4 Projects and Management Actions

To achieve this Plan's sustainability goal by 2042 and avoid undesirable results as required by SGMA regulations, multiple projects, and management actions (PMAs) have been identified for potential implementation by the GSA. This section provides a description of PMAs that may be implemented to achieve and maintain the sustainability goal and to respond to changing conditions in the SV Subbasin. PMAs are described in accordance with §354.42 and §354.44 of the SGMA regulations. The PMAs may be combined to the degree stakeholders find appropriate and provide the maintenance of sustainability goals. As PMAs are implemented, additional actions not included here may become evident and desirable. As such, the implementation of PMAs will be commensurate with measured conditions, progress toward sustainability goals, and effectiveness. Projects generally refer to infrastructure features and other capital investments, their planning, and their implementation, whereas management actions are typically programs or policies that do not require capital investments but are geared toward engagement, education, outreach, changing groundwater use behavior, adoption of land-use practices, etc. PMAs discussed in this section will help achieve and maintain the sustainability goals and measurable objectives, and avoid the undesirable results identified for the SV Subbasin in Chapter 3. These efforts will be periodically assessed during the implementation period, at minimum every five years. The suite of PMAs stakeholders choose to implement will follow the progress toward reaching sustainability goals. The assessments performed each five-year period will allow adaptive management of emphasizing particular PMAs to provide the portfolio of actions to prevent undesirable effects.

4.1 Introduction

In developing PMAs, key considerations include effectiveness toward maintaining the sustainability of the SV Subbasin, minimization of impacts to the SV Subbasin's economy, cost-effective solutions for external funding, and selection of voluntary and incentive-based programs over mandatory programs. These planned or proposed PMAs are at varying stages of development. As they advance, additional information will be obtained on construction and permitting requirements, operations, and overall costs. Chapter 5, GSP Implementation, contains details about PMA prioritization and implementation.

In Sierra Valley, the PMAs are designed to achieve the major objectives related to the SMCs presented in Chapter 3:

- Stopping groundwater level decline.
- Maintaining groundwater-dependent ecosystems to enhance the presence of wildlife and support wetlands for migratory and local birds.
- Preventing significant and unreasonable land subsidence in the SV Subbasin. Infrastructure and agriculture production in Sierra Valley remain safe from permanent subsidence of land surface elevations.

The identified PMAs reflect a range of options to achieve the goals of the GSP. Many of the PMAs can only be completed through an integrative and collaborative approach with other agencies, organizations, landowners, beneficial users, and stakeholders. The success of implementing some PMAs will depend on establishing an agreed-upon approach for proceeding. The extent to which any given PMA is advanced will depend on the ability and need

to provide progress toward a Measurable Objective, and the agreement and ability of stakeholders to continue implementation. For some PMAs, the GSAs may not be able to fully quantify the overall benefits and, for this reason, PMAs are envisioned to be implemented at progressive stages, starting with pilot projects that will provide a preliminary understanding of the chances of success in supporting the achievement of the previously mentioned goals.

Few PMAs will be implemented by the GSAs alone. The GSAs are one of multiple parties collaborating on achieving overlapping, complementary, multi-benefit goals across the integrated water and land use management nexus in the SV Subbasin. Multi-benefit PMAs will be most successful if implemented to meet multiple objectives with cooperating or collaborating partners: for example, the Regional Board could be a partner for water quality PMAs, while the Audubon society could work collaboratively to maintain good wildlife conditions. For many of the PMAs, the GSAs will therefore enter informal or formal partnerships with other agencies, non-governmental organizations (NGOs), or individuals. These partnerships may be in various formats, from GSAs participation in informal technical or information exchange meetings to collaborating on third-party proposals, projects, and management actions, to leading proposals and subsequently implementing PMAs.

PMAs are classified under three main categories: (1) demand management for groundwater; (2) supply augmentation; (3) others. This last category includes mostly management actions, such as enhancement of data collection. Project types within these three categories are shown in Table 4.2-1 and Table 4.3-1. Furthermore, PMAs are organized into two tiers reflective of the timeline for implementation:

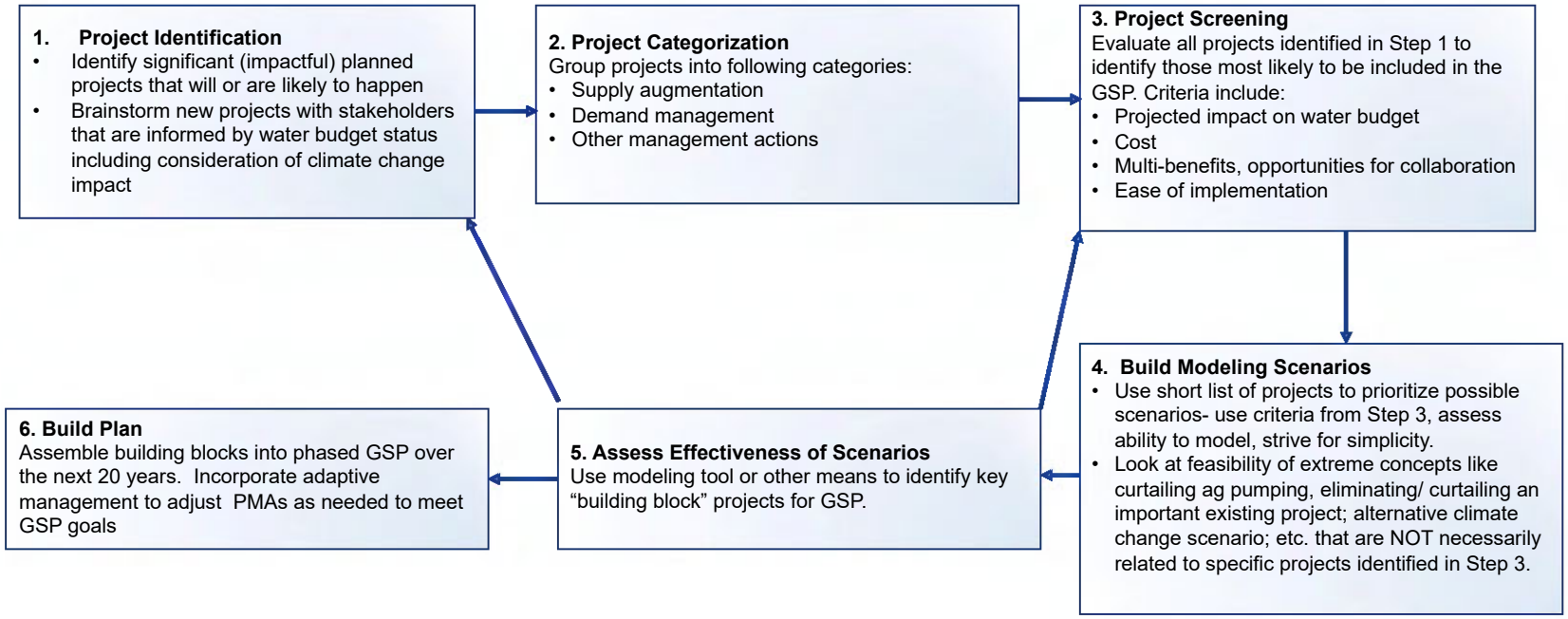
1. **TIER I:** Existing PMAs that are currently being implemented and are anticipated to continue to be implemented, potentially with enhancements.
2. **TIER II**: PMAs identified for consideration within the first five-years of the GSP. The initiation and implementation by the GSAs will occur based on an evaluation of feasibility and funding availability. Within this tier, we understand that some PMAs may require a longer timeframe for development, and those are expected to initiate the conceptual development in the first five years but would not be fully operational until sometime after 2027. It is also possible that upon further evaluation, certain PMAs would not be implemented if the expected benefit is not likely to contribute to achieving sustainability.

A general description of existing and ongoing (Tier I) PMAs are provided in Table 4.2-1; descriptions of Tier II PMAs are provided in Table 4.3-1.

The process of identifying, screening, and finalizing PMAs is illustrated in Figure 4.1-1 and spans a different timeframe depending on the specific PMAs. As a first step, existing and potential projects were identified based on input from the TAC, the GSAs' staff and board members, irrigators, and other stakeholders and review of proposed projects in other similar basins. These projects were then categorized into the two tiers introduced above. All projects are included in the GSP with more details developed for those that were considered most likely to be implemented in the near term. Using the Sierra Valley Watershed Hydrogeological Model (SVWHM), the effectiveness of each project or a combination of projects will be assessed to finalize those projects that, if implemented, will most likely support the achievement of sustainability in the SV Subbasin. Monitoring will be a critical component for evaluating PMA benefits and measuring potential impacts. A road map for prioritizing PMAs based on feasibility and potential for success of each project (or a combination of projects) is discussed further in Chapter 5.

The ability to secure funding is an important component in the viability of implementing a particular PMA. Funding sources may include grants or other fee structures (Appendix 5-1). Under the Sustainable Groundwater Management Implementation Grant Program Proposition 68, grants can be awarded for planning and projects with a capital improvement component. Funding will also be sought from other local, state, federal, and private (NGO) sources.

Figure 4.1-1: Process for Identifying Projects and Management Actions



4.2 Tier I: Existing or Ongoing Projects and Management Actions

As shown in Table 4.2-1, there are existing and ongoing PMAs in the SV Subbasin (Tier I). The SV Subbasin has a range of existing PMAs in place to provide demand management, supply augmentation, and other management actions (e.g., data management, monitoring and education, and outreach). Potential enhancements are included in the description of several of these existing PMAs. These enhancements would be evaluated and only implemented if considered technically and economically feasible. The PMAs in Table 4.2-1 are discussed in detail in the remainder of Section 4.2.

Table 4.2-1: Existing or Ongoing Projects and Management Actions for Sierra Valley

Category	Title	Description	Near-Term Actions
Other Management Actions	High Capacity Wells Metering	**Current MA**: SVGMD maintains a list of large-capacity wells in the SV Subbasin, including active metered wells and inactive wells. All active large-capacity agricultural wells are fitted with flow meters owned and read by SVGMD. **Potential MA Enhancement**: SVGMD is continuing and enhancing metering efforts for high-capacity wells to support groundwater management.	• Continue existing metering and data collection program • Refine well inventory & registry program, including GPS coordinates for each high capacity well • Install, reinstall, repair, calibrate, and replace flowmeters as needed
Other Management Actions	Monitoring and Reporting	**Current MA**: SVGMD reads flowmeters on large-capacity agricultural wells monthly during the growing season and sounds monitoring wells for groundwater levels periodically. DWR measures groundwater levels in the SV Subbasin twice per year and posts results in CASGEM. The Sierra Valley Watermaster collects stream flow data in the SV Subbasin, which is not published publicly. **Potential MA Enhancement**: Optimize/implement monitoring networks and data gathering, sharing, and analysis for: groundwater levels and quality, surface water flows, subsidence, and GDEs/ISW.	• Optimize water level monitoring network, as proposed in this plan (Section 4.2.1) • Investigate external funding or implementation by state/federal agencies to help mitigate costs of stream/ surface water monitoring • Perform groundwater-dependent ecosystem (GDE) monitoring • Implement subsidence monitoring • Develop comprehensive, streamlined, easy-to-use reporting systems to comply with SGMA and to support management decisions • Include groundwater quality monitoring plan and optimize groundwater quality monitoring as needed

Category	Title	Description	Near-Term Actions
Other Management Actions	Data Management and Modeling	**Current MAs**: SVGMD collects water usage data from large-capacity agricultural wells as well as usage data from municipal well operators in the SV Subbasin. SVGMD and DWR collect water-level data in monitoring wells around the SV Subbasin, with DWR data posted in CASGEM and SVGMD data reported in public board meetings. Water quality data has been sporadically collected by DWR and more regularly collected by County Environmental Health Departments for public supply wells **Potential MA Enhancement**: Optimize data collection to inform management decisions in the SV Subbasin and support updates of the hydrogeologic conceptual model.	• Continue data collection from existing water level and water use monitoring • Determine frequency of updates and recalibration of model • Initiate data collection from newly identified wells in monitoring network • Implement use of Data Management System
Other Management Actions	Education and Outreach	**Current MA**: SVGMD and UCCE have conducted periodic workshops to update stakeholders on topics related to water management. **Potential MA Enhancement**: Continue current education and outreach programs to cover additional topics related to sustainable groundwater management, GSP implementation, and on-farm best management practices (BMPs) for landowners. Educational workshops for domestic well owners could also be initiated.	• Host periodic educational workshops to continue outreach on GSP and groundwater conditions to all parties • Determine frequency of workshops that are feasible or determine appropriate alternative approaches (e.g., annual workshops and supplement with additional educational materials and information sharing
Demand Management	Well Permit Ordinances	**Current MA**: SVGMD has enacted ordinances that: • Require meters on all high-capacity wells (Ordinance 82-03) • Require review of water availability for new development applications (83-01) • Restrict installation of new high-capacity agricultural wells in specific areas of the SV Subbasin (18-01 §3a) **Potential MA Enhancement**: Continue existing protections and adjust as-needed to include process for reactivating inactive wells and permitting wells outside the restricted zone	• Develop a decision-making process for review of requests to reactivate registered inactive large-capacity wells • Develop decision-making/review process for permitting large-capacity wells outside the restricted zone and developing monitoring strategies to launch if other areas of the SV Subbasin become active with high-capacity groundwater pumping.

