct precipitation, and not streamflow which would require SWRCB jurisdictional water rights permit
Option 2 *Assumptions* *8 feet height* *volume 400-800AF*	*Medium to large scale project(s) 40-100 acres , 20-50 acres each?* Possible location(s) Cost range $4,000,000-$20,000,000 Land purchase/easement $20,000 to $100,000 per acre for purchase; $5,000 - $10,000 per year for easement Planning/Design $100,000-250,000 Construction $250,000-$1,000,000 Operation & Maintenance $2,000 to $5,000 per year Timing – will require studies, site acquisition, design and environmental compliance; estimate 2 to 5 years to get project operational Cost/AF $500 – $2,850/AF for land purchase - $100 – $1,300/AF for easement Estimated over 20 year time Assumes capture of sheetflow, upland flows and direct precipitation, and not streamflow which would require SWRCB jurisdictional water rights permit

Groundwater Banking	Bank imported Russian River in Sonoma Valley aquifers using wells. Evaluate how much Russian River water could potentially be banked, optimal banking locations, and the facilities needed.
Option 1 *Assumptions* *Recharge 100-500 AFY* Recovery efficiency: 90%	Water Contractor facilities One to two wells each for City of Sonoma and Valley for the Moon Water District Distributed in areas of City and Valley of the Moon jurisdictional areas Cost range Capital cost & permitting – $350,000 for retrofits to existing wells & permitting or $2,000,000, for two new wells O&M - $25,000/year/well for 20 yrs = $1,000,000 Cost of the water to bank $900/AF at 500AF for 20 yrs = $9,000,000 Schedule – Feasibility level complete – requires pilot testing perhaps as early as next year - Commence in 2020, assume 20 year period for estimating Cost/AF - $1,000 - $5300/AF Retrofitted Wells $1,200-$6,000/AF new wells
Option 2 *Assumptions* Recharge volume: 500-1,000 AFY Recovery efficiency: 95%	Deliveries outside Water Contractor areas One to two wells each for both of the depleted areas Distributed in the two groundwater depletion areas jurisdictional areas Cost range Capital cost - 2 to 4 wells @ $1M/well = $2M-$4M Conveyance 5 to 10 miles @ $1,000,000~~500,000~~/mi = $~~2.5M~~5 - $~~5M~~10M O&M - $25,000/year/well for 20 yrs = $1,000,000 - $1,000,000 Cost of the water to bank $900/AF at 500AF – 1000 AF for 20 yrs = $9,000,000 - $18,000,000 Timing – requires institutional coverage in those areas – also studies and design; assume commence project operation in 2025 Cost/AF - $1,450
Increase Recycled Water	Increase the use of recycled for agricultural and landscape irrigation. Evaluate recycled water availability with Sonoma County Sanitation District build out as in lieu substitution to reduce groundwater demand, and optimal locations for application.
Option 1 *Assumptions*	Agricultural irrigation and commercial landscape irrigation Build-out of Sonoma Valley Sanitation District plant recycled water piping Distributed in rural areas in southern Sonoma Valley Groundwater replacement volume ~~2,400~~1,500 AF/yr Cost range $ Timing - build out by ~~2035~~2025 Cost/AF $700 to $1,000

Increase Conservation	Increase rural area domestic and agricultural conservation. Assess potential for rural domestic conservation by reducing groundwater demand using tools and incentives available for urban area BMPs. Develop assumptions and evaluate potential additional viticulture and non-viticulture additional conservation amounts.
Option 1 *Assumptions* *This is Voluntary – Non-Mandatory – Mandatory would fall under Institutional/Regulatory Options* *Indoor water efficient appliance/fixtures save 0.06 AF/yr/household* *Turf removal saves 0.10 AF/yr/parcel*	Rural domestic conservation Number of domestic residences and approximate savings per residence Distributed in rural areas in southern Sonoma Valley Assume one third of total 4,500 parcels = 1,500 parcels Groundwater replacement volume ~~240~~ 375 AF/yr Cost range Timing Cost/AF Description: Provide incentives for and funding for increasing conservation with water efficient appliances and fixtures, and improved water efficiency in landscape irrigation and landscaping with native and drought tolerant plans and cash for grass.
Option 2 *Assumptions* *25% conservation with range of participation 10-50% (Sonoma RCD)*	Rural agricultural conservation Number of acres and approximate savings per acre Distributed in rural areas in southern Sonoma Valley Groundwater replacement volume 100-500 AF/yr Cost range Timing – Over twenty year period Cost/AF $100-170 Description:
In Lieu Surface Water Substitution for Groundwater	Assess potential for expanding deliveries of surface water for in lieu substitution to meet groundwater demands, focused in areas of groundwater declines, considering conveyance and connection costs.
Option 1 *Assumptions*	Rural agricultural and domestic wells replacement with imported surface water Number of wells to replace, cost of conveyance piping and connection Requires additional institution or institution expansion Distributed in rural areas in southern Sonoma Valley Groundwater replacement volume 500-1,000 AF Cost range Conveyance 20 to 50 miles @ $1M/mi = $20m -$70M Timing – will require institutional changes (General Plan and LAFCo), studies, design and environmental compliance Cost of the replacement water $900/AF at 500AF – 1000AF for 20 yrs = $9,000,000-$18,000,000 Cost/AF Very High $2,900-$4,400/AF – does not include storage or CEQA or permitting or design Facilities description: Requires Additional conveyance and/or storage

