Napa Valley Grapegrowers
Water Mitigation Strategies in Napa Valley Vineyards

Presentation to the Technical Advisory Group for the Napa Groundwater Sustainability Agency

Garrett Buckland
Partner, Premiere Viticulture and Board Member, Napa Valley Grapegrowers

Molly Moran Williams
Industry & Community Relations Director, Napa Valley Grapegrowers
Presentation Outline

PART I: Molly Moran Williams, Industry & Community Relations Director, NVG
- NVG 2023 Water-Focused Survey Results
  - Growers Want to Conserve Water
  - Water Conservation Tactics
  - Monitoring Plant Water Status
  - Water Sourcing
  - Water Use Practices in the Last 5-10 Years
  - Survey Takeaways

PART II: Garrett Buckland, Partner, Premiere Viticulture and Board Member, NVG
- Dry Viticultural Areas and Rainfall
- Application & Efficacy of Supplemental Irrigation
- Plant Adaptation
- Tactics and Farm Practices
- NVG’s Proposed Data Collection Project to Improve County Water Use Model

PART III: Concluding Remarks & Q&A with Molly and Garrett
Growers Want to Conserve Water

*Report on Water-Focused Survey 2023*

- Napa Valley Grapegrowers conducted a water-focused survey of members in January 2023

- A total 100 growers/companies responded to the 2023 survey. 89% of respondents are interested in more programs related to water use and water conservation, a slight increase over 2022.

- In 2023, NVG was awarded a grant from the US Department of Agriculture’s Risk Management Agency allowing us to expand education on water management strategies, converting to recycled water, and complying with the Groundwater Sustainability Plan as it rolls out.
Groundwater Sustainability Plan

The Groundwater Sustainability Plan is a basin wide plan that lays out a path for sustainable management of a groundwater basin over a 20-year period, and focuses on avoiding undesirable results. It was designed to keep groundwater resources at or above 2015 levels.

The plan was designed through the lens of 6 different sustainability indicators and safeguards against:

1. Lowering of Groundwater Levels
2. Reduction in Groundwater Storage
3. Seawater Intrusion
4. Degradation of water quality
5. Land subsidence
6. Surface water depletion

Source: https://www.napagrowers.org/groundwater-sustainability-plan.html
Water & Irrigation

California droughts are becoming more frequent and persistent, as warmer winter temperatures driven by climate change reduce water held in the Sierra Nevada snowpack and result in drier soil conditions. To increase our resilience to future droughts, Californians must use water more wisely and efficiently.

External Resources

Napa County WCCC
Napa County UCCE
Napa RCD

Heat & Drought

Water Conservation Seminar: Drought Farming Strategies 2023
Sustainable Vineyard Practices: Drought & Irrigation 2022
Farming Strategies for Drought 2021

Sources:
https://www.napagrowers.org/water--irrigation.html
Recycled Water

Recycled water is wastewater effluent that has been further treated and disinfected to provide a non-potable (non-drinking water) water supply. Recycled water is safe and suitable for uses such as vineyard irrigation and is an environmentally responsible way to conserve scarce and expensive water supplies. Learn more at Napa Sanitation District.

Sources:
https://www.napagrowers.org/water--irrigation.html
https://youtu.be/vRYU_E601sA
**Water Conservation Tactics**  
*January 2023 Survey*

**Question:** What water conservation methods do you employ in your vineyards?

<table>
<thead>
<tr>
<th>Conservation Practice</th>
<th>2023</th>
<th>Change YOY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover crops</td>
<td>82%</td>
<td>-2%</td>
</tr>
<tr>
<td>Rootstock selection</td>
<td>81%</td>
<td>6%</td>
</tr>
<tr>
<td>Soil management practices (cultivation)</td>
<td>75%</td>
<td>3%</td>
</tr>
<tr>
<td>Soil nutrition</td>
<td>64%</td>
<td>8%</td>
</tr>
<tr>
<td>Vineyard trellising and design</td>
<td>64%</td>
<td>13%</td>
</tr>
<tr>
<td>Vineyard site selection</td>
<td>30%</td>
<td>2%</td>
</tr>
<tr>
<td>Dry farming</td>
<td>20%</td>
<td>-1%</td>
</tr>
<tr>
<td>Drip Irrigation</td>
<td>94%</td>
<td>n/a</td>
</tr>
<tr>
<td>Irrigation system evaluation</td>
<td>72%</td>
<td>n/a</td>
</tr>
</tbody>
</table>
## Monitoring Plant Water Status

