Public Review Draft
Section 7 – Projects and Management Actions

Corning Subbasin
Groundwater Sustainability Plan

September 2021

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7 PROJECTS AND MANAGEMENT ACTIONS

7.1 Introduction

This section describes the projects and management actions that will allow the Subbasin to attain and maintain sustainability in accordance with §354.42 and §354.44 of the GSP regulations. In this GSP, the term management actions generally refers to activities that support groundwater sustainability without infrastructure; projects are activities supporting groundwater sustainability that require infrastructure and associated permitting processes to implement (e.g., California Environmental Quality Act [CEQA]).

The general approaches adopted by the projects and management actions in the Corning Subbasin for achieving sustainability revolve around the following:

- Provide for more flexible use of water resources to increase conjunctive use such that groundwater supplies are augmented or conserved to facilitate beneficial use during dry conditions and not worsening current groundwater conditions or impacting beneficial users
- Develop an array of best practices in water management applicable to the Subbasin
- Incentivize beneficial users of water to apply best practices
- Maximize available surface water use to allow for in-lieu recharge of groundwater for Subbasin sustainability
- Set the stage for cooperation and collaboration for local, state, and federal agencies in successful water resources management in the Subbasin

The projects and management actions included in this section outline a potential framework for achieving sustainability. However, several details remain to be negotiated before many of the projects and management actions can be implemented:

- Additional vetting by all necessary stakeholders, since implementing projects and management actions will be a collaborative effort between the GSAs and coordinating partners such as the USBR, TCCA, and local water districts.
- Funding sources will need to be identified as projects and management actions and are likely beyond the agreed-upon scope for funding operation of the GSA, collecting monitoring data, and compiling required reports
- Projects that extend beyond Subbasin boundaries may require additional coordination efforts with neighboring GSAs

The projects and management actions included in this section are supported by the best available information and best available science; however, further information may need to be collected in the implementation period to refine projects and management actions.

The list of projects and management actions included herein will be refined during GSP implementation. Any potential changes to the list of projects and management actions will be reported in annual reports and/or the 5-year GSP update, as appropriate. Not all of the projects and management actions described are likely necessary to attain sustainability. The GSAs will initiate negotiations and discussions regarding specific projects and management actions during the early years of GSP implementation.

Per the GSP Regulations, descriptions of each priority project and management action summarized in the sections below include the following:

- Relevant measurable objectives benefitting from the project or management action
- Description and evaluation of expected benefits
- Circumstances for implementation, including the criteria that would trigger implementation or termination of projects or management actions, public noticing requirements, relevant regulations, and required permits
- Possible implementation schedule
- Legal authority to implement the project or management action
- Estimated costs

The approach to implementing the projects and management actions will provide public entities and individual landowners flexibility in how they manage water and how the Subbasin achieves groundwater sustainability.

7.2 Process for Identifying and Developing Projects and Management Actions

Throughout the GSP development, information was gathered on the current and potential future challenges to maintaining sustainability in the Subbasin. The following subsections describe how information was assessed and compiled to develop a set of applicable projects and management actions that are tailored to the needs of the Subbasin.

7.2.1 Overview of Current and Projected Conditions

General data collection and analysis provided for an overview of current conditions (see Section 3, Basin Setting) and identification of areas of concern that will be the focus of GSP implementation, to make sure Subbasin sustainability is achieved everywhere in the Subbasin, by taking into consideration applicable beneficial users and uses of groundwater. In addition, the simulated projected water budget (see Section 4, Water Budgets) was used to assess projected conditions accounting for historical variations in hydrologic year types, the decrease in surface water use and the increase in groundwater use, and projected climate change. On average, over the 50-year planning and implementation horizon, the model predicts increased pumping and a storage change that goes from net increase to net decrease. In other words, the additional pumping is inducing a negative change in storage, with more outflows than inflows. The additional pumping is predicted to induce increased stream leakage. This information indicates that some areas in the Subbasin need targeted projects and management actions to achieve and maintain sustainability (see Figure 7-1).

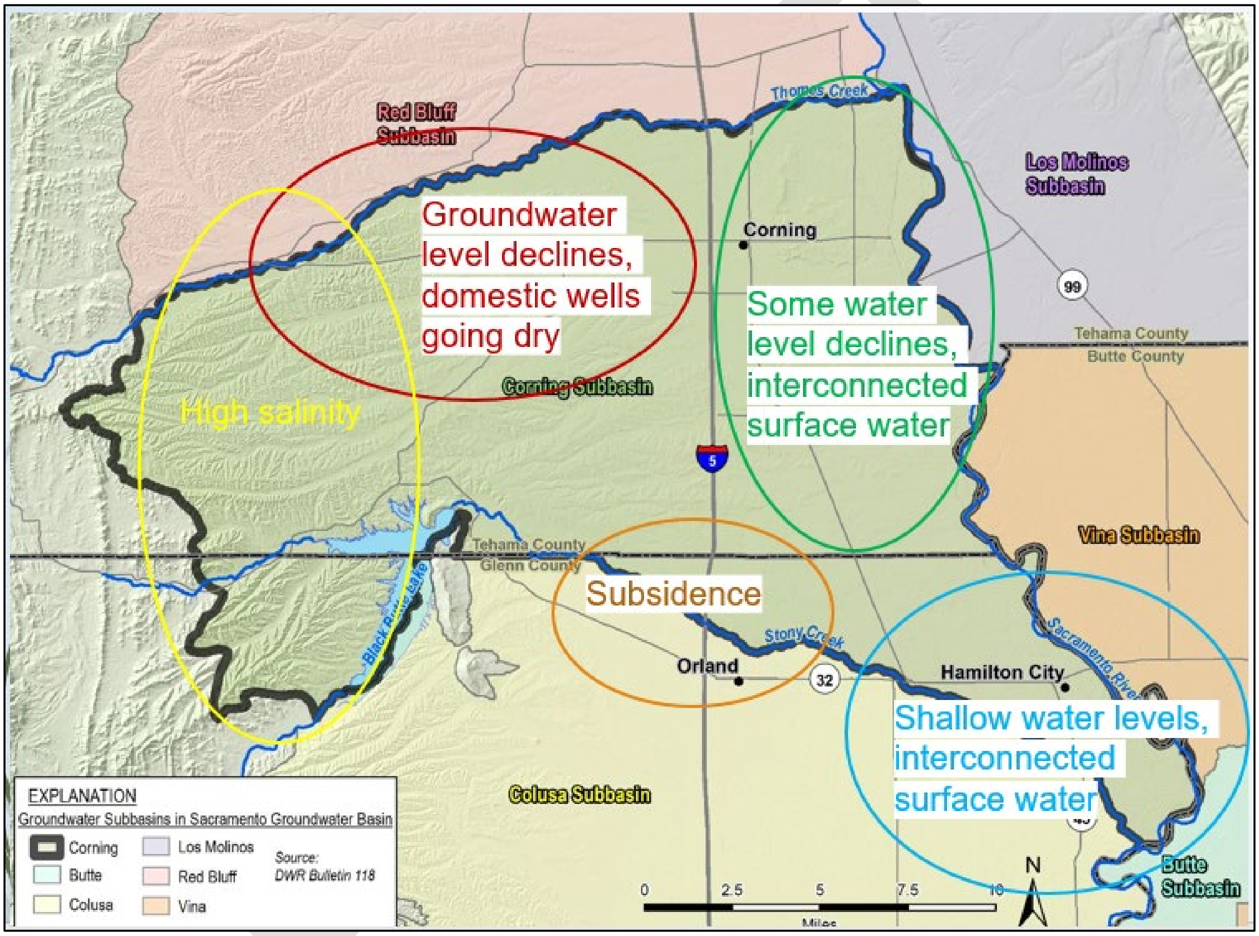

Figure 7-1. Areas Identified with Groundwater Concerns or Protection Needs

7.2.2 Report Reviews

During GSP data collection and background review, a number of applicable reports were identified that could not only provide information on subbasin conditions, but also provide input on past, planned, and potential projects and management actions that had been identified in the Subbasin. These reports included the following:

- Agricultural Water Management Plans developed by Water Districts
- Orland Unit Water Users' Association reports and planning documents
- County Hazard Mitigation Plans
- Tehama County Groundwater Recharge Investigation and Pilot Program Report
- Glenn County Groundwater Reliability and Recharge Pilot Project Summary Report
- County General Plans
- City of Corning General Plan
- Resource Conservation Districts (RCD) Websites and Reports
- Tehama County Watershed Reports

Applicable projects from these reports were compiled for further evaluation.

7.2.3 Stakeholder Outreach and Understanding of Project Needs

A series of outreach calls and interviews was conducted with stakeholders and advisors in the Subbasin to identify water resource management challenges and planned or conceptual projects and management actions that may help with overall subbasin sustainability. Outreach calls and interviews were held with Water District General Managers, the Stony Creek Watermaster, County RCD managers, City of Corning public works staff, University of California – Davis extension specialists and farm advisors, USBR staff, and Farm Bureau representatives. During these calls, past feasibility studies and reports were assessed for current applicability, and additional newer reports and studies were identified to add to the inventory of applicable projects and management actions.

Some of the key items identified during these interviews revolved around the need for:

- Improved surface water reliability in areas that have access to surface water (Water Districts)
- Recharging flood waters
- Identification of areas where supply wells have gone dry and how this could be mitigated
- Land use planning approaches and well permitting
- Invasive species control

7.2.4 Projects and Management Actions Compilation and Prioritization

The information gathered on potential projects and management actions was then compiled into a comprehensive list for evaluation with stakeholders and CSAB members. Project information was categorized based on the type of project or management action, the purpose and description of the project, potential effects on sustainability indicators, and identification of collaborating agencies and potential funding sources. The detailed lists were made available to the public for review and discussed at several CSAB public meetings. Stakeholder feedback was gathered at the public meetings, and CSAB members provided additional input to be considered for prioritization. Several screening criteria were considered at a high level in the general evaluation and prioritization of the projects, such as:

- Cost (capital and operations and maintenance [O&M])
- Recharge benefit and other benefits
- Potential impacts
- Status of implementation (feasibility study, pilot project, permitting, conceptual)
- Water source(s), rights, and legal authority
- Effects on sustainability indicators
- Permitting and regulatory compliance needs
- Administration logistics
- Water availability
- General feasibility
- Public acceptance
- Beneficial users that benefit from the project or management action
- Implementing agency(ies)

The detailed lists of potential projects and management actions that were initially considered and reviewed with the stakeholders and CSAB are provided in Appendix 7A. Additional details on priority management actions and projects are provided in the subsections below. A few primary projects and management actions were identified that addressed concerns for long-term sustainability, as shown on Figure 7-2. There was great emphasis by stakeholders and CSAB members on the need for collaboration with water districts, counties, cities, and USBR, and other agencies, as appropriate. Also, emphasis should be given to incentivizing rather than mandating local users in adapting new approaches to water use and implementing projects.

As such, management actions will be prioritized over projects for early implementation. Many projects described below are in the conceptual phase, and the projects will require additional information gathering and thorough feasibility studies before they can be implemented.

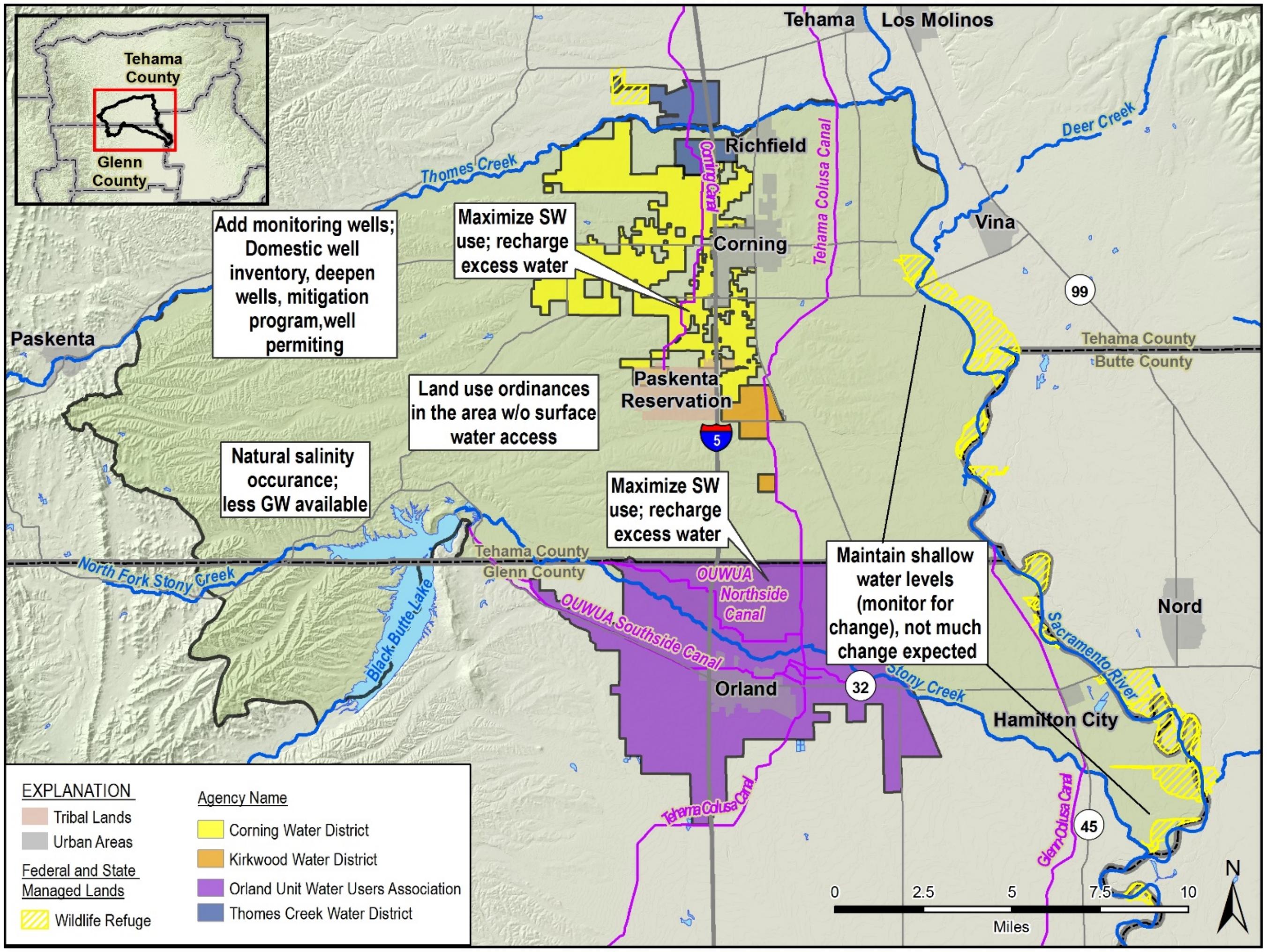

Figure 7-2. General Project and Management Action Categories and Areas of Implementation to Assist with Groundwater Sustainability

7.2.5 Challenges and Opportunities

Stakeholders and CSAB members identified a number of potential challenges that may prevent successful project implementation, as well as opportunities for collaboration (Table 7-1). Additional details on implementation challenges that relate to each specific project are further described in the project descriptions below.

Table 7-1. Challenges and Opportunities for Implementation of Projects and Management Actions

Challenge	Opportunity
Availability and cost of surface water from CVP – current water pricing is prohibiting surface water use	Review pricing structure and collaborate with DWR and USBR on water allocations, water rights, and streamlined permitting processes
Surface water availability for recharge	Identify potential surface water sources for groundwater recharge projects.
Uncontrolled ag growth in areas with insufficient quantity of water (lack of surface water, and declining groundwater levels)	Coordinate with county general planning, ordinance, and well permitting, as well as cities and other agencies with land use planning authority
Grower and beneficial user outreach and education	Collaboration with a variety of partners to improve water management and efficiency for all beneficial uses (UCCE, NRCS, Water Districts, TCCA, USBR, municipal water providers, etc.); take advantage of grant funding and education opportunities

7.3 Management Actions

Management actions are new or revised non-structural programs or policies that are intended to reduce or optimize local groundwater use. Management actions will be implemented as a priority to ensure more sustainable water resources management, on-farm practices, and well permitting. Management actions are generally deemed a locally cost-effective way to achieve and maintain sustainability, prior to developing more costly projects and programs.

7.3.1 Overview of Management Action Types

Five major types of management actions are identified that can be implemented to help the Subbasin achieve sustainability:

1. Water demand management
2. Well management
3. Policy and ordinances that control pumping growth
4. Water transfers / contracting
5. Grower education / best management practices

7.3.1.1 Management Action Type 1: Water demand management

Demand management would decrease the demand for groundwater by completing irrigation system improvements for reduced water loss and reductions of non-beneficial ET, or land idling to eliminate crop evapotranspiration. Reducing demand through irrigation system improvement generally requires that steps be taken to reduce evaporation of applied water or reduce or eliminate applied water that otherwise leaves the Subbasin. Although there are benefits for crop health and yields, reducing the amount of applied water through efficient irrigation also reduces the volume of unintended groundwater recharge, so water savings benefits from irrigation efficiency may not always result in increased water levels or groundwater in storage. This management action type can also be implemented as part of a grower education program, as described below.

7.3.1.2 Management Action Type 2: Well management

Shallow domestic and small agricultural wells have been reported to go dry because of lowering groundwater levels in some parts of the Subbasin and in some dry years. It is important to identify if the reasons for the well impacts are due to 1) well maintenance and construction issues, 2) influence by deeper pumping in the vicinity, or 3) drought conditions. A thorough well inventory of currently used, abandoned, and dry wells will help the GSAs in identifying areas of concern that warrant additional protective measures.

7.3.1.3 Management Action Type 3: Policy and ordinances that control pumping growth

Sustainable groundwater management is inherently linked to land use management. Land use ordinances and other County and City policies can help set limits on future land use to control water demands and pumping growth, commensurate with the sustainable groundwater management goals of the subbasin. In addition, well permitting revisions can help with better well management and protection of nearby wells.

