California Resilience Challenge

2020 Grant Program Final Report

CALIFORNIA RESILIENCE CHALLENGE

BAY AREA COUNCIL

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The California Resilience Challenge is an initiative of the Bay Area Council Foundation, a nonprofit corporation, qualified as a tax-exempt organization under section 501(c)(3) of the Internal Revenue Code. The Challenge is administered by the Bay Area Council, a business-sponsored public policy advocacy organization for the nine-county Bay Area that was founded in 1945. Learn more about the Bay Area Council at bayareacouncil.org. Learn more about the California Resilience Challenge at resilientcal.org.

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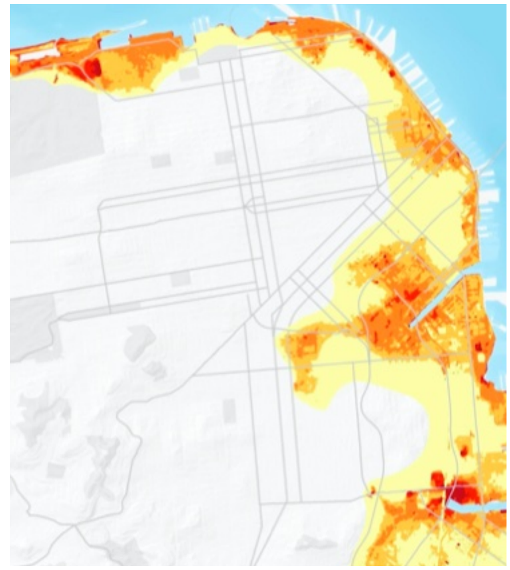

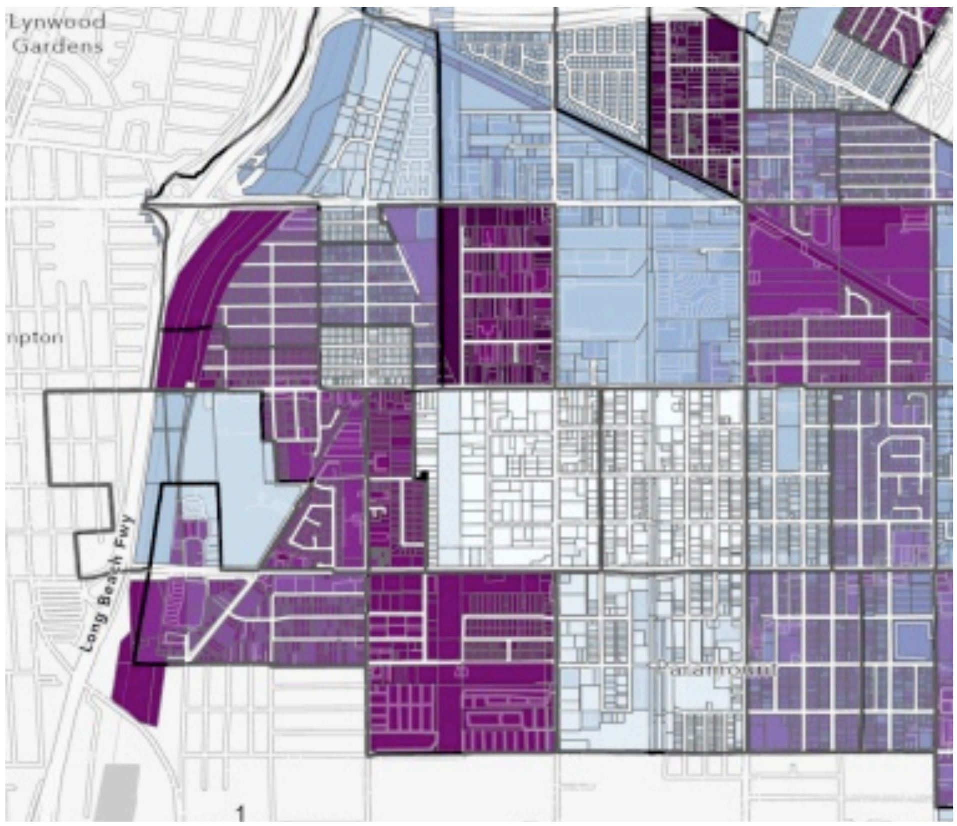
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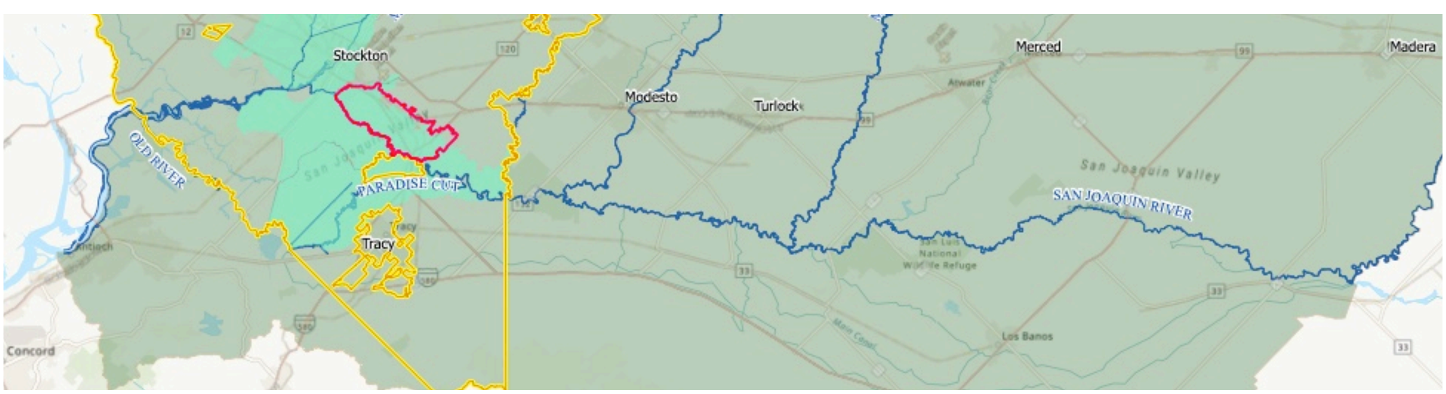
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Executive Summary

- Communities Served: **12**
- Total Grant Awards: **$2,031,723**
- Additional Funding Leveraged: **$33,894,754**

The Bay Area Council Foundation's California Resilience Challenge was launched in December 2019 with an invitation to local and regional public entities to propose innovative planning projects to strengthen wildfire, drought, flood, and/or heat resilience in diverse communities across California. The program's primary goal was to help innovative and replicable projects in under-resourced communities compete for advanced planning and implementation grants from state, federal, and philanthropic programs by providing them with small, early stage planning grants to help these communities get a jumpstart on their projects. Four years later, the 2020 Challenge's initial $2 million investment has been leveraged by grantees to raise an additional $34 million, including nearly $7 million for project implementation.

This report provides a summary of the progress made, and challenges encountered, by each of the winners of the 2020 Challenge. Highlights include:

- **1,600 workers trained** in geospatial forest LiDAR mapping to improve forestry management (Humboldt County Resource Conservation District)
- **Tree canopy analyses** in four under-resourced communities to reduce urban heat island effects (Gateway Cities Council of Governments).
- **Advanced modeling for several proposed flood protection projects** to protect Stockton area (San Joaquin Area Flood Control Agency).
- **Benefit calculator to expand use of green bonds** to finance Sierra meadow restoration projects (Yuba Water Agency).
- **Expanded groundwater recharge and recovery** opportunities in the Tulare Lake sub-basin (South Fork Kings Groundwater Sustainability Agency).
- **Interactive groundwater maps** detailing the impact of sea level rise on Bay Area groundwater tables (Aquatic Science Center).
- **Microgrid planning** at critical facilities in four under-resourced Southern California communities (Western Riverside Council of Governments).
- **Comprehensive green infrastructure plan** for the City of Watsonville (City of Watsonville).
- **Design plans to transform three San Mateo County K-6 schools** into local resilience centers (City/County Association of Governments of San Mateo County).
- **Microgrid designs** for the Santa Ana Regional Transportation Center (City of Santa Ana).
- **Tribe-managed, publicly accessible water quality data** and monitoring at Clear Lake (Big Valley Band of Pomo Indians).

The Challenge received 82 proposals with a combined ask of over $15 million. These proposals provided a rare glimpse into the demand for climate adaptation planning assistance across California. In consultation with an expert Advisory Committee and the California Governor's Office of Planning and Research, the California Resilience Challenge awarded over $2 million in climate adaptation planning grants to 12 communities across California, with at least one project in each of California's 10 census regions. Grantees included a mix of cities (2), counties (1), California Native American Tribes (1), resource conservation districts (1), flood protection agencies (1), water districts (2), Councils of Governments (2), and Joint Powers Authorities (2). Winning projects were required to demonstrate an innovative approach to strengthening local resilience either to droughts (1), wildfires (2), extreme heat (2), and floods (3), or a combination of multiple climate-stressors (4).

Grantees also faced several challenges. Grant work on nearly all projects was delayed due to the COVID-19 pandemic, which began in the United States three months prior to the grant award dates for each project. Public outreach meetings were shifted to virtual platforms, while other work—especially initial meetings between different public agencies and the release of RFPs for consultants—were delayed, in some cases up to a year. The COVID pandemic also resulted in one of the grant projects being cancelled after the grantee, San Diego County Office of Emergency Services, instead partnered with a United Policy-led initiative to develop a uniform set of mitigation standards adopted by the California Department of Insurance, Institute for Business and Home Safety, and Cal Fire. This funding was returned to the Bay Area Council Foundation and was folded into the next California Resilience Challenge grant round. Some challenges were unique to specific grantees. The Western Riverside Council of Governments was compelled to readjust project deliverables after determining their original project was beyond the reach of their resources. The South Fork Kings Groundwater Sustainability Agency was forced to delay the beginning of their groundwater replenishment and recovery pilot after the onset of severe drought disrupted the water deliveries needed to proceed with the pilot. The Big Valley Band of Pomo Indians struggled with capacity and staffing issues. These challenges resulted in an approximate 18-month delay to the completion of this final report on the 2020 grant round.

Global lessons from the 2020 grant round were challenging to identify given the sheer diversity of the projects in terms of geography, climate stressors, project types, and grantee type, and each project carried with it its own unique lessons explored further in each of the following sections. That said, nearly each project grappled with an infrastructure environment with incomplete or insufficient data, and insecure funding streams for later implementation. Grantees with robust partnerships with local community based organizations performed particularly well, for example the Gateway Cities Council of Governments partnership with Loyola Marymount University and Tree People. These types of partnerships will become a stronger feature of future California Resilience Challenge grant rounds.

To learn more about the Bay Area Council's climate initiatives, please contact Adrian Covert, Senior Vice President of Public Policy, at acovert@bayareacouncil.org

Aquatic Science Center

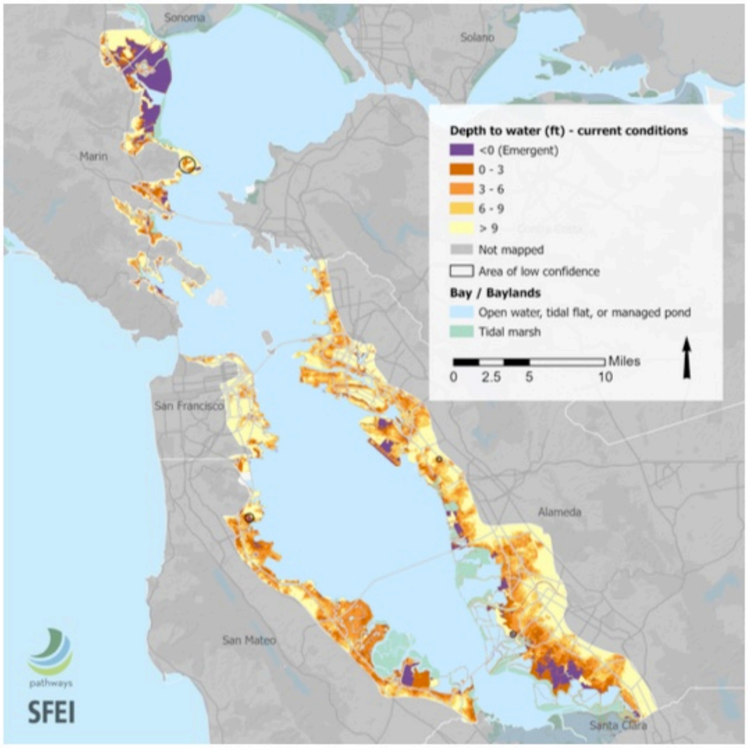
Project: Shallow groundwater response to sea level rise
Focus area: San Francisco Bay Area
Grant amount: $200,000
Climate threat(s): Flood
Additional funding leveraged: $105,000
Read the full report >>>

Summary
As sea levels rise and extreme storms become more frequent, many shoreline communities are developing climate adaptation plans to protect housing, jobs, ecosystems, and infrastructure from flooding. However, these plans often neglect an important potential flood hazard – rising groundwater. Shallow groundwater in coastal communities will rise as sea levels rise, which can damage buried infrastructure, flood below-grade structures, mobilize contaminants, and create aboveground urban flood hazards even before coastal floodwaters overtop the shoreline. Under this project, the Aquatic Science Center developed four groundwater maps that considered the response of shallow coastal aquifers to several sea level rise scenarios for Alameda, San Francisco, San Mateo, and Marin counties. These maps fill a critical data gap in regional climate resilience planning along the San Francisco Bay shoreline. Project managers were able to leverage progress made in this effort to raise an additional $105,000 to expand groundwater mapping to additional Bay Area counties.

Approach
This study mapped the existing shallow groundwater table and projected the rise of the groundwater table in response to sea-level rise. The methods build upon previous efforts to map the shallow groundwater table, including the rapid assessment of potential shallow and emergent groundwater hotspots in the Bay Area (Plane et al., 2017, 2019) and the subsequent efforts for the Cities of Alameda and Palo Alto (May et al., 2020; Pathways, 2022).
The existing shallow groundwater table was characterized using the following data sources:

- State Water Resources Control Board monitoring well observations
- Geotechnical reports with soil boring logs provided by city and county partners and collected from state agency databases
- San Francisco Bay tidal datums
- Water surface elevations in tributaries and managed ponds and lagoons

Using an interpolation technique in ArcGIS, the data sets described above were transformed into an approximation of the highest annual groundwater table (conditions during a wet winter after rainfall raises groundwater elevations). The groundwater surface was reviewed for irregularities and inconsistencies by the project team and city and county partners. Following the development of the existing conditions layers, the team developed layers approximating future conditions with sea-level rise under 10 different scenarios. The team also furnished additional overlay analyses to augment future-conditions projections.
Outcome



Existing conditions depth to water map. This layer is the baseline used to create the future conditions maps.

The project resulted in the creation of a complete project report describing the challenge of groundwater rise, the methods used in this study, the layers available for use by planners and associated guidance, and outcomes from the adaptation workshop; an existing and future condition depth to groundwater GIS dataset available for download (geodatabase format); a StoryMap providing background information and graphical representations of the processes and impacts of groundwater rise, accessible to a general audience; and interactive web maps showing (1) existing depth to groundwater; and (2) future conditions under various sea-level rise scenarios. The Aquatic Science Center leveraged work from this grant to receive an additional $75k from the State Water Board and $30k from the Pathways Climate Institute to extend the analysis into Contra Costa County.

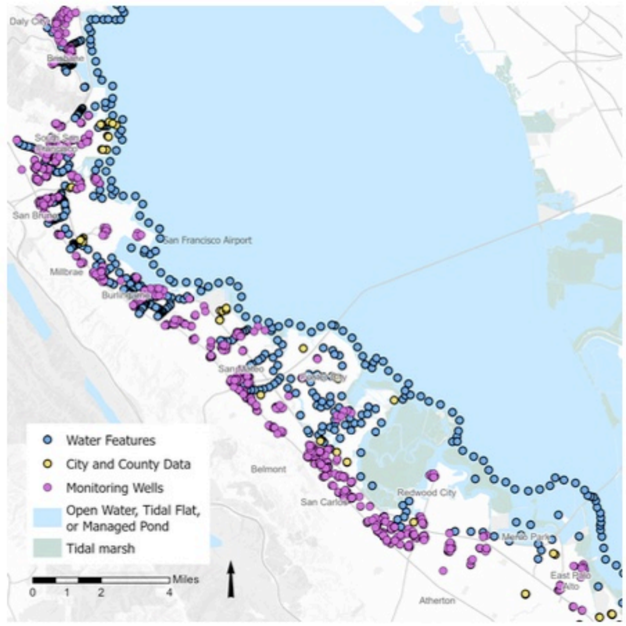
Sharing Results + Media

The project team presented this work at a special session on groundwater rise at the National Adaptation Forum in Baltimore, Maryland in October, 2022. Attendees from across the US were interested to learn how they might apply a similar mapping method for shorelines in their home regions. The final results also received extensive coverage in California media outlets.

