



Rock Creek Flood Study Project Description

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Project Overview

The Rock Creek Flood Study Project is a feasibility study to identify flood risk reduction solutions in the Rock Creek-Keefer Slough watershed. The project will involve significant community input, with a series of at least four meetings to 1) Introduce the project, process, and timeline; 2) Seek input on solutions and criteria that will help prioritize project alternatives; 3) Refine project alternatives; and 4) Present a comparative analysis of costs and benefits of each project alternative. Meetings will be both virtual and in-person to accommodate as many people as possible. Additional meetings may be held as needed.

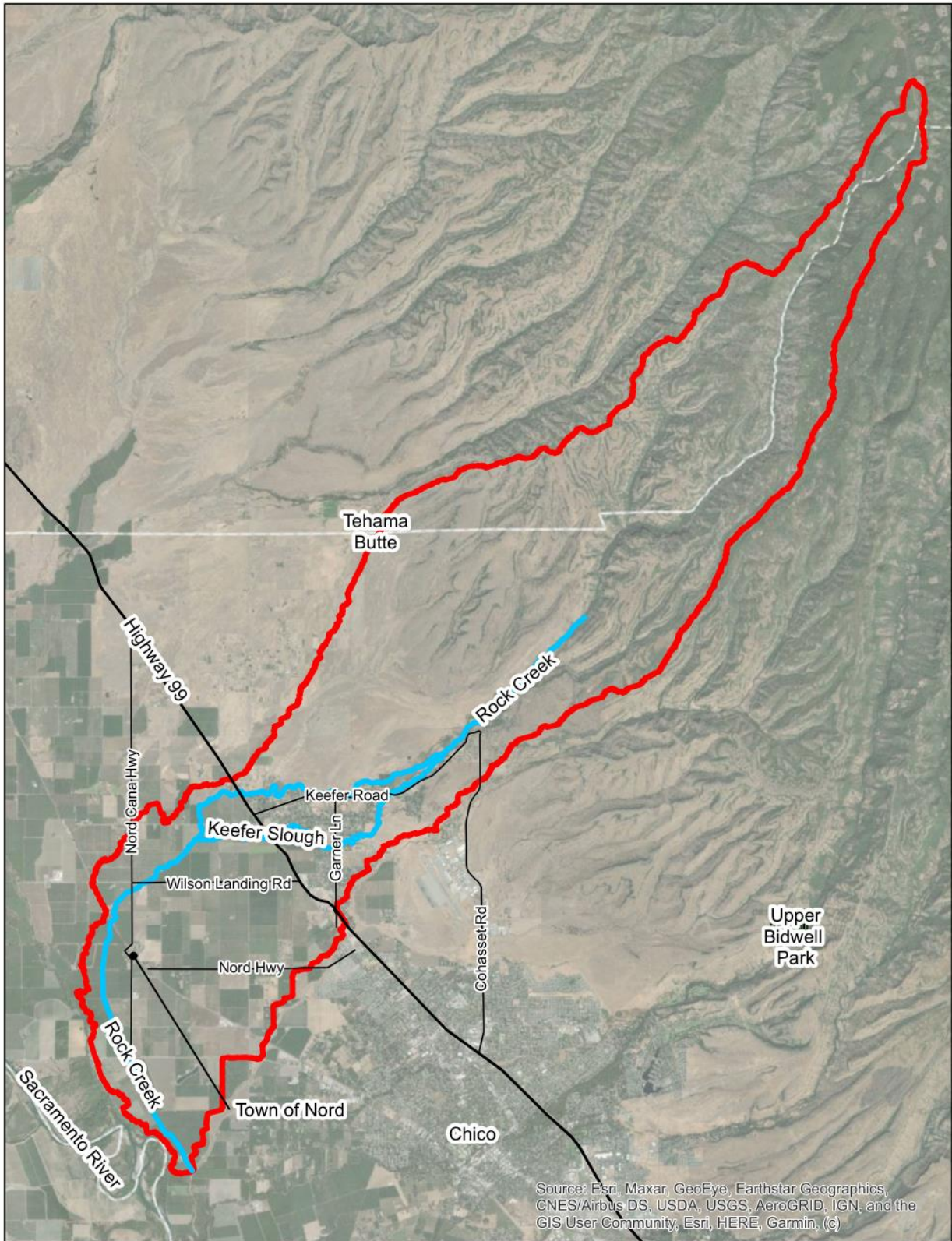
The Rock Creek Flood Study Project will help to determine the most effective and feasible projects that can be implemented to reduce flooding and improve flood safety in the Rock Creek-Keefer Slough Watershed. This feasibility study is the first step toward design and implementation of flood risk reduction projects in the watershed.