7.3.1.4 Management Action Type 4: Water transfers / contracting

There is limited surface water available in the Subbasin and its reliability can be impacted during dry years, contractual limitations or allocations, or other regulatory constraints. However, CVP contractors in the western Sacramento Valley have been working together to implement water transfers and revise contracts to help efficiently manage the available resources on an annual basis. Long-term planning and incentives to keep more surface water within the Subbasin will help with overall sustainable groundwater management.

7.3.1.5 Management Action Type 5: Grower education / best management practices

Adoption of irrigation best management practices through water management education will help growers make the best use of available water resources and support Subbasin sustainability. Grower best management practices include using irrigation and soil management techniques that use water as efficiently as possible. Incentivizing conjunctive use of surface water and groundwater through grower education is crucial for efficient use of the water resources available in the Subbasin. Conjunctive use means that surface water is used in years it is available so that groundwater can be relied on during times of drought. Currently, groundwater is often the preferred water source for landowners using modern pressurized irrigation systems as it is available on demand, arrives to the surface already pressurized, has substantially less filtration requirements than surface water, and has historically been reliable in quantity and quality. Pumping costs are comparable to surface water costs or, where costs are higher, additional benefit justifies a higher expense. Stressing the importance of conjunctive use through grower education will be critical for Subbasin sustainability.

7.3.2 Priority Management Actions

Based on these general categories, 4 priority management actions summarized in Table 7-2 were identified for achieving sustainability in the Subbasin. These management actions were identified as the most reliable, implementable, locally cost effective, and acceptable options to stakeholders and are described in the sections below.

Table 7-2. Priority Management Actions

Name	Management Action Type	Purpose	Location	Description
Well Management Program	Well management	Better understand domestic and small ag well issues in the Subbasin and protect well owners from future impacts	Entire Subbasin	Includes various projects, incentives, and actions, such as: 1. Compile well inventory 2. Provide education and outreach to well owners 3. Develop a well incident reporting system 4. Establish a well mitigation program
Grower Education	Grower education/best management practices	Grower education relating to on-farm practices for sustainable groundwater management. This includes promoting conjunctive water use and water use efficiency. Provide information on water resource management for more flexible use	Focus on Corning, Thomes Creek, and Kirkwood WDs	Educate growers on the value of using surface water over groundwater when available, replacing inefficient wells, adding organic amendments to improve moisture retention, soil mapping for custom irrigation timing and duration. Explore starting a groundwater users cooperative to coordinate pumping schedules (this could also happen in the Capay Area).
Policies and Ordinances	Policy and ordinances that control pumping growth	Establish water and land use management restrictions on future well pumping and new agricultural growth, for better sustainable groundwater management	Both Counties, start with Tehama County	Establish or revise County well permitting, water use, and land use ordinance or policies to align with GSP.
Use of Full Surface Water Allocation	Grower education/best management practices & water transfers/contracting	Incentivize growers within districts to use all contracted surface water when available in wet years, for better conjunctive use	Water Districts	Implementation-Ready project in Corning WD. Needs infrastructure improvements in OUWUA, Thomes Creek WD, and Kirkwood WD

7.3.2.1 Management Action 1: Well Management Program

This program is aimed at better understanding domestic and small agricultural well issues in the Corning Subbasin to protect well users from potential future impacts. Potential activities that could be part of this program include:

- WELL INVENTORY:
  A more thorough well inventory will be developed that includes information on well location, construction, and use. The GSAs will compile publicly available data from DWR's Well Completion Report Application and SGMA Data Viewer. These applications provide access to a continuously updated dataset that provides a link to the well completion report for each well and information on well use, location, location accuracy, and construction. This dataset will be used to identify domestic wells within the Corning Subbasin. In many cases, well locations are tagged at the center of a PLSS section, and many wells do not have construction information, so additional research needs to be conducted to further refine the data. A previous domestic and irrigation well inventory program in Glenn County began in approximately 2010 and was further refined in 2016-2017 to support an initial Glenn County HCM. This inventory entailed robust quality control and digitization of available well completion reports from the year 1970 forward provided by DWR and Glenn County Environmental Health Department and included GIS placement of each well to at least the Assessor Parcel Number (APN) scale. This project spanned all of Glenn County and therefore overlaps the southern portion of Corning Subbasin. A similar analysis can be extended through the remainder of the Subbasin to detail existing domestic wells within Tehama County as well.

- EDUCATION AND OUTREACH:
  The GSAs and/or other partnering organizations and agencies will provide information and resources to domestic and small agricultural well owners. The information and resources will include guidance and potential funding for well testing, inspection, and replacement. These resources will be targeted to well owners in locations where supply wells have gone dry or have water quality impacts.

- WELL INCIDENT REPORTING SYSTEM:
  The GSAs could assist Tehama County and Glenn County with developing or improving a well incident reporting system in each county. Each county and DWR have basic well incident tracking systems that record reported water supply issues due to wells running dry or other related well maintenance issues such as pump cavitation and air entrainment. This system could be expanded with the help of the GSAs. This interface would facilitate communication with stakeholders and, when combined with groundwater elevation measurements, would allow robust analysis of areas with declining groundwater elevations. Specifically, the counties will use information on groundwater trends to identify areas where wells are likely to have gone dry or have other well impacts,

whereupon communication and outreach could be targeted to owners/drillers of wells in these areas. This system would also provide a way for well owners/drillers to report well problems, allowing the counties to more actively respond and target assistance through the well mitigation program.

- WELL MITIGATION PROGRAM:
  A well mitigation program will be established to address impacted wells. Specific actions that could be implemented by this mitigation program include well deepening, well replacement, or connection to existing public supply networks. Wells requiring mitigation based on specific criteria, may be identified using the well incident reporting system described above. Recommended methodology for developing a well mitigation program including potential cost is presented in Appendix 7B, a document developed by Self-Help enterprises, Leadership Counsel for Justice and Accountability, and the Community Water Center. This document outlines 6 key elements required for a robust mitigation program:

  1. A thorough inventory of active well locations to increase understanding of the distribution and groundwater conditions in at-risk wells

  2. An adaptive management trigger system developed in conjunction with SMC to allow for management to adjust prior to the occurrence of adverse impacts

  3. A drinking water well impact model to quantify understanding of how groundwater elevation and quality declines in monitoring wells may lead to negative impacts in nearby at-risk drinking water wells

  4. Public outreach and education to ensure the public is aware of the mitigation program and its intended benefits

  5. Mitigation measures to adjust groundwater management activities and implement short- or long-term solutions where applicable

  6. Eligibility and access documentation to determine which Subbasin residents are eligible to participate in the mitigation program, well eligibility based on well construction parameters, and protocols to determine potential mitigation actions such as well deepening, repair, or replacement

To confirm that the GSP protects domestic well water availability and quality to the extent practicable, the Plan was reviewed per the "Human Right to Water Scorecard for the Review of Groundwater Sustainability Plans" guidance[1]. This guidance was prepared by a consortium of the Leadership Counsel for Justice and Accountability, California Integrated Water Systems,

[1] https://leadershipcounsel.org/wp-content/uploads/2020/05/HR2W-Letter-Scorecard.pdf

Union of Concerned Scientists, Self-Help Enterprises, Community Water Center, and Clean Water Action to help GSAs address the human right to water in GSPs. Implementation of domestic well management measures described in this section would ensure that the GSP is protective of the human right to sufficient quantity and quality water to meet all beneficial uses, including drinking water supply.

7.3.2.1.1 Relevant Measurable Objectives

Measurable objectives benefiting from improved well management include:

- **Groundwater elevation.** Mitigation and avoidance of wells going dry will help meet the Subbasin sustainability goals.

7.3.2.1.2 Expected Benefits and Evaluation of Benefits

The primary benefit of implementing a well management program is to mitigate impacts to well owners by reducing the number of wells that would be impacted by lowering of groundwater levels. By developing a more complete inventory of wells and identifying the wells more likely to be impacted by lowering of groundwater levels, the GSAs can provide education and outreach to well owners to deepen or replace wells. An improved dry well reporting system would facilitate this targeted outreach. The well mitigation program would help identify and avoid impacts to well owners.

7.3.2.1.3 Circumstances for Implementation

Since domestic and small agricultural wells are already experiencing challenges in the Subbasin, this program will be implemented immediately upon adoption of the GSP. The well mitigation program will rely on the cooperation of well owners to share their information with the GSAs. Collaboration with organizations such as Rural Community Assistance Corporation (RCAC) and Self-Help Enterprises would help foster relationships between the GSAs and local well owners to help with development of future outreach, education, and mitigation programs.

7.3.2.1.4 Public Noticing, Permitting, and Regulatory Process

Information about this program will be shared with stakeholders through the GSAs' e-mail lists, will be posted on the GSP website, and information will be available at GSA offices. In addition, water districts, and other local agencies will be asked to help spread the word to domestic and small agricultural well owners. Well deepening or replacement would require a well permit from the respective county. No other permitting or regulatory requirements are anticipated to implement this management action.

7.3.2.1.5 Implementation Schedule

A general schedule to implement the domestic well management program is outlined below. It should take approximately 3 years to build the well mitigation program after which it will be used and maintained annually during the GSP implementation process.

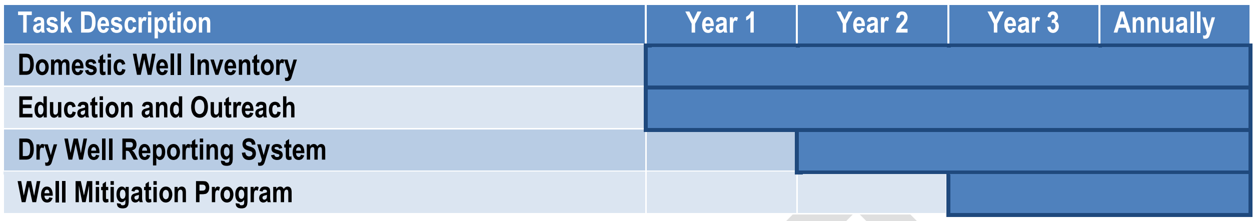

Figure 7-3. Domestic Well Management Implementation Schedule

7.3.2.1.6 Legal Authority

No legal authority is needed to implement a well management program.

7.3.2.1.7 Estimated cost

The total cost of the well management program is expected to be proportional to the expansion of the program over time. Costs will be developed and described in the GSP annual reports as specific activities are planned and implemented. The initial annual cost for grower education and outreach on well management is estimated to be $100k per year, for developing the well inventory and dry well reporting system is a $150k one-time cost, and implementing the well mitigation program is $500k per year.

7.3.2.2 Management Action 2: Grower Education Relating to On-Farm Practices for Sustainable Groundwater Management

The purpose of this management action is to provide research, education, and outreach to growers on the following topics: on-farm - groundwater management nexus, essential water use terms, the promises and pitfalls of irrigation efficiency, and on-farm practices for sustainable groundwater management. This section summarizes the main concepts related to grower education with additional detail of grower education topics and implementation practices provided in Appendix 7C.

Groundwater sustainability is inextricably connected to the on-farm water management decisions that growers make. The aquifers in which groundwater is stored and transmitted are dynamic systems that are directly impacted by conditions on the land surface. The water sources that growers use, the irrigation practices they apply, and the many other agronomic decisions they make can have impacts on groundwater quantity and quality.

This management action for the Subbasin will be comprised of a grower outreach program that will inform and educate growers about opportunities and resources to support groundwater sustainability through their on-farm practices, while also maintaining or improving agricultural productivity. Implementation of these on-farm practices will be recorded, along with estimated or measured benefits to groundwater sustainability resulting from these practices. Topics identified for the grower education program are summarized in Appendix 7C.

The 4 categories of on-farm management actions for sustainable groundwater management are:

1. Maximizing the use of surface water. This allows for less groundwater pumping and promotes in-lieu recharge.
2. Managing soils to improve infiltration and root zone soil moisture storage. This will allow crops to more effectively use precipitation and reduce the need for irrigation.
3. Reducing (and minimizing) non-beneficial ET. This could be accomplished through precision irrigation scheduling, switching from flood irrigation to micro-irrigation when appropriate, and practicing regulated deficit irrigation.
4. Establishing a groundwater user cooperative. This cooperative will coordinate agricultural pumping schedules to lessen the stress on the aquifer due to concentrated pumping in an area.

In aggregate, these practices will promote sustainable groundwater management throughout the Subbasin. The GSAs will consider forming an On-Farm Working Group to facilitate communication with growers during GSP implementation.

7.3.2.2.1 Relevant Measurable Objectives

The measurable objectives benefiting from grower education include:

- **Groundwater elevation.** BMPs that promote less pumping will result in higher groundwater levels.
- **Groundwater storage.** Groundwater in storage is directly related to groundwater levels, so higher groundwater levels will help achieve long-term sustainable yield.
- **Land subsidence.** BMPs that reduce the pumping stress on the local aquifer(s) thereby reduce the potential for subsidence.
- **Interconnected surface.** Conjunctive use of water resources lessens the burden of groundwater-pumping induced streamflow depletion.

7.3.2.2.2 Expected Benefits and Evaluation of Benefits

The primary benefit of implementing an outreach and education program is to provide the latest technologies and opportunities to modify agricultural practices that would allow farmers to optimize their operations. This program could also be a mechanism for securing grant opportunities, funded through the GSAs to identify pilot programs and other innovative technological advancements that could provide an overall groundwater basin benefit.

Implementation of grower education activities is expected to benefit all of the relevant measurable objectives. Encouraging growers to implement on-farm water management practices that maximize surface water use, reduce non-beneficial evapotranspiration is expected to provide in-lieu recharge benefits to the groundwater system, which helps mitigate depletion of surface water and subsidence caused by groundwater pumping. Encouraging soil management to enhance infiltration is expected to enhance direct groundwater recharge. Both in-lieu and direct recharge are anticipated to benefit groundwater levels and groundwater storage.

7.3.2.2.3 Circumstances for Implementation

The circumstance for implementation is for willing farmers to participate in an education and outreach program and to work with the GSAs to identify opportunities. No other triggers are necessary or required.

GSAs will implement the grower education program by planning, preparing, and conducting outreach efforts related to the topics above. Outreach efforts may include seminars, trainings, workshops, and publications on topics related to on-farm water management and groundwater sustainability.

As GSAs begin to conceptualize and implement specific grower education programs and tools, they may consider partnering with local grower groups, educational and agricultural extension professionals, and others who are experienced in grower outreach and are knowledgeable about local agricultural practices. Potential agencies and groups that GSAs may consider partnering with are:

- University of California Cooperative Extension (UCCE; formerly the Farm and Home Advisor)
- County RCDs
- NRCS
- California State University, Chico (Chico State)
- University of California, Davis (UC Davis)
- Farm Bureau

Staff and researchers at UCCE, Chico State, and UC Davis regularly partner with counties and other local agencies to conduct applied research and education programs throughout California.

7.3.2.2.4 Public Noticing, Permitting, and Regulatory Process

Public outreach would be a key component of a grower education program. The public and other agencies will be notified of planned grower education activities through outreach and communication channels. There are no anticipated permitting or regulatory processes that would affect the grower education program.

7.3.2.2.5 Implementation Schedule

Implementation of grower education programs is anticipated throughout GSP implementation, with planning efforts beginning the first year of GSP implementation. Over time, programs will be tailored to reflect current technologies and best practices in on-farm water management, especially as the GSAs' understanding of groundwater conditions in the Corning Subbasin grows. A general implementation schedule for grower education programs is presented on Figure 7-4.

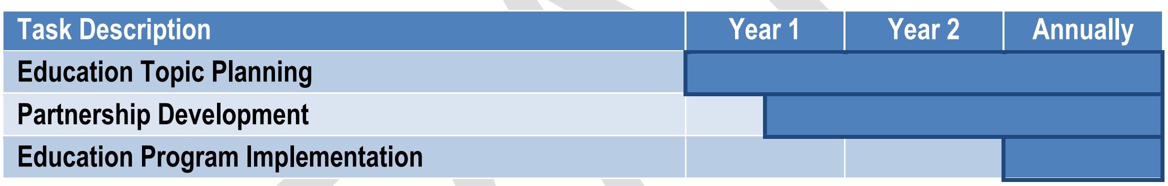

Figure 7-4. Grower Education Program Implementation Schedule

7.3.2.2.6 Legal Authority

GSAs have the authority to plan and partner with other groups to implement grower education activities.

7.3.2.2.7 Estimated Cost

The total cost of the grower education program will vary depending on the types and extent of educational outreach. Grower outreach and education through social media communication may be inexpensive, while seminars, trainings, workshops, and publications will likely incur planning and development costs. Total costs are expected to be proportional to the expansion of the education program over time. Costs will be developed and described in the GSP annual reports as specific education activities are planned and implemented. The initial estimated cost for grower education and outreach is $100k per year.

7.3.2.3 Management Action 3: Policies and Ordinances

Policies and ordinances pertain to County or GSA actions such as land use change restrictions, well permitting modifications, or water use ordinances. Land use restrictions and well permitting fall under the purview of the County (planning department and environmental health department, respectively), while water use ordinances and policies can be adopted and implemented by the GSAs per their statutory role. The GSAs will actively work with land use planners and well permitting entities in their respective counties to develop and/or suggest policies and ordinances that would help manage groundwater sustainably.

One example of revised policies for sustainable groundwater management is a revised well permitting process that considers groundwater levels, sustainable management criteria, nearby wells, and well construction details when permitting new wells. Tehama County has started discussion and development of a well permit modification process, whereby certain areas within the Subbasin that show vulnerability to groundwater sustainability due to declining groundwater levels, lack of surface water, or rapid expansion of agricultural lands, would necessitate additional well permitting requirements in order to get permitted. Glenn County is also considering a similar well permitting modification. In addition, all new wells permitted within Glenn County that are larger than 6 inches in diameter, are required to install a well meter. Potential requirements around this Tehama County well permit registration activity include:

- Well data tracking
- Domestic well management
- Design criteria for new agricultural wells
- Requirements for deeper seals and/or placement of well seals at certain depths
- Restrict new pumping in specific areas

A similar approach could be developed for Glenn County.