Pumping Redistribution	Assess potential for pumping redistribution to reduce demand in areas of groundwater level decline.
Option 1 Assumptions	Rural agricultural and domestic pumpage redistributed from groundwater depletion areas Number of wells to replace, cost of conveyance piping and connection May require additional institution or institution expansion Distributed in rural areas in southern Sonoma Valley Groundwater replacement volume Cost range Capital cost - 2 to 4 wells @ $1M/well = $2M-$4M Conveyance 5 to 10 miles @ $1M mi = $5M -$10M O&M - $25,000/year/well for 20 yrs = $500,000 - $1,000,000 Cost of the water to bank $900/AF at 500AF – 1000AF for 20 yrs = $9,000,000-$18,000,000 Timing – will require studies and design and environmental compliance Cost/AF $1,650 **Requires Conveyance and may require New Wells**
Salinity Intrusion Mitigation	Consider different options and preliminary cost estimates for salinity intrusion mitigation.
Option 1 Assumptions	Replace groundwater wells with imported surface water along southern valley Groundwater replacement volume 250-1,000 AF Cost range Conveyance 5 to 20 miles @ $1M/mi = $5m -$20M Timing – will require institutional changes (General Plan and LAFCo), studies, design and environmental compliance Cost of the replacement water $900/AF at 500AF – 1000AF for 20 yrs = $9,000,000-$18,000,000 Cost/AF Very High 1,900-2,800/AF – does not include storage or CEQA or permitting or design
Option 2 Assumptions	Recharge wells along southern valley – recycled water and/or imported Number of wells: 10 – 20 ? Distributed along southern Sonoma Valley, based on additional studies to locate wells Groundwater replacement volume 500-1,000AFY Cost range Capitol Capitol cost per well $ 250,000/well - $2.5M-$5M Conveyance 5 miles @ $~~500,000~~1,000,000/mile = $~~2.~~5M Water use per well 50-100 AF/yr Water cost per year - $250,000-$1,000,000 @$500-$1,000/AF O&M cost per well – average $ $1,000/well/yr for 20 years =$2,000,000 $12,000,000 - $19,500,000 Capital and O&M and water Timing – will require studies and design and environmental compliance Cost/AF $~~1,200~~12,000 to $~~975~~9,750

	Estimated over 20 year life
Desalination	Consider different options and preliminary cost estimates for seawater desalination.
Assumptions	Desalination plant with intake at San Pablo Bay Groundwater replacement volume Timing – will require studies and design and environmental compliance Cost range – $0.5-1.0B capital cost Cost/AF - $~~950-$1,000~~2,000 per AF Conveyance and Storage Costs Unknown
Baseline	
No Action Alternative	Considers the costs and consequences of not taking action – no changes to current practices.

Sonoma Valley Vineyard Water Conservation Potential

7.7.15

Prepared by Keith Abeles-Sonoma RCD

Assume average use in Sonoma Valley Watershed is 4" per year

4" per acre per year equals	108,617	gallons
1" per acre per year equals	27,154	gallons

Assume 1" water savings can practically be achieved by implementing a variety of conservation measures

Sonoma Valley Watershed Acres	14,000
Acreage Rounded Down 15%	11,900
4"/acre/year in gallons	108,617
Watershed water usage/year in gallons	1,292,543,999
Watershed water usage/year in acre feet	3,967

Considerations

Acreage is rounded down from total vineyard acres to account for vines dry farmed, and sites where measures are already being implemented

Table below does not include water use or potential savings for frost protection, wineries, and tasting rooms

Yearly Water Savings in Sonoma Creek Watershed (acre feet)		Potential Water Savings in Sonoma Creek Watershed Vineyards									
		Producer Participation Level									
		10%	15%	20%	25%	30%	33%	35%	40%	45%	50%
10%	397	40	59	79	99	119	131	139	159	178	198
15%	595	59	89	119	149	178	196	208	238	268	297
20%	793	79	119	159	198	238	262	278	317	357	397
25%	992	99	149	198	248	297	**327**	347	397	446	496
30%	1,190	119	178	238	297	357	393	416	476	535	595
33%	1,309	131	196	262	327	393	432	458	524	589	654
40%	1,587	159	238	317	397	476	524	555	635	714	793
50%	1,983	198	297	397	496	595	654	694	793	892	992

Cost of Savings

7.7.15

Prepared by Keith Abeles-Sonoma RCD

	Cost
Lowest Cost Method	
10% savings can be achieved through monitoring shoot tips and delaying irrigation 2x	$0

Low Cost Method

Use Irrometer/Watermark sensors and digital reader

Assume 6 sensors/30 acres, 30 acre vineyard average, 5 year lifespan

		Assumptions
Cost per sensor	$ 37.5	
Sensors needed/30 ac	8	2 replacement sensors used during 5 year period
Sensor cost	$ 300	
Labor cost to install	$ 75	1 hour to prep sensors, 2 hours to install, $25/hr
labor cost to monitor	$ 1,563	.5 hour per week for 25 weeks/yr, $25/hour, 5 years
Sensor meter reader	$ 235.00	
Total Cost	$2,172.80	
life of equipment	5 years	
cost per year	$ 435	
acres	30	
cost per acre per year	$ 14	Because meter reader is fixed cost, cost/acre goes up on smaller vineyards, and down on larger vineyard. Used 30 acres as average size.