*January 2023 Survey*

**Question:** How do you monitor plant water status?

<table>
<thead>
<tr>
<th>Monitoring Practices</th>
<th>2023</th>
<th>Change YOY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual symptoms in the field</td>
<td>74%</td>
<td>-3%</td>
</tr>
<tr>
<td>Soil moisture probes</td>
<td>51%</td>
<td>-1%</td>
</tr>
<tr>
<td>Pressure bombs</td>
<td>45%</td>
<td>0%</td>
</tr>
<tr>
<td>Remote imaging (NDVI)</td>
<td>39%</td>
<td>-2%</td>
</tr>
<tr>
<td>Specialized software</td>
<td>28%</td>
<td>14%</td>
</tr>
<tr>
<td>Leaf temperature</td>
<td>12%</td>
<td>1%</td>
</tr>
<tr>
<td>Surface renewal technology</td>
<td>26%</td>
<td>17%</td>
</tr>
<tr>
<td>Sap flow</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>Leaf porometer</td>
<td>4%</td>
<td>-1%</td>
</tr>
</tbody>
</table>

7% responded with “Other” that includes:
- Neutron probes, dendrometer
- Direct plant sensing and data analytics
- Water monitoring wells
**Question:** Where do you source water for irrigation?

<table>
<thead>
<tr>
<th>Water Source</th>
<th>2023</th>
<th>Change YOY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater</td>
<td>81%</td>
<td>-2%</td>
</tr>
<tr>
<td>Surface water</td>
<td>50%</td>
<td>6%</td>
</tr>
<tr>
<td>Recycled water - NapaSan</td>
<td>16%</td>
<td>0%</td>
</tr>
<tr>
<td>Municipal water</td>
<td>6%</td>
<td>-5%</td>
</tr>
<tr>
<td>Water delivery by truck</td>
<td>8%</td>
<td>-1%</td>
</tr>
<tr>
<td>Recycled water - private source</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>9%</td>
<td>-3%</td>
</tr>
</tbody>
</table>

*Other includes:
- Reservoirs
- Other municipal recycled water
- Captured drain tile water

**NOTE:** This slide exhibits that growers use more than one source of water within a growing season, allowing for seasonal flexibility and leveraging water supplies when they are at highest levels.
Measuring Applied Water
January 2023 Survey

*New* Question: Do you measure the amount of applied water?

<table>
<thead>
<tr>
<th>Measures Applied Water</th>
<th>2023 Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, we use irrigation schedules to calculate the amount of applied water</td>
<td>33%</td>
</tr>
<tr>
<td>Yes, groundwater pumping is metered</td>
<td>28%</td>
</tr>
<tr>
<td>Yes, applied surface water is metered</td>
<td>21%</td>
</tr>
<tr>
<td>Yes, surface renewal technology/remote sensing is used</td>
<td>6%</td>
</tr>
<tr>
<td>No, we dry farm; the vines use what they need</td>
<td>5%</td>
</tr>
<tr>
<td>No, we use other technologies to assess vine health and water needs</td>
<td>4%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>3%</td>
</tr>
</tbody>
</table>

*Other includes:
• Vineyard irrigation is automized
• Visually assess when pumping into a pond
• NapaSan meters
• Planning to add meters this year
• Dry farm
*New* Question: Do you retain stormwater on site?

