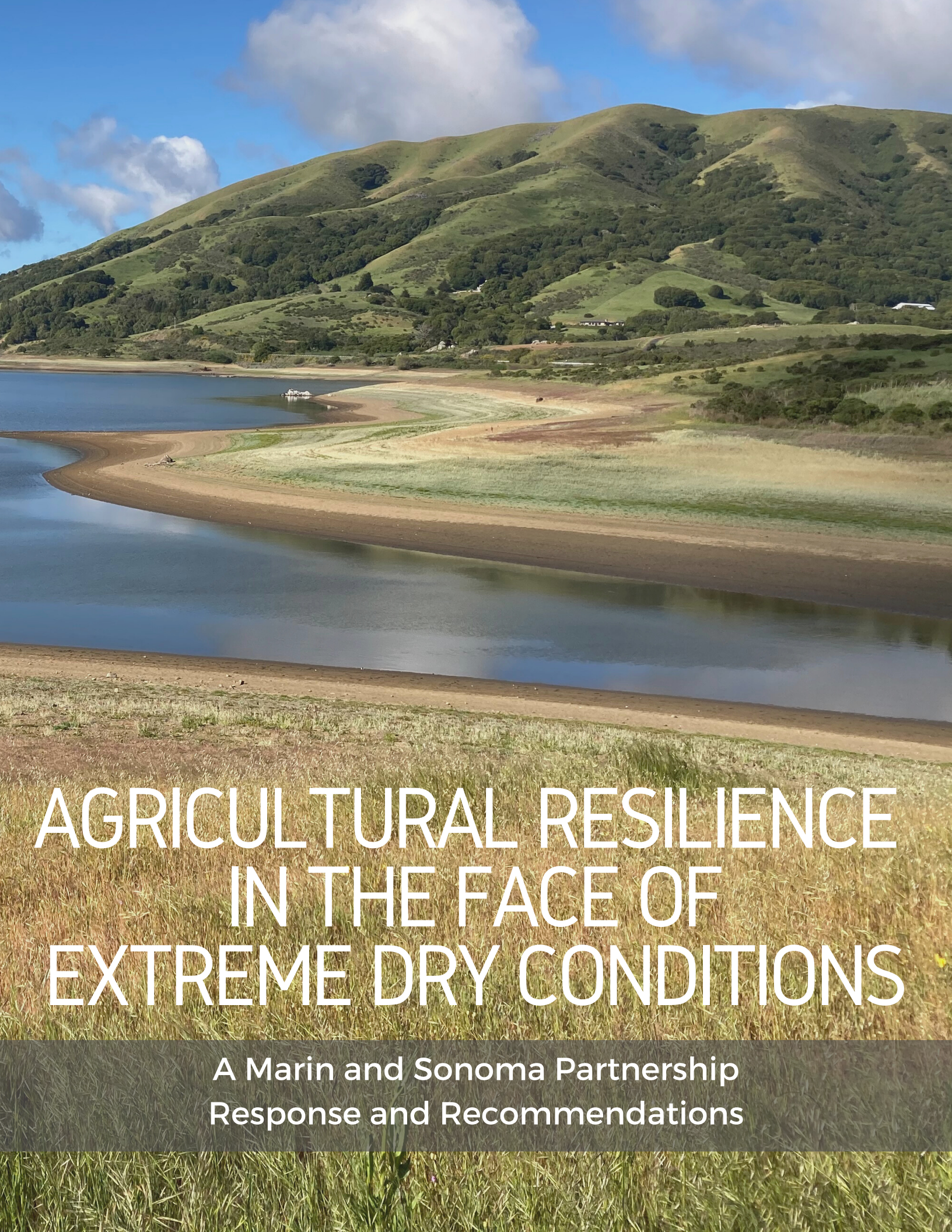

AGRICULTURAL RESILIENCE IN THE FACE OF EXTREME DRY CONDITIONS

A Marin and Sonoma Partnership
Response and Recommendations

PARTNERS

Agricultural institute of Marin

USDA Farm Services Agency – Petaluma District Office

Gold Ridge Resource Conservation District

Marin Agricultural Land Trust

Marin County Department of Agriculture, Weights & Measures

Marin County Farm Bureau

Marin Resource Conservation District

Marin Water

USDA Natural Resources Conservation Service – Petaluma District Office

North Coast Soil Hub

North Marin Water District

Sonoma County Agricultural Preservation & Open Space District

Sonoma County Department of Agriculture, Weights & Measures

Sonoma County Farm Bureau

Sonoma Land Trust

Sonoma Resource Conservation District

Sonoma Water

University of California Cooperative Extension Marin

University of California Cooperative Extension Sonoma

Cover image: Nicasio Reservoir April 2021, credit Marin Department of Agriculture.

Cite as: Agricultural Resilience in the Face of Extreme Dry Conditions: A Marin and Sonoma Partnership Response and Recommendations. 2022. Marin and Sonoma Counties, California. University of California Cooperative Extension, 1682 Novato Boulevard, Suite 150-B Novato, CA 94947

CONTENTS

PURPOSE

Marin and Sonoma Counties have strong agricultural communities and dedicated working lands. The combination of wine grape growers, grazing livestock ranchers, and small diversified fruit and vegetable growers contributes to a diversity of locally grown and produced agricultural products. By 2021 estimates, the combined total production value of Marin and Sonoma agriculture was more thank $356 million, not including wine grapes with an additional value over $540 million[1].

These operations depend upon reliable water resources for farm production. The ability of individual producers and the larger agricultural community to adapt to changes in water availability and adopt innovations to meet agricultural water demand is critical now and into the future.

According to a recent study published in *Nature Climate Change*, the Western U.S. and northern Mexico have been experiencing their driest period in at least 1,200 years. Climatologists have reported that the last multi-decade megadrought, comparable to this dry period, occurred in the 1500s.

Severe, extreme, and exceptional droughts in California and many western states have become more frequent, intense, unpredictable, and damaging over the past two decades as climate change impacts have intensified. This most recent drought that began in the fall of 2019 and has continued through 2022, is one of the most severe droughts California has faced. It is imperative that we use the lessons learned from our predecessors to proactively respond to this drought and create long-term resiliency.

In a 1978 drought report Ronald B. Robie, California Director of the Department of Water Resources, stated, "We must take the opportunity now, while events are still fresh in mind, and we have the breathing spell provided by the 1978 rains, to plan for coping with the next dry period. There is no assurance that the next drought is not just beyond the horizon. We can be assured, however, that drought will return, and, considering the greater needs of that future time, its impact, unless prepared for, will be much greater." Our collective goal with this report is similar to Director Robie's sentiment in 1978, specifically to document our response to the current drought within Marin and Sonoma Counties so that the community adaptations and readiness we have achieved are maintained and advanced.

"We must take the opportunity now, while events are still fresh in mind, and we have the breathing spell provided by the 1978 rains, to plan for coping with the next dry period."

Ronald B. Robie, California Department of Water Resources Director

As a collaborative of agencies and organizations working in support of Marin and Sonoma Counties' agricultural communities, we provide this report for two main purposes. Firstly, it will facilitate the continued momentum of our partnership by documenting how we mitigated the impacts of this drought and guiding our preparations for the next one. Secondly, we offer this report to policy makers and agency representatives who can build on the adaptation strategies and elements we have initiated for the benefit of their communities.

We each have a responsibility to do our part to support water conservation and drought mitigation efforts and help build climate resiliency for the driest and wettest of years yet to come. These extreme climate conditions know no boundaries. The collaboration, communication, and actions that have occurred across Marin and Sonoma Counties during this drought have been exceptional. In this moment, let us heed Robie's words and seize the opportunity to use what we have learned to prepare for future conditions so that we may respond with care and competence.

[1] Marin and Sonoma 2021 Crop Reports

FROM RESISTANCE TO RESILIENCY

Climate scientists are projecting there will be a minimum 25% increase in extreme dry-to-wet precipitation events by the end of the 21st century. This includes extremes between years and the severity of events within years.[2] This whiplash between more extreme wet and dry conditions is compounded by previously referenced analysis confirming that North America's southwest is experiencing the most protracted and severe drought in over 1,200 years.[3]

In the face of these conditions, what was standard response and resistance to dry conditions followed by a return to pre-drought business as usual is no longer an option. Even the extreme drought of 1976 and 1977 left little mark in the community's collective memory on how water was stored and used. And if anecdotes from those who experienced both the 1976-1977 and 2019-2022 droughts are confirmation of the changes in condition extremes and severity, just consider a Marin dairyman's observations when comparing the two, "At least then [1976-1977] we could find water. Today [2021] there is no water on the landscape to be had.[4]"

"To build collective resilience, communities must reduce risk and resource inequities, engage local people in mitigation, create organizational linkages, boost and protect social supports, and plan for not having a plan, which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns."

Dr. Fran H. Norris, Dartmouth Medical School, Hanover, New Hampshire

The alternative for resistance to disaster is resilience. Resilience within the community and on each agricultural operation, borne out of adaptation to the new and altered environment. In their article on community resilience, Dr. Fran H. Norris and co-authors share that "To build collective resilience, communities must reduce risk and resource inequities, engage local people in mitigation, create organizational linkages, boost and protect social supports, and plan for not having a plan, which requires flexibility, decision-making skills, and trusted sources of information that function in the face of unknowns.[5]" Described and organized another way, Dr. Sonny Patel and colleagues encourage the use and application of a set of elements important for a community facing or recovering from a disaster[6], including:

- Local knowledge
- Community networks and relationships
- Communication
- Health
- Governance and leadership
- Resources
- Economic investment
- Preparedness
- Mental outlook

[2] Swain et al. 2019, https://doi.org/10.1038/s41558-018-0140-y

[3] Williams et al. 2022, https://www.nature.com/articles/s41558-022-01290-z

[4] Personal Communications with Marin Dairy Farmer

[5] Norris et al. 2008

[6] Patel et al. 2017

The response of the Marin and Sonoma agricultural community to the 2019-2022 extreme dry conditions, in partnership with local water districts, leadership, and support organizations, demonstrated many of the aspects or elements of a resilient community. There was advanced recognition and planning for conditions in the late winter of 2019. Frequent and routine communication between local leaders, technical and financial services providers, and with agricultural producers were established and maintained. Water to meet minimum needs for both rural residential and agricultural uses was allocated and delivered. Local, state, and federal sources of funding were secured and distributed as an investment to counter the economic costs from extreme dry conditions to agricultural operations. Innovations in on-farm water management were scaled up through cost-share and technical assistance programs.

This report shares the details of these efforts organized by specific adaptation practices. In providing the background, effort, and progress, as well as needed advancements for each practice, the intent is to galvanize the community resilience achieved and strengthen it into the future.

CONDITIONS

RAINFALL

The rainfall based on a water year is from October 1 in one year to September 30 in the next year. Rainfall amounts in Marin and Sonoma Counties during 2019/2020 and 2020/2021 were paltry for most months, below average to average for a handful of months, and historic for one month (October 2021). For reference, Novato's average annual rainfall is 38.00 inches a year.

Table 1: Annual precipitation in Marin and Sonoma Counties during dry conditions from 2019 to 2022 (source – California Irrigation Management Information System (CIMIS)).

	Annual Precipitation (inches and percent of average)	
	Marin County	Sonoma County
Water Year	Black Point Weather Station	Bennett Valley Weather Station
2019-2020	13.35" or 35.2 percent of average	13.22" or 49.4 percent of average
2020-2021	6.35" or 16.7 percent of average	9.41" or 30.2 percent of average
2021-2022	15.64" or 39.6 percent of average	20.84" or 68.3 percent of average

In October 2021 a historic atmospheric river passed over Marin and Sonoma Counties and other parts of California, resulting in over a foot of rain in some areas of Marin County and 10.68" of rain in Santa Rosa (Figure 1). This single, multi-day event surpassed the total annual rainfall received in 2020 for many north San Francisco Bay communities. And still the total annual precipitation for Marin in 2022 was in the five lowest on record (Figure 2).

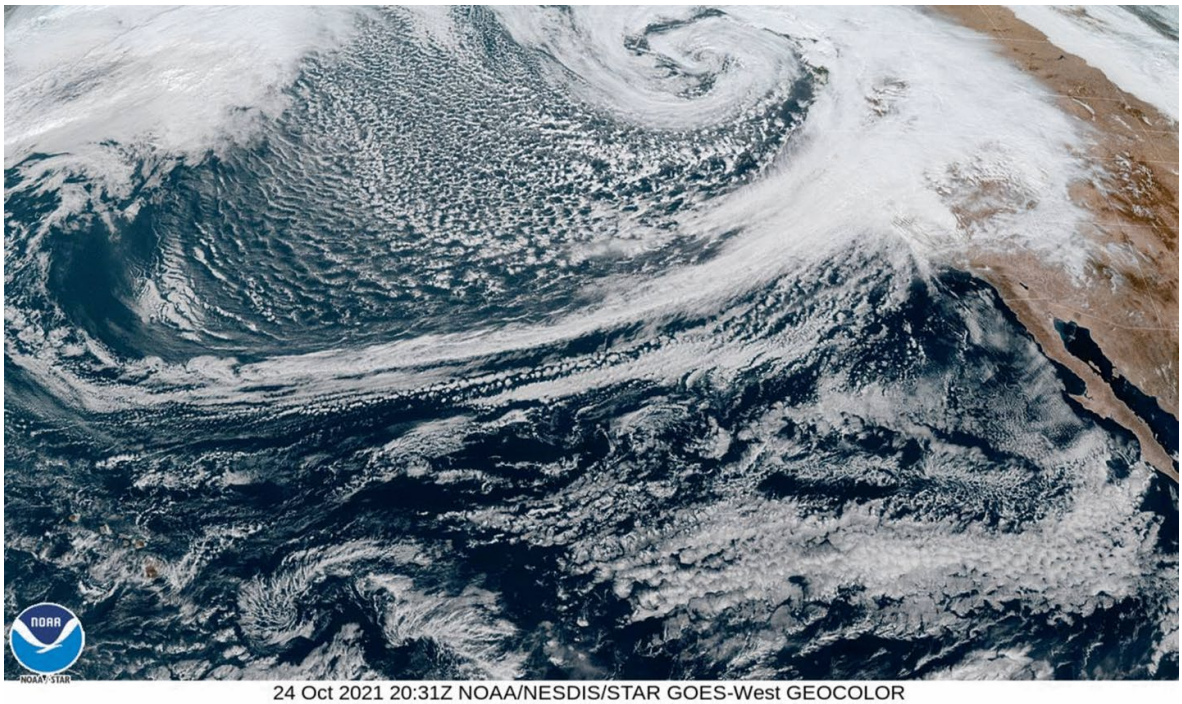

Figure 1: Atmospheric river covering California, October 24 and 25, 2021 (source NOAA 2022).