7.3.2.3.1 Relevant Measurable Objectives

The measurable objectives benefiting from updated policies and ordinances include:

- **Groundwater elevation.** Policies and ordinances that promote less pumping will result in higher groundwater levels.
- **Groundwater storage.** Policies and ordinances that reduce pumping contribute to increasing groundwater elevations. In turn, groundwater in storage will also increase and will help achieve long-term sustainable yield.
- **Land subsidence.** Policies and ordinances that reduce pumping stress on the local aquifer(s) thereby reduce the potential for subsidence.

- **Interconnected surface water.** Policies and ordinances that reduce pumping stress on the local aquifer(s) thereby reduce the depletion of interconnected surface waters.

7.3.2.3.2 Expected Benefits and Evaluation of Benefits

Policies and ordinances regarding land use restrictions (such as to curb new agricultural growth expansion), water use (such as pumping restrictions during certain water year types), and well permitting (to reduce effects in shallow wells), all provide benefits to beneficial users and uses in the Subbasin by reducing pumping growth and lessening the impacts on all well owners.

7.3.2.3.3 Circumstances for Implementation

The GSA staff plan to initiate conversations with land use planning and well permitting entities within Glenn and Tehama Counties to share information and discuss potential policy and ordinance changes early in the GSP implementation process. These management actions will continue to be pursued throughout GSP implementation.

7.3.2.3.4 Public Noticing, Permitting, and Regulatory Process

Any policy or ordinance change will need to follow strict public meeting and noticing requirements, pursuant to the Ralph M. Brown Act. The GSA will follow proper permitting and regulatory processes for implementing policy changes.

7.3.2.3.5 Implementation Schedule

The Tehama County revised well permit registration process will be finalized within 1 year after GSP submittal. A schedule for additional land use, water use, and well permitting policy changes will be developed during GSP implementation and provided in annual GSP updates.

7.3.2.3.6 Legal Authority

The GSAs will coordinate with the Counties for any action that falls under the County jurisdiction and may affect GSP implementation or groundwater sustainability.

7.3.2.3.7 Estimated Cost

The costs for this management action will be determined based on the policy or ordinance that is implemented and will be developed as more specific items are developed.

7.3.2.4 Management Action 4: Use of Full Surface Water Allocations

The use of the full surface water allocations available to Water Districts in the Subbasin would improve conjunctive use of water resources and improve overall stability of water levels and access to groundwater in times of drought.

Surface water use in the Subbasin has declined since the last major drought from 2012-2016, in response to surface water availability challenges and increased grower preference for groundwater use, due in part to investments made in wells. Currently, approximately 40% of the Subbasin's irrigated area has access to surface water supplies, with major active purveyors including OUWUA through the Orland Project and Corning WD, Thomes Creek WD, and Kirkwood WD through CVP contracts and surface water deliveries by the TCCA (Figure 7-5). If these purveyors were able to ensure full utilization of their contracted surface water allocations in wet and above normal years, it would improve the Subbasin's overall water balance and lead to recovery or stabilization in groundwater levels. In 2014 and 2015 the CVP-contractors in the Subbasin received none of their surface water allocations, causing growers that relied on surface water to install groundwater production wells or fallow their fields. Since the 2012-2016 drought, growers have continued to use their wells rather than return to surface water irrigation due to surface water reliability, increasing surface water cost, investments made in infrastructure and systems to support using a groundwater well for irrigation purposes, and high costs for setting up a dual water source system for surface water and groundwater irrigation.

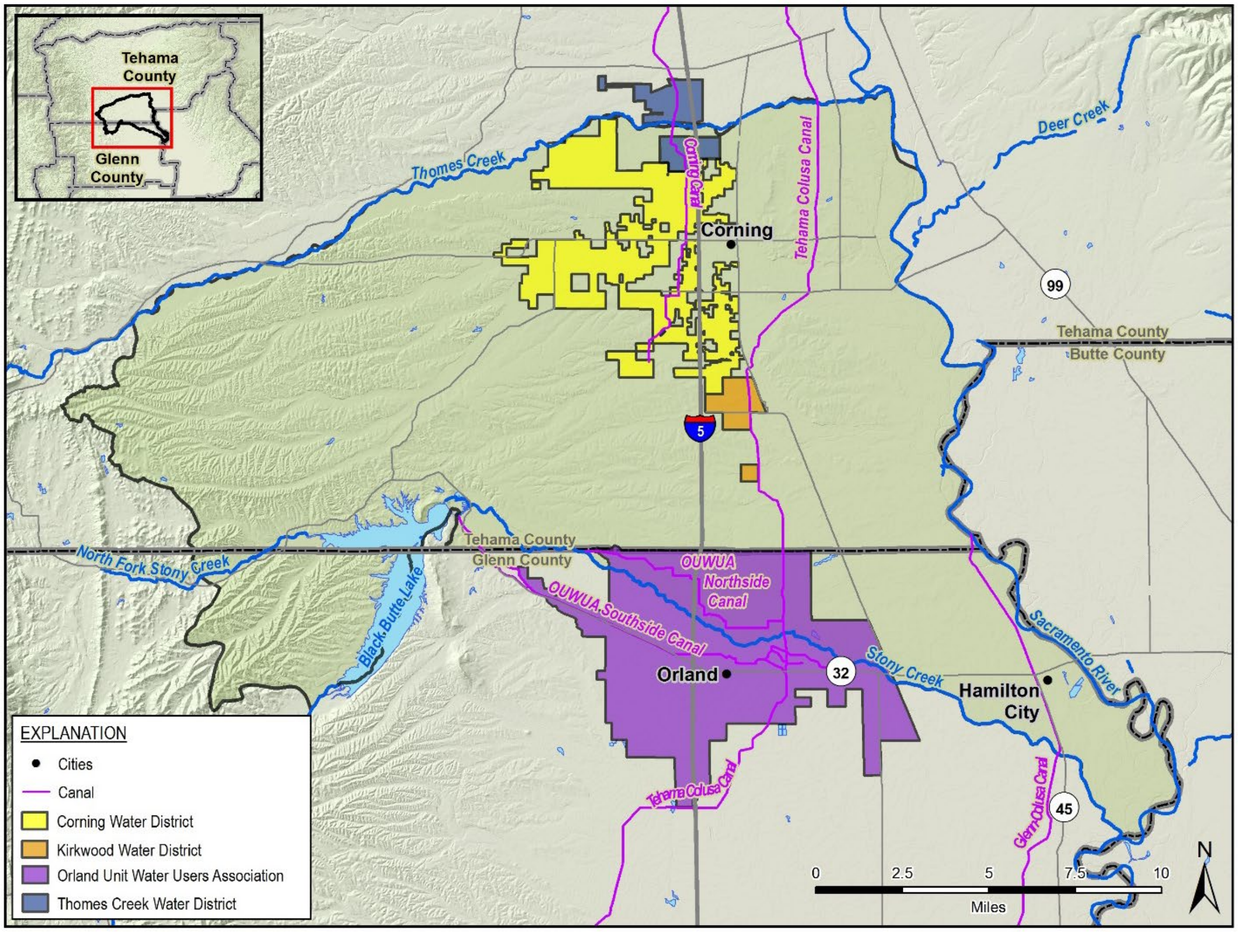

Figure 7-5. Active Water Districts and Canals in Corning Subbasin

7.3.2.4.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from use of the full surface water allocation include:

- **Groundwater elevation.** Surface water use in-lieu of groundwater will result in less groundwater pumping and higher groundwater levels.
- **Groundwater storage.** Surface water use in-lieu of groundwater contributes to increasing groundwater elevations, increased groundwater in storage, and will help achieve long-term sustainable yield.
- **Land subsidence.** Surface water use in-lieu of groundwater reduces the potential for subsidence caused by groundwater pumping.
- **Interconnected surface water.** Surface water use in-lieu of groundwater reduces the pumping stress on the local aquifer(s) and thereby reduces the depletion of interconnected surface waters.

7.3.2.4.2 Expected Benefits and Evaluation of Benefits

Expected benefits from project implementation were evaluated using a groundwater model scenario that aims to simulate effects of Water Districts utilizing their full surface water allocations in the future. The simulation approach and results of this Full Allocation Scenario (FAS) is described in detail in Appendix 7D. The FAS simulation results in a 10,500 AF decrease in annual groundwater pumping compared to the projected baseline scenario. This decrease in pumping produces an average of 900 AF/yr of additional groundwater storage, building to an additional 42,700 AF of cumulative groundwater storage after 50 years of simulation. This increase in storage increases the groundwater levels by up to 20 feet in portions of the Subbasin in Corning WD where groundwater level trends have been declining since 2012. Reduced groundwater pumping, positive change in groundwater storage, and increased groundwater levels also have positive benefits on the land subsidence and interconnected surface water sustainability indicators.

This project assumes the preservation of current surface water allocations for the active water districts within the Subbasin. If surface water allocations for one or multiple districts are lowered in the future, the expected benefit of this project will be decreased.

7.3.2.4.3 Public Noticing, Permitting, and Regulatory Process

There are no public noticing, permitting, or regulatory requirements for the Water Districts to use their full surface water allocations.

7.3.2.4.4 Circumstances for Implementation

Increased use of surface water allocations can be implemented immediately as no new surface water right must be acquired. There are some challenges and costs associated with utilization of additional surface water in some areas, primarily related to additional filtration and installation of pressurization required to utilize surface water. The increased cost of CVP water is also a factor. The GSAs will collaborate with the Districts to support use of existing surface water allocations as funds become available and specific plans begin to form. No additional circumstances for implementation are necessary.

Coordination with USBR and existing active water districts, namely Corning WD, Thomes Creek WD, Kirkwood WD, and OUWUA, will be crucial to the success of this project. Grower education within the Water Districts will be needed for successful implementation of conjunctive use of surface water and groundwater. Corning WD has installed pressurized irrigation systems in most of their district for using surface water to source drip irrigation systems. The OUWUA and other Water District irrigation systems are not pressurized so would need significant upgrades to use surface water in lieu of groundwater for supplying drip irrigation. The cost to install and operate pressurized systems could be prohibitive.

7.3.2.4.5 Implementation Schedule

Use of full surface water allocations may theoretically begin immediately in the Corning WD since their infrastructure has been updated. It is anticipated that a period of up to 5 years may be required to implement additional infrastructure changes required to facilitate this management action in Thomes Creek WD, Kirkwood WD, and OUWUA. Implementation may also vary according to existing district surface water infrastructure. A more concrete implementation schedule for this effort will be initiated as soon as funds and stakeholder buy-in allows. After initial infrastructure improvements are completed, additional efforts are not anticipated beyond routine operations and maintenance activities.

7.3.2.4.6 Legal Authority

The GSAs will collaborate with the water districts and USBR to follow legal authority regarding utilization of surface water allocations and construction of surface water infrastructure, as needed.

7.3.2.4.7 Estimated Cost

The estimated cost of utilizing surface water, as opposed to groundwater, has been estimated by Corning WD in previous annual reports and water management plans (Corning WD, 2009; Corning WD, 2017; Davids Engineering, 2020). Table 7-3 below summarizes the agricultural groundwater and surface water costs to Corning WD growers in previous years. Total approximate surface water costs to the grower have gradually risen over the past 10 years. In addition, surface water use may entail further expenses such as secondary filtration, further adding costs to the Water Districts and/or grower (Section 7.3.1.3). Trends in groundwater and surface water costs to Corning WD growers are likely mirrored in the Subbasin's other water districts.

Despite costs being roughly equivalent or slightly greater than surface water, groundwater use is typically more flexible and reliable. Groundwater can be pumped at any time for immediate availability for frost protection and early or late season irrigation and does not typically require additional filtration. The slightly lower cost of surface water is outweighed by the flexibility and reliability of groundwater.

Table 7-3. Agricultural Groundwater and Surface Water Costs to Corning WD Growers

Annual Report Year	Approximate Groundwater Cost per acre-foot	CVP Surface Water Cost per Acre-Foot	Corning WD Fees	Total Approximate Surface Water Cost to Grower per acre-foot
2009	-	$45	$7.40 or $10.41*	$52.40 or $55.41*
2017	$70-$100	$45	$19	$64
2019	$70-$100	$57**	$18	$75

* Dependent on acreage

**CVP cost backed out from total costs to grower and Corning WD Fees

7.4 Projects

Projects involve new or upgraded infrastructure to improve sustainable groundwater management in the Subbasin. Several potential projects that are currently being pursued by other agencies are included in this GSP. Most of the projects are still at the conceptual level and will require additional development and feasibility studies during Plan Implementation.

The GSAs compiled a list of potential projects based on prior planning efforts conducted in the Subbasin, meetings with stakeholders, and feedback from the public. The list of all potential projects for the Subbasin is in Appendix 7A. The project list was narrowed by cost effectiveness and likelihood of implementation. The GSAs selected 8 priority projects for further consideration based on the projects being the most reliable, implementable, locally cost-effective, and acceptable to stakeholders. A subset of these priority projects will be implemented by the GSAs or partner agencies during the SGMA planning horizon between 2022 and 2042. Alternative projects are lower priority concepts that may be implemented based on the need for additional measures to achieve sustainability.

In summary:

- **Priority Projects**: The priority projects are the projects with the most potential per the selection criteria, that could be implemented under the GSP. However, not all Priority Projects may be required depending on final benefit of each project.
- **Alternative Projects:** The alternative projects are the generally less cost-effective or less-developed projects. Depending on the efficacy of the priority projects, one or more of the alternative projects may be implemented to meet the SMCs. Alternative projects are described at a higher level, to be considered during GSP implementation.

Each of the projects listed below should be treated as a generalized project representative of a range of potential project configurations. Details of the projects including facility locations, pipeline routes, recharge mechanisms, and other details may change in future analyses and planning efforts.

7.4.1 Overview of Project Types

Priority and alternative projects described in this section generally fall into one of three primary types or mechanisms that promote or enhance sustainable groundwater management: Direct recharge, in-lieu recharge, and reduction of non-beneficial evapotranspiration (ET).

7.4.1.1 Project Type 1: Direct Recharge

Direct recharge of aquifers can be done through percolation of water in recharge basins or using injection wells to inject water directly into the groundwater basin. Intentional, direct recharge is commonly referred to as Managed Aquifer Recharge (MAR), or Flood-Managed Aquifer Recharge (Flood-MAR) if recharge is done with flood water. Several of the projects listed in this section fall into this project type. Potential sources of water to be used for direct recharge projects are summarized in Appendix 7E.

Groundwater recharge projects can be coupled with flood risk reduction benefits to increase groundwater storage and decrease flood risks in the Subbasin. These types of projects include levee setback, river restoration, managed aquifer recharge using flood flows (Flood-MAR), improved stormwater management, and runoff reduction through watershed fire damage restoration.

Recharge basins are large artificial ponds that are filled with water that seeps from the basin into the groundwater system. Recharge efficiencies can range greatly, and the recharge efficiency of a recharge basin is contingent on the properties of the underlying soil, losses to evaporation, and potential seepage into streams or shallow sediments before it can recharge the deeper aquifers. Injection wells can be used to inject available water supplies directly into the groundwater basin. Injection can occur year-round, including during the rainy season. Injection wells are typically more efficient at raising groundwater elevations than recharge basins because they target specific aquifer zones. Although they have a very high efficiency, injection wells are generally more expensive to operate than recharge basins. They may require storage ponds to temporarily hold water prior to injection. Additionally, injection wells require higher quality water than recharge basins and permitting requirements are more extensive.

In addition, dry wells can be used to collect and store stormwater runoff in urban areas.

7.4.1.2 Project Type 2: In-lieu Recharge

The practice of using surface water supplies to meet crop water demands instead of pumping groundwater is referred to as in-lieu recharge. This practice reduces groundwater extraction and allows the groundwater basin to recharge naturally. In-lieu recharge is the primary mechanism of "conjunctive use" whereby surface water is used when available (generally in wet year types) and groundwater is used in dry years.

Groundwater is often the preferred water source for landowners using modern pressurized irrigation systems as it is available on-demand, arrives to the surface already pressurized, has substantially less filtration requirements than surface water, and has historically been reliable in quantity and quality. Additionally, depths to groundwater in areas of the Subbasin are relatively shallow and thus pumping costs are low. In contrast, existing surface water suppliers are generally limited by infrastructure capacity to provide water to their users on a rotational or arranged demand schedule, both of which do not provide the same convenience and flexibility as private groundwater pumping. However, improved conveyance systems, irrigation infrastructure modernization and grower education can increase the level of water delivery service (flexibility in frequency, rate, and duration) offered by water districts and incentivize conjunctive use. Full use of available allocated surface water would help provide in-lieu groundwater recharge in the Subbasin where surface water is available.

Incentivizing surface water use for in-lieu recharge projects can be difficult because there are several significant advantages to groundwater pumping for growers.

7.4.1.3 Project Type 3: Reduce non-beneficial ET

Many of the irrigation canals and streams that provide natural recharge and habitat in the Subbasin are overgrown with arundo and other invasive plants that transpire water intended for crop irrigation. Removal of invasive, high water using plants from surface water features in the Subbasin would increase water available for irrigation, recharge, or other uses.

7.4.2 Assumptions used in developing projects

Assumptions and issues for each project need to be carefully reviewed and revised during the pre-design phase of each project. Project designs, and therefore costs, could change considerably as more information is gathered.

The cost estimates included below are order of magnitude estimates. These estimates were made with little to no detailed engineering data. The expected accuracy range for such an estimate is within +50% or –30%. The cost estimates are based on perception of current conditions at the project location. They reflect professional opinion of costs at this time and are subject to change as project designs mature.

7.4.3 Priority Projects

The priority projects are summarized in Table 7-4. Short descriptions of each priority project are included in the sections below. Generalized costs are also included for planning purposes.

