EXECUTIVE SUMMARY

California's historic Sustainable Groundwater Management Act (SGMA) became effective on January 1, 2015, at the height of the state's last drought. SGMA mandated that groundwater resources be sustainably managed to ensure that water will be available today and into the future for all beneficial users, including flora and fauna, municipal and domestic, agricultural, and business users. The Petaluma Valley Groundwater Sustainability Agency (Petaluma Valley GSA) was formed under SGMA to develop and implement this Groundwater Sustainability Plan (GSP or Plan) for the Petaluma Valley Groundwater Basin (Basin) (refer to **Figure ES-1**).

This GSP lays out a management process for ensuring a sustainable groundwater supply in the future by improving the understanding of this hidden resource, measuring progress through metrics that will be monitored, actively implementing projects, and, as necessary, adopting management actions in response to groundwater levels if they continue to decline unacceptably, and developing the funding needed for long-term implementation. The GSP implementation process includes active engagement of local stakeholders by the GSA Board, Advisory Committee, and periodic community meetings.

The Basin is classified by California Department of Water Resources (DWR) as a medium-priority basin, with groundwater levels declining in some areas of the Basin. Based on the medium-priority designation, the GSA must submit the GSP to DWR by January 31, 2022. The Petaluma Valley GSA began work on the GSP in 2018, to identify and quantify existing problems and data gaps, define local goals for sustainable management of the Basin, and develop a Plan that achieves and maintains groundwater sustainability 50 years into the future.

Prior to the passage of SGMA, the U.S. Geological Survey (USGS) began work on a comprehensive study of groundwater resources in the Basin and contributing watershed. The USGS study was sponsored by the City of Petaluma and Sonoma County Water Agency (Sonoma Water) and is foundational to this GSP.

This GSP presents detailed, technical information to build upon the work done by USGS and to better understand groundwater in the Basin. The GSP uses quantifiable sustainable management criteria to define sustainability and includes projects, management actions, and an implementation plan necessary to achieve locally determined sustainability goals.

Because Petaluma Valley once again faces historic drought conditions, and with climate change projections showing that longer, more severe droughts are inevitable, the GSP lays out a path for long-term sustainability and resiliency as defined by SGMA. While the current drought highlights water resource challenges, GSPs are not intended to address immediate short-term issues, but are focused on long-term, systemic groundwater issues. For example, using a computerized model, described in **Section ES-3**, the GSP projects a 50-year climate future characterized by a few very dry years, followed by several wet or very wet years, and then a long drought. This scenario is representative of projected conditions in the North Bay, but is one of multiple options that could have been used. The climate scenario will be reevaluated as more refined projections become available, and at a minimum of every 5 years when the

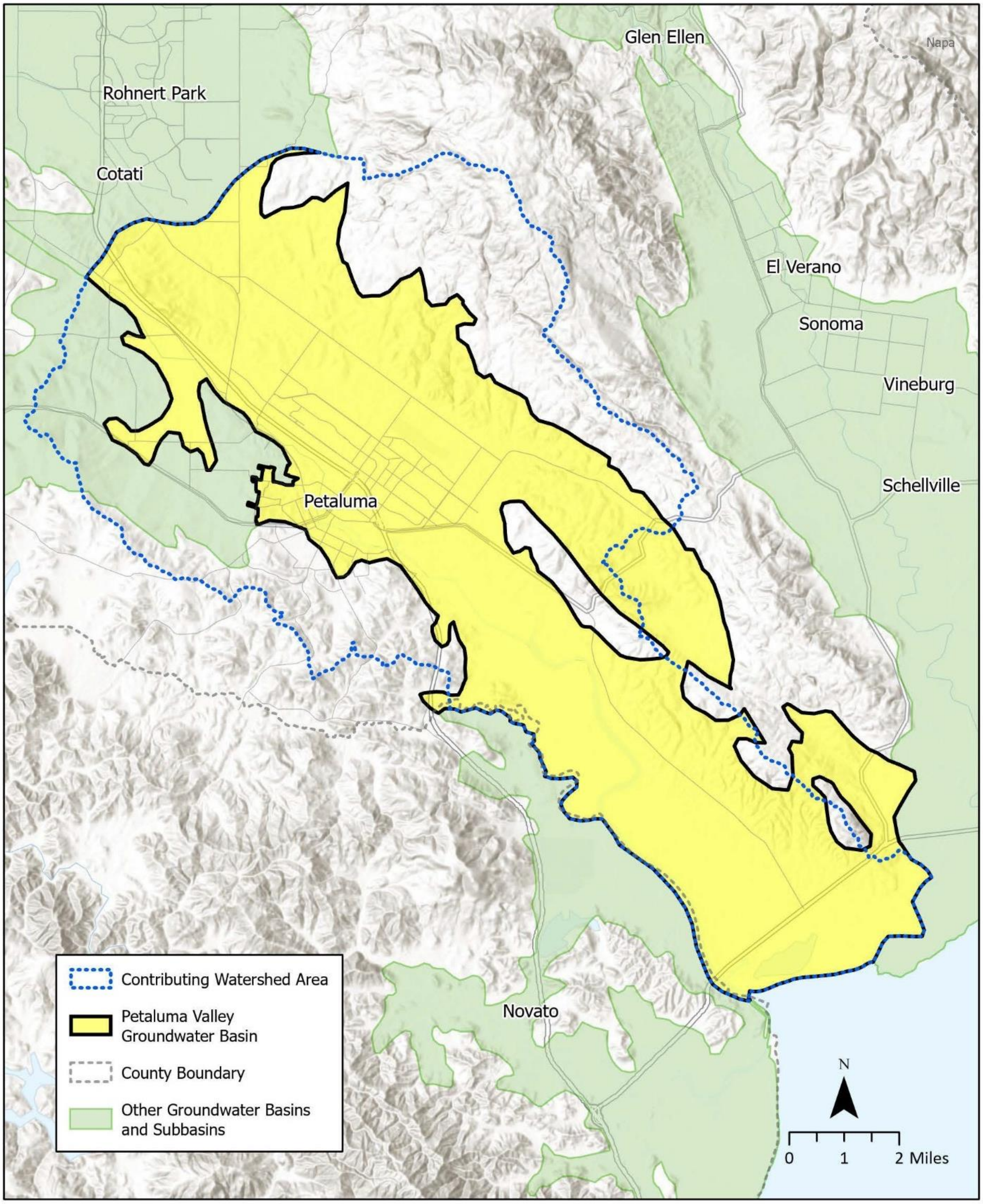


Figure ES-1. Plan Area/Petaluma Valley Groundwater Basin

GSP is required to be updated. This approach reflects a key component of this GSP, which is adaptive management. The document identifies areas of uncertainty and describes how new information will developed and incorporated into GSP implementation to make adjustments and to correct course if necessary.

Adaptive Management
A key tenant of this GSP is adaptive management. Adaptive management is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via monitoring and through the incorporation of new information as it becomes available.

This GSP and Executive Summary are organized following DWR's guidance documents (DWR 2016a):

- Executive Summary
- Section 1 Introduction
- Section 2 Description of the Plan Area
- Section 3 Basin Setting
- Section 4 Sustainable Management Criteria
- Section 5 Monitoring Networks
- Section 6 Projects and Management Actions to Achieve Sustainability
- Section 7 Implementation Plan
- Section 8 References and Technical Studies Used to Develop the GSP

ES.1 Introduction

In June 2017, the Petaluma Valley GSA, whose jurisdiction is the Basin, was formed as a Joint Powers Authority with five member agencies: North Bay Water District, Sonoma County (County), Sonoma Water, Sonoma Resource Conservation District, and the City of Petaluma. The Petaluma Valley GSA Board of Directors (Board) includes one representative from each member agency. The Board meets approximately six times annually in meetings that are open to the public.