<table>
<thead>
<tr>
<th>Retain Stormwater</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>No, stormwater runoff is managed with drainage ditches</td>
<td>48%</td>
</tr>
<tr>
<td>Yes, temporarily in a pond</td>
<td>38%</td>
</tr>
<tr>
<td>Stormwater runoff is managed with drain tiles</td>
<td>30%</td>
</tr>
<tr>
<td>Yes, manage drainage to retain water on fields</td>
<td>18%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>8%</td>
</tr>
</tbody>
</table>

*Other includes:*
- Flat site / little or no runoff
- Use rainwater for vegetable garden irrigation
- Not allowed to retain stormwater hillside

NOTE: This data needs clarification and the question will be edited in the 2024 survey to better align with growers’ methods for retaining stormwater.
Conservation Barriers
January 2023 Survey

*New* Question: For the vineyard(s) that you manage, what are the most significant barriers to the implementation of conservation methods above and beyond what you’re already doing?

<table>
<thead>
<tr>
<th>Challenges</th>
<th>2023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>35%</td>
</tr>
<tr>
<td>Uncertainty about the efficacy of a given method</td>
<td>23%</td>
</tr>
<tr>
<td>Uncertainty about a potentially negative effect on yields or quality</td>
<td>17%</td>
</tr>
<tr>
<td>Timing to align with vine maturity and replacement</td>
<td>11%</td>
</tr>
<tr>
<td>Inability to convince owner/decision maker to adopt a new practice(s)</td>
<td>6%</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>8%</td>
</tr>
</tbody>
</table>

*Other includes:
- Need for evidence and a plan to make the argument at decisionmaker level
- Variability of soil and vineyard; would need too many probes/meters/data points
- Not enough labor for monitoring and analysis
- We’ve already maximized water efficiency; only irrigate when absolutely necessary
- Difficult to measure water usage
- Young vines need more water
- Climate change
Water Use Practices in the Last 5-10 Years
January 2022 Survey

Question: Please explain how your water use practices have changed over the last 5-10 years.

“[Irrigation] used to be on a calendar schedule. Now it's tailored to specific blocks/varietals based on climatic demand and water stress.”

“We've gotten better at monitoring our water use and are continually looking for ways to reduce consumption.”

 “[We are taking a] different approach to vineyard design and rootstock choice. Defined the goal of having a self-sustaining vine, encouraging deep roots and stronger, bigger vines.”

“Doing larger, less frequent irrigations, have reduced water use by more than half in most locations.”

“All irrigation recommendations are driven by data from multiple sources.”

“Installation of subsurface delivery of drip irrigation. Monitoring of soil moisture levels combined with vineyard observation to delay and schedule irrigation. In general, using 30 percent less water than 10 years ago.”
**Survey Takeaways**

- Napa County growers want to be part of the solution when it comes to protecting communitywide water resources; growers in Napa County are deeply committed to water conservation and have been employing best practices since the beginning of this long-term drought.

- There are an array of tactics currently being employed in Napa County vineyards, and in most cases several tactics are being employed; it’s not a “one size fits all” approach due to different sites, soil types, vineyard designs, and farming practices.

- Many growers use more than one source of water allowing for seasonal flexibility and leveraging water supplies when they are at highest levels.

- As a community, we can proactively meet the goals of the GSP. We’ve hit a trigger when it comes to sustainable yields, which gives an opportunity to respond to achieve overall 10% reductions across the industry; 2023 survey results indicate positive trends that we will continue to track in 2024.

- Education is desired and key in achieving the results the County would like to see; since the survey, NVG hosted a comprehensive Water Forum for growers and has increased tools and resources related to water conservation.

- NVG added survey questions to get more into the nuance of some of these tactics; NVG has identified willing vineyard sites when it comes to a pilot data collection program that would inform the County’s GSP work plan.
The Otters of Bale Slough!