Category	Title	Description	Near-Term Actions
Supply Augmentation	Reuse	**Current MA:** Reuse of treated wastewater from Loyalton WWTP and former Loyalton Mill/Co-gen plant for crop irrigation **Potential MA Enhancement**: Explore feasibility of repairing leaks in Loyalton sewer pipes and/or other infrastructure improvements	• Evaluate if additional opportunities for reuse exist
Supply Augmentation	Sierra Brooks—Smithneck Wildland Urban Interface Fuels Reduction Project	**Current MA:** Grant-funded project to reduce heavy fuel loads through mastication, manual forest thinning, and brush abatement to improve water retention and water quality. Builds on other projects in the area to increase forest resilience and resistance to destructive wildfire, disease, and insect infestation, and protect the community of, and water supply for, Sierra Brooks.	• Coordinate with Sierra Valley RCD to identify opportunities to support this project and other watershed health projects • Explore opportunities with other agencies (e.g., NRCS, CalFire)

4.2.1 Inventory and Metering

4.2.1.1 Project Description

This management action (MA) of maintaining a comprehensive inventory of high-capacity wells will help assess impacts associated with the SMCs set in the GSP. Implementation of the MA can be focused on critical locations, to protect wells where minimum thresholds are in jeopardy of being reached, or measurable objectives are not being attained.

This existing/ongoing MA involves gathering exact coordination and information on wells, replacing old flowmeters, calibrating existing flowmeters, and completing analysis for telemetry options, including initial and ongoing costs for the replacement and adjustments to flowmeter installations on high-capacity wells to achieve installations consistent with meter specifications.

A detailed well inventory and assessment of impacts improves the understanding of SV Subbasin conditions and will be valuable for calibrating model results and management decisions. Currently, SVGMD maintains an inventory of large capacity wells. To account for large-scale pumping of the SV Subbasin, metering is required by the GSAs for all active and inactive large-capacity wells that are 100 gpm or larger, or that have larger than 6-inch casings[1]. Large-capacity agricultural well owners purchase the first meter for their well, with the meter becoming the property of the Sierra Valley Groundwater Management District, and maintenance provided by the District's meter technician. This has been required since ordinance 82-03 was passed by SVGMD in 1982, with refinements, such as diameter requirements, passed in subsequent years [2]. Municipal wells in Sierra Brooks, Loyalton, and Calpine are also metered with management by the local water utility districts. Application depths can be estimated by combining groundwater pumping volume and acreage served to support model calibration. Information collected is confidential and reported in aggregate to maintain confidentiality. Further information regarding how monitoring groundwater use may be used is further explained in Section 4.3.7.

Through feedback provided on other GSPs, DWR has made clear that a detailed inventory and definition of active wells are to be included in annual reports. DWR suggests including a discussion of anticipated impacts to these wells due to instances such as continuing water level decline, as some shallow wells may be impacted if minimum thresholds (MTs) for groundwater levels are reached, as described in Chapter 3.

4.2.1.2 Measurable Objective

Replacement of, calibration of, and installation of new flowmeters for wells to be identified and development of a comprehensive inventory of active domestic, industrial, and stock wells. By optimizing the number and location of wells used for the WQ monitoring well network, a more accurate characterization of current groundwater quality conditions can also be developed.

4.2.1.3 Public Noticing

Public noticing for this project will be conducted by the GSAs prior to project implementation if required. Public notification is planned to be executed with significant project changes or additional project elements.

[1] https://www.sierravalleygmd.org/files/ea2824af1/18-01+Ordinance+%28Requirements+for+New+Water+Well+Permits+%2B+Amended+map%29+%28signed%29.pdf

[2] The ordinance that defines the 6-inch diameter distinction (18-01) says "constructed with casings larger than seven (7) inch outside diameter (OD)." See: https://www.sierravalleygmd.org/files/42f03652e/82-03+Ordinance+%28Req+Metering+Extraction+Facilities%29.pdf

4.2.1.4 Permitting and Regulatory Process

Permitting is not applicable to this MA.

4.2.1.5 Schedule for Implementation

This MA is existing and ongoing. Future actions will include developing a more comprehensive well inventory and evaluating the feasibility and need for additional metering within three years of GSP implementation.

4.2.1.6 Implementation

Implementation of the well inventory and metering program is ongoing. Future implementation efforts would include:

- Finalize the internal database/well inventory for the high-capacity wells.
- Identify wells in need of flowmeter replacement or repair.
- Calibrate, install, repair, and replace flowmeters as necessary.
- Investigate different options for telemetry for meters and associated costs.

4.2.1.7 Expected Benefits

A comprehensive database would provide improved understanding of the high-capacity active wells including locations and depths. More precise metering could result in better understanding of groundwater use geographically and could support water use efficiency programs.

4.2.1.8 Legal Authority

Article 6, Section 601 of SB 1391 authorizes SVGMD to require metering of any new, deepened, or previously-abandoned-then-reactivated well. As such, the GSAs are legally authorized to collect data and require metering to facilitate the data collection.

4.2.1.9 Estimated Costs and Funding Plan

Currently, the SVGMD budget includes $6,100/yr for meter installation, maintenance, and monitoring. In addition, the budget includes $2,000/yr for data logger analysis associated with this program and $11,500 for new flow meters and repair and replacement of meters

4.2.2 Monitoring and Reporting

4.2.2.1 Project Description

The SV Subbasin has identified monitoring networks for water levels, streamflow depletion, land subsidence, and water quality which are presented and described in Chapter 3. The monitoring networks are comprised of data collected by local, state, and federal agencies. This MA of continuing and optimizing monitoring and reporting would enhance and optimize existing monitoring networks for sustainability indicators to further improve the current calibration of the Sierra Valley model. This would include identifying additional wells to be monitored, measuring water quality at existing wells, adding stream gages and subsidence monuments as needed. Once better calibration has been achieved, the model will be used to simulate the basin response to different PMAs under current and future conditions. Specific data will be used to monitor the effectiveness of specific PMAs and therefore will be included in the model and used in future model simulations. Monitoring includes data gathering, frequent reporting, and analysis. For example, to better monitor streamflow depletion, near-term actions could include the installation of streamflow gages. GDE monitoring could be utilized to analyze changes in ecosystem health using vegetation indices (e.g., NDVI) derived from satellite imagery, rainfall

records, and groundwater data from existing wells. Proposed optimization of monitoring networks is described in Chapter 3 and further justified in the data gaps section (Appendix 2-5).

4.2.2.2 Measurable Objective

Collect and report accurate data sufficient to provide accurate groundwater levels, water quality, subsidence, and GDEs conditions and demonstrate whether the sustainable management criteria outlined in Chapter 3 for all indicators are being met through the projects and management actions in place in the basin. As discussed in Chapter 3, the proposed groundwater elevation network uses 36 monitoring wells and covers 82% of the Subbasin according to spatial coverage estimates by Sophocleous (1983). The proposed monitoring well density should allow for extrapolating seasonal groundwater elevation maps to support analysis of impacts to shallow domestic wells, GDE impact analysis, and to monitor seasonal changes in hydraulic gradients that may indicate changes in ISW depletion. Additional monitoring wells will be incorporated to adequately cover the remaining 18% of the Subbasin. Up to five existing monitoring wells may be added as part of the water quality network. Wells will be measured at least biannually, in spring (mid-March) and fall (mid-October), in line with DWR Best Management Practices (DWR, 2016).

Subsidence will be monitored annually using InSAR data provided by DWR. Four subsidence monuments will be installed in high-risk areas of the Subbasin and surveyed every five years. Additional surveys will be conducted if the InSAR subsidence increases by 50% of the average annual subsidence from the baseline period (2015-2021). The GSAs may at their discretion elect to survey monuments more frequently, pending available funds. If subsidence is detected additional evaluation may be warranted to assess how declining groundwater levels contributed to observed subsidence.

4.2.2.3 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.2.2.4 Permitting and Regulatory Process

Permitting may be necessary for the installation of new monitoring wells or streamflow gages. Land subsidence and water quality can be monitored without acquiring additional permits. All applicable permits will be obtained as necessary.

4.2.2.5 Schedule for Implementation

This PMA is existing, partially funded through the current grant, and will be enhanced immediately after GSP submission. Future actions will include evaluating the feasibility for expansion of the program within three years of GSP implementation, but this will be based on funding availability. GSP annual reports and five-year updates will include an evaluation of the monitoring network and provide a description of the remaining monitoring network data gaps.

4.2.2.6 Implementation

Considering the monitoring needs highlighted in chapter 3, the GSAs will work toward getting permits and access permissions, as needed, purchasing, and installing monitoring equipment, collecting, and synthesizing data, and reporting on trends. Additionally, the GSA will work with technical staff, state, and federal agencies to collect and incorporate additional datasets into the GSP development process. For example, DWR is currently conducting airborne electromagnetic (AEM) surveys in California's high- and medium-priority groundwater basins. Once the data is available, the GSA will work on incorporating the additional geophysical data into their HCM and to better identify locations for project implementation, as funding allows.

4.2.2.7 Expected Benefits

The data collected for the monitoring networks will provide the information needed to comply with SGMA requirements and to evaluate the effectiveness of the implemented (or planned) PMAs in achieving the criteria for all the sustainability indicators as defined in Chapter 3. Annual reports will be submitted by the GSAs to DWR as required by SGMA.

4.2.2.8 Legal Authority

The GSAs are legally authorized to develop and maintain the representative monitoring network points (RMPs) discussed in chapter 3. Adding more RMPs can be beneficial, but their installation and collection can be dependent on funding availability.

4.2.2.9 Estimated Costs and Funding Plan

Based on estimated operations and maintenance costs for other basins, annual reporting and monitoring costs range from $43,000- $65,000 (SCI, 2021, Appendix 5-1). This is currently included as part of the GSAs' operating budget. It will cost the GSAs approximately $3,000 annually to survey the subsidence monuments. The GSAs may elect to survey the monuments annually, pending funding, or as described in Section 4.2.2.2.

4.2.3 Data Management and Modeling Updates

4.2.3.1 Project Description

This MA of maintaining and periodically updating the hydrogeologic model would analyze SV Subbasin conditions (e.g., groundwater levels and quality) to support maintenance of the criteria described in chapter 3 for all the sustainability indicators. Frequency of model updates will be considered based on current projects and funding availability.

The newly collected data described in Section 4.2.2 would provide information to implement the Sustainable Management Criteria in Section 3 and provide accurate records for use in the hydrogeological model. The database management system (DMS) developed for the GSP will be used to store the new data collected from the optimized monitoring network as discussed in Section 4.2.2 and Chapter 3. The DMS will be designed and developed to require minimal user interaction reducing ongoing implementation costs. Scripts will be developed to populate the DMS, and output figures and tables used to populate GSP annual reports and 5-year GSP updates.

4.2.3.2 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.2.3.3 Permitting and Regulatory Process

Permitting is not applicable to this MA.

4.2.3.4 Schedule for Implementation

This MA is existing and ongoing. The data management system will be updated on an annual basis to add new data and to review for quality control. The integrated hydrological model will use the new data to be recalibrated on an annual or biannual basis (precise frequency can be determined based on which projects are being implemented and funding availability) to better determine SV Subbasin conditions.

4.2.3.5 Implementation

This MA has been implemented with the development of the SVHM model. Future actions will include updating the model periodically with new information.

4.2.3.6 Expected Benefits

A modeling analysis of SV Subbasin conditions supports the sustainable management of the SV Subbasin through its use to evaluate impacts of changing conditions and implementation of PMAs. A comprehensive DMS is a critical tool for characterizing groundwater conditions in the Subbasin.

4.2.3.7 Legal Authority

The GSAs are legally authorized to implement this MA.

4.2.3.8 Estimated Costs and Funding Plan

Costs and funding for development of the model have been funded through a SGMA related grant from DWR. The GSAs have estimated that the annual cost to update the data management system by incorporating newly collected data would be approximately $3000. Updates of the model to reflect changing conditions (e.g., impacts of wildfires) and extend the simulation period to include a more current timeframe (i.e., extending from 2020 to 2025) are estimated to cost approximately $21,000 for each update. A more comprehensive update could cost up to $85,000 and would involve reviewing and recalibrating the model using recently collected data (e.g., USGS study currently in progress, anticipated DWR airborne electromagnetic (AEM) survey) to better simulate hydrologic conditions in Sierra Valley. This level of maintenance will not be required on an annual basis allowing the $21,000-$85,000 to be spread over a period of 3-5 years and be allocated based on funding availability through grants and other capital projects. These costs are consistent with estimates for updates and model maintenance for similar basins of $28,000-$65,000 per year (SCI,2021, App 5-1). Potential funding sources for ongoing model updates will be explored during the first year of GSP implementation.