- Los Angeles Times: New Bay Area maps show hidden flood risk from sea level rise
- Mercury News: New Bay Area maps show hidden flood risk from sea level, groundwater
- KQED: New Study Finds Rising Groundwater Is a Major Bay Area Flooding Risk
- San Francisco Chronicle: New map shows where rising groundwater adds flood risks
- KneeDeep Times: New Maps Reveal Bay Area Flood Threat From Below
- San Francisco Examiner: Rising groundwater is coming for your basement
- Marin Independent Journal: Marin's heightened flood risks illustrated in new study
- KALW: New study focuses on flood risks from sea level rise & rising groundwater
- ABC News: Study uncovers underground flood risk in Bay Area
- KRON4: Rising groundwater table levels could put these inland areas under water

Challenges

The largest barrier we encountered in this project was inconsistent collection of geotechnical reports with soil boring logs. Due to the COVID-19 pandemic, many of our city and county partners were unable to access these documents (many of which are stored on paper in government offices) in a timely fashion, which resulted in delays in our process. This was a key data source, used to fill geographic gaps in our primary dataset (State Water Resources Control Board monitoring wells). In most cases, we were able to wait until the geotechnical reports could be retrieved. In other cases, we were able to come up with creative solutions to fill data gaps, including finding data from state databases (Caltrans and the Department of Water Resources) and including additional points from hydrological features to smooth the interpolated surface. Another barrier encountered was in coordinating with local government partners. In some jurisdictions, staff turnover meant that those who had initially signed letters of support promising in-kind services were no longer available to help with the project, which resulted in additional coordination and outreach time to collect input data and review key outputs. In the end, we were successful in establishing new partnerships in jurisdictions where previous staff had moved on.



Data points compiled to map shallow groundwater in San Mateo County.

Lessons Learned

- Start with publicly available data if possible. The State Water Resources Control Board's Geotracker monitoring well dataset underpins the success of this effort; it is particularly valuable because wells are measured multiple times per year (seasonal variation is captured) and many of them have a long data time series (20+ years)

- Coordination is key. This project would not have been possible without the assistance of our city and county partners, who collected additional input data and reviewed outputs for accuracy. Engaging with partners early and often throughout the process resulted in a better product and hopefully more effective integration of results by planners.

- Gathering and georeferencing data from handwritten/scanned/PDF reports is time-consuming. Plan ahead if this will be a key input in groundwater mapping.

- Monitoring well data is more reliable than boring logs. Many geotechnical reports only report "first encountered" rather than "equilibrium" depth to groundwater. When groundwater was not allowed to reach equilibrium before measurement, data was often unusable based on comparison with surrounding wells.

- Automate processes whenever possible. Many changes arose throughout the process resulting in re-running analyses many times. We would not have been able to complete the project in a timely manner without creating scripts to automate analyses.

Next steps

The completion of this effort provides a wealth of groundwater information for Alameda, Marin, San Francisco, and San Mateo Counties that can inform climate resilience and adaptation efforts. However, additional work is needed to complete the mapping in Napa, Santa Clara, Solano, and

Sonoma Counties. The San Francisco Bay Regional Water Quality Control Board has provided $75k in additional funding for mapping Contra Costa County. Pathways Climate Institute and San Francisco Estuary Institute are working to identify funding sources for follow-up work, including:

- Map the remaining counties.
- Incorporate groundwater mapping into the ART Shoreline Flood Explorer.
- Analyze the potential for rising groundwater to mobilize contaminants.
- Develop outreach and messaging to support communities at highest risk of impacts related to rising groundwater, including vulnerable communities already facing other environmental and climate impacts.

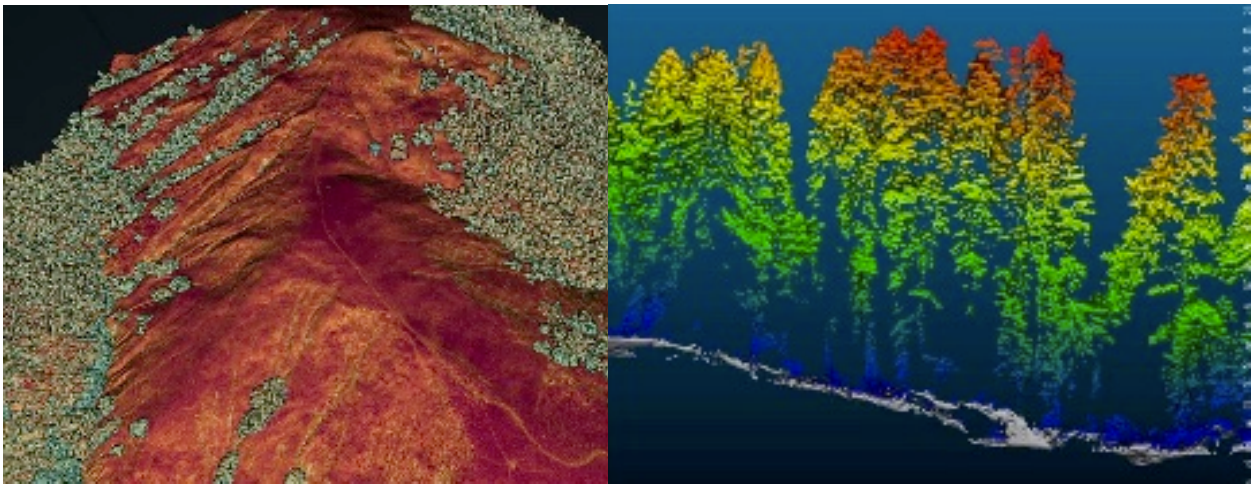
Learn more: Los Angeles Times, Mercury News, KQED, San Francisco Chronicle, KneeDeep Times, San Francisco Examiner, Marin Independent Journal, KALW, ABC News, KRON4

Humboldt County Regional Conservation District

Project: California Forest LiDAR Analytics Collaborative
Focus area: Humboldt County
Grant amount: $200,000
Climate threat(s): Wildfire
Additional funding leveraged: $4,480,500
Read the full report >>>

Summary
California and the federal government have together committed unprecedented resources to strengthening forest resilience via the Forest and Wildfire Taskforce. As these resources are deployed there is a growing need to monitor the effectiveness of various efforts with Airborne LiDAR—a uniquely effective tool for assessing the condition of forest structures. LiDAR-derived forest practices have been a core strategy in precision forestry and in commercial carbon offset forestry approaches for more than a decade. However, these practices have not been picked up by the public interest forestry sector responsible for implementing California's forest climate resilience strategy. The California Forest LiDAR Analytics Collaborative was developed to support technical adoption of LiDAR derived analytics by the community of practice, which also includes nonprofits, local agencies, tribal governments, and resource conservation districts. Under this project, the California Forest LiDAR Collaborative trained 1,600 workers in the forestry space and provided direct technical support to 10 geospatial forestry projects collectively worth $47 million, and leveraged initial an additional $4.5 million from state and federal agencies for specific LiDAR analysis projects.

Approach
The Collaborative launched with a series of presentations to 1,600 unique spatial data users within the climate resilience project developer community in the USGS Broad Area Announcement. These included the American Geophysical Union, the FOSS4G geospatial software conference, six different Forest Management Taskforce committees, Several Regional Geo Spatial User Group meeting, the Fire Adapted Communities Network, and the Regional Forest and Fire Capacity program. The Collaborative then held two training sessions with 18 participants spanning 10 weeks each. In total 65 people applied to take part in the workshops. Participants were selected competitively, with preference given to participants that had a clear nexus with forest health project proposals. These included employees from the USFS, CalFire, Department of Conservation, three Resource Conservation Districts, and two watershed councils. Every week we held one hour of prepared lectures and demonstration and then an hour discussion to explore common issues, work through code. Through this training we developed user story narratives and identified barriers to deployment of this technology. The core analytical and processing tools were the R package LidR, and PDAL, the Pointcloud Data Abstraction Library. There were a number of other tools like cloudcompare and grass that were also demonstrated. Participants developed geospatial data products that served their organizations goals.



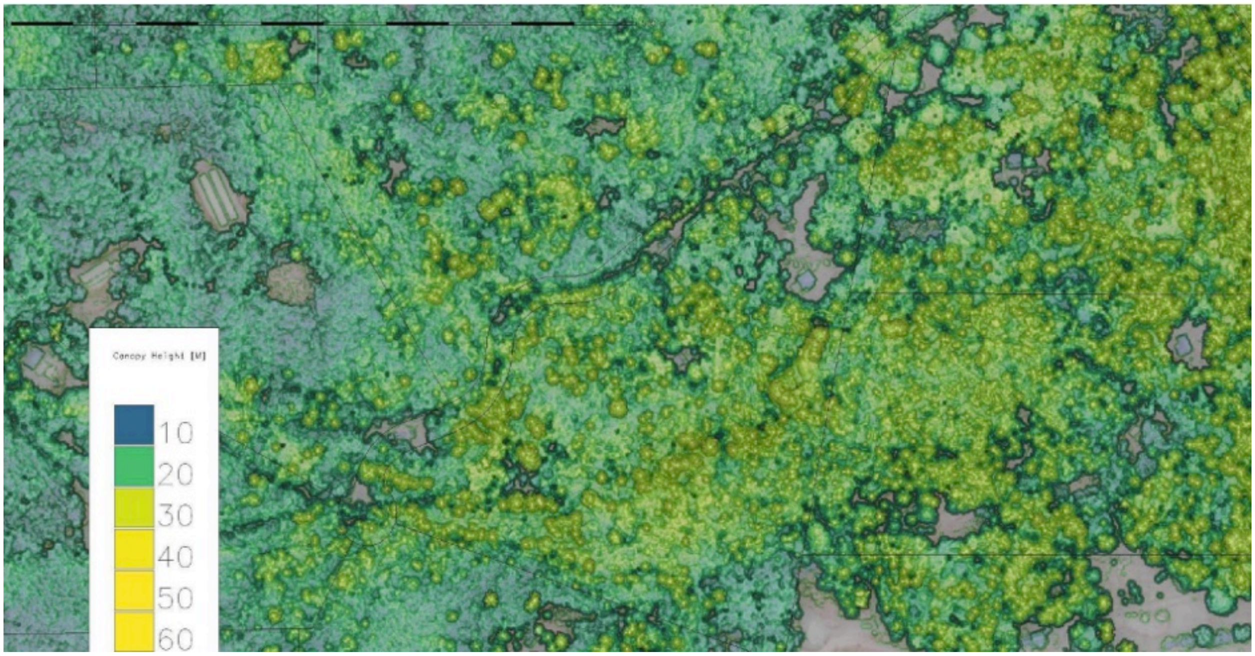
Outcome
Educated 1,600 people in the forestry sector about opportunities to improve management practices utilizing forest LiDAR technology; trained 36 workers in the community of practice across tribes, local governments, industry, and NGOs on how to incorporate LiDAR into forestry management; and provided direct technical support to 10 geospatial forestry projects worth $47 million. These include:

- **USGS Northern California 3D Elevation Program LiDAR Broad Agency Announcement ($7 million)**. The Collaborative helped the North Coast Resource Partnership secure a $7 million grant from the USGS for a 50,000 square kilometer Level 1 LiDAR acquisition across 13 Northern California counties while laying groundwork for additional data collections covering additional Northern California Counties. Learn more >>>

- **Yurok Tribal Fisheries, Dept. of Commerce Economic Development Grant ($5 million)**. The Collaborative supported the development of the Yurok Tribal Government's technical strategy portion of their USGS LiDAR collection effort on the mainstream of the Klamath River, an important step towards the Klamath Dam removal projects. In addition, the Yurok were awarded a portion of the Northern California 3DEP grant covering their ancestral territory. Learn more >>>

- **Klamath Basin Post-Fire Mutual Aid Agreement ($11 million).** Assisted the Yurok Tribe in securing a 10 billion point photogrammetric point cloud over 90,000 acres flown 18 days after catastrophic debris flows following the McKinney Fire in Siskiyou County to create a unique dataset recording an extreme post-fire sediment event before and after the first winter and will be instrumental in the post-fire recovery work.

- **Northern Mendocino Forest Health Collaborative ($4.5 million).** Working with the Redwood Forest Foundation and the Bureau of Land Management (Arcata Field Office), the Collaborative developed single tree inventories of proposed treatment areas that were included in a 2021 Forest Health award the early dataset was particularly important for the fuel break near the Northern terminus of Highway 1. Development of the treatment and access plan was especially important because it reduced the traffic control issues during implementation.



- **Sonoma State University CalFire Forest Health Research Grant ($500,000).** This project involves validation and operationalization of data from the GEDI full wave form LiDAR system on the International Space Station for statewide forest canopy change detection between 2019 and 2022.

- **Tenmile Creek Forest Health Assessment Pilot Project ($140,000)**. Developed 15 forest management plans in the Ten Mile Creek Watershed. For each parcel LiDAR derived tree inventories were developed and provided to the landowners and the foresters developing the plans. **Learn more >>>**

- **Tenmile Creek Watershed Forest Health Implementation Plan ($5.9 million)**. Building on the community outreach from the North Coast Resource Partnership Forest Health Pilot Regional Assessment, a large environmental compliance and implementation plan was developed in a critical coho salmon watershed near the source of the South Fork Eel River in Mendocino County. This was particularly innovative because it included a record number of small nonindustrial forest landowners in a Forest Health proposal. **Learn more >>>**

- **Upper Trinity Wildfire Resilience Planning Grant ($1.5 million)**. In 2022, the Sierra Nevada Conservancy invested in a planning proposal that included a significant investment in geospatial planning infrastructure. This included a watershed wide LiDAR derived tree census and the second USGS 3DHP compliant elevation derived hydrography coverage in California. This is arguably, one of the leading geospatial forest and watershed planning initiatives in the State.

- **Klamath Meadows Partnership ($1.5 million).** The Klamath Meadows Partnership is a consortium of 20 NGO's, tribal governments, agencies and Universities working on meadow restoration in the Klamath, Cascades and Coast Ranges. LiDAR hydrologic assessments and landform analysis is a critical component of the regional prioritization strategy.

- **Humboldt Bay Municipal Watershed Forest Health Watershed Recovery Plan ($5 million).** Cross boundary post fire recovery proposal in the Mad River Watershed, which is the source for the Humboldt Bay Municipal Water District and was severely affected by the August complex in 2020.

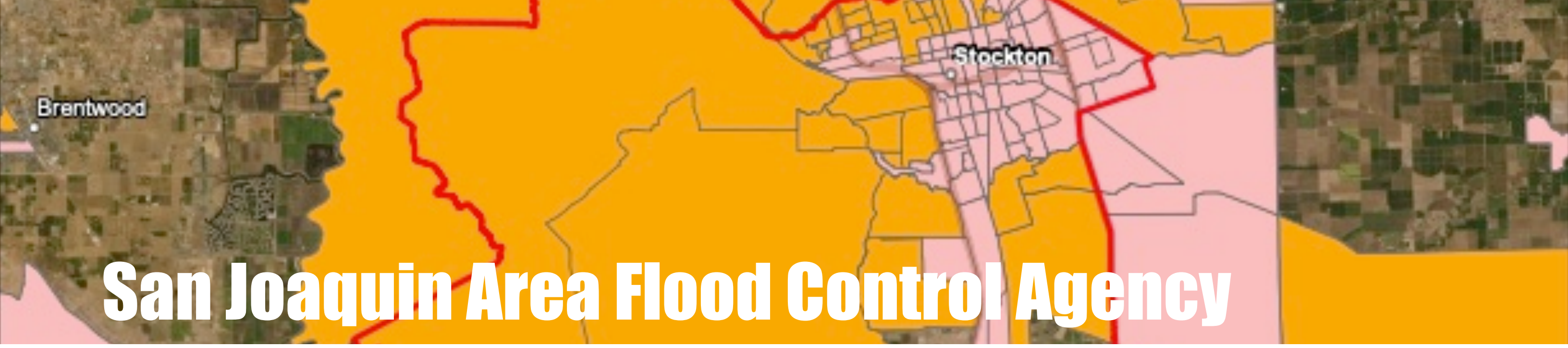
Challenges & Lessons Learned
Many of the Collaborative's early assumptions about efficiencies using cloud resources were not be as compelling as initially believed. Most projects are ultimately achievable with current generation, consumer-grade equipment. In most use cases that we worked with users elected to migrate to local resources at the end of our support. The scaling issues are much more pronounced for enterprise users at agencies. For example, if you have a 800 square km Forest Service Ranger District with a USGS QL1 LiDAR coverage your primary point cloud could be 250 gb. Individually this is manageable with consumer grade storage solutions. If you have ten advanced geospatial users accessing the point cloud and creating individual copies, the storage costs will ramp up dramatically. For rural ranger stations or other outposts reliant on limited internet bandwidth, hybrid strategies that deployed a blend of cloud and local applications can help optimize performance. Our assessment is that enterprise geospatial users have some of the highest returns for investments implementing FAIR best data management practices. Thus far agencies only have limited ability to implement these practices. Unfortunately, we see that the enterprise investment in commercial software acts to reinforce idiosyncratic file management systems by individuals at the agencies. These practices result in several systemic inefficiencies. These patterns were on display in a project to populate a county wide geospatial infrastructure system using internal Forest Service data products.