In recognition of the importance of stakeholder input, the Board created a 10-member Advisory Committee to provide feedback and advice on all aspects of the GSP to the Board. The Advisory Committee meetings are open to the public, advertised through a monthly email update, and posted on the Petaluma Valley GSA website, petalumavalleygroundwater.org.

Both the Board and Advisory Committee continued to meet despite multiple wildfire emergencies affecting our community. During the public health emergency, meetings continued virtually. GSP development was a collaborative effort among the Board, Advisory Committee, and technical consultants, and was further informed by input from member agencies, resource agencies, and the community (**Figure ES-2**). Key policy issues were vetted, discussed, and modified based on this open, public exchange.

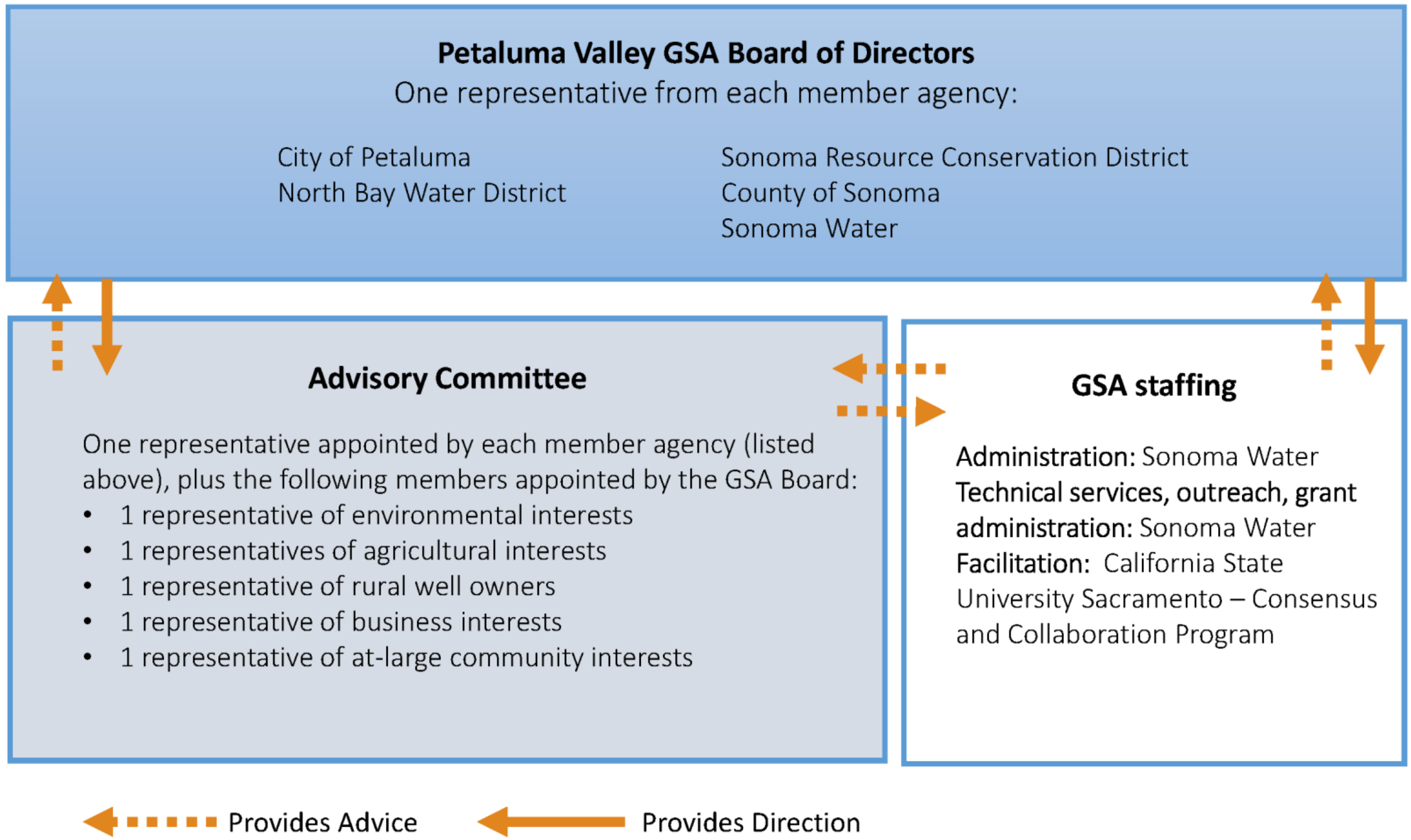


Figure ES-2. Petaluma Valley GSA Organizational Structure

ES.2 Plan Area

Section 2 of the GSP or Plan describes the Plan Area, including government jurisdictions, land use, water sources and uses, topography, surface water features, current monitoring and water management programs, and the well-permitting process.

The Plan Area is the entire Petaluma Valley Basin (**Figure ES-1**), located immediately north of San Pablo Bay, bounded on the east by Sonoma Mountains and on the west by low-lying hills. The approximately 46,000-acre Basin stretches from the Baylands northward, incorporating the City of Petaluma and the communities of Penngrove and Lakeville. The Petaluma River, which is the principal stream draining the Basin, is located within the larger Petaluma Valley watershed. In August 2019, the Basin boundaries were modified as part of DWR's reprioritization process to include additional areas of the City of Petaluma and the northwest section of Marin County.

The major urban water supplier in the Basin is the City of Petaluma, which relies primarily on imported Russian River water supplied by Sonoma Water. The City also pumps groundwater for supplemental supply, and during droughts and in emergencies. The majority of land in the Basin is native vegetation or surface water (57 percent) followed by agriculture (23 percent) and urban, commercial, and industrial, which total about 20 percent of land use. The majority of the native vegetation is located in the lower portions of the Basin along the tidal marshlands and in the hills northeast of the City of Petaluma (**Figure ES-3**).

Climate, water, and streamflow conditions in the Basin are informed by monitoring networks. Multiple studies, programs, land use plans, and regulations affect, inform, and protect current and future water resources, water use, and water quality in the Basin. The County is responsible for administering well permits in both the City of Petaluma and the unincorporated areas.

ES.3 Basin Setting

Section 3 describes the Basin setting based on existing studies related to geology, climate, and historical groundwater conditions.

ES.3.1 Hydrogeologic Conceptual Model

The Hydrogeologic Conceptual Model (HCM) characterizes the physical components of the surface water and groundwater systems, regional hydrology, geology, water quality, and principal aquifers and aquitards.

The Basin and its contributing watershed are located within a region of geologic complexity caused by long periods of active tectonic deformation, volcanic activity, and sea level changes. The northern Coast Ranges structure is dominated by the San Andreas zone of faults to the west, and the Rodgers Creek, Burdell Mountain, and Petaluma Valley fault zones. The regional tectonic faulting has helped shaped the Basin, the surrounding northwest trending valleys and ridges, and underlying geology (**Figure ES-4**).

