

The Lodi Rules for Sustainable Winegrowing Companion Document

Introduction

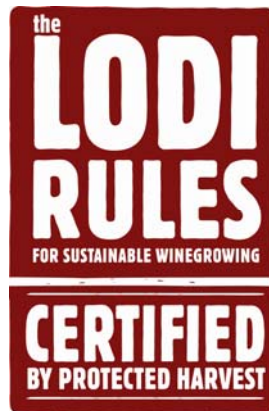
It is important to have a transparent certification process for *The Lodi Rules* program. The companion document is a critical part of that process and is primarily for the use by a grower whose vineyard is being certified and by the auditor who ensures that the standards have been met.

Three elements are listed for each standard:

1. Purpose – what aspect of sustainability is addressed by the standard and why it was included in *The Lodi Rules*.
2. Verification – what the auditor needs to examine to ensure that the standard was met by the grower for the vineyard being certified.
3. References – citations where the scientific basis of the standard is presented.

Some standards require plans and these plans must incorporate specific components. Guidelines for creating these plans and example plans are included immediately following the corresponding standard.

Some standards address an issue that is relevant to the whole farm. These are called farm level standards and are indicated by an ‘F’ superscript. Other standards address an issue that relates to each vineyard and must be addressed for each one. These are called vineyard level standards and are indicated by a ‘V’ superscript.



Chapter 1: Ecosystem Management

1.1 Sustainability Vision ^F

Purpose	Creating a sustainable vision for the farm provides the foundation for sustainable winegrowing, helping ensure the long-term health, biodiversity, and productivity of the farm and surrounding ecosystem. Once a vision statement has been created, each potential farming practice can be evaluated as to whether it moves one toward or away from this vision. Because a specific practice does not move one toward the vision, does not necessarily mean it should not be done. However, knowing where it fits into the sustainable vision for the farm is important for achieving the goals of the vision.
Verification	Certificate of completion of LWWC workshop, sustainability vision statement and (plan)
References	1, 10, 22

Use the following guidelines and example to create a sustainability vision for your farm.

Developing a Sustainability Vision for your farm involves identifying your farm’s resources, creating a set of sustainable goals, and then producing a sustainable vision (plan) for your farm. This process will help ensure the long-term health, biodiversity, and productivity of your farm and the surrounding ecosystem.

Note: The Sustainability Vision Plan may also include components from:

- Ecosystem Management: Environmental Survey (New or Existing Vineyard) (Standard 1.3)
- Education, Training and Teambuilding: Human Resources Plan (Standard 2.1)
- Soil Management: Nutrition Management Plan (Standard 3.1), Soil Erosion Plan (Standard 3.12)
- Pest Management: Economic Threshold Plan (Standard 6.2), Powdery Mildew Plan (Standard 6.11), Soil-Borne Pest Management Plan (Standard 6.15.1), Weed Management Plan (Standard 6.16.1), Vertebrate Pest Management Plan (Standard 6.17.1), Sprayer/Duster Maintenance Plan (Standard 6.18.1), Spray Drift Management Plan (Standard 6.18.4)

Defining the Resource Base

A resource base includes the tools and people available to manipulate your environment (land base). To help identify your farm’s resources, follow the guidelines below.

1. Land Base

- Describe and map the physical boundaries of your property to be managed. (You may wish to use your Soil Erosion Management Plan and/or Environmental Survey site descriptions.)

- This should include: total acres, neighbors, driveways and road systems, water access rights, streams and riparian corridors, vernal pools, wet swales, drainages, degree of slope, any existing erosion, and the presence of animal and plant species including any threatened or endangered species that may affect farming and the site and/or be subjected to local, state, or federal regulations.

Note: The following examples came from a workshop where a group of LWWC members created a Sustainability Vision for the entire Crush District 11

*Example Land Base**

The vineyards managed by Lodi-Woodbridge Winegrape Commission members within the land delineated as Crush District 11.

(Your site description will probably be more detailed and only include the property on the farm for which this Sustainability Vision (plan) is being created.)

2. Participants

- List all the participants who will be involved with the operations. These are individuals needed for ecosystem and sustainability management solutions to be viable (You may wish to include your Human Resources Plan).
- This may include any or all of the following: family, friends, employees, neighbors, community members, other stakeholders, bankers, farm advisors, PCAs, public officials, regulators, environmental groups.
- Since ecosystems do not stop at traditional boundary lines, a good idea is to look across boundaries and develop an active partnership with neighbors and other stakeholders. Try to be as inclusive as possible.

Example Participants

Winegrape Growers, Winery Owners, Suppliers, Retailers, Consumers, Politicians, Government Agencies, Educators, Crop Advisors, Neighbors, Laborers, Financial Institutions, Foundations, Media, and Non-government organizations, LWWC Staff.

3. Available Resources

- Brainstorm about what resources you have available to manage your operations?
- These include financial resources, human resources, capabilities of the participants, and equipment.
- List the major physical resources from which revenue is generated and the people who influence or will be influenced by management decisions. List the capabilities of people who can act as resources for your operation. (There may be a slight blurring

here between *Participants* and people who act as a *Resource Base*; it is okay for there to be an overlap.)

Example Available Resources

Operating budget for the LWWC for one year and the capabilities of the *Participants* and people involved who influence Crush District 11. The capabilities of the people who influence the LWWC include Cooperation; Leadership; Education; Experience; Time; Research Involvement; Compassion; Energy; Understanding; Risk Takers; Knowledge of Opportunity; and Commitment.

Developing Sustainable Goals

To help identify some possible sustainable goals for your farm and strategies for producing objectives within those goals, follow the steps below.

1. Shared values (Quality of Life)
 - a. This is a statement articulated by the participants of the sustainable management process (family, employees, stakeholders, etc.) and is the foundation of the vision. It is an expression of the way people want to live their lives and accomplish together based upon what they value most.
 - b. What are your social values? What draws you to the farming life? What values do you want reflected in your farm?
 - c. How do these values influence the overall quality of life of those participating?

Example Shared Values

A brainstorming by the workshop participants revealed these shared values:
Love, security, family, health, purpose, companionship, happiness, peacefulness, peace, stress relief, time, harmony, a reason for all this, intrinsic worth, to feel good, and fun.

The following statements are a summary of what the above brainstorming indicates about the participants shared values.

We value a life surrounded by family and friends filled with companionship. We feel good and secure in our homes and community. We want our lives to be filled with love, purpose, happiness, harmony, and peace. And, because we strive to fill our lives in a positive way, there is less chance for stress. We would like time for fun and to enjoy the intrinsic worth of our lives with friends and family.

2. Forms of production
 - a. From the land base being managed, what supports your shared values or quality of life? What do you need to produce and create your desired quality of life?
 - b. Examples include: profit, recreation, culture, aesthetics, other products, etc.

Example Forms of Production

A brainstorming by the workshop participants revealed these forms of production:

- Produce a profit from winegrapes
- Produce good quality winegrapes and wine
- Produce name recognition
- Produce thirsty buying customers
- Produce content, viable, and skilled workforce
- Produce demand for Lodi wine
- Produce clean air, water and healthy soil
- Produce good community relations
- Produce a good environment

The following statements are a summary of what the above brainstorming indicates about the participants shared values.