Next Steps
While there are specialized skills needed to work with Lidar and point clouds there is also clear need for building geospatial capacity in general. One proposal in development is for a micro credential system to be hosted between the Watershed Center and Shasta College. This would serve as a professional geospatial development hub for the North State. There are several geospatial data systems in development including the Climate and Wildfire Institutes regional toolkits, the USGS 3DHP program, and the Air Resources board's interagency implementation tracker are recent developments. In each case we are seeing a need for advanced workforce development to make these tools work for the network of users. Additional needs and opportunities including drone-based sensing for monitoring forest treatment and species recovery projects such as the Yurok Tribe's Condor Aviation Program.

San Diego County Office of Emergency Services

Project: Fire Mitigation Certificate Pilot Project
Focus area: San Diego County
Grant amount: $20,000
Climate threat(s): Wildfire
Read the full report (N/A)

Summary
Worsening wildfire risks across California are prompting insurance companies to cancel policies, raise rates, and consider dropping out of the California property insurance market altogether. The Fire Mitigation Certificate Pilot Program intended to create a viable model for certifying wildfire mitigation improvements to property for discounted insurance premiums. The COVID pandemic allowed one of the pilot's partners, United Policy to remotely convene subject matter experts, researchers, community Fire Wise and Firesafe groups, and industry and government representatives for monthly brainstorming meetings to advance consensus on mitigation standards. With this rare opportunity, the effort to define the mitigation standards moved swiftly and was incorporated into efforts by the California Department of Insurance, Institute for Business and Home Safety, and Cal Fire, resulting in a uniform set of mitigation standards adopted by all, and the roll out of the IBHS "Wildfire Prepared HomeTM" designation in the Town of Paradise, which made the mitigation certification pilot irrelevant. A majority of funding was returned to the Bay Area Council Foundation and was folded into the 2023 California Resilience Challenge grant fund.



San Joaquin Area Flood Control Agency

Project: Lower San Joaquin River Regional Flood Risk Reduction & Climate Resilience Reconnaissance Study
Focus area: San Joaquin County
Grant amount: $200,000
Climate threat(s): Flooding
Additional funding leveraged: $23,000,000
Read the final report >>>

Summary
The California Department of Water Resources estimates climate change will roughly triple the flood risks along the Lower San Joaquin River in the next 50 years. A future major flood event could overwhelm existing flood protection infrastructure, threatening structures, critical infrastructure, and residents living near lower San Joaquin River, the majority of whom are located in under-resourced or severely under-resourced communities in and around Stockton and Manteca. This project helped identify goals, opportunities and constraints along the Lower San Joaquin River; review information and key findings from past and ongoing studies; improve coordination and planning amongst key stakeholders within the LSJR region and upstream areas of the SJR watershed; and conduct initial screening and prioritization of systemwide flood risk reduction concepts to advance for further study. The project identified several opportunities for flood protection for which project managers have subsequently received over $23 million in state and federal funding for further development.

Approach
SJAFCA staff first organized a comprehensive outreach strategy to key stakeholders about increasing flood risks and potential flood protection opportunities the agency could pursue, these included:

- SJAFCA Member Agencies, including the cities of Lathrop, Manteca, Stockton, and San Joaquin County
- SJAFCA Board members
- Counties of Merced and Stanislaus
- Reclamation District (RD) in the LSJR Region
- San Joaquin County Advisory Water Commission
- California Department of Water Resources (DWR) Technical Teams, including: San Joaquin Water Resilience Portfolio 25.4 Transitory Storage working group, the FIRO-MAR learning group, the Central Valley Flood Protection Board (CVFPB), the CVFPP Project Team
- Non-Governmental Environmental Organizations including River Partners and American Rivers

These stakeholders offered valuable advice and recommendations for the project management team, including the incorporation of

- Broader integrated water management opportunities (including water supply, groundwater recharge, and reservoir operations) into the study's flood risk reduction strategies

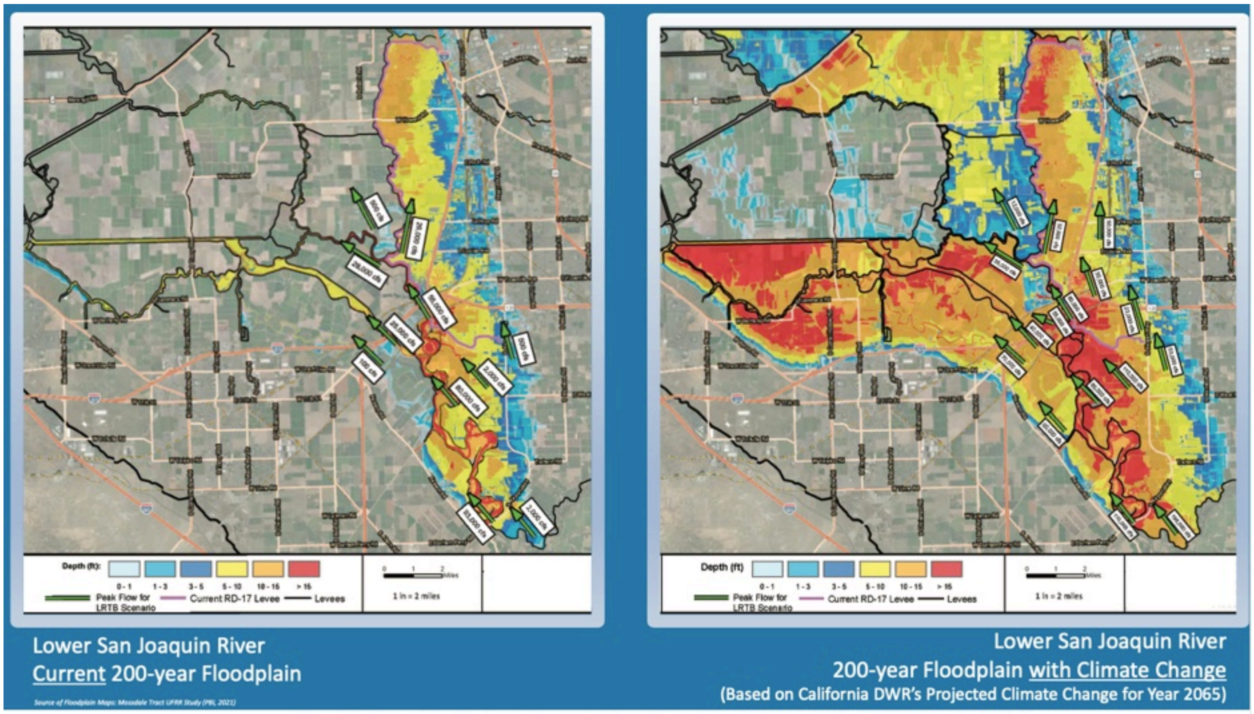


Figure ES-2. 200-year flooding along the Lower San Joaquin River - Current Climate vs. Projected Future Climate Conditions

- Transitory storage opportunities in upstream areas along tributary streams.
- Modifications at reservoirs, including increased storage and re-operation, into the study's flood risk reduction strategies was a high priority.
- And non-structural measures into the systemwide flood risk reduction strategies.

The project management team also undertook a comprehensive analysis of past and ongoing studies relating to flood risks on the Lower San Joaquin River and climate projections, including:

- Central Valley Flood Protection Plan (CVFPP) [DWR, 2012, 2017, 2022]
- San Joaquin River Basin-Wide Feasibility Study (BWFS) [DWR, 2017]
- Reservoir Vulnerability Analysis [DWR, 2022]
- Lower San Joaquin River and Delta South Regional Flood Management Plan (LSJRDS RFMP) [SJAFCA, 2014, 2020]
- Mossdale Tract Area Urban Flood Risk Reduction (UFRR) Study [PBI, 2021]
- Paradise Cut Expansion Project Conceptual Design Technical Memo [American Rivers & South Delta Water Agency, 2019]
- DWR Flood-MAR Studies for various SJR watersheds [In-Progress]
- UC Davis Soil Agricultural Groundwater Banking Index [O'Geen, 2015]
- Delta Adaptation Strategy [Delta Stewardship Council (DSC), 2022]
- USACE Lower San Joaquin River Feasibility Study (LSJRFS) [USACE/SJAFCA, 2018]
- USACE Lower San Joaquin River Project (LSJRP) [In-Progress]
- USACE Water Control Manual Updates for various SJR Reservoirs [In-Progress]

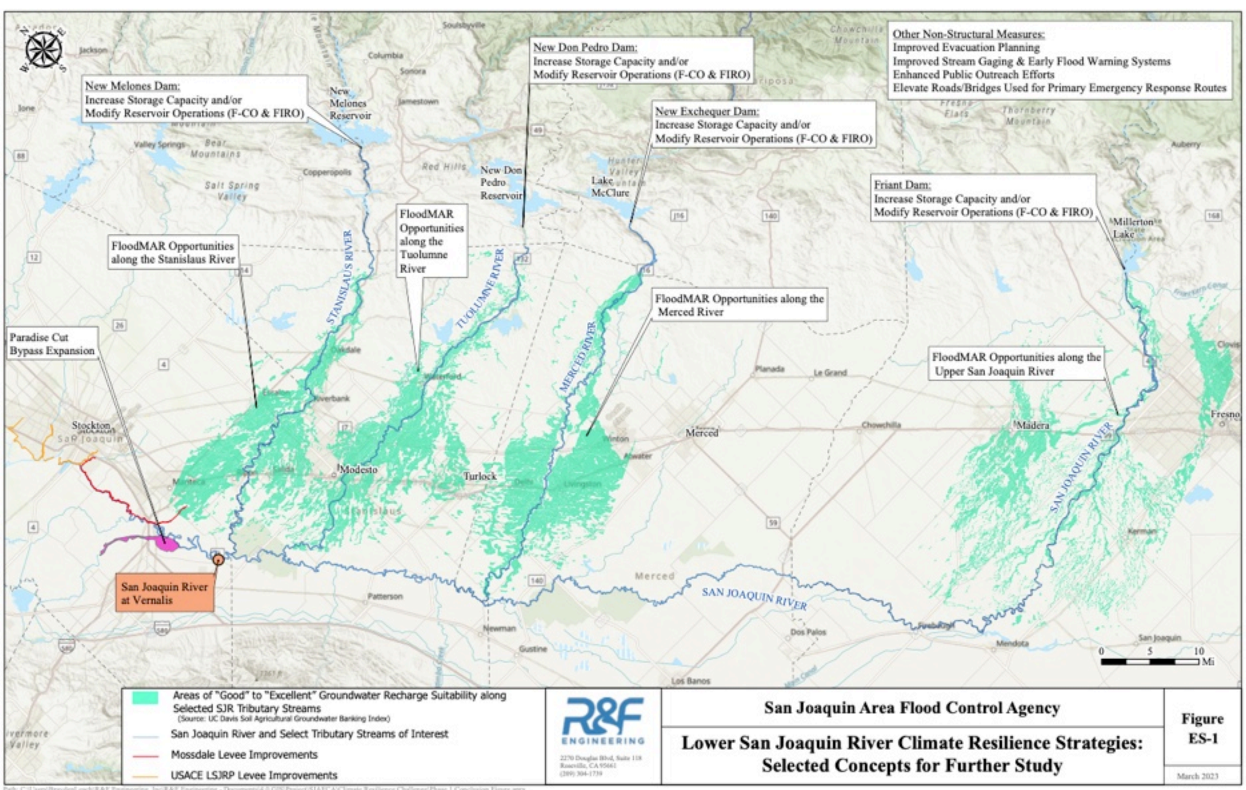
Outcome
Following preliminary screening evaluations and stakeholder discussions, the project team produced a narrowed-down list of conceptual projects to guide the direction of SJAFCA's future planning efforts. The selected concepts include:

- **Paradise Cut Bypass Expansion:** Recommendation to look at three different variations of modifying the Paradise Cut channel as an expanded flood bypass.

- **Modifications to Upstream Reservoirs**: Recommendation to look at modifications to upstream reservoirs along the San Joaquin River, including modifications to expand storage capacities and modernizing reservoir operations with enhanced forecasting technology. Don Pedro, New Melones, McClure, and Millerton reservoirs were selected as the reservoirs to evaluate in Phase 2 of the study as they are the most vulnerable to climate change and have the greatest potential impact on peak flows along the Lower San Joaquin River.

- **Flood-MAR Opportunities on Tributary Streams**: Recommendation to identify promising opportunities along tributary streams of the SJR to take excess flows from river systems and spread them out onto adjacent lands to promote managed aquifer recharge.

Enhanced outreach to SJAFCA partners and other stakeholders was also a critical element to the success of the LSJR Climate Resilience Study. The outreach efforts reached a broad group of stakeholders. As a result, the project team received valuable feedback from federal, State, and local perspectives that represented various interests throughout the watershed. This project resulted in an additional $23,418,600 worth of investments from the California Department of Water Resources and United States Army Corps of Engineers to further develop the potential projects identified by the agency as part of this Resilience Challenge grant.



Challenges & Lessons Learned
The primary barrier that occurred during the LSJR Climate Resilience Study was a lack of opportunities to gather with stakeholders due to the ongoing pandemic in 2020 and 2021. This issue is further described in the 'External Factors' section below. The CRC grant agreement was signed and executed in June 2020 and the project started in September 2020, during the first year of the COVID-19 pandemic. As previously mentioned, stakeholder outreach is critical and necessary for this type of large-scale, regional flood risk reduction study. The pandemic presented a challenge in planning the approach to stakeholder outreach. In-person workshops, tours, and meetings of technical working groups did not occur early on in the project (2020 and 2021) due to ongoing social distancing measures. However, extensive outreach was accomplished through virtual meetings and in-person meetings in 2022 which fostered involvement of stakeholders that brought multiple perspectives to the table.

Next Steps
With additional support from the state and federal governments, the San Joaquin Area Flood Control Agency is further developing each of the opportunities first targeted by this project including:

- **$13,000,000** from the California Dept. of Water Resources to study and design the Paradise Cut Bypass Expansion and Multi-Benefit Project

- **$260,000** from the California Dept. of Water Resources' Regional Flood Management Program (RFMP) to ensure that the climate resilient features identified in SJAFCA's 2020 California Resilience Challenge study get incorporated into state policy and planning documents, including the 2022 Central Valley Flood Protection Plan (CVFPP). The RFMP funding has also been used to advance communications and collaboration with upstream stakeholders with regards to implementation of modifications at upstream reservoirs and implementation of FloodMAR opportunities in upstream areas of the San Joaquin River watershed which were both identified as a key, regional strategies in SJAFCA's 2020 CRC Study.

- **$7,000,000** from the U.S. Army Corps of Engineers for a federal feasibility study to advance improvements to the Mossdale Tract area levee system.

- **$3,153,600** from the California Dept. of Water Resources to advance improvements to the Mossdale Tract area levee system.