Higher Cost Method

Using soil probes, porometers, and pressure chambers

assume 7.5 acres/probe

assume 30 acre vineyard average size

	30	acres
	7 5	acres per probe
	4	probes per vineyard-30 acre vineyard
$	4,150	cost for 4 probes and supporting services (use of porometers, pressure chambers, and interpretations of results)
$	138	per acre/year

Range of Costs	**$14-140/acre/year**		
If saving 10,000 gallons/ac/yr by observing shoot tips/ delaying irrigation 2x	**$ 109**	per acre foot water saved	Assumes 1 hour per week observing vines for 4 weeks, $25/hour, 30 acre vineyard
If saving 1"/year/acre with lower cost method	**$ 168**	per acre foot water saved	Costs lower as acreage goes up, and increase as acreage goes down
If saving 2"/year/acre with higher cost method	**$ 840**	per acre foot of water saved	

Ag Conservation Measures 7.7.15

Prepared by Keith Abeles-Sonoma RCD

Delay the Onset of Irrigation

Implement a soil moisture monitoring program using sensors or neutron probes
Measure plant water stress with porometers and/or pressure chambers
Utilize historic data and experience
Visually observe shoot tip growth/stage

Reduce Water Use Once Irrigation is Initiated

Implement leak detection/repair program
Implement a soil moisture monitoring program using sensors or neutron probes
Irrigate at night, early morning or late day
Measure plant water stress with porometers and/or pressure chambers
Reduce % of crop ET water target
Use Surface Renewal Technology for ET
Use CIMIS or onsite weather station to monitor ET and schedule irrigations
Use remote sensing, telemetry and electronic alerts
Use timers and controllers

General Measures to Conserve Water

Abandon weak vines and production areas
Cover Ponds
Develop rain and surface water catchment systems
Dry Farm (or come as close to dry farming where possible)
Improve Distribution Uniformity
Install flow meters to detect leaks, track usage and measure progress on conservation
Manage cover crops to maintain soil moisture
Set up second line for weak vines and areas

For Frost Protection (Not Included in Savings Spreadsheet)

Convert systems from conventional overhead to micro sprinklers
Use frost alert systems
Use wind machines

SVGMP Monitoring Program Time to Review/Update

- Good practice to review/update monitoring programs periodically
- New Funding is available
  - Proposition 1
- Sustainable groundwater Management Act
  - Raises the bar on groundwater management and monitoring

7/08/15

Monitoring Program Objectives

- Develop and maintain adequate information to assess the status of the Sonoma Valley, trends in groundwater elevations and quality, and response to future management actions.
- Capture and maximize the use of all existing Sonoma Valley groundwater data.
- Establish monitoring protocols to ensure the adequacy and consistency of data collected, and provide a framework and format for data collection and maintenance.

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PARAMETER MONITORED	BEGINNING PROGRAM	CURRENT PROGRAM	FUTURE PROGRAM
Groundwater Levels (biannual measurements)	City - 12 wells	12	12
	VOMWD - 34 wells	34	34
	DWR - 9 wells	9	9
	Voluntary - 0 wells	86	150?
	Dedicated monitoring wells	2 nested wells	4-6 nested wells?
Groundwater Quality (biannual sampling) Specific Conductance	DWR - 9 wells	9	9
General Minerals	DWR - 9 wells	9	9
Drinking Water Title 22 Analytes	Public & private water systems	Same	Same
Land Surface Subsidence	Periodic review of benchmark elevations	To be determined	5-10 benchmarks biennial survey
Surface Water Sonoma Creek Monitoring	1 stream gauge Agency & USGS	2 stream gauges	4-6 stream gauges?
Rainfall	4 state and national stations	4 state and national stations	10 in highlands? 6 on valley floor?
Surface Water – Groundwater Interaction	None	Seepage Monitoring	Seepage Monitoring Additional shallow wells

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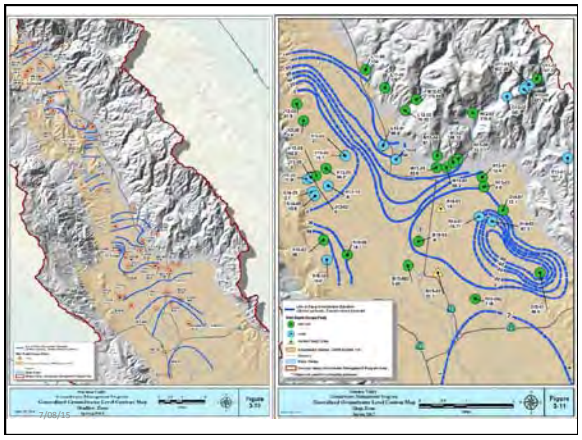

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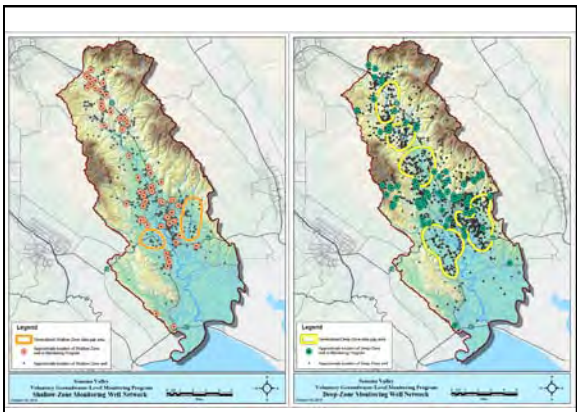

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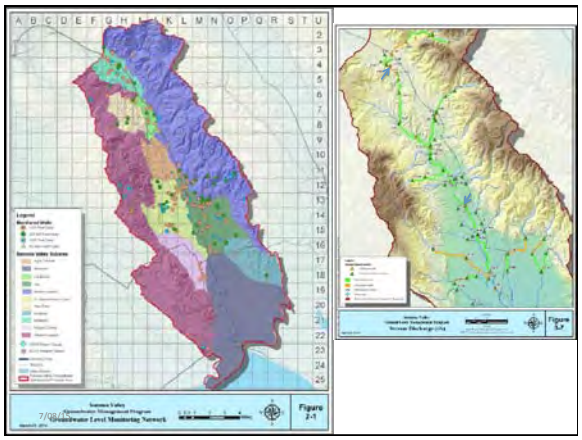