The process will begin with project scoping, continue with a robust alternatives analysis, and then clearly identify a preferred alternative. The study will incorporate quality engineering, economics, real estate, and environmental analyses, with the goal of ensuring that the feasibility study results in actionable and concise decision documents within a reasonable time frame and cost. The goal of the feasibility study is to identify a preferred alternative, which can include structural alternatives such as levees, and nonstructural alternatives such as waterproofing and raising structures.

Residents and community members will be integral in selecting the preferred alternative, as any governance mechanism for operation and maintenance of structural alternatives is likely to rest with the community. Multi-benefit projects that integrate other resource needs (such as water supply, ecosystem, recreation, open space, effective flood emergency response, storage, etc.) are more competitive in the future grant funding process during design and implementation, as will projects that can adapt to changing conditions (hydrologic, climate change, social, political, regulatory, or ecological conditions) and recover quickly after damaging floods.

Project Location

The project study area is the Rock Creek-Keefer Slough Watershed north of the City of Chico. The watershed includes several residential neighborhoods, the community of Nord, agricultural land, and other community uses in unincorporated Butte County. The watershed and study area boundaries are shown in Figure 1 below, and are generally east and west of Highway 99 from the headwaters of Rock Creek to the Sacramento River to the southwest. Principal roadways within the study area include Keefer Road, Garner Lane, Highway 99, Wilson Landing Road, Nord Highway, and Nord Canal Highway.



Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, HERE, Garmin, (c)

Project Need

The small community of Nord is vulnerable to flooding due to deficiencies in the Rock Creek/Keefer Slough system. Keefer Slough bifurcates from Rock Creek east of Highway 99 near Haggin Ridge and then rejoins Rock Creek approximately one mile west of State Highway 99. The lower reaches of Keefer Slough and Rock Creek impact the community of Nord.

Since 1995, four separate flood events have caused an average of \$19 million dollars in damages per disaster. The majority of the damage affects more than 200 single-family residences, businesses and up to 4,700 acres of farmland. Areas of State Highway 99 and 32 are frequently closed during flood events due to significant sheet flows. State Highway 32 serves as a critical evacuation route and emergency supply delivery route across the Sacramento River for Nord (including Hamilton City, Chico, and Princeton). The community of Nord also hosts a Red Cross Shelter (at Nord Elementary) that is critical for residents and the Mid & Upper Sacramento Region. Nord is located near the confluence of several major creeks and the Sacramento River. Rock Creek and Pine Creek flow southward to the west of the community, joining together with Mud Creek and Big Chico Creek before flowing into the Sacramento River south of Nord. These streams can back up and significantly impede local drainage in the community.

Flood events as well as changes in the landscape over the past sixty years have compounded the flood risks and intensified flooding as the current Rock Creek-Keefer Slough channel capacities are inadequate for this drainage basin. Some of these changes include the leveling of fields, increased private levees, and sedimentation in the system. There is strong local support for developing a flood control plan for the Rock Creek-Keefer Slough system.