Yuba Water Agency

Project: Climate Resiliency with Forest Health Collaborations Mines and Meadows in the Yuba River Watershed
Focus area: Sierra Nevada Foothills
Grant amount: $200,000
Climate threat(s): Wildfire
Additional funding leveraged: $1,313,956
Read the final report >>>

Summary
The Sierra Nevada Mountains and Foothills contain California's most important green infrastructure for water and carbon storage: annual snowpack, meadows, and forests. Yet the 5,000-8,000-foot elevation band where these resources occur has suffered significant damage from past mining and grazing activities and is also the zone predicted to experience the greatest impacts due to climate change over the next century. This project sought to strengthen forest resiliency by integrating the economic value of hydraulic mine and meadow restoration projects into forest health projects by developing planning and financial mechanisms that fund a combination of restoration and remediation activities. Climate resilience outcomes include

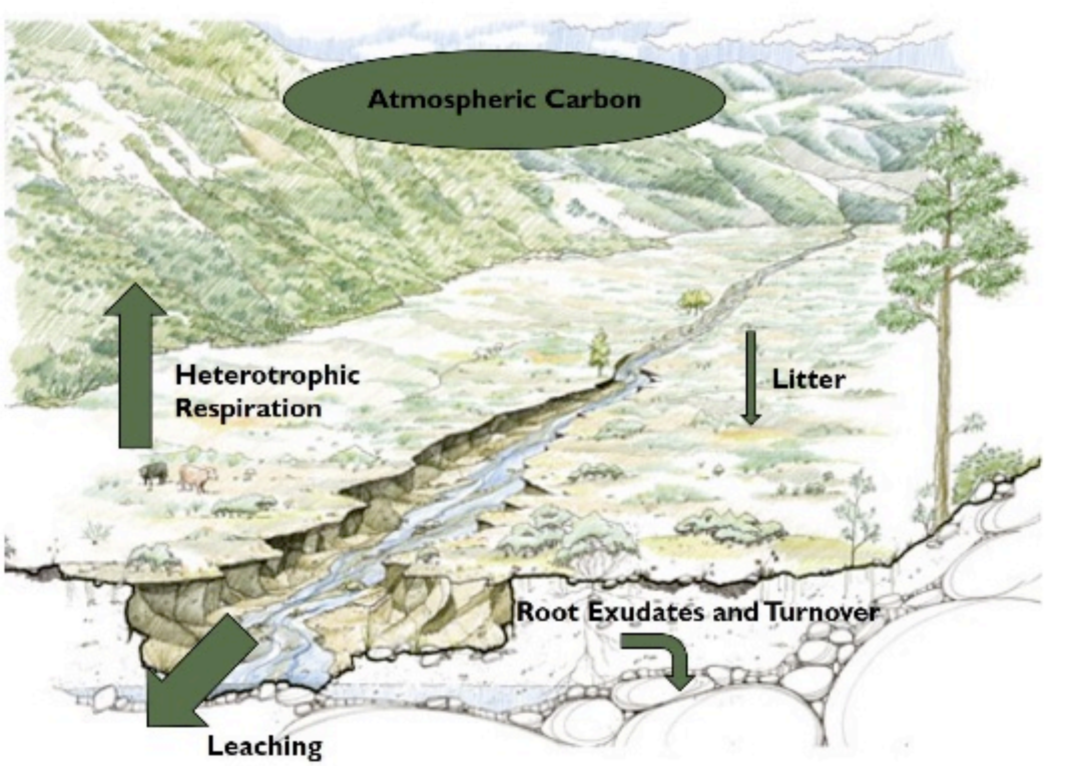


Figure 1. Degraded Meadow Conceptual Model for Carbon Cycling. Size of arrows correlates to carbon flux rates. (Base Image property of Restoration Design Group).

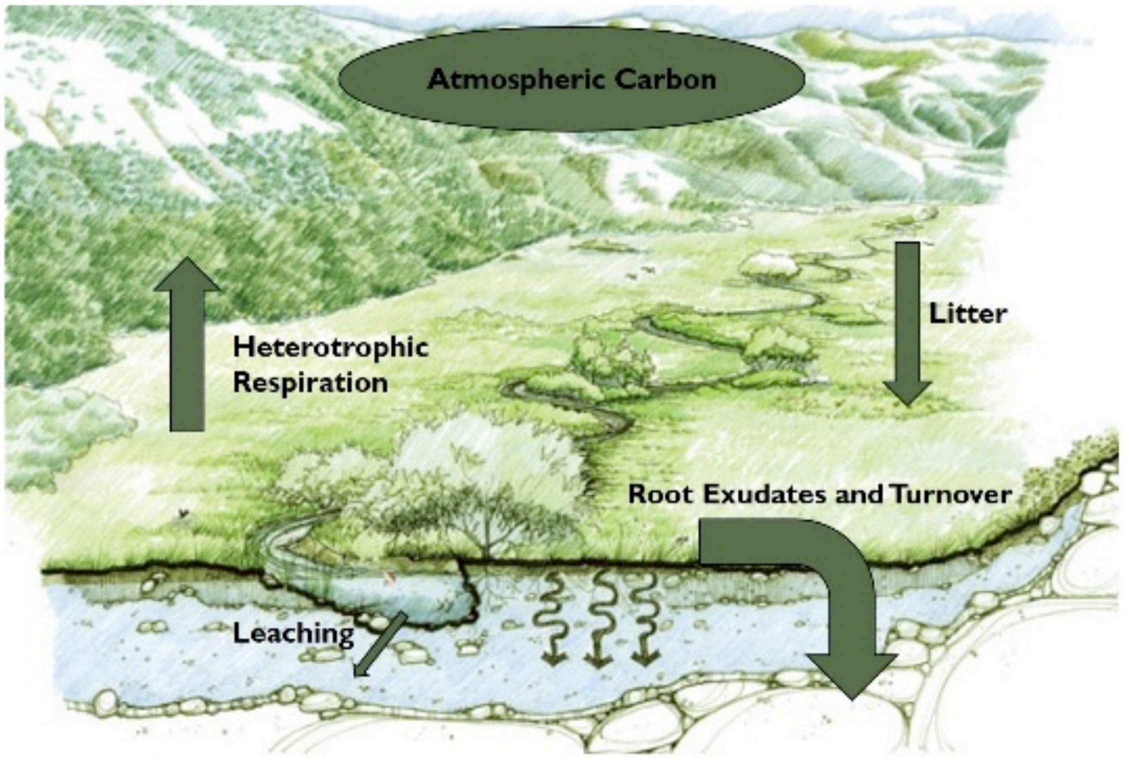


Figure 2. Functional Meadow Conceptual Model for Carbon Cycling. Size of arrows correlates to carbon flux rates. (Base Image property of Restoration Design Group).

reduced wildfire risk and improved water quality in the Yuba River and sequestered carbon in restored mountain meadows and on hydraulic mines remediated with erosion control and biochar. Project managers incorporated meadows and mine remediation into landscape-level permitting efforts while inviting additional restoration practitioners to join the movement of integrated forest health efforts. This project supported the disbursements of more than $30 million for restoration efforts for meadows and hydraulic mines as part of forest health while demonstrating new systems change models that built on tribal partnerships under the Tribal Forest Protection Act and the Trust responsibility to Indian Tribes in the Stewardship of Federal Lands and Waters.

Approach

Project managers first focused on coordinating forest resilience planning efforts with meadow restoration and mine remediation planning. Managers met regularly with the Yuba Forest Network (YFN) (formerly named the Yuba Watershed Forest Collaborative), The Headwater Mercury Source Reduction (HMSR) working group, co-led the Sierra Meadows Partnership (SMP) and co- founded the new California Process Based Restoration Network (Cal-PBR). The Sierra Fund is on the coordinating committee leading the Sierra Meadows Partnership and engaged in a process to distribute $27 Million in funding to meadow restoration secured from the Wildlife Conservation Board. The Sierra Fund has also co-led the SM-WRAMP subgroup and the All-Lands subgroup, the goals of which are to measure restoration progress and to integrate meadows into all forest health efforts, respectively.

The Sierra Fund is a founding member and co-host of the California Process Based Restoration Network (Cal PBR) and lead of the subcommittee on Hydraulic Mines and Process Based

Restoration. Process Based Restoration emphasizes working with nature to heal nature by removing manmade constraints and restoring the processes (water flow, fire, connectivity, carbon) that sustain ecosystem resiliency. The Sierra Fund's outreach in the Network attracted the interest of new partners to start hydraulic mine remediation efforts elsewhere. The Cal PBR Network meets quarterly and has 100-400 attendees.

The second task including building a benefit calculations model for meadow restoration and mine remediation. The Sierra Fund built two models to incentivize meadow restoration and hydraulic mine remediation. The model to incentivize meadow restoration is completed and called the "Carbon Market Feasibility Study for Sierra Nevada Meadows" (Attachment A: Carbon Market Feasibility Study). And the model to incentivize hydraulic mine remediation is completed and called the "Benefit-Cost Analysis of Hydraulic Mine Remediation in the Middle Yuba and Oregon Creek Watersheds" (Attachment B: Benefit-Cost Analysis of Hydraulic Mine Remediation in the Middle Yuba and Oregon Creek Watersheds Report).

The third task involved the development of Multi-Benefit Project Portfolios Supported by Alternative Funding Streams for Meadow Restoration and Mine Remediation. Project portfolios were created to support multiple prioritization scenarios. The first project portfolio was to demonstrate where the hydraulic mines were in relation to planned fuel treatments in the Trapper planning unit. This map overlaid hydraulic mines with fuel treatments and found that 20% of the planned treatments were hydraulic mines. This highlighted the need for multi-benefit projects to protect forest health.

To support funding requests, we needed to know what sites were most ready to proceed. This led to selecting hydraulic mines from the inventory that met the following criteria 1) more than 40% of their acres were on National Forest Land 2) Cultural Resource assessments had been completed 3) Sites were within an associated NEPA project area and 4) sites that had remediation designs. These criteria when applied across the Tahoe National Forest identified 9 sites with a total of 406 acres of hydraulic mines to remediate. At the time we used a $50K/acre estimate and called this a $20M investment opportunity that the US Endowment advanced for Federal funding sources in 2021.

When we developed the Benefit-Cost Analysis for Hydraulic Mines we selected sites that were within the contributing watershed area to two impoundments, Our House Dam and Log Cabin Dam. We selected these watersheds because Yuba Water had known maintenance costs for these impoundments. Our portfolio is described in the Benefit-Cost Analysis report, it totals 105 hydraulic mines with approximately 1,318 impacted acres for a total of $57M of restoration. The analysis explains how there is a $169M benefit to this remediation scenario with a 195% ROI, and that it would pay for itself in 11 years.

Outcome

- **Benefit calculation model:** The Carbon Market Feasibility Study for Sierra Nevada Meadows states that over the next 20 years as much as 7.3 to 17.5 million metric tons of CO_2 equivalent can be sequestered with restoration of privately owned degraded Sierra Nevada Meadows. With nature-based carbon credits selling in the $10 per credit range, this carbon sequestration potential is valued between $73 and $176 million on the voluntary carbon market. The Hydraulic Mine High Remediation Scenario generates the highest net present value (NPV) at $112 million over 30 years, with a payback period of 11 years. The benefit-cost ratio (BCR) is

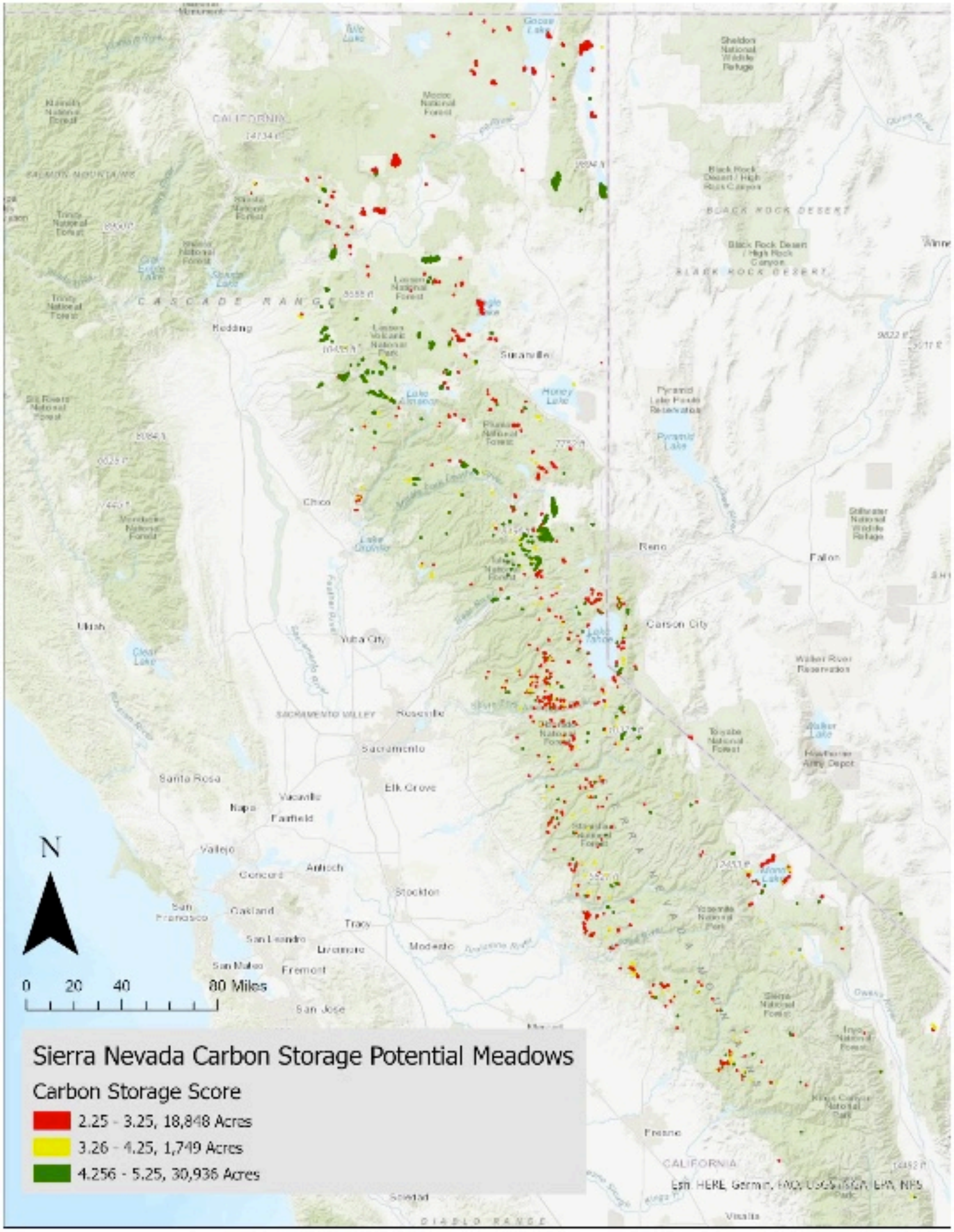


Figure 3. Map of privately owned Sierra Nevada meadows that have a carbon storage potential score between 2.25 and 5.25 (Point Blue, 2019).

2.9, meaning Yuba Water can expect $2.9 dollars in benefits for every dollar it invests in hydraulic mine remediation. This equates to a return on investment (ROI) of 195%.

- **Forests**: As a result of the coordination that occurred in task 1, hydraulic mine remediation for the first time can take place as part of Forest Health projects as part of NEPA. The Sierra Fund also helped submit comments (available upon request) as part of a collective to advance meadow restoration in a forest landscape proposed action which were largely accepted and are being implemented.

- **Meadows**: The Sierra Fund co-developed a Block Grant that secured $27M for Meadow Restoration to Sierra Meadows Partnership from the Wildlife Conservation Board. This grant is administered by partner organization Point Blue. In 2023, The Sierra Fund began participating in a partnership process to disburse these funds to implementation partners. In addition, our outreach and education as part of the SMP All Lands-All Hands subcommittee has resulted in other organizations' crafting holistic meadow restoration projects. Partners are crafting meadow restoration proposals that include fuels reduction activities and building beaver dam analogs to restore meadows. Prior to our conducting and doing outreach about our innovative meadow projects that incorporated these techniques, no other partners were crafting these multi-benefit projects.

- **Mines**: The Sierra Fund formed new work groups with other restoration focused organizations, and we are seeing these work group partners beginning to include hydraulic mine restoration as part of forest health projects they plan. The results of the Biochar test results and use of PBR at Grizzly Creek Hydraulic Mine were presented at the SRF conference and were presented at the American Society of Reclamation Science conference June 2023, Boise Idaho (Conference proceedings available here.

- The outcome of the BiPartisan Infrastructure Law funds for forest health and for restoring mine-impacted lands is that our partners, the federally recognized Concow-Maidu Indians of the Mooretown Rancheria, have asked for interagency agreements from the Plumas National Forest, Humboldt Toiyabe National Forest, Lassen National Forest, and the Tahoe National Forest to conduct fuels reduction, meadow restoration, and hydraulic mine remediation work. Their requests come under the Tribal Forest Protection Act and the Trust Responsibility to Indian Tribes joint secretarial order (No. 3403) and the expansion of Service First to Federally Recognized Tribes. This means that Mooretown should be able to get work through an agreement and not go through a granting or the bid procurement process. Unlike their requests from the Plumas, Lassen, and Humbolt-Toiyabe National Forests, their request for an Interagency Agreement from the Tahoe National Forest to do hydraulic mine remediation work has been delayed, in part, because the local forest districts are unfamiliar with these processes.

Work from this grant also was leveraged for additional funding from the below resources:

- California Department of Water Resources grant ($358,968) for community outreach in Sierra City and Downieville to prioritize Hydraulic Mine Restoration projects in their watershed and to complete hydraulic mine restoration Phase 2 Grizzly Creek and Tippecanoe.

- US Endowment Grant ($150,000) for the Grizzly Creek planning and permitting and Phase implementation.

- US Endowment Grant ($399,988) to support our capacity to scale up our hydraulic mine restoration work.