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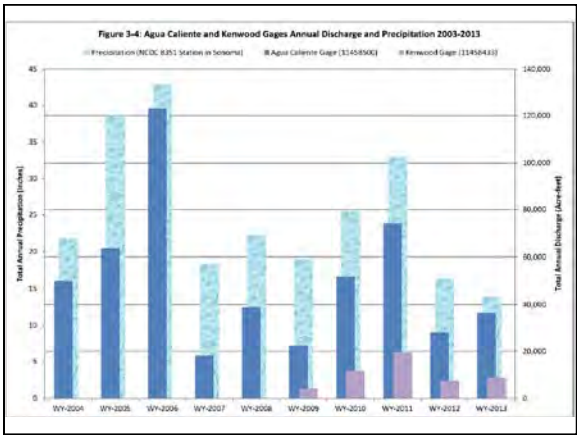

General Methods

- Comparison of groundwater level measurements to surface water level measurements provides direction and magnitude of flow – although local variations can be obscure, such as vegetation transpiration between wells and stream body
- Seepage measurements to gain insights into the direction into the direction, timing and spatial distribution of surface water-groundwater interactions
- Instream piezometers – screened and installed a few feet into stream beds
- Thermal profiling of streambed sediments – arm piezometers with thermistors
- Seepage meters to measure seepage at a point
- Calibrated Groundwater Flow Model

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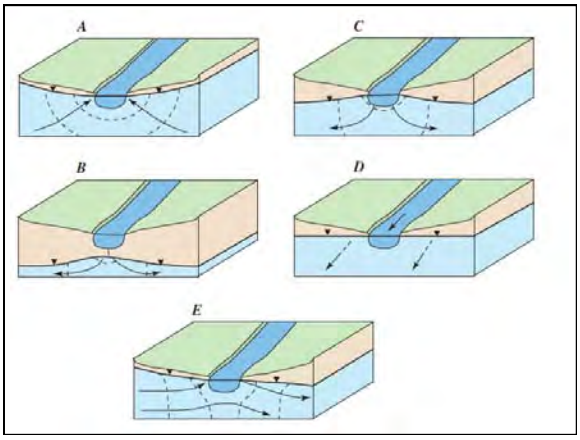

Seepage Measurements

- Seepage measurements, applicable to smaller streams, are made by current or flow meter and making observations along a number of sections of the stream of width, depth and velocity
- Conducted at a number of cross-sectional line locations along a stream seepage reach
- These summation of the discharges of all the subsections, usually 25 to 30 in number, are used to sum and compute the total discharge of the stream at the cross-sectional line of measurement

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Next Steps Surface Water-Groundwater Interaction Monitoring

- Inventory existing monitoring near streams
- Verify key areas for seepage runs
- Develop framework approach for areas, seepage run timing, potential voluntary well monitoring augmentation, and new well installations
- Use Model for sensitivity analysis

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Develop Proposal and Approach Increased Surface Water Groundwater Interaction Monitoring

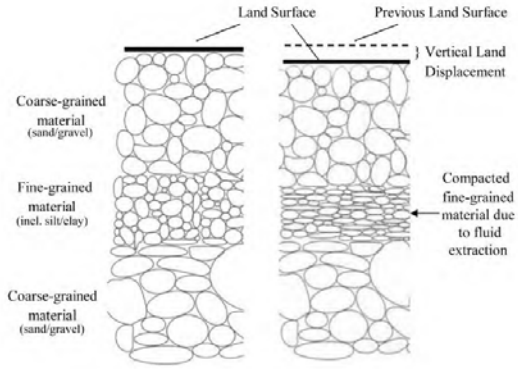
- Summary of existing monitoring, possible locations for seepage runs, and additional monitoring data needs
- Estimate for seepage runs and additional monitoring wells
- Partners and agreements to conduct seepage runs and additional monitoring wells
- Identify funding opportunities

7/08/15

LAND SUBSIDENCE

1. Tectonic
2. Organic Sediment Compaction
3. Groundwater Extraction

7/08/15



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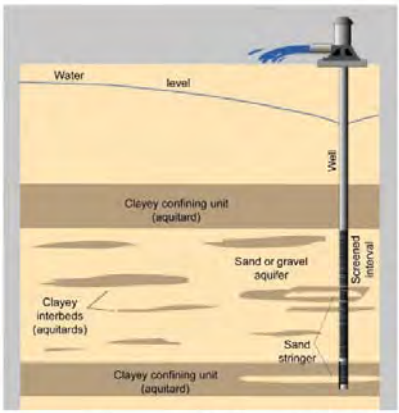

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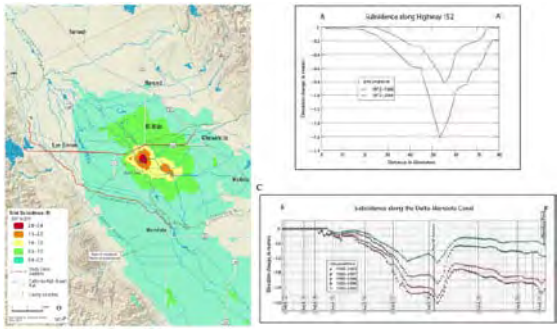