4.2.4 Education and Outreach

4.2.4.1 Project Description

An education and outreach program currently exists through development of the GSP and includes public workshops along with presentation of information at Board meetings that are open to the public as described in Section 2.1.5, Notice and Communication, and in Appendix 2-3, Communication and Engagement Plan. In addition, GSP materials are all posted on the SVGMD website. A more robust education and outreach program is proposed as a MA for the SV Subbasin. The program will provide irrigators, landowners, and other groundwater users with educational resources to implement actions for sustainable use of water resources. Educational programs will add value to other groundwater sustainability efforts throughout GSP implementation. Over time, programs will be tailored to reflect current technologies and best practices in on-farm water management, especially as groundwater conditions change in the SV Subbasin and as proposed pilot projects yield results. Additionally, well owners and other stakeholders are encouraged to report information, such as when and where domestic wells are going dry and groundwater quality concerns, to the GSA to help educate governing agencies and their consultant team. DWR has set up an online portal to submit problems with wells going dry. The website can be accessed at: https://mydrywell.water.ca.gov/report/. Similar web portals can be developed and/or provided, if already existing, to encourage stakeholder data sharing.

The GSAs would consider partnering with local organizations, or professionals, or groups with experience providing education and outreach to growers and landowners. Potential agencies and groups that the GSAs may consider partnering with are:

- University of California, Davis (UC Davis)

- Natural Resources Conservation Service (NRCS)
- Resource Conservation District (RCD)
- UC Cooperative Extension (UCCE)
- University of Nevada, Reno (UNR)
- Desert Research Institute (DRI)
- The Nature Conservancy (TNC)

Often periodic outreach events are not sufficient to help individual landowners identify Best Management Practices (BMPs). Individual ranch assessments may be needed to identify BMPs to implement on a case-by-case basis. For larger ranches, a water resources inventory and operations assessment can be conducted to identify BMPs that will contribute to achieving the sustainability goals outlined in the GSP. BMPs may include utilizing in-lieu recharge, constructing new and/or increase storage of existing off-stream reservoirs, improving on-farm irrigation efficiencies, and methods to maintain farm production and profitability. Water resources and operation assessments can be completed through performing farm water budgets, seepage tests on open ditches, conducting bathymetric surveys determining reservoir capacity, land grading assessments, etc. Opportunities to collaborate with other potential agencies and groups will be explored. Related details are also found in Section 4.3.6 discussing PMA on water conservation.

4.2.4.2 Measurable Objective

Education and outreach programs could provide resources for landowners and result in reductions in groundwater pumping or surface water depletion through workshops and activities. To this end, workshops will be conducted annually to provide resources and training regarding practices to better manage water resources. Outreach materials will also be distributed to provide information. Individual ranch water resources and operations assessments will be conducted as funding allows.

4.2.4.3 Public Noticing

It is anticipated that the public and other agencies will be notified of planned education activities through outreach and communication channels identified in the GSP.

4.2.4.4 Permitting and Regulatory Process

Permitting is not applicable to this MA. However, permits may be required for stakeholders to implement specific BMPs.

4.2.4.5 Schedule for Implementation

Planning and partnership development would be expected to begin with the first two years of GSP implementation. Educational programs would be expected to occur throughout the implementation of the GSP, with a fully developed program within three years.

4.2.4.6 Implementation

The education and outreach program would consist of workshops that would cover topics surrounding best management practices for sustainable groundwater management. A committee would develop a schedule and list of topics that would be beneficial for attendees, such as managing soils, reducing ET, and other on-farm practices. The GSAs could partner with other agencies to develop workshop content. The workshops would provide resources for growers to implement these practices in their water management and agricultural practices.

4.2.4.7 Expected Benefits

Implementation of an outreach and education program is expected to benefit groundwater levels, groundwater storage, and water quality by providing education resources for irrigators and other water users to implement BMPs that may reduce non-beneficial ET and provide in-lieu recharge benefits to the groundwater in the SV Subbasin, for example.

4.2.4.8 Legal Authority

The GSAs are legally authorized to provide education and outreach.

4.2.4.9 Estimated Costs and Funding Plan

Depending on size, scale, and participation, typical education and outreach programs based on similar basins range from $7,000 to $18,000 per year (SCI, 2021, App 5-2). If individual ranch inventories and assessments are conducted, the cost may exceed $50,000 per year spanning the project duration depending on the level of effort. Additional funding sources can be identified to support these activities.

4.2.5 Well Permit Ordinances

As an ongoing MA, the GSAs manage and enact well-permitting ordinances. SVGMD has enacted ordinances that:

- Require meters on all high-capacity wells (82-03);
- Require review of water availability for new development applications (83-01), and
- Restrict installation of new high-capacity agricultural wells in specific areas of the SV Subbasin (18-01 §3a).

Permit approval is required for newly constructed wells to ensure that new wells are used for accepted purposes and do not adversely impact groundwater within the SV Subbasin. Active ordinances prohibit the installation of high-capacity wells in certain hydrogeologic areas or wells of a certain size to avoid declining groundwater levels. The ordinance also specifies that high-capacity wells shall not be located within a one-quarter mile from other high-capacity wells.

Future activities under this MA could include additional spacing requirements for construction of new wells to limit negative impacts to the SV Subbasin, developing a process for reviewing requests to reactivate currently inactive wells, and a permitting process for wells outside the restricted zone, and specifying minimum well design requirements. For example, wells can be designed and installed so large capacity wells extract water from deeper in the aquifer sealing the upper aquifer minimizing the risk to shallow domestic wells and GDEs. Shallow domestic wells should be sufficiently deep considering groundwater and ground surface elevations and sufficient submergence to allow groundwater fluctuations during periods of drought.

4.2.5.1 Measurable Objective

The objective of the well permit ordinance is currently to avoid high-capacity wells in areas with declining groundwater levels potentially impacting domestic wells and GDEs. The GSA will monitor groundwater well installations to prevent wells from being installed in high-risk areas. A review of ordinances/policies on an annual basis is recommended to ensure that they are an effective tool to support sustainable management of groundwater resources. Modifying existing or adding new ordinances and policies can be considered to offer protection against harming GDEs and domestic well owners, as necessary while ensuring agricultural production and profitability, which is vital to the local economy.

4.2.5.2 Public Noticing

Public noticing for this project will be conducted by the GSAs prior to project implementation as required for all new and adjusted ordinances

4.2.5.3 Permitting and Regulatory Process

External permitting from regulatory agencies is not anticipated for this management action.

4.2.5.4 Schedule for Implementation

This MA is ongoing. Ordinances will be updated on an annual basis.

4.2.5.5 Implementation

The GSAs would research and propose ordinances based on SV Subbasin conditions and water use.

4.2.5.6 Expected Benefits

Implementation of well permit ordinances is expected to benefit groundwater levels, groundwater storage, water quality, GDEs, and domestic well owners by limiting high-capacity wells in specific subdivisions as appropriate in the SV Subbasin.

4.2.5.7 Legal Authority

The GSAs have the legal authority to issue new construction well permits, uphold restrictions for use, size, and spacing and prohibit installation of new wells.

4.2.5.8 Estimated Costs and Funding Plan

Costs for implementing existing ordinances and for updating and implementing revised or new ordinances are standard functions of the GSA and are included in the current annual budget. Cost may vary depending on if new ordinances or if modifying existing ordinances extends beyond their standard procedures and require additional technical and legal input. A cost to make changes to ordinances is not provided at this time since no specific changes have been identified that extend beyond the GSA routine review of ordinances. The GSA will consider incorporating additional ordinance(s), which will be discussed in the annual reports and the 5-year update as groundwater conditions dictate.

4.2.6 Water Reuse

Reuse of treated municipal wastewater for irrigation presents an alternative to groundwater. This then provides the opportunity for groundwater supplies that could be reserved for other uses where higher quality may be needed (i.e., meet drinking water standards). Currently, treated wastewater from the City of Loyalton's wastewater treatment plant is used to irrigate crops. Similarly, when in operation, discharges from the former Loyalton Mill/Co-gen plant are used for crop irrigation. Other opportunities to reuse treated wastewater in compliance with the State Water Board Recycled Water Policy (Resolution No. 2018-0057) will be explored through evaluation of activities at commercial and municipal facilities to determine if water is discharged that could be reused.

As an example of an opportunity to expand reuse, increased volumes of recycled water may be achieved by repairing leaking pipes or making other infrastructure improvements if needed in the City's collection system and increasing the volume of wastewater to be treated and reused. Other reuse opportunities could include reusing process or wash water at commercial or industrial facilities for dust control or landscape irrigation.

4.2.6.1 Measurable Objective

The amount of groundwater supply that is conserved as a result of increasing the use of recycled water for approved applications such as irrigation or dust control. Specifically, quantities of recycled water used for irrigation and other approved uses would be tracked.

4.2.6.2 Public Noticing

Public noticing may be required for new uses of recycled water and signage may be required indicating where recycled water is being used for irrigation

4.2.6.3 Permitting and Regulatory Process.

Recycled water use is regulated by the State Water Resources Control Board and Central Valley Regional Board under the Statewide Water Reclamation Requirements for Recycled Water Use (Order WQ 2016-0068-DWQ)

4.2.6.4 Schedule for Implementation

This MA is ongoing.

4.2.6.5 Implementation

The GSAs may coordinate with the City of Loyalton and other recycled water users to estimate the amount of water reuse occurring and how it impacts local groundwater supplies.

4.2.6.6 Expected Benefits

Water reuse is expected to benefit groundwater levels and groundwater storage by reducing the use of groundwater for certain applications.

4.2.6.7 Legal Authority

Legal authority is delegated to the Water Boards.

4.2.6.8 Estimated Costs and Funding Plan

Costs to the GSAs are primarily associated with tracking the benefits of recycled water use and coordinating with the City of Loyalton as needed. The potential for the GSAs to share costs associated with infrastructure repair (i.e., leaking sewer lines) could also be explored.

4.2.7 Sierra Brooks – Smithneck Wildland Urban Interface Fuels Reduction Project[3]

This MA is for the GSAs to coordinate actions with an existing fuels reduction project in an effort to take advantage of actions to reduce vegetation thus improving water retention and water quality. As detailed in PMA 4.3.11 Assessment of Post-Fire Hydrology, reducing vegetation in overstocked forests may increase the amount of water that infiltrates into the aquifer, both from interconnected surface waters and from precipitation.

The Sierra Valley Resource Conservation District (SVRCD) will reduce heavy fuel loads on 723 acres of U.S. Forest Service and California Department of Fish and Wildlife lands adjacent to the Sierra Brooks Subdivision and one mile southeast of the community of Loyalton in Sierra County. Implementation of proposed treatments will benefit wildlife, including critical winter range for the Truckee-Loyalton deer herd, increase forest resilience and resistance to destructive wildfire, disease, and insect infestation, and protect the community of, and water supply for, Sierra Brooks.

[3] https://sierranevada.ca.gov/what-we-do/2021-early-action-projects/#project1314

The long-term goal of the project is to return the landscape to a condition within the range of natural variability of forest density, allowing for prescribed underburns that will maintain healthy forest conditions. Treatments were identified as high priorities for fuels reduction in the Sierra County Community Wildfire Protection Plan, by the Sierraville Ranger District and the Sierra Brooks Firewise Community.

The project furthers the Integrated Regional Water Management Plan for the Upper Feather River Watershed and meets the goals of improving local water retention and improving water quality. The project will complement existing adjacent forest health and fuels reduction projects which have recently been completed by private landowners. Several minor projects have been executed within the last five years and include manual fuel treatments along the Forest Service 04 Road, mastication and manual thinning in the Loyalton Pines Subdivision, and thinning/brush abatement within the Sierra Brooks Subdivision. The SVRCD has been conducting ecosystem restoration and providing forest health assistance to landowners in Sierra County for over 25 years.

The GSAs will coordinate with the RCD to identify opportunities for this project to further benefit management of groundwater resources in the SV Subbasin.

4.2.7.1 Measurable Objective

Vegetation management and fuels reduction projects have the potential to increase recharge of groundwater aquifers and increase groundwater levels.

4.2.7.2 Public Noticing

Public noticing for this project will be conducted by the SVRCD as appropriate and will be reported to the GSAs.

4.2.7.3 Permitting and Regulatory Process.

Any permitting or regulatory process required by the project would be conducted by the SVRCD. The GSAs would support these processes as necessary.

4.2.7.4 Schedule for Implementation

The scope of the project has been developed, and the project is ready for bid. As of December 2021, the project has not gone out to bid. The project is expected to take two years and there will be an additional six months of post-project monitoring.