- Yuba Water Agency grant ($325,000) to conduct permitting and planning at three sites in the Yuba watershed so bring them to "shovel-readiness."

- Resource Legacy Fund grant ($80,000) to advance partnership with Mooretown Rancheria (Concow-Maidu) to startup tribal department doing Hydraulic Mine Restoration on Tahoe National Forest.

Challenges & Lessons Learned

- Restoration practitioners (NGOs, local governments, academics) interested in remediating hydraulic mines should contact local water agencies to ensure investments produce multi-benefit forest health restoration where possible. Remediating mines will restore soil health and store more carbon. Water Agencies that have expensive maintenance costs for removing sediment from downstream impoundments because of legacy mining could spend their dollars on erosion control techniques at upstream hydraulic mine sites and see returns on investment.

- Water Agencies with upstream hydraulic mines should consider the return on investment for remediating mines. See #1.

- Tribes can explore how the Tribal Forest Protection Act and Service First for Tribes allows federal agencies to partner with them to do the work on forest service lands without having to go through the granting or procurement process. As a result, multiple funding sources can be placed in the same interagency agreement allowing for tribes to do more holistic-integrated forest health work that includes mine remediation and meadow restoration.

- Private Landowners could restore meadows and receive payment in a Voluntary Carbon Market: Currently, CARB does not have a developed program for this – but our findings indicate this has great potential. Private landowners with degraded meadows could manage their lands to sequester carbon using PBR for meadows and cattle exclusion – and then if CARB develops this – they could receive a check from the air resources board. This would allow private landowners to pay for fencing, alternative watering sources for livestock, and not lease their land, but rather, manage it for carbon sequestration.

- We think the lessons learned from our work demonstrate alternative funding paths that create support for scaling up forest stewardship and creating more climate resilience.

Next Steps

- The Sierra Fund implementing model project partnering with Mooretown Rancheria to demonstrate how they can quickly scale up multi-benefit projects using their Interagency agreements. Projects will combine Process Based Restoration for forests, mines, and meadows.

- Continuing the partnership between The Sierra Fund and Yuba Water to define and invest in implementation opportunities for hydraulic mine remediation and forest health work in their watershed. We will continue to gather data and analyze the results of this implementation to showcase successes and lessons learned to others.

- The Sierra Fund educating a broad array of decision makers, agency leaders, funders, restoration practitioners and the public about the two modeling study results. We hope to gain statewide attention to these findings.

- The Sierra Fund taking key decision makers, agency leaders, funders, and practitioners on tours at the site of the pilot project at Grizzly Creek Diggins hydraulic mine - demonstrating the benefits and how this project can be replicated by others.

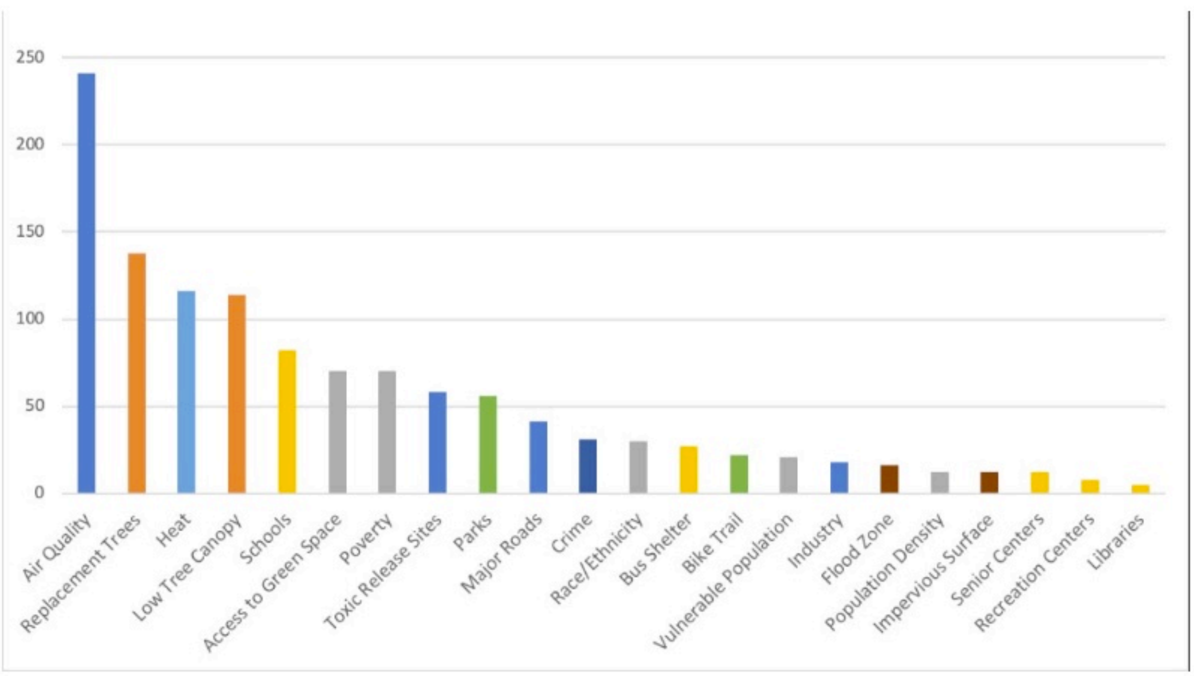
- The Sierra Fund facilitating, leading, and participating in successful networks that attract people to identify, design and implement restoration projects that benefit the forests.

- The Sierra Fund working with the Air Resources Board to augment the carbon protocol for meadow restoration and then designing and launching an effort to support private landowners to receive carbon credits for meadow restoration.

Gateway Cities Council of Governments

Project: Urban Tree Canopy Community Prioritization Project
Focus area: Cities of Lynwood, Montebello, Paramount, and Vernon
Grant amount: $200,000
Climate threat(s): Heat
Read the full report >>>

Summary
The Urban Tree Canopy Community Prioritization Project involved the Gateway Cities Council of Governments (COG), the nonprofit organization TreePeople, and Loyola Marymount University collaborating on developing local tree canopy assessments and community prioritization reports for four disadvantaged communities within Southeast Los Angeles County: the cities of Lynwood, Paramount, Montebello, and Vernon. Importantly, this project intended to provide insight into improving the tree canopy in these cities in a deliberate and thoughtful manner that prioritized the needs and desires of the residents within these communities and to invest in areas that have been historically excluded from accessing necessary resources and funding. The project sought to lay the groundwork for cities to bring about the benefits associated with increasing urban tree canopy, such as improved air quality, the mitigation of extreme heat, aesthetic value, and increased property values, by providing maps, data, and reports that can help guide the cities' urban forestry strategies for the future. The project aimed to address a knowledge gap in the Gateway Cities subregion concerning community desires in urban forestry practices.



SURVEY RESULTS OF LYNWOOD RESIDENTS ON WHERE/WHAT PURPOSE THEY WANT AN EXPANDED TREE CANOPY

Approach

First, the cities' spatial data was analyzed to better understand existing tree canopy as well as the potential for new plantings. Each of the cities were covered by a lower percentage of tree canopy than the Los Angeles County average of 18% (Galvin et. al., 2019), indicating a need for greater investment. Analysis found that each city also had numerous site opportunities to increase their tree canopy; high resolution, high accuracy tree canopy data indicated that over 40% of each of the cities' land area could be categorized as possible tree canopy. A series of planning meetings were held with the cities' staff. These meetings allowed the project team to further understand the environmental context of the cities from a qualitative perspective. These meetings offered a holistic view of each city and allowed project managers to gain a comprehensive understanding of the physical landscape of the city as well as identifying city priorities and challenges not included in spatial data. Next, a community tree summit was conducted in each city. These summits introduced the project to residents and informed them of the various benefits that tree canopies provided. Participants discussed their own personal experiences and values regarding trees and a survey was distributed that assessed what tree canopy benefits were seen as highest priority to the community. Lynwood, Paramount, and Montebello respondents all prioritized Air Quality as the most important benefit in tree planting. Vernon respondents prioritized Reduced Heat.

Outcome

- **City of Lynwood:** Analysis showed up to 41% of Lynwood is suitable for urban forestry compared with the current tree canopy covering just 16% of the city. Surveys of Lynwood residents showed residents most desired an increased tree canopy along the eastern and western edges of the city abutting the I-710 freeway and Alameda truck corridor for air quality benefits. These findings are helping inform the planting of 1,000 trees through a

California Department of Forestry and Fire Protection (CalFire) grant.

- **City of Paramount**: Analysis showed up to 45% of Paramount is suitable for urban forestry compared with the current tree canopy covering just 15% of the city. Surveys of Paramount residents showed residents most desired an increased tree canopy in the southeastern, southern central, and northern central areas of the city. Resident surveys also cited air quality improvements as most urgent rationale for expanding the canopy.

- **City of Vernon**: Analysis showed up to 51% of Paramount is suitable for urban forestry compared with the current tree canopy covering just 2% of the city. Vernon is a unique city in that it has only 200 residents but tens of thousands of individuals commute daily to the city for industrial work. Project managers hosted workshops with surveyed business owners and civic leaders, who identified parcels throughout the city as strong candidates for canopy densification and reported reducing heat island effects were to top priority. Following the work, the City cited project data to approve planting 144 new trees in existing vacant tree wells.

- **City of Montebello:** Analysis showed up to 48% of Lynwood is suitable for urban forestry compared with the current tree canopy covering just 13% of the city. Surveys of Montebello residents showed residents most desired an increased tree canopy in the city center. Resident surveys also cited air quality improvements as most urgent rationale for expanding the canopy.

Challenges & Lessons Learned
The onset of the COVID-19 pandemic altered many planned engagement activities and no doubt had an effect on the success of outreach efforts. With public health and safety at risk, the project team had no choice but to migrate programming to a virtual format much of the time, making an accessibility an issue for those without access to the internet or a computer. Recommendations to socially distance also contributed to the digital divide – with little opportunity for face-to-face interaction, virtual communication became imperative to this project. The project also encountered administrative challenges, include staff turnover within both the cities and the project team. For one city, the point of contact shifted three times during the project.

Other communities considering similar projects should try to hold multiple tree summits in order to provide as much opportunity for community engagement as possible. Maintaining at least two project staff dedicated to community outreach and engagement throughout the duration of the project is also recommended. Lastly, a regular and consistent series of meetings with each partner city's main point of contact (biweekly would be ideal) is another best practice.

Next Steps
Project managers have leveraged work from their California Resilience Challenge grant to raise an additional $2.6 million, including $700k from Cal Fire for tree planting in Lynwood, $283k for tree planting in Paramount; and $1.75 million from the California Strategic Growth Council to implement extreme heat mitigation projects in communities in the study area. Implementation projects informed by the Urban Tree Canopy reports and related deliverables would be an ideal opportunity for the new Regional Climate Collaborative to leverage its structure to ensure successful projects to improve urban forestry within the Gateway Cities.

Resources
Gateway Cities project website (link)

South Fork Kings Groundwater Sustainability Agency

Project: Aquifer Storage and Recovery Pilot
Focus area: Kings County
Grant amount: $200,000
Climate threat(s): Drought
Read the full report >>>

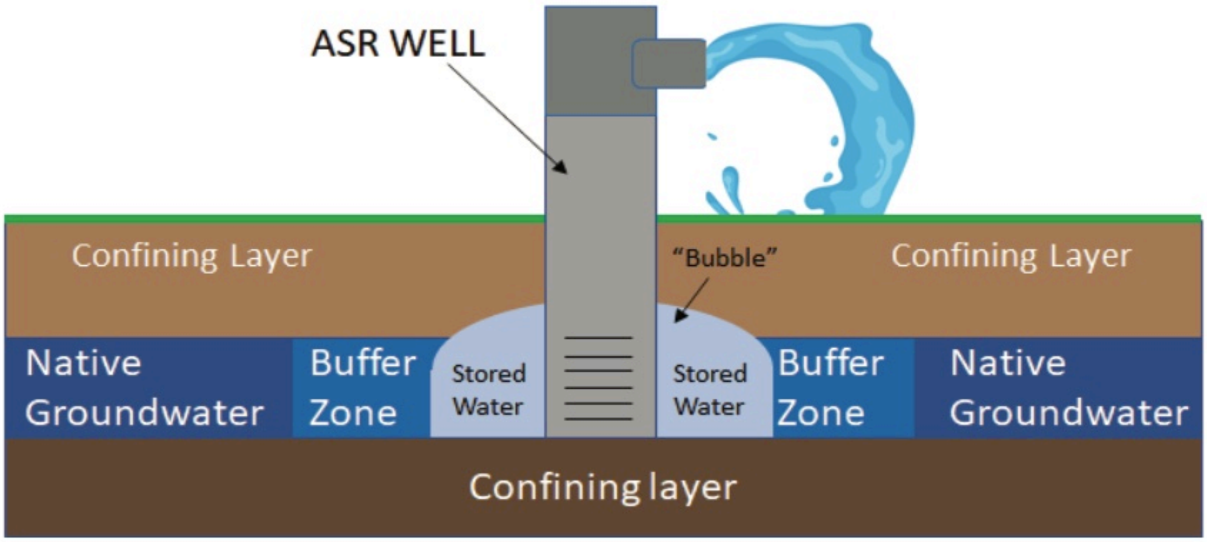
Summary

The South Fork Kings Groundwater Sustainability Agency (Agency) is part of the Tulare Lake Subbasin, an agricultural, drought-prone region of California's central valley. Aquifer Storage and Recovery (ASR) is a form of Managed Aquifer Recharge, which is gaining widespread interest in California as an approach to improving the reliability of water supply by storing "excess" surface water in underground aquifers. This stored water can then be either pumped at a later time for beneficial use (potentially reducing demand on surface water) or it could remain in the aquifer and help increase or restore groundwater levels. In the context of the Sustainable Groundwater Management Act (SGMA), MAR is being considered in many different forms as an implementation component of groundwater sustainability plans across the state. The objective to the ASR Pilot Test was to provide an initial technical assessment of the feasibility of implementing a broad ASR program across the Agency. The goal of the Pilot Test was to collect physical and geochemical data to demonstrate the suitability of the local aquifer for ASR using surface water from local irrigation canals.

Approach

The project area encompasses about 445 acres in Kings County, California just north of the City of Lemoore. A monitoring network was established consisting of seven total wells, with five wells used for water level monitoring and seven wells for water quality sampling. The Tulare Lake Subbasin GSP recognizes three aquifer zones, A-C. For this project grantees used the B-zone, which consists of multiple layers of sand, gravel, and clay, ranging in thickness from a few feet to tens of feet. This finer scale stratigraphy is an important element of understanding the response of the aquifer to ASR. The summer of 2021 was one of the driest on record in the area and delivery of irrigation water from the Kings River to the Lemoore Canal was severely curtailed. Surface water from Lateral 4 of the Lemoore Canal became available for injection on June 19, 2021. Water was conveyed from Lateral 4 through a PVC pipe via gravity to the wellhead. A 10" tee with butterfly valve in the conveyance lateral was used to connect the lateral to the inlet of the injection pump (described below). The pipe from Lateral 4 also conveyed water to an adjacent delivery canal and storage area. Surface water flow rates entering the injection infrastructure were monitored by a totalizing flow meter. This meter was also used by the Lemoore Canal Company to calculate charges for the surface water used for injection.

After the initial start-up described above, the overall testing sequence consisted of 7 "cycles" of injection, followed by a 37-day storage period and 16 days of recovery (pumping). Each injection cycle lasted between 3 and 5 days and concluded with a full backflush of the well. Throughout each injection cycle, periodic backflushing of the filter system occurred. A total of 80 acre-feet (AF) of water was injected into the aquifer. During the storage phase, pumping continued at



Explanation:
Injected water does not immediately mingle with ambient, or native groundwater creating a "bubble" of stored water near the well with a buffer zone of limited mixing on the fringes of the "bubble".

Figure adapted from South Florida Water Management District and United States Army Corps of Engineers 2021 Aquifer Storage and Recovery (ASR) Science Plan.

https://www.sfwmd.gov/sites/default/files/2021_draft_asr_science_report_main.pdf

ASR Concept
ASR Pilot Test Final Report
South Fork Kings GSA
Tulare Lake Subbasin, Kings County, California

Geosyntec consultants

Project No.: SAC229C | May 2022

Figure 1-2

adjacent irrigation wells. Initial recovery involved recovery of 87 AF from the injection well with routine water quality sampling during. A step test was then conducted to evaluate well efficiency. The injection well was then put back into service for irrigation. After irrigation ceased (in November), the well was inspected with a video log and conditioned using an acid wash, followed by another step test to evaluate well efficiency.