7/08/15

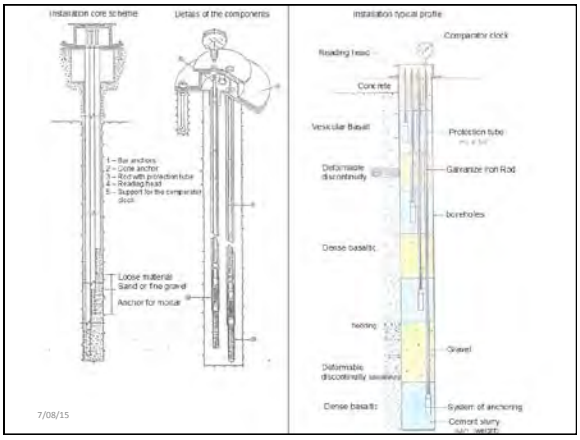
Method	Displacement Direction	Resolution[1] (millimeters)	Spatial Density[2] (measurements per survey)	Spatial Scale (elements)
Spirit level	vertical	0.1-1	10-100	line-network
Electronic Distance Measuring (EDM) Device	horizontal	1	10-100	line-network
Borehole extensometer[3]	vertical	0.01-0.1	1-3	point
Horizontal Extensometer				
Tape	horizontal	0.3	1-10	line-array
Invar Wire	horizontal	0.0001	1	line
Quartz tube	horizontal	0.00001	1	line
GPS	vertical horizontal	20 5	10-100	network
Satellite SAR Interferometry				
InSAR	range (satellite to ground)	5-20	100,000-10,000,000	map pixel[4]
PS InSAR	range (satellite to ground)	1-5	variable[5]	map pixel[4]
LIDAR				
Tripod	vertical horizontal	10 10	1,000,000-100,000,000	3-D point cloud
Airborne	vertical horizontal	300 360	variable	Map pixel[6]

7/08/15

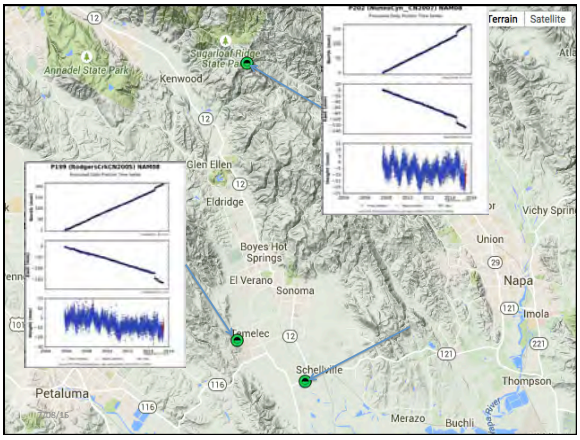
Continuous GPS (CGPS) Sites

1. Plate Boundary Observatory (PBO) of the University Navstar Consortium (UNAVCO)
2. NASA/JPL
3. UC Berkeley's Bay Area Regional Deformation (BARD) network
4. Scripps Orbit and Permanent Array Center (SOPAC)
5. US Geological Survey
6. California Spatial Reference Center (CSRC)
7. NGS
8. US Coast Guard
9. CalTrans
10. Various commercial operations

7/08/15



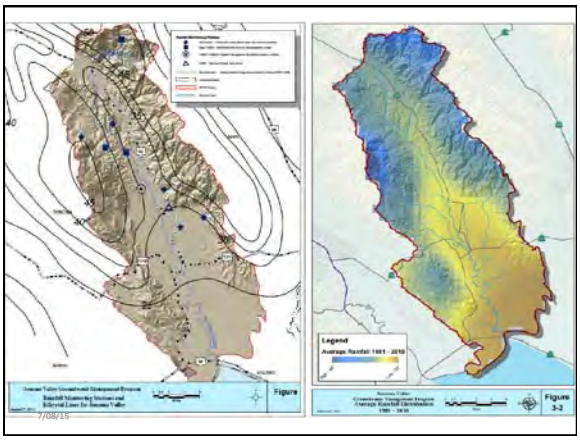
DWR SUMMARY OF LAND SUBSIDENCE, 2014
FIGURE 5, PAGE 8

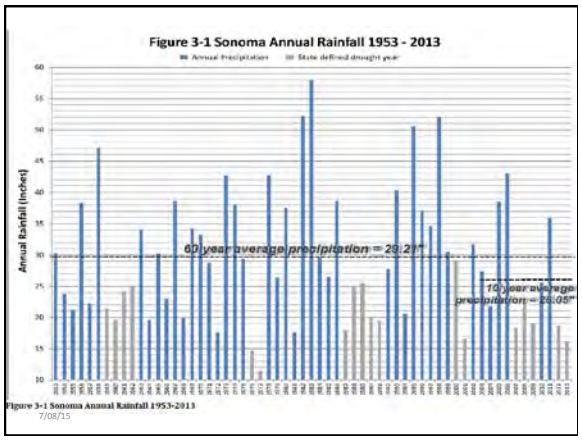


Next Steps to Monitor for Possible Land Subsidence

- Water Agency Survey Group compiling benchmark locations and survey options/costs
- Identify key areas of vulnerability and approximate locations for survey network which should include groundwater level and pumping data
- Develop work plan, cost estimate and identify funding opportunities

7/08/15





Verify Existing Rainfall Monitoring

- Identify existing federal, state and local agency monitoring
- Identify other precipitation monitoring stations (COCORAS, Weather Underground)
- Review CIMIS and NCDC websites
- Compile information and identify data gaps