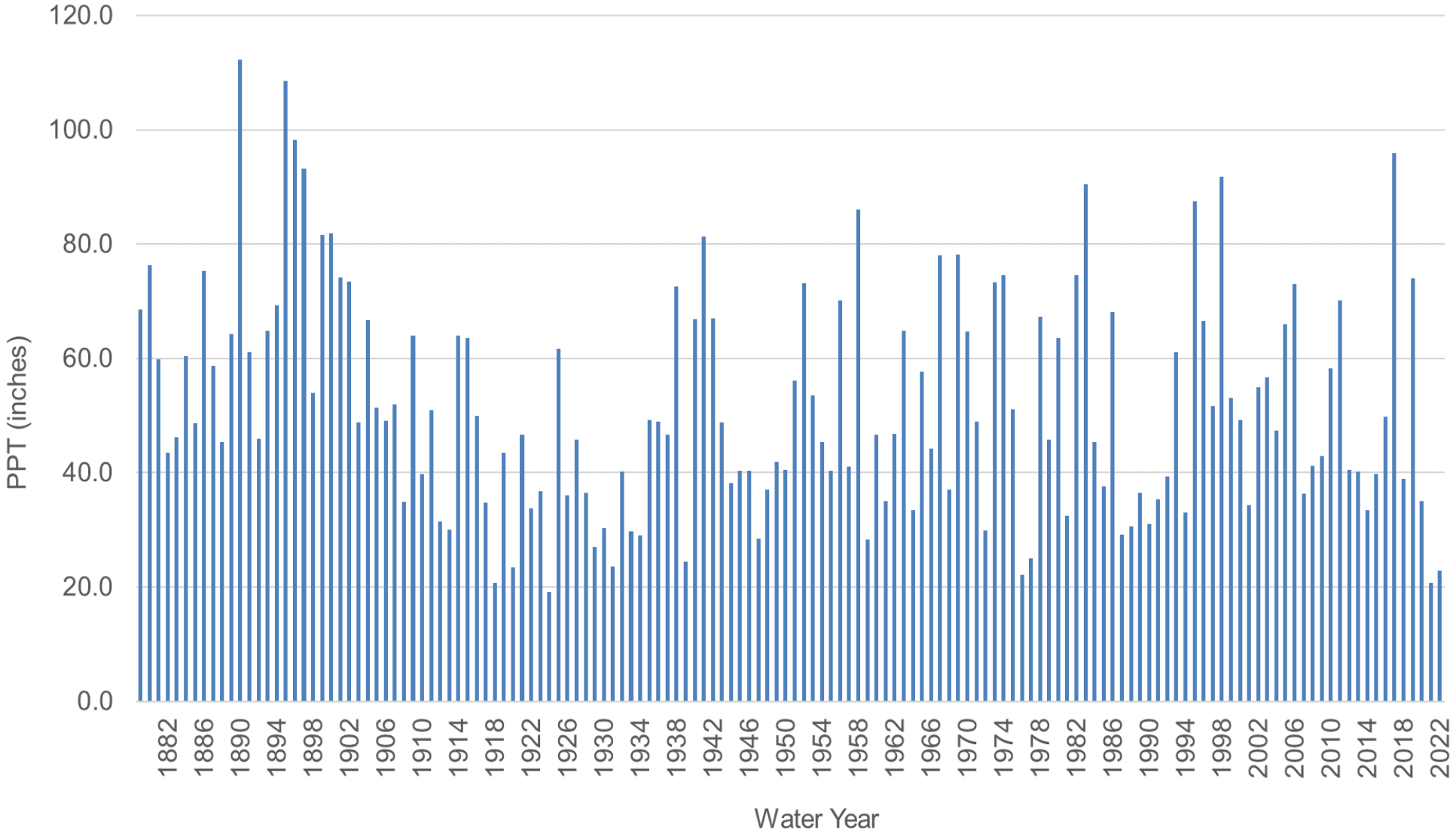

Figure 2: Annual precipitation measured at Lake Lagunitas from 1879 to 2022 (source: Marin Water).

RESERVOIR STORAGE

Marin County

Marin County has two primary water districts – Marin Water and North Marin Water District (NMWD). Marin Water serves a population of over 191,000 people with 75% of its water coming from seven reservoirs in their service area. The remaining 25% of its water comes from the Russian River water system. NMWD serves a population of 64,000 people in Novato and West Marin with 25% of its water coming from Stafford Lake, while 75% comes from the Russian River water system. Both water districts have water supply agreements with Sonoma Water to receive water from the Russian River water system.

Marin Water recorded just 20.4 inches of rain in the 2020-2021 water year at its Kent Lake gauge. That amount was the second lowest in the district's 143 years of rainfall records and less than half of what the district normally receives.

After two consecutive dry winters, levels in Marin Water's seven reservoirs dropped to historic low levels by mid-October 2021, or 32% of capacity overall. It was determined that Marin Water had approximately one year of water remaining assuming a third consecutive dry year. Many intense discussions early in 2021 and throughout the summer were held on finding solutions to bringing water into Marin County if rains did not replenish the reservoirs during the 2021-2022 rainy season. This included implementation of mandatory conservation rules in May 2021, the first time since 1988.

NMWD recorded just 8.1 inches of rain in 2019-2020 at its Stafford Lake reservoir, the lowest amount since records began in 1916. Stafford Lake is primarily tapped during the summer when water use increases and would have been empty by mid-October 2021 (Figure 3) had the district not filled it with 360 million gallons of Russian River water in anticipation of a dry winter. The district plans to repeat this strategy as needed to help ensure drought resiliency in the future. The NMWD Board also adopted emergency water conservation rules that went into effect on July 1, 2021 and mandated a 20% reduction in residential water use from July 1 to November 1. Only seven years earlier, NMWD issued mandatory conservation measures in 2014 and 2015, requiring residents to cut water use by up to 24%.

Fortunately, mother nature answered with the previously mentioned atmospheric river of historic proportions in October 2021, delivering 17.94 inches of rain over three days. These rains filled the seven Marin Water's reservoirs up to over 50% capacity. Another series of powerful storms arrived in December pushing the capacity of Marin Water and NMWD reservoirs to over 90% capacity by December 31, 2021. Marin Water and NMWD were given reprieves by the 2021-2022 rains and still continue to move forward with community discussions and planning to find solutions to ensure drought resiliency long-term. As of June 14, 2022, Marin Water's seven reservoirs were 86.7% full. Storage for this date the year before was at 45.7%, and average storage for this date is 85.6%. NMWD's Stafford Lake was 74% full as of June 14, 2022. Last year at this time it was at 49%, and average storage since 1994 for this date is 74.5% (Figure 2).

Sonoma County

The Sonoma County Water Agency (SCWA or Sonoma Water) provides drinking water to the: City of Cotati, Marin Water, North Marin Water District, City of Petaluma, City of Rohnert Park, City of Santa Rosa, City of Sonoma, Valley of the Moon Water District, and Town of Windsor. Lake Sonoma is the largest reservoir in Sonoma County and the 20th largest in California with a supply capacity of 245,000 acre-feet. It is operated by the U.S. Army Corps of Engineers, managed by Sonoma Water for water supply purposes, and serves 630,000 residents and businesses in the North Bay. Current water

supply levels for Lake Sonoma and Lake Mendocino can be found at https://www.sonomawater.org/current-water-supply-levels.

Lake Sonoma dropped to 43% capacity by mid-October 2021 before the atmospheric river came through and increased storage to 50%. As of December 31, 2021, Lake Sonoma was at 60% capacity (Figure 3). The maximum storage reached during the rainy season was 62 percent (at the end of January 2022), when seasonal withdrawals began and reservoir levels started to decline. As of June 9, 2022, Lake Sonoma was 56.2% full. Storage for this date the year before was at 55.6%, and the 30-year (1991-2021) average storage for this date is 94.2%.

Lake Mendocino, in Mendocino County is approximately one-third the size of Lake Sonoma and relies on year-to-year rainfall to fill, as well as water diverted from the Potter Valley Project. Lake Mendocino is a key drinking water source for the city of Healdsburg in Sonoma County (as well as Ukiah and Hopland in Mendocino County) and provides water to Sonoma Water's Russian River water supply system. It is operated by the U.S. Army Corps of Engineers and managed by Sonoma Water for water supply purposes. The total storage capacity of Lake Mendocino is 116,500 acre-feet with a water supply pool of 68,400 acre-feet. Lake Mendocino dropped to less than 16% of its water supply pool by mid-October 2021 and was at 61% of its water supply pool as of December 31, 2021. As of June 9, 2022, Lake Mendocino was 46% of its water supply pool. Storage for this date the year before was at 30%, and 30-year (water years 1993-2022) average storage for this date is 65%.

The amount of water released from both Lake Sonoma and Lake Mendocino for water supply purposes must be enough to meet minimum stream flow requirements measured at various points in the Russian River and Dry Creek. The current minimum flow requirements were established by the State Water Resources Control Board in 1986. Since the beginning of the drought, Sonoma Water has requested (and the State Water Board has approved) six temporary changes that have led to reductions in minimum flow requirements, helping preserve water supply in the reservoirs.

In addition, in order to preserve stream flows and reservoir levels, Sonoma Water applied for and received emergency drought funding to implement the Santa Rosa Plain Drought Resiliency project, which is re-establishing the functionality of groundwater production wells in the Santa Rosa Plain. In addition, the project helped drought-impacted well-owners whose water sources had dried up, by providing additional water to the City of Petaluma who then made water available for farmers and non-urban residents.

Through an operational strategy known as 'conjunctive use', Sonoma Water increases its use of groundwater during droughts to offset declines in surface water. During wet or normal water years, Sonoma Water reduces groundwater use to allow aquifers to recover. Increasing water conservation efforts during droughts is a third component of drought response water management.

The project will also add recharge capacity for at least one of Sonoma Water's production wells. This will allow the well to work in 'reverse'. Instead of pumping water out of the ground, the well will receive treated, high-quality drinking water when it's plentiful. The water will be stored in underground reservoirs known as aquifers. This water will recharge the aquifer and will be available for use during future droughts and emergencies.

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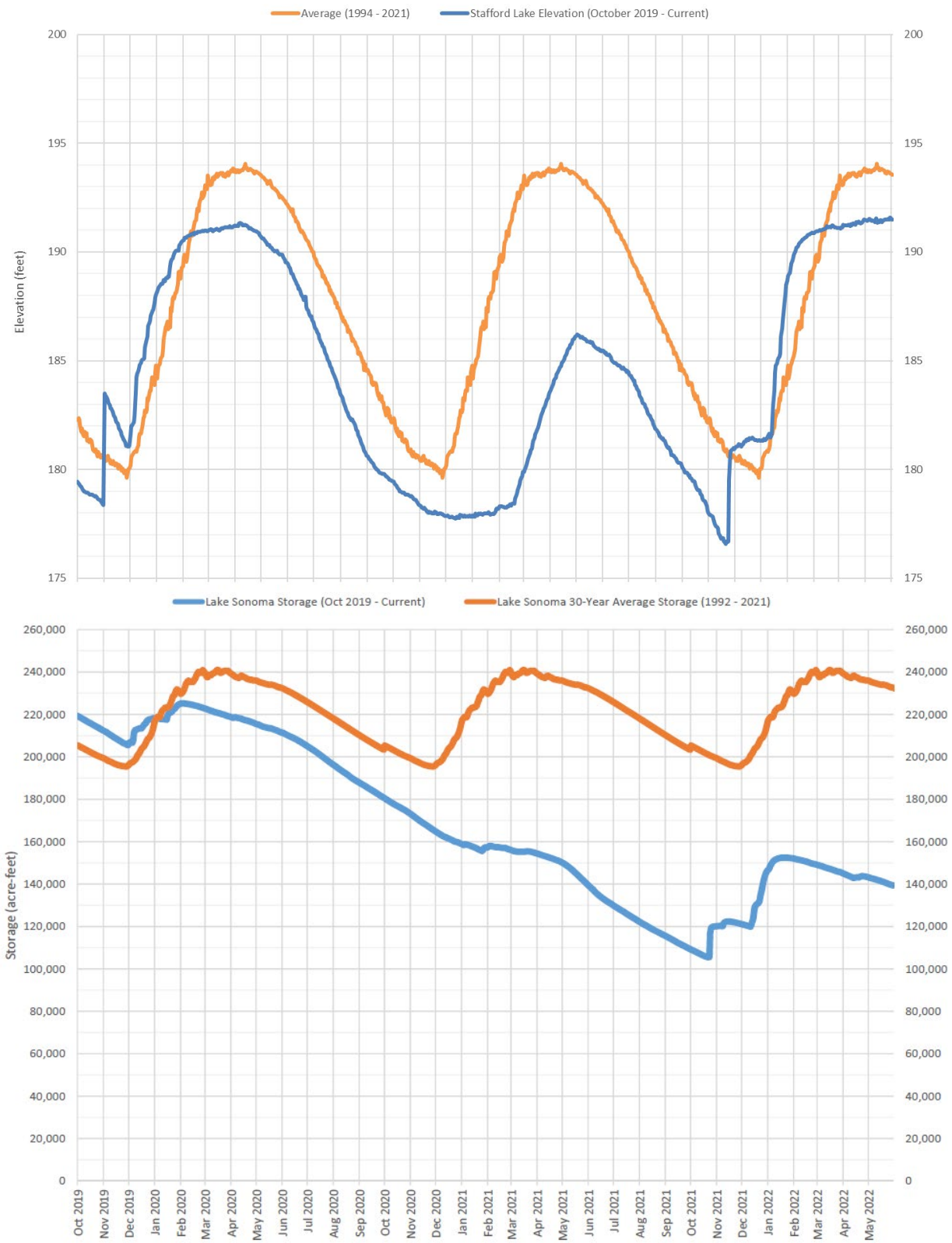

Figure 3: Stafford Lake elevation (above) and Lake Sonoma storage (below) from October 2019 through April 2022 (Source: North Marin Water District and Sonoma Water).