In order to sustain our *Shared Values*, we will generate profit from high quality winegrapes that produce high quality wine. This will create name recognition and demand for Lodi wine from thirsty buying customers. We will produce good relations with the local community. Our workforce will be content, viable and skilled. Our winegrape production will result in clean air and water, healthy soil, and a robust environment.

3. Desired future landscape
 - a. Describe what the landscape of your farm would look like in the future in order to sustain production and quality of life.
 - b. Where would you like the farm to be in five years? Ten years? When you retire and pass the farm along to your children?
 - c. You may include components of the Land Base that you described above.
 - d. Historical knowledge of what the landscape used to look like and what has been done to change it may help you develop this landscape description. You may include pictures, maps and/or a written description of your desired landscape.

Example Desired Future Landscape

For our Forms of Production to be truly sustainable, our future land base will have a healthy and diverse soil with good populations of soil microbes. There will be an abundance of available nutrients for all plants and we will create an appreciation within the community for the importance of a healthy soil.

The water cycle will be adequately beneficial to crops, land, people and nature. There will be an abundance of water from healthy rivers, streams, other surface water sources, and ground water. There will be greater availability and affordability of water with a balance of use between urban and rural communities.

Sufficient solar energy will be captured efficiently by healthy vigorous grapevines and native plants. Native vegetation communities will be thriving and biologically diverse. Renewable energy sources (e.g. solar power) will be used by more people and businesses in the community. This will create more sources of sustainable energy. These practices will result in better air quality for our community.

There will be adequate healthy and diverse biological communities. These communities will have ample vegetation of native plants that in combination with abiotic components provide good habitat for healthy wildlife populations. These environments will also provide for diverse arthropod populations beneficial to agriculture. Our community will understand and recognize the importance of a diverse and robust ecosystem.

There will be good rural and urban cooperation in the pursuit of our shared vision. This will provide a balance of good agriculture land and sustainable economic growth. Urban centers are planned and clustered on non-arable land preserving our small town and farming atmosphere. Our community will value vineyards, sustainable agriculture, and farmers.

Creating a Sustainability Vision Plan

Based on your answers above, brainstorm about actions that you will need to take to produce your desired future landscape vision. Determine whether each of these actions is shorter term (1-5 years) or longer term (6+ years). Then, list the goals, objectives, strategies, and monitoring programs that you can use to accomplish these actions.

Goals should be longer term. Objectives are shorter term and when combined with other objectives, achieve the longer term goals. Strategies are the actions used to produce the objectives. Monitoring evaluates the effectiveness of your strategies to ensure that your goals are met.

Example Goal: When I was growing up, I used to see a lot of quail and other wildlife on the farm and now I rarely see any. My goal is to see more quail and other wildlife on my property.

Objective 1: In order to see more quail on my farm, I need to improve their available habitat. I will do this by planting and maintaining a hedgerow of quail brush (*Atriplex* spp.) along 100 feet of my western fence line.

Strategy: Proposed actions to achieve this objective include spraying my western fence line with an herbicide in January, digging 25 plant holes in February, installing a drip line after the holes are dug, buying 25 small quail brush plants and planting them in early March. I will give the plants a deep watering once a week during the first summer or more often if needed.

Monitoring: I will monitor the plants to see if they are receiving adequate water during the first summer. I will monitor the weed population in the hedgerow and remove troublesome competitive weeds when necessary.

Objective 2: To reintroduce quail onto my farm.

Strategy: Once the quail brush hedgerow is established (1-2 years), I will reintroduce 3 breeding pairs of quail in the early spring. I will also provide three covered ground nesting boxes to protect the quail from predators.

Monitoring: Monitoring will include walking the hedgerow weekly to determine if there have been any causalities and to count the number of birds. I will record the number of quail observed, the time and date on each outing. Once a month I will examine the nesting boxes and clean or repair them if needed.

Objective 3: To provide secure nesting sites for waterfowl using my reservoir.

Strategy: I will place 5 wood duck boxes along the reservoir edge, maintain the boxes not less than three times a year and cooperate with California Waterfowl Association.

Monitoring: Monitoring will be done as a part of the maintenance program. Not less than three times a year, I will check and maintain the boxes; I will record the date, time, signs that indicate the presence of occupancy, number of inhabitants, and condition of the box.

Example 2:

Goal: I want to earn more money from my farm

Objective: To produce high quality winegrapes and receive a premium price for them.

Strategy: Proposed actions to achieve this objective include, more precise and improved water management, nutrient management, and pest management and a more active roll in marketing my grapes to smaller higher paying wineries.

Monitoring: Demand for my grapes, number of long term contracts, increased value, reduced costs, and bottom line improvements.

Creating a Sustainability Mission Statement

Now that you have developed a future vision for your farm and defined a Sustainability Plan to help you achieve your vision, you need to develop a Sustainability Mission Statement. A Sustainable Mission Statement is defined by answering three questions:

1. What are the opportunities or needs that we exist to address (The purpose of the organization) (i.e. to grow high quality grapes)?
2. What are we doing to address these needs (The business of the organization) (i.e. Using sustainable techniques like protecting the environment and providing social equity)?
3. What principles or beliefs guide our work (The core values of the organization)?

A well defined sustainability mission statement builds understanding about your farm, provides a framework for making wise decisions, and provides a sense of direction for the future. In our society we tend to be “doers” and this process may seem like you are not doing things, but a sustainability mission statement provides the ultimate foundation for making sustainable management decisions.

Example:

Lytin S Ranches strives to produce the highest quality winegrapes possible in an environmentally sound, socially responsible, and profitable manor. This goal is accomplished by using sustainable viticulture techniques, restoring adjacent non-farmed land to a more historic natural setting, and reducing off-farm inputs whenever possible. Our work is guided by a deep respect for the land, our community, and pride in the product that we produce.

1.2 Watershed Management ^F

Purpose	Many of the major environmental issues faced by the Lodi region, such as water quality, are best addressed by viewing things at the watershed level. Additionally, landscape planning is best done at the watershed level and there are many watershed stewardship groups that have formed to aid in this planning. Participation in such a local watershed group is the best way to stay informed on watershed issues and participate in community development. The Lower Mokelumne River Watershed Stewardship Group was formed in 1998 and all growers and stakeholders are welcome to attend their meetings. For more information see www.sjcrd.org .
Verification	Watershed Stewardship Membership list, Meeting Attendance List
References	35

1.3 Environmental Survey for New or Existing Vineyard ^V

Purpose	Identifying and mapping sensitive areas on the farm, such as vernal pools, swales, and oak trees, ensures minimizing adverse environmental impacts on existing habitat due to vineyard establishment and management. Furthermore, it will encourage better integration of the vineyard into the surrounding ecosystem.
Verification	Environmental survey.
References	2, 10, 28, 34, 42

Use the following guidelines for developing an environmental survey for a new or existing vineyard.