7/08/15

Develop Additional Data Needs

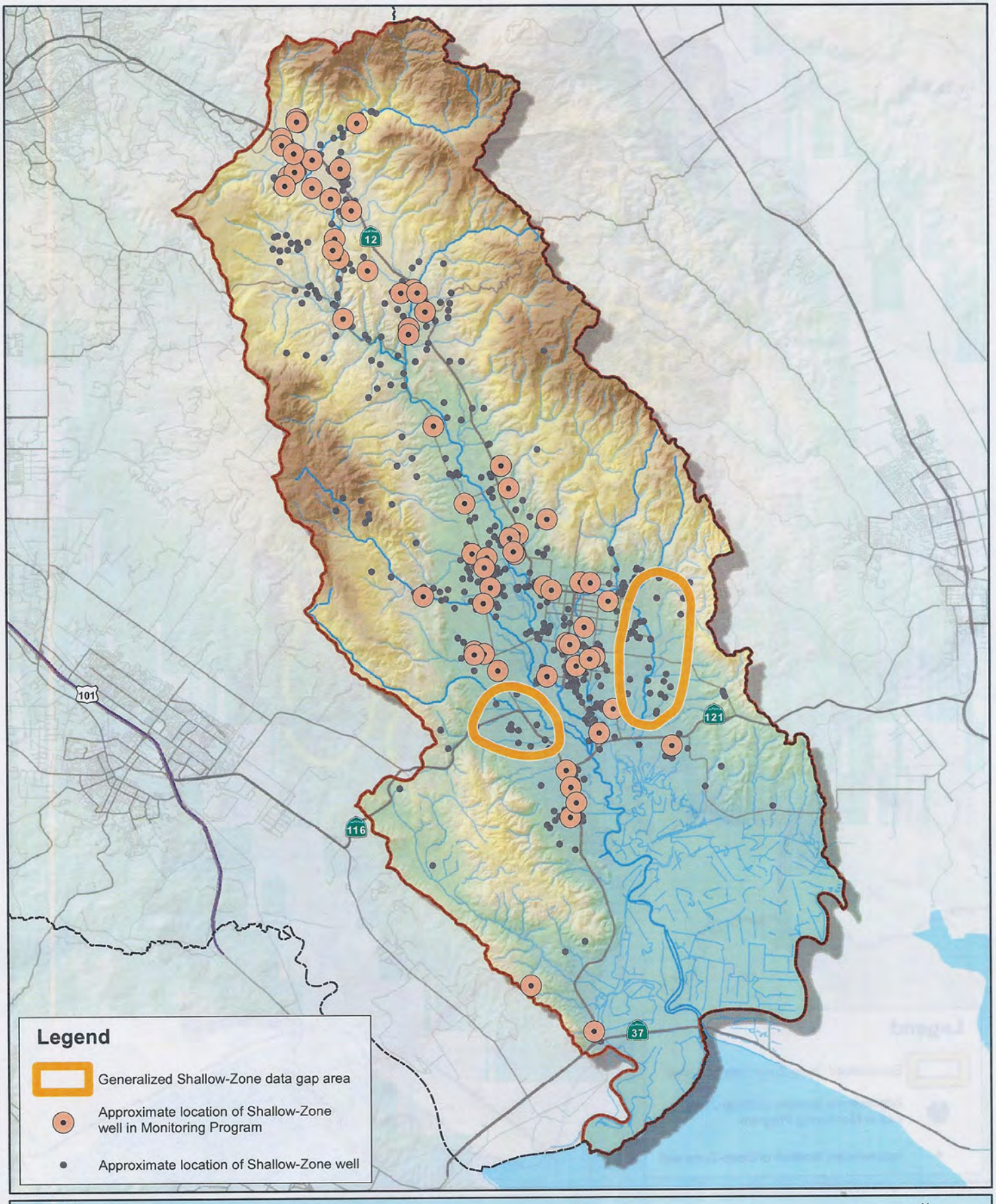
- Develop additional monitoring needs based on data gaps
- Identify approximate per station equipment costs and develop estimate
- Identify possible monitoring partners to maintain stations and provide data downloads to data management system

7/08/15

Develop Proposal and Approach for Increased Precipitation Monitoring

- Summary of existing stations and network, data collection equipment and quality
- Additional data needs
- Estimate for additional stations
- Partners and agreements to maintain new stations
- Identify funding opportunities

7/08/15



Sonoma Valley
Voluntary Groundwater-Level Monitoring Program
Shallow-Zone Monitoring Well Network