ADAPTATION PRACTICES

SECRETARIAL DROUGHT DISASTER DESIGNATION, REPORTING AND ASSESSMENTS

Background

Disaster designations, including for drought, are made at the local or county, state, and federal levels with varying coordination and implications for the approval and implementation of emergency relief funding and financial assistance program delivery. For this specific drought, a series of steps were taken to establish the drought disaster designation for Marin and Sonoma Counties and the state of California (see "2021 California Drought State of Emergency Proclamations"). These proclamations and designations facilitated the release of county and state funding for agricultural support.

The Farm Service Agency (FSA) administers USDA Secretarial disaster designations. The drought disaster designation process allows for nearly automatic disaster designation of any county in which drought conditions, as reported in the U.S. Drought Monitor, meet Drought Monitor Intensity Classification value of at least D2 (Severe Drought) for 8 consecutive weeks in any portion of the county. If any portion of a county is physically located in an area with a value of D3 (Extreme Drought) or higher during any part of the growing season of the crops affected by the disaster in the county, then the county will be designated a disaster area by the USDA Secretary. The growing season is from January to December. In these cases, a Loss Assessment Report (LAR) is not required for Secretarial disaster determination. FSA is always in arrears with programs, which means agricultural producers must suffer losses first and then request assistance. FSA only uses the US Drought Monitor for two programs:

- Livestock Forage Disaster Program (LFP) as the trigger to release funding to cover expenses associated with forage losses for grazing animals.
- Emergency Assistance for Livestock, Honeybees and Farm-Raised Fish Program (ELAP) as the trigger for water hauling and was expanded in 2021 to include other costs such as assistance for feed transportation costs.

When there appears to be concerns that a county may begin experiencing severe drought conditions, the local county Department of Agriculture and UC Cooperative Extension (UCCE) Advisor will monitor drought conditions very closely with local agricultural producers and partner organizations. The county Department of Agriculture and the UCCE Advisor will contact ranchers to help determine forage losses caused by drought, which will help support a Secretarial disaster designation. The local Department of Agriculture will also complete a Disaster Assessment Report (DAR) which details crop damage, such as pasture, rangeland, and grassland. A letter and DAR report are sent to the local FSA branch as supporting documentation for a Secretarial disaster designation.

To approve an FSA Noninsured Assistance Program (NAP) due to drought, the local FSA requires an independent source assessment by two official sources, which are typically the UCCE Advisor and the local Department of Agriculture. It is important to point out that NAP is directed at producers of specialty crops as well as forage crops raised for livestock. Each independent source assessment letter must include average estimated forage and crop losses for the county based on a percentage. These letters also include justification for the estimated average percent loss, such as rainfall totals, temperature extremes and impacts, and direct contact with growers and ranchers suffering losses. Various other conditions due to drought may also be mentioned in these letters to bolster justification, including documentation of producers hauling water, fallowing land, reducing herd size, purchasing additional feed, and shipping cattle early at a lower weight.

2021 California Drought State of Emergency Proclamations	
April 5, 2021	United States Department of Agriculture Secretary declared 50 California Counties, including Marin and Sonoma, as natural disaster area due to drought
April 5, 2021	Supervisor Dennis Rodoni, on behalf of the Marin County Board of Supervisors, sent a letter to state and federal legislators requesting aid for California agricultural producers due to extreme drought conditions, especially with Marin, Mendocino, and Sonoma Counties.
April 21, 2021	Governor Gavin Newsom "proclaimed a regional drought emergency for the Russian River watershed in Sonoma and Mendocino Counties where reservoirs were at record lows following two critically dry years and accelerated action may be needed to protect public health, safety and the environment." Governor Newsom, "directed state agencies to take immediate action to bolster drought resilience and prepare for impacts on communities, businesses and ecosystems if dry conditions extend to a third year." To encourage Californians to reduce water use and conserve supplies in case drought conditions continue next year, the proclamation also directs state agencies to partner with local water suppliers to promote conservation tips and messages through the Save Our Water campaign.
April 27, 2021	Sonoma County Board of Supervisors proclaimed a local emergency due to existing drought conditions. The County requested the Governor to make California Disaster Assistance Act funds available, as needed and to see a Presidential Declaration. This was the first drought proclamation from the County for this drought and has remained in place since, with the Board of Supervisors renewing it approximately every 60-days.
April 28, 2021	Water Advisory Committee approved a resolution seeking 20% voluntary conservation from Sonoma Marin Water Saving Partnership members.
May 10, 2021	Governor Gavin Newsom expanded the drought emergency to 39 more counties for a total of 41 counties. This included the addition of all counties in the Klamath River, Sacramento-San Joaquin Delta and Tulare Lake Watersheds. The Governor's executive action in April 2021 directed state agencies to partner with local water suppliers to promote conservation through the Save Our Water campaign, a critical resource for Californians during the 2012-2016 drought.
May 11, 2021	Joint presentation to the Sonoma County Board of Supervisors and the Sonoma Water Board of Directors regarding drought conditions. Outcomes from this Board presentation included: Establishment of County Drought Task Force to be led by Sonoma Water; Support for petition to State for changes to Russian River flow by committing to 20% mandatory diversion; and Adopted resolution calling for countywide 20% water use reduction – regardless of water source.

2021 California Drought State of Emergency Proclamations	
May 18, 2021	The Marin County Board of Supervisor declared a Drought Emergency in Marin County with an associated Resolution. The declaration acknowledged the extent and impacts of the drought in Marin, already severely affecting dairies and ranchers in West Marin, and made Marin eligible for California Disaster Assistance and other forms of state funding and resources. It also temporarily provided new authorities to aid response and recovery efforts available to the County, water suppliers, farmers, impacted businesses and residents.
June 14, 2021	Supervisor Dennis Rodoni, on behalf of the Marin County Board of Supervisors, sent a letter to Governor Newsom requesting that the drought emergency be expanded to include Marin County. The letter highlighted current drought impacts to Marin Municipal Water District, North Marin Water District, and agriculture in Marin.
July 8, 2021	Governor Gavin Newsom added nine more counties to the drought emergency for a total of 50 counties, which included Marin County. He also implemented a statewide voluntary 15% reduction in water use to protect water reserves.
October 19, 2021	Governor Gavin Newsom issued a new proclamation and extended the drought emergency statewide to include all 58 counties and urged Californians to redouble their water conservation efforts. The proclamation enables the State Water Resources Control Board to ban wasteful water practices, including the use of potable water for washing sidewalks and driveways.

Efforts and Progress

In both Marin and Sonoma Counties, the respective Departments of Agriculture and UC Cooperative Extension Advisors responded with the necessary letters and DARs. In this case, to facilitate the gathering of needed information, surveys were administered to agricultural producers in both counties. Similarly, partnering organizations gathered photographs and testimonial information from producers, making them available for use in the respective DARs.

Needed Advancements

- Consistency in the disaster designations across the North San Francisco Bay region would improve the availability of emergency funding support and roll out of financial assistance programs for all producers in all counties. The staggering of California drought proclamation from Sonoma and Mendocino counties in April 2021 to Marin later in July 2021 created delays and confusion in the administration of programs and financial aid.
- Continued and improved coordination for the collection and compilation of on-farm drought condition documentation will avoid duplication of effort and help to accelerate the implementation of financial assistance programs. The reality is that some aid and emergency funding support programs require a DAR and direct reporting process from the local Department of Agriculture and

UCCE Advisor, while others rely on the Drought Monitor Intensity Classification. However, in general the same documentation and assessment of on-the-ground conditions can serve both purposes.

- Use of producer surveys met with varying levels of participation, bringing into question the benefits and merits of using these types of tools for condition assessment and documentation. Before administering a survey, it will be useful to work closely with a focus group of agricultural producers and the local FSA representatives to confirm the benefits and effectiveness of a survey relative to other methods. Suggested other methods should include a grassroots gathering of photographs and documentation across a network of agricultural support organizations.

FINANCIAL ASSISTANCE AND GRANT PROGRAMS

Background

In the wake of persistent and intensifying drought conditions, many landowners sought to improve drought resilience and address short and long-term water security with projects such as livestock watering systems and expansions, storage tanks, rain catchment systems, and spring re-developments. However, with the combination of Covid-19 related supply chain issues and an increase in demand for materials, the costs of these critical projects increased by a large percentage, and in some cases doubled from pre-pandemic prices. To partially ease these inflated material and labor costs, a number of programs were developed by local, state, federal, and non-profit agencies to provide funding directly to landowners to ameliorate the rapidly rising costs. For example, an estimated $47 million in financial assistance was issued to Sonoma and Marin producers between January 2020 and June 2022.

Efforts and Progress

Marin Agricultural Land Trust

MALT has utilized its Stewardship Assistance Program (SAP) to plan, design, and implement conservation practices across west Marin for nearly 20 years. This program uses private donations and gifts, in addition to leveraging partner funding, to help offset landowner project costs through the form of reimbursement. The Drought Resilience and Water Security (DRAWS) initiative was created as an emergency response initiative under the existing SAP. It was a direct response from MALT stewardship staff as they fielded an increased demand in water development projects from a community with accelerated drought concerns. After initiating a fundraising campaign, developing project guidelines/criteria, and attaining board approval in just one week, the DRAWS initiative was launched in April 2021 with one noticeable difference. While SAP is solely available to landowners with a MALT conservation easement, the DRAWS initiative became eligible to all agriculturalists in Marin County. With much appreciation to generous donors, and their significant gifts, over $750,000 has been invested into the initiative just over a year and a half after conception. This tangible investment has helped reduce herd losses and develop long-term infrastructure that keeps producers producing and profitable while also having a positive impact ecologically and on the agricultural management practices. Typical improvements included adding water storage tanks for offloading water that is trucked in or pumped from other sites on the ranch, spring re-developments, and livestock water system extension projects.

Natural Resource Conservation Service (United States Department of Agriculture)

NRCS offers technical and financial assistance to farmers and ranchers through a series of programs. NRCS staff utilizes science-based solutions and technical experts on the ground to help farmers and ranchers address drought concerns, prepare them for more dramatic weather events, and build resilience into their operation. The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers to address natural resource concerns on agricultural and forest land through the development of conservation plans that will emphasize improving a soil's capacity to be more drought-resilient. Particular conservation practices that will be employed include residue management practices, such as mulch till, no-till, cover crops, mulching, and crop rotation. NRCS works closely with producers to ensure successful implementation of planned conservation practices. Where conservation activities have failed because of drought, NRCS will look for opportunities to work with farmers and ranchers to re-apply those activities.

Farm Service Agency (United States Department of Agriculture)

The FSA implements agricultural policy, administers agricultural loan and credit options, and manages conservation, commodity, disaster, and marketing related programs across the country. FSA programs are geared towards helping producers through stressful situations and include:

1. *Emergency Assistance for Livestock, Honeybees, and Farm-Raised Fish Program (ELAP):* This program provides eligible producers with compensation for water hauling expenses associated with transportation of water and feed to livestock. For ELAP, producers needed to file a notice of loss within 30 days and honeybee losses within 15 days. Between October 1, 2021 and June 1, 2022 approximately $2.4 million was issued locally.
2. *Livestock Forage Disaster Program (LFP):* Livestock producers were eligible for the LFP for 2021 grazing losses due to drought. LFP benefits were available in situations with loss of grazing acres due to wildfires on federally managed lands on which a producer is prohibited, by a federal agency, from grazing normally permitted livestock. FSA maintains a list of counties eligible for LFP and makes updates each Thursday. Between October 1, 2021 and June 1, 2022 approximately $1.1 million was issued locally.
3. *Tree Assistance Program (TAP):* Producers, namely orchardists and nursery tree growers, were eligible for TAP to replant or rehabilitate eligible trees, bushes or vines lost during the drought. This complements the Noninsured Crop Disaster Assistance Program (NAP) or crop insurance coverage, which covers the crop but not the plants or trees in all cases. For TAP, a program application had to be filed within 90 days. Between October 1, 2021 and June 1, 2022 approximately $900,000 was issued locally through NAP.

California Department of Food and Agriculture

While not designed to assist directly with drought, the CDFA offers three programs which indirectly fund projects improving water efficiency and supply. These programs receive funding through the California State Budget, with varying program allotments annually. The CDFA's purpose for these programs is to incentivize implementation of agricultural conservation practices which reduce greenhouse gasses. Assistance is available through the Marin, Sonoma, and Gold Ridge RCDs and UCCE to apply for all programs.

1. *Healthy Soils Program (HSP)*: The objective of the HSP is to build soil organic matter and reduce atmospheric greenhouse gasses. The program allows for a multitude of eligible practices which improve soil water holding capacity, including compost application, range planting, cover cropping, no-till or reduced till, and others. Agricultural operations can apply for up to $100,000 without a need for cost share. Applications are accepted on a rolling basis until all funds are expended, making early application essential.
2. *State Water Efficiency and Enhancement Program (SWEEP)*: The purpose of the SWEEP is to incentivize activities that reduce on-farm water use and greenhouse gas emissions. Producers can apply for program funding to install more efficient irrigation equipment (i.e. sprinklers, guns), pumping stations to irrigate previously non-irrigated land, water catchment systems, and others. Applicants can apply for up to $200,000 without a need for cost share. Applications are accepted on a rolling basis until all funds are expended, making early application essential.
3. *Alternative Manure Management Program (AMMP)*: The purpose of the AMMP is to award projects which reduce emissions from manure management related activities. This includes improvements to pasture, increasing time grazing, installation of manure separators, allowing for more easily irrigated effluent water, and transition from flush to scrape manure collection

systems, reducing the need for water to remove manure from alleyways. Grants are awarded for up to $750,000 without need for cost share. Awards are highly competitive and require documentation for bids, financials, and manure management practices.