Table 7-4. Priority Projects

Project Name	Project Type	Purpose	Location	Project Development Status
OUWUA Infrastructure Improvements for In-Lieu Recharge	In-lieu groundwater recharge	Improve surface water conveyance and irrigation infrastructure for surface water use in lieu of groundwater pumping	Orland Project Area	Pre-Design/Planning Stage
Regional Surface Water Transfers for In-Lieu Recharge	In-lieu groundwater recharge	Incentivize the use of surface water within the subbasin by transferring water into the Subbasin from other CVP districts	Water Districts	Implementation-Ready
Invasive Plant Removal	Reduction of Non-Beneficial ET	Invasive plan removal to reduce shallow groundwater use and restore native habitat	Focus on Stony Creek	Pre-Design/Planning Stage
Groundwater Recharge through Unlined Conveyance Features	Direct Groundwater Recharge	Groundwater recharge through unlined canals and natural drainages	Tehama County	Conceptual
Off-stream Surface Water Storage	In-lieu groundwater recharge	Off-stream temporary storage of flood waters on private lands	Outside District Areas - Tehama County	Conceptual
Recycled Water Use for Irrigation	In-lieu groundwater recharge	Recycled water program for treated wastewater (Corning and Hamilton City)	City of Corning/ Hamilton City	Conceptual
City of Corning Stormwater Recharge	Direct Groundwater Recharge	City of Corning stormwater improvements/groundwater recharge	City of Corning	Pre-Design/Planning Stage

7.4.3.1 Priority Project 1: OUWUA Infrastructure Improvements for In-Lieu Recharge

The OUWUA Infrastructure Improvements for In-Lieu Recharge project goal is to modernize infrastructure and add management tools necessary to support and promote expanded surface water use for irrigation in lieu of groundwater pumping. The project incentivizes existing surface water users to continue using surface water for modern pressurized irrigation systems. The goal of the project is to maximize the use of surface water on lands within the OUWUA service area and potentially on neighboring lands within the context of strategic annexations.

The In-Lieu Recharge project would include infrastructure modernization that would be planned, designed, and implemented over time per a strategic phasing plan. The modernization project for this Subbasin is focused on OUWUA's Northside service area and is guided by four broad objectives:

1. Maintain and enhance the reliability and utilization of the surface water supply to promote long-term sustainability of and access to groundwater for agriculture production, domestic, and urban uses in dry years.
2. Modernize infrastructure that has reached the end of its useful life, become obsolete, or does not support current and future water management initiatives
3. Expand data collection and data management within OUWUA to support modernization, planning, and water management best practices
4. Increase knowledge of OUWUA water users and staff and support initiatives (by OUWUA and others) regarding conjunctive use, groundwater conditions, water use efficiency, and best management practices

The scope of this project only includes lands within the Subbasin, that are irrigated by the Northside canal. Should a similar project be undertaken within the Southside service area, in the neighboring Colusa Subbasin, the two neighboring GSAs will coordinate with OUWUA for efficiency.

The broadly defined objectives of the project are developed in large part based on past work that the OUWUA has completed or been involved in, including:

- 2003 CALFED Modernization (Planning Study)
- 2003, 2006 Stony Creek Fan Report
- 2005 ITRC Orland Unit Water Users' Association Modernization Plan and Specifications
- Orland Project Regulating Reservoir and Associated Canal Improvements
- 2016 ITRC Rapid Appraisal
- Northside Phase 1 Modernization (Completed)

- Northside Phase II Modernization (Conceptual).
- On-Canal Pump Turnout Policy
- Lateral Pipeline Conversion in Urban Areas (On-Going)
- 2017 AWMP

The Program is formulated around the following 6 focus areas or project concepts that would improve OUWUA's ability to increase delivery flexibility with the objective of increasing in-lieu recharge. More details on the OUWUA projects are provided in Appendix 7F.

1. Northside Phase II Modernization Project

The Northside Distribution System Improvement Project would combine a regulating reservoir with improvements to lateral headings and the Northside main canal (Laterals 100 and 130). The improvements would pass flow adjustments from the lateral headings to regulating reservoirs to minimize system spillage while enabling system operators to provide additional delivery flexibility to growers.

2. Lateral Pipeline Conversions

OUWUA delivers water to its water users on a rotational basis whereby each water user receives water on a set interval, typically 12-14 days, that varies by water availability. Converting certain lateral canals to closed, gravity pressurized pipelines that can be left charged would enable increased flexibility and reduced operations cost and effort to accommodate this flexibility.

3. Data Collection and Management

This project would include the expansion of the OUWUA's existing SCADA system with additional monitoring locations to inform operations and to maximize the benefits of the modernized infrastructure.

4. Tehama-Colusa Canal Interties

This project would formulate and effectuate an agreement between OUWUA, the TCCA, and the USBR to allow OUWUA to utilize the Tehama-Colusa Canal as an intertie conveyance between its Northside laterals and also to its Southside service area. This would enable surpluses to be discharged to the canal and either conveyed to other lateral systems or exchanged as credit to meet demands elsewhere in the OUWUA. The canal connection could also facilitate future water transfers to other CVP contractors. OUWUA is currently in discussion with USBR to take title of the Orland Project facilities and allow for revenue generation through the transfer and sale of surplus water.

5. Potential Land Annexations

This project would consider existing or future annexations and consider opportunities to expand surface water delivery service to areas that currently rely on groundwater.

6. Grower Outreach and Education

Educating existing water users and growers on the modernization initiatives and delivery service offerings is essential to encouraging conjunctive use. Outreach and education would be conducted by OUWUA staff with support from local agencies and technical consultants. Additional details on such a grower education program are provided in Management Action 2 above.

7.4.3.1.1 Relevant Measurable Objectives

The relevant measurable objectives benefiting from this project are:

- **Groundwater elevation.** Surface water use in-lieu of groundwater will result in less groundwater pumping and higher groundwater levels.
- **Groundwater storage.** Surface water use in-lieu of groundwater contributes to increasing groundwater elevations, increased groundwater in storage, and will help achieve long-term sustainable yield.
- **Land subsidence.** Surface water use in-lieu of groundwater reduces the potential for subsidence caused by groundwater pumping.
- **Interconnected surface water.** Surface water use in-lieu of groundwater reduces the pumping stress on the local aquifer(s) and thereby reduces the depletion of interconnected surface waters.

7.4.3.1.2 Expected Benefits and Evaluation of Benefits

The proposed project, in its entirety, is estimated to facilitate increased conjunctive use in the OUWUA resulting in approximately 12,000 to 25,000 AF/yr of additional surface water use in-lieu of groundwater pumping. This in turn would increase groundwater levels and groundwater in storage. More than half of OUWUA water use is in the Colusa Subbasin to the south. Since the OUWUA is along an interconnected stream (Stony Creek) and near an area of known subsidence centered in the Colusa Subbasin, preventing groundwater level declines through in-lieu groundwater recharge would benefit both of these sustainability indicators.

7.4.3.1.3 Public Noticing, Permitting, and Regulatory Process

A planning study and preliminary design phases would be required to refine the defined projects, project features, costs, and benefit. Implementation would be contingent upon this planning stage, and also on final permits and environmental approvals. The following permitting agencies would be involved in project implementation: USBR, USACE, CDFW, USFWS, TCCA, SWRCB, RWQCB, and Glenn County. OUWUA would be the project owner. The project would require environmental clearance at the Federal level (National Environmental Policy Act [NEPA]) and at the State level (CEQA).

OUWUA currently participates or initiates discussions with the USACE, the USBR, and other agencies to evaluate policies that limit OUWUA's flexibility in delivering and storing water. Part of these negotiations include OUWUA having the ability to transfer water through the TCCA. Such action, however, will require Congressional authorization.

7.4.3.1.4 Circumstances for Implementation

This project is considered a priority project and the GSA and OUWUA would seek to implement all or parts of the project as soon as financially and legally possible. The GSAs and OUWUA will seek funding sources and continue dialogue with the TCCA and USBR partners necessary to implement the project. Should the costs outweigh the benefits to the extent that the project is not practical for immediate implementation, the project may be initially implemented on a smaller scale and expanded over time.

7.4.3.1.5 Implementation Schedule

Implementation of this project would require up to 6 years to plan, design, permit, and construct (Figure 7-6). Implementation may be expedited if a single funding source can be readily identified or extended if the project must be phased according to available funds.

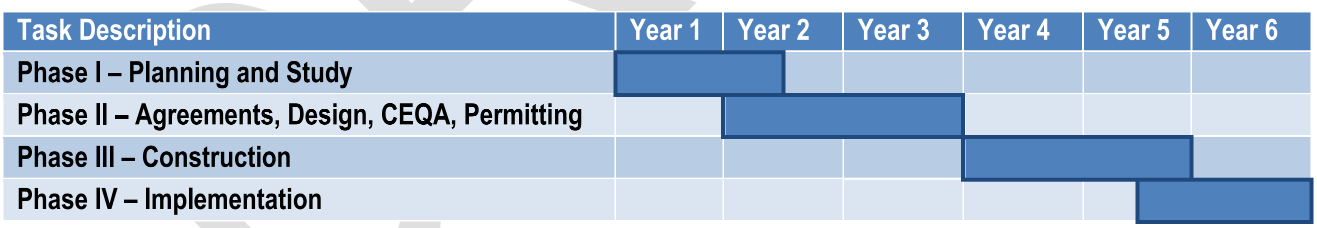

Figure 7-6. OUWUA Modernization Implementation Schedule

7.4.3.1.6 Legal Authority

The OUWUA Orland Project infrastructure lies entirely within the Glenn County portion of the Corning Subbasin and therefore only the Corning Sub-basin GSA has jurisdiction over this project. The Corning Sub-basin GSA has the authority under the CWC (Section 10726.2 (b)) to "Appropriate and acquire surface water or groundwater and surface water or groundwater rights" and "conserve and store within or outside the agency" as well as authority regarding "the spreading, storing, retaining, or percolating into the soil of the waters for subsequent use" (CWC, 2014). For implementation of this project, the Corning Sub-basin GSA would likely partner with individual landowners or other stakeholders within the Subbasin that may also have legal authority to implement this project, including OUWUA, USBR, USACE, and TCCA. In addition, coordination with the Glenn Groundwater Authority, the GSA for the area in the Colusa Subbasin may occur if timing for the southside modernization project is concurrent to the northside modernization project.

7.4.3.1.7 Estimated Cost

Construction costs are based on prior estimates where available. TCCA intertie costs are from the 2003 OUWUA Modernization Assessment (CH2M Hill, 2003) and Northside Phase II project costs are from the 2017 AWMP (Davids Engineering, 2017). Other costs were independently estimated for this GSP. All estimates are referenced to 2021 dollars and are considered preliminary and subject to change. The range of costs reflects uncertainty at this stage of planning. Total capital and O&M costs are summarized in Table 7-5 below:

Table 7-5. OUWUA Modernization Cost Estimates

Project Cost Category	Estimated Total Cost	Notes
Estimated Capital Costs	$15,000,000 to $23,000,000	Includes estimated costs for the six projects listed
Estimated O&M Costs	$350,000 to $550,000	Includes estimated annual costs for the six projects listed

7.4.3.2 Priority Project 2: Regional Water Transfers for In-Lieu Recharge

The objective of this project is to facilitate inter- or intra-basin transfers of CVP or Orland Project water to maximize surface water use in lieu of groundwater pumping. To realize recharge benefits, this project must be complemented by other actions such as the OUWUA Infrastructure Improvements for In-Lieu Recharge to encourage surface water use over groundwater.

Within the Corning Subbasin, surface water deliveries are largely made through contracts with the Federal Government as part of the CVP and conveyed through the Tehama-Colusa and the Corning Canals, or from Stony Creek under rights held by the Orland Project and operated by OUWUA. The Tehama-Colusa Canal also conveys supplies to districts in the Colusa and Yolo Subbasins. Engaging in inter- and intra-basin water transfers of excess surface water supplies to maximize its use would offset groundwater pumping for irrigation purposes. Excess water availability varies by water district and year type, primarily due to differences in water contracts.

There are multiple factors that will influence the ability of contractors in the Corning Subbasin to divert what have historically been excess supply. Although allocations are determined on an annual time period, there are also limitations based on the time of diversion, the flow rate diverted, and the bypass flow requirements. In-lieu recharge projects should be designed to be as flexible as possible in order to divert water based on supply conditions. Historically, the destination of CVP excess supply is determined by the water transfer market and supplies may be transferred out of basin. Therefore, prioritizing in-basin use would require agreements and funding strategies.

Incentivizing surface water use for in-lieu recharge projects can be difficult because there are several significant advantages to groundwater pumping for growers. Groundwater is available on-demand, arrives to the surface already pressurized, and has substantially less filtration requirements than surface water. Depth to groundwater in the Stony Creek Fan (which stretches from Black Butte Reservoir east to the Sacramento River and south to Willows) is typically between 10 and 40 feet, keeping groundwater pumping costs low. These advantages make groundwater pumping generally preferred especially for micro-irrigation systems typically used for orchards. For in-lieu recharge projects to be successful, the water districts must incentivize surface water use so that is preferred by growers.

To determine when there has been surplus water available under existing CVP Tehama-Colusa and Corning Canal contracts – allocations in excess of deliveries – historical data from 2000 to 2019 were reviewed for a general indication of excess water that could be transferred into the Subbasin from other Districts. The average total excess for CVP contractors in the Corning, Colusa, and Red Bluff Subbasins, across all water year types and Water Districts, was 44,300 AF/yr. The average total excess was 9,100 AF/yr for Corning Subbasin, 34,700 AF/yr for Colusa Subbasin, and 500 AF/yr for Red Bluff Subbasin. Table 7-6 below shows average annual excess by water year type for the Corning Subbasin, while Table 7-7 shows the same for the Red Bluff and Colusa Subbasins. Red Bluff and Colusa Subbasin excess water could be transferred into (or exchanged with) the Corning Subbasin CVP contractors. Negative values are likely due to the purchase of transfer water in low allocation years, although the actual volume of transferred water is not known.

It was estimated that an additional 40,000 to 120,000 AF/yr of supplemental supplies may be available in the Stony Creek watershed, that could allow for transfers into the Corning Subbasin (CH2M Hill, 2003). It is possible that conditions have changed since this report was published and revised estimates will be developed during implementation feasibility study for this project.

Table 7-6. Estimated Average Surplus Allocation by Water District in Corning Subbasin and by Water Year Type

Corning Subbasin Average 2000-2019 Allocation - Deliveries (Surplus Allocation), AF				
Water Year Type	**Corning WD**	**Thomes Creek WD**	**Kirkwood WD**	**Corning Subbasin**
W	11,900	3,200	1,900	**17,000**
AN	6,200	500	2,100	**8,800**
BN	10,800	2,500	2,100	**15,400**
D	2,900	-500	1,600	**4,000**
C	-1,900	-1,900	300	**-3,500**
Average	**6,500**	**900**	**1,700**	**9,100**

Note: Estimated values from available CVP delivery data

Table 7-7. Estimated Average Surplus Allocation by Water District in Neighboring Subbasins and by Water Year Type

Water Year Type	**Average 2000-2019 Allocation - Deliveries (Surplus Allocation), AF**													
	Red Bluff Subbasin	**Colusa Subbasin**												
	Proberta WD	**CCWD**	**OAWD**	**Westside WD**	**Kanawha WD**	**Glide WD**	**La Grande WD**	**Davis WD**	**4-M WD**	**Holthouse WD**	**Glenn Valley WD**	**Cortina WD**	**Myers-Marsh MWC**	**Colusa Subbasin Total**
W	1,800	10,700	8,000	30,900	12,300	-2,600	2,300	900	3,700	1,700	100	600	100	**68,700**
AN	300	13,100	400	30,800	18,000	-3,900	1,500	2,300	3,900	600	1,100	900	-200	**68,300**
BN	1,300	17,300	12,300	34,200	19,100	300	3,200	1,000	4,000	1,600	700	900	200	**94,700**
D	-300	-10,400	-6,900	12,800	700	-6,500	0	200	1,800	1,000	100	400	100	**-6,700**
C	-1,000	-30,300	-8,300	-18,500	-10,600	-3,700	-600	-2,400	-500	200	-600	-300	0	**-75,600**
Average	**500**	**1,300**	**1,700**	**19,700**	**8,500**	**-3,200**	**1,400**	**400**	**2,700**	**1,100**	**300**	**500**	**0**	**34,700**

Note: Estimated values from available CVP delivery data

7.4.3.2.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project:

- **Groundwater elevation.** Surface water use in-lieu of groundwater will result in less groundwater pumping and higher groundwater levels.
- **Groundwater storage.** Surface water use in-lieu of groundwater contributes to increasing groundwater elevations, increased groundwater in storage, and will help achieve long-term sustainable yield.

7.4.3.2.2 Expected Benefits and Evaluation of Benefits

Maximizing water transfers with the intent of facilitating in-lieu groundwater recharge has the benefit of increasing groundwater levels and groundwater storage. This stored groundwater can be extracted in years when no transfer water is available, or if delivery systems are capacity constrained.

7.4.3.2.3 Public Noticing, Permitting, and Regulatory Process

No new water supply sources are required for this project. The project would utilize existing supplies held in right or contractually by the Orland Project or the CVP Contractors. Therefore, there are no public noticing, permitting, or regulatory requirements necessary to transfer water. There are regulatory requirements in place that could be revised to make water transfer easier and more financially viable.

Water transfers or exchanges between CVP contractors are not regulated by the State Water Resources Control Board unless the point of diversion, purpose of use, or place of use under CVP's water right will change to complete the transfer. Thus, CVP transfers only need review and approval from the USBR.

7.4.3.2.4 Circumstances for Implementation

Increased use of Orland Project and CVP surface water allocations through inter-basin transfers is an ideal project due to predictable anticipated benefits on groundwater elevations and relative ease of implementation as no new surface water right must be acquired. However, for widespread adoption the cost of transfer water and the installation of dual-source irrigation systems must be equal to or less than the cost of groundwater pumping. This could present a significant financial challenge for the GSA. Water transfer fees charged by the USBR also increase the cost. The framework and administration process are established for water transfers and conveyance and distribution infrastructure is present in existing water districts. Therefore, no additional circumstances for implementation are necessary.