October 30, 2014

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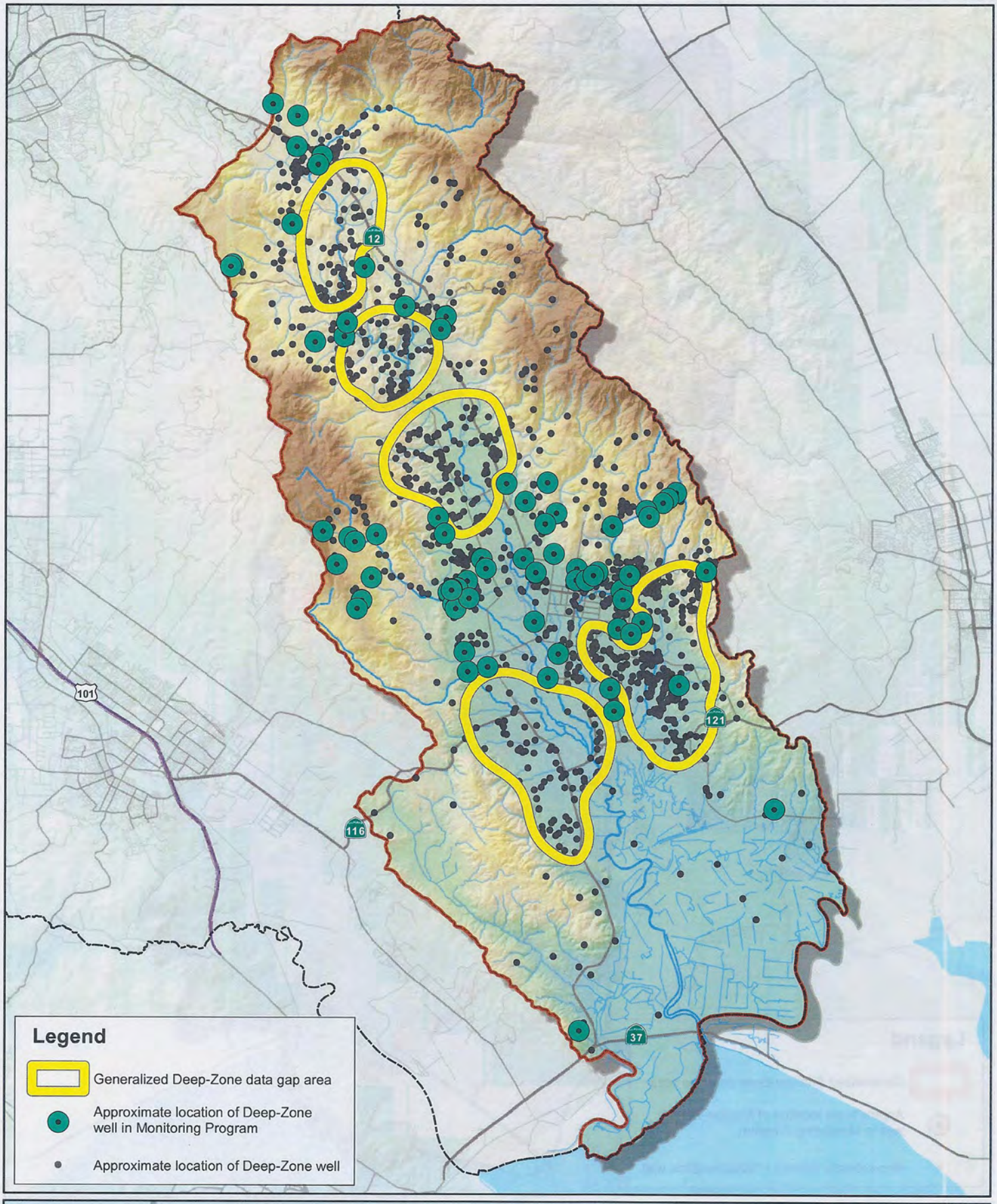

Sonoma Valley
Voluntary Groundwater-Level Monitoring Program
Deep-Zone Monitoring Well Network

October 30, 2014

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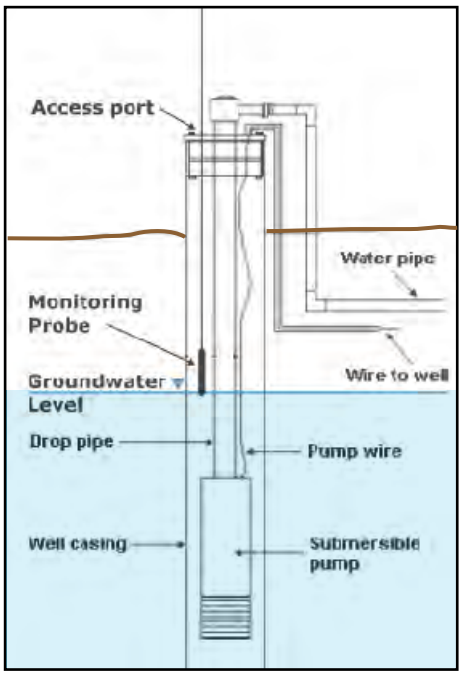
GOT GROUNDWATER? NOT SURE?

The Sonoma Valley Groundwater Management Program Basin Advisory Panel is seeking more information concerning groundwater levels in portions of the Sonoma Valley where there is insufficient data. This information will help further refine models of our groundwater basin and potential actions that may be taken to conserve and increase our groundwater resources.

Measurements are quickly completed by trained volunteers twice a year.

You can help by volunteering your well for use in this study. If selected, the groundwater level in your well will be measured twice a year by trained personnel. It's that simple. And it's absolutely FREE – there is no cost to you! You will be informed of the groundwater level below your property and will help ensure that localized conditions of you and your neighbors are included in the study. Your participation, including name and address, will be kept confidential.



Contact Marcus Trotta, Sonoma County Water Agency at mtrotta@scwa.ca.gov (707) 547-1978 or one of our well measurement volunteers, Ed Nelson, at nelsonoma@vom.com, for more information on how you can help with this important study, or visit the program website at www.scwa.ca.gov/svgroundwater.

Use of Groundwater Level Data

- Monitor groundwater level trends over time
- Better understand how surface water and groundwater interact
- Maintain a database of groundwater level information
- Improve the accuracy and reliability of computer models

Benefits of Participating

- Obtain accurate groundwater level data for your well
- Help shape the future of groundwater planning and management in the Santa Rosa Plain
- No cost to landowner

Measurements involve placing a monitoring probe or tape through your well's access port at the top of the well and lowering it down to the water surface.

http://www.scwa.ca.gov/svgroundwater/

Version: 07152015

VOLUNTARY GROUNDWATER LEVEL MEASURING PROGRAM

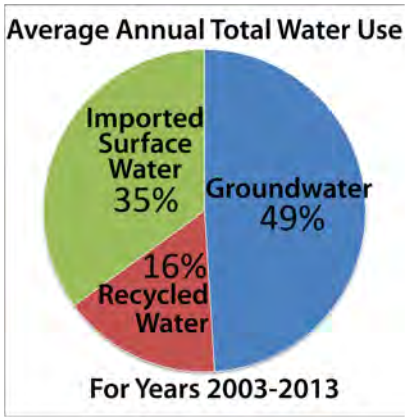
Sonoma Valley Groundwater Management Program

FREQUENTLY ASKED QUESTIONS

Sonoma Valley Groundwater

What is groundwater and why is it important to the Sonoma Valley Watershed?