Needed Advancement

- These grant programs provided much needed funding in a time of dire need, however, projects often faced hurdles and restrictions delaying implementation and drought-related relief. Most notably, supply chain shortages stemming from the Covid-19 pandemic and exacerbated demand on contractors created significant delays for drought-related project completion. In particular, well development was backlogged for nearly a year due to delays in contractor availability and county issued well-permits. Developing systems to streamline drought-related (or other emergency) projects from the project design level to permitting to grant awarding, particularly in designated times of drought, will be imperative to adequately addressing emergency situations.
- Fortunately, there has been an increase in grant assistance over the past few decades, but there still can be a disconnect between a grantor's program, application and process, and the applicant. Continuous feedback from the community states that the process can be confusing, challenging, and frustrating. As grantors, it is probably best practice to increase one-on-one technical assistance, revisit program guidelines and process, adjusting to shifting climates and needs as the work on the ground continues to evolve.
- Cost share requirements for grants or through a relief program assumes that a participating grower or rancher has the capital available to contribute. This often is not the case and is a significant barrier to participation and receiving program support. Establishing a revolving loan program is just one option to explore for relieving this initial demand for capital and barrier to entry.

AGRICULTURE WATER ACCESS, TRUCKING, AND ASSOCIATED COST SHARE PROGRAMS

Metered hydrant and truck being filled to haul water to ranches with limited water supplies.

Background

Marin County's Response to Water Access for Agricultural Producers

As this drought worsened during the summer of 2020, it became apparent that some agricultural producers would likely have to start hauling water if ample rains did not fill storage ponds during fall 2020 and winter 2021. Unfortunately, this was the case as the region received extremely low rainfall amounts and water storage ponds did not refill; most were one quarter to one third of their capacity in March 2021. In response to these on-farm conditions, the following agencies and organizations contributed to making water immediately available and providing a cost-share program:

- Marin Municipal Water District (Marin Water)
- North Marin Water District
- Marin County Department of Agriculture, Weights and Measures
- City of Petaluma Water Service and Utility
- County of Marin – Board of Supervisors

Efforts and Progress

In the fall of 2020, in anticipation of agricultural producers needing access to water, the Marin County Department of Agriculture began discussions with the North Marin Water District (NMWD) to set up hydrant meters at strategic locations for agricultural producers. A hydrant meter for potable water was set along San Antonio Road north of the Silveira Ranch in April 2021, and a meter for raw water was set below the dam at Stafford Lake in August 2021. The Marin County Department of Agriculture also collaborated with Marin Water and a hydrant meter for raw water was placed below Nicasio Reservoir for agricultural producers in May 2021.

Both MMWD and NMWD Boards of Directors had to approve a resolution granting the County of Marin authority to oversee the hydrant meters to support agricultural operations severely impacted by drought. The Marin County Department of Agriculture filed the required water district forms, paid all invoices, carefully tracked which agricultural producers needed to haul water from each meter, and was the main point of contact for the water districts with respect to these meters.

Total potable and raw water trucked by agricultural producers and water haulers from the two NMWD hydrant meters and the one MMWD meter was approximately 10-acre feet for each water district, or a total of 20-acre feet overall. This represents the size of a typical livestock water storage pond on a given ranch.

The Marin County Board of Supervisors approved three separate requests from the Marin County Department of Agriculture to set up and administer three cost share programs to support

agricultural producers impacted by severe drought conditions. The first request was for a water hauling cost share program for Marin County dairies in FY 2020-21 to help support their operations. A total of $50,000 was approved by the Marin County Board of Supervisors for the water hauling program. Nine Marin dairies participated in this program.

In FY 2021-22, the Marin County Department of Agriculture requested and received approval of $150,000 to support agricultural producers. Additionally, the Marin County Board of Supervisors approved $250,000 of drought mitigation funds for FY 2021-22 that could be used to aid agriculture. Based on the needs of the agricultural industry, two additional cost share programs were implemented in FY 2021-22. One was for a $150,000 cost share program with specialty crop and nursery stock producers, and the other was for $200,000 for a water hauling cost share program for agricultural producers.

A committee was created by the Marin County Department of Agriculture to help determine how best cost share funds could be equitably distributed to agricultural producers most impacted by severe drought conditions. The committee was made up of members from:

- Agricultural Institute of Marin (AIM)
- Marin's agricultural community
- Marin County Department of Agriculture, Weights and Measures
- Marin Resource Conservation District (Marin RCD)
- UC Cooperative Extension Marin (UCCE Marin)

In addition to the water made available during the heart of the drought by Marin Water and NMWD, the Marin County Department of Agriculture communicated closely with the City of Petaluma, discussing possible hydrant meter locations in southwest Petaluma. Because there were no requests from agricultural producers to set up hydrant meters in this region, none were pursued.

Sonoma County's Response to Water Access for Agricultural Producers

Background

Through a strategy known as 'conjunctive use', Sonoma Water couples increased water conservation with increases in groundwater use during droughts to offset declines in surface water. During wet or normal water years, Sonoma Water reduces groundwater use to allow aquifers to recover.

In keeping with this strategy, the two-phased Santa Rosa Plain Drought Resiliency Project provided water to Sonoma Water customers by re-establishing the functionality of three groundwater production wells in the Santa Rosa Plain and helped drought-impacted well-owners whose water sources had dried up. The Drought Resiliency Project was the outcome of a Sonoma County Board of Supervisors' emergency request from Second District Supervisor David Rabbitt, whose South County District was facing water hauling issues for impacted agriculture and residential uses. On May 11, 2021, Sonoma Water presented to its Board of Directors (Board) an overview of the current status of the drought in Sonoma County, and specific actions underway or planned by Sonoma Water and other county departments in response to the drought emergency. Supervisor Rabbitt advocated for emergency action to support water hauling to affected agriculture and residential customers in South County who were facing extreme shortfalls in water storage and underground wells. The Board directed Sonoma Water to return on the May 18, 2021, Agenda to receive funds from the County's Contingency Funds to design and perform environmental review for a proposed Production Well Activation Project, to bolster water supply reliability for the region. At the May 18 meeting, the Board approved $400,000

for phase one of the project, including preliminary design, environmental review, and other related costs of upgrading and reactivating one well.

Sonoma Water leveraged emergency and other funding opportunities to implement phase two of the proposed project. This included an Aquifer Storage and Recovery (ASR) capital project at the well location to replenish groundwater extracted during the drought. It also included the planning and pre-design activities necessary to seek anticipated state drought emergency funding to activate the remaining two Santa Rosa Plain wells in addition to adding recharge capabilities via groundwater banking. Upon the completion of Phase 2, Sonoma Water successfully pursued state grant funding, receiving $6.9 million to activate the other wells and to develop an ASR project that will help recharge the well field during the rainy season. These collective activities are intended to result in increased drought resiliency by helping drought impacted communities and assist in long term groundwater management activities under the Sustainable Groundwater Management Act.

Water from the upgraded wells was conveyed through Sonoma Water's aqueducts to customers, providing Sonoma Water's water contractors with additional water supply reliability. One customer in particular, City of Petaluma through an agreement with NMWD and Sonoma County Water Agency, allowed water hauling to customers outside of the city. This agreement allowed Petaluma to meet it's mandated 20 percent reduction, while supplying water to agricultural and residential users that needed an emergency supply of water. This agreement was primarily negotiated by Supervisor Rabbitt, who serves as a Director on Sonoma Water board and who represents the geographical territory that was seeing the highest demand for emergency water for health and safety.

The City of Petaluma Water Service and Utility has furnished water to agricultural users and trucking companies for over two decades through the City load accounts and the trucking program. Customers can rent a hydrant meter and be set up at a certain location, if feasible, or they can go to 202 North McDowell and fill up at the standpipe. Meters are tracked by monthly readings and the standpipe is tracked by haul cards and totaled at the end of the month.

Starting in the winter of 2020 due to drought conditions, small ranchettes and other residences relying on well water were added either directly to the hauling program or through outside hauling companies. In July of 2021, Sonoma Water in response to the State Water Resources Control Board's order to reduce Russian River diversions by 20%, set allocations from July to October on water delivered to the contractors. Petaluma worked with Sonoma Water, Sonoma County Department of Agriculture, Marin County Department of Agriculture, NMWD, and MMWD to better track water used for agriculture focusing mainly on dairies and beef cattle operations.

Contributing agencies and organizations:

- City of Petaluma Water Service and Utility
- Sonoma Water
- County of Sonoma – Board of Supervisors
- Sonoma County Department of Agriculture, Weights and Measures

Efforts and Progress

The city of Petaluma's primary source of water is groundwater. This well water is used to serve its Petaluma's municipal and industrial customers and to supply (through the trucking program) water to users who have no other method of obtaining water for both health and human safety needs and for agricultural needs. Petaluma supplemented this primary source from July of 2021 to October 2021, through an agreement beginning on July 2, 2021 with Marin Water to receive an extra 100,000 GPD, specifically for supplying water to those in need. The total ranches/ranchettes supplied from Petaluma

either directly or through a hauler by the County included 45 in Sonoma County and 17 in Marin County for a total monthly water use average of 3.8 million gallons.

Needed Advancement

- At the first signs of long-term drought, reach out to all key partners to initiate a preliminary discussion about possible needs and preparatory work if conditions worsen. Partners include water districts, USDA Farm Services Agency, USDA Natural Resources Conservation Service, UCCE Marin, Marin RCD, AIM, Marin Department of Agriculture, and others. Depending on the expected severity of the drought, be sure to include all counterparts in Sonoma County to collaborate and share resources and to leverage political influence to garner state and federal aid as needed.
- The funding intervention by the County of Marin at a time of deepest need made a difference. In both Marin and Sonoma County, discussing and preparing for this emergency relief through a contingency plan would contribute to resilience through improved response time and implementation.
- The connection and integration of water hauling with the on-farm capacity and infrastructure for storage needs to be improved. Working now to ensure that every farm or ranch has the ability to switch from well, reservoir, or spring over to trucked water is an investment in resilience.
- It needs to be acknowledged that at the peak demand for hauled water there was a bottleneck in the availability of trucks and haulers. This led to prioritizing some customers over others. What could/should be done to ensure that if water must be mobilized, there are sufficient means to ferry that water out to all who need it?

RESIDENTIAL WATER ACCESS AND TRUCKING

Marin County Residential Water Access and Trucking

Background

As this historic drought continued to worsen in the summer of 2021, concerns were raised about domestic wells potentially going dry from residents living in the unincorporated areas of the county, especially Nicasio Valley and Lucas Valley.

Marin County Supervisor Dennis Rodoni responded by leading the creation of a residential potable water hauling program for domestic use of up to 55 gallons per day, per person. The cost share program was mirrored after the Ag Water Access and Trucking program with the Marin County Department of Agriculture as lead. Contributing agencies and organizations included:

- Marin Municipal Water District (Marin Water)
- Marin County Office of Emergency Services
- Marin County Environmental Health Division
- Marin County Health and Human Services
- Marin County Department of Agriculture, Weights and Measures

Efforts and Progress

In October 2021, the Marin Agriculture Department collaborated with Marin Water to source potable water from a metered hydrant located in San Geronimo on the south side of San Geronimo Valley Road and Meadow Way. The hydrant was equipped with fittings that would allow a water hauling truck to fill.

To date, no residents have requested to take part in the cost share program. Funding for the program was to come out of the drought mitigation funds the Marin County Board of Supervisors approved in FY 2021-22.

The structure of the program was outlined as follows:

- Support and vetting of any residents interested in participating in the program would be done through Marin County Health and Human Services and the County's Office of Emergency Services, with support from of the County's Environmental Health Division. Vetting criteria included:
    - Property located in Marin
    - Dry well
    - Can the resident afford the service? If not, they would be eligible for cost share funds.
- Once candidates were vetted, they would be referred to the Marin County Department of Agriculture (Ag Department).
- The Ag Department was prepared to coordinate with the primary water hauler for Nicasio Valley and Lucas Valley to provide service to any residents in the program.
- Residents would be invoiced directly from the water hauling company. For residents unable to pay, invoices would be submitted to the appropriate agency, who would use cost share funds to pay for the water service.

Needed Advancement

- At the first signs of long-term drought, all key partners should be engaged to initiate a preliminary discussion about possible needs within the unincorporated areas, including concerns about domestic wells running low or dry. Partners include local Office of Emergency Services, Health and Human Services, Environment Health, Department of Agriculture, etc.

ROOF CAPTURE

Background


Barn with gutter and plumbing system to capture roof runoff for storage and later use.

As a result of the October 2021 atmospheric river that deposited from 10 to 20 inches of rain across Marin and Sonoma Counties in 24 to 48 hours, bone-dry and nearly empty ponds and reservoirs across the region filled quickly. In some cases, they even overflowed. To a certain degree, there was almost too much rain in a short period of time. For some producers, however, having means of storing water beyond ponds and reservoirs, resulted in an added layer of water security.

Lonny Grafman, a renowned rain catchment expert, explains that the concept of rainwater harvesting is to "catch the water falling from the sky and use it with more direct purpose." For agricultural producers in California this equates to increased water security in the hottest, driest months of summer. Many people in urban, suburban and rural areas across the world have relied on passive and active methods of increasing water security for centuries. However, the legality of harvesting rainwater has often come under scrutiny for a variety of reasons. As such, most current landowners and agricultural producers do not have rainwater harvesting systems in place, nor are they aware of the benefits of the systems.

In 2012, California Governor Jerry Brown signed into law the Rainwater Capture Act, which was intended to help ease the stress on public water supplies and build water resilience in the face of ongoing drought conditions and climate change. This law determined that rooftops are not a natural waterway and therefore did not apply to the State's Water Control Board's Division of Water Rights which regulates natural waterways and their associated ecological and societal benefits. Prior to this law, residents could still capture rainwater, but needed a permit. By legalizing the capture of rainwater statewide, it reduced the barriers of harvesting rainwater for residential and agricultural landowners. The law stipulates that rainwater may be harvested for a variety of non-potable uses, including livestock watering systems, crops, and fire protection, but may not be used for potable purposes such as drinking water.