Environmental Survey Requirements: *Your environmental survey must contain an inventory of your properties physical characteristics that may affect farming the site and may be subject to local, state or federal regulations.*

All forms of development, including vineyard development, impact natural resources and the environment. Vineyard development requires changes to the landscape that affect immediate and surrounding land, air, water, and living organisms. Vineyard development activities can include land clearing, tree removal, herbicide applications, riparian vegetation removal, brush burning, grading, disking, deep-ripping, re-contouring, altering water drainages, excavating, installing erosion control measures, and construction of roads, dams, wells, and fences. Many of these activities can affect natural resources and the environment and regulatory programs exist to protect them. By examining your proposed or existing vineyard property and creating an environmental due diligence survey, you can help to safeguard against environmental damage and ensure that no laws are broken.

An environmental due diligence survey is an inventory of your properties physical characteristics that may affect farming the site and also may be subject to local, state or federal regulations.

These physical characteristics may include driveway and road systems, water access rights, streams and riparian corridors, vernal pools, wet swales, drainages, degrees of slope, existing erosion, and the presence of animal and plant species, such as oak trees or threatened or endangered species. These regulations vary considerably from region to region and county to county.

Site Description

Begin your survey with a site description. You may wish to use portions of similar descriptions found in your Sustainability Vision Plan (Standard 1.1), Soil Conservation Plan (Standard 3.12), Nutrient Management Plan (Standard 3.1), Spray Drift Management Plan (Standard 6.18.4), etc. if they pertain to this property.

Include a map of the existing vineyard area or proposed vineyard development area with all of the following that apply: total acres, driveways, road systems, water access rights, streams and riparian corridors, vernal pools, wet swales, drainages, degree of slope, any existing erosion, and the presence of animal and plant species including any threatened or endangered species that may affect farming and the site and/or be subjected to local, state, or federal regulations. You may also want to include photographs of your site and of sensitive areas on your property (e.g. wetlands, vernal pools, etc.). It is also a good idea to include information about your proximity to neighbors, schools and anything else that may be affected by your farming operation.

Sensitive Areas

Use Table 1 to help identify any sensitive areas on your property and any property directly adjacent to your property.

Table 1. Sensitive Areas Potentially Affected by an Existing or New Vineyard

Land	Water	Species	Air	Human/other
Hillsides; soil loss	Surface water quality	Plants	Air quality: Smoke	Historical sites
Habitat, contiguous habitat	Surface water abundance	Terrestrial animals	Air quality: Dust	Archaeological sites
Wetlands	Ground water quality	Aquatic species, including anadromous fish		Sacred Sites
Riparian Areas	Ground water abundance	Species of special concern: migratory, listed, other protected species		Open space and views
Coastal Zones				Schools and Neighbors
Floodplains				Roads

Record these sensitive areas on your site map and indicate on a separate document what measures you will use to mitigate adversely affecting these areas with the vineyard development and day to day management operations.

Laws, Regulations and Ordinances

To determine which county ordinances are relevant consult Table 2. For the state and federal laws that may pertain to your site, use the University of California publication titled “Growers’ Guide to Environmental Regulations & Vineyard Development: First Edition 2000”. The book can be found in the LWWC offices at the Lodi Wine and Visitor Center or ordered through the California Association of Winegrape Growers (CAWG) at 555 University Ave., Suite 250, Sacramento, CA 95825. This book will guide you in the proper procedure that you need to take to ensure that no laws are broken and to help to ensure environmental protection.

Table 2. County Regulations found in Crush District 11

County Regulations	San Joaquin County	Sacramento County
Agricultural Burning Ordinance	XXX	XXX
Grading Ordinance	XXX	XXX
Natural Bank Buffer	XXX	
Pesticide Regulation	XXX	XXX
Right to Farm	XXX	
Tree Ordinance	XXX	XXX
Zoning Ordinance and County Planning		XXX

1.4 Woodlands^F (A woodland is at least a half acre of land with more than 10% tree cover)

1.4.1 Woodland Management^F (Including oak woodland)

Purpose	Maintains or enhances the quality of woodlands adjacent to the vineyard. Woodlands provide refuges for pest natural enemies, nesting sites for birds, shelter for vertebrates, perches for raptors that prey on vertebrate pests and act as windbreaks.
Verification	Vineyard site map and/or visual inspection
References	10, 11, 28, 34, 42

1.5 Trees^F

1.5.1 Individual Tree Management^F (e.g. Individual trees, small groups of trees, hedgerows)

Purpose	Maintains or enhances the quality of existing trees adjacent to or in the vineyard. Trees provide refuges for pest natural enemies, nesting sites for birds, perches for raptors that prey on vertebrate pests in vineyards and act as windbreaks.
Verification	Vineyard site map and/or visual inspection
References	2, 10, 26, 28, 34, 42

1.6 Habitat Other Than Trees ^F

1.6.1 Enhancing Biodiversity and Soil Microbial Communities Within the Vineyard ^V

Purpose	Cover crops grown in the vineyard provide habitat for vertebrates as well as invertebrates, both above and below ground. They also provide nutrients and organic matter which enhance soil microbial communities.
Verification	Vineyard inspection and farming records.
References	20

1.6.2 Vegetative Habitat Management around Vineyard ^F

Purpose	Hedgerows provide refuge for important vineyard pest natural enemies, nesting sites for birds, shelter for animals, and variety in the landscape, and increases the farm's biodiversity.
Verification	Farm site map and/or visual inspection.
References	10, 11, 28, 34, 42

1.7 Vernal Pools ^F

Purpose	Ensures minimizing adverse environmental impacts on vernal pools due to on-going farming practices. Vernal pools provide critical habitat for many plant and animal species which increase the farm's biodiversity.
Verification	Vineyard site map and/or visual inspection
References	2, 10, 28, 34, 42

1.8 Riparian Habitat ^F

1.8.1 Riparian Habitat Management ^F

Purpose	Maintains or enhances the quality of riparian habitat on the farm. Riparian sites greatly increase farm biodiversity by providing critical habitat for many plant and animal species and helps maintain water quality in the watercourse.
Verification	Farm and vineyard site maps and/or visual inspection
References	10, 28, 34, 35, 42

1.9 Moving Water Aquatic Habitats^F

1.9.1 Moving Water Aquatic Habitat Management^F

Purpose	Maintains or enhances the quality of moving water aquatic habitat on the farm. Moving water provides critical habitat for many animals, plants and other organisms.
Verification	Environmental plan
References	10, 28

1.10 Nest Boxes for Wildlife that Prey on Vineyard Pests^F

Purpose	Owls and hawks are capable of killing a large number of gophers and ground squirrels. Providing nesting sites and perches increases the likelihood that these predators will be active on the farm. Likewise, bats are the most important predator of night-flying insects and consume vast number of pests, but need warm, dry and protected places to roost such as bat boxes.
Verification	Farm site map and/or visual inspection.
References	10, 28, 34, 40, 42

1.11 Nest Boxes and Plant Habitat for Birds Other than Raptors^F

Purpose	A healthy, biodiverse farm ecosystem contains many animal and plant species that are not directly related to the growing of winegrapes.
Verification	Farm site map and/or visual inspection.
References	10, 34, 40, 42

1.12 Managing Livestock Access^V

Purpose	Managing or limiting access of livestock to streams, ponds, surface waters, and waterways prevents environmental degradation and ground water contamination.
Verification	Farm site map and/or visual inspection.
References	27

1.13 Livestock Grazing Plan^V

Purpose	Managing or limiting access of livestock to streams, ponds, surface waters, and waterways prevents environmental degradation and ground water contamination.
Verification	Livestock Grazing Plan
References	27

Use the following guidelines to help you develop your livestock grazing plan.