Groundwater is surface water that has infiltrated or "recharged" through the ground surface or along streambeds or mountain fronts, and is stored in the cracks and spaces in soil, sand, and rock. Groundwater is contained in formations known as aquifers, which consist of materials such as sand and gravel that are permeable (having large connected spaces between the materials that allow water to flow through). A recharge area is the place where surface water enters the aquifer, and a discharge area where groundwater leaves the aquifer. Open space, agricultural areas and streams provide valuable recharge areas in the Watershed; most discharge occurs through wells and along streams.



Groundwater resources have long played a significant role in the development, growth and sustainability of Sonoma Valley, with nearly 50% of the annual water demand met by local groundwater resources, and the remainder supplied by imported water from the Russian River, and recycled water for irrigation.

What is the Voluntary Groundwater Level Measuring Program and why is it being undertaken?

The Voluntary Groundwater Level Measuring Program will help improve our understanding of the overall status and resiliency of the aquifer system by tracking groundwater level trends, which will help achieve our Groundwater Management Plan Goal - ***To locally manage and protect groundwater resources by a balanced group of stakeholders through non-regulatory measures to support all beneficial uses, including human, agriculture, and ecosystems in an environmentally sound, economical, and equitable manner for present and future generations.*** Privately owned volunteered wells will augment the network of stations tracking groundwater elevations throughout Watershed.

Why are groundwater level measurements needed?

Existing data are insufficient to understand trends in groundwater levels throughout the basin. Increasing monitoring across the Sonoma Valley Watershed, including wells of varying depths, will greatly improve understanding of the aquifer system. The long-term goal is to help prevent drops in groundwater levels that may impact surface water resources or would require drilling wells deeper at great expense to local landowners.

Will the program involve measuring how much groundwater I use?

No measurement of the amount of groundwater pumped will be taken. The measurement will document the depth to groundwater in the well only.

Will someone try to curtail my groundwater use if I participate in the program?

No. The groundwater level measuring is a voluntary program to measure groundwater levels in the Sonoma Valley. Groundwater use is not being measured as part of this program - the program is for monitoring not metering.

What are the benefits of monitoring groundwater levels?

- Providing well owners information regarding trends that influence their well's function and reliability
- Assessing annual and long-term changes of groundwater in storage
- Estimating recharge rates and where recharge occurs
- Determining direction and gradient of groundwater flow

How long is the monitoring program anticipated to last?

The program will last indefinitely into the future. As groundwater level trends in the Sonoma Valley Watershed become better understood, the number and locations of monitoring wells may change.

Who is eligible to participate?

Anyone who owns a well in the Sonoma Valley is encouraged to contact Program Manager Marcus Trotta at 707-547-1978 or mtrotta@scwa.ca.gov to discuss whether or not their well is suitable for measurring as part of this program. The well owner will be asked to provide a list of information available on the well including whether there is a well log, water level and water quality data, and the well's condition.

Version 07062015

Sonoma Valley Groundwater Management Program

Sonoma Valley Groundwater

What is required from me if I want to participate?

Willingness to allow trained personnel to visit the well a minimum of 2 times each year. Participating well owners will sign a permit to enter letter indicating the frequency of the visits and other details.

If I agree to participate, what is the frequency and duration of visits?

Trained personnel will visit the well in the spring and fall at minimum. The trained personnel will be on the property about 15 minutes for each visit to take measurements of the groundwater depth in the well. The well owner will be contacted at least 48 hours in advance of each visit to make final arrangements.

Who will be taking the groundwater level measurements?

Measurements require special equipment and training. Local trained volunteers, Sonoma County Water Agency staff, and other organization's staff will conduct the monitoring.

How are groundwater level measurements taken at the well?

Measuring groundwater levels is quite simple, but needs to be done in a consistent and objective manner to ensure results that can be tracked over time. A shut down period is required prior to the measurement. Devices that may be used include downhole sounding tapes that are lowered into the well through existing access ports and sonic devices that also use existing access ports but don't need to be lowered into the well.

Will participating in the program cause any problems with my well or water quality?

Prior to accepting a well into the program, the well will be inspected to ensure that access for the measurements can be accomplished without disrupting the wellhead. Sonic measuring devices do not require lowering equipment inside the well casing. Should a downhole sounding tape be used, personnel performing the measurements will be trained on proper sanitary practices. Equipment will be thoroughly cleaned and sanitized prior to collecting each measurement.

What if a well owner wants to take the groundwater level measurements? Will this be allowed?

If individual well owners want to measure their own well, they will be encouraged to work with trained personnel as the tools and methods required are specialized. However, training for interested parties may be made available if there is enough interest.

How will the information collected be used?

Information will be used to:

- Monitor groundwater level elevations
- Understand the relationship and interaction between surface water and groundwater along streams
- Maintain a central data management system of monitoring information
- Improve the reliability and accuracy of relevant computer models

Will people have access to the collected data? How is my privacy protected?

Sonoma County Water Agency will maintain all information securely and privately and will not publish your personal information as part of the monitoring program activities. Data collected will be used to create maps indicating groundwater levels. These maps will be publicly available, but specific well locations will not be shown. The Water Agency will not disclose any of your personal information unless required to do so under California law or court order. We will also promptly notify all parties in the unlikely event this is requested.

What if a well owner decides to quit the program?

Volunteers can leave the program any time. However, gathering data over long periods of time is critical to understanding groundwater level trends. Volunteers are encouraged to participate in the program over the long term.

Will participating cost me anything?

No. There will not be any fees or costs for participating in this program.

How do I get more information or talk about participating in the program?

For more information, please contact Marcus Trotta at 707-547-1978 or mtrottta@scwa.ca.gov, or visit the website:

www.sonomacountywater.org/svgroundwater/