Efforts and Progress

As drought conditions worsened in summer and fall of 2021, landowners and tenants began to inquire more about rainwater harvesting systems. Technical service providers including the Natural Resources Conservation Service (NRCS), Marin Agricultural Land Trust (MALT), and UCCE, were contacted by landowners to better understand the feasibility of a rain catchment system on their ranch to address long-term water security and drought resilience. In late spring and summer of 2021, many producers had already begun utilizing existing grant programs including NRCS' Environmental Quality Incentive Program (EQIP) and MALT's Drought Resilience and Water Security (DRAWS) to implement drought mitigation practices such as spring re-development, well development, adding storage tanks, and using pumps to distribute water. For a couple of producers, these partnerships, coupled with

existing favorable infrastructure, allowed for rainwater harvesting to be a seamless amendment and complement to their ongoing water security pursuit. Examples of these practices in action include:

- Dairy Barn*:* In the construction of a new loafing barn at a dairy, NRCS EQIP project design included gutters that could serve as the initial infrastructure for a rain catchment system. Later that year, MALT DRAWS provided funding for storage tanks, piping and a solar pump to distribute water from the barn to the dairy. Through the combined work of the NRCS and MALT programs, the rain catchment system is complete and the landowners are now capable of capturing 785,000 gallons of water using the 36,000 square foot roof with an average rainfall year (35”). This project will add nearly 2.5 acre feet of water to their operation, which is equivalent to roughly 40 days of the water use for the dairy.
- Cow/Calf Beef Grazing*:* Another project, on a nearby cow/calf operation, installed gutters on two smaller roofs totaling roughly 4,300 square feet of roof space. On an average rainfall year (30”) it is calculated that 80,000 gallons of water will be collected, which would water the existing beef grazing herd of 40 cows for roughly 70 days. In addition, the captured water may be used to help irrigate vegetation planted by Point Blue Conservation Science’s Students and Teachers Restoring a Watershed (STRAW) as part of a riparian restoration project.
- A group of partners including RCDs, Sonoma Water, Daily Acts, and cities launched a coordinated rainwater catchment rebate program. While some cities had previously offered such programs, the new program added the opportunity for rebates outside city limits and for larger systems. The new program has been met with great interest, and the biggest challenges to meeting demand have included availability of system designers and installers, and available funding resources.
- In Sonoma County, a group of partners including RCDs, Sonoma Water, Daily Acts, and cities launched a coordinated rainwater catchment rebate program. While some cities had previously offered such programs, the new program added the opportunity for rebates outside city limits and for larger systems. The new program has been met with great interest, and the biggest challenges to meeting demand have included availability of system designers and installers, and available funding resources.

Needed Advancements

- By eliminating the regulatory hurdles in the 2012 law and showcasing successful implementation, many landowners, agricultural producers, and even residential homeowners may look to incorporate rainwater harvesting practices into their water security plans. With minimal to low infrastructural investment necessary, rainwater harvesting and rain catchment systems have a huge potential to directly augment ongoing drought resilience measures for operations of any size and for management objectives of any kind. Many agricultural operations have some combination of barns with gutters, sheet metal roofing, and existing storage systems, which are the three basic components of a successful rainwater capturing system. If an operation is missing one of the components, financial assistance programs like the EQIP, DRAWS, and others could help offset landowner costs to create a complete and functioning rainwater capture system.
- Our shifting climate is creating less predictable, more severe and erratic storm systems. Having systems in place to take advantage of these more extreme rain events can build increased water security and drought resilience into an operation. Given inventory of farm buildings on local farms and ranches, technical assistance providers should expect regular inquiry about these systems. They also stand to benefit from added education around the legality of these systems,

particularly in Creek Conservation Areas and other sensitive habitats. Additionally, ongoing education about project design, including from Lonny Grafman's book "To Catch the Rain," will ensure projects are as sustainable and efficient as possible.

- As demand for rainwater catchment systems increases, it will be important to increase the local capacity to design and install these systems.

POND MAINTENANCE

Background

Water storage pond in March 2021, at less than one-third its total storage capacity.

There are nearly 300 privately held ponds on Marin lands, the vast majority of which are used to irrigate crops, water livestock, or otherwise support agricultural production in the county. Collectively, they represent more than 2,000 acre-feet of water that has been beneficially used for generations, but as we emerged from the winter of 2020-2021, many of those ponds were dry. For all of the challenges this created for ranchers around the county, the historic low rainfall also provided an opportunity to plan ahead for future winters: to clean out accumulated sediment from the ponds and restore them to their original, permitted capacity before the rains returned.

Ag-support organizations around Marin County began receiving inquiries as early as April of 2021 from producers asking how they could do this work and what sort of permits would be required. These questions touched on an awkward and sometimes hard to comprehend reality regarding ponds: most landowners regard them as a specific, well-defined resource which they (or their forebears) established for their own use, but to the State of California and U.S. Federal government, they represent nodes in a contiguous, interrelated system of creeks, streams and wetlands over which they have ultimate jurisdiction. And while there are a host of well-defined programs and permits involved when working inside stream channels, the unique dynamics of working in a stock pond which is cut off from the rest of the watershed for most of the year, combined with the emergent nature of these projects, created some confusion among the agencies about the best way to proceed.

Efforts and Progress

Getting answers for ranchers who hoped to repair and restore their ponds before the return of winter rains required a lengthy period of dialogue and collaboration that ultimately led to two conclusions:

1. There was a pathway acceptable to state and federal agencies that would allow these pond projects to take place in the near-term with a minimum of time and cost.
2. There needed to be a long-term strategy for how such projects (and pond restoration, in general) could proceed in the future without triggering a host of obstacles that would make this work essentially infeasible for producers.

Agreement around both the near-term and long-term scenarios came as a result of conversations that began in June and concluded in September and involved numerous entities:

- Marin Resource Conservation District (Marin RCD)
- University of California Cooperative Extension Marin (UCCE Marin)
- California Department of Fish & Wildlife (CDFW)
- Marin County Department of Public Works (DPW)
- San Francisco Bay Regional Water Quality Control Board (RWQCB R2)
- U.S. Army Corps of Engineers (USACE)
- Prunuske Chatham, Inc.

A critical forum for investigating the proper and most expedient pathway for these projects was the Marin County Stormwater Pollution Prevention Program (MCSTOPPP) and its Marin Project Coordination (MPC) meeting. The MPC brings together multiple agencies on a monthly basis, allowing landowners to discuss potential projects involving streams, creeks, and waterways with the regulatory agencies that oversee these systems. In the MPC, landowners explain their needs and goals, and regulators can share potential challenges and lay out both the necessary permits as well as the best practices that would facilitate success for these projects.

With a narrow window of time to secure permits and complete work before mid-October when most agencies halt in-stream work, the chronology of action was as follows:

1) **June, 2021:** Conversations between UCCE Marin and Marin County DPW quickly established that most pond projects could proceed with a simple notification to DPW of the intent to conduct maintenance on an existing dam.
2) **July 1, 2021**: First meeting with MCSTOPPP MPC. UCCE Marin brought three hypothetical projects to illustrate the needs/concerns of ranchers and explore permitting pathways.
3) **July – Aug, 2021**: Multiple one-on-one's and follow-up conversations between CDFW, WQCB R2, USACE, UCCE Marin and Prunuske Chatham, Inc., under contract to Marin RCD. Ultimately, it was established that:
    a) Basic assumptions/expectations for these projects would include:
        i) Ponds are linked to a licensed or registered diversion with CA Division of Water Rights
        ii) Removal of sediment would not result in a pond capacity greater than the license/registration
        iii) Projects would result in net improvements for wildlife habitat
        iv) Projects would incorporate best practices established by CDFW and WQCB R2
    b) Projects fit within the Army Corps of Engineers' Nationwide Permit #3, requiring a simple Pre-Construction Notification (PCN) to the District Engineer.
    c) Projects fit within the State Water Quality Control Board's General 401 order for Small Habitat Restoration Projects (401 SHRP) which requires submittal of a Notice of Intent.
    d) Projects fit within CDFW's Habitat Restoration & Enhancement Act (HREA) which, following certification with the Water Board's 401 SHRP, can be granted within 30 days under Section 1653 of the Fish & Game Code. Forms can be submitted through CDFW's online system, EPIMS
4) **Sept 2, 2021:** UCCE Marin met with MPC again to confirm the sequence of permits and address any outstanding concerns by regulators. At the same time, a Marin ranch brought details of a pond restoration project to "pilot" through the now established procedure.
5) **Sept-Oct, 2021:** UCCE Marin worked with the ranch to define project elements and complete permit applications, but ultimately the ranch opted not to carry the project forward.
6) **Oct-Nov, 2021:** Rains began, ponds filled, attention turned to a more durable, standardized process for future years.

The procedures identified in 2021 by relevant state and federal agencies were intended to open a pathway for pond restoration projects to advance quickly in the context of the historic drought. While these procedures represented a willingness by these agencies to apply a flexible mindset to the urgent needs of ranchers, this expedited and somewhat simplified set of permits still necessitated a project-by-project approach in which each landowner applied individually for permits and required technical assistance to do so. Additionally, it is unclear if the flexibility and collaborative spirit shown by all involved would persist beyond the drought. As such, it was established that a more durable process was needed if we were going to see any meaningful number of ranchers engaging in habitat-improving restorations in their ponds. That ideal process would most likely require the RWQCB R2 Water Quality Control Board to establish a General Order for pond improvement/restoration that would contain a set of standards and practices which, if followed, would provide umbrella coverage under the California Environmental Quality Act (CEQA) and align the projects with existing permits within Federal (ACE) statute. General Orders, by and large, save applicants time and money because they establish up-front the best practices for a project and eliminate much of the project-by-project analysis on the part of the RWQCB.

A General Order such as this could take 12-24 months to gain RWQCB approval, but if an entity such as the Marin RCD were to draft the language, adoption by the RWQCB could potentially happen faster.

It is important to note that a General Order would still require consultation with CDFW regarding impact on California protected species and could trigger an Incidental Take Permit (ITP) from CDFW at a cost of $7,000 – $17,000 as well as implementation of mitigation practices. However, studies suggest that the number of California listed species in Marin are relatively low, and they have not appeared to affect any historic projects in the Marin RCD service area. As such, the need for acquisition of an individual ITP has been limited in the past and might not present a serious obstacle in the future.

An alternative pathway to the General Order would be to facilitate the development by CDFW, RWQCB, and the NRCS of a Voluntary Local Program similar to that which is in effect in Alameda County. Such a program would be designed to encourage farmers and ranchers to conduct work in their ponds that, through removal of sediment and other stream restoration activities, leads to improvements in water quality and wildlife habitat. Because sensitive and threatened species would benefit from the habitat maintenance activities described in the Voluntary Local Program, these activities are exempted from the California Endangered Species Act, and projects carried out under the program would not require an ITP. Nevertheless, the coordination required for the establishment of such a program would likely have an even longer time-horizon than that of a General Order and, as such, may not be the preferred pathway.

Needed Advancements

As producers in Marin County look to repair and restore their ponds as one means to build their resiliency in the face of future low-rainfall winters, other issues will need to be addressed:

- A critical assumption in these projects is that they represent a restoration to original condition/capacity which will ultimately improve the pond's service as wildlife habitat. However, establishing how much sediment to remove is a complex matter. Ranchers need:
    - Technical assistance to establish the difference between the allotted amount stipulated on their water right and the current, impaired capacity.

    - Engineering/geotechnical assistance in evaluating the condition of pond linings and establishing what additional project elements would help minimize leakage either through the bottom or weaknesses in the dam face.
- The establishment of a program to provide this analysis to producers in advance of the next drought would give producers a head start on a pond project so that they could move swiftly into the permit process. A combination of these two actions – identification of the right volume of sediment to remove in order to restore capacity, and geotechnical assessment of liner and other weaknesses – would be a boon to overall preparedness and also provide valuable insight into our watershed as a whole.
- While nothing yet suggests that Marin could become a place where the use of water stored in farm reservoirs and ponds might be cut off by the RWQCB during times of drought, we have seen that in places as close as Sonoma County, access to these waters has been subject to Curtailment of Diversions orders. This creates an obvious cognitive dissonance for producers whose ponds are not set up to either bypass winter flows from the surrounding landscape nor release water easily once it has accumulated within the reservoir itself. Language or policy is warranted to recognize the distinction between diversions associated with ponds which fill passively during rainy periods and diversions that draw directly from surface water stream flow via pumps or other controllable mechanisms. Those passive diversions could then be somehow insulated from curtailment and allay the fears of some producers.
- In 2021 we saw situations where some ranches had water in excess of their needs while neighboring operations couldn't meet the basic demands of their livestock. In these scenarios, ranchers wanted to know the procedure for transferring water to a neighbor for their use. However, individual licenses and registrations specify that the water diverted to ponds is strictly for on-site use by the license-holder. Transfer of such waters to another site of use without authorization jeopardizes the water right itself. The procedures for allowing the transfer of water diverted under one water right to another point of use are designed for massive transfers between state and municipal agencies, not immediate and temporary transfers between two landowners. As a result, the permits are too complex, expensive, and legally fraught to allow for an individual rancher to come to the aid of a neighbor without risking the loss of their water right. Policies and procedures should be developed at the state level to create a simple pathway for such emergency situations.

WATER REUSE

Background

The treatment and use of recycled water is regulated in California by the State Water Resources Control Board with individual recycled water producers permitting through each respective Regional Water Quality Control Board. NMWD, for example, can provide clean and safe tertiary-treated recycled water through its Recycled Water Truck Program for certain agricultural uses. A relatively simple permit process and a $100 application fee is required. Filling of approved water trucks is limited to select recycled water hydrant locations in the northeastern portion of the NMWD Novato Service Area.

Title 22 of California's Code of Regulations, Chapter 3 Water Recycling Criteria sets the standards for the treatment and use of recycled water. Included in the 40 uses listed in Title 22 is pasture for milk animals, orchards, nursery stock and sod farms, seed crops, and other agricultural production. Not included is watering of livestock for the production of fiber, meat, or dairy.

In 2014, during the heart of the 2012-2016 drought, then California Assembly Member Marc Levine introduced and led to enactment legislation directing a review and revision of Title 22 recycled water uses to include livestock watering. This legislation called for, among other steps, the formation of an expert panel to review the state of the science in recycled water use for livestock watering, and revisions of Title 22 criteria for nonpotable recycled water uses by January 2023.