Coordination with USBR and existing active water districts, namely Corning WD, Thomes Creek WD, Kirkwood WD, and OUWUA, will be crucial to the success of this project. Additionally, the ability for OUWUA to complete water transfers is contingent on their acquisition of title for the Orland Project and the construction of connections to the TCC. Grower education within the Districts will also be needed for successful implementation of conjunctive use of surface water and groundwater within the Districts.

7.4.3.2.5 Implementation Schedule

While water transfers may theoretically begin immediately, it is anticipated that additional infrastructure and education is required to create and facilitate the demand for transfer water amongst existing groundwater users within districts or those districts with chronically insufficient supply. Additionally, strategies for improving the cost effectiveness of using transfer water must be developed.

7.4.3.2.6 Legal Authority

The GSAs will collaborate with the water districts and USBR to follow legal authority regarding water transfers, use of existing CVP and Orland Project infrastructure for conveyance, and construction of surface water infrastructure, as needed.

7.4.3.2.7 Estimated Cost

Information from Corning WD suggests that groundwater pumping costs can range from $70-$100 per AF while the cost of CVP project transfer water is highly variable and has been as high as $350 per AF during recent dry years. The cost of water transfers must be lower than the cost of pumping groundwater for water transfers to be financially viable.

7.4.3.3 Priority Project 3: Invasive Plant Removal

The Subbasin has significant populations of *Arundo donax* (arundo) and tamarisk species along reaches of the Sacramento River, Stony Creek, Thomes Creek, and other smaller ephemeral streams and drainages. Ongoing invasive plant removal work is performed in the Subbasin under the oversight of the Resource Conservation District (RCD) of Glenn County in partnership with local agencies, organizations, and private landowners. The GSAs will support and seek to enhance the existing eradication programs in the Subbasin, including in Tehama County, as applicable, by working with the Tehama County RCD.

Arundo and tamarisk thrive and spread quickly in braided stream habitats endemic to the Corning Subbasin (Cal-IPC, 2020; Cal-IPC, 2003). The riparian corridors in the Subbasin along Stony Creek, Thomes Creek, and the Sacramento River provide natural, unchanneled waterways for establishment of dense stands of these invasive plants. Where established, the plants can replace much of the natural abundance and diversity of native species found in GDEs. At this time, there is not enough information about the feasibility of tamarisk removal to make it a priority of this GSP and this project will focus on arundo removal only. The California Invasive Plant Council (Cal-IPC) compiled a recent study on arundo in the Central Valley, summarizing the extent, impacts, recommended treatment strategies, and benefits of plant removal (Cal-IPC, 2020). The study incorporated 2019 arundo mapping provided by Cal-IPC shown on Figure 7-7. The extent of arundo occurrence in these reaches in the Subbasin was found to be some of the most widespread and impactful in the Central Valley, particularly on lower Stony Creek. Based on the Cal-IPC database, about 600 acres of land in the Subbasin is infested with arundo (Figure 7-7).

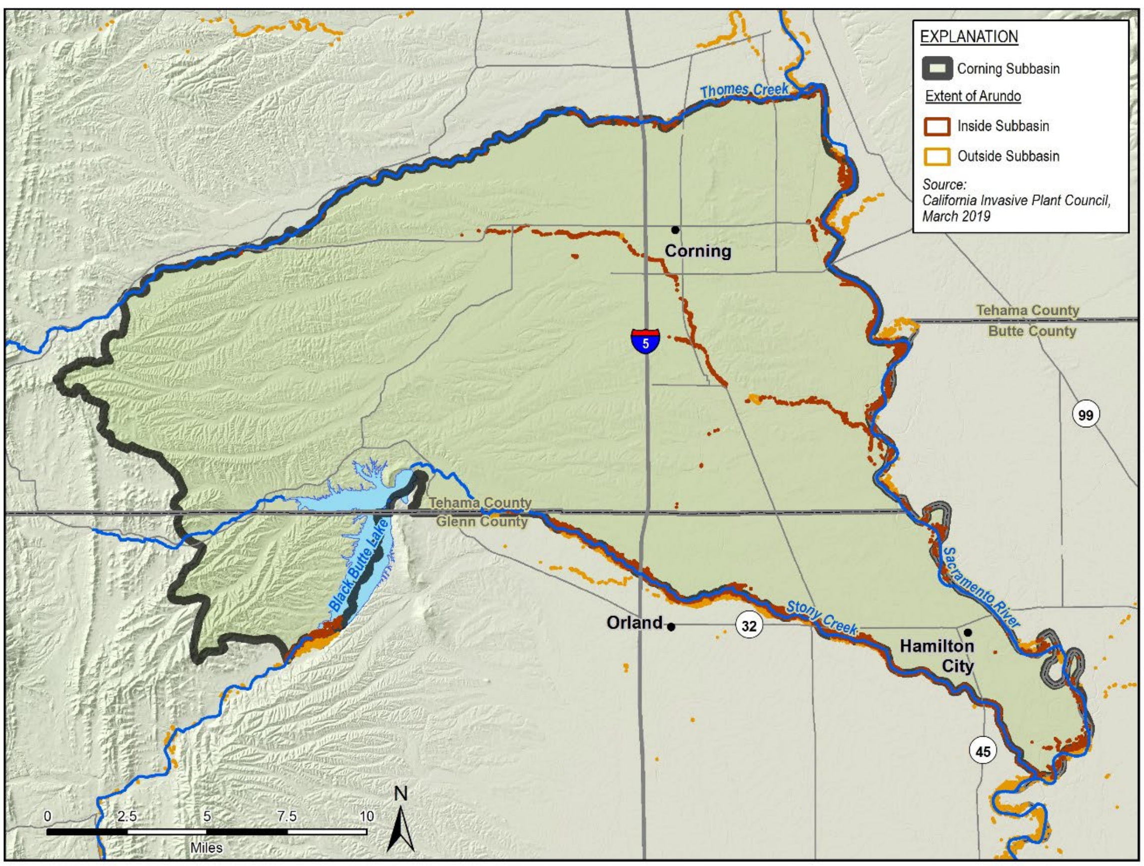

Figure 7-7. Extent of Arundo within and Close to the Subbasin

Removal of arundo is challenging due to its widespread nature, resistance to removal, environmental permitting restrictions, and funding. Arundo is commonly spread downstream during flood events; therefore, the Cal-IPC recommends working upstream to downstream for eradication. Growth patterns for these plants are slow and steady once established, making removal feasible with a systematic approach. The study estimated the costs and benefits of arundo removal, outlined in Section 7.4.3.3.7. There are numerous permitting requirements for invasive plant management that must be considered in the cost assessment.

In the Glenn County Community Wildfire Protection Plan, Glenn County RCD declared invasive species removal planning as one of four priorities for wildfire protection in the County (Glenn County RCD, 2011). The plan identified priority areas for invasive plant control for fire management along Lower Stony Creek and the Sacramento River wildlife conservation areas under jurisdiction of the USFWS, CDFW, and TNC. Securing long-term funding for invasive plant removal was one of the priorities of this plan. A Lower Stony Creek Watershed Restoration Plan was completed by Glenn County RCD (Glenn County RCD, 2010), and one of the management goals and objectives of this plan was to control arundo and tamarisk spread. The Glenn County Community Wildfire Protection Plan is currently being updated with an anticipated finalization date in early 2022; the invasive plant removal project remains a high priority in the updated document, and will likely include Upper Stony Creek to the priority list.

The City of Orland is also involved with arundo removal on Stony Creek because of the fire risk it presents. Arundo has become so thick in the Orland area that it has provided significant fuel for wildfires. In May 2021, the City of Orland submitted a grant application to the California Department of Forestry and Fire Protection for the purchase of a bulldozer, transport vehicle, and trailer, specifically for the removal of arundo on Stony Creek. If successful, the City of Orland Fire Department offered contributing funds, equipment, and staff to help address routine arundo maintenance along the Stony Creek corridor in the Corning and Colusa Subbasins.

This preferred project proposes continuing the efforts made by the RCDs, City of Orland, and other local entities to clear arundo from the riparian corridors around Stony Creek, Thomes Creek, and the Sacramento River. For thorough removal of these invasive species, routine maintenance would have to be performed to ensure that plants do not re-establish after eradication efforts. The scope and schedule for the arundo removal project will be developed by the GSA in collaboration with the Glenn and Tehama County RCDs and local landowners.

7.4.3.3.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation.** Removal of invasive, high water using plants will result in lower evapotranspiration and shallow groundwater use, therefore will increase groundwater levels.

- **Groundwater storage.** Removal of invasive, high water using plants contributes to increasing groundwater elevations, increased groundwater in storage, and will help achieve long-term sustainable yield.
- **Interconnected surface water.** Removal of invasive, high water using plants reduces depletion of interconnected surface waters and benefits GDEs and in-stream habitat.

7.4.3.3.2 Expected Benefits and Evaluation of Benefits

There are many benefits of arundo removal from the riparian corridors in the Subbasin. As it relates to this GSP, the primary benefit of this project is increased surface water available for environmental flows, irrigation, and groundwater recharge due to reduced evapotranspiration. Invasive species removal would increase the volume of water in the rivers and creeks for environmental flows, irrigation supply, and groundwater recharge. Cal-IPC provided a summary of literature and an estimate of the water savings benefit of regional arundo removal (Cal-IPC, 2020). Arundo in the Central Valley uses approximately 19.4 AF/yr of water per acre of vegetation and the Cal-IPC standard water use for replacement vegetation or open substrate after invasive plant removal is 4 AF/yr per acre. By removing and replacing arundo with a less water intensive vegetation, the Subbasin may save 15.4 AF/yr per acre of arundo removed. Since approximately 600 acres of land in the Subbasin are covered with arundo, removal of this invasive species would result in a 9,240 AF/yr reduction in water use.

In addition to water savings and fire risk reduction, invasive plant removal has other benefits. Thick stands of invasive plants can over time lead to a narrower river channel, increase flow velocities, erode channel banks, and damage bridges when large portions of vegetation break loose. One modeling study estimated that flooding has increased by 10-19% as a result of arundo in the Stony Creek River system (Cal-IPC, 2020). Removal of arundo would help restore the natural braided stream profile, which would in turn decrease flooding and improve conveyance in the Subbasin. Invasive species also crowd out native species and remove valuable riparian habitats which harbor bird species and provide shading, bank stability, and lower temperatures for instream habitat and associated species such as steelhead.

Changes in groundwater elevation, and surface water depletion due to invasive plant eradication will be monitored using the networks described in Section 5 of this GSP. A direct correlation between invasive species eradication and changes in groundwater elevations, or surface water depletion is likely not possible because this is only one among many management actions and projects that will be implemented in the Subbasin.

7.4.3.3.3 Circumstances for Implementation

Arundo removal is already a priority of the Glenn County and Tehama County RCDs and other partnering agencies, organizations, and private landowners. The GSA intends to support these ongoing efforts as funds become available and specific plans begin to form. No additional circumstances for implementation are necessary.

Arundo removal efforts to date have not been fully successful due to the following:

- Lack of public acceptance in some areas
- Lack of funding support
- Intensive permitting costs and restrictions
- Need for ongoing maintenance

Widespread stakeholder approval of this project will be needed for successful arundo removal and maintenance. As a result, community engagement will be instrumental in any successful invasive plant eradication program.

7.4.3.3.4 Public Noticing, Permitting, and Regulatory Process

Information about this program will be shared with stakeholders through the GSAs' e-mail lists, will be posted on the GSP website, and information will be available at GSA offices. In addition, RCDs will work with local landowners to describe this project and gather public input.

The permitting process of the existing invasive species eradication programs will be continued as part of this project. Glenn County RCD has secured CEQA permits for arundo eradication in the past, but updated CEQA permits would need to be acquired. In addition to CEQA, it is also likely that CDFW Streambed Alteration Agreement permit will need to be acquired for large-scale plant removal efforts (Cal-IPC, 2020). Other permits may be required if work is to be performed on federal land, if endangered species are to be disturbed, or if herbicides are to be applied.

7.4.3.3.5 Implementation Schedule

The implementation schedule is presented on Figure 7-8. The implementation schedule for these ongoing efforts will be initiated as soon as funds and stakeholder buy-in allows. Arundo control is a long-term process, with projects implementing initial work lasting 3 to 5 years and typically taking an additional 10 to 15 years of re-treatments (Cal-ICP, 2020).

Task Description	Year 1	Year 2	Year 3	Year 4+
Phase I – Initial Treatment				
Phase II – Re-treatment				
Phase III – Ongoing Monitoring and Maintenance				

Figure 7-8. Implementation Schedule for Invasive Species Eradication

7.4.3.3.6 Legal Authority

The GSAs will collaborate with the Glenn and Tehama County RCDs to follow the legal authority for invasive species eradication contained in the existing eradication programs.

7.4.3.3.7 Estimated Cost

The cost of arundo control using an integrated approach with mechanical and chemical tools was estimated as $35,000 per acre (Cal-IPC, 2020). This cost accounts for initial treatment, permitting, and long-term maintenance to ensure removal. Since there are approximately 600 acres of arundo in the Subbasin, the cost to remove the plants would be approximately $21,000,000. The indirect projected yield for the invasive species eradication project is estimated at 9,240 AF/yr. The amortized cost of water for this project is estimated at $2,270/AF/yr. Benefit values for arundo removal were provided by Cal-IPC for water, geomorphology, fire reduction, and sensitive species benefits (Cal-IPC, 2020). The benefit to cost ratio for the Sacramento, Thomes Creek, and Stony Creek watersheds was estimated to be 1.4 to 1.7, meaning the benefits outweighed the costs by nearly 50% (Cal-IPC, 2020).

7.4.3.4 Priority Project 4: Groundwater Recharge through Unlined Conveyance Features

This multi-benefit project would utilize the Corning and Tehama Colusa Canals to transport winter and spring flows from the Sacramento River to streams and drainages in the Corning Subbasin. The main goals of the project are:

1. Increase groundwater recharge in areas with recent declining groundwater level trends in some portions of the Subbasin, through conveyance by the unlined Corning Canal and creek beds
2. Enhance stream flows, increase interconnected surface water, and improve overall GDE health along streams in the Subbasin

The source of water for this project would be the Sacramento River, upstream of the Subbasin. During the winter and spring when Sacramento River discharge is at its highest, a small percentage of total flow would be diverted at the Red Bluff Diversion to the Corning and Tehama Colusa Canal systems. The canals would be used to convey the water to the Corning Subbasin where water would be discharged using existing flood control turnouts and drains to numerous stream reaches including Thomes Creek, Stony Creek, and a few smaller ephemeral streams shown on Figure 7-9,. This project would use existing canals, diversions, turnouts, and drains where possible. It is assumed that there are existing operational turnouts or drains on the TCCA canals where they cross Thomes Creek, Stony Creek, and other ephemeral creeks in the Subbasin including Jewett, Burch, Brannin, Hall, and Sour Grass Creek (Figure 7-10 and Figure 7-11). Some new infrastructure may be needed to add lifting pump stations and maybe additional turnouts to creeks. Some groundwater recharge would be induced through the unlined Corning Canal and the natural creek beds. Except for the water that percolates to groundwater, most of the water used for this project would flow back to the Sacramento River in one of several places in the Subbasin. This project could also be used to benefit the Red Bluff Subbasin to the north and the Colusa Subbasin to the south.