Outcomes

A total of 80 AF of water was injected over 7 cycles of injection, followed by 37 days of storage. A total of 87 acre-feet of water was then recovered, and the well was put back into service for irrigation and was not monitored further. In general, results can be summarized as follows:

- Water level build-up in the injection well increased continuously during each injection cycle and a steady state water level was not achieved for any injection cycle.
- Peak build-up of 200 to 250 feet was achieved after 3-4 days of injection at injection rates of between 500 and 600 gpm.
- Water quality during injection was consistent in the injection well and no changes were observed in the observation wells. This is consistent with the "bubble" concept, where in

injected surface water displaced native groundwater with a relatively small radius of influence.

- Field water quality (pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction [redox] potential) of recovered water showed now water quality changed at the edge of the bubble, represents a mixing zone between surface water and native groundwater.

- The differences in water quality between injected surface water and native groundwater caused chemical reactions at the edge of the bubble that resulted in increases in metals, including arsenic and uranium.

- Geochemical chemical equilibrium between the injected surface water and native groundwater was not achieved after 37 days of storage, as indicated by the water quality changes at the edge of the bubble.

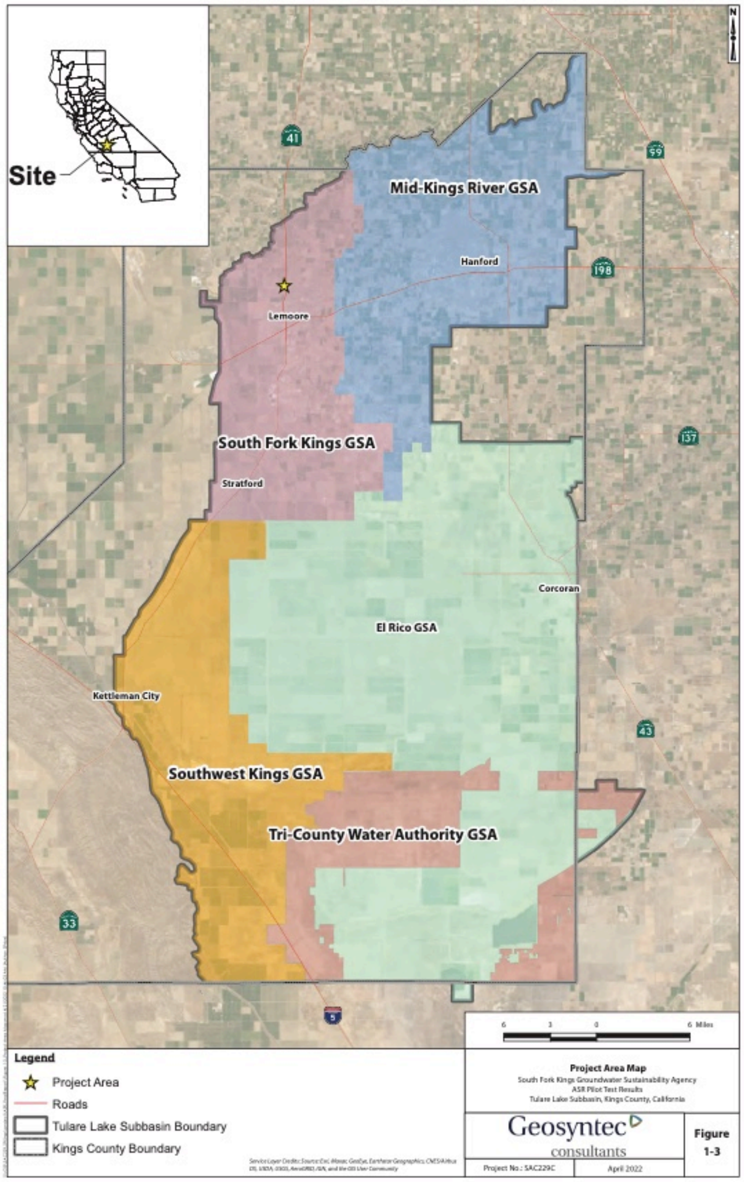
On a per-well basis, a planning level volume estimate of 200 AF of storage per well is suggested. This is equivalent to an injection rate of 750 gpm for 60 days. Higher or lower per-well storage yields are possible depending on site and well-specific conditions. This planning target does not consider the availability of surface water for injection.

On a site-area basis, a planning-level well spacing of 1,500 feet is suggested. Well interference should be minimal at this radius and would provide a maximum injection well density of 10 wells per 160 acres. At this density, a grower with 1,600 acres could potentially consider a 10- well ASR program with a 1-year storage capacity of 2,000 AF. Again, higher or lower site-area storage yields could be possible depending on site and well-specific conditions. This estimate does not incorporate availability of surface water for injection.

Note that 2,000 AF is equivalent to irrigation of 1,000 acres at an irrigation demand of 2 AF/acre. Therefore, ASR could be considered as a component of a fallowing program, where storage could occur during a fallow year, and then recovered the following year to put the land into production.

On a more regional GSA-area basis, a planning-level estimate of total maximum storage capacity could be as high as 100,000 AF. This is based on an assumption of 100 ASR sites with an injection capacity of 1,000 AF per site. This estimate does not factor in the availability of surface water. At this scale of analysis, the primary constraint on the feasibility of ASR is the volume and time-window over which surface water can be made available for ASR. The ability to use ASR to store a flood event is limited by the injection capacity of individual wells. It will take at least 60 days to inject 100,000 AF of water at 100 ASR sites. So, in the event that a large volume of surface water could be made available from a flood event, some form of surface storage would be needed to hold that water over a 60-day period and then deliver/inject it into the aquifer for ASR.

Combined CAPEX + OPEX is therefore estimated at about $2.6M for 5,000 AF of total storage over 5 seasons. This is equivalent to a $500 per AF ASR "mark-up" on the cost of injection water. The best way to describe the cost implications from a grower perspective is to compare the cost of ASR (including the cost of injection water) to the cost of obtaining a conventional water supply during a drought year. If the cost of injection water is $0, then ASR makes financial sense to a grower for any alternative drought-year water supply that costs more than 500 $/AF. If the cost of obtaining injection water is $500 $/AF, then ASR makes financial sense to a grower for any alternative water supply that costs more than $1,000 $/AF. Different combinations of injection



water cost and the ASR mark-up would yield different break-even points between ASR and an alternative conventional water supply. Individual grower situations would also yield different break-even conditions.

Challenges & Lessons

Specific issues during the initial start-up included: (1) insufficient back pressure in the well and pump column initially resulting from the relatively deep static water level; and (2) a large pressure drop across the filtration system combined with temporary pressure drop during backwash cycles. One of the causes for these pressure problems was a combination air valve was used at the well head which allowed atmospheric air to be pulled into the column pipe to prevent a vacuum condition. This valve was later replaced with a continuous air vent without vacuum relief, so air was only permitted to be vented from the column pipe and not allowed to enter. These problems should be recognized for future applications. Once the system was stabilized, it operated relatively smoothly for the duration of the test. The automated filter backwash was typically triggered every 2-3 hours and there was minimal air-entrainment in the pump column. The well was fully backwashed every 3-4 days using the well pump.

Learn more: Geosyntec website and educational video

Western Riverside Council of Governments

Photo Credit: WRCOG

Project: Western Riverside County Energy Resilience Plan
Focus area: Western Riverside County
Grant amount: $200,000
Climate threat(s): Extreme Heat
Additional funding leveraged: $421,000
Read the full report >>>

Summary
Nearly 2 million people live in the Western Riverside County subregion. In the last five years power outages have been on the rise throughout California as the power grid deals with high energy consumption, clean energy transition, and impacts from climate events such as severe weather, extreme heat, and wildfires. Extreme heat days, wildfires, and severe weather are all predicted to increase in the subregion due to climate change. These challenges will be exacerbated by large population growth anticipated in the subregion, which will increase energy demand and further stress the energy grid. More than half of WRCOG's Member Agencies contain census tracts identified in the SB 535 Disadvantaged Communities Map, which are areas in the highest 25% percentiles for environmental burden in the state. Without planning for energy resilience, the

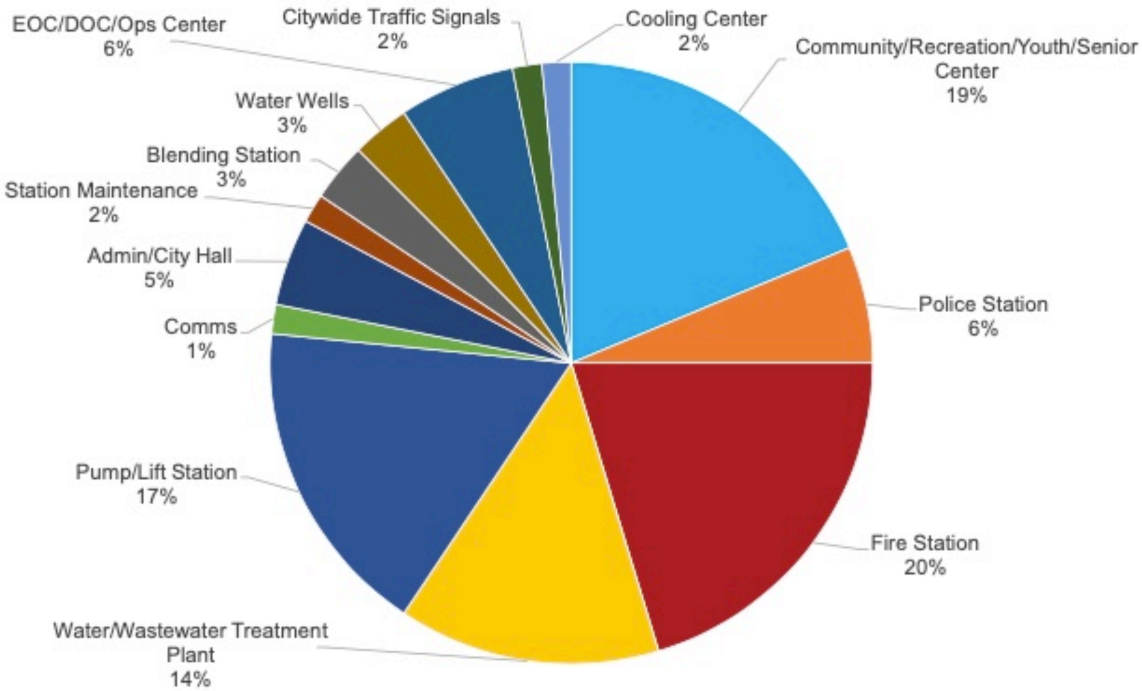


Figure 2.1. Critical Facility Typology Distribution across WRCOG

combination of climate-change impacts and energy consumption has potential to disrupt power supply to critical facilities and communities in Western Riverside County.

The Western Riverside Council of Governments (WRCOG) developed an Energy Resilience Plan as a resource for WRCOG Members to develop and implement energy resilience solutions against power outages at critical facilities and infrastructure. The Plan utilizes four evaluation factors to prioritize critical facilities, including social vulnerability, operational needs, physical hazard sensitivity, and existing onsite power infrastructure. WRCOG worked with its Member Agencies to identify critical facilities and critical loads, prioritize facilities based on the evaluation factors, and select facilities for microgrid case studies. The microgrid case studies, which were conducted at a wastewater recycling plant, a senior center, and two fire stations, found that a combination of onsite power generation sources and battery energy storage systems could maintain power during an outage.

Approach
WRCOG staff created an advisory group of staff from Member Agencies and UCR CE-CERT consultants that could provide input and give feedback on the methods, findings, and selection of the facilities or infrastructure for the microgrid case studies. WRCOG held multiple workshops with the advisory group that were open to all Member Agencies as well, and found them to be very useful in gathering outside perspectives throughout development of the Plan. Once the top three facilities were selected, WRCOG staff conducted outreach to the Member Agency and facility managers that are responsible for the facility to gather building information, consumption data, and operational needs.

The microgrid case studies were completed by assessing various building construction documents and energy use data, along with microgrid modeling software. During the data and document sourcing process, staff encountered another barrier where not all documentation and construction documents were readily available for the facilities undergoing a case study. Staff and the consultant team were able to fill in information for the missing documents by working closely with facility managers for most case studies, however, the Fire Station 16 case study was more difficult and eventually found that the building was not fit to be a future microgrid and resilience center. An alternative facility, Fire Station 17, was selected as a replacement as it was still located within the city, scored highly in the prioritization matrix, and was of the same type of facility. Future agencies conducting similar case studies could consider the availability of construction documents and associated information as a prerequisite to qualify for a microgrid case study.

Outcomes
The Energy Resilience Plan's prioritization tool was used to select four sites for microgrid case studies, including:

- Wastewater Reclamation Plant (Banning, CA)
- Kay Ceniceros Senior Center (Menifee, CA)
- Riverside County Fire Station 16 (Jurupa Valley, CA)
- Riverside County Fire Station 17 (Jurupa Valley, CA)

Case studies for the senior center and fire stations were completed by the consultant, AECOM, utilizing the HOMER microgrid modeling software to identify and assess potential energy resilience options. The software provided various scenarios and combinations of power sources, but overall found that installing solar photovoltaic (PV) systems with battery energy storage

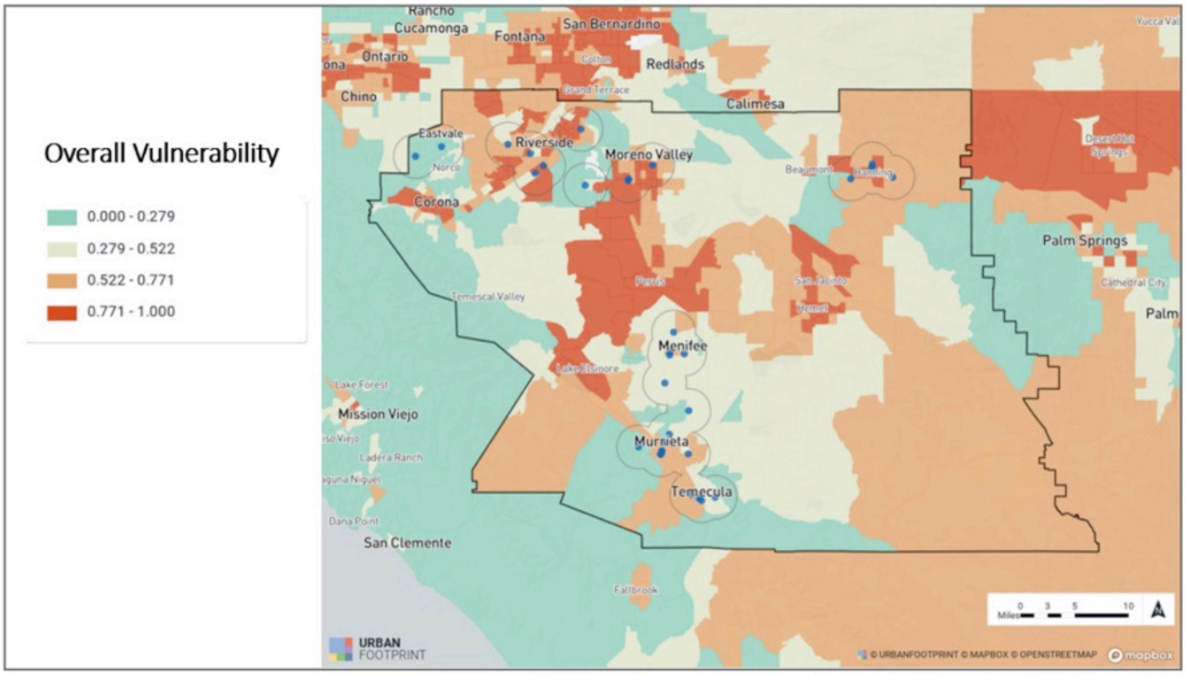


Figure 2.6. Overall Vulnerability Scores

systems (BESS), and a backup generator were optimal to maintain power at each of the facilities during an outage. Each facility also showed a potential for a microgrid based on the energy resilience options identified, preliminary project economics, and the facility's setup and local grid infrastructure.

For the selected wastewater reclamation plant, UCR CE- CERT was hired to conduct a resilience analysis of water systems in Western Municipal Water District's (Western Water) service area, which was completed as a supplement to an existing project UCR had with Western Water. The analysis found that by reducing energy consumption and demand at the Bergamot and Holcomb pump stations, the existing energy infrastructure at the pump stations have capacity to maintain operations due to the stations having both electric and natural gas-driven pumps. Additionally, the study assessed the power supply and natural gas pipeline and found potential interconnection points to add additional electricity and natural gas supply to these facilities. Finally, the study recommended the addition of backup generators along with solar PV and BESS could increase resilience to outages.