The issues below are to be used as guidelines while you develop your own livestock grazing management plan. The goal of a grazing management plan is to manage the controlled harvest of weedy and/or cover crop vegetation in and around your vineyards with grazing animals while maintaining or improving water quality and quantity, reducing soil erosion and improving soil conditions, improving or maintaining the quantity and quality of food and/or cover available for wildlife, and ultimately, promoting economic stability. Not all of these guidelines may apply to you, but try to be as thorough as possible.

Note: These practices apply to all vineyard property where grazing animals are managed. Your livestock grazing plan should also conform to all applicable federal, state and local laws. Seek measures to avoid adverse affects to endangered, threatened, and candidate species and their habitats.

Goals

State the goals and objectives that you want to achieve by grazing livestock in and around your vineyard.

Site Description

Your grazing plan should include a site description. You may wish to use portions of similar descriptions found in your Sustainability Vision Plan (Standard 1.1), Soil Conservation Plan (Standard 3.12), Nutrient Management Plan (Standard 3.1), etc. if they pertain to this property. Include a map of the existing vineyard area or proposed vineyard development area with all of the following that apply: total acres, driveways, road systems, water access rights, streams and riparian corridors, vernal pools, wet swales, drainages, degree of slope, any existing erosion, and the presence of animal and plant species including any threatened or endangered species that may affect farming and the site and/or be subjected to local, state, or federal regulations. You may also want to include photographs of your site and of sensitive areas on your property (e.g. wetlands, vernal pools, etc.). Indicate in your description or on the map where you plan to graze livestock and any exclusionary devices that you will use to keep the animals in the designated area.

General Criteria

1. Indicate how you will graze your land with site production limitations (slope, rainfall, etc), rate of ground cover growth and the physiological needs of forage plants (cover crop).
2. How will you manage the kind of animal, animal number, grazing distribution, length of grazing periods and timing of use to provide efficient use of your land and livestock? Livestock feeding, handling, and watering facilities should be designed and installed in a manner to improve and/or maintain animal distribution. These facilities should also be designed and installed to minimize stress, the spread of disease, parasites, contact with harmful organisms and toxic plants. Supplemental feed and/or mineral requirements should be balanced with the forage consumption to meet the desired nutritional level for the kind and class of grazing livestock.

3. Indicate how you will protect soil, water, air, plant and animal resources when locating livestock feeding, handling and watering facilities.
4. Indicate how you will manage grazing animals to maintain adequate vegetative cover on sensitive areas (i.e. riparian, wetland, vernal pools, slopes, etc.).

Criteria to Improve or Maintain the Health and Vigor of Plant Communities

1. On what will the duration and intensity of grazing be based? How will you adjust grazing periods and/or stocking rates to meet the desired objectives for the plant communities and the associated resources, including the grazing animal?
2. Indicate how you will schedule livestock movements. You can base this on rate of plant growth, available forage and utilization, but try not to use calendar dates.

Criteria to Improve or Maintain Water Quality and Quantity and Soil Condition

1. Indicate how you will maintain adequate ground cover, plant density, litter and canopy to maintain or improve the filtering capacity and the soil condition of your vineyard floor. Also indicate how you will limit livestock access to rivers, stream, and other surface water?
2. How will you minimize concentrated livestock areas to enhance nutrient distribution and improve or maintain ground cover and minimize trailing and trampling to reduce soil compaction, excess runoff and erosion?

Criteria to Improve or Maintain Food and/or Cover for Wildlife Species

1. How will you manage for diverse plant communities? Consider the roll of plant height, structure and density for desired wildlife habitat.
2. Indicate if and when you will provide rest from grazing during critical nesting periods.

Operation and Maintenance

Is your grazing strategy meeting your goals and objectives? Make adjustments as needed to ensure that the goals and objectives of your livestock grazing strategy are met.

Resource:

Natural Resources Conservation Service, Conservation Practice Standard, Prescribed Grazing, Code 528. pp 4. <http://www.nrcs.usda.gov/technical/Standards/nhcp.html>

Chapter 2: Education, Training and Team Building

2.1 Human Resources Plan ^F

Purpose	The HR plan provides the farm a framework for HR policy and management.
Verification	Written HR plan on file
References	10

*Use the following guidelines for developing a human resources plan for a farm with one or more employees.
(Developed by Dr. Liz Thach, Sonoma State University)*

Company Mission:

See Sustainability Vision Guidelines used for Ecosystem Management standard 1.1.

Company Values:

See Sustainability Vision Guidelines used for Ecosystem Management standard 1.1.

Company Strategy:

See Sustainability Vision Guidelines used for Ecosystem Management standard 1.1.

Human Resources Strategy:

SAMPLE STATEMENT: To support the mission, vision, values, and strategy of XYZ Company by implementing human resource policies and practices to ensure employees have the appropriate skills and motivation to perform their work in a safe, productive, satisfying, and sustainable manner.

The tactics to implement the strategy include progressive policies and practices in: 1) Staffing & Recruiting; 2) Training & Development; 3) Performance Management & Employee Relations; 4) Compensation & Benefits; and 5) Record-Keeping.

(NOTE: Or other HR services you offer in your company)

Staffing and Recruiting:

Describe exactly what your company policies and practices are regarding staffing and recruiting. For example:

- Do you have a job analysis and job description for each job? Do you update job descriptions on a yearly basis?
- Have you developed a staffing plan for next 3, 5, 10 years?

- What is your organizational design (e.g. creating new departments as you grow; determining which jobs report into which department; which functions can be outsourced, etc.)?
- When new position comes open, do you recruit internally first? If no one is available, then what recruiting methods do you use (e.g. newspaper, word-of-mouth, internet, search firm, etc.)
- What is your resume screening and evaluation process?
- What is your interview process? What is your training for interviewers? How will you evaluate candidates?
- Do you have a process for references checks, testing, health exams, etc.?
- What are your costs, budgets, and evaluation metrics for staffing and recruiting?
- What are your roles and responsibilities for staffing and recruiting?
- What are the legal policies and required paperwork for staffing and recruiting?