4.2.7.5 Implementation

This project will be implemented by SVRCD. The GSAs may explore approaches to coordinating with SVRCD on this project.

4.2.7.6 Expected Benefits

The expected benefit is to return the landscape to a natural state, which will improve forest health, including water retention in the soils, and reduce the risk of wildfires.

4.2.7.7 Legal Authority

SVRCD has the legal authority to install monitoring equipment and work with other organizations / public agencies.

4.2.7.8 Estimated Costs and Funding Plan

Funding for this project is coordinated through SVRCD. The project is funded by the Sierra Nevada Conservancy. The total cost of this project is estimated at $1,100,000. Tahoe National

Forest's Sierraville Ranger District and CDFW are helping to fund this project. Costs for the GSAs to coordinate with this project would need to be determined.

4.3 Tier II: Potential Projects and Management Actions

Tier II PMAs are potential projects for the GSAs to implement based on an evaluation of which are most likely to be effective and technically and financially feasible. The GSAs will work to evaluate and prioritize these PMAs during the first year of GSP implementation. Based on these evaluations, the highest priority PMAs will be scheduled for near-term initiation and implementation (2022-2027) by individual agencies, while others will be designated as needing feasibility studies or pilot projects that will be implemented over the first five years of GSP implementation. It is also possible that a PMA will be determined to be infeasible or not beneficial. Where found feasible and effective, these PMAs will be advanced to further design. Where funding exists these PMAs will be scheduled as part of the GSP implementation. As noted, the prioritization and more specific plan for PMA implementation and grant applications will be one of the initial tasks taken on in February 2022 under GSP implementation.

The Tier II Potential PMAs are identified in Table 4.3-1. Project descriptions are provided for each of the identified Tier II PMAs. The level of detail depends on the status of the PMA. Where possible, PMA descriptions include information under §354.42 and §354.44 of the SGMA regulations

Table 4.3-1: Potential Projects and Management Actions for Sierra Valley

Category	Title	Description	Potential Actions

Demand Management	Agricultural efficiency improvements	Various equipment and operational improvements designed to reduce overall water demand	• Develop individualized conservation plans with ranchers/other irrigators to
			  ○ Install soil moisture sensors
			  ○ Fix leaking irrigation pipes
			  ○ Convert to low-profile (near ground-level) sprinkler applicators, as appropriate
			  ○ Manage irrigation time of day to reduce evaporative and wind drift losses
			  ○ Reduce use of end guns on center pivots
			  ○ Convert flood irrigation to sprinkler
			  ○ Convert wheel lines to center pivot systems
			• Evaluate cost implications for landowners and approaches to addressing costs including supporting potential for grant funding for improving irrigation efficiencies

Other Management Actions	Well Inventory Expansion	Enhance inventory and metering efforts to support groundwater management. Expand the inventory to all types of wells, including domestic wells used for drinking water.	• Consider adding inventory for domestic, commercial, industrial, and stock well inventory and use estimation
Supply augmentation	Reoperation of, or adjustments to, surface water supplies	More efficient use of surface water resources to reduce long-term groundwater pumping	• Investigate process and evaluate feasibility of modifying surface water rights delivery from Frenchman Lake and Little Last Chance Creek for more efficient use of surface water • Divert some Lake Davis water into Sierra Valley • Gain benefit from winter spills from Frenchman Lake and winter runoff from other streams by winter diversions to pasture (icing) • Evaluate feasibility of increasing capacity of Frenchman Lake (long-term project)
Supply augmentation	Off-stream storage	Develop off-stream surface water storage projects	• Increase on-farm storage of surface water (Smithneck and Little Last Chance) • Store flood water for later use through catchments, tanks

Category	Title	Description	Potential Actions
Other Management Actions	Drought mitigation & planning	Drought mitigation planning and identification of drought triggers tied to precipitation, runoff, and other factors	• Develop Drought Mitigation Plan to address this critical element of water management in the valley including determination of drought status and what tiers of drought would trigger actions and adjustments
Demand Management	Water Conservation	Develop a water conservation program to reduce water demand to offset ground and surface water pumping	• Develop voluntary water conservation agreements (e.g., only going to irrigate to crop ET, foregoing a fourth cutting, cutting back pumping by x %, moving irrigation start date from March 1 to March 15) • Develop pilot program for implementation of water use conservation agreement
Demand Management	Groundwater Trading and Allocations System	Develop an approach for establishing groundwater pumping allocations if other management actions do not result in needed reductions	• Develop an approach for limiting groundwater extractions, – that would be available if and as needed – to incrementally reduce the permitted pumping amount, allowing for transfers and flexibility. • Develop approach for trading or transferring allocations
Supply Augmentation	Watershed and Upland Management and Restoration	Implement multi-benefit projects that enhance precipitation retention and infiltration (i.e., reducing runoff), reduce fuel loads, and support ecosystem services such as reducing peak flood flows and enhancing summer baseflows; Improvement of recharge in the higher elevations and provide multi-benefits, including potential benefit for fire prevention.	• Watershed management • Upland management (forest/meadow restoration, road improvements or removal, soil decompaction) • Enhance wetlands and meadows to better retain water in GDEs • Planning study with pilot program • Forest treatment to promote recharge

Category	Title	Description	Potential Actions
Demand Management	Voluntary Managed Land Repurposing	This includes a wide range of voluntary activities that make dedicated, managed changes to land use (including crop type) on specific parcels in an effort to reduce consumptive water use in the SV Subbasin	• Support alternative crop conversion There are limits to what can be grown. Early freezes affect what is planted in the fall. Some crops will survive the early freezes. • Develop terms contracts through a Conservation Reserve Program (need more details) this would involve marginal lands – might be a benefit to wildlife. This is for dryland cultivated land. Would not generally be applicable, raising more concerns than benefits. • Develop crop rotation program • Develop irrigated margin reduction
Supply Augmentation	Groundwater Recharge / Managed aquifer recharge (MAR)	Develop aquifer recharge projects to store and augment water supply.	• Planning study/GIS study to determine the feasibility of MAR in SV Subbasin • Spreading SV Subbasins • Flooding agricultural fields • Injection wells • Streams and canals: e.g., diversion from Badenaugh Creek • Indirect recharge • Distributed stormwater collection and MAR
Supply Augmentation	Assessment of post-fire hydrology – water supply augmentation	The Plumas County Fire Safe Council has received funding and is in the process of developing the Eastern Plumas Wildfire Protection Project to reduce fuel conditions that can contribute to catastrophic wildfires.	• SVGMD will coordinate with Plumas County Fire Safe Council to identify opportunities for monitoring changes in streamflow and groundwater levels that result from the project actions. • Other specific actions to be identified as the project is developed
Other Management Actions	Climate Change Impact Assessment	Incorporate additional climate change scenarios into the hydrologic model to assess potential impacts and to evaluate and prioritize PMAs.	• Identify funding source(s) to evaluate additional climate change scenarios. • Assess how climate change may impact reaching sustainability. • Use refined model results based on climate change scenarios to prioritize PMAs for implementation.

4.3.1 Agricultural Efficiency Improvements

4.3.1.1 Project Description

Achieving increases in irrigation efficiency through equipment improvements is anticipated to reduce overall water demand. This management action would include development of work plans tailored to individual ranches based on identifying viable alternatives for existing practices and initially conducting pilot projects to evaluate their effectiveness.

Existing agriculture in Sierra Valley primarily produces forage crops for cattle and dairy industries. This includes flood irrigated pasture, and cultivated alfalfa, grass hay, and grains as rotation crops. Irrigation efficiency refers to the quantity of water required to meet crops' water demand versus the volume of water applied. Irrigation efficiency can be improved by accomplishing more uniform distribution of water to soils, minimizing losses to wind (wind drift), minimizing evaporation, and preventing overapplication of water, with a goal of applying just the right amount of water to meet the crop evapotranspiration (ET) requirement, while minimizing deep percolation past the root zone, or runoff from the irrigated area. Depending on climate and soil salinity, some over application of water above the required ET amount is necessary for leaching of salts, and prevention of salt buildup in the root zone. In reality, due to non-uniformity of applied water and soils variability, achieving perfect efficiency is not possible, and when approached, will result in some percentage of the irrigated area experiencing crop distress and crop loss.

In Sierra Valley, most groundwater is pumped to center-pivot irrigation systems. Mid-Elevation Spray Application (MESA) sprinkler heads are used throughout the valley, with few exceptions. Some end-guns are in use to expand the irrigated area. A smaller amount of irrigation is accomplished using wheel line irrigation systems, and smaller yet, some groundwater is pumped to pastures for flood irrigation. Center pivot irrigation technology is generally considered the most efficient of these means for irrigation. However, lower elevation Spray Application (LESA) and Low Energy Precision Application (LEPA) are not currently used in the valley. Sprinkler modifications to existing pivots, and possibly wheel lines, presents opportunities to increase irrigation efficiency and reduce pumping water demand to produce an equal quality and quantity of forage crop. A study by Bachand and Associates in 2018 and 2019 (Bachand and Associates, 2020) assessed use of LESA sprinkler systems in Sierra Valley and estimated a 7% water reduction was achieved. Studies conducted by Washington State University and University of Idaho found water savings of 5% to 15% in pilot demonstration projects (Bonneville Power Administration, n.d.). Further studies indicated a 15% decrease by use of water using LESA versus MESA systems. Other studies in the Northwest (Oregon and Washington) have found similar 15% reductions in water use.

As a proposed project for Sierra Valley, a pilot test of LESA and LEPA systems is proposed. The pilot study varies from the Bachand (2018) evaluation, in that a control MESA pivot would be compared with reduced water LESA or LEPA retrofitted pivots, with an objective to reduce applied water by 15% as contrasted with the control MESA pivot.

All ranches in Sierra Valley could improve upon existing irrigation efficiencies. This could be accomplished through other approaches specific to applicability at each Sierra Valley ranch:

- Use of Variable Frequency Drive (VFD) pump controls systems to modulate pumping rates from wells to meet crop water demand more effectively, minimizing over-application of water.
- Use of soil moisture sensors to aid in adjustment of applied water amounts and minimize deep percolation (percolation beyond the root zone).

- Use weather stations or weather monitoring to avoid, if possible, irrigation during excessively windy conditions.
- Irrigation system automation for improved water delivery to match crop water requirements.
- Reduce use of end-guns (especially high-capacity end guns), which are not as efficient in irrigating peripheries of the fields, and if not used would result in mildly smaller irrigated areas.
- Convert wheel line irrigation to center-pivot irrigation, where possible.
- Minimize use of groundwater for use in low-efficiency flood irrigation of pastures.
- Consider use of soil amendments to increase water holding capacity.

As a related groundwater efficiency improvement on the farm level, improvements to minimize water conveyance losses will reduce groundwater pumping. Specific items to consider at the ranch/farm level are:

- Reduce leakage from pipelines.
- Evaluation of the efficacy of reducing conveyance of pumped groundwater through unlined open ditches. Included in this evaluation would be if there are any benefits associated with seepage for near-surface groundwater and marshy areas and if there are adverse impacts to wildlife if ditches were lined and infiltration reduced.

Also, for consideration for reducing groundwater consumption on the ranches are crop types being grown. Conversion to economical alternative crops that have lower required water amounts could reduce pumping in the valley while maintaining a viable agricultural community. However, the climate in Sierra Valley, including freezing spring temperatures, limits potential alternative crops. Also, many of the ranches engage in farming of forage crops to in part, or whole, support cattle that are also raised by the ranching operations.

As opportunities are identified for alternative crops, willing ranches can conduct tests to further gage the variability of alternative crop types. Hemp has been tested on the Roberti Ranch and working with agricultural extension groups of universities in the region (California and Nevada) should be pursued.

Future benefits of actual implementation will be evaluated and assessed with the Sierra Valley Integrated Hydrogeologic Model (SVIHM) using the methodology described in Chapter 3.3 and using data collected through the GSPs monitoring program along with tracking information specific to this process.

Monitoring data that will be collected by this project include, but are not limited to:

- Total acreage with improved irrigation efficiency equipment
- Location of fields under improved irrigation efficiency equipment
- Assessment of the increase in irrigation efficiency, with particular emphasis on assessing the reduction or changes in consumptive water use (evaporation, evapotranspiration) based on equipment specification, scientific literature, or field experiments
- Cropping systems in fields with improved irrigation efficiency equipment

4.3.1.2 Measurable Objective

Reductions in pumping volumes will be used to measure reductions in groundwater use for individual properties and overall.

4.3.1.3 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.3.1.4 Permitting and Regulatory Process

External permitting from regulatory agencies is not anticipated for this management action.

4.3.1.5 Schedule for Implementation

A plan to implement irrigation efficiencies will be developed in the first two years of GSP implementation.