Challenges & Lessons Learned

While the advisory group was helpful with providing feedback and input, it raised attention to an important issue which is additional education and training is needed for Member Agency staff and stakeholders to effectively work on climate adaptation, energy efficiency, and energy resilience work in the subregion. Some of WRCOG's Member Agencies are small to medium local governments that don't have the technical or staff capacities to work on climate adaptation and energy resilience planning projects. This made seeking input on a potential microgrid and energy resilience project limited at first until some education was provided to gain a better understanding of energy and climate resilience, the proposed microgrid case studies and how these fit into the overall goals of climate adaptation. One recommendation for future grant managers would be to include a small portion of grant funding for education and peer-to-peer learning so that staff and potential stakeholders can be knowledgeable in climate adaptation, energy efficiency, and resilience planning.

Next Steps

WRCOG completed the Energy Resilience Plan and presented the document to its Executive Committee at the December 5, 2022 meeting. The WRCOG Executive Committee approved the Energy Resilience Plan and directed staff to pursue funding opportunities to advance the identified projects further along in the design process and conduct energy resilience planning activities. Staff can continue to take steps towards implementation of the microgrid case study projects, such as seeking additional grant funding to conduct additional case studies, or funding to complete the microgrid engineering design process on the case study facilities to make them “construction ready”. In October 2023, WRCOG announced it received $421,000 grant from the Governor’s Office of Planning & Research to develop an Energy Resilience Plan 2.0 to conduct additional microgrid feasibility analyses at up to 10 new sites in the COG jurisdiction.

City of Watsonville

Photo Credit: City of Watsonville

Project: Green Infrastructure Implementation Plan
Focus area: City of Watsonville
Grant amount: $200,000
Climate threat(s): Heat, drought, flooding
Additional funding leveraged: $827,000
Read the final report >>>

Summary
The City of Watsonville is located along the flood-prone Pajaro River in the Pajaro River Watershed. Watsonville is developing a plan to integrate green infrastructure across the city's existing plans and to identify a pipeline of implementation projects that will improve flood protection along the Pajaro River, increase local water supply resilience, sequester carbon, reduce heat-island effects, and generally improve public health and well-being.

Approach
The development of the plan included community engagement and the involvement of a diverse group of stakeholders. The project team conducted outreach to build and strengthen partnerships internally between City departments and externally with groups such as Watsonville Wetlands Watch and architects consulting on City projects. The plan also seeks to align policies such as tree protection ordinances, residential incentive programs and existing City planning efforts such as the Climate Action and Adaptation Plan and the Urban Forestry Management Plan.

The plan evaluated the existing storm drain network in the City, the topographical features of the City, major drainage areas, the location of impervious surfaces, and existing stormwater facilities. Using this information the plan identifies priority locations for green infrastructure projects for four basic types of projects: green roofs, parking lot permeable pavements, green streets, and detention pond retrofits. Once sites were identified a detailed engineering feasibility review was conducted and a project prioritization process was employed to identify priority projects and

Figure 7. Example Green Street BMP that can manage stormwater with vast multi-benefits.

Priority GREEN Infrastructure Projects

RAMSAY PARK - Use permeable pavement and bioretention in parking lots, green roofs, and channel naturalization to clean water flowing to Struve Slough.

Impervious Area Treated: 7.6 acres

Pollutant Load Reduction: 0.42 tons/yr

Runoff Reduction: 11.1 acre-ft/year

Cost: $3.55M

DOWNTOWN CORRIDOR - Promote urban greening to enhance pedestrian passageways, improve stormwater quality, and reduce heat island effects in concert with the Watsonville Downtown Specific Plan.

Impervious Area Treated: 2.75 acres

Pollutant Load Reduction: 0.28 tons/yr

Runoff Reduction: 4.5 acre-ft/year

Cost: $1.72M

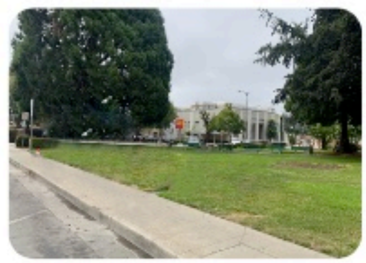
DOWNTOWN PLAZA - Install permeable pavement and use bioretention features to clean water and slow traffic.

Impervious Area Treated: 2.55 acres

Pollutant Load Reduction: 0.18 tons/yr

Runoff Reduction: 11.1 acre-ft/year

Cost: $245,000



ROLLING HILLS MIDDLE SCHOOL - Create a protected bike lane and sidewalk to create a safe route to school using bioretention features that also clean water and improve aesthetics.

Impervious Area Treated: 9.8 acres

Pollutant Load Reduction: 1.66 tons/yr

Runoff Reduction: 17.8 acre-ft/year

Cost: $370,000

WATSONVILLE HIGH SCHOOL - Use permeable pavement, bioretention, and rainwater harvesting to create high visibility projects than enhance the environment - and integrate into educational programming (e.g., FFA).

Impervious Area Treated: 12.73 acres

Pollutant Load Reduction: 1.90 tons/yr

Runoff Reduction: 20.56 acre-ft/year

Cost: $1.89M

future (next phase) projects. Projects were ranked based on pollutant capture potential, runoff capture, urban heat island reduction, greening opportunity, and pollutant reduction magnitude. Five projects were identified and developed into conceptual plans to allow for grant funding application and incorporation into larger planning efforts. Funding strategies were identified and explored and include traditional grants and loans, a City funding measure, public private partnerships, and credit trading. The 2NFORM platform was used throughout the process to facilitate project identification, quantify benefits, and create an interactive dashboard to showcase the priority concepts.

Outcomes
The completed Green Infrastructure Implementation Plan identifies short, medium, and long-term goals for community engagement, policy alignment, and project construction and maintenance. The plan also identifies five priority projects, including adding bioretention infrastructure at Ramsay Park, urban greening of the Downtown Corridor, permeable pavement and bioretention features of the Downtown Plaza, incorporating bioretention infrastructure into a protected bike lane to Rolling Hills Middle School; and permeable pavement and rainwater harvesting infrastructure at Watsonville High School. The projects would reduce runoff by 54 acre-feet per year and cost approximately $4.2 million.

Challenges & Lessons Learned
Due to the Covid-19 pandemic traditional outreach efforts for a project of this nature had to be abandoned and a modified outreach effort and an assessment of past outreach efforts was used instead. Although less than ideal, the combination of input and feedback from City Departments, Community Based Organizations, and limited input from the public resulted in a balanced design approach that took many different viewpoints into consideration. An additional barrier that was unexpected is the comfort with and commitment to traditional design approaches that many City staff have.

Selecting an engineering and outreach firm with proven success in similar projects through a competitive Request for Proposals (RFP) process was critical in creating the City's Green Infrastructure and Implementation Plan. Having an experienced team ensured that projects developed were realistic and feasible to implement. Watsonville, like most communities, strives to integrate planning objectives across local hazard mitigation, climate action and stormwater planning. However, funding and implementation of projects continues to be siloed. As a result, low income communities will continue to struggle with acceptance of green infrastructure implementation unless green infrastructure gets adopted into Statewide architecture, building and/or water quality programs. Fully understanding the cost, feasibility, and long term value of green infrastructure will be a crucial step in integration with other programs and shifting the burden of implementation away from the development community.

Next Steps
In October 2023 the City of Watsonville received $827,000 grant from the California Natural Resources Agency to begin building a green roof, bioswales, and other green infrastructure related to the Ramsay Park project. Similarly, integrating the concepts presented in the plan into City standards and design and planning requirements to ensure that green infrastructure becomes part of the City culture will be an ongoing process that will ultimately lead to positive community benefits.

Learn More: [Monterey Bay Economic Partnership]

City of Santa Ana

Project: Santa Ana Regional Transportation Center Microgrid Feasibility Report
Focus area: City of Santa Ana
Grant amount: $176,807
Climate threat(s): Flood, Heat
Read the final report >>>

Summary
The Santa Ana Regional Transportation Center (SARTC) is a five-story, 47,000 square-foot facility and the main transportation hub for Orange County. Services at SARTC include train, bus, taxi, airport transportation services, and one dual-port ChargePoint EV charger for public use. The SARTC facility is a critical component in Santa Ana's Emergency Operations Plan for delivering vital services in the event of an emergency. However, the facility is today threatened by numerous climate stressors, including flooding and power outages due to extreme weather-related public safety power shutoffs. Under this effort, the City of Santa Ana explores the feasibility of outfitting the facility with a climate-resilient microgrid, including battery storage, photovoltaic solar panels, and additional EV charging infrastructure.

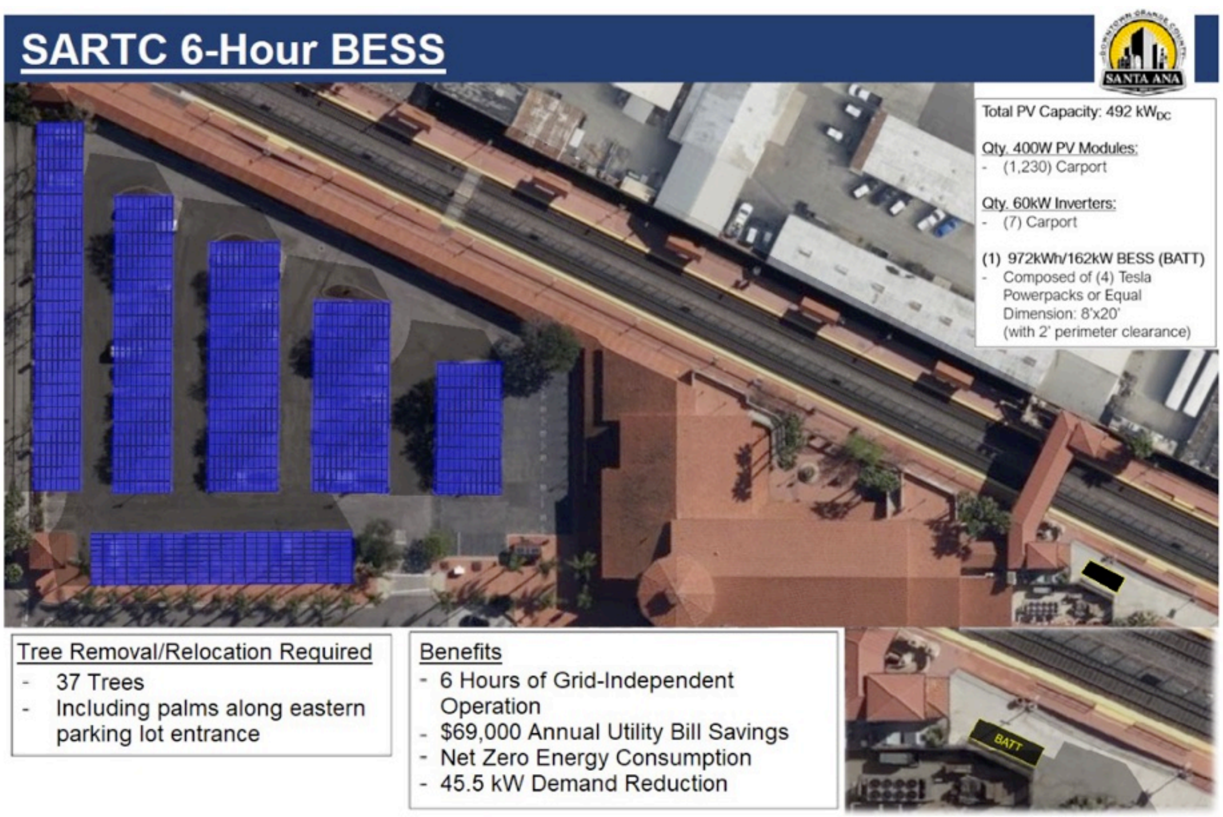


Figure 9: Renewable Asset Summary with 4-Hour BESS (Option 1).

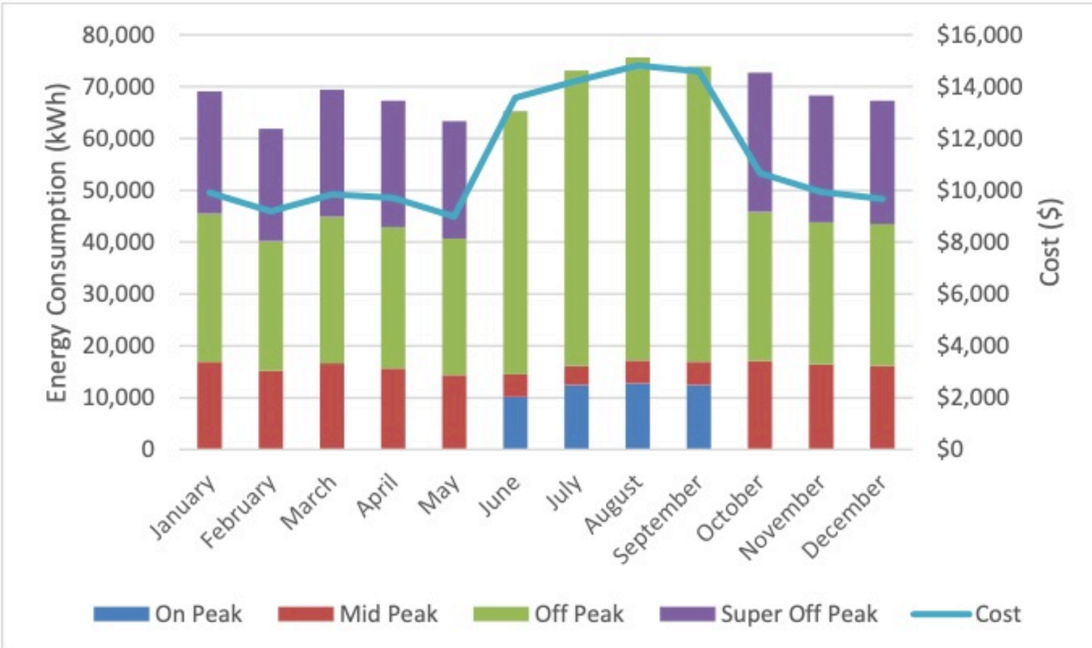


Figure 5: Seasonal Building Load Shape

Approach
City staff developed an RFP to select a consultant to lead the work, eventually hiring TRC Companies. TRC conducted numerous inspections across several different site visits and worked with SARTC staff and Southern California Edison to collect information on energy use, parking demand, and other variables.

Outcome
TRC found that a microgrid system is a feasible solution to satisfy the SARTC facility's goals of resiliency, EV accessibility, greenhouse gas (GHG) reduction, and cost effectiveness. The proposed microgrid system is composed of 492-kW of carport solar PV, 972-kWh of battery storage, and 10 Level-2 EV chargers. TRC estimates the system will generate 832,000 kWh of electricity annually, bringing the site to net zero energy consumption. The battery storage system is sized to provide backup power to the site for six hours of peak consumption. Total projected GHG reduction of 4,145.5 metric tons of CO2e is achieved over the project's 25-year effective useful life (EUL) with a total annual savings of approximately $43,400 when factoring reduced grid demand and solar production. The project also analyzed three different ownership cases for the solar and battery storage system: cash purchase, standard power purchase agreement (PPA) and PPA with a year 10 buyout. This final option was recommended because it avoids large upfront costs while maximizing long-term return on investment (ROI). Before accounting for VOR, Option 1 does not achieve positive payback. Options 2-3 achieve positive financial impacts by the end of the equipment life.

City/County Association of Governments of San Mateo County

Project: Resilient San Carlos Schoolyards
Focus area: San Carlos School District, San Mateo County
Grant amount: $97,671
Climate threat(s): Drought, Flood, Heat
Read the final report >>>

Summary
The Resilient San Carlos Schoolyards (RSCS) Project develops specific improvements to three elementary schools in the San Carlos school district to strengthen climate resilience for students and the surrounding communities. The focus on schoolyard resilience planning provides a critical opportunity to incorporate schools, often an important and overlooked application for greening, into the broader efforts in our communities to reduce the impacts of climate change with respect to less frequent but larger storms, periodic drought, high heat and water quality degradation. The RSCS Project was developed for the San Carlos School District (SCSD) in partnership with the City/County Association of Governments of San Mateo County (C/CAG). The RSCS focuses on the opportunity to transform the ecological function of asphalt schoolyards through seamless integration of child-compatible green infrastructure.

Approach
The Project team worked collaboratively to develop each milestone and deliverable from visioning to site selection and evaluation to community engagement and developing the Resilient Schoolyard Concept Plans and Report. The five tasks of the project were:

1. Project Initiation and Vision included developing the goals and selecting the sites;

2. Stakeholder Engagement encompassed all school community input prior to and during the creation of the concept plans to understand the communities, uses, and desires for each site;

3. School Site Surveys comprised developing base maps of each site and studying the physical elements of each site and its relationship to its watershed;

4. Resilient Schoolyard Concept Plans incorporated the information from the first three tasks to develop comprehensive concept plans for each site;

5. The Final Report is the record of the previous four tasks and a guide for next steps.

The Project Team was comprised of a multi-agency group (representatives from SCSD, C/CAG, the Cities of San Carlos and Belmont, and the San Mateo County Office of Education) with shared regional interests on climate adaptation with respect to stormwater management and capacity to help with future investments. The Stakeholder Advisory Committees (SACs) for each school facilitated the participatory design process and prioritized near term site improvements at their respective schools.