Training and Development:

Describe exactly what your company policies and practices are regarding training and development. For example:

- What is your new employee orientation process or training?
- What is required training for all jobs (e.g. safety)?
- What specific training is required for each major job category or family?
- How is training implemented (e.g. One-on-one; self-study; training class, etc.)?
- How is managerial or leadership training handled (e.g. Staying up to date and informed with industry conferences, journals, etc.)?
- How is new training determined and what are your needs assessment methods?
- How is training designed? Is it outsourced?
- What are the plans for overall organization development? Is your company growing, staying the same, improving quality, promoting sustainability, etc.?
- What are the costs, budgets and evaluation metrics for training and development?
- What are the roles and responsibilities for training and development? Who does it?
- What are the legal policies and required paperwork for training and development?

Performance Management and Employee Relations:

Describe exactly what your company policies and practices are regarding performance management and employee relations. For example:

- How do you communicate company strategies and goals, etc. to employees (e.g. Meetings, 1-on-1, etc.)?
- What type of performance management system do you have in place to provide employees with individual goals linking to department and company goals (e.g. Performance Appraisal form; joint goal-setting with employees; how often do you meet 1-on-1 to review performance, etc.)?
- How do you communicate employee policies (e.g. handbook, etc.)? Do employees sign-off on handbook?

- What is your discipline process?
- How do you motivate employees (e.g. Teambuilding, recognition, financial and non-financial methods)?
- How do you deal with employee grievances?
- Do you communicate in both Spanish and English?
- What are the costs, budgets and evaluation metrics for performance? What are some management and employee relations activities?
- What are the roles and responsibilities for performance management and employee relations? Who does it?
- What are the legal policies and required paperwork for performance management and employee relations?

Compensation and Benefits:

Describe exactly what your company policies and practices are regarding compensation and benefits. For example:

- What is your compensation and benefits philosophy and strategy (e.g. “to pay 5% above marke, etc.)?
- How do you determine salaries for each job or job family? Which salary surveys do you participate in? How often do you update your salary structure? How is it organized and documented?
- How is salary communicated to employees? Who has access to salary structure information?
- How is payroll administered? Who does it? When? What methods are used, etc?
- Are salary increases linked to a performance management system?
- Do you have a bonus system? How is it determined and administered?
- What other financial perks do you provide employees (e.g. car allowance, etc.)?
- What benefits do you provide to employees? Document complete list, including government required benefits, such as worker’s compensation and others? Describe why you offer each benefit.
- How are benefits administered? Who does it? How? When? What are the eligibility requirements?
- What are the costs, budgets and evaluation metrics for your compensation and benefits program?
- What are the roles and responsibilities for your compensation and benefits program? Who does it?
- What are the legal policies and required paperwork for your compensation and benefits program?

Record Keeping:

Describe exactly what your company policies and practices are regarding record-keeping for Human Resources. For example:

- Record the list of employee records and documents that you maintain (e.g. I-9s, employment applications, performance appraisals, discipline records, etc.).
- Describe where you keep records (e.g. employee file, on a computer, etc.).
- Describe how long you keep each document (e.g. must keep resumes you receive for any advertised job at least 2 years).
- Describe your process for preparing and submitting required documents to the state and federal government (e.g. social security, etc.).
- What are the costs, budgets and evaluation metrics used for your record-keeping?
- What are the roles and responsibilities for your record-keeping? Who does it?

2.2 Employee Orientation ^F

Purpose	An annual company orientation helps employees feel a part of a greater whole and helps maintain intra-company communications.
Verification	Orientation agenda and signup list.
References	10

2.3 Safety Training ^F

Purpose	Safety training is not only a legal requirement but essential for a sustainable farming operation.
Verification	Meeting schedules and sign-up lists.
References	5, 10, 14

2.4 Safety Rewards Program ^F

Purpose	Recognition of safe job performance is a good incentive for employees.
Verification	Written company safety incentives program.
References	5

2.5 LWWC and University-sponsored Professional Training and Development ^F

Purpose	Keeping current with the latest in sustainable farming practices, safety regulations, new pest problems, etc. is critical for continued improvement of ones sustainable farming program.
Verification	Certificates of completion (of classes), meeting signup lists, Continuing Education credits.
References	5, 10, 28

2.6 Staying Informed With Industry ^F

Purpose	Support of industry associations is critical in the long-term sustainability of the wine industry in the Lodi community and the state of California.
Verification	Membership cards, dues receipts
References	10

2.7 Teambuilding for Sustainability ^F

Purpose	Teambuilding helps develop cohesiveness among employees enhancing job performance.
Verification	Meeting/workshop agendas and signup lists
References	10

2.8 Employee Handbook ^F

Purpose	Employees need a document to refer to regarding company policies and practices.
Verification	Employee handbook, list of employee’s receiving handbook.
References	10

2.9 Employee Meetings ^F

Purpose	Regular company meetings help build employee unity.
Verification	Meeting agendas and/or signup lists.
References	5, 10

2.10 Salary Survey Participation ^F

Purpose	Staying current with industry norms for salaries is important in determining fair wages for employees.
Verification	Copies of surveys.
References	10

2.11 Sustainability Bonus System ^F

Purpose	Material recognition of employees for sustainable practices is an incentive for continual improvement within the farming operation.
Verification	Copy of sustainability bonus policy for farm.
References	10

Chapter 3: Soil Management

3.1 Nutrition Management Plan ^F

Purpose	The nutrient management plan is the foundation of the vineyard nutrition program and ensures the optimization of nutritional inputs to the vineyard.
Verification	Written nutrition management plan
References	8, 16, 18, 19, 41

Use the following guidelines and example to help develop your Nutrition Management Plan.

The issues below are to be used as guidelines while you develop your own nutrient management plan. The goal of a nutrient management plan is to determine how much fertility your vineyard needs to produce the crop quality that you want and not adversely affect the environment or the economics of production. Not all of these guidelines may apply to you, but try to be as thorough as possible.

1. Field Parameters:

- Field Map:
- Soil series:
- Acres of property/farm/vineyard:

2. Soil Analysis:

- Soil analysis taken from the area around the roots:
- List any soil composition deficiencies from soil analysis:

(For suggestions on soil sampling technique and interpretation of soil analyses results see pg. 17, 26 - 28 in the *Lodi Winegrower's Workbook*)

3. Water Analysis:

- What is your water contributing to the nutritional balance of your soil?
Example: PPM of Nitrogen in water (see Table 4 below):

(Irrigation water might affect the levels of nitrate, bicarbonate, pH, salinity, EC, suspended solids, chlorides, boron, manganese and magnesium):

4. Petiole Analysis:

- Petiole analysis at bloom time:
- Petiole analysis at any other time:
- List any nutrient deficiencies from petiole analysis:

(For suggestions on petiole sampling technique and petiole analyses results see pg. 26 - 28 in the *Lodi Winegrower's Workbook*)

5. Yield:

- Historical: ____ tons per acre averaged over the last ____ years.
- Estimated Yield for coming year [based on weather, crop maturity, bunch counts, nutritional status, vine vigor, etc. (update as conditions change)]:

6. Sources and Forms of Nutrients:

- Type of cover crop:
(Note: see below for proper cover crop analysis procedures and N calculations)
Weight of sample:
% dry weight N content:
% moisture content:

N Contribution from cover crop (see Table 7 below):
Is it mowed or disked?
- Type of natural fertilizer (i.e. compost, etc.)¹:
Tons applied:
Nutritional analysis:
Nitrogen contribution:
How well is it composted (Raw compost has more N content see Table 6; well composted material might tie up N see Table 5)?
- Type of mined or non-biological fertilizer:
Nutritional analysis:
How is it applied (fertigate, shank, etc.)?
- List any other sources of nutrition:
Nutritional analysis:
- Nutrients removed with harvest (see Table 3):
- Nutrients incorporated into root and trunk growth (5-10% of that removed with harvest):

7. Sensitive areas:

- Predominant wind direction:
- Water table depth:
- Vineyard irrigation system (micro, furrow, flood, sprinkler):
- Potential for leaching based on soil type and water table:

Adjacent areas of concern (i.e. wetlands, well heads, residences, schools):

Type:	Proximity to vineyard:	Buffer present:
Type:	Proximity to vineyard:	Buffer present:

Areas that may need extra attention

- List any unproductive regions of field:
- List any overly vigorous regions of field:
- List any regions with poor water drainage:
- List any areas with very shallow top soil:

¹ For a list of pros and cons of compost and manures see pg. 32 in the *Lodi Winegrower's Workbook*.

8. Recommended rates.

- Based on the nutrients available to the vines, the amount removed with harvest, and the vineyard vigor, estimate how much you should apply so that vines are balanced, leaching is minimized, and nutrients are not over or under applied:

N: P: K: B: Zn:
Micronutrients:

9. Recommended timing.

- Based on the Recommended Rates, what type of fertilizer will you apply to your vineyard?
- What time of year will you apply?
- How many times during the year?

10. Recommended methods.

- Where will it be applied (below dripper, row middles, etc.)?
- Will the irrigation system be used to apply?
- Who will apply if someone from your operation won't be doing the application?
- What equipment will be used?
- What factors will you use to adjust application date or method and how will they change (i.e. slope, rainfall patterns, soil type, etc.)?

11. Annual review and update. (To be done before starting your fertility program for the following year)

- What were your actual application rates?
- When did you actually apply?
- How did you actually apply?
- What material was actually used?
- What was your tonnage?
- Was the fertility enough, too much, just right for your crop and quality goals?
- What events caused deviation from the plan (weather, lack of labor, crop maturity, etc.)?
- Reflect on these deviations from you plan and update or change components to better predict next season.

Tables to help with above calculations:

Table 3	Pounds per acre removed with harvest				
Tons/acre	N	P	K	Ca	Mg
1.0	2.9	0.6	4.9	1.0	0.2
1.5	4.4	0.8	7.4	1.5	0.3
2.0	5.8	1.1	9.9	2.0	0.4
2.5	7.3	1.4	12.4	2.5	0.5
3.0	8.8	1.7	14.8	3.0	0.6
3.5	10.2	2.0	17.3	3.5	0.7
4.0	11.7	2.2	19.8	4.0	0.8
4.5	13.1	2.2	22.2	4.5	0.9
5.0	14.6	2.8	24.7	5.0	1.0
5.5	16.1	3.1	27.2	5.5	1.1
6.0	17.5	3.4	29.6	6.0	1.2
6.5	19.0	3.7	32.0	6.5	1.3
7.0	20.5	4.0	34.4	7.0	1.4
7.5	21.9	4.3	36.8	7.5	1.5
8.0	23.4	4.6	39.2	8.0	1.6
8.5	24.9	4.9	41.6	8.5	1.7
9.0	26.4	5.2	44.0	9.0	1.8
9.5	27.8	5.5	46.4	9.5	1.9
10.0	29.3	5.8	48.8	10.0	2.0

Table 4	Amount of Nitrogen per acre foot of irrigation water						
PPM	Lbs N /acre ft	PPM	Lbs N /acre ft	PPM	Lbs N /acre ft	PPM	Lbs N /acre ft
1	2.7	11	29.7	21	56.7	31	83.7
2	5.4	12	32.4	22	59.4	32	86.4
3	8.1	13	35.1	23	62.1	33	89.1
4	10.8	14	37.8	24	64.8	34	91.8
5	13.5	15	40.5	25	67.5	35	94.5
6	16.2	16	43.2	26	70.2	36	97.2
7	18.9	17	45.9	27	72.9	37	99.9
8	21.6	18	48.6	28	75.6	38	102.6
9	24.3	19	51.3	29	78.3	39	105.3
10	27	20	54	30	81	40	108

Table 5	Amount of Nitrogen applied with Compost (well-composted)									
	% N of in Compost									
	1	2	3	4	5	6	7	8	9	10
Tons per acre	Lbs of nitrogen applied per acre									
0.5	2	4	6	8	10	12	14	16	18	20
1	4	8	12	16	20	24	28	32	36	40
1.5	6	12	18	24	30	36	42	48	54	60
2	8	16	24	32	40	48	56	64	72	80
2.5	10	20	30	40	50	60	70	80	90	100
3	12	24	36	48	60	72	84	96	108	120
3.5	14	28	42	56	70	84	98	112	126	140
4	16	32	48	64	80	96	112	128	144	160
4.5	18	36	54	72	90	108	126	144	162	180
5	20	40	60	80	100	120	140	160	180	200
5.5	22	44	66	88	110	132	154	176	198	220
6	24	48	72	96	120	144	168	192	216	240
6.5	26	52	78	104	130	156	182	208	234	260
7	28	56	84	112	140	168	196	224	252	280
7.5	30	60	90	120	150	180	210	240	270	300
8	32	64	96	128	160	192	224	256	288	320
8.5	34	68	102	136	170	204	238	272	306	340
9	36	72	108	144	180	216	252	288	324	360
9.5	38	76	114	152	190	228	266	304	342	380
10	40	80	120	160	200	240	280	320	360	400

Table 6		Amount of Nitrogen applied with Compost (Fresh incorporated)									
					% N of in Compost						
		1	2	3	4	5	6	7	8	9	10
Tons / acre	Lbs of Nitrogen applied per acre										
0.5	6	12	18	24	30	36	42	48	54	60	
1	12	24	36	48	60	72	84	96	108	120	
1.5	18	36	54	72	90	108	126	144	162	180	
2	24	48	72	96	120	144	168	192	216	240	
2.5	30	60	90	120	150	180	210	240	270	300	
3	36	72	108	144	180	216	252	288	324	360	
3.5	42	84	126	168	210	252	294	336	378	420	
4	48	96	144	192	240	288	336	384	432	480	
4.5	54	108	162	216	270	324	378	432	486	540	
5	60	120	180	240	300	360	420	480	540	600	
5.5	66	132	198	264	330	396	462	528	594	660	
6	72	144	216	288	360	432	504	576	648	720	
6.5	78	156	234	312	390	468	546	624	702	780	
7	84	168	252	336	420	504	588	672	756	840	
7.5	90	180	270	360	450	540	630	720	810	900	
8	96	192	288	384	480	576	672	768	864	960	
8.5	102	204	306	408	510	612	714	816	918	1020	
9	108	216	324	432	540	648	756	864	972	1080	
9.5	114	228	342	456	570	684	798	912	1026	1140	
10	120	240	360	480	600	720	840	960	1080	1200	

Table 7 Cover crop N analysis		
Cover Crop	Disked lbs / acre	Mowed lbs / acre
No	0	0
Poor	21	15
Good	49	35
Great	84	60

Cover crop analysis procedures:

Cut out a 3x3 foot sample area of your cover crop. Send a 1 pound sub sample to the lab for moisture content and dry weight N content analysis.