4.3.1.6 Implementation

As needed and in coordination with other outreach efforts (see Section 4.24, Education and Outreach)., the GSAs will attempt to engage with landowners to identify appropriate practices for each property and develop and implement plans based on landowner input.

Short-Term Goals (first 2-3 years of GSP implementation):

- Implement the pilot LESA – LEPA evaluation
- Support efforts by ranches to identify areas for irrigation efficiency improvements, such as implementation of soil moisture sensors, conversion to LEPA and LESA systems, and automation to improve water application to match crop requirements.
- Identify possible funding sources (e.g., NRCS) for on-farm irrigation efficiency improvements.
- Encourage ranches to identify and improve groundwater conveyance to minimize losses.

Long-Term Goals (within first 5 years of GSP implementation:

- Engage university Ag Extension groups for input and ideas on potential alternative crops.

In addition, reporting of volumes of groundwater pumping will continue over the implementation phase of the GSP in the same format as what the SVGMD is already collecting. Including a system for continuing reporting using telemetry is under consideration.

Data will be used to better quantify groundwater extraction spatially and temporally throughout the SV Subbasin.

4.3.1.7 Expected Benefits

Implementation of irrigation efficiencies will result in reduced groundwater usage to help maintain groundwater levels and other SMCs.

4.3.1.8 Legal Authority

This MA is primarily implemented through voluntary actions not requiring legal authority on the part of the GSA.

4.3.1.9 Estimated Costs and Funding Plan

Currently, this project is in the planning phase and funding options will be explored during the first five years of GSP implementation. The costs for the installation of flowmeters or other

equipment to manage irrigation efficiency practices that may be needed for implementation can be obtained through Prop 68 Implementation funds.

4.3.2 Well Inventory Expansion

4.3.2.1 Project Description

This management action (MA) would build on the Tier 1 MA for tracking large-capacity agricultural wells (Section 4.2.1). As noted in Section 4.2.1, a comprehensive well inventory that includes all types of wells in the valley will help assess impacts associated with the SMCs set in the GSP. Outreach will be conducted to domestic well owners to create awareness about the importance of checking groundwater levels and periodically testing groundwater quality.

A detailed well inventory and assessment of impacts improves the understanding of SV Subbasin conditions and will be valuable for calibrating model results and management decisions.

This MA will potentially add a comprehensive inventory of all wells in the valley including active domestic wells based on density analysis that identified locations in the Plan Area where the number of wells is currently unknown as shown in Figure 2.1.1-7. Currently available information on both large capacity wells and smaller domestic wells is included in Appendix 3-1 (Well Impact Analysis), and includes precise locations (GPS coordinates), along with the number and general locations of domestic and stock wells, and discussion of current and potential impacts to domestic wells due to approaching the criteria set in chapter 3 (e.g., decline in groundwater levels or quality).

An enhancement of the current MA is suggested to provide a more complete inventory of small domestic wells, including their current water levels (and therefore their chances of being impacted by a decline in groundwater levels in the SV Subbasin) and adding more water quality sampling. This should improve the understanding of SV Subbasin conditions and will be valuable for future management decisions and modeling results. The University of California Cooperative Extension (UCCE) conducted a cross-sectional analysis to assess Nitrate+Nitrite as N, arsenic, boron, and total dissolved solids in agricultural and domestic wells across Sierra Valley Groundwater Management District.[4] The study determined the presence of high-quality water within the District with localized exceptions. The study filled a data gap of water quality in the GAMA program and data collection should continue to provide further guidance with focused attention on potential areas of concern.

4.3.2.2 Measurable Objective

Development of a comprehensive inventory of active domestic, industrial, and stock wells. By optimizing the number and location of wells used for the WQ monitoring well network, a more accurate characterization of current groundwater quality conditions can also be developed.

4.3.2.3 Public Noticing

Public noticing for this project will be conducted by the GSAs prior to project implementation if required. Public notification is planned to be executed with significant project changes or additional project elements.

4.3.2.4 Permitting and Regulatory Process

Permitting is not applicable to this MA.

[4] Study accessible here: https://ucanr.edu/sites/Rangelands/files/358503.pdf

4.3.2.5 Schedule for Implementation

The implementation of this MA is depending on availability of funding as a considerable outreach effort can be foreseen. Future actions will include evaluating the feasibility and need for additional metering within three years of GSP implementation.

4.3.2.6 Implementation

Future implementation efforts would include:

- Identification of wells in key locations with unknown well density. Areas of focus would include all communities and corridors of decentralized homes.
- Outreach to domestic well users regarding importance of level and water quality monitoring.
- Finalize the internal database/well inventory.
- Investigate different options for telemetry for meters and associated costs.

4.3.2.7 Expected Benefits

More information and outreach on domestic wells will ensure protection of domestic wells used for drinking water and help preserve water quality.

4.3.2.8 Legal Authority

Article 6, Section 601 of SB 1391 authorizes SVGMD to require metering of any new, deepened, or previously-abandoned-then-reactivated well. As such, the GSAs are legally authorized to collect data and require metering to facilitate the data collection.

4.3.2.9 Estimated Costs and Funding Plan

Additional funding would be needed for expanding the well inventory with the budget to be determined once funding is available.

4.3.3 Reoperation of Surface Water Supplies

Opportunities to use surface water resources more efficiently may be an important strategy to reduce long-term groundwater pumping in Sierra Valley. Opportunities may exist for Frenchman Lake / Little Last Chance Creek, Lake Davis / Grizzly Creek (Plumas County water right allotment), Smithneck Creek, and smaller tributaries to the northern and eastern sides of the basin.

Frenchman Lake/Reservoir north of the Chilcoot-Vinton impounds waters of the Little Last Chance Creek. Current and historical reservoir operations will be reviewed to identify opportunities to provide more reliable surface water delivery (i.e., delivery of water that is more efficient in meeting crop water demands and modification of the timing of water delivery), which in turn could help reduce groundwater pumping on ranches that have access to surface water and surface water rights in the SV Subbasin. Implementing a new reservoir management scheme can be reviewed to increase storage capacity, maintain higher minimum pools for more assured drought supply, and/or to reduce flood spills and conserve water, which in Sierra Valley might involve managed winter releases to recharge the aquifer, or impound additional water on farms through augmented on-farm storage, or winter icing of flood irrigated pastures.

The Pumping Management Actions via Improved Surface Water Management may include the following activities:

- Identification of Irrigation Areas with Combined Surface Water and Groundwater Use.

- Review of Reliability of Surface Water Resources and Dependency on Supplemental Groundwater over a range of year types (Wet Year, Normal Year, Dry Year).
- Review of DWR Water Master Surface Water Management and Decree Rights, along with potential legal issues.
- Review of Historical Frenchman Lake/Reservoir Storage and Managed Releases for Irrigation.
- Review and Quantification of Historical Frenchman Lake/Reservoir Spill Releases.
- Concept Review for Modifications to Frenchman Lake/Reservoir Operations.
    - Increased minimum pool in fall to carryover for potential drought supply
    - Modifications to reduce spill (Winter Release concept)
    - Institutional/Legal arrangements necessary to implement operational changes
- Review for Development of Additional On-Ranch Surface Water Storage.
- Review of Lake Davis Possible Water Availability and Potential Use (physical limitation to routes to divert, place of use limitations, possible use for aquifer recharge along northern edge of valley)
- Preliminary Concept Review of Reservoir Improvements, such as Increasing Storage Capacity (Frenchman Lake/Reservoir).

This MA will be evaluated in the context of a Pumping Management Actions document which will include:

- Preliminary feasibility analysis of timing and magnitude of Frenchman Lake/Reservoir releases for agriculture, and preliminary identification of potential reservoir management improvement to reduce long-term pumping on ranches that supplement Little Last Chance water with groundwater.
- Conceptual review of options and alternatives for reservoir operations, which may require further analyses. This may include releases prior to irrigation season (winter releases), releases specifically for aquifer recharge, releases for on-farm storage, modification of release timing for improved efficiency (conveyance losses and match to crop water demands).
- Documentation from engagement of the Sierra Valley Watermaster and DWR in discussions on possible opportunities.
- Preliminary analysis of potential use of Lake Davis water in Sierra Valley (topographic routing along the northern periphery of the valley for aquifer recharge, or direct use to offset uses of groundwater in the northern part of the basin).
- Potential for enhanced recharge of intermittent and ephemeral drainages tributary to the eastern and northern portion of Sierra Valley.

4.3.3.1 Measurable Objective

This MA provides critical information to be included in the model and will enable the model to provide refined information of this MA on the entire water budget of the SV Subbasin. The refined water budget will benefit the measurable objectives for all the critical Sustainability Indicators.

4.3.3.2 Public Noticing

Public noticing for this project will be conducted by GSAs during regular meetings prior to project implementation if required.

4.3.3.3 Permitting and Regulatory Process

External permitting from regulatory agencies is not anticipated for this management action during the planning phases. If water rights changes are required, significant permitting may be required during implementation.

4.3.3.4 Schedule for Implementation

A preliminary feasibility review related to surface water management to reduce groundwater pumping will be included in the Pumping Management Actions Review to be completed by September 2022. A schedule for future actions will be developed based on the findings of the Pumping Management Actions review.

4.3.3.5 Implementation

The following actions will be taken to implement this MA:

Short-Term Goals (first 2 years of GSP implementation)

- Conduct more detailed evaluations, as needed, to advance potentially feasible alternatives, as identified in the Pumping Management Actions analyses.
- Secure DWR grant funding to conduct more detailed evaluations.
- Implement a pilot program of alternative Frenchman Lake/Reservoir operation, if determined to be potentially viable. This may include winter releases, modified timing of irrigation season releases, reservoir level management modifications, etc.

Long-Term Goals (to be implemented within 10 years of GSP implementation if determined to be feasible and beneficial)

- Implement projects to improve use of surface water to meet farming and crop water demands and lessen reliance upon groundwater. This may include construction of additional on-farm storage facilities.
- Implement a new operational scheme for Frenchman Lake/Reservoir and Little Last Chance Creek water deliveries to ranches with combined surface water and groundwater use.
- Implement projects to use Lake Davis water to offset existing groundwater uses, and potentially benefit other GSP goals for GDEs, etc.
- Implement projects to increase the effective recharge to the deep aquifer (not shallow aquifer) – Little Last Chance, Lake Davis, and other ephemeral/intermittent drainages on the northern and eastern side of the basin.

4.3.3.6 Expected Benefits

Implementation of reoperation of surface water supplies will provide refined information on water use that will be incorporated in the integrated model: this will improve estimates for the current water budget and will support the simulation of future water use scenarios. Such scenarios could include increased storage capacity for droughts or winter releases to recharge the aquifer.

4.3.3.7 Legal Authority

Planning for this MA will include evaluating the water rights, who holds rights, times, and quantities of diversions to verify the reoperation is within the water rights.

4.3.3.8 Estimated Costs and Funding Plan

At the time of GSP preparation, the costs and funding plan for this project have not been estimated or developed.

4.3.4 Off-Stream Storage

Increased off-stream surface water storage projects are a potential strategy to augment water supply by diverting and storing surface water that would otherwise exit the SV Subbasin as runoff. This water, captured during the wet season and periods of increased surface runoff, would be stored, and then used during dry periods to supplement groundwater pumping or surface water diversion that may cause seasonal depletions. Storage of this water can be achieved through the construction of small-scale reservoirs (e.g., agricultural ponds or site-specific ponds), or utilization of storage tanks or catchments. The stored water can be used to supplement supply to agricultural operations, as well as domestic or municipal uses. A consideration for off-stream storage is to beware of potential off-stream ponding consequences, such as invasive species, and possible stranding of important species. In addition, impacts to critical habitats of diverting water to storage should also be considered. Through the water rights permitting process, the amount diverted is ensured to not impact downstream human and ecological uses.

Off-stream storage in the Sierra Valley SV Subbasin would be comprised of multiple dispersed storage projects located throughout the SV Subbasin, as opposed to a small number of large-scale projects. Therefore, a key initial step to understanding the viability of this project is to conduct site-specific surveys that quantify the diversion potential of surface water, as well as the storage potential located near the point of diversion. These storage projects are likely to supply water on a site-specific basis, and therefore the stored water will need to be located in close proximity to the ultimate use of the water. Two streams that have been identified for potential on-farm storage of surface water include Smithneck Creek and Little Last Chance Creek.

4.3.4.1 Measurable Objective

Off-stream storage projects are designed to preserve groundwater storage during periods of dry weather by supplementing groundwater demand with stored surface water. Off-stream storage has the potential to increase groundwater storage if adequate amounts of stored surface water are reliably available during times of high groundwater demand. Additionally, the stored surface water has the potential to not only offset pumping but also reduce surface water diversions during dry weather that may cause seasonal depletions.

4.3.4.2 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.3.4.3 Permitting and Regulatory Process

Permitting from the Regional Water Quality Control Board may be required to divert surface water. Additional external permitting may be required and could include permits from the Department of Fish and Wildlife and the Army Corps of Engineers.