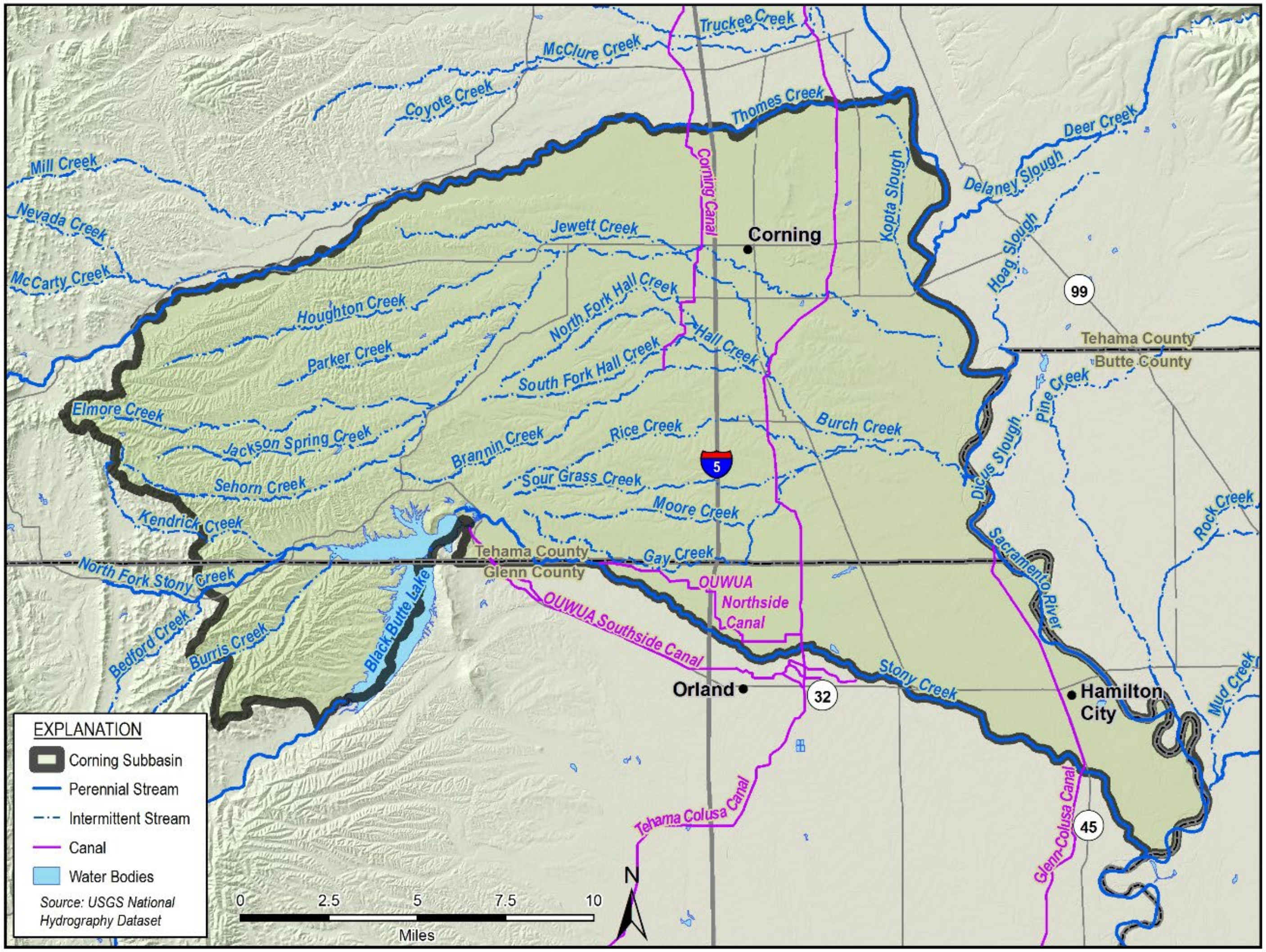

Figure 7-9. Layout of Canals and Surface Water Features in Corning Subbasin

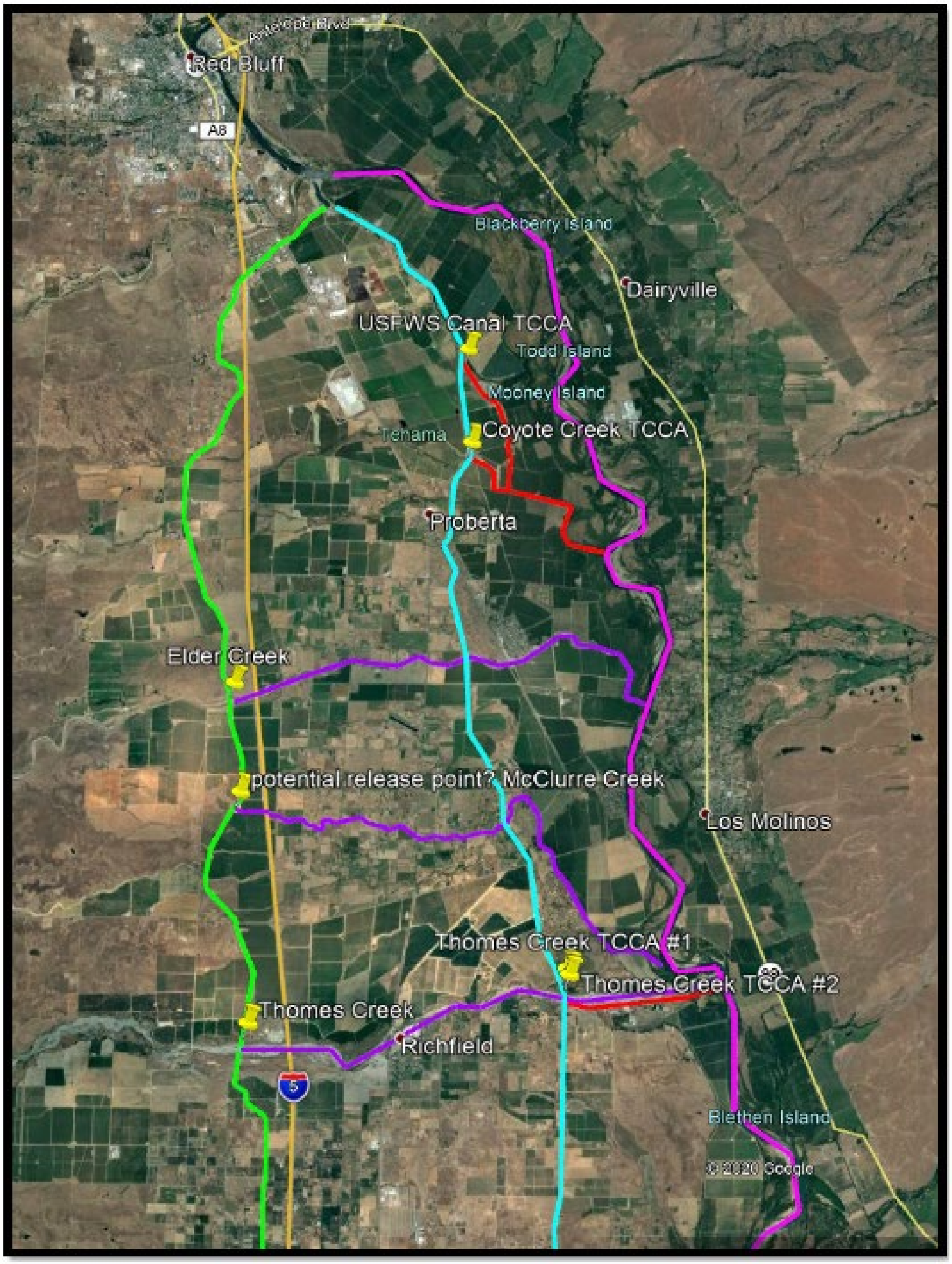

Figure 7-10. Conceptual Diversion Points North of Corning Subbasin

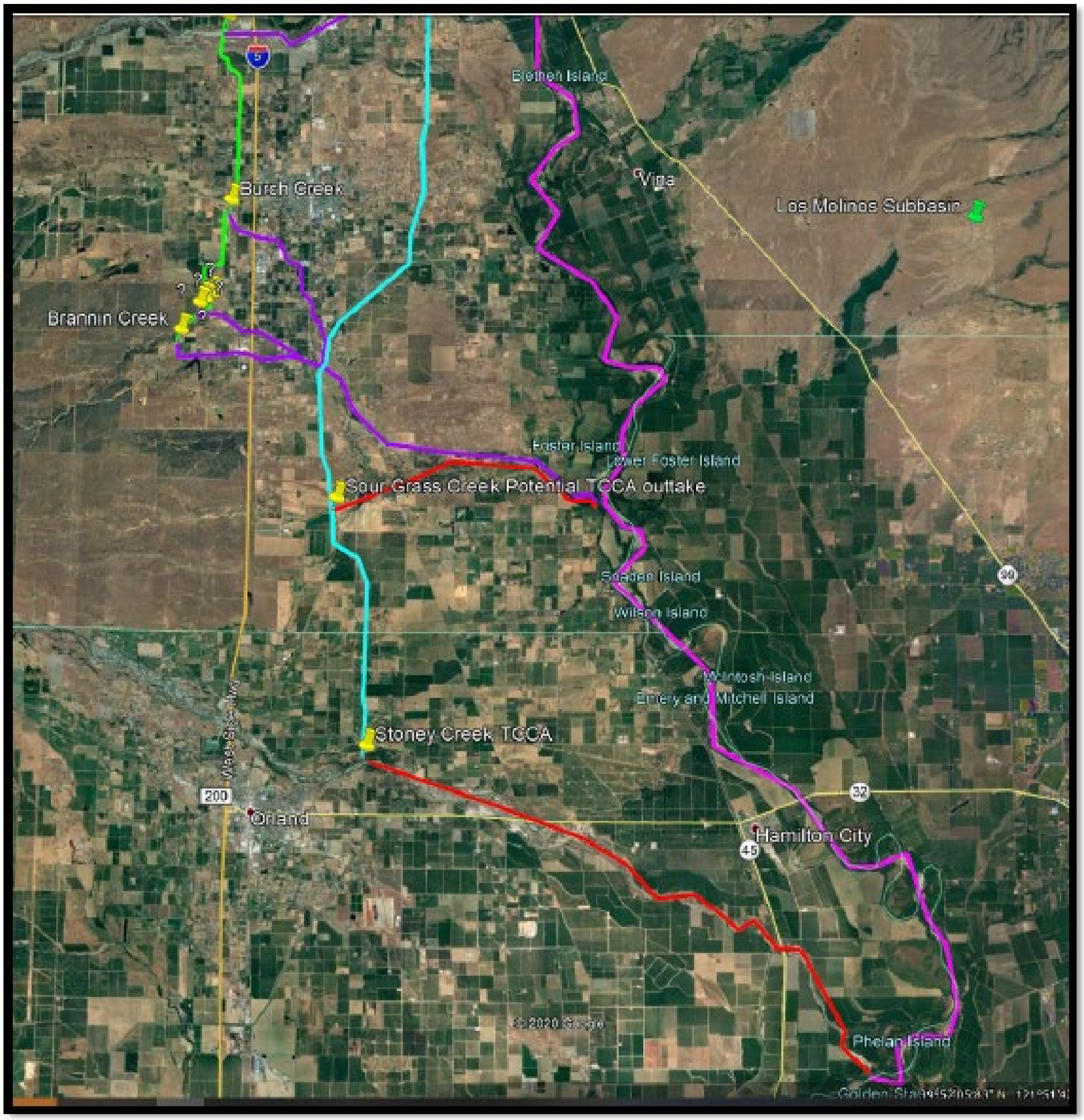

Figure 7-11. Conceptual Diversion Points within Corning Subbasin

7.4.3.4.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation.** Increased groundwater recharge will result in higher groundwater levels.
- **Groundwater storage.** Increased groundwater recharge will result in higher groundwater levels, increased groundwater in storage, and will help achieve long-term sustainable yield.

- **Interconnected surface water.** Increased groundwater recharge will result in higher groundwater levels, which reduces the depletion of interconnected surface waters.

7.4.3.4.2 Expected Benefits and Evaluation of Benefits

The project would increase groundwater recharge in the Subbasin, that would benefit areas with groundwater pumping for irrigation and declining groundwater level trends. An example area that could benefit from groundwater recharge induced increase in groundwater levels and storage is the Corning WD lands downstream of where the Corning Canal intersects Thomes Creek.

Increasing in-stream flows would benefit priority species, such as salmon and steelhead, by increasing stream stage, improving rearing habitat, and providing potential spawning habitat. The USBR could potentially receive credit for ecosystem enhancement provided by this project to meet environmental mitigation measures in the 1992 Central Valley Project Improvement Act (CVPIA), Title 34 of Public Law 102-575.

7.4.3.4.3 Public Noticing, Permitting, and Regulatory Process

This project is currently in a conceptual approach stage, as it is not feasible as constituted under the current regulatory framework of the TCCA, USBR, and DWR. The general high costs and cumbersome regulations associated with moving water through federal infrastructure in the Northern Sacramento Valley has been a significant barrier for utilizing the existing CVP infrastructure for non-irrigation uses such as conveyance for groundwater recharge projects and flood control. This project may require revised legislation and more flexible agreements for it to be advanced to feasibility planning stages during GSP implementation. Discussion of public noticing, permitting, and regulatory process for implementation of this conceptual project is premature. Implementation of this project relies upon coordination between many stakeholders, but most importantly between the USBR, TCCA, DWR, and the GSAs. As currently constituted, the canals cannot be used to carry excess flood waters in the winter and spring for groundwater recharge projects. Ultimately, the proposed project cannot be implemented until the CVPIA is revised.

7.4.3.4.4 Circumstances for Implementation

Following the necessary amendments to the CVPIA, a feasibility study would be prepared for the project. If the costs are greater than the benefits the project may not be practical. Also, there may be timing issues with the project as canal maintenance is performed during the season that it would be implemented. Should the feasibility study show that benefits outweigh the costs of the project, the GSAs in collaboration with water districts that manage the infrastructure may wish to proceed and implement the project.

7.4.3.4.5 Implementation Schedule

Should the GSAs decide to pursue this project, the first step would be to engage the USBR, TCCA, and DWR in feasibility discussions. If an agreement is made that allows the project to proceed, then the next step would be a feasibility study for developing the more detailed conceptual design and estimating the costs and benefits. This study is anticipated to be conducted over 1 to 2 years. Following the feasibility study, if the project is implemented, it is anticipated the planning, design, and construction may take up to 5 years.

7.4.3.4.6 Legal Authority

The GSAs have the authority under the CWC (Section 10726.2 (b)) to "Appropriate and acquire surface water or groundwater and surface water or groundwater rights" and "conserve and store within or outside the agency" as well as authority regarding "the spreading, storing, retaining, or percolating into the soil of the waters for subsequent use". In addition, the 1957 Tehama County Flood Control and Water Conservation Act was established to: "provide for control of and disposition of storm and flood waters of the District; provide water for any present or future beneficial use or uses of lands or inhabitants within the district, including acquisition, storage, and distribution for irrigation, domestic, fire protection, municipal, commercial, industrial, recreational, and all other beneficial uses."

For implementation of this project, the GSAs would need to cooperate with the TCCA and USBR to ensure that use of the CVP infrastructure does not violate the current agreements in place as well as coordination on logistics.

7.4.3.4.7 Estimated Cost

This is a conceptual project; more details will be developed during Plan implementation.

7.4.3.5 Priority Project 5: Off-Stream Surface Water Storage

This concept of diverting flood waters for off-stream storage and subsequent irrigation or for direct recharge has been widely studied and is being pursued in numerous groundwater basins across California. Off-stream surface water storage would provide water for irrigation in-lieu of groundwater pumping. This concept has been pursued in the past on a smaller scale by individual landowners within the Subbasin; these landowners will be consulted during the feasibility study. This project is dependent upon acquiring a new water supply, likely from ephemeral streams.

There are a number of ephemeral streams that originate in the foothills of the Coastal Range in the western portion of the Corning Subbasin and flow eastward towards the Sacramento River. These streams include Jewett Creek, Houghton Creek, Parker Creek, Burch Creek, Hall Creek, Brannin Creek, Rice Creek, Sour Grass Creek, Moore Creek, and Gay Creek (Figure 7-12).

During periods of high flow in the winter and spring, a portion of these flood flows could be diverted for either (1) off-stream storage and subsequent use for irrigation or (2) direct groundwater recharge through Flood-MAR or dedicated recharge basins. A new water right through the SWRCB would have to be obtained for diversion in storage in off-channel ponds or small reservoirs. Infrastructure would likely be located on private property through collaborative arrangements with the landowner.

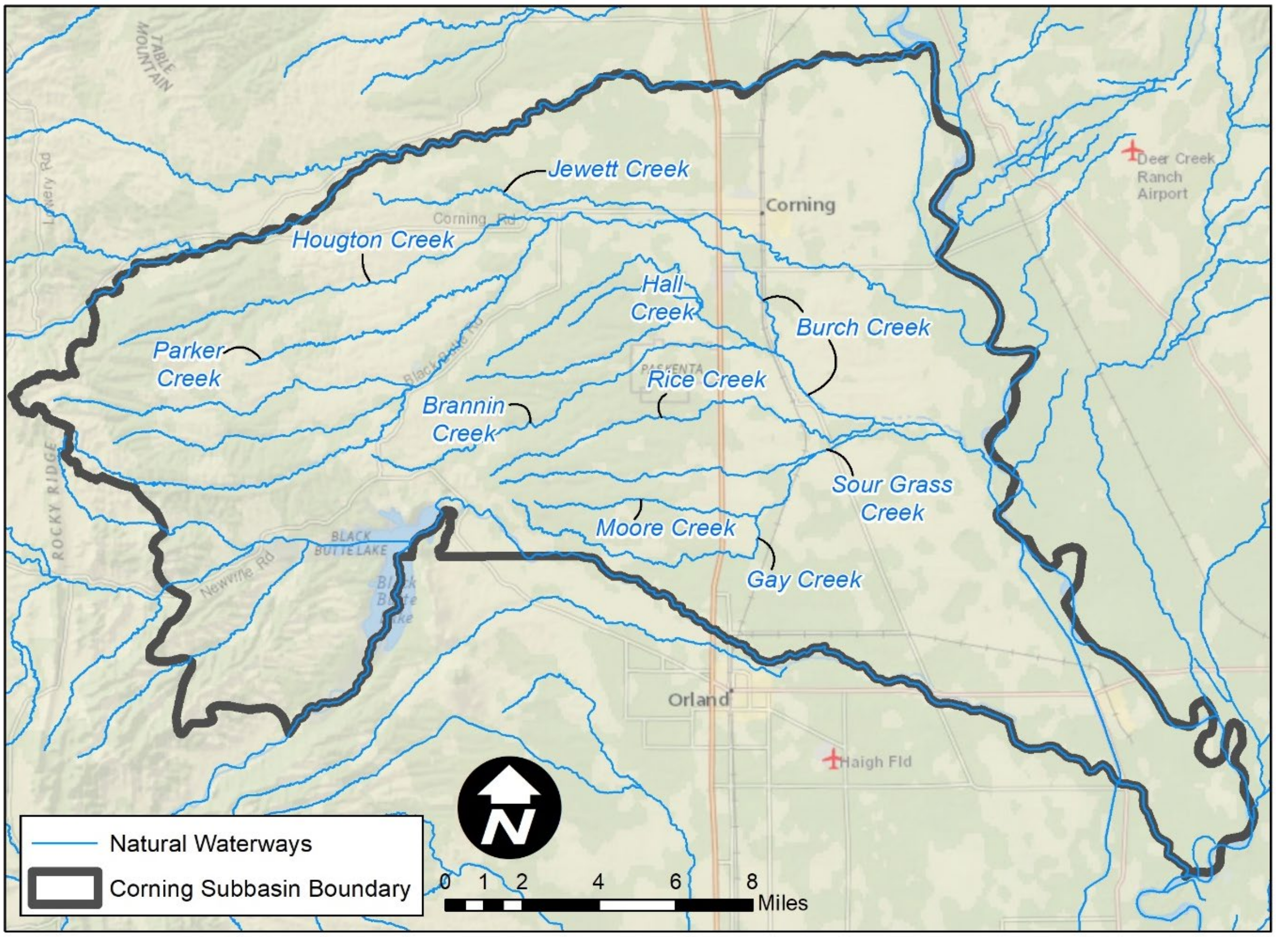

Figure 7-12. Ephemeral Streams within the Corning Subbasin.