A deficiency in the existing system is the Rock Creek-Keefer Slough flow split. Increased sediment and gravel accumulation have occurred on the Rock Creek side of the fork which then sends the majority of upstream flows through Keefer Slough, causing significant damage to areas downstream. Keefer Slough is designed to overflow in order to relieve flows from Rock Creek, but overland flow is hindered by inadequate sizing, design, and installation of flood control facilities (i.e. culverts, flap gates, detention basins, etc.). One such location exists just to the south of Nord, where floodwaters pond against the railroad tracks and impact residences along the southern edge of Nord.

The County is aware of the number of past studies that have developed solutions for flood protection in this watershed. However, not only is there a program requirement under the grant funding source for a feasibility study prior to any design and/or implementation projects, but the best outcomes for flood protection will consider evolving flood channel conditions, incorporate contemporary modeling, use up-to-date engineering analysis, and consider existing residents' current desires and financial climate when selecting feasible governance solutions.

Project Goals and Objectives

The broad goals of the Rock Creek Flood Study will be to evaluate alternatives for providing watershed residents with a 100-year level of flood protection. These goals also provide opportunities to improve aquatic and terrestrial habitat along Rock Creek and Keefer Slough, while also being sensitive to the needs and values of the local landowners.

More specifically, the objectives of the Feasibility Study are to:

- Identify the causes of the flood threats to the study area;
- Evaluate both structural and non-structural options for increased flood protection;
- Evaluate alternatives that contribute to measurable objectives for targeted metrics under the ecological objectives and goals set forth by “Metrics for Ecosystem Process, Habitat, and Stressor Objectives” outlined in DWR’s Draft Conservation Strategy;
- Assess current flood emergency response capabilities and recommend actions for improvements to flood emergency preparedness;
- Identify actions and groups of actions that may lead to reliable, sustainable and acceptable flood protection and improved ecosystem health and/or function along the project reach;
- Transfer information to landowners, stakeholders, and the public, and acquire landowner feedback;
- Develop a range of alternatives that may satisfy project goals;
- Identify preferred alternative(s);
- Evaluate funding opportunities needed to implement the preferred alternative(s); and
- Develop strategic plan for next steps and actions needed to advance the preferred alternative(s) closer to implementation.

Project Process

The project includes the following steps, which will be accomplished through a combination of public and stakeholder meetings, as well as technical review and analysis:

1. *Define goals, objectives, and constraints* – Develop a clear understanding of what the study will need to achieve and what the constraints are to achieving those goals. The public will play a key role in this task, as will coordination with other agencies to ensure alignment with other ongoing efforts such as the Upper and Mid-Sacramento River Regional Flood Management Plan, DWR’s 2017 Central Valley Flood Protection Plan (CVFPP), and the Conservation Strategy.
2. *Define existing conditions, problems, and opportunities* – Conduct a baseline assessment of the study area. Key to accomplishing this task will be analysis of existing data and studies, field surveys to identify types of hydraulic and/or flood control structures and map cross sections, and community input on recent conditions.
3. *Define project evaluation criteria* – With the community’s input, define the criteria that will be used to evaluate the identified projects for a preferred alternative.
4. *Project Development* – A menu of alternatives will be developed with input from the community as well as the following technical support:
 - a. *Hydrologic and hydraulic analysis* – The Feasibility Study Team will develop hydrological and hydraulic models to incorporate the latest topographic and bathymetric data from the Central Valley Floodplain Evaluation and Delineation (CVFED) program hydrological and hydraulic analysis of the study area included in the 1999 U.S. Army Corps of Engineers (USACE) Rock Creek – Keefer Slough Flood Protection Project Feasibility Study to incorporate the latest topographic and bathymetric data from CVFED. The onsite field surveys will be used to supplement the terrain data at critical locations.
 - b. *Floodplain mapping* – The Feasibility Study Team will use hydrologic and hydraulic models described above to develop a floodplain map for the study area. The Study Team will perform a floodplain evaluation for existing conditions and alternatives to

determine the potential for loss of life and property and better define the benefits of the array of alternatives. The Study Team will produce detailed floodplain work maps to include a delineation of the 100-year floodplain boundaries and water surface elevations. This will be done for existing conditions, as well as for each proposed project alternative.