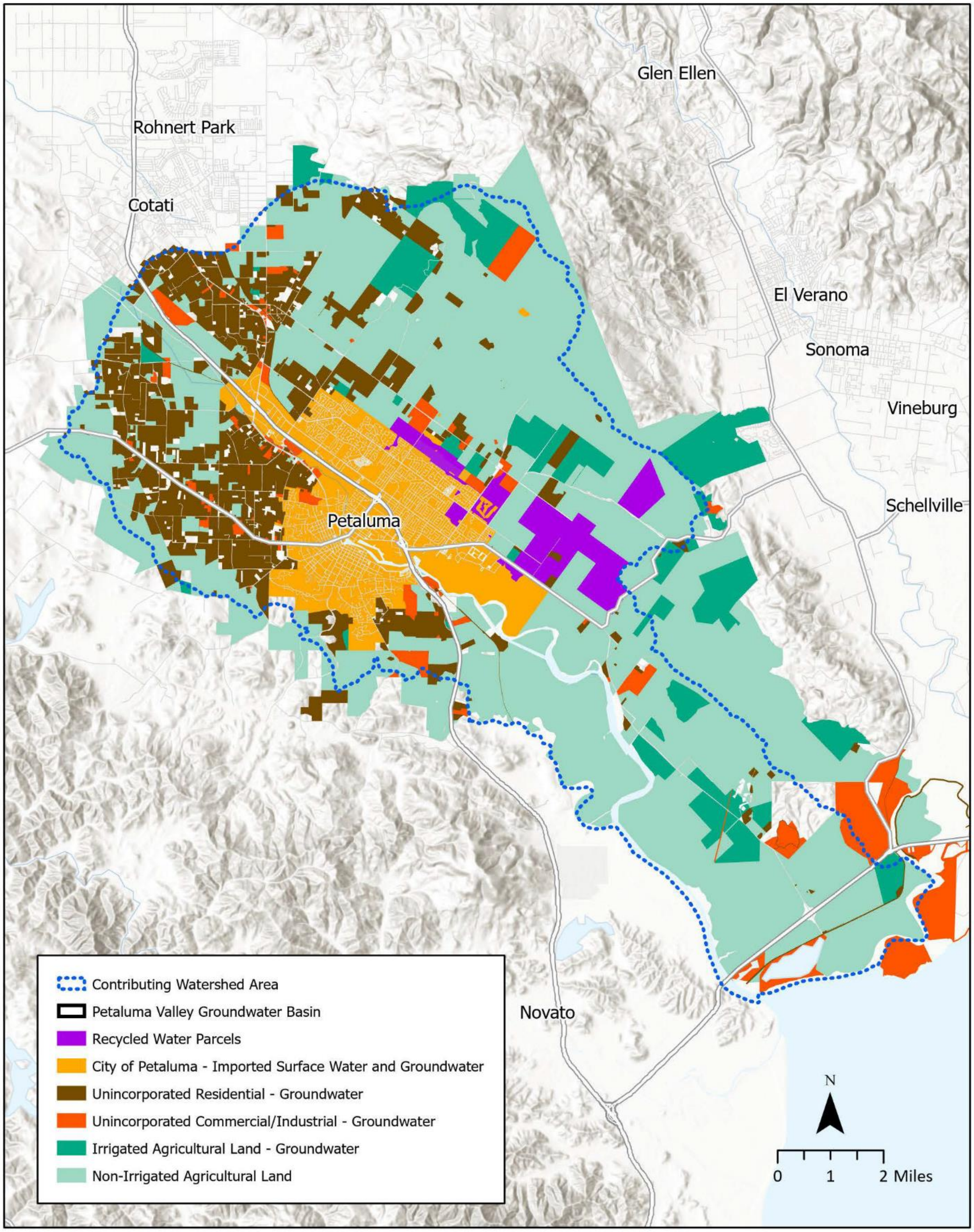


Figure ES-3. Water Sector and Water Use

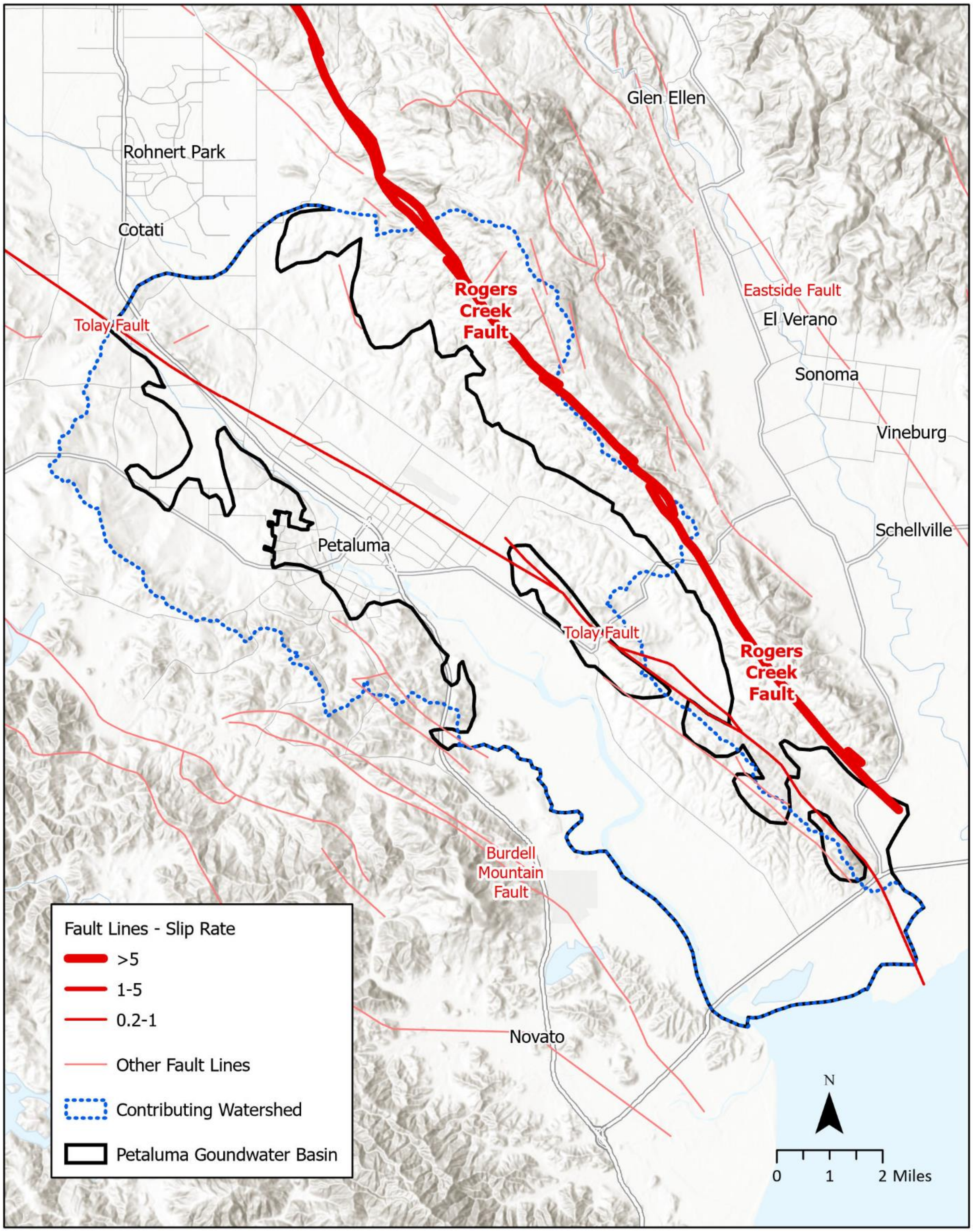


Figure ES-4. Fault Lines

Groundwater resources are variable throughout the Basin. Wells in the Petaluma Formation aquifer unit, which covers the largest area of the Basin, generally have low yields; wells in the Wilson Grove Formation aquifer unit are generally considered to be fair to good groundwater producers; and wells in the Sonoma Volcanics have large variations in water-bearing properties.