This project is conceptual in nature and further investigation into the feasibility and potential costs and benefits is required. Further evaluation of this project and potential implementation would be accomplished by the GSAs, in coordination and partnership with individual landowners or other stakeholders within the Subbasin.

This project would require the design and construction of new diversion and conveyance infrastructure, as well as either off-stream storage facilities or recharge areas. A feasibility study would need to be conducted to evaluate the timing and estimated volumes of water available for diversion, as well as associated sizes and estimated costs for construction of required infrastructure. The ephemeral streams in the Corning Subbasin are flashy, or prone to short periods of high flow. The flashy nature of stream flows leads to a need for large pumps to capture as much water as quickly as possible when unallocated stream flows are available, but the infrequent occurrence of such high flow on these ephemeral streams risk leaving pumps sitting idle a high proportion of time. This in turn affects costs and economic feasibility.

An analysis of streamflow frequency and volume of the ephemeral streams in the subbasin would need to be completed to determine the potential volumes and reliability of the water source for this project. Assuming the feasibility study determines that available volumes are sufficient to justify planning and construction costs, GSAs or private landowners would need to submit an application for a temporary, streamlined, or permanent appropriative water right permit from SWRCB.

Further evaluation of this project and potential implementation would be accomplished by the GSAs, working in coordination and partnership with individual landowners or other stakeholders within the subbasin. Monitoring and quantification of benefits would also be accomplished by the GSAs in coordination with other stakeholders and partners.

7.4.3.5.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation.** Surface water use in-lieu of groundwater or increased groundwater recharge will result in higher groundwater levels.
- **Groundwater storage.** Surface water use in-lieu of groundwater or increased groundwater recharge will result in higher groundwater levels, increased groundwater in storage, and will help achieve long-term sustainable yield.
- **Groundwater quality.** Increased groundwater recharge with high quality surface water may improve the naturally higher salinity groundwater in the western portion of the Subbasin.

7.4.3.5.2 Expected Benefits and Evaluation of Benefits

Surface water storage and subsequent use for irrigation will provide a new surface water supply source that would reduce groundwater pumping, while increasing in-lieu groundwater recharge. This will help offset current and future groundwater pumping in areas of the Subbasin that have not historically had access to surface water supplies. This project may also provide flood reduction benefits to the extent high flow events are reduced by diversions. Surface storage and groundwater recharge projects both conceptually use high surface water flows to increase groundwater in storage. Surface storage is subject to some evaporation. However, this practice has the advantage of preserving groundwater in storage by reducing pumping, which makes this method potentially more efficient than other direct recharge methods like Flood-MAR or dedicated groundwater recharge basins. With direct recharge methods there is more uncertainty about the fate of the recharge waters both in terms of where and when they are ultimately stored and available for pumping, and the potential for water quality impacts.

7.4.3.5.3 Circumstances for Implementation

The implementation of this project will be dependent on the results of the feasibility study. Additionally, if the costs and benefits do not make the project practical and reasonable for immediate implementation following the feasibility study, the project may still potentially be implemented in the future if the conditions of the Subbasin change such that the benefits outweigh the cost. The project may also be initially implemented on a smaller scale and expanded over time. Circumstances that would influence or dictate feasibility and implementation of this project include:

- Availability of surface water and approval of temporary or permanent appropriative water right from SWRCB.
- Suitability of lands for construction of capture, conveyance, and storage infrastructure.
- Interested and willing landowners and project partners.
- Permitting and environmental compliance.

7.4.3.5.4 Implementation Schedule

The feasibility study and closer evaluation of the project will be the first phase of implementation; this is anticipated to be conducted over 1 to 2 years. Following the feasibility study, if the project is implemented, it is anticipated the planning, design, and construction may take up to 5 years.

7.4.3.5.5 Legal Authority

The GSAs have the authority under the CWC (Section 10726.2 (b)) to “Appropriate and acquire surface water or groundwater and surface water or groundwater rights” and “conserve and store within or outside the agency” as well as authority regarding “the spreading, storing, retaining, or percolating into the soil of the waters for subsequent use”. For implementation of this project, the GSAs would also likely partner with individual landowners or other stakeholders within the subbasin that may also have legal authority to implement this project.

7.4.3.5.6 Estimated Cost

The estimated costs for implementation of this project will be dependent on the project location(s) and stream(s) selected for recharge, as well as the anticipated diversion volumes and resulting construction and maintenance costs for diversion and conveyance infrastructure. Decisions regarding whether the diverted waters are used for off-stream storage and subsequent irrigation or for direct recharge will also have an impact on cost. Estimated costs will be evaluated more closely during the feasibility study. The project(s) might need grant support in some form to be affordable for local users.

7.4.3.6 Priority Project 6: Recycled Water Use for Irrigation

The purpose of this project is to use treated wastewater from local cities for agricultural irrigation purpose for in-lieu groundwater recharge. There is little treated wastewater available in the Subbasin to use for irrigation and treatment plants are located near the Sacramento River for convenient discharge. However, there is a potential for City of Corning and Hamilton City wastewater treatment plant recycled water to be used for irrigation at nearby fields.

The City of Corning's wastewater treatment plant effluent is currently about 0.8 million gallons per day. It is permitted for 1.4 million gallons per day, should the City grow through population increase or annexation. However, water use efficiency measures for drought impact reduction have caused total water consumption to decrease and is now at 76% of water consumption compared to 2008.

This conceptual project requires additional evaluation to identify potential feasibility and grower interest.

7.4.3.7 Priority Project 7: City of Corning Stormwater Improvements and Groundwater Recharge

The City of Corning is situated close to several ephemeral streams that are conducive to flash floods. Localized flooding during recent wet years within the urban limits and to the south of the City overwhelmed existing drainage systems and inundated streets and bridges causing flooding damage to property and infrastructure. The GSAs could work with Tehama County and the City to identify locations that would benefit from improved stormwater management with the added benefit of increasing stormwater infiltration to groundwater (Flood-MAR). Specific information regarding past flooding events, locations, and damages is limited. The specific locations where historical flooding and high-water events noted in the Tehama County reports and in local news sources are shown on Figure 7-13.

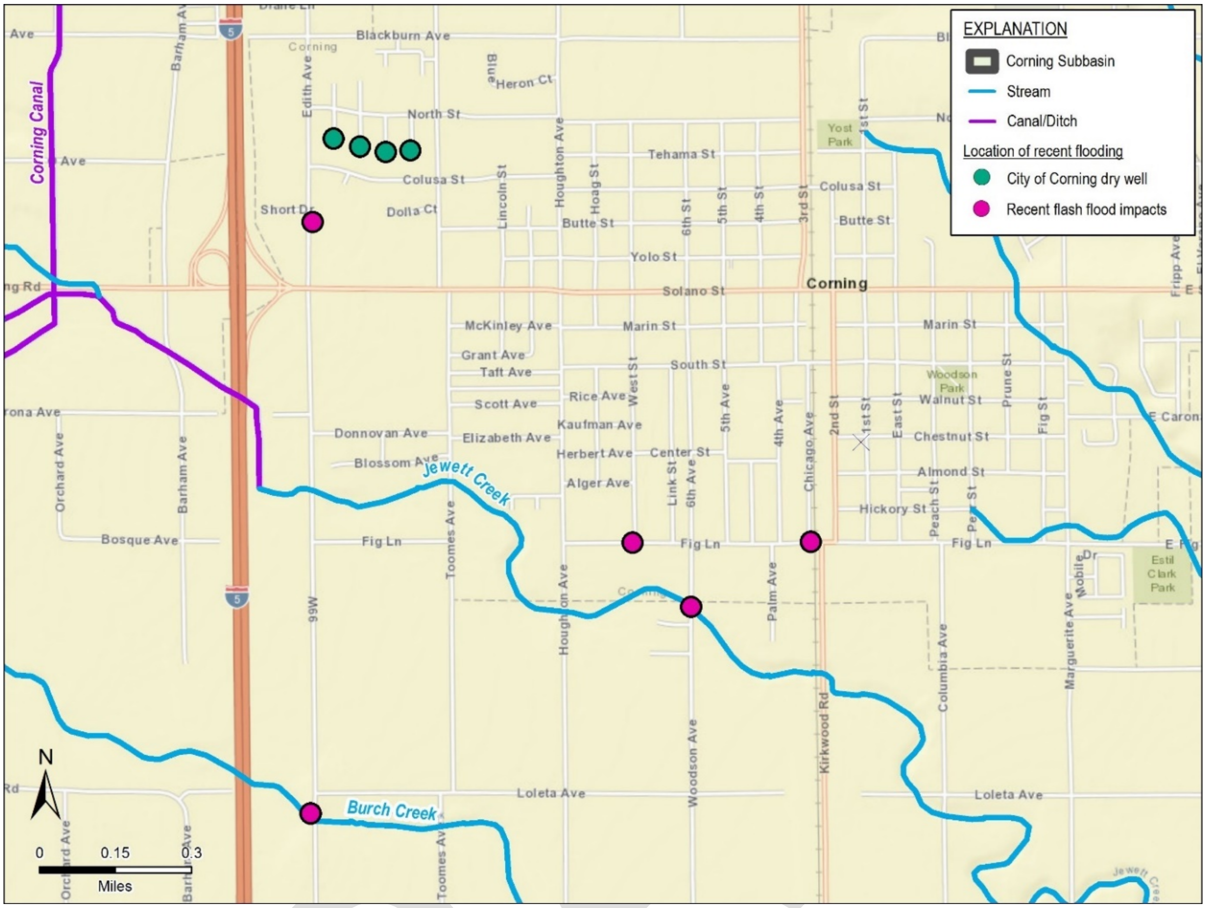

Figure 7-13. Recent Flooding Locations in the City of Corning

The Tehama County flood and hazard mitigation planning efforts recommend that the City address areas with drainage problems to prevent future damage to properties and infrastructure (Wood Rodgers, 2006; Tehama County, 2018). Recommendations in these plans include improving drainage, increasing stream carrying capacity by removing invasive plants, silt, and other debris from channels, and potentially improving road and railroad crossings that either cause or at risk from future flood damage.

Multi-benefit stormwater capture mitigation strategies could be implemented in partnership between the GSAs and the City of Corning DPW and the Tehama County RCD. The City of Corning DPW maintains and operates a standard stormwater system. This project could either tie into the existing stormwater conveyance system or consist of independent, localized drainage systems in areas with recurring flooding. This GSP project would entail installation of stormwater capture technology that promotes stormwater infiltration for groundwater recharge. Two strategies to improve stormwater capture and increase groundwater recharge that are well suited for the City of Corning include low impact development (LID) and dry wells.

The USEPA defines low impact development as, "systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat".[2] LID technologies include vegetative swales, permeable asphalt, planter beds, and other similar features. LID is best suited for areas with high surface infiltration rates.

Dry wells are stormwater infiltration galleries installed in the vadose zone (above the groundwater table), for infiltration of stormwater and groundwater recharge (Geosyntec, 2020). Dry wells are better suited than LID for locations with poor surface drainage or with limited surface space or access for LID construction. Both LID and dry wells have the benefit that they do not necessarily need to be connected to the city stormwater capture and piping system. A typical schematic of a dry well is shown on Figure 7-14. Dry wells can be constructed with features that maximize removal of pollutants, reduce dry well clogging, and promote efficient infiltration. This configuration allows water to flow passively through pre-treatment before percolating through the dry well to the vadose zone. This multi-faceted approach decreases the risk of dry well clogging causing flooding impacts or groundwater quality degradation from stormwater runoff.

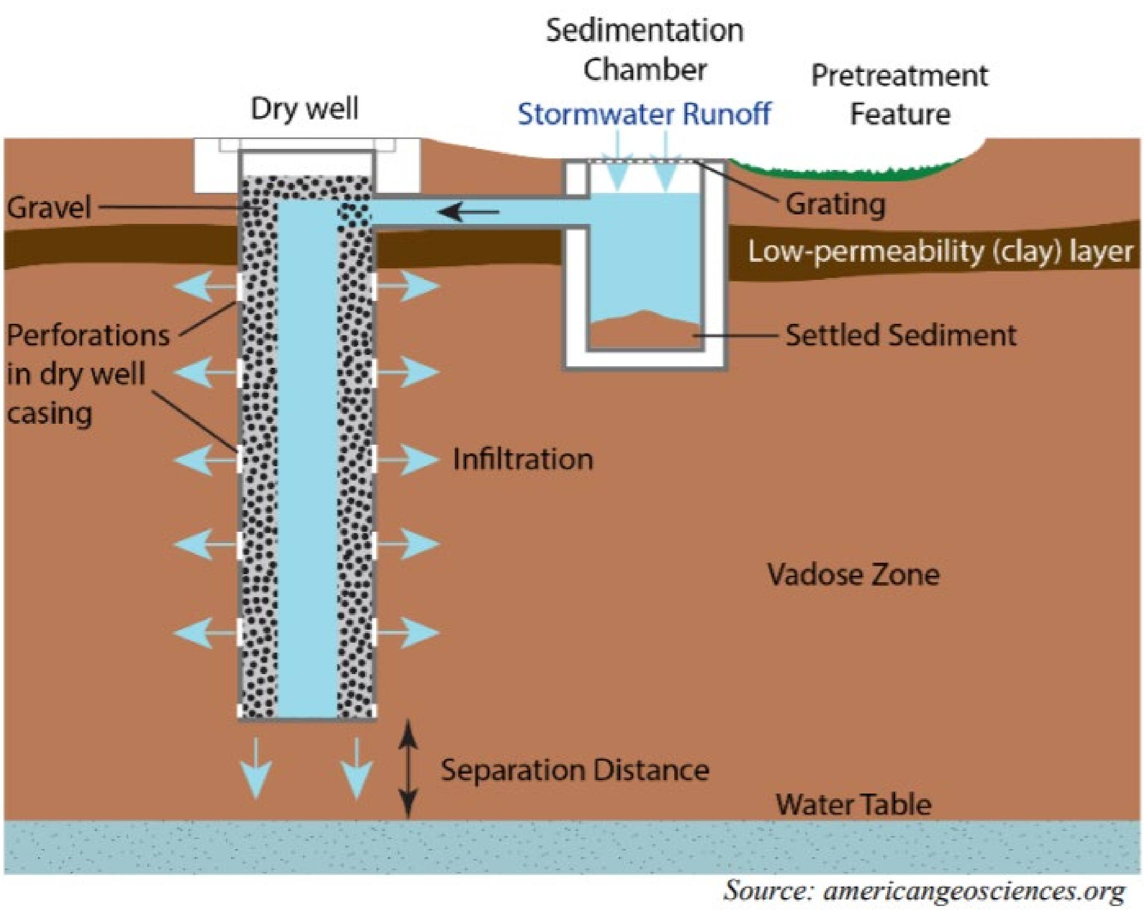

Figure 7-14. Typical Schematic for Dry Well Stormwater Recharge System (SWRCB, 2020)

[2] https://www.epa.gov/nps/urban-runoff-low-impact-development

There are 2 general concerns about LID and dry well feasibility (Geosyntec, 2020):

1. Groundwater quality degradation is possible from stormwater infiltration
2. Groundwater mounding from stormwater infiltration can cause surface seeps

This type of project works best in areas like the City of Corning with deep groundwater levels, low risk for shallow groundwater contaminants, and permeable subsurface geologic layers. Groundwater levels in the City of Corning were between 60 and 90 feet below ground surface between 2012 and 2020. This groundwater level should be deep enough to avoid mounding issues and allow contaminants that infiltrate with stormwater to attenuate in soil before they reach and impact the groundwater supply. Groundwater quality is good in municipal and small water system wells in and around the city, suggesting that groundwater quality impacts from urbanization and stormwater infiltration have not been an issue to date. Some pilot studies and water quality testing would likely have to be performed should the City implement a large scale dry well or LID project, in collaboration with the GSAs. Finally, most of the soil around the City of Corning was classified as "moderately good," "good," or "excellent" groundwater banking suitability, making it promising for surface infiltration projects (Figure 7-15). Areas with soil classified as "poor" groundwater banking suitability are less promising for surface recharge, but subsurface conditions could be better suited. The quaternary alluvium geology in this area has subsurface ancestral stream channels with coarse grained sediments that support groundwater recharge.