In the winter of 2020-2021, the potential for livestock watering with recycled water was again raised as an adaptation and response to drought for Marin and Sonoma livestock agricultural producers. Agencies and organizations that participated in this discussion and strategy building included:

- National Water Resources Institute (NWRI)
- North Marin Water District (NMWD)
- San Francisco Bay Regional Water Quality Control Board (RWQCB R2)
- State Water Resources Control Board Division of Drinking Water (SWRCB DDW)
- UC Davis School of Veterinary Medicine
- UC Cooperative Extension Marin (UCCE Marin)

Efforts and Progress

- In April 2021 a meeting was held with the NWRI Director and Chair of the NWRI Expert Panel, to learn about the Panel's findings and the next steps NWRI and the SWRCB are taking to revise Title 22 criteria. Important to point out that the NWRI Expert Panel focused its 2018 research and recommendations on the use of recycled water to water nonlactating animals. At the time of this meeting, the target completion date for Title 22 revisions was January 2022.
- In May 2021 a meeting was held with staff from SWRCB DDW and SFRWQCB to learn about the process for permitting recycled water use and the potential to add livestock watering to recycled water producer permits. This meeting acknowledged the NWRI Expert Panel recommendations and included SWRCB DDW staff leading the Title 22 updates. At the time of this meeting, there were no recycled water producers permitted to provide water for livestock watering in California. RWQCB staff were willing to pursue an amendment to an existing permit if a recycled water producer could meet the NWRI Expert Panel measurement recommendations.
- From July through September 2021, the option and opportunity to amend an existing permit was explored and discussed with area recycled water producers. There was interest in doing this

and the need to prioritize already permitted recycled water uses in response to the drought response. The recycled water producers shared a willingness to engage in this effort once the Title 22 criteria are revised and include livestock watering as a permitted use.

- In December 2021, a group of researchers from UCCE, UC Davis School of Veterinary Medicine, and UC Davis Animal Sciences Department met to discuss the NWRI Expert Panel findings. The primary focus was on the opportunities and needs to fill information and research gaps to facilitate this use and water resource management tool. In this discussion, it was recognized that there has been research post the NWRI Expert Panel 2018 report on the use of recycled water for lactating animals. Additionally, the group considered options for additional research on both experimental and working dairy farms.

Needed Advancements

- Continue monitoring and engagement in the SWRCB's process and timeline to revise Title 22 Criteria, and include livestock watering as a use for recycled water.
- Pilot the addition of livestock watering as permitted use to an existing recycled water producers permit, including the distribution and use of this water by livestock agricultural producers.
- Water treatment facilities, as the source for this water, are far from farms and ranches. While there is some existing infrastructure to support distributing and trucking of this water, more infrastructure is needed if this water is to be put to fuller agricultural use.
- Conduct and compile a literature search of recycled water use for lactating animals, including risk to livestock health from consuming recycled water and to human health in the dairy products produced.
- Pursue opportunities for researching the risks and measures to reduce the risks in using recycled water for watering lactating animals.

ANIMAL MANAGEMENT STRATEGIES DURING DROUGHT

Supplemental feed provided to beef cattle to compensate for drought-caused reductions in forage.

Background

In addition to the scarcity of water for livestock watering, the ultimate impact of drought conditions to livestock agriculture was the reduction in forage production and quality. When forage and nutrients are limited, animals may experience reduced milk production, loss of body condition, reduced pregnancy rates, increased time to market weight, and other performance reductions leading to economic hardships. Based on the 2017 USDA Census of Agriculture there were 480 grazing beef and 366 grazing sheep operations in Marin and Sonoma combined. Similarly, there are 73 operating dairies across both counties. These producers have two options when dealing with forage concerns: supplement feed to animals, or reduce the nutrient requirement of the herd or flock. Supplemental feeding adds an increased financial burden to farmers and ranchers and should be limited. As discussed, programs like ELAP and LFP through USDA's Farm Services Agencies helped to mitigate increased feed costs during drought. While area ranchers considered and did participate in those financial assistance programs, they all had to take immediate action and implement management strategies on their ranches to alleviate drought impacts to their operations and herds or flocks. Technical assistance providers from UCCE, NRCS, MALT, and others provided input and guidance for area producers taking these actions.

Efforts and Progress

In May and June of 2021, program partners organized and facilitated the North Bay Drought Webinar Series. These two sessions provided livestock producers the practices they could take immediately in response to the current drought and the strategies they could develop and implement long-term to build ranch resilience to drought. The following provides a summary of the management practices and strategies shared during these workshops and considered and implemented by Marin and Sonoma livestock agriculture producers.

Youngstock Culling

The first consideration in culling should be the early weaning of calves. Weaning calves early can improve the cow's body condition, increase subsequent pregnancy rates, reduce postpartum interval, and reduce feed consumption. Calves could be weaned 30 to 90 days early. Once calves are removed from the cows, producers will need to decide whether or not to sell or keep and feed the calves. Selling weaned calves immediately is usually the most economically sound option, but if low-cost feed is available, it may make sense to feed them.

Mature Animal Culling

The most common strategy to reduce forage need is reducing the herd/flock size.

- Producers should consider removing low production animals, thin animals, animals not bred after three services, animals still open after 150 days, and older animals which may consume more feed to maintain body condition.
- Bulls can consume up to 25% more forage than cows. Producers can semen-check within a month after the breeding season to determine which bulls should be culled, thus saving feed.

Replacement Animals

Replacements represent the genetic and productive future of livestock herds; however, they require financial investment over years before returning profit.

- Cull replacements that are from dams with poor performance or body composition (i.e. bad feet and legs, udder conformation, etc.), not growing or keeping up with group mates, and consuming more feed than group mates.
- Only keep replacements that breed early in the breeding season or after fewer services. Checking for pregnancy status as early as 90 days after bulls are turned out or breeding date allows for quick culling of late-bred animals.
- Feed to 55% mature body weight at breeding. Fewer animals will be bred, but the emphasis will weigh more on animals that breed with limited resources.

Feeding

Producers can often feed alternative feedstuffs or products that can offset purchased feed needs or supplement poor quality feeds.

- Drought can drastically surge the price and demand for alfalfa hay, making it difficult to obtain. Feeding a lower quality forage, such as rice straw or corn stover, can work as alternative roughage; however, a feed analysis should be conducted to ensure a complete diet is supplied.
- Feeding high energy feeds, such as grains, barley, and corn, can provide an energy source with low-quality hay.
- Almond hulls are similar to grass or grain hay as a source of energy but are lower in protein. Producers should get a purity percentage and/or nutrient testing before comparing price. Shells in the hulls can cause bowel impaction and death, and should be avoided.
- Adding liquid supplements to provide either protein or energy to low-quality hay can improve nutrient composition of the diet.
- By-products from other industries can offer a low-cost feed source in times of feed shortages; however, issues with odor, nutrient fluctuations within loads, and pests should be considered.
- Group animals based on nutritional needs (i.e. early vs. late lactation) to reduce over conditioning of animals.

Pasture and Range

Implementing sound pasture and range management strategies can help producers extend forage availability throughout the drought.

- Pasture rotation allows areas to rest and produce more forage.
- Pasture utilization uses different aspects of positions of the pasture to maximize forage production. Taking advantage of south and west aspects early in the grazing season, grazing the

earlier maturing forage before it dries, and then grazing forage on north and east facing pasture extends the grazing season.

- Rangelands and pasture with deeper, more fertile soils, hold water longer (swales), and will produce more forage. During this cold winter season, however, these areas are growing at a slower pace. Producers may want to install temporary fencing placed around these swales and "bank" feed for spring. These later maturing plants will help extend the growing season.
- If and when it rains, applications of nitrogen fertilizer will produce a quick forage production response, as long as it keeps raining. This can also increase forage protein quantity.

Trough Maintenance

Water troughs are the main source of hydration for animals, making their operation critical for animal health and performance. However, poorly operating troughs can lead to wasted water.

- Check troughs daily to ensure they are working and not experiencing leaks or overflowing.
- Keep water troughs clean to avoid performance reductions related to contamination.
- Install shade cloth over the water trough to reduce sun exposure and temperature increases.
- Turn off rarely used water troughs.

Animal Cooling

Overheated animals consume more water while producing less milk and meat. In dairy animals, overheating leads to declines in milk quality and components. Providing shade and fans within pastures and barns reduces the thermal stress on animals and their water requirement to mitigate that stress.

Parlor Water Use

Milking parlor cleanliness is critical to protect food safety and animal health and can be an area with high water use to achieve these objectives. To save on water, producers can:

- Limit water use between milking groups, when possible.
- Scrape manure from the parlor first, then flush with water for final cleaning.
- Determine water efficiencies for cleaning the bulk tank and milking equipment.

Dry Off

Lactating animals drink 30 gallons of water daily compared to 11 gallons daily for dry cows. Drying cows off early can reduce the water requirement for animals in critical times.

- Low production animals (less than 30 lbs. milk per day) can be dried off abruptly with body condition monitored throughout the dry period.
- High production animals (greater than 30 lbs. milk per day) can be fed a low nutrient dense, high forage diet to naturally reduce milk production and switch to once daily milking. Once cows become low production, they can be abruptly dried off and their body condition monitored throughout the dry period.

References:
UC ANR Publications #8555, #8563 and #8565.

SPECIALTY CROPS STRATEGIES DURING DROUGHT

Background

Growers participate in a shortcourse on specialty crop production in low-water conditions.

The 2017 Agricultural Census published by the USDA documents nearly 400 farms producing various fruit and vegetable crops across Marin and Sonoma Counties. In the spring of 2021, as these farms turned their attention to soil preparation and planting, it became clear to many that there was not enough water to keep their usual crops alive.

Some farms, thanks to deep wells or well-situated, spring-fed ponds (or some combination of both), were able to proceed without much change to their crop plan. Others cut production significantly due to low pond levels or loss of access to direct diversions. In some situations, where water was shared between livestock and field production, vegetable producers saw their access to water cut off by landowners who needed to prioritize the welfare of animals, and, in some cases, were forced to exit the land.

A survey of 22 Marin County fruit and vegetable operations (not including wine grape producers) revealed that 43% of lands usually planted in specialty crops were fallowed due to lack of water, and of the remaining acreage that was planted, more than 20% failed due to insufficient water to sustain them.

Efforts and Progress

Given the sheer number of farms facing hardship, an effort was made to equip them with some tools and assistance to adapt. These efforts fell into three categories:

- Immediate actions to maintain some level of production
- Long-term actions to better prepare for future droughts
- Emergency assistance to cope with losses associated with the drought

In this effort, multiple local entities coordinated resources to assist:

- USDA Natural Resource Conservation Service (NRCS) and Farm Service Agency (FSA) offices, Petaluma Service Center
- Marin Agricultural Land Trust (MALT)
- Marin Resource Conservation District (Marin RCD)
- Gold Ridge Resource Conservation District (Gold Ridge RCD)
- Agricultural Commissioner's Offices for Sonoma and Marin Counties
- University of California Cooperative Extension (UCCE), Sonoma and Marin County offices
- …And many others who assisted with outreach and the distribution of information

For those farms looking to maintain production in 2021 with less water, UCCE and partners held a webinar exploring the practices of dry farming and deficit irrigation. This was intended to give farms the option to shift practices for the current season and perhaps maintain more of their production than they would otherwise have contemplated given the lack of water. In addition to dry farming and deficit irrigation, these webinars underscored the necessity to redouble maintenance of irrigation systems and increase careful monitoring of soil moisture to avoid unnecessary irrigation sets. The webinars were provided in both Spanish and English and recorded and distributed afterwards so that as many producers as possible might benefit, including those from outside of the region.

Looking beyond the 2021 season, a series of webinars and newsletter/mass-mailings were undertaken to communicate long-term actions that farms could take over the following months and years to make their operations more resilient in the face of future down-cycles. These included:

- Best practices in water development projects, including siting of wells, use of tanks and low-flow pumps, and even pond improvements.
- Building up water-holding capacity of soils through use of compost, cover crops, and reduced tillage.
- Installation of precision watering and soil moisture monitoring equipment.
- …And referrals to funding sources that farms could access to finance such projects.

Additionally, the collective organizations communicated via multiple websites, direct-mailings, and during abovementioned webinars the relief programs available to specialty crop producers that might help offset losses due to drought. Unfortunately, the range of options in drought assistance for specialty crop farms is exceedingly small by comparison to the programs available for livestock producers. Besides emergency loans, the only program offered by the USDA was a modified form of crop insurance called the Noninsured Crop Disaster Assistance Program (NAP) which producers would have had to have applied for the previous year. The previously discussed TAP program provided help with tree and vine replacement costs, but this did not benefit any of the annual crop producers. In Marin County, the advocacy of the Agricultural Commissioner, Stefan Parnay, yielded a one-time $150,000 allocation by the Marin County Board of Supervisors to provide emergency grants offsetting losses suffered by specialty crop producers. An advisory group of producers and staff from ag support organizations helped allocate these funds equitably to Marin farms.

In the final analysis, the efforts to assist farms in implementing long-term adaptations and securing short-term emergency funding were perhaps the most impactful of the three categories of intervention. Attempts to shift production practices for the 2021 season were not particularly successful because of several reasons:

- Dry farming and deficit irrigation are not practices that can be used for many of the most commonly grown specialty crops in Marin and Sonoma Counties (lettuces, bunching greens, cool-weather brassicas, etc.)
- Even crops that thrive in a dry farming system require sufficient water in the soil profile to sustain them. A winter that produced less than half of a typical year's rainfall simply did not add enough water to the soil to sustain dry-farmed crops.
- The success of dry farming is also heavily dependent on soil type. Farms whose soil leans toward sand or sandy-loam cannot generally retain enough water in the profile - even in good winters - to sustain dry-farmed crops. The work of building soil carbon and organic matter to increase water-holding capacity is a long-term endeavor that cannot be short-circuited in times of need.