Example:	Weight of 9 ft ² sample	8 lbs
	Lab analysis of moisture content	82%
	Lab analysis of dry weight N content	2.8%
	Sample dry matter	100% - 82%
		= 18%

Calculation of N contribution from above cover crop:

8 lbs X 18% (0.18) dry matter	= 1.44 lb dry matter / 9 ft ² area
1.44 lb dry matter X 2.8% (0.028) N	= 0.04032 lb N / 9 ft ²
0.04032 lb N ÷ 9 ft ²	= 0.00448 lb N / 1 ft ²
0.00448 lb N / 1 ft ² X 43,560 (1 acre)	= 195.1 lb N/planted acre of cover crop
Swath covers 50% of row	= 97.6 lbs N/ vineyard acre

Resources:

Ingels, C. A, Bugg, R. L., McGourty, G. T., Christensen, L. P., 1998, Cover Cropping in Vineyards: A Grower’s Handbook. University of California, Division of Agriculture and Natural Resources, Publication 3338.

Brown, P.H., Zang, Q., Stevenson, M., and Rosencrance, R.C., Nitrogen fertilization recommendation for almond. Last updated 11/12/04.

<http://fruitsandnuts.ucdavis.edu/almondNKmodel/almondNKmodel.htm>

3.2 Soil Series ^v

Purpose	Knowing the series of the vineyard soil provides access to important basic soil properties that will help in managing the soil’s chemical and physical properties.
Verification	Vineyard soil map
References	5, 8, 10, 16, 28, 41

3.3 Soil Analysis for Micronutrients ^v

Purpose	Soil sample analyses can be used to diagnose general soil and nutrient problems. Optimum timing frequency to sample soil for micronutrients is different than it is for soil macronutrients requiring a separate standard for each.
Verification	Copy of soil analyses report
References	5, 8, 10, 16, 28, 41

3.4 Soil Analysis for Macronutrients ^v

Purpose	Soil sample analyses can be used to diagnose general soil and nutrient problems. Optimum timing frequency to sample soil for macronutrients is different than it is for soil micronutrients requiring a separate standard for each.
Verification	Copy of soil analyses report
References	5, 8, 10, 16, 28, 41

3.5 Plant Analysis ^v

Purpose	Analyses of plant tissue samples indicate what elements the vines have enough of and what ones are limiting and therefore need to be supplemented.
Verification	Copy of petiole or leaf blade sampling records and lab analyses
References	5, 8, 10, 16, 28

3.6 Monitoring Water Quality ^v

Purpose	Many ground water sources in the Central Valley contain a significant amount of nitrogen in the water. If this is the case it is important that this is taken into account in the vineyard nutrient management plan to prevent excess nitrogen fertilization.
Verification	Water monitoring records and lab analyses records
References	10, 28

3.7 Nitrogen Application ^v

3.7.1 In my vineyard, petiole analyses, water quality analyses, crop/pruning ratio, and visual inspection of the canopy indicate sufficient vine balance and vigor and no additional Nitrogen inputs are needed.

Purpose	One soil management goal is to create a sustainable vineyard system that requires no nitrogen input due to the presence of the right combination of cover crops, soil microbial community, vine balance, etc. Because some nitrogen is removed from the vineyard with the crop, this may not be achievable on many sites and in many years. However, it is a goal nevertheless. Nitrogen should only be added if there are not adequate amounts being provided by the soil, cover crop and/or irrigation water.
Verification	Copies if tissue analyses, water analyses and canopy monitoring and nutrient input records.
References	10, 19, 28

3.7.2 Source of nitrogen fertilizer.

Purpose	From a sustainable perspective, the best sources of nitrogen are biological in origin such as from legume cover crop, fully processed compost, or grape pomace. That is because biological materials stimulate important soil processes and usually benefit the soil in other ways, such as increasing organic matter.
Verification	Fertilization records.
References	8, 10, 16, 19, 28, 41

3.7.3 I applied the following non-mined biologically sourced nitrogen to my vineyard:

Purpose	Biological sources of nitrogen vary in quality, particularly composts. Fully processed compost provides the lowest risk for leaching of nitrates. They also add organic matter. Compost quality is important but there is a wide range of opinions about what the quality parameters are. There are some programs that certify compost which helps ensure quality. However, some large growers make their own compost. As long as the components of the compost are suitable and the composting process has gone to completion, the quality of the compost should be acceptable.
Verification	Fertilization records.
References	10, 20, 28

3.7.4 If I apply non-mined, biologically sourced nitrogen as compost, manure, or pomace² (C/M/P):

Purpose	It is important to know the nutrient makeup of any biologically sourced nitrogen in order to add the proper amount of nitrogen to the vineyard.
Verification	Fertility analyses of the material applied to the vineyard
References	39

3.7.5 If I use synthetically-produced or mined nitrogen:

Purpose	It is important to only add nitrogen fertilizer when it is needed, to add it in amounts required by the vine, and at a time when the vine roots are taking up nitrogen to optimize the nitrogen application and minimize nitrate leaching.
Verification	Fertilization records.
References	20, 39

3.8 Amendments for Water Penetration^v

Purpose	If water penetration of the soil is not adequate, run-off will occur, causing soil erosion and also be a possible source of non-point source pollution.
Verification	Soil management records
References	5, 8, 10, 16, 28, 41

3.9 Amendments for pH^v

Purpose	Improper soil pH will adversely affect vine root nutrient uptake.
Verification	Soil sample analyses
References	10, 18, 28

3.10 Organic Matter (OM)^v

² Do not apply white grape pomace from vineyards infested with vine mealybug.

Purpose	The breakdown of soil organic matter by microbes promotes the formation of soil aggregates which enhances soil aeration as well as water and nutrient holding capacity of the soil.
Verification	Vineyard floor management records and/or records of compost or manure additions.
References	8, 10, 16, 19, 20, 28, 39, 41

3.11 Tillage of Vineyard Floor ^v

Purpose	Soil tillage breaks down soil structure and increases the respiration of soil organic matter which adversely affects soil aggregation.
Verification	Vineyard floor management records.
References	8, 10, 16, 20, 28, 41

3.12 Soil Erosion: Soil Conservation Plan ^v

Purpose	An essential component of a sustainable farming program is a soil conservation plan to minimize off-site movement of soil and water.
Verification	Soil conservation plan, vineyard site map, visual inspection, and vineyard floor management records.
References	10, 20, 28

Use the following a guidelines and example to help develop your soil conservation plan.