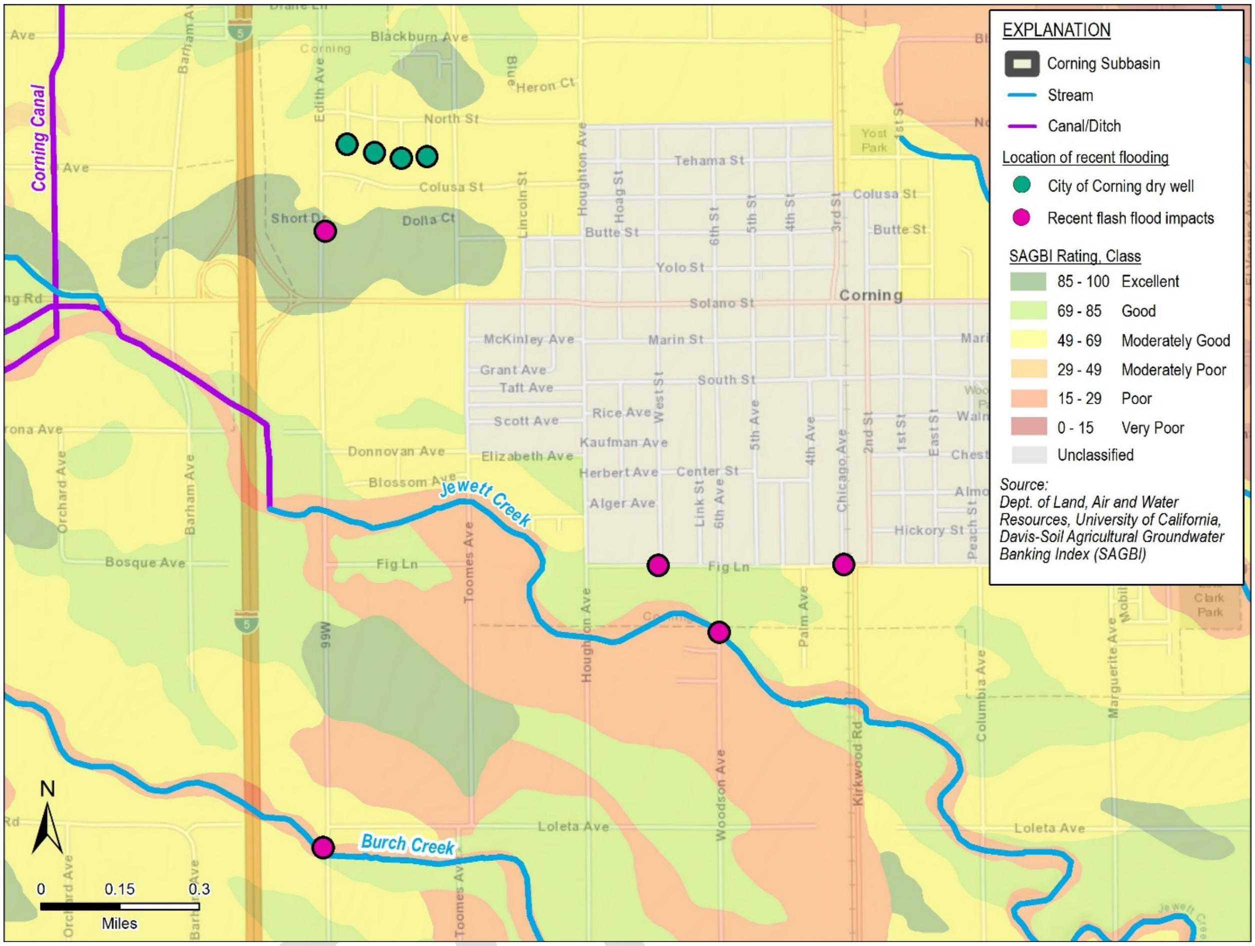

Figure 7-15. Soil agricultural Banking Index Near City of Corning Flooding

7.4.3.7.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation.** Increased groundwater recharge will result in higher groundwater levels.
- **Groundwater storage.** Increased groundwater recharge will result in higher groundwater levels, increased groundwater in storage, and will help achieve long-term sustainable yield.
- **Land subsidence.** Increased groundwater recharge reduces the potential for subsidence caused by overdraft from lowering of groundwater levels.

7.4.3.7.2 Expected Benefits and Evaluation of Benefits

This proposed project provides multiple benefits to City of Corning residents and the City of Corning DPW. LIDs or dry wells would decrease flood risks in areas where recent flood impacts have been noted. Most of the watershed to the west of the Subbasin was burnt in the 2020 wildfire season and therefore runoff is expected to increase in the future. In addition, climate change impacts are expected to increase flash flood events in the future as well. Through implementation of this project, the DPW could improve stormwater capture and prevent flooding, while providing a source of groundwater recharge for the aquifer. With LID or dry wells, stormwater infiltration would percolate to groundwater, rather than being conveyed through surface water drainages out of the Subbasin through the Sacramento River. Groundwater recharge from LID or dry wells would offset some groundwater level declines and storage loss due to pumping for the City of Corning municipal supply and other groundwater users in this area creating a more reliable groundwater supply.

7.4.3.7.3 Public Noticing, Permitting, and Regulatory Process

Multi-benefit stormwater capture mitigation strategies could be implemented in partnership between the GSAs, the DPW, and the Tehama RCD. Since this project is still in its conceptual phase, exact permitting and reporting requirements are uncertain. It is possible that LID and/or dry wells would require permitting and reporting for construction, operation, and maintenance. Requirements for municipal dry wells are likely more involved than LID since they require an additional U.S. Environmental Protection Agency (U.S. EPA) permit, as summarized from the SWRCB Dry Well Handout (SWRCB, 2014):

Dry wells are subject to the U.S. EPA Underground Injection Control (UIC) regulations. In California, Class V wells are overseen by the US EPA's Region 9 office. A dry well is considered a Class V injection well, which is defined as a conduit for non-hazardous fluids that is deeper than it is wide. Dry wells may be authorized to operate as long as they are registered with the US EPA, and only inject uncontaminated stormwater. The US EPA has no design requirements for dry wells; that responsibility is left to local authorities. However, the following design practices are encouraged:

- *Should not be constructed deeper than the seasonal high-water table*
- *Follow local guidelines for setback distances from the dry well bottom to the water table*
- *Go through a thorough site evaluation to prevent the spread of contaminants*
- *Utilize pre-treatment to remove sediment and the pollutants that they frequently carry*
- *Use backfill to improve dry well column stability*

Many requirements and design specifications for dry wells come from guidelines linked to the NPDES (National Pollution Discharge Elimination System) permits, issued by the State or Regional Water Boards for stormwater systems. Not all cities and counties have such requirements.

7.4.3.7.4 Circumstances for Implementation

The GSAs intend to support ongoing efforts by the City of Corning DPW to maintain and improve flood control structures. Project implementation will be initiated as funds become available and specific plans begin to form. No additional circumstances for implementation are necessary.

7.4.3.7.5 Implementation Schedule

Should the City of Corning DPW and GSAs decide to pursue this project, the first step would be to conduct a design study for estimating the planning, design, and construction costs and benefits. This analysis may take up to 5 years to initiate and complete prior to project implementation.

7.4.3.7.6 Legal Authority

The GSAs have the authority under the CWC (Section 10726.2 (b)) to "conserve and store water within or outside the agency" as well as authority regarding "the spreading, storing, retaining, or percolating into the soil of the waters for subsequent use".

7.4.3.7.7 Estimated Cost

The costs and maintenance requirements for LID and dry wells vary depending on site specifics and are therefore uncertain at this point for this conceptual project. LID stormwater basins are generally low cost and low maintenance alternatives to traditional stormwater capture systems. Dry wells are higher maintenance and higher cost alternatives to LIDs but are likely comparable in cost to a retrofit the current stormwater capture system. Dry wells have an added benefit of groundwater recharge that should be accounted for in future cost analyses. Operation and maintenance requirements for LID and dry wells include periodic removal of sediment and other debris from pre-treatment swales, sedimentation basins, and dry wells. LID and dry wells do not require the substantial stormwater capture and piping systems used for most stormwater systems. The permitting and monitoring costs and permit requirements for LID and dry wells is uncertain. The City of Corning may need a separate NPDES permit for the new stormwater capture mitigation strategies. Since the scope of this project is not fully developed, estimated costs will be evaluated during the design study of the project.

7.4.4 Alternative Projects

The priority projects listed above, coupled with the management actions described in Section 7.3 might not lead to full sustainability in the Subbasin. Five alternative projects are included in this GSP for further review during implementation, as needed. These projects will be implemented only if they are deemed cost effective, more favorable than priority projects, and/or are necessary to achieve sustainability. The alternative projects are summarized in Table 7-8 and described below.

Table 7-8. Alternative Projects

Alternative Project #	Project Name	Water Supply	Project Type
1	Groundwater Recharge Pond South of Corning	215 CVP water and irrigation runoff	Direct recharge
2	TNC multi-benefit recharge projects	215 CVP water or unused irrigation water	Direct recharge
3	California Olive Ranch Groundwater Recharge Project	215 CVP water or unused irrigation water	Direct recharge
4	Thomes Creek flood water diversions for recharge	Thomes Creek flood flows	Direct recharge
5	Groundwater Substitution Transfers from other Tehama County Subbasins	1. Environmental flows from Los Molinos habitat restoration projects 2. City of Red Bluff WWTP	In-lieu groundwater recharge

Note: Section 215 of the Reclamation Reform Act (RRA) allows for excess and unstorable winter/spring flows to be purchased by Water Districts through USBR (Appendix 7E).

7.4.4.1 Groundwater Recharge Pond South of Corning

As part of the Tehama-Colusa Canal water delivery system, a pond managed by USBR collects runoff and stormwater north of Liberal Avenue near the Corning Canal. This pond is between 2 and 4 AF in size. This pond has historically been used in the winter for flood control when the Corning Canal overtops, or during maintenance. This pond could be used as an opportunity to store 215 water for use during the irrigation season, or for direct recharge. This project would require USBR approval and collaboration. The potential sources of water for this project are summarized in Appendix 7E.

7.4.4.2 TNC Multi-benefit Recharge Projects

TNC is interested in partnering with growers for an on-farm, multi-benefit groundwater recharge program that provides critical wetland habitat for migratory birds. The program would use surface water supplies to flood and maintain shallow ponds on fallow or dormant fields using existing diversion, conveyance, and on-farm infrastructure. The program provides financial compensation to growers for recharging groundwater in the course of normal farming operations on a variety of crops. TNC seeks to implement the project in July to October or March to April to provide wetland habitat for migratory birds when water is scarce on the landscape. This on-farm recharge program requires short-term commitments from growers to irrigate and maintain shallow depths of 4 inches or less of water on enrolled fields. The program pays for field preparation, irrigation, and water costs. A pilot program was initiated in Colusa County in 2018 and concluded in the spring of 2020. This program was expanded to include DWR as a partner and include flood reduction benefits with pilot projects expected in Yolo, Colusa, Glenn, and Tehama Counties beginning in 2021, provided that water is available. Preliminary conversations were initiated with Corning WD as a potential partner to implement a pilot project in the Corning Subbasin.

7.4.4.3 California Olive Ranch Groundwater Recharge Project

An artificial recharge project at the California Olive Ranch property on South Avenue near the City of Corning is being developed concurrently with the GSP. The project layout shown on Figure 7-16 involves diverting water from the Tehama-Colusa Canal through an existing irrigation canal into an existing unlined basin where it can percolate to groundwater. The source of water could include Section 215 flood flows and possibly other water sources conveyed through the canal such as unused CVP contract water.

Feasibility analysis on this project is ongoing. Work is underway to determine the frequency of Section 215 and other available surface water in the area, to make projections about how frequently recharge could take place for this project. Discussions have been had with the TCCA regarding Tehama-Colusa Canal conveyance. A new turnout would be required for this project. The California Olive Ranch is considering an on-farm ponding test in the winter of 2022 to estimate infiltration rates in the proposed basin.

This project could be used as a proof of concept by the GSAs to design and implement other similar groundwater projects in the Subbasin using available surface water supplies.

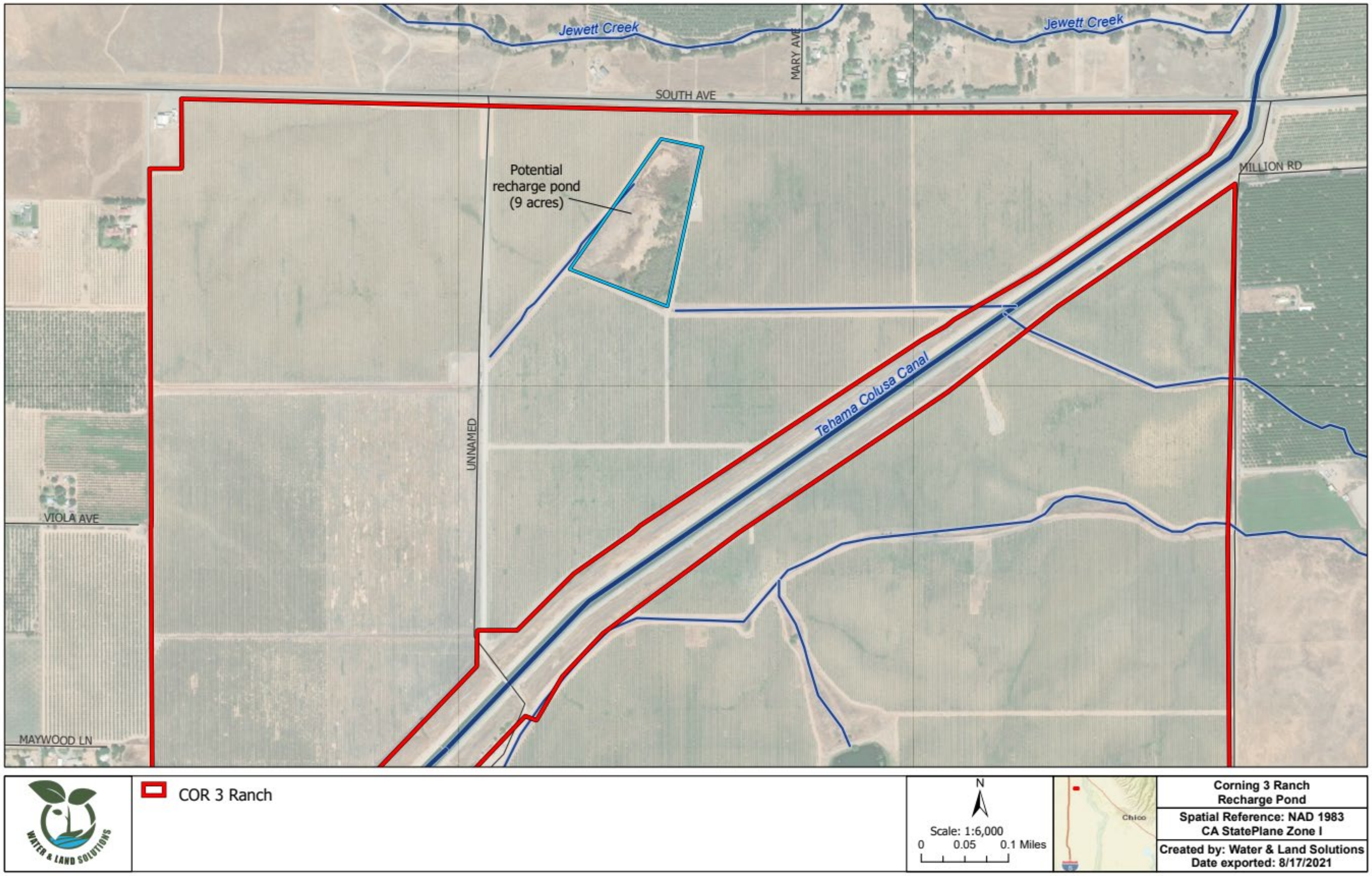

Figure 7-16. California Olive Ranch Groundwater Recharge Project Proposed Layout

7.4.4.4 Thomes Creek Flood Water Diversions for Recharge

It is unclear if there may be additional winter flood flows on Thomes Creek available for diversion of recharge; this project would evaluate the potential and feasibility of diverting winter flood flows on Thomes Creek to store off-stream to satisfy summer irrigation needs, or divert to a recharge pond. The potential sources of water for this project are summarized in Appendix 7E.

7.4.4.5 Groundwater Substitution Transfers from the Tehama County Subbasins

The purpose of this project is to capture surface water flows that were left upstream in streams tributary to the Sacramento River in the Los Molinos Subbasin for habitat restoration projects. Two groundwater substitution transfer projects are currently being evaluated conceptually before going into a feasibility study:

1. Trout Unlimited groundwater substitution transfer (on Deer Creek)
2. TNC groundwater substitution transfer on Mill Creek (or just simply releasing water down the creek for habitat benefits, that can be diverted to Corning Canal)

The potential habitat restoration projects are in various planning stages but may result in surface water being left in the streams to improve streamflow conditions for fish passage and other environmental benefits. TNC is working on the development of a deep test well to see if it would affect shallow groundwater, should a substitution transfer project be initiated.

This overall conceptual project would be developed in collaboration between Los Molinos and Corning Subbasins to get access to more surface water. Additional details will be developed during GSP implementation. The Water Districts in both subbasins will be involved to coordinate the use of the available infrastructure to divert the available surface water.

7.5 Funding and Collaboration Opportunities

Most of the projects and management actions described above cannot be implemented solely by the GSAs because they do not own water rights, need support for funding, as well as honoring the jurisdiction of other agencies. As noted above, collaboration between many entities will need to occur to implement the projects and management actions, with the GSAs acting as liaisons between state and local agencies, local water districts, and USBR. Additional discussion regarding project funding and grant opportunities is provided in the Plan Implementation Section 8.

7.5.1 Land Use Planning

The GSAs will work on an as-needed basis with Glenn and Tehama Counties, the City of Corning, Hamilton City CSD, and the Paskenta Band of Nomlaki Indians to assist with land use planning efforts. Coordination with the Counties on land use planning will primarily focus on general plan updates, as they occur in the future. The GSAs intend to provide input to the Counties regarding land use development, water demands, water availability, and locations of sensitive habitat including GDEs. The GSAs intend to notify the Counties and City of Corning planning departments during General Plan updates about the potential effects of land use changes on the GSAs ability to meet SMC for the various sustainability indicators.

7.5.2 Watershed Protection and Management and Flood Control

Watershed restoration and management benefits include enhanced flood control, greater groundwater recharge, reduced fire risk, and improved GDE habitat. While not easily quantified and therefore not currently included as projects in this Plan, watershed management activities may be worthwhile and benefit the basin, particularly in areas impacted by 2020 wildfires. Vegetated land reduces flood risk as plant roots hold soil in place, uptake stormwater, and slow overland flow. Healthy watersheds lead to greater groundwater recharge due to less stormwater runoff. Many small tributaries in the watersheds have high levels of siltation and diminished flood-carrying capacity due to invasive vegetation overgrowth. Invasive arundo overgrowth presents a wildfire risk because it forms thick stands of inaccessible and flammable vegetation. Finally, watershed restoration could benefit GDE habitat and priority species by providing more suitable habitat. Removal of silt, debris, and overgrowth of vegetation from streambeds is a recommended action in the Tehama and Glenn County Hazard Mitigation Plans (Tehama County, 2018; Michael Baker International, 2018).