An example of the volunteer efforts being taken on by growers is the restoration of Bale Slough. Saving water isn’t just about using less, but also supporting the natural systems that help our aquifers recharge.
Patterns of Land Use & Future Development

Through Analysis of Napa County Crop Reports and ECPAs, we know:

- Vineyard acreage is increasing at an annual rate of less than a half percent over the last 5 years – a .4% annual increase as of 2022
- In 2020 and 2021 Napa County saw a slight decrease in overall vineyard acreage
- Pending ECPAs represent a .009% increase over current vineyard acreage

What does this mean in the context of the GSP?

- We are seeing very slow growth when it comes to anticipated vineyard development
- In the subbasin being monitored by the GSP, acreage has remained virtually the same or even, in some years, decreased over the last five years
- It is possible that in areas of decreased acreage water uses are being traded for other uses, whether commercial, landscaping, or housing related
What are Other “Dry” Viticultural Areas?

• **California**
  - Paso Robles: 14”
  - Fresno: 11”
  - Coachella Valley: 3.2”

• **Australia** (not as dry as you’d think)
  - Barossa Valley: 21”
  - McLaren Vale: 20”

• **Washington**
  - Walla Walla: 20”
  - Prosser: 8.9”
  - Western Idaho: 10”

• **West Texas & New Mexico**
  - 8”

• **Argentina**
  - Almost every area: 4-8”

• **Napa River Sub-Basin**
  - 22-36”
<table>
<thead>
<tr>
<th>Area</th>
<th>Rainfall (inches) 7/1/14 - 5/28/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas Peak</td>
<td>33</td>
</tr>
<tr>
<td>St. Helena</td>
<td>32.5</td>
</tr>
<tr>
<td>Angwin</td>
<td>34</td>
</tr>
<tr>
<td>Calistoga</td>
<td>33</td>
</tr>
<tr>
<td>Rutherford</td>
<td>29.3</td>
</tr>
<tr>
<td>Coombsville</td>
<td>28.8</td>
</tr>
<tr>
<td>Oak Knoll</td>
<td>29</td>
</tr>
<tr>
<td>Carneros</td>
<td>22.6</td>
</tr>
</tbody>
</table>
Rainfall Total versus Rainfall Timing

- Timing is everything
  - After reaching field capacity, the plant only cares about timing of rainfall
  - Most soils in the sub basin “hold” no more than 8-10 inches of water available to grapes
  - Rainfall in April/May has a much larger outcome on the type of season than cumulative rainfall

- The last day of “field capacity” is what concerns growers in a low rainfall year
  - Nutrient status is affected in a dry spring
  - Canopy growth is affected in a dry spring
  - Supplemental irrigation can often be initiated earlier in a dry spring, but not always
**Supplemental Irrigation Application and Efficiency**

- Conventional tools
  - Neutron Probes
  - ET Deficit Irrigation Model
  - A Shovel
  - Our own Eyes

- Pressure Chamber
  - Pre-Dawn LWP
  - Mid-day Leaf Water Potentials
  - Stem Water Potentials
  - Porometer

- Real Time (constant) vineyard sensors
  - Weather stations
  - Soil Moisture probes
  - Sap Flow Sensors
  - Actual ET sensors (Tule Technologies)
  - Phytogram
  - Dendrometer
  - AI technology to replace Pressure the Pressure Chamber
Grapevines are extremely drought tolerant but need to balance commercial viability with resource conservation.
Rootstocks

- Wide variety of rootstocks, many drought tolerant options
- Replanting today is focusing primarily on drought tolerance and water stress tolerance
- We have a wide variety of options for different soil types