The aquifer system is recharged primarily through streambed recharge along portions of Petaluma River and its tributaries, as well as through direct infiltration of precipitation and along the margins of the valley areas (mountain-front recharge). Groundwater is discharged to the Petaluma River, streams, springs, seeps, interconnected wetlands, through evapotranspiration, and by groundwater pumping.

Data gaps in the HCM include the geometry and properties of aquifer and aquitards, the origin and extent of brackish water, and how faults in the Basin affect groundwater flow. Additionally, more data are needed to better understand groundwater recharge and discharge mechanisms in the Basin, including surface water-groundwater interaction and the amount and locations of groundwater extractions.

ES.3.2 Current and Historical Groundwater Conditions

SGMA requires GSAs to evaluate groundwater conditions using six indicators of groundwater sustainability: groundwater levels, groundwater storage, groundwater quality, land subsidence, seawater intrusion, and interconnected surface water-groundwater. In **Section 3**, previous studies, monitoring well data, and data from other monitoring networks are used to describe current and historical groundwater conditions for these six sustainability indicators**.**

Groundwater Levels: Groundwater levels for the majority of observed wells are generally stable and predominantly above sea level (except in the southern portion of the Basin near the Baylands and the tidally influenced reach of the Petaluma River). However, some wells near the upper reaches of Lynch Creek, near the northeastern edge of the Basin, and along the northern boundary of the Basin exhibit decreasing groundwater levels.

Groundwater Storage: The groundwater budget finds that the amount of groundwater stored in the aquifers is declining on average by about 40 acre-feet per year (AFY), but is shown as zero in **Table ES-1**, due to rounding.

Table ES-1. Summary Historical (WY 1969-2018), Current (WY 2012-2018), and Projected (2021-2070) Average Annual Change in Groundwater Storage (acre-feet/year)[a]

Water Budget Periods	
Average, Historical Period (1969-2018)	0
Average, Current Period (2012-2018)	-100
Average, Future (2021-2070)	100

Note:

[a] Values rounded to nearest 100.

Land Surface Subsidence: Existing data from both Interferometric Synthetic-Aperture Radar (InSAR) and global positioning system (GPS) stations do not indicate that inelastic (irrecoverable) land subsidence is occurring as a result of groundwater pumping. Small, measured changes in land surface elevation (averaging 0.0325 inch annually between 2015 and 2019) appear to reflect variations observed regionally.

Groundwater Quality: Groundwater quality sampling performed throughout the Basin for numerous different studies and regulatory programs finds that groundwater quality is generally adequate to support existing beneficial uses. Groundwater quality is poor in some local areas, related to the brackish waters of San Pablo Bay and tidal marshland areas and deep connate waters related to ancient seawater. There are some limited human-caused inputs from land use activities, such as agriculture, septic systems, and urban uses.

Seawater Intrusion: The seawater/freshwater interface likely occurs beneath the tidal marshlands near the boundary with San Pablo Bay. While salinity has been found in groundwater in the Basin, the limited data make it difficult to discern whether potential groundwater quality changes are due to either the distribution of monitored wells over different timeframes and/or the presence of older connate water.

Interconnected Surface Water and Groundwater: Information on interconnected surface water is limited within the Basin and is complicated by the presence of tidal-influenced reaches of streams. The groundwater flow model developed by the USGS (described briefly in the next section and in **Section 3.3**) indicates that much of the Petaluma River, along with much of Tolay Creek and the lower reaches of Lichau, Lynch, Washington, Adobe, Ellis, and Capri creeks are likely interconnected surface waters. Groundwater dependent ecosystems (GDEs) in the Basin support steelhead, red-legged frogs, riparian woodlands, oak woodlands, and freshwater marshes. More data are needed from monitoring wells near creeks and from stream gages to determine the specific impacts of groundwater pumping on surface water and on these GDEs.

ES.3.3 Groundwater Flow Model

A computerized numerical groundwater flow model, the Petaluma Valley Integrated Groundwater Flow Model (PVIHM), developed by USGS in conjunction with Sonoma Water, and used as a groundwater management tool, calculates groundwater flows into and out of the Basin (**Figure ES-5**). The model accounts for precipitation, surface water, and groundwater entering the Basin through runoff, streams, septic systems, and other sources; and surface water and groundwater leaving the Basin through evapotranspiration, streams, pumping, diversions, and other means.

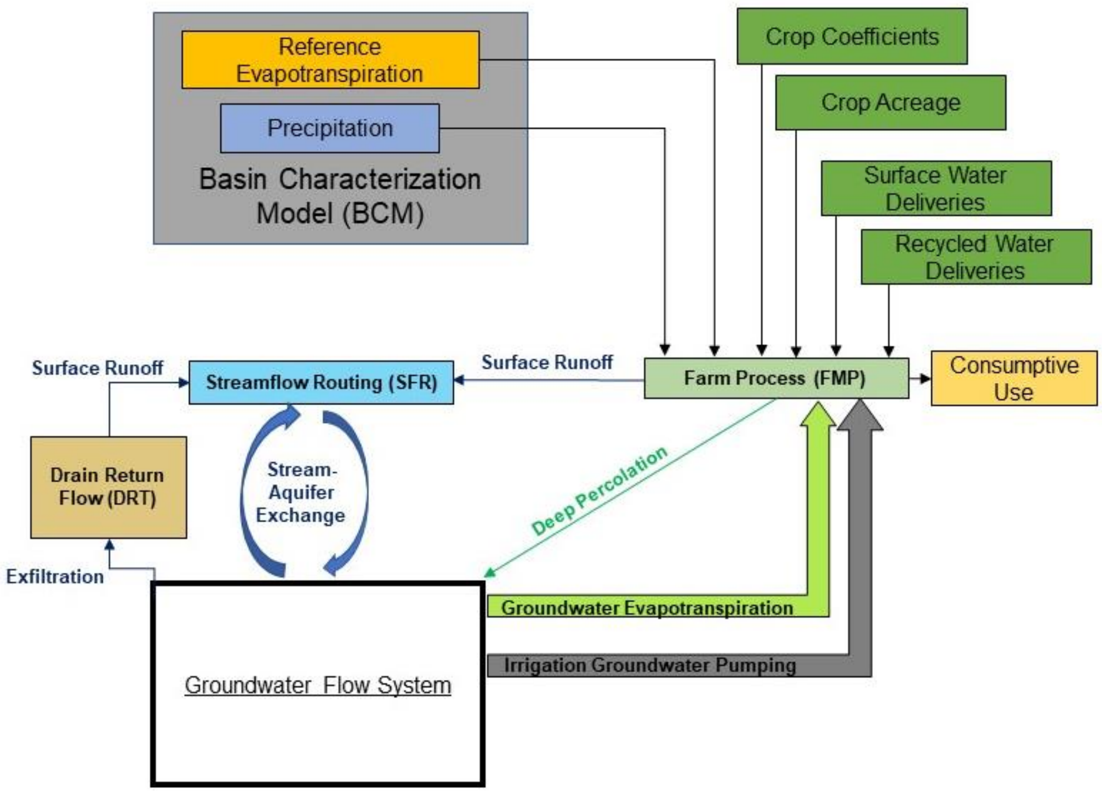


Figure ES-5. Representation of Water Budget Components in Petaluma Valley Integrated Groundwater Flow Model

ES.3.4 Projected Future Basin Conditions, Land Use, and Climate Change

Sustainability in the Basin must be achieved and maintained even as conditions—including land use and the climate—change.