- c. *Geotechnical exploration* - The Study Team will perform a study of the regional geology and geotechnical characteristics, review potential new levee alignments and suitable tie-in locations along existing levees, and identify potential borrow sites for suitable levee materials. Subsequently, a limited field investigation, which relies in part on the paper study discovery, will be performed along potential alignments. A field investigation will include borings and Cone Penetration Tests (CPTs) that will be used to further develop locations suitable for levee alignments and borrow areas.
5. Environmental analysis – An environmental analysis of the feasibility study will be completed per grant requirements to determine what the environmental constraints and opportunities are for the project.
6. Feasibility Study finance plan –The first phase of the finance plan includes working with the engineering and environmental teams after the alternative formulation process, to assist with alternative evaluation. Because financial feasibility is such an important factor in the alternative selection process, this effort will work to identify the following items for the array of alternatives being evaluated, the beneficiaries of each alternative, feasible local and non-local funding sources, and the associated near term and long-term funding requirements. These key data points are expected to factor into the evaluation and selection of the preferred alternative. The second phase will develop a full financial plan for the preferred alternative, including identification of the funding mechanisms proposed to implement the project, the quantification of the needed revenues, any associated financing and a strategy for the project’s implementation that includes a discrete set of recommendation for the project’s implementation.
7. Preferred alternative selection – This task consists of doing a comparative analysis of all alternatives and selecting a preferred alternative. The task will begin with the generation of feasibility level cost estimates for all construction, real estate requirements, operations and maintenance, and environmental mitigation costs, as well as an analysis of cost benefits. Consideration will also be given to the potential construction impacts and risks, and environmental and other permitting requirements. The alternatives will then be ranked based on the comparison of the costs and benefits to each of the other alternatives and the No-Action alternative, relative to the evaluation criteria defined in Step 3, in order for a preferred alternative to be selected. The community will provide much of the input on this task once the comparative analysis has been completed.
8. Implementation Strategy – An implementation strategy for the preferred alternative will be developed with the help of the community and the technical team.

Study and Project History

There have been several studies of the Rock Creek-Keefer Slough drainage area dating back to 1979. The most recent study is the 1999 U.S. Army Corps of Engineers (USACE) Rock Creek - Keefer Slough Flood Protection Project Feasibility Study; this study has not been completed due to a lack of funding.

The USACE enlisted the services of Borealli & Associates, Inc. in 1999 to complete an initial assessment to investigate flood problems within the Rock Creek-Keefer Slough watersheds in order to develop and evaluate preliminary alternative flood control plans. Major conclusions of the assessment are listed below:

- Frequent flooding of the study area (which includes Nord in Butte County) occurs due to overflow from Rock Creek and Keefer Slough;
- Frequent flooding of the study area causes significant damage;
- Alternatives exist to protect the study area from the 100-year flood event;
- Strong support is expressed by Butte County, The State Reclamation Board, and Caltrans for flood control measures;
- Butte County and The State Reclamation Board, the non-federal sponsors, have indicated a willingness and capability to share the costs of a Feasibility Study for Rock Creek and Keefer Slough; and
- A Flood Control Plan would yield an implementable and economically justified project that would reduce flood damages to public facilities, private property, agricultural lands, and reduce the occurrence of road and highway closures during storm events.