The Stakeholder Advisory Committees (SACs) for each school included representatives from all parts of each school including the principal, teachers and staff, students, family members, and NGO volunteers. These Committees brought an in-depth knowledge of: how the sites are currently used throughout the year; what investments the schools have made to their grounds through SCSD, PTA or NGO funds, and volunteer efforts; and what interests the schools have in expanding outdoor curriculum integration, climate resilience infrastructure, and different landscape elements and spaces that support the development of the “whole child / youth”. These Committees acted as the ambassadors for their communities during Task 2 - Stakeholder Engagement by attending all community engagement meetings at their schools and ensuring that the students at each school had an opportunity to learn about Resilient Schoolyards and voice their interests in potential site plan elements. In Task 4 - Resilient Schoolyard reviewed the draft concept plans, shared with their school communities, and provided consolidated feedback from the communities at each site for refining the Final Plans. SAC comments were integrated with the Project Team comments to create the Final Plans. In Task 5 - Report the Committees continued with their role as primary reviewer and collector of comments as well as providing input and effort into the next steps.

The Consulting Team took the next step of evaluating the selected sites for Resilient Schoolyard planning and developing the participatory community engagement strategy by creating opportunities and constraints maps for each school. The Team studied the existing uses, circulation, local ecology, existing materials, and regional context for each site. Garnering this information included separate site walks with District Facilities and with the SAC from each school. These walks served dual purposes: (1) helping the Team with site understandings and (2) serving as the first step in brainstorming with each school, including with students.

Outcome
For each school the project team created campus maps identifying areas most suitable for optimization to meet child-centered goals, onsite-ecology goals, regional ecology goals, constraints, and underutilized space. Following community meetings and surveys of students, the

project team further developed these maps into specific proposals for each school, including restored creeks, wider turf areas for stormwater entrainment, rain gardens, heat reflective asphalt paint, gardening spaces, permeable pavement, trees and forested areas, educational structures like watershed maps, and other physical improvements. For all three projects community leaders were identified to continue the work and search for implementation funding. The report also provides additional schools interested in developing their own plans with a framework for site selection and community engagement. The resilient schoolyards concepts were also incorporated into the school district's facilities master plan, and the incorporated schools intend to pursue funds from a recently passed $176 million local bond to begin implementation.

Challenges & Lessons Learned

The primary barriers encountered in the RSCS Project were related to ongoing challenges for the San Carlos School District and sites in managing COVID-19 and associated impacts on staffing, school resources, and shifting community-engagement to virtual platforms. The Project Team shifted to full remote meeting and engagement, with the exception of one in-person Student Design Workshop at one of the schools and School Stakeholder Advisory Committee site walkthroughs, which were originally not planned for and scoped as part of the project proposal, but were deemed necessary for having the level of input needed from site leaders on resilient schoolyards project priorities. Meeting remotely and reducing the overall number of planned meetings, allowed for the district staff and site leads to attend as available and to provide input on the most important elements of community engagement. As a result of limited opportunities to engage and the additional time needed to coordinate schedules for meetings that aligned with the school calendar, the project ended up spanning one and a half school years. Ideally this planning effort should happen in one school calendar year to support consistent student body/teacher/administrator engagement and buy-in.

The following provides key lessons learned and take-aways from this project to help inform future Resilient Schoolyard program developments in other communities:

- If partnering with agencies or organizations outside of a school district, have clear expectations for roles and responsibilities on different aspects of the planning effort and for what level of engagement is appropriate for school district and site staff.

- If working at a district scale, propose an overarching quantitative/qualitative site evaluation and assessment process at the project outset, including interviews with site leadership to help identify and prioritize sites for advancing planning work, especially if resources are limited.

- Maintain flexibility for school engagement to allow for appropriate and timely integration with the project (i.e., time student design workshops with teacher/curriculum schedule) and plan coordination meetings around typical/site specific school schedules.

- Core Project Team should include reps from key partner entities, as well as the Superintendent, and director staff representing facilities, business administration, finance from the School District; potentially could include site administration leadership/champions though these representatives could participate in stakeholder groups.

- Set clear goals for the scope of the project and ensure project partners, especially school district and site leaders are aware of planning efforts vs. implementation and what the proposed timeline and phases for full implementation might look like.

- Identify early on in the project opportunities to integrate resilient schoolyards planning with other district or site policies and programs (i.e., master planning, sustainability initiatives, etc.)

- It is helpful to have a website to refer community partners and engagement audience to develop the project and promote the overall program.

- Clearly articulate how projects should or might be constructed in phases and identify high likely and high priority funding strategies.

- Support long-term vision of advancing and maintaining resilient schoolyards by promoting ongoing focused engagement with site Stakeholder Advisory Committees and developing tools and resources to support actual stewardship and maintenance of facilities once constructed.

Next Steps

With the completion of the RSCS Project, the next steps to bring these plans to fruition include advancing through the multi-phase Resilient Schoolyard program design, including fundraising, technical drawings, permits, and construction at each site. Beyond construction, resilient schoolyards featuring green stormwater infrastructure must also be properly maintained to ensure durable and lasting benefits to schools and school communities. The RCSC Report provides guidance and resources to help the SCSD and sites grow their resilient schoolyard programs into complete and sustainable programs backed by the necessary stewardship and maintenance practices for long-term success. To support achievable implementation given time and resource constraints, this report recommends that elements within each plan may be developed separately via sequential grants or as part of SCSD Bond or Modernization processes. This multi-year process will require significant and dedicated engagement from the school communities. The proposed overarching strategy and sequential process for developing Resilient Schoolyards in San Mateo

County is shown in the graphic below. The project partners, including C/CAG and the County Office of Education, plan to continue to advance this model of scaling Resilient Schoolyards in collaboration with other interested School Districts throughout the county in coming years. Ideally, a pilot funding program would be established to create a pipeline of districts and sites to move through the planning and implementation process.

Learn More
Resilient San Carlos Schoolyards Project Website **here >>>**
View the recording of the Arundel Elementary brainstorming session **here>>>**
View a recording of the Tierra Linda/Mariposa Elementary brainstorming session **here >>>**
Green Schools National Network, California Association of Councils of Governments.

Big Valley Band of Pomo Indians

Project: Mitigating Climate Change Impacts Threatening Community Ecosystems and Health on Clear Lake
Focus area: Lake County
Grant amount: $144,033
Climate threat(s): Drought
Additional funding leveraged: $592,298
Read the final report >>>

Summary

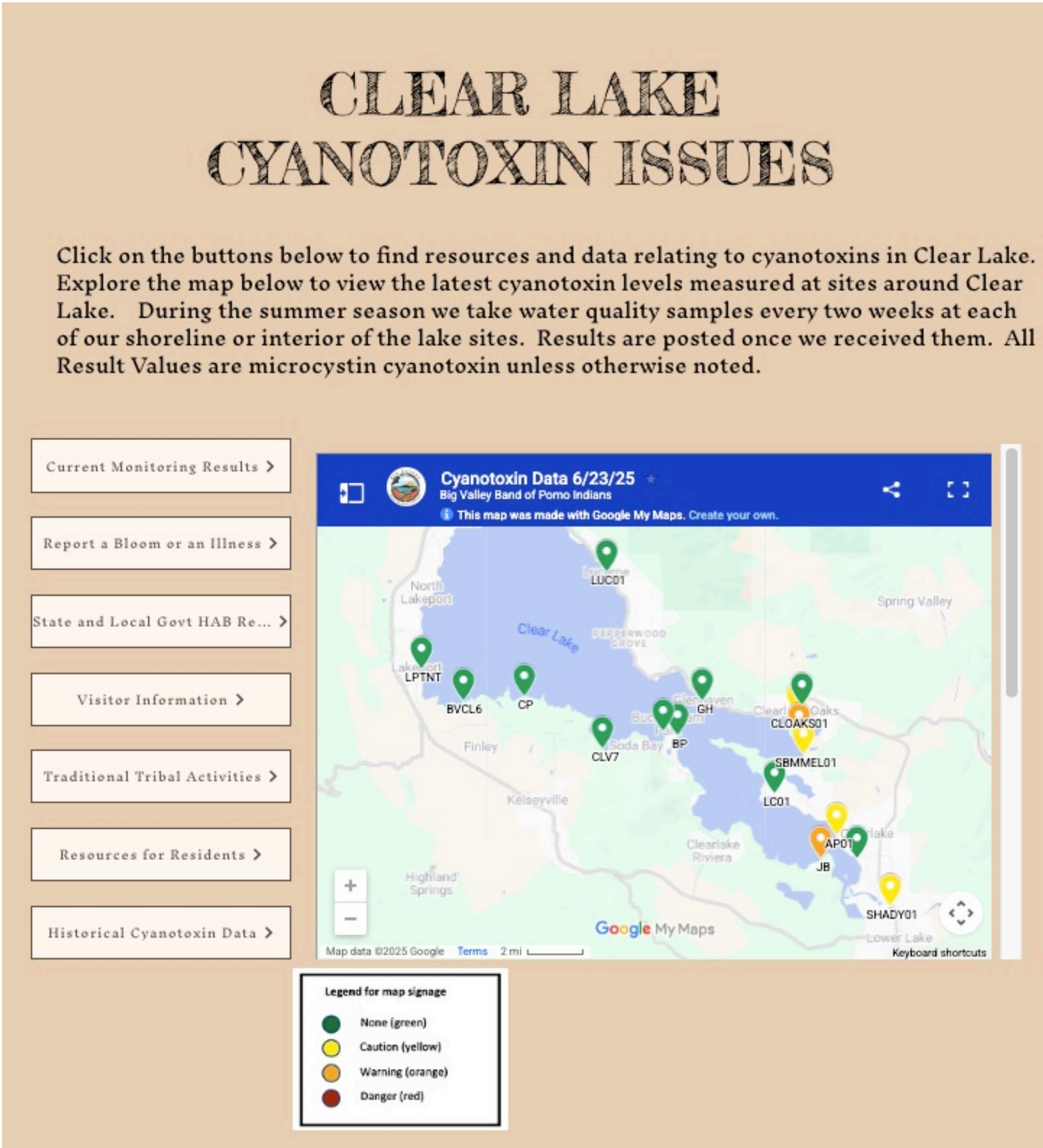
Clear Lake has supported indigenous peoples for centuries. However, Clear Lake is experiencing significant fish die-offs and toxic algal blooms due to increased water temperatures. The California Resilience Challenge is helping the Big Valley Band of Pomo Indians expand water quality monitoring to improve public health and the recreational economy of the Clear Lake region.

Approach

Big Valley Rancheria Environmental Protection Department (BVR EPA) used each of the grants listed above to expand and deepen water quality monitoring on Clear Lake, surrounding lakes, and waterways within Big Valley Band of Pomo Indian's traditional territories. The grant supported training of Tribal staff in advanced water quality data entry, assessment, and interagency collaboration for climate emergencies and climate action plans. Data collected by BVR EPA has been shared with Clear Lake Tribes and water purveyors, Lake County Water Resource Dept., UC Davis Tahoe Environmental Research Center scientists, CalEPA, USEPA Water Quality Exchange, Central Valley Regional Water Quality Control Board, State Water Resources Board, and the Office of Environmental Health Hazards Assessment.

Data collected using grant funds that supported the purchase, installation, and management of sophisticated data loggers and sensors in Clear Lake is provided to regional and statewide planning agencies. Water quality monitoring results are sent to Mywaterquality.ca.gov (CCHABs) and shared in the County cyanobacteria messaging group; shared with the CalWatch team (OEHHA, State Waterboards and Tracking California), and is also shared online, on our website, and social media.

The Big Valley Rancheria EPA also awarded a subgrant of $6,000 to Lake County Office of Education Learning Support Specialist in Science Taylor Observatory STEAM Center Educator & Coordinator to support a project team including six classroom teachers from five schools around the lake, 221 students, two aides, five chaperones, one field biologist, and two Taylor Observatory STEAM Center educators. The teachers will incorporate the background and testing science into

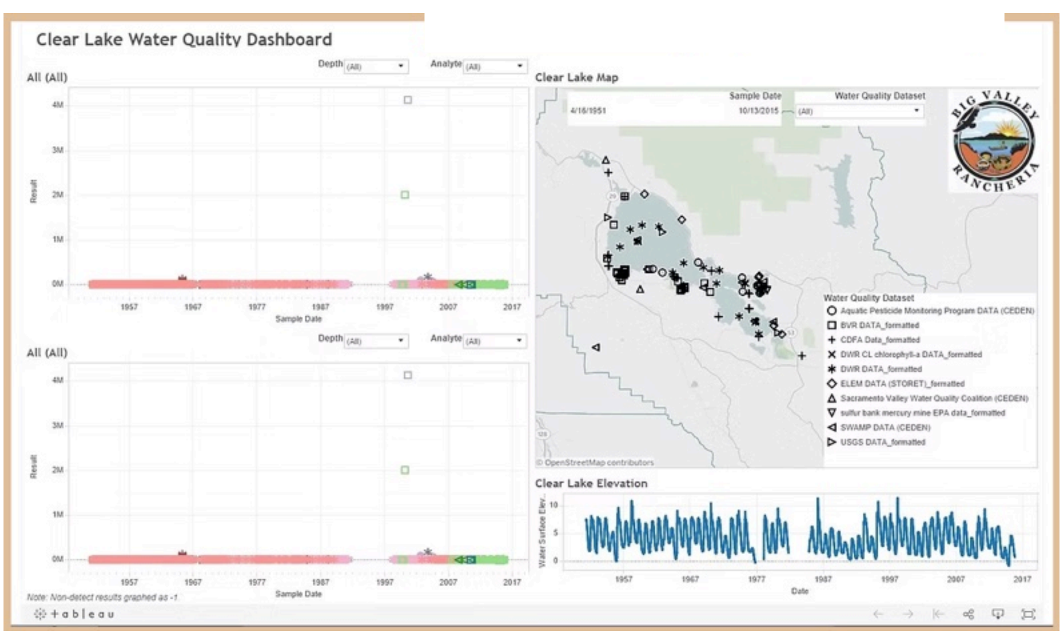


their curriculum. The students will collect the data on field trips. The students will analyze their own results and share their results with other members of the team. The data will be analyzed by location. Connections to lake health, eutrophication, and climate change will be analyzed. The Taylor educators are applying for the grant and organizing the field study from pre-testing lessons, collection of data, and post collection analyzing and sharing of the results. The results for this team's efforts will function as a benchmark (a starting point) for a comparative long-term study of the environmental conditions of Clear Lake by Lake County middle and high school students and their teachers. It is expected that the participating students will learn the science behind the lake that is in their community. They will discover the reasons for its diversity of wildlife, how it has played a significant role in the ecology of the area, the impacts of its condition to those living near its shores, and how the changes in environmental conditions can affect nature's balance. This imbalance acts as a catalyst that damages the sustainability of the area and has a far-reaching impact on the ecology, economy, health, and heritage of the area. Students will learn the reasons for these changes, and provide evidence through water analysis of phosphates, nitrates, pH, dissolved oxygen, turbidity, temperature, and mercury, as well as a study of the bacterial, algal, plant, and animal species endemic and introduced to the lake, beneficial and problematic.

Outcome

BVR EPA's ongoing water quality reports, made available on the BVR EPA website and via Facebook postings, help residents and visitors make healthier choices about whether or not to use tap water for drinking and bathing; help residents and tourists make informed decisions about how and when to recreate in the lake (for example, tourists coming to Lake County who are concerned about water quality and potential HAB blooms are able to consult BVR EPA posts and decide where they can recreate safely in the lake, protecting their health and that of their family pets; ditto for Airbnb and VRBO property owners); and helps local physicians and veterinarians to determine how to diagnose cases of potential waterborne cyanotoxin poisonings. The first BAC grant supported increased engagement in watershed management activities to protect culturally significant species. Successes included the installation of accessible real time water quality dataloggers, development of citizen science classes, multi-agency collaboration efforts on fish kills. The tribe was also able to leverage CRC grant funds for an additional $592,298 in funding for improving water quality at Clear Lake, including $400,000 from the USEPA to develop a regional master plan for data collection and management, $82,106 to support tule restoration and hitch habitat, and $110,192 Bureau of Indian Affairs grant to study and anticipate the climate impacts on water quality at Clear Lake.

Learn more: The Center for Collaborative Investigative Journalism, The Press Democrat, California Water Blog, Lake County News



CALIFORNIA
RESILIENCE
CHALLENGE

BAY AREA
COUNCIL