Assumptions for future projected land use changes and water demands were estimated for rural-residential groundwater pumping, agricultural land use footprint, and municipal demands. Two practitioner workgroups, and surveys and input from the Advisory Committee, helped develop the data used in the projected model.

The Petaluma Valley GSA chose one potential climate change scenario to limit the number of simulations and provide better comparability between various potential projects and actions. The climate change scenario HadGEM2-ES RCP 8.5 simulation provides for several very dry years through 2025; normal and wetter years through 2050; and then a long-term drought after the mid-twenty-first century. This climate scenario allows for a significant stress test for groundwater resources planning during the GSP implementation horizon. The PVIHM was modified to simulate the 1-in-200 change (0.5 percent probability) sea level rise trajectory, which results in a projected sea level rise of 3.5 feet at the end of the projected 50-year water budget. As part of its adaptive approach to groundwater management, the GSA anticipates revising and updating climate projections as part of the 5-year update.

ES.3.5 Water Budget

The water budget was developed using PVIHM. The water budget provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Basin and the change of the volume of groundwater in storage under historical, current, and projected water budget conditions.

For the current water budget (2012-2018), groundwater outflows are larger than inflows, resulting in a loss of groundwater in storage by about 100 AFY during the current period (2012-2018). Current groundwater lost from storage is greater than the historical period (1969-2018) average loss of about 40 AFY.

During the future period (2021-2070), groundwater inflows are projected to be greater than groundwater outflows through 2045, due to a projected wetter climate. Consequently, groundwater storage is projected to increase at a rate of 500 AFY through 2040. After 2045, projected groundwater outflows exceed projected inflows, due to the projected severe longer drought, resulting in groundwater losses from storage at a rate of 100 AFY from 2041 through 2070. Overall, groundwater in storage is projected to increase by 100 AFY on average over the future period.

Table ES-1 summarizes the historical, current, and projected annual changes in groundwater storage for the Basin.

ES.3.6 Sustainable Yield

The sustainable yield of the Basin is an estimate of the quantity of groundwater that can be pumped on a long-term average annual basis without causing undesirable results. Basin-wide pumping within the sustainable yield estimate is neither a measure of, nor proof of, sustainability, but estimates of sustainable yield using the historical simulations may prove useful in estimating the need for projects and management actions to help achieve sustainability.

The sustainable yield of the Basin is 8,000 AFY of total groundwater pumping. Both the estimated current average groundwater pumping of 4,500 AFY and the projected future groundwater pumping of 2,300 AFY are below the sustainable yield. There is a significant amount of uncertainty in the estimate of the sustainable yield and as new information is developed, the sustainable yield will be refined and updated.

ES.4 Sustainable Management Criteria

SGMA provides specific language and criteria for establishing and maintaining sustainability, including the development of a sustainability goal, which Petaluma Valley GSA defines as follows:

The goal of this GSP is to adaptively and sustainably manage, protect, and enhance groundwater resources while allowing for reasonable and managed growth through:

- Careful monitoring of groundwater conditions
- Close coordination and collaboration with other entities and regulatory agencies that have a stake or role in groundwater management in the Basin
- A diverse portfolio of projects and management actions that ensure clean and plentiful groundwater for future uses and users in an environmentally sound and equitable manner

Central to SGMA is the development of sustainable management criteria (SMC) for six sustainability indicators depicted on **Figure ES-6.** The Petaluma Valley GSA identified undesirable results, minimum thresholds, measurable objectives, and interim milestones for the sustainability indicators as discussed in GSP **Sections 4.4** through **4.10**. The six sustainability indicators required by SGMA are listed below with a summary of what the GSA considers significant and undesirable conditions for each indicator. **Table ES-2** provides the SMC for all sustainability indicators.

Chronic Lowering of Groundwater Levels: Chronic lowering of groundwater levels that significantly exceed historical levels or cause significant and unreasonable impacts on beneficial users.

Reduction in Groundwater Storage: Reduction of groundwater storage that causes significant and unreasonable impacts on the long-term sustainable beneficial use of groundwater in the Basin, as caused by either:

- Long-term reductions in groundwater storage
- Pumping exceeding the sustainable yield

Seawater Intrusion: Seawater intrusion inland of areas of existing brackish groundwater that may affect beneficial uses of groundwater is significant and unreasonable.

Degraded Groundwater Quality: Significant and unreasonable water quality conditions occur if an increase in the concentration of constituents of concern (arsenic, nitrates, and salinity) in groundwater leads to adverse impacts on beneficial users or uses of groundwater, due to either:

- Direct actions by Petaluma Valley GSP projects or management activities
- Undesirable results occurring for other sustainability indicators

Table ES-2. Petaluma Valley Basin Sustainable Management Criteria

Sustainability Indicator	Significant and Unreasonable Statement	Minimum Threshold	Measurement	Measurable Objective	Undesirable Result
Chronic lowering of groundwater levels	Chronic lowering of groundwater levels that significantly exceed historical levels or cause significant and unreasonable impacts on beneficial users.	Maintain above historical low elevations while accounting for droughts/climate variability and protect at least 95% of nearby water supply wells. Metric: Shallower (more protective) of historical low elevations minus 4-year drought OR above the 95th percentile of nearby water supply well depths.	Monthly or monthly-averaged groundwater levels measured at representative monitoring point wells.	**Stable Wells:** Maintain within historical observed ranges. Metric: Historical median spring groundwater elevation. **Wells with Declining Trends**: Recover groundwater levels to historical groundwater elevations prior to declining trend. Metric: Historical (generally pre-2010) median groundwater elevation.	25% of RMPs exceed MT for 3 consecutive years.
Reduction in groundwater storage	Reduction of groundwater storage that causes significant and unreasonable impacts to the long-term sustainable beneficial use of groundwater in the Basin, as caused by: • Long-term reductions in groundwater storage • Pumping exceeding the sustainable yield	Measured using groundwater elevations as a proxy. MT for groundwater storage is identical to the MT for the chronic lowering of groundwater levels.	Annual groundwater storage will be calculated and reported by comparing changes in contoured groundwater elevations. However, monitoring for the chronic lowering of groundwater levels will be used to compare with MT and MOs.	MO for groundwater storage is identical to the MO for the chronic lowering of groundwater levels.	Undesirable result for groundwater storage is identical to the undesirable result for the chronic lowering of groundwater levels.
Seawater Intrusion	Seawater intrusion inland of areas of existing brackish groundwater that may affect beneficial uses of groundwater is a significant and unreasonable condition.	The 250 mg/L chloride isocontour located in an area that is protective of beneficial users of groundwater. This MT isocontour is initially located between the currently inferred 250 mg/L isocontour (inferred interface of brackish groundwater) and beneficial users of groundwater (known water wells supplying beneficial users). This MT will need to be reassessed during early stages of GSP implementation once additional monitoring data and information are available, because the initial location is selected from very limited available data.	The chloride isocontour will be developed based on chloride concentrations measured in groundwater samples collected from an RMP network, which will be developed during the early stages of GSP implementation.	The 250 mg/L chloride isocontour at the currently approximate interface of brackish groundwater (i.e., current conditions).	When two conditions are met: (1) Three consecutive years of MT exceedances and (2) The MT exceedance is caused by groundwater pumping.
Degraded water quality	Significant and unreasonable water quality conditions occur if an increase in the concentration of COCs in groundwater leads to adverse impacts on beneficial users or uses of groundwater, due to: • Direct actions by Petaluma Valley GSP projects or management activities, • Undesirable results occurring for other sustainability indicators	The MT is based on two additional supply wells exceeding the applicable maximum contaminant levels for (1) arsenic, (2) nitrate, or (3) salts (measured as TDS).	The number of public water supply wells with annual average concentrations of arsenic, nitrate, or TDS that exceed maximum contaminant levels in groundwater quality data available through state data sources.	The MO is based on no additional supply wells exceeding the applicable maximum contaminant level for (1) arsenic, (2) nitrate, or (3) salts (measured as TDS).	An undesirable result occurs if, during 2 consecutive years, a single groundwater quality MT is exceeded when computing annual averages at the same well, as a direct result of projects or management actions taken as part of GSP implementation.