4.3.4.4 Schedule for Implementation

This project is in the conceptual stage and has not yet been planned. Interest in the project will be confirmed within the first 5 years of GSP implementation. If interest is confirmed within this period, an implementation schedule will be determined.

4.3.4.5 Implementation

Once interest for off-stream storage has been confirmed, the project will be implemented by first conducting site-specific surveys that quantify the potential for diversion of surface water, as well as the storage potential that is located near the point of diversion. The site-specific surveys will be planned within one year of confirming project interest.

4.3.4.6 Expected Benefits

Implementation of off-site storage is expected to benefit groundwater levels, groundwater storage, and surface water depletion by utilizing stored surface water during dry periods to supplement groundwater pumping or surface water diversions that may cause seasonal depletions.

4.3.4.7 Legal Authority

The GSAs have the legal authority to issue new construction permits for surface water storage (e.g., ponds or storage tanks). As previously noted, the diversion of surface water may need to be approved by the Regional Water Quality Control Board and other agencies.

4.3.4.8 Estimated Costs and Funding Plan

At the time of GSP writing, the costs and funding plan for this project have not been estimated or developed. It is estimated that private landowners will partially finance the projects as they will receive direct benefit from the additional stored water, and that grant funding opportunities related to increased water storage will be sought in the future to share in project costs.

4.3.5 Drought Mitigation Planning

Drought mitigation planning is an important tool that will be used to identify and quantify the impacts to the Valley's water supplies caused by extended periods of dry weather. Once these impacts have been characterized, triggers tied to variables such as precipitation, runoff, and other factors such as the quantity of water in storage, will be developed to minimize stress to water resources, and plan for the appropriate level of use during the dry period. A Drought Mitigation Plan will be developed to address this aspect of water management in the Valley including determination of drought status and what tiers of drought would trigger specific actions and adjustments. With the unprecedented changes in climate that have recently been observed, the Drought Mitigation Plan will be a critical document that may inform other PMAs. Throughout its development, it is important to emphasize how drought status is determined, and how tiers of drought will trigger adjustments to different PMAs.

4.3.5.1 Measurable Objective

Implementation of the Drought Mitigation Plan is intended to safeguard the SV Subbasin's groundwater resources from experiencing significant and unreasonable effects related to lowering of groundwater levels, reduction in storage, degraded groundwater quality, and surface water depletion. The amount of water conserved during a specified drought period is a measurable component of this PMA.

4.3.5.2 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.3.5.3 Permitting and Regulatory Process

External permitting from regulatory agencies is not anticipated for this management action.

4.3.5.4 Schedule for Implementation

This project is in the conceptual stage and has not yet been planned. The schedule for implementation will be based on the release of relevant state funding for drought relief planning.

4.3.5.5 Implementation

Drought mitigation plans or similar contingency plans related to drought planning have been developed for districts, tribes, and municipalities throughout California. This PMA involves obtaining such documents and evaluating them to find common conservation and supply reliability actions that involve coordination within the SV Subbasin or watershed to serve a larger beneficial user group. During the development of the Drought Mitigation Plan, the GSAs' Board of Directors would direct staff to research and propose ordinances based on SV Subbasin conditions and water use. If deemed necessary, the GSAs will coordinate with other partners to develop and implement the Plan.

4.3.5.6 Expected Benefits

The Drought Mitigation Plan will be used as a planning document to conserve water resources and ensure economic and environmental prosperity are preserved during drought periods. The Plan will: determine appropriate mitigation and response actions to reduce risk and vulnerability to drought, identify measurable triggers to start or stop mitigation actions during the onset and termination of drought, and identify the appropriate agencies or organizations that will develop and implement the mitigation actions.

4.3.5.7 Legal Authority

The GSAs have the legal authority to develop and implement a Drought Mitigation Plan.

4.3.5.8 Estimated Costs and Funding Plan

At the time of GSP writing, the costs and funding plan for this project have not been estimated or developed. It is estimated that state grant funding opportunities will share in the project cost.

4.3.6 Water Conservation

A prescribed or voluntary GSP water conservation program could be implemented to promote use of water conservation methods, equipment, or techniques to reduce water demand to offset groundwater pumping. For example, a conservation program could establish a voluntary conservation agreement, in which users would agree to reduce water use during summer months or practice the utilization of stored water only during critical dry months of the year.

Additionally, the PMA may provide incentives and rebates for water-efficient appliances, utility improvements, leak detection, and improved metering. The agricultural sector may be involved through the development of voluntary water conservation agreements (e.g., only irrigating crop ET, foregoing a fourth cutting, or modifying irrigation start and stop dates). Real-time monitoring of an array of parameters related to water demand such as soil moisture, ET potential, and environmental and delivered flows are important to measure to accurately match supply to demand. Outreach and coordination with irrigators and other stakeholders may also be critical to ensure practices are adopted for enough of the affected areas to achieve needed reductions.

4.3.6.1 Measurable Objective

This MA would implement water conservation measures designed to maintain groundwater levels and groundwater storage, as well as prevent surface water depletion below levels

corresponding to the most recent twenty-year period. The seasonal reduction in demand for water resources is a measurable component of this PMA.

4.3.6.2 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.3.6.3 Permitting and Regulatory Process

Permitting is not anticipated for this MA.

4.3.6.4 Schedule for Implementation

Depending on funding availability, planning and development of a robust program would be expected to begin with the first two years of GSP implementation and implemented within three years of GSP implementation.

4.3.6.5 Implementation

Implementation of a water conservation program could include partnerships with local and state agencies to establish a pilot program to implement water use efficiency practices, such as the installation of soil moisture sensors throughout the SV Subbasin.

4.3.6.6 Expected Benefits

Implementation of a water conservation program is expected to benefit groundwater levels, and groundwater storage by reducing groundwater extraction. Prevention of streamflow depletion will also be gained through this PMA. Water use is expected to be optimized through implementation of this PMA, as real-time water demands versus actual requirements will be better understood.

4.3.6.7 Legal Authority

GSAs have the legal authority to plan and partner with other agencies to implement water conservation activities. Permitting would likely not be necessary.

4.3.6.8 Estimated Costs and Funding Plan

Costs and funding for this project have not yet been explored. Potential funding sources will be explored during the first two years of GSP implementation. The GSAs could pursue partnerships and grant funding opportunities to offset the cost to ratepayers. Additional funding may become available in the future as the state releases grant funding opportunities to grapple with the recent increase in drought and extended dry periods.

4.3.7 Groundwater Trading and Allocations System

Groundwater trading and an allocations system is a mechanism to reduce long-term groundwater pumping. This manner of demand management action would support sustainable groundwater management in the Subbasin through the implementation of policies, programs, and agreements that require, promote, and/or incentivize water conservation and efficient water use. Demand management refers to water management actions that would require a reduction in the use of groundwater and may include defining water allocations (shares) to each high-volume user of groundwater. Normally, allocations would not be required for typical residential water uses below a threshold, such as 2 acre-feet (~650,000 gallons) per year. Allocations can be initially assigned to users based on historical water uses and irrigated acres, along with considerations for supplemental surface water or treated effluent water sources. Shares are managed on an annual use audit, and duties may be fixed or variable depending on the water year and anticipated irrigation water requirements for the growing season. To effectively result

in long-term groundwater use reductions, allocations may also be ramped down in duty so as to gradually result in reduced pumping, and duties can be fine-tuned in an adaptive management approach based on aquifer water level responses and projected ability to meet the 20-year sustainability goals of the GSA. The allocations could also be traded or transferred to alternative locations throughout the basin or within prescribed areas. These groundwater trading programs are being proposed or explored by GSAs for a mechanism to assure that sustainability goals can be achieved, and an equitable format for pumping reduction is established.

The structure for an allocation system has not been extensively explored at the time of this GSP, as allocations and associated requirements to reduce pumping within allocations is not a desired management action if other less economically impactful tools and management actions can be implemented to reach sustainability goals. An allocation program can limit groundwater pumping in certain areas and/or from certain aquifer layers. The GSAs would like to better understand the relationship between pumping from the lower and upper aquifer layers, which can be further simulated in the hydrologic model. Limiting pumping in the upper aquifer layer so GDEs and domestic well users are not impacted from deep agricultural wells is a potential option to allocate groundwater pumping while minimizing economic impact. This potential management action can be reassessed while developing annual reports and at the 5-year GSP audit point to determine need, in consideration of the effectiveness and refined understanding of the feasibility of other management actions to meet sustainability goals.

4.3.7.1 Measurable Objective

This MA would implement demand management measures designed to maintain groundwater levels and groundwater storage, as well as prevent surface water depletion below levels corresponding to the most recent twenty-year period. The seasonal reduction in demand for water resources is a measurable component of this PMA.

4.3.7.2 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation if required.

4.3.7.3 Permitting and Regulatory Process

Permitting or regulatory requirements would be evaluated and developed during the planning process.

4.3.7.4 Schedule for Implementation

Because of the economic implications associated with the MA, it will be assessed for feasibility at the 5-year point of the GSP to determine if other MAs have been effective and if this MA is still needed. It would be implemented during the second 5 years of GSP implementation if needed.

4.3.7.5 Implementation

Implementation of a groundwater allocation system would include outreach to residential and agricultural users and development of program requirements for both groups.

4.3.7.6 Expected Benefits

Implementation of groundwater allocation or demand management actions is expected to benefit groundwater levels, and groundwater storage by reducing groundwater extraction. Prevention of streamflow depletion will also be gained through this PMA. Water use is expected to be optimized through implementation of this PMA, as real-time water demands versus actual requirements will be better understood.

4.3.7.7 Legal Authority

GSAs have the legal authority to plan and partner with other agencies to implement groundwater trading or transfer and to set allocations for their users.

4.3.7.8 Estimated Costs and Funding Plan

Costs and funding for this project have not yet been explored. Potential funding sources will be explored during the first two years of GSP implementation. The GSAs could pursue partnerships and grant funding opportunities to offset the cost to ratepayers. Additional funding may become available in the future as the state releases grant funding opportunities to grapple with the recent increase in drought and extended dry periods.

4.3.8 Watershed Management and Upland Restoration

Watershed management and restoration would seek to implement multi-benefit projects that enhance precipitation retention and infiltration (i.e., reducing runoff), reduce fuel loads, and support ecosystem services such as reducing peak flood flows and enhancing summer baseflows. Projects could be identified on a watershed-wide scale or to focus on specific areas. A focus on specific areas may allow for more feasible projects that are easier to evaluate with respect to effectiveness. As an example of a focus on a specific area of the watershed, upland management, as described further below, could include forest/meadow restoration, thinning of vegetation, road improvements or removal, and soil decompaction (i.e., goal of increasing water retention in the soils).

In addition, projects to enhance wetlands and meadows could better retain water to support GDEs. For example, the US Forest Service implemented meadow restoration projects at Perazzo Meadow and Knutson Meadow.

In the Sierra Nevada, snowmelt from higher elevations serves as the main source of water that recharges groundwater aquifers in the valleys of the range, particularly for valleys that receive lower annual precipitation such as Sierra Valley. Snow accumulates in high-elevation forests during the winter and the snowmelt is typically released gradually. Percolation of precipitation and snowmelt to aquifers often takes several or many years depending upon the permeability of soil layers, the hydraulic gradient, and the distance between the aquifer and source precipitation. Bedrock fissures and faults can provide a much faster path for delivery of snowmelt to aquifers, resulting in measurable increases in aquifer water tables within one year of a high precipitation season.

In the upper watershed, hydrologic connectivity is often disrupted by disturbances from historic and ongoing management practices, including, for example, logging, fire suppression, railroad building, road building, and the construction of other linear features (powerlines, pipelines, etc.) that can re-route stream and surface flows, compact soils, and have altered the natural forest condition. According to a watershed study prepared by Vestra (2005), the Sierra Valley watershed is 297,000 acres and “is defined. . . where slopes are generally less than five percent. It includes approximately 115,000 acres or about 40 percent of the watershed.” This suggests that over half of the contributing area to the groundwater basin is in upland areas. When rainfall and snowmelt contact the ground surface in those upland areas, that water either infiltrates or runs off. In areas of compacted ground, water runs off at a much greater rate than that from uncompacted ground. Water that leaves that site and enters a watercourse is no longer available for infiltration and potential groundwater recharge. As the precipitation regime changes due to climate change, it is expected that more precipitation will fall as rain rather than snow within and around Sierra Valley which could result in an increase in erosion and runoff,

making restoration efforts geared at increasing infiltration and protecting against erosion increasingly important.