Needed Advancements

- Further efforts to expand understanding of practices like deficit irrigation are needed to support farms' implementation, where appropriate. To this end, the AIM teamed up with MALT and UCCE Marin to provide a field day focused on this topic in the Spring of 2022. Further one-on-one technical assistance would be a welcome follow-on to ensure that farms have the confidence to implement.
- Similarly, more precise irrigation management including deficit irrigation requires local real time evapotranspiration and precipitation data. The investment and installation of CIMIS stations in the western portion of both Marin and Sonoma Counties are recommended to support this improvement in water use.
- Additional work in promoting infrastructure development that increases farms' water storage capacity (with funding to match) would make a big difference. This will require collaboration not just among the above-mentioned ag-support organizations, but also with County-level permitting agencies such as Planning/Land Use where the installation of ponds, wells, or even simply tanks and irrigation lines necessitates Coastal Development Permits within the Coastal Zone. Advance notice to these agencies so that they can anticipate new permit applications and provide a measure of fast-tracking would help ensure that infrastructure can be completed in time to capitalize on future winter rains. Widespread improvement or expansion of this infrastructure will particularly require assistance with engineering and biological surveys, as projects like sheet-flow and rain-fed catchments depend on these preliminary services.
- California state-funded programs such as SWEEP and HSP can provide funding for irrigation improvement projects as well as investments in compost application and other practices to build the soil's water-holding capacity. Continued technical assistance by local RCDs and UCCE offices for designing such projects, making the necessary applications to the state and, if selected, implementing them, will be essential to helping farms act on some of these long-term strategies to weather future low-water winters.
- Financial assistance programs, including SWEEP and HSP, are not well designed to support the small, diversified crop producer. Rotating crops and growing two or three different crops a year is not conducive with program requirements like having a funded practice be in place in a given field for the duration of the grant. Adapting these programs to the production system of small, diversified operations is needed to increase program participation and reach.
- Research and piloting of growing practices by UCCE in partnership with specialty crop producers could help normalize the use of newer, less well-understood methods of achieving drought tolerance in certain crops such as tomato and watermelon grafting.

MANURE MANAGEMENT

Background

During drought conditions, pastures and silage fields suffer from lack of water and produce less and lower quality forage. While water for cow drinking and parlor sanitation requires fresh water, practices can be implemented on the dairy to offset fresh water use on pasture, increase fertigation, or extend pasture availability. This section discusses practices which are funded through the California Department of Food and Agriculture's Alternative Manure Management Program (more information on the application process is discussed in the "Grants" section of this paper) and which have been implemented on dairies in the North Bay region.

Efforts and Progress

Conversion from Flush to Scrape Manure Collection

While the majority of Marin and Sonoma Counties' dairies are certified organic, requiring cows to graze on pasture during the pasture season, cows spend a significant portion of their time in a barn with access to feed, water, and lying space. Animals deposit manure and urine in the barn alleyways, which is collected in a manure lagoon. Manure collection methods include flush and scrape systems.

Flush manure collection systems utilize fast flowing water to collect and transfer manure and urine down alleyways and into the manure lagoon. Water used within this system may be fresh water, often collected from rainwater in storage ponds, effluent water (or recycled water), obtained by using settling ponds to remove a portion of solids from collected manure, or a combination of both.

Scrape systems utilize mechanical means (i.e. tractor with rubber tire scrapper, automatic alleyway scraper, manure vacuum, etc.) to push or collect manure and urine from alleyways and deposit it into the manure lagoon. The volume of material in a scraping system is less than that in a comparable flush system, reducing storage requirements for manure collection.

Conversation from a flush collection system to a scrape system offers benefits and drawbacks. Positive impacts include:

- Ability to utilize effluent water on pasture and silage fields for increased forage production through fertigation.
- Diversion of all fresh water to cow drinking and parlor sanitation needs.
- Reduced manure storage needs.

Negative impacts include:

- Need for existing or planned installation of irrigation infrastructure to use effluent water for fertigation.
- Increased labor needs to operate the manure collection system if not automated.
- Potential for animal injury if alleys are too slippery from manure residues.

Dairy operators may also consider a hybrid system, utilizing scraping systems during summer grazing months when cows spend less time in the barn and pasture needs are greater, and a flush system in winter during times of higher cow barn occupancy. Still, dairies should weigh the pros and

cons of manure collection systems and choose the system that suits their management and financial goals.

Solids Separation Technology

Solids separation is the partial removal of solids from manure. The process generates two streams of manure products, a solids portion and a liquid portion. Numerous technologies exist to separate solids, from simple, passive technologies to automated, mechanical technologies. Installation of solids separation generates usable products which can influence pasture performance during drought.

The solids portion created can be applied to pasture and silage fields as either a manure fertilizer or further processed into compost and used as a soil amendment. While manure can be a readily available source of nutrients to crops, both manure and compost can be used to increase soil organic matter and improve soil structure and water holding capacity. The liquid portion will be easier to pump through irrigation equipment with a portion of solids removed and can be used to deliver essential nutrients to crops, improving silage or pasture forage yields. Soil samples should be used to inform land managers about the needs of their soil and the application that best suits their soil and crop goals.

Needed Advancements

- Dairy producers continue to pursue and invest in new ideas and methods to help sustain their farms into the future. However, manure technologies come with high capital investments and may be cost prohibitive when farmers are choosing between feeding and watering their animals and upgrading farm technologies. Creation of cost share programs that incentivize adoption of manure management technologies would increase implementation of innovative drought strategies during times where funds may be limited. State programs, such as the CDFA Alternative Manure Management Program, exist to fund implementation of the mentioned management methods to reduce greenhouse gas emissions while also having additional benefits to the dairy farmer. However, these programs have been highly competitive and have had variable funding over the past 5 years, making the program unreliable for our local farms when interested in project funding. Offering more stable funding and less competitive programs would help farmers invest in their farms and ensure they are more resilient in times of drought.
- Providing more technical assistance to livestock producers and particularly dairies for on-farm compost production through the use of on-farm materials like manure in combination with additional green waste from the community would have multiple benefits, including increasing the overall supply of compost for raising the water-holding capacity of dairies' own pastures and silage fields, as well as reducing GHG emissions from lagoons (due to solid separation pre-lagoon) and helping keep green waste out of the landfills.

WATER STORAGE AND DISTRIBUTION

Four 3,000 gallon tanks and plumbing that form a small above ground storage system. This system can store hauled water and is also connected to on-site water sources for storage.

Background

Most of the land use in west Marin County is for beef grazing, often cow-calf pair operations. Some other common land uses are goat or sheep grazing, dairies, row crops, hay/silage production, and egg laying chicken operations. Sonoma County is generally more diversified in its land use but has similar land use in addition to many dairies and poultry operations. Unlike dairies, vineyards, or specialty crops, grazing operations have a little more flexibility with their water use in many ways, but often have more land to cover. Ideally with any livestock grazing operation, each field has high utility of feed, adequate shade, and sufficient water access.

As drought conditions intensified, many livestock producers were forced to get creative with their water resources. Most livestock producers had already begun culling herds, traditionally one of the first management techniques used in drought conditions. In addition to managing their feed as best they could, they focused on three water areas of water management:

- Water sources: Often small stock ponds, developed springs, creeks, seasonal wet areas.
- Water storage: Most often installing 3,000 – 5,000 gallon polyurethane water tanks to new or existing water lines. Occasionally some landowners increased storage by clearing some sediment from small stock ponds to increase capacity when rains do fall.
- Water distribution: With less natural water sources, cattle depend solely on water troughs or some form or artificial water source.

Working collaboratively, members from MALT, NRCS, and RCDs provided technical and financial assistance to area producers to facilitate design, permitting, and construction of practices and infrastructure to improve conditions in these three areas.

Efforts and Progress

Most producers are very familiar with the location and capacity of their water resources on the ranch. While in the planning phase of a water storage or distribution project, a landowner is generally thinking of how to most efficiently move water to the greatest area on the ranch. With regards to water sources on a livestock grazing ranch, there are generally four ways to address such an issue:

- Clean/repair existing springs or stock ponds: Most springs on Marin and Sonoma ranches were developed sometime in the 20th century with existing pipes, spring boxes, and other infrastructure that may be dilapidated or in disrepair. Extreme drought conditions and the high value of any potential water source motivated landowners/tenants to revisit these springs that may have fallen offline.

- Develop Springs: Springs that historically were not developed due to remoteness or lack of infrastructure were considered and, in some cases, developed.
- Redevelop or develop a well: Landowners might have developed a well in the past if they knew they had access to sufficient groundwater. Some of these wells may have been abandoned or not maintained and in the face of the drought were brought back online. Additionally, producers explored and installed new wells.
- Haul in Water: If the naturally occurring springs, creeks, and ponds go dry or production runs low, a rancher's only alternative is to truck in water. In this scenario, it is helpful to have storage, most often in the form of a tank or several tanks to store the delivered water.

Regulatory and Permitting Process

For many existing projects, the water tanks, pipelines, troughs, spring development and repairing existing infrastructure does not trigger permitting. A few scenarios that will trigger permitting are:

- Large Water Tanks: Installing water tanks larger than 5,000 gallons will require a building permit in Marin County.
- Pond Maintenance: With regards to cleaning and maintaining sediment loads in ponds, this area is a little more nuanced. Permits may be necessary to do larger grading work through the local county or state water resource control board (see section on Pond Maintenance).
- Drilling a New Well: This process is permitted. The landowner must do their due diligence both with the well driller contractor and the county. This includes any additional review and permitting required in the California Coast Zone or in high and medium priority basins per the California Sustainable Groundwater Management Act.
- Developing a new spring: The development of a new spring or the excavation of new pipelines may alter the hydrology of an existing wetland and alter wetlands and/or the presence of special status species which would therefore require regulatory permits.

Needed Advancements

- The ultimate goal of these projects is to increase water security and water management options by securing water sources, ensuring sufficient storage, and building distribution lines so that there are a variety of management options. For example, setting up a system where there are multiple water sources and multiple distribution options for moving water to different parts of a ranch. These water systems help with rotational grazing, a proven way to better manage rangelands. Ultimately these improved water sources and systems build resilience into the operation, allowing a producer to continue ranching even if a water source dries up or equipment breaks or fails.

HEALTHY SOILS/CARBON FARMING

Background

There is increasing recognition of the role soil health plays in drought resilience on agricultural lands. By applying principles of soil health via management decisions, agricultural producers can increase the water holding capacity of their soil and make efficient use of scarce rainfall. The five core soil health principles are:

- Protect the soil surface
- Minimize soil disturbance
- Maximize biodiversity
- Integrate livestock
- Maintain continual living plants and roots

Compost application on rangeland (from MRCD).

Applying these principles supports soils that have good structure and aggregation, an active soil food web, adequate soil organic matter, and reduced risk of erosion. Investing in soil health pays dividends by banking water in the soil; it is estimated that a 1% increase in soil organic matter allows soil to hold an additional 20,000 gallons per acre. Healthy soils are also able to soak up water faster when it rains, which means less flooding and loss of valuable topsoil to erosion. The value of utilizing every drop of rainfall and irrigation water is more salient than ever to farmers and ranchers in Marin and Sonoma who face increased drought, water shortages, and curtailments.

Practices that improve soil health include compost application, diverse cover crops, reduced-disturbance tillage, no-till planting, perennial plantings, managed grazing, and many other conservation practices. Many agricultural producers benefit from collaborating with local technical assistance providers to plan, fund, and implement these practices.

One approach to planning for enhanced soil health is the carbon farm planning framework. This framework emphasizes carbon as the organizing principle and supports soil health through increasing soil organic matter and focusing on opportunities for enhancing the capacity of the farm system to receive, store, and release energy. Carbon is a key component of soil organic matter, increasing water holding capacity and providing a food source for soil microorganisms that build soil structure. Carbon farming practices that support healthy soils have the added benefit of reducing GHG emissions and storing more carbon on the landscape, as well as providing vital ecosystem services such as clean water, habitat for wildlife and pollinators, and healthy, nutrient-dense foods.

Efforts and Progress

Over the last decade, Resource Conservation Districts (RCDs) in Marin and Sonoma counties, in partnership with NRCS, county extension services, agricultural departments, and the Carbon Cycle Institute, have been building carbon farming programs directly linked to county-level climate action planning and regional supply chains for climate-smart fiber, organic dairy, pasture-raised meat, and sustainably produced wine. These local conservation partnerships and our collective accomplishments

have become a model across the state for advancing agricultural climate solutions grounded in community economic development, consumer awareness, and climate action.

As an example, our local conservation partnerships have successfully integrated climate-smart agriculture into formal climate action planning documents in both counties. The 2030 Marin County climate action plan (CAP) included a goal of expanding carbon farm planning and implementation to engage 60 farms across 30,000 acres by 2030. Achieving this goal would entail a carbon sequestration target of more than 55,000 metric tons of carbon dioxide equivalent (MT CO_2e) annually. This increased carbon sequestration rate is ***in addition to*** GHG reductions associated with manure management on local dairies.

The three RCDs have already completed 40 carbon farm plans (CFPs) for dairy, livestock, vineyard, orchard, and vegetable producers across nearly 15,000 acres of agricultural land. If fully implemented, the completed CFPs would have a collective GHG reduction benefit of 514,061 MT CO_2e over 20 years. RCDs in Marin and Sonoma counties have a current waitlist of 92 producers interested in completing carbon farm plans. In 2023 the Sonoma-Marin partnership received a significant funding boost with a $10 million grant awarded by the USDA Climate Smart Commodities program. High rates of producer interest in carbon farming across a wide range of agricultural land uses reflects a strong regional commitment to climate-smart agriculture and the scalability of producer participation in this larger pilot program.

Needed Advancements

Although interest and momentum is steadily increasing, there are a number of advancements needed in order to maximize the benefits these practices have to offer in the face of drought:

- Identify additional finance mechanisms and funding sources to support the ongoing development and implementation of CF plans, possibly through a carbon finance committee (identified in Marin CAP).
- Develop business plan(s) for implementing identified agricultural climate solutions.
- Build the capacity of local technical assistance providers to significantly increase the number of carbon farm plans developed and implemented.
- Build the capacity of local agricultural producers to plan, implement, and scale carbon sequestration through increased farmer-to-farmer networking and resource sharing (identified in Marin CAP and the Sonoma County Climate Mobilization Strategy), including through partnerships with RCDs, county extension services, the Carbon Cycle Institute, and local agricultural industry partners.
- Increase investments that directly support producers in implementing practices that support soil health, through programs such as the California Department of Food and Agriculture's Healthy Soils Incentive Program, and ensure funding programs are accessible to all producers.
- Increase funding for compost application and streamline funding mechanisms so that funds are available quicker and are flexible enough to accommodate site-specific conditions. Increase dedicated funding for technical assistance to plan and implement compost application. Streamline permitting pathways for on-farm compost production. Create a municipal compost site in Sonoma County (the County's previous municipal site was closed in 2015).
- Streamline permitting requirements (e.g. Marin coastal permit fees and requirements for carbon farming practices).
- Develop drought contingency plans in the development of carbon farming projects to ensure project success (e.g. irrigation alternatives for hedgerows, windbreaks and riparian projects).
- Provide financial incentives to restrict livestock from sensitive wetland areas under drought conditions.