Sustainability Indicator	Significant and Unreasonable Statement	Minimum Threshold	Measurement	Measurable Objective	Undesirable Result
Subsidence	Any rate of inelastic subsidence caused by groundwater pumping is a significant and unreasonable condition everywhere in the Basin and regardless of the beneficial uses and users.	0.1 feet per year of total subsidence.	DWR-provided InSAR dataset average annual subsidence for each 100-meter-by-100-meter grid cell.	The MO is identical to the MT (0.1 feet per year of subsidence).	Annual MT of 0.1 feet total subsidence is exceeded over a minimum 50-acre area or cumulative total subsidence of 0.2 foot is exceeded within a 5-year period and MT exceedance is determined to be correlated with: (1) groundwater pumping, (2) an MT exceedance of the chronic lowering of groundwater-level SMC (that is, groundwater levels have fallen below historical lows).
Depletion of interconnected surface water (ISW)	Significant and unreasonable depletion of surface water from interconnected streams occurs when surface water depletion, caused by groundwater pumping within the Basin, exceeds historical depletion or adversely impacts the viability of GDEs or other beneficial users of surface water.	Maintain estimated streamflow depletions below historical maximum amounts. Metric: Shallow groundwater elevations are used as a proxy for stream depletion. The MT is set at 1 foot below the 2020 dry-season average minimum groundwater levels.	Monthly-averaged groundwater levels measured in representative monitoring points (shallow monitoring wells near ISW).	The MO is to maintain groundwater levels within historical observed ranges. Metric: The halfway point between the MT value and the average observed dry-season surface water stage from November 2019 to December 2020.	Undesirable result occurs if MT is exceeded at two wells during dry years or at one well during normal and wet years.

Figure ES-6. Sustainability Indicators

Land Surface Subsidence: Any rate of inelastic land subsidence caused by groundwater pumping is a significant and unreasonable condition, everywhere in the Basin and regardless of beneficial uses and users.

Depletion of Interconnected Surface Water: Significant and unreasonable depletion of surface water from interconnected streams occurs when surface water depletion, caused by groundwater pumping within the Basin, exceeds historical depletion or adversely impacts the viability of GDEs or other beneficial users of surface water.

Components of Sustainable Management Criteria

Sustainability Goal: A succinct statement of the GSA's objectives and desired conditions and how the basin will achieve these conditions.

Significant and Unreasonable Condition: A qualitative statement regarding conditions that should be avoided.

Undesirable Results: A quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the Basin.

Minimum Thresholds: The quantitative values that reflect what is significant and unreasonable at every measuring site.

Measurable Objectives: Specific, quantifiable goals at each representative monitoring site to maintain or improve groundwater conditions in order to maintain or achieve the sustainability goal for the basin.

Representative Monitoring Sites: These are typical monitoring sites within the broader network of sites that reliably provide high-quality data that characterize groundwater conditions in the basin.

SGMA requires the use of monitoring networks to quantitatively measure Basin health and the GSA's progress in meeting or maintaining sustainability. The monitoring network is described in **Section 5**. Because the Petaluma Valley GSA lacks detailed information needed to measure changes for several of the sustainability indicators, groundwater level monitoring will initially be used as proxy for monitoring Basin health for reductions in groundwater storage and depletion of interconnected surface water. Additionally, an assessment of how other sustainability indicators could be influenced by groundwater level minimum thresholds indicates that if groundwater level undesirable results are avoided, undesirable results for other sustainability indicators (reduction in groundwater storage, land subsidence, seawater intrusion caused by groundwater pumping, and degraded water quality caused by groundwater pumping) are not expected to occur. For these reasons, groundwater levels are a main focus of sustainability planning.

ES.5 Monitoring Networks

SGMA requires monitoring networks to quantitatively measure Basin health and the GSA's progress in meeting or maintaining sustainability. **Section 5** describes the monitoring networks that are planned in the Basin and in the contributing watershed area. The section also discusses how the existing monitoring networks described in **Section 2** were evaluated and refined.

The purpose of the monitoring networks is to demonstrate progress toward achieving measurable objectives, monitor impacts on groundwater users and uses, monitor changing groundwater conditions, and quantify changes in the water budget.

Representative Monitoring Point (RMP) networks are a subset of the larger set of monitoring networks and area. The RMPs described in detail in **Section 5** and summarized in **Table ES-3** are wells where sustainability indicators are monitored. **Figure ES-7** shows the RMP network for the chronic lowering of groundwater levels.

Table ES-3. Monitoring Networks and Initial Representative Monitoring Point Networks

Sustainability Indicator	Monitoring Network	Initial Representative Monitoring Point Network
Chronic Lowering of Groundwater levels	20 wells within the contributing watershed area (including 15 wells in the Basin)	11 wells (3 dedicated monitoring wells; 5 private supply wells; 3 inactive municipal wells)
Reduction in Groundwater Storage	20 wells within the contributing watershed area (including 15 wells in the Basin)	11 wells (3 dedicated monitoring wells; 5 private supply wells; 3 inactive municipal wells)
Seawater Intrusion	Within 1 to 2 miles of Baylands: 9 public water supply wells	Within 1 to 2 miles of Baylands: 9 public water supply wells
Degraded Water Quality	Existing supply well groundwater quality monitoring programs, as follows: Arsenic: 18 wells Nitrate: 30 wells Salts: 13 wells	Existing supply well groundwater quality monitoring programs, as follows: Arsenic: 18 wells Nitrate: 30 wells Salts: 13 wells
Land Surface Subsidence	1 GPS location; InSAR satellite in most of the Basin	InSAR dataset
Interconnected Surface Water	16 stream gages; 3 shallow monitoring wells adjacent to streams	3 shallow monitoring wells adjacent to streams