Forests in the higher elevations of Sierra Valley are managed by the US Forest Service (USFS) as well as private forest landowners, with USFS lands north of CA Highway 70 managed by Plumas National Forest and Tahoe National Forest managing the Sierra Valley watersheds south of CA Highway 70. On US Forest Service lands in the upper watershed, restoration activities are focused on restoring hydrologic connectivity are often planned and implemented as components of forest restoration and timber projects. Increases in water infiltration to the groundwater due to forest restoration and timber projects have been documented across the Sierra Nevada (Tague et al. 2018) while road improvements, soil decompaction, and mulching can result in restored upstream to downstream surface and groundwater hydrologic connectivity (Drake et al. 2013) and are part of the implementation actions associated with forest restoration projects. Additionally, meadow restoration projects recharge groundwater and support summer baseflows (Hunt et al 2018).

Groundwater recharge is affected by forest management, largely due to greater uptake of soil water by trees and to increased water-holding capacity of forest soils, arising from higher organic content (Allen 2001; Tague et al. 2018). Increased tree density in forests typically results in a reduction of runoff and groundwater recharge, mainly due to interception of rainfall by forest canopies and increased moisture in the forest root zone resulting in higher forest evapotranspiration rates. Forest thinning has the opposite impact. Beginning in the mid-1980s, in the western United States, the frequency of large forest fires and the length of the wildfire season increased suddenly and markedly (Glazer 2012). This trend has accelerated since the 2010s. In the last two years, two large fires have impacted the upper watershed, with 13,425 acres burning in the Loyalton Fire in 2020 and 73,773 acres burning in the Beckwourth Fire in 2021. These fires create the potential for increased erosion and hydrologic disruption while the burned area recovers.

Over this same period, forests worldwide have been subjected to ‘‘stress complexes,’’ combinations of biotic and abiotic stresses, that have led to an increasing number of large-scale forest dieback events (Glazer 2012). These stress complexes typically involve some combination of drought, insects and/or fungi, and fire. A growing body of evidence indicates that climate change has contributed to these dieback events (USDA Region 5 Ecology Program 2021). Trees in coniferous forests are deep-rooted and require large amounts of water. When exposed to protracted water stress by a combination of drought and warmer temperatures, these trees maintain themselves as long as possible by upward hydraulic redistribution of groundwater through their deep roots, resulting in less groundwater available to recharge aquifers.

Forest restoration projects can improve groundwater recharge but must also address issues related to soil compaction and disturbance related to ground-based operations. Disturbed or compacted soil areas that are rehabilitated infiltration rates can increase, in some cases, by an order of magnitude or more following soil decompaction/loosening or incorporation of woodchips/organic material. For instance, in a simulated 1” per hour rainstorm, 90-95% of that rainfall can be infiltrated on a treated site, as compared to an untreated site (Grismer, Hogan, 2004).

Meadow and wetland restoration can include the reconnection of the stream channel to the floodplain or the reconnection of disconnected surface and groundwater hydrology due to roads and trails. Degradation of a meadow’s surface and groundwater connectivity and function can be directly correlated with a decline in key ecosystem services including water filtration

(Woltemade 2000), flood attenuation (Loheide et al. 2009; Lowry et al. 2011), headwater storage capacity (Lord et al. 2011), greenhouse gas emissions (Blankinship and Hart 2014; Reed et al. 2020), conifer encroachment (Lubetkin et al. 2017), loss of bird and other wildlife populations (McKelvey et al. 1996; Campos et al. 2020), and resilience against invasive plant species (Hammersmark et al. 2009).

Upper watershed restoration efforts can have a positive impact on downstream groundwater and surface water resources and should be taken into consideration when considering the long-term sustainability of groundwater resources in Sierra Valley. Specific soil treatments designed to maximize soil infiltration can be combined with forest health projects, road and trail construction, range management, and otherwise to address areas of low infiltration throughout the watershed and thus contribute to an increase in groundwater storage. Collaborative projects that work across ownership boundaries promote shared stewardship and can create more grant funding opportunities and have a positive influence on the local economy.

4.3.8.1 Measurable Objectives

The objective of this upland management project is to improve recharge in higher slopes. This project will have multiple benefits, including potential for fire prevention.

4.3.8.2 Public Noticing

Public noticing for the upland management project will be conducted by the GSAs prior to project implementation and include a CEQA and NEPA Negative Declaration if required. Public notification is planned to be executed with significant project changes or additional project elements.

4.3.8.3 Permitting and Regulatory Process

Permits will be obtained as necessary.

4.3.8.4 Schedule for Implementation

This project is in the conceptualization stage. An exploration of funding sources, project location, and project feasibility is planned within the first ten years of GSP implementation.

4.3.8.5 Implementation

This PMA would require further studies to evaluate the feasibility of implementing such projects. An evapotranspiration study to assess the impact of wildfires and forest management can provide insights into the amount of water available for groundwater recharge. The reduction in forest ET is equivalent to the increased amount of water available for groundwater recharge and surface runoff. Methods to estimate evapotranspiration include:

1. Use available commercial evapotranspiration products, such as OpenET. OpenET provides a historical archive on remote sensed ET estimates going back to 2016.[5]
2. Complete a Mapping EvapoTranspiration at High Resolution and Internalized Calibration (METRIC) analysis to estimate actual evapotranspiration before and after an event like a forest fire or thinning. A METRIC analysis can be further calibrated based on additional ground-truthed sources of forest ET, such as from Ameriflux.[6]

Evapotranspiration estimates would serve as an input into the hydrologic model to assess what portion of the precipitation infiltrates into the groundwater system or contributes to surface runoff under historical, present, and projected forest conditions.

[5] OpenET website: https://openetdata.org/

[6] Ameriflux website: https://ameriflux.lbl.gov/about/about-ameriflux/

4.3.8.6 Expected Benefits

Expansion of preexisting seasonal recharge to groundwater levels for domestic and agricultural supplies. Data from Grismer and Hogan (2004) can be considered to help determine benefits vs costs, and implications of precipitation capture, retention, and infiltration

4.3.8.7 Legal Authority

With the appropriate permitting, and without infringement on existing water rights, the GSAs are authorized to implement projects to enhance infiltration.

4.3.8.8 Estimated Costs and Funding Plan

Multi-benefit projects such as those discussed in this section may be able to leverage multiple funding sources and grant programs. In addition, there are likely to be implementation/funding partners such as the USFS and NRCS which will also reduce the costs to the GSAs.

4.3.9 Voluntary Managed Land Repurposing

4.3.9.1 Project Description

Voluntary managed land repurposing programs include a wide range of voluntary activities that make dedicated, managed changes to land use (including crop type) on specific parcels in an effort to reduce consumptive water use in the SV Subbasin to improve and increase groundwater levels. By repurposing previously irrigated land into new uses that use less or no water, voluntary land management practices can result in multiple benefits, such as sustainable water supplies and healthier air and soil. This MA would include a preliminary evaluation of land repurposing activities to determine if further actions are viable for the SV Subbasin and groundwater users. Similar activities may be described in Sections 4.3.7 and 4.3.2. These activities may include any of the following:

Term Contracts: In some circumstances, programs like the Conservation Reserve Program (CRP) could provide a means of limiting irrigation on a given area for a term of years. Because of low rates, the CRP has not been utilized much in California, but this could change in the future. In addition, other term agreements may be developed at the state or local level with the implementation of SGMA. Further research is needed to evaluate the effectiveness of term contracts, or the level of participation anticipated for groundwater users.

Alternative Crops/Return to Native Vegetation Alternatively, landowners could be encouraged to retire high water-use crops and switch to alternative, low-water-use crops such as grain. Such a conversion could reduce irrigation of land and groundwater pumping. Landowners could also convert agricultural land to non-irrigated native vegetation or grassland.

Other Uses: In some circumstances, portions of a farm that are currently irrigated may be well suited for other uses that do not consume water. For example, a corner of a field may be well suited for wildlife habitat or solar panels, subject to appropriate zoning requirements to avoid undesirable outcomes.

4.3.9.2 Measurable Objective

Determine available acreage that irrigation could be reduced and estimate the corresponding reduction in water usage.

4.3.9.3 Public Noticing

Public noticing for this project, if required, will be conducted by GSAs during regular meetings prior to project implementation.

4.3.9.4 Permitting and Regulatory Process

External permitting from regulatory agencies is not anticipated for this management action.

4.3.9.5 Schedule for Implementation

The initial inventory and potentially feasible projects would be identified within the first two years of GSP implementation. For identified projects, funding would be pursued to allow implementation within the first five years of GSP implementation

4.3.9.6 Implementation

Implementation of this project type includes the following elements to be conducted.

- Determine role of the GSAs versus other agencies, local organizations, and NGOs.
- Development of education and outreach programs in collaboration with local organizations.
- Exploration of program structure.
- Contracting options.
- Exploration and securing of funding source(s).
- Identification of areas and options for easements or other contractual instruments.

Monitoring data collected in this voluntary managed land repurposing program include, but are not limited to:

- Total acreage and timing of land repurposing.
- Location of parcels with land repurposing.
- Assessment of the effective decrease in evapotranspiration (consumptive water use) and applied water use.
- Description of the alternative management on repurposed land with:
    - Quantification and timeline of surface water dedications to instream flow specified in the easement.
    - Quantification and timeline of groundwater pumping, including water year type or similar rule to be applied and specified in the easement.
- Annual Water Master certification of easement implementation, as appropriate.

4.3.9.7 Expected Benefits

Future benefits of implemented land purposing projects to stabilizing groundwater levels will be evaluated and assessed with the hydrogeologic model using the methodology described in Chapter 3 and using the above monitoring data that describe the implementation of voluntary managed land repurposing programs.

4.3.9.8 Legal Authority

The implementing organizations such as Land Trusts, have the legal authority to implement term contracts with individual property owners.

4.3.9.9 Estimated Costs and Funding Plan

At the time of GSP writing, the costs and funding plan for this project have not been estimated or developed. It is estimated that state grant funding opportunities will share in the project cost.

Changes to agricultural activities by individual landowners may result in impacts to the rural economy that should be considered for the MA.

4.3.10 Groundwater Recharge/Managed Aquifer Recharge

4.3.10.1 Project Description

Managed Aquifer Recharge (MAR) is the process of intentionally adding water to aquifers. Both active and passive conjunctive uses can be considered in the SV Subbasin to provide water supplies for MAR projects. Active conjunctive use, or direct recharge, includes any practice that delivers water to the aquifer and increases groundwater storage. Passive conjunctive use, or indirect recharge, includes conjunctive use practices (i.e., coordinated uses of surface water and groundwater) that reduce the amount of groundwater withdrawals which leads to increased aquifer storage.

SVGMD is currently working with the State Water Board to develop a project to divert water in the winter from Badenaugh Creek to irrigation fields and wildlife areas for groundwater recharge.

Key to MAR projects is the identification of water to drive the project, which generally is limited to excess stormwater runoff or increased water deliveries. Direct recharge can be accomplished via the following:

- Spreading Basins: Spreading Basins facilitate the movement of water from the ground surface to the underlying hydraulically connected unconfined aquifer. A large volume of infiltrating water is concentrated on the ground surface which provides opportunities for recharge over larger areas and for longer periods than what would otherwise occur.
- Flooding agricultural fields (Flood-MAR): This practice involves use of floodwater or stormwater for managed aquifer recharge on agricultural lands and engineered landscapes. Flood-MAR projects can provide multiple benefits to the water supply system, ecosystem, and wildlife habitat by increasing water supply reliability, flood risk mitigation, drought preparedness, aquifer replenishment, ecosystem enhancement, subsidence mitigation, water quality improvement, working landscape preservation and stewardship, climate change adaptation, recreation, and aesthetics.
- Injection wells and/or dry wells: Using injection or dry wells involves the installation and operation of equipment to inject water into specific aquifers. Aquifer storage and recovery (ASR) wells are the most common injection method used in California. Groundwater injection projects are typically most effective when utilizing a consistent, designated water supply (such as recycled water). ASR wells do not have seasonal constraints and do not depend on surficial soil characteristics but require controlled operation and regular maintenance to sustain adequate recharge rates. Injection wells are necessary for MAR into a confined aquifer, due to the higher pressure of the groundwater under the confined layer. Modifications to existing wells could be used for injection in wintertime. However, one of the main disadvantages of injection into confined aquifers is the low injection rate per well and the resulting need for additional wells. Additionally, clogging of the aquifer can become an issue for injection wells into confined aquifers, therefore, the feasibility of utilizing an injection well in a confined aquifer needs to be established.
- Streams and canals: These features can be used to infiltrate water and increase groundwater recharge. For example, diverting water during non-irrigation seasons into

unlined canals can supplement groundwater recharge if canal seepage reaches the underlying aquifers.

Additionally, recharge sites can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide habitat for wildlife and aquatic species. Further information can be found in the "Multi-Benefit Recharge Project Methodology Guidance Document" provided by The Nature Conservancy.[7]

4.3.10.2 Measurable Objective

Use of MAR has been explored in different Subbasins in California as an option to increase groundwater recharge. It could be implemented in Sierra Valley to help maintain or increase groundwater levels and storage to meet the GSP's Measurable Objective.