The project will compile all the available information from local, state and federal agencies, public records, and/or stakeholders to properly evaluate the existing and proposed hydraulics of the floodplain. The available study information will assist in review of existing flood control issues, developmental impacts, and wildlife habitat considerations. Various documents, models, and data are available which provide a history and depiction of the study site that will help to better understand local flooding concerns, including the following known data:

- USACE Rock Creek – Keefer Slough Flood Protection Project Feasibility Study
- DWR's FloodSAFE LiDAR and terrain data
- DWR's Flood Control System Status Report
- DWR's Non-Urban Levee Evaluation Program
- FEMA Effective FIS Report and DFIRMs
- DWR Central Valley Hydrology Study
- DWR Central Valley Floodplain Evaluation and Delineation
- Mid & Upper Sacramento River Regional Flood Management Plan
- Mid & Upper Sacramento River Regional Flood Emergency Response Project

Potential Alternatives/Solutions

The feasibility study will evaluate a suite of alternatives including but not limited to:

- Rock Creek/Keefer Slough bifurcation stabilization;
- Fix-in-place existing levees;
- New setback levees;
- Ring levees;
- Wing levees;
- Non-structural alternatives such as flood-proofing, raising existing structures, and improved emergency preparedness and response.

Any solutions will also need to consider ongoing maintenance and capital expenditures, and will likely require a governance structure to do so. A Proposition 218 Special Assessment was passed in 2013 for Rock Creek Reclamation District to implement improvements to the existing drainage system. In addition, Rock Creek Reclamation District is also pursuing funding to implement their Rock and Sand Creek Flood Mitigation Project. The proposed Rock and Sand Creek Flood Mitigation Project will build upon the work already initiated by the USACE to develop and assess potential solutions to flooding from the Rock Creek system, focusing on the potential for floodwater detention on Sand Creek. The project will assess potential hydrologic benefits of alternative detention strategies including creation of seasonal wetland habitats. The magnitude and timing of flood flows down Sand Creek and down the main-stem of Rock Creek will be also analyzed. The project will include an assessment of potential detention dam sites and examine the potential ecological benefits of new seasonal wetlands and groundwater recharge. Deliverables will include a feasibility analysis and conceptual designs, and there may be potential opportunities to include ecosystem restoration elements into the project. Future projects will also ultimately result in a reduced flood risk to the town of Nord.

Grant Program Funding

The Rock Creek Flood Study project is being funded by a State Department of Water Resources grant under the Small Communities Flood Risk Reduction Program (SCFRR). This grant program is an outflow of the 2012 Central Valley Flood Protection Plan, which provides for small communities (non-urban areas with fewer than 10,000 residents) to meet the FEMA 100-year level of flood protection.

The SCFRR program requires that selected projects first conduct a feasibility study of alternatives for providing 100-year flood protection, and all eligible projects for the grant application were limited to project feasibility studies. Structural alternatives identified in the feasibility study can lead to additional grant funding for the design and construction of projects to repair, rehabilitate, reconstruct, or replace facilities to improve flood protection.

Eligible project costs include the reasonable costs of studies, engineering, design, land and easement acquisition, legal fees, preparation of environmental documentation, environmental mitigations, monitoring, and project construction. Ineligible costs include operations and maintenance costs, reserve funds, and support of existing agency mandates. The SCFRR program provides the following shares of funding for this feasibility study:

- 100% of eligible costs up to \$500,000
- 50% of costs over \$500,000

Flood Management Authority

Butte County Public Works is responsible for responding to floods in unincorporated areas. However, the Rock Creek/Lower Keefer Slough Joint Operations Plan (Appendix to the Butte County Emergency Operations Plan) states that County staff will work with Rock Creek Reclamation District staff and local residents in order to meet flood response objectives.

Butte County has been a key participant and stakeholder in the Mid & Upper Sacramento River (MUSR) Regional Flood Management Plan (RFMP). Butte County is also a lead agency in the Upper Butte Unified Flood Fight Command. The MUSR RFMP was adopted in November 2014 and providing 100-year

protection for Small Communities within the region, including Nord, has been identified as a key priority for the MUSR RFMP. The Rock Creek Flood Study is specifically listed as a priority project within the MUSR Regional Plan.