Table 4. Rootstocks with Some Degree of Tolerance to Soil Limitations

<table>
<thead>
<tr>
<th>Water Stress</th>
<th>Wet Soils</th>
<th>Saline Soils</th>
<th>Sodium &amp; Chloride</th>
<th>Acid Soils</th>
<th>Alkaline Soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>99R</td>
<td>R. Gloire</td>
<td>140R</td>
<td>140R</td>
<td>99R</td>
<td>5BB</td>
</tr>
<tr>
<td>110R</td>
<td>SO4</td>
<td>101-14</td>
<td>Schwarzmann</td>
<td>140R</td>
<td>420A</td>
</tr>
<tr>
<td>140R</td>
<td>Schwarzmann</td>
<td>Schwarzmann</td>
<td>1616C</td>
<td>140R</td>
<td></td>
</tr>
<tr>
<td>1103P</td>
<td>1616C</td>
<td>1616C</td>
<td>Ramsey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO4</td>
<td>Harmony</td>
<td>Harmony</td>
<td>Ramsey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5BB</td>
<td>Dogridge</td>
<td>Dogridge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125AA</td>
<td>Freedom</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>St. George</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramsey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dogridge</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1616C</td>
<td></td>
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</tr>
</tbody>
</table>

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Row Orientation

• Can have a dramatic impact on baseline and supplemental water use

• 30-40% reduction by shading the canopy and fruit at peak radiation intensity 1:00-4:00pm mid-summer

• Most vineyards being replanted to better row orientations than 30 years ago
Canopies

New, fleshy leaves using water-inefficiently

Water-conserving canopy
Soil Moisture View of Drip Irrigation:
Drip Irrigation Delays Soil Drying Trend
Proposed Data Collection to Improve Water Use Model

• Choose 5 representative **volunteer** sites throughout the basin
  – Collect water usage data on well water, surface water, recycled water
    • Collect method of use i.e. drip, overhead, microsprinklers, misters, etc...
  – Classify main soil types, water holding capacity, depth, clay content, depth to hardpan, etc...
  – Aggregate historical usage, integrate ET modeling through weather station and crop coefficients
  – Document cover crop usage and estimated increase in water usage
  – Interview property manager about water use strategy and changes over time
  – Test captured data against assumptions in the model and revise data collection as needed to improve water usage estimates
• Query membership on water use trends, decision making around water use over time
Example Site: Yountville South

- Cole Silt Loam
  - A horizon 0-24” Silt Loam
  - C1 horizon 24-45” Silt Loam
  - C2 horizon 45-60” Silt Loam
  - Restrictive layer at 80+, no rust mottling
  - Effective rooting depth 80”
  - Fairly well drained
  - Hydrologic soil group B
  - Medium susceptibility to compaction
  - Plant available water: 0-150 cm (effective rooting depth): 30 cm (11.8”)
Example Site: Yountville South

- Vineyard Details
  - 039-16 Rootstock (medium drought tolerance)
  - Cabernet Sauvignon: 9 tons/acre
  - Average Length of season budbreak-harvest: 180 days
  - Row orientation: 55 degrees east of north (moderate/low water use orientation)
  - Seasonal Kc factor = .9 (VSPquad with crossarms)
  - Average supplemental drip irrigation = .21 acre ft/acre/year
  - Frost sprinklers used & heat mitigation (micro-sprinklers)
  - Onsite rainfall average = 32”
  - Well water use, Surface Water use, Drainage recapture and storage
  - 50% disked, 50% Fescue permanent cover crop
Example Site: Yountville South

- Comparison by blocks
  - Highest water use blocks 2023
    - .41 acre ft/acre
  - Lowest water use blocks 2023
    - .06 acre ft/acre
  - Lowest use blocks had one primary irrigation, 5 double poly irrigations, no heat suppression, no overhead sprinklers
  - Cover crop was reduced to 1/4 of rows to reduce TCAH habitat in the vineyard and 3/4 rows tilled
  - 1/4 rows that remained were mowed extremely tight, reducing water use.
  - Supplemental water was used from 8/7 through 10/24
  - Groundwater use was significantly reduced
  - Surface water use was significantly reduced
Q&A and Additional Resources

Napa Valley Grapegrowers Community Resources:

- **Water & Irrigation**
- **Heat & Drought**
- **NVG Groundwater Sustainability Plan Page**
- **Climate Resilience**
- **2023 NVG Water Conservation Seminar**
- **Water Reclamation in the Napa Valley – NVG Viticultural Best Practices Video Series**
- **Napa County’s Conservation Landscape**

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