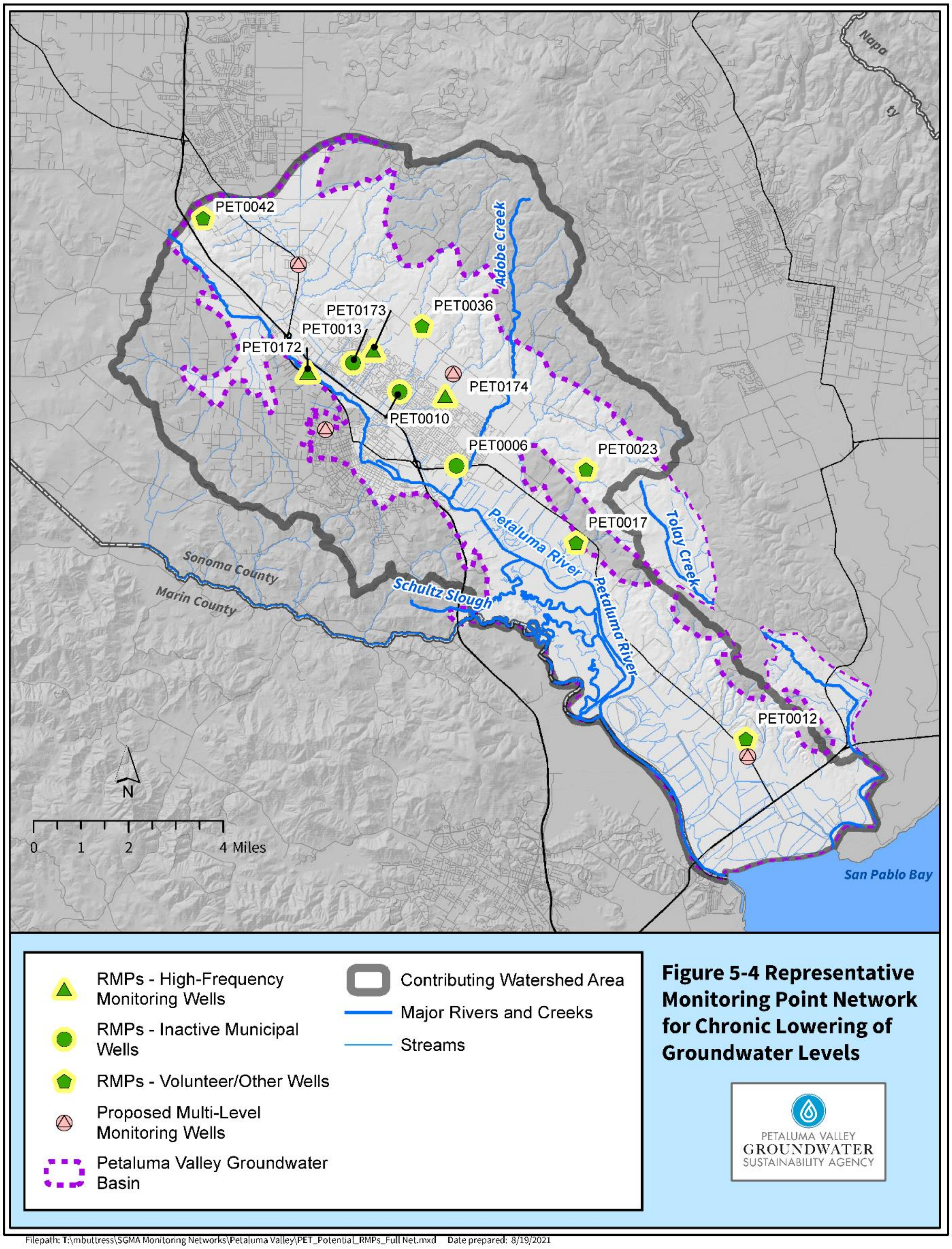


Figure ES-7. Representative Monitoring Point for Groundwater Levels

Section 5 also identifies the data gaps that exist in the monitoring networks, and describes how these gaps will be filled during GSP implementation. While a DWR Technical Support Services grant for 12 new shallow monitoring wells near streams and DWR Proposition 68 grant funding for four new multilevel monitoring wells have helped address some data gaps, the early years of GSP implementation will specifically focus on filling additional data needs to better monitor interconnected surface water, seawater intrusion, and specific groundwater levels.

ES.6 Projects and Management Actions

GSPs are intended to help communities achieve groundwater sustainability as defined by the SMC and based on current and projected future groundwater conditions. **Section 6** of the GSP identifies conceptual projects and management actions to help avoid undesirable results as described in **Section 4**. The model indicates that minimum thresholds for groundwater levels will be reached in only one well during the projected future period, and that undesirable results will not occur.

Projects and management actions considered are:

1. Voluntary reductions in rural domestic, agricultural, commercial, and industrial groundwater use through water conservation tools (such as appliance rebates and replacement, smart irrigation controllers, and water use audits), onsite rainwater capture, and greywater use. The programs and education offered to domestic, commercial, and industrial groundwater users will mirror programs offered to regional municipal water users, which have led to a 37 percent reduction in per capita water use since 2010. Many grape growers already use drip irrigation and rely on new technologies to determine when and how much to irrigate vines. The programs and education offered to agricultural users would be focused on leveraging existing best management practices and working with farmers who have not had access to or the resources available to reduce water use. For the purposes of simulating these projects using the model, it was assumed that these tools would result in a 20 percent reduction in rural domestic groundwater use and a 10 percent reduction in agricultural groundwater use.

2. Recycled water system expansion: The GSA will coordinate with the City of Petaluma to assess additional recycled water opportunities. It is anticipated that the assessment will include:

   - Evaluation of existing and future availability, delivery commitments, and constraints

   - Assessment of options for optimization of existing and projected future available supplies

   - Preliminary cost/benefit analysis for future prioritizing options

3. Assessment of stormwater capture and recharge and aquifer storage and recovery (ASR): The GSA will coordinate and support studies with other entities to assess the feasibility of enhanced recharge projects including stormwater capture and recharge and ASR.

Stormwater capture and recharge includes multi-benefit projects that can help reduce flooding and contribute to increasing summer and fall streamflows. Conceptually, an ASR program would involve the diversion and transmission of surplus Russian River water produced at existing drinking water production facilities during wet weather conditions (that is, the winter and spring seasons) for storage in the deeper portions of the aquifer system of the Basin. The stored water would then be available for subsequent recovery and use during dry weather conditions (that is, the summer and fall seasons) or emergency situations.

4. Study of and prioritization of potential policy options: This management action involves a collaboration between the GSA Board, local land use agencies, GSA member agencies, other Sonoma County GSAs, and stakeholders to assess and prioritize future policy options that may be appropriate for the GSA to consider adopting or recommending for adoption by other agencies. Policy options for potential inclusion in the assessment include water conservation requirements for new development; expand low impact development or water efficient landscape plan requirements; well construction and permitting recommendations; well metering program for non-residential wells; study of water markets; and permitting and accounting of water hauling.

5. Coordination of farm plans with GSP implementation: This management action involves a collaboration between the three Sonoma County GSAs and interested members of the agricultural community to evaluate the feasibility of developing a program that coordinates farm plans, developed at individual farm sites, with the implementation of the Basin-wide GSP. This effort will identify areas of mutual interest (for example, improved water use efficiency, increased groundwater recharge, increased monitoring and data collection, coordinated information sharing, and reporting) and recommend standards, metrics, and incentives for the program.

Model simulations of the voluntary reductions in groundwater use result in minor improvements in groundwater conditions, with slight increases of groundwater in storage and groundwater contributions to surface water.

ES.7 Plan Implementation

ES.7.1 Estimated Implementation Costs

Section 7 provides a high-level budget for the estimated cost over the initial 5 years of GSP implementation. Costs are based on the best estimates available and reflect Petaluma Valley GSA's understanding of the effort necessary for effective management and to comply with the SGMA requirement for monitoring and reporting. In Petaluma Valley, projects and actions are not projected to be needed in the near term to avoid undesirable results and a significant portion of the estimated costs are associated with the need to fill data gaps and improve monitoring networks.