AGRICULTURAL RESILIENCE IN THE FACE OF EXTREME DRY CONDITIONS

A MARIN AND SONOMA PARTNERSHIP RESPONSE AND RECOMMENDATIONS

COMPENDIUM OF ADAPTATION PRACITCES NEEDED ADVANCEMENTS[7]

SECRETARIAL DROUGHT DISASTER DESIGNATION, REPORTING AND ASSESSMENTS

- Consistency in the disaster designations across the North San Francisco Bay region would improve the availability of emergency funding support and roll out of financial assistance programs for all producers in all counties. The staggering of California drought proclamation from Sonoma and Mendocino counties in April 2021 to Marin later in July 2021 created delays and confusion in the administration of programs and financial aid.
- Continued and improved coordination for the collection and compilation of on-farm drought condition documentation will avoid duplication of effort and help to accelerate the implementation of financial assistance programs. The reality is that some aid and emergency funding support programs require a DAR and direct reporting process from the local Department of Agriculture and UCCE Advisor, while others rely on the Drought Monitor Intensity Classification. However, in general the same documentation and assessment of on-the-ground conditions can serve both purposes.
- Use of producer surveys met with varying levels of participation, bringing into question the benefits and merits of using these types of tools for condition assessment and documentation. Before administering a survey, it will be useful to work closely with a focus group of agricultural producers and the local FSA representatives to confirm the benefits and effectiveness of a survey relative to other methods. Suggested other methods should include a grassroots gathering of photographs and documentation across a network of agricultural support organizations.

FINANCIAL ASSISTANCE AND GRANT PROGRAMS

- These grant programs provided much needed funding in a time of dire need, however, projects often faced hurdles and restrictions delaying implementation and drought-related relief. Most

[7] A compilation of needed advancement from Agricultural Resilience in the Face of Extreme Dry Conditions: A Marin and Sonoma Partnership Response and Recommendations. 2022. Marin and Sonoma Counties, California. University of California Cooperative Extension, 1682 Novato Boulevard, Suite 150-B Novato, CA 94947

notably, supply chain shortages stemming from the Covid-19 pandemic and exacerbated demand on contractors created significant delays for drought-related project completion. In particular, well development was backlogged for nearly a year due to delays in contractor availability and county issued well-permits. Developing systems to streamline drought-related (or other emergency) projects from the project design level to permitting to grant awarding, particularly in designated times of drought, will be imperative to adequately addressing emergency situations.

- Fortunately, there has been an increase in grant assistance over the past few decades, but there still can be a disconnect between a grantor's program, application and process, and the applicant. Continuous feedback from the community states that the process can be confusing, challenging, and frustrating. As grantors, it is probably best practice to increase one-on-one technical assistance, revisit program guidelines and process, adjusting to shifting climates and needs as the work on the ground continues to evolve.
- Cost share requirements for grants or through a relief program assumes that a participating grower or rancher has the capital available to contribute. This often is not the case and is a significant barrier to participation and receiving program support. Establishing a revolving loan program is just one option to explore for relieving this initial demand for capital and barrier to entry.

AGRICULTURE WATER ACCESS, TRUCKING, AND ASSOCIATED COST SHARE PROGRAMS

- At the first signs of long-term drought, reach out to all key partners to initiate a preliminary discussion about possible needs and preparatory work if conditions worsen. Partners include water districts, USDA Farm Services Agency, USDA Natural Resources Conservation Service, UCCE Marin, Marin RCD, AIM, Marin Department of Agriculture, and others. Depending on the expected severity of the drought, be sure to include all counterparts in Sonoma County to collaborate and share resources and to leverage political influence to garner state and federal aid as needed.
- The funding intervention by the County of Marin at a time of deepest need made a difference. In both Marin and Sonoma County, discussing and preparing for this emergency relief through a contingency plan would contribute to resilience through improved response time and implementation.
- The connection and integration of water hauling with the on-farm capacity and infrastructure for storage needs to be improved. Working now to ensure that every farm or ranch has the ability to switch from well, reservoir, or spring over to trucked water is an investment in resilience.
- It needs to be acknowledged that at the peak demand for hauled water there was a bottleneck in the availability of trucks and haulers. This led to prioritizing some customers over others. What could/should be done to ensure that if water must be mobilized, there are sufficient means to ferry that water out to all who need it?

RESIDENTIAL WATER ACCESS AND TRUCKING

- At the first signs of long-term drought, all key partners should be engaged to initiate a preliminary discussion about possible needs within the unincorporated areas, including concerns about

domestic wells running low or dry. Partners include local Office of Emergency Services, Health and Human Services, Environment Health, Department of Agriculture, etc.

ROOF CAPTURE

- By eliminating the regulatory hurdles in the 2012 law and showcasing successful implementation, many landowners, agricultural producers, and even residential homeowners may look to incorporate rainwater harvesting practices into their water security plans. With minimal to low infrastructural investment necessary, rainwater harvesting and rain catchment systems have a huge potential to directly augment ongoing drought resilience measures for operations of any size and for management objectives of any kind. Many agricultural operations have some combination of barns with gutters, sheet metal roofing, and existing storage systems, which are the three basic components of a successful rainwater capturing system. If an operation is missing one of the components, financial assistance programs like the EQIP, DRAWS, and others could help offset landowner costs to create a complete and functioning rainwater capture system.
- Our shifting climate is creating less predictable, more severe and erratic storm systems. Having systems in place to take advantage of these more extreme rain events can build increased water security and drought resilience into an operation. Given inventory of farm buildings on local farms and ranches, technical assistance providers should expect regular inquiry about these systems. They also stand to benefit from added education around the legality of these systems, particularly in Creek Conservation Areas and other sensitive habitats. Additionally, ongoing education about project design, including from Lonny Grafman's book "To Catch the Rain," will ensure projects are as sustainable and efficient as possible.
- As demand for rainwater catchment systems increases, it will be important to increase the local capacity to design and install these systems.

POND MAINTENANCE

- A critical assumption in these projects is that they represent a restoration to original condition/capacity which will ultimately improve the pond's service as wildlife habitat. However, establishing how much sediment to remove is a complex matter. Ranchers need:
  - Technical assistance to establish the difference between the allotted amount stipulated on their water right and the current, impaired capacity.
  - Engineering/geotechnical assistance in evaluating the condition of pond linings and establishing what additional project elements would help minimize leakage either through the bottom or weaknesses in the dam face.
- The establishment of a program to provide this analysis to producers in advance of the next drought would give producers a head start on a pond project so that they could move swiftly into the permit process. A combination of these two actions – identification of the right volume of sediment to remove in order to restore capacity, and geotechnical assessment of liner and other weaknesses – would be a boon to overall preparedness and also provide valuable insight into our watershed as a whole.
- While nothing yet suggests that Marin could become a place where the use of water stored in farm reservoirs and ponds might be cut off by the RWQCB during times of drought, we have seen that in places as close as Sonoma County, access to these waters has been subject to Curtailment of Diversions orders. This creates an obvious cognitive dissonance for producers whose ponds are not

set up to either bypass winter flows from the surrounding landscape nor release water easily once it has accumulated within the reservoir itself. Language or policy is warranted to recognize the distinction between diversions associated with ponds which fill passively during rainy periods and diversions that draw directly from surface water stream flow via pumps or other controllable mechanisms. Those passive diversions could then be somehow insulated from curtailment and allay the fears of some producers.

- In 2021 we saw situations where some ranches had water in excess of their needs while neighboring operations couldn't meet the basic demands of their livestock. In these scenarios, ranchers wanted to know the procedure for transferring water to a neighbor for their use. However, individual licenses and registrations specify that the water diverted to ponds is strictly for on-site use by the license-holder. Transfer of such waters to another site of use without authorization jeopardizes the water right itself. The procedures for allowing the transfer of water diverted under one water right to another point of use are designed for massive transfers between state and municipal agencies, not immediate and temporary transfers between two landowners. As a result, the permits are too complex, expensive, and legally fraught to allow for an individual rancher to come to the aid of a neighbor without risking the loss of their water right. Policies and procedures should be developed at the state level to create a simple pathway for such emergency situations.

WATER REUSE

- Continue monitoring and engagement in the SWRCB's process and timeline to revise Title 22 Criteria, and include livestock watering as a use for recycled water.
- Pilot the addition of livestock watering as permitted use to an existing recycled water producers permit, including the distribution and use of this water by livestock agricultural producers.
- Water treatment facilities, as the source for this water, are far from farms and ranches. While there is some existing infrastructure to support distributing and trucking of this water, more infrastructure is needed if this water is to be put to fuller agricultural use.
- Conduct and compile a literature search of recycled water use for lactating animals, including risk to livestock health from consuming recycled water and to human health in the dairy products produced.
- Pursue opportunities for researching the risks and measures to reduce the risks in using recycled water for watering lactating animals.

SPECIALTY CROPS STRATEGIES DURING DROUGHT

- Further efforts to expand understanding of practices like deficit irrigation are needed to support farms' implementation, where appropriate. To this end, the AIM teamed up with MALT and UCCE Marin to provide a field day focused on this topic in the Spring of 2022. Further one-on-one technical assistance would be a welcome follow-on to ensure that farms have the confidence to implement.
- Similarly, more precise irrigation management including deficit irrigation requires local real time evapotranspiration and precipitation data. The investment and installation of CIMIS stations in the western portion of both Marin and Sonoma Counties are recommended to support this improvement in water use.

- Additional work in promoting infrastructure development that increases farms' water storage capacity (with funding to match) would make a big difference. This will require collaboration not just among the above-mentioned ag-support organizations, but also with County-level permitting agencies such as Planning/Land Use where the installation of ponds, wells, or even simply tanks and irrigation lines necessitates Coastal Development Permits within the Coastal Zone. Advance notice to these agencies so that they can anticipate new permit applications and provide a measure of fast-tracking would help ensure that infrastructure can be completed in time to capitalize on future winter rains. Widespread improvement or expansion of this infrastructure will particularly require assistance with engineering and biological surveys, as projects like sheet-flow and rain-fed catchments depend on these preliminary services.
- California state-funded programs such as SWEEP and HSP can provide funding for irrigation improvement projects as well as investments in compost application and other practices to build the soil's water-holding capacity. Continued technical assistance by local RCDs and UCCE offices for designing such projects, making the necessary applications to the state and, if selected, implementing them, will be essential to helping farms act on some of these long-term strategies to weather future low-water winters.
- Financial assistance programs, including SWEEP and HSP, are not well designed to support the small, diversified crop producer. Rotating crops and growing two or three different crops a year is not conducive with program requirements like having a funded practice be in place in a given field for the duration of the grant. Adapting these programs to the production system of small, diversified operations is needed to increase program participation and reach.
- Research and piloting of growing practices by UCCE in partnership with specialty crop producers could help normalize the use of newer, less well-understood methods of achieving drought tolerance in certain crops such as tomato and watermelon grafting.

MANURE MANAGEMENT

- Dairy producers continue to pursue and invest in new ideas and methods to help sustain their farms into the future. However, manure technologies come with high capital investments and may be cost prohibitive when farmers are choosing between feeding and watering their animals and upgrading farm technologies. Creation of cost share programs that incentivize adoption of manure management technologies would increase implementation of innovative drought strategies during times where funds may be limited. State programs, such as the CDFA Alternative Manure Management Program, exist to fund implementation of the mentioned management methods to reduce greenhouse gas emissions while also having additional benefits to the dairy farmer. However, these programs have been highly competitive and have had variable funding over the past 5 years, making the program unreliable for our local farms when interested in project funding. Offering more stable funding and less competitive programs would help farmers invest in their farms and ensure they are more resilient in times of drought.
- Providing more technical assistance to livestock producers and particularly dairies for on-farm compost production through the use of on-farm materials like manure in combination with additional green waste from the community would have multiple benefits, including increasing the overall supply of compost for raising the water-holding capacity of dairies' own pastures and silage fields, as well as reducing GHG emissions from lagoons (due to solid separation pre-lagoon) and helping keep green waste out of the landfills.

WATER STORAGE AND DISTRIBUTION

- The ultimate goal of these projects is to increase water security and water management options by securing water sources, ensuring sufficient storage, and building distribution lines so that there are a variety of management options. For example, setting up a system where there are multiple water sources and multiple distribution options for moving water to different parts of a ranch. These water systems help with rotational grazing, a proven way to better manage rangelands. Ultimately these improved water sources and systems build resilience into the operation, allowing a producer to continue ranching even if a water source dries up or equipment breaks or fails.

HEALTHY SOILS/CARBON FARMING

- Identify additional finance mechanisms and funding sources to support the ongoing development and implementation of CF plans, possibly through a carbon finance committee (identified in Marin CAP).
- Develop business plan(s) for implementing identified agricultural climate solutions.
- Build the capacity of local technical assistance providers to significantly increase the number of carbon farm plans developed and implemented.
- Build the capacity of local agricultural producers to plan, implement, and scale carbon sequestration through increased farmer-to-farmer networking and resource sharing (identified in Marin CAP and the Sonoma County Climate Mobilization Strategy), including through partnerships with RCDs, county extension services, the Carbon Cycle Institute, and local agricultural industry partners.
- Increase investments that directly support producers in implementing practices that support soil health, through programs such as the California Department of Food and Agriculture's Healthy Soils Incentive Program, and ensure funding programs are accessible to all producers.
- Increase funding for compost application and streamline funding mechanisms so that funds are available quicker and are flexible enough to accommodate site-specific conditions. Increase dedicated funding for technical assistance to plan and implement compost application. Streamline permitting pathways for on-farm compost production. Create a municipal compost site in Sonoma County (the County's previous municipal site was closed in 2015).
- Streamline permitting requirements (e.g. Marin coastal permit fees and requirements for carbon farming practices).
- Develop drought contingency plans in the development of carbon farming projects to ensure project success (e.g. irrigation alternatives for hedgerows, windbreaks and riparian projects).
- Provide financial incentives to restrict livestock from sensitive wetland areas under drought conditions.

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