4.3.10.3 Public Noticing

Public noticing for this project will be conducted by GSAs prior to project implementation and include a CEQA Negative Declaration if required. Public notification is planned to be executed with significant project changes or additional project elements.

4.3.10.4 Permitting and Regulatory Process

Permitting will be required to implement MAR and will depend on the project. For example, if the project involves diversion of surface water, a temporary Water Rights permit (i.e., SWRCB Application for Temporary Permit filed pursuant to Water Code 1425 to Divert to Underground Storage During High Flow Events) would be needed to allow diversion of water. These permits can be issued for up to 180 days. Tributaries that are not adjudicated over the winter season will be prioritized to minimize the permitting and regulatory process.

4.3.10.5 Schedule for Implementation

This project is in the planning and conceptualization stage. An exploration of funding sources, project location, and project feasibility is planned within the first ten years of GSP implementation.

4.3.10.6 Implementation

A Managed Aquifer Recharge Project would initially be developed as a pilot project on one property to evaluate its feasibility for the Subbasin and expanded to other properties and areas of the SV Subbasin if applicable.

This project utilizes excess winter and spring flows for recharge. The project includes:

- Finding landowners willing to participate
- Securing project funding
- Obtaining water rights, protecting existing natural and human uses of water, and meeting other permit requirements as necessary
- Constructing infrastructure and installing monitoring equipment as necessary to identify potential project impacts and quantify project benefits.

4.3.10.7 Expected Benefits

Expansion of preexisting seasonal recharge to groundwater levels for domestic and agricultural supplies.

[7] Multi-Benefit Recharge Project Methodology Guidance Document. The Nature Conservancy. June 2021. Website: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance

4.3.10.8 Legal Authority

With the appropriate permitting, and without infringement on existing water rights, the GSAs are authorized to divert surface water for use with MAR and injection wells.

4.3.10.9 Estimated Costs and Funding Plan

Costs and funding for this project have not yet been explored. Potential funding sources will be explored during the first ten years of GSP implementation.

4.3.11 Assessment of Post-Fire Hydrology and Potential Water Supply Augmentation

Forest management projects are being implemented in and around Sierra Valley that are multi-benefit projects intended to manage for impacts of climate change and to protect wildlife and other resources through forest management, thinning/brush abatement, and other fuels reduction efforts. These projects, which reduce vegetation, have the benefits of reducing the severity of wildfires and potentially augmenting groundwater supplies. Reducing vegetation in overstocked forests may increase the amount of water that infiltrates into the aquifer, both from interconnected surface waters and from precipitation.

The Plumas County Fire Safe Council has received funding and is in the process of developing the Eastern Plumas Wildfire Protection Project to reduce fuel conditions that can contribute to catastrophic wildfires. As shown in Figure 4.3-1. the project area overlaps with the Sierra Valley Watershed. To the extent that on-the-ground fuels reduction projects occur in locations that recharge impacted areas of the Sierra Valley Subbasin, an opportunity may present itself for the Sierra Valley Groundwater Sustainability Agencies (GSAs) to coordinate with this project to measure and monitor beneficial impacts to the aquifer. The goal of the GSAs would be to support fuels reduction and watershed management efforts in Sierra Valley that have the potential to increase groundwater recharge, while also addressing wildfire severity. As the Eastern Plumas Wildfire Protection Project is developed, the GSAs are proposing to work with the Plumas County Fire Safe Council to develop approaches to monitoring changes in streamflow and groundwater levels that result from the project actions.

4.3.11.1 Measurable Objective

Vegetation management and fuels reduction projects have the potential to increase recharge of groundwater aquifers and increase groundwater levels.

4.3.11.2 Public Noticing

Public noticing for this project will be conducted by GSAs in coordination with the Plumas County Fire Safe Council prior to project implementation if required.

4.3.11.3 Permitting and Regulatory Process

Any permitting or regulatory process required by the project would be conducted by the Plumas County Fire Safe Council. The GSAs would support these processes as necessary.

4.3.11.4 Schedule for Implementation

The scope of the project is currently being developed with the goal of initial implementation being in the Fall of 2022. The GSAs would coordinate with the Plumas County Fire Safe Council to develop a monitoring program to be ready to begin collecting data when the project implementation is initiated.

4.3.11.5 Implementation

The project will be implemented in coordination with the Plumas County Fire Safe Council's program.

4.3.11.6 Expected Benefits

Implementation of off-site storage is expected to benefit groundwater levels, groundwater storage, and surface water depletion by utilizing stored surface water during dry periods to supplement groundwater pumping or surface water diversions that may cause seasonal depletions.

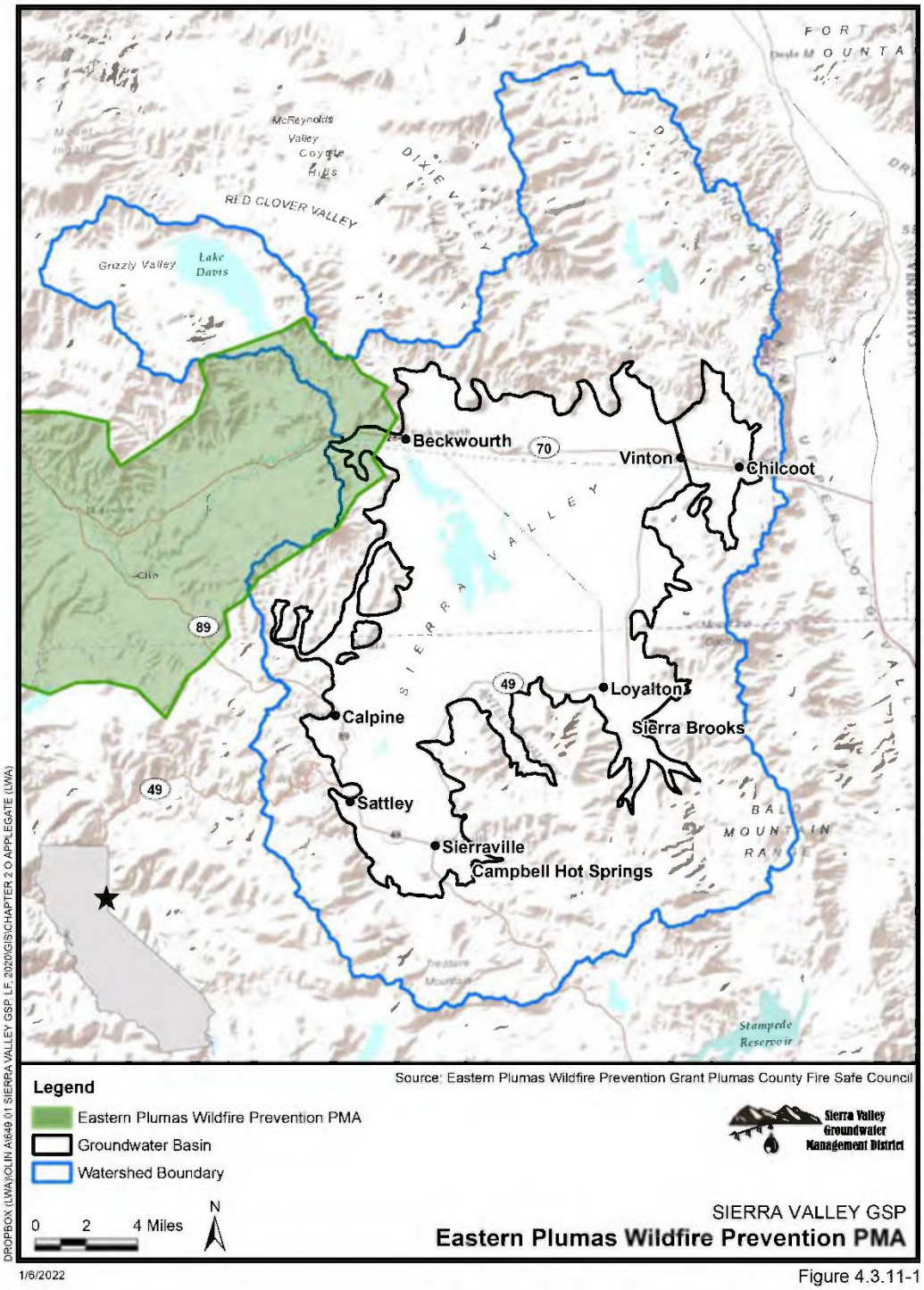
4.3.11.7 Legal Authority

The GSAs have the legal authority to install monitoring equipment and work with other organizations/ public agencies.

4.3.11.8 Estimated Costs and Funding Plan

The overall project is currently funded through a grant awarded to the Plumas County Fire Safe Council. Costs associated with the GSAs portion of the project will be developed during the first 6 months of 2022 and additional funding will be sought if needed.

Figure 4.3-1: Easter Plumas Wildfire Prevention PMA Project Area



4.3.12 Climate Change Impact Assessment

The GSA acknowledges the importance of assessing the impacts of climate change in all aspects of the GSP and providing adaptability to mitigate such effects efficiently and effectively. The significance of these changes has been made ever so clearer during the recent drought in Sierra Valley.

The GSA has simulated a 2030 central tendency, a 2070 central tendency, and two 2070 extreme scenarios (i.e., one drier with extreme warming and one wetter with moderate warming) suggested by the DWR to assess climate change impacts on Basin's sustainability. This approach is consistent with several submitted critical basin GSPs. These simulations are discussed in Section 2.2.3 of the GSP as wells as Appendix 2-7. These scenarios and their impacts on groundwater levels and water budget were extensively discussed at GSA Board and its technical committee meetings and were considered in setting sustainable management criteria and planning the future of the Basin. However, the GSA is aware that these scenarios may not represent the full spectrum of impacts and uncertainty that climate change may impose on the Basin. Due to DWR methodology, it is difficult to assess the impacts of climate change on precipitation patterns, including changes to timing and intensity of precipitation events. It is also important to consider the increasing lengths and severity of droughts and dry years, which this methodology may not represent due to repeating the historical hydrology.

The GSA also acknowledges data gaps and existing uncertainty in its Sierra Valley integrated hydrological model (SVIHM), as outlined in Appendix 2-7. While the model was developed based on the best available science and data and provided a sufficient understanding of Basin conditions, further improvements are needed to conduct climate change studies and simulate future scenarios. GSA has sought to coordinate with local and regional stakeholders in generating and conducting climate change scenarios to include the largest spectrum of expected changes possible. Surface water availability can have significant impacts on the Basin and need to be incorporated into future scenarios.

Conducting such extensive studies needed major enhancements to the SVIHM and significant cooperation from the GSAs and stakeholders that could not fit within the scope of the GSP development. Therefore, a PMA is added to outline the path forward for conducting climate change studies and future scenarios evaluating PMA impacts.

4.3.12.1 Measurable Objective

The climate change impact assessment will improve the understanding of the Basin’s conditions and will enhance integrated hydrological model and projected conditions prioritizing PMAs.

4.3.12.2 Public Noticing

The GSAs would inform the public of project status at the GSAs’ scheduled meetings.

4.3.12.3 Permitting and Regulatory Process

Any permitting or regulatory process required by the project would be conducted by the GSAs. The GSAs would support these processes as necessary.

4.3.12.4 Schedule for Implementation

A plan to evaluate climate change impacts will be developed in the first five years of GSP implementation.

4.3.12.5 Implementation

The project will be implemented in coordination with the GSAs, stakeholders, and state and federal agencies. Climate change impacts will be documented in annual reports and the 5-year GSP update.

4.3.12.6 Expected Benefits

Implementation of climate change impact assessment will ensure the GSAs are identifying and implementing PMAs that address a changing climate.

4.3.12.7 Legal Authority

This MA is primarily implemented through voluntary actions not requiring legal authority on the part of the GSAs.

4.3.12.8 Estimated Costs and Funding Plan

Currently, this project is in the planning phase and funding options will be explored during the first two years of GSP implementation.

4.4 Other Management Actions

Management actions described in Sections 4.2 to 4.4 focus on demand management and maintaining groundwater levels in the SV Subbasin. Other management actions may include projects that indirectly help the GSAs meet the sustainability goals of the SV Subbasin and help the SV Subbasin adapt to future climate conditions.

4.4.1 Future Actions

Future basin actions could include:

1. **Developing a study of the economic impacts of the PMAs included in the GSP**. This would include an evaluation of how implementation of the PMA could affect the economic health of the region and on local agricultural industry. It would also consider the projected changes to the region's land uses and population and whether implementation of these PMAs would support projected and planned growth.
2. **Develop actions to reduce energy use for groundwater pumping.** This would include land repurposing and using solar panels to offset costs of energy used for pumping. To maintain the character of the region, solar installations likely would be limited in scale to power individual wells. It would also include the installation of variable frequency drive pumps in appropriate wells.