Costs are divided into the following categories: administration and operations (including legal and grants); communication and stakeholder engagement; routine monitoring, data evaluation, and reporting; addressing data gaps; model maintenance, updates, and improvements; conceptual projects and planning design; and 5-year GSP update (**Figure ES-8**).

The mid-range budget projections for the first 5 years total about $5.6 million, averaging $1.1 million annually.

ES.7.2 Funding Sources and Mechanisms

Currently, the five GSA member agencies annually contribute funding for operations, outreach, and GSP development. The Petaluma Valley GSA has successfully applied for and received more than $2 million in funding for GSP development and to help address data gaps. Grant funding through Proposition 68 and future state bond measures will continue to be a critical source of revenue, particularly for closing data gaps and for project planning and implementation. In addition, Petaluma Valley GSA has initiated a funding study to identify local financing options moving forward, including possible groundwater user fees.

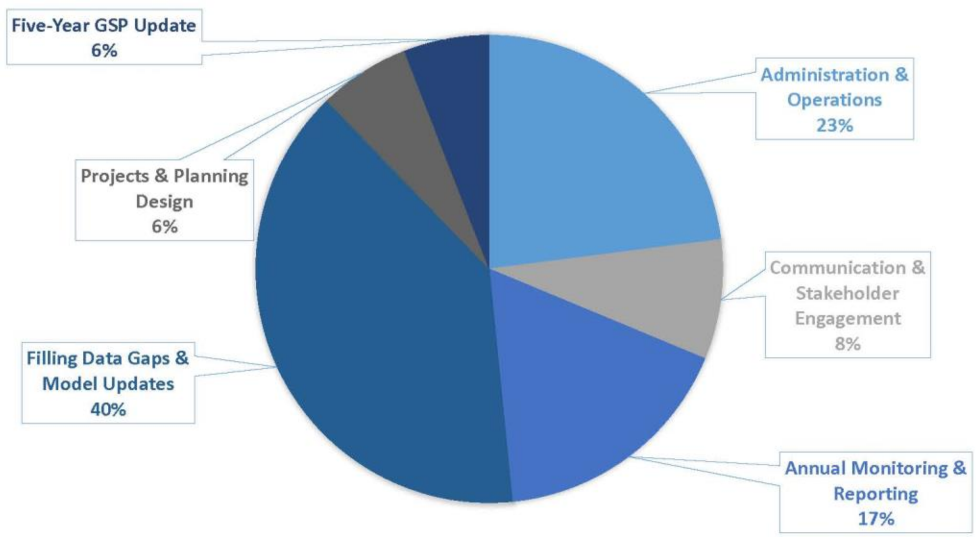


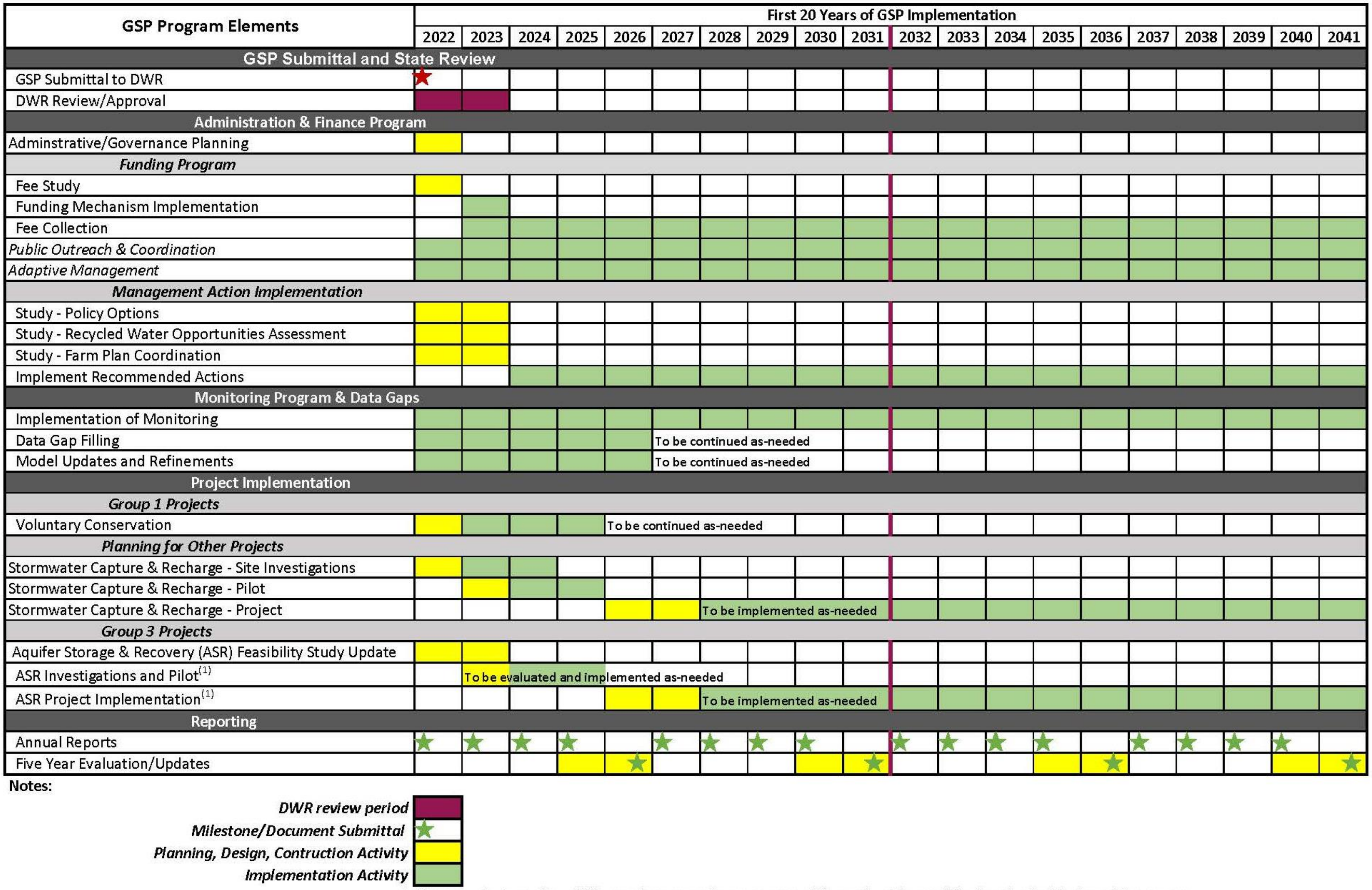
Figure ES-8. Percentage Cost Allocations for Major Spending Categories for First 5 Years of GSP Implementation

ES.7.3 Implementation Schedule

While DWR has 2 years to review the GSP before it is final, the GSA will begin implementing the Plan in 2022 (**Figure ES-9**). Administration, finance, monitoring, and reporting are ongoing tasks that begin immediately and continue throughout implementation. It is anticipated that filling data gaps and pursuing policy options will begin in 2023, and the voluntary conservation projects will be implemented by Petaluma Valley GSA and project partners by 2025.

ES.8 References and Technical Studies

The final section of the GSP includes a complete list of references and technical studies that supported the development of this GSP.



1 *Some projects, such as ASR, may be pursued on a more rapid pace by other entities involved with drought response.*

Figure ES-9. GSP Implementation Schedule