NOTE: NRCS’s planning strategy is governed by SWAPA+H. A good plan should take in consideration all of the following: Soil, Water, Air, Plants, Animals and Humans.

Vineyard’s Name:

Site Description:

Describe your vineyard site. Include: acres, location, adjacent land, roads, avenues, row orientation, any non-crop vegetation, irrigation system, water source, row middle, etc. NRCS prefers their plans to be written as a narrative. You may wish to use portions of similar descriptions found in your Sustainability Vision Plan (Standard 1.1), Soil Conservation Plan (Standard 3.12), Nutrient Management Plan (Standard 3.1), Spray Drift Management Plan (Standard 6.18.4), etc. if they pertain to this property.

Soil Description:

Describe the soil type, its drainage aspects, permeability, water holding capacity, runoff potential, etc.

Current Management Practices:

What are the current management practices (other than irrigations practices) that you are employing to reduce irrigation runoff, wind erosion, water erosion, etc.? Describe the specific practices and how they will benefit air, water, and soil quality. Describe the time of year when a specific practice is done.

Water Erosion:

What are the irrigation/water management practices that you are employing to reduce irrigation and storm water runoff. Also indicate, if runoff were to occur, where it would go.

Air Quality:

Describe practices that you employ that reduce air pollution from dust, machinery, etc.

Note: also see Spray Drift Management Plan and Ecosystem Plan

Plant / Animal:

Note: see Ecosystem Sustainable Vision and Plan (Standard 1.1), Environmental Survey (Standard 1.3), Economic Threshold Plan (Standard 6.2), Soil-borne Pest Plan (Standard 6.15.1), Weed Management Plan (Standard 6.16.1), and Vertebrate Management Plan (Standard 6.17.1)

Human:

Note: see Human Resources Plan (Standard 2.1), Sustainability Statement, and Ecosystem Sustainability Vision and Plan (Standard 1.1).

Example Soil Conservation Plan:

Lodi Wine & Visitor Center Demonstration Vineyard Soil Conservation Plan:

Site Description:

The LWWC Demonstration vineyard is located at 2545 West Turner Road in Lodi, California. It encompasses one tenth of an acre. The vineyard is bordered to the south by Turner road, to the east by the Lodi Wine & Visitor Center parking lot, and to the north and west by the Katzakain City Park lawn. There is a public path through the center and a 24 ft by 15 ft utility pad surrounded by a grape stake fence in the SE corner. A landscaped area of drought tolerant vegetation runs along the entire southern end of the vineyard between the vines and the road. Vineyard rows are aligned in a north south fashion and are drip irrigated. Water is provided from the water system at Katzakain Park. Cover crop is present in row middles and rose bushes border both sides of the center path at row ends. The slope is zero and runoff potential is very low. The soil is Hanford sandy loam.

Soil Erosion Prevention Procedures:

1. Vineyard is planted on very flat sandy loam soil.
2. Minimum tillage is practiced.
 - a. Type of implement used: The only soil implement used during the four years since vineyard establishment, has been a hand hoe used for weed removal directly under the vines.
 - b. Time of year implement is used: Year-round -- once a month during the summer and early fall and every two weeks during the late fall, winter and spring.
3. A permanent cover crop is present between vine rows.
 - a. Type of cover crop: Several different cover crop species are being used including the following: big three grass mix, habitat blend, and a leguminous mix.
 - b. Cultural procedures used for cover crop: These cover crops were planted in the spring of 2004 and have been allowed to reseed themselves. They are not mowed down, but allowed to die-back naturally.
4. Drip irrigation is used to minimize water use and runoff.
5. When irrigating, runoff never occurs.
6. Mulch is created from rose and landscape prunings from around the vineyard and is used along the eastern border to inhibit water movement into the parking lot area.
7. The center path is covered with decomposed granite and creates very little dust even on windy days.
8. Grape pomace is spread under the vines and in the vine rows during the fall.
9. Composted chicken manure is added to the soil to improve soil nutrition, tilth and water penetration.

Adjacent Areas to Property that could be affected by Runoff:

Any runoff that occurs to the north or west will be carried away from the vineyard and into Katakain Park lawn. Any runoff that occurs to the east will be carried away from the vineyard and into the Wine and Visitor Center parking lot and down to the Turner Road storm drain. The landscaping berm to the south of the vineyard will prevent any runoff from occurring in that direction.

3.13 Cover Cropping to Minimize Soil Erosion ^v

Purpose	A cover crop provides multiple benefits to the vineyard, but in particular it minimizes off-site movement of soil and water. A California native grass is the best suited plant species for a permanent cover crop because it has evolved with the local rainfall patterns and goes dormant in the summer so it does not compete with the vines for nutrients and water during that period.
Verification	Vineyard floor management records, visual inspection
References	10, 20, 28

Chapter 4: Water Management

4.1 Irrigation System ^v

Purpose	Low volume irrigation systems, particularly drip, result in the most efficient use of water in a vineyard and also provide the most flexibility regarding regulating the timing and amount of water provided to the vines. This is particularly important for producing the highest quality winegrapes in Lodi.
Verification	Vineyard site map and visual inspection. For dry farmed vineyards - records of soil moisture monitoring that indicates adequate water availability.
References	5, 10, 28, 36

4.2 Irrigation Pumps ^v

Purpose	Water is brought to many Lodi vineyards using a pump. Solar powered pumps have become an economically viable option for many vineyards and are the most sustainable regarding energy production and consumption.
Verification	Vineyard records, visual inspection
References	www.renewable.com , 10, 43

4.3 Offsite Irrigation Water Movement ^v

Purpose	Off-site movement of water is a significant source of non-point source pollution in surface water and can result in significant soil loss depending on soil type, slope, etc.
Verification	Vineyard floor management records, visual inspection
References	10, 20, 28

4.4 Irrigation System Maintenance ^v

4.4.1 Maintenance for Low Volume Irrigation Systems ^v

Purpose	Low volume systems are expensive to install and highly engineered. For proper performance, it is necessary that filters, lines and emitters are operating as designed without interference from clogging, leaks or breaks.
Verification	Irrigation system maintenance records
References	5, 10, 28, 36, 38

4.4.2 Maintenance for Sprinkler Systems^V

Purpose	Sprinkler systems are expensive to install and highly engineered. For proper performance it is necessary that filters, lines and sprinkler heads are operating as designed without interference from clogging, leaks or breaks.
Verification	Irrigation system maintenance records
References	5, 10, 28, 36, 38

4.4.3 System Maintenance for Surface Irrigation Systems^V

Purpose	Irrigation system leaks waste water and can result in significant off-site movement of water contributing to non-point source pollution.
Verification	Irrigation system maintenance records
References	10, 28, 36, 38

4.4 Distribution Uniformity^V

Purpose	It is important that irrigation water is distributed evenly throughout the vineyard so that the vine canopy, yield and fruit quality are uniform throughout the block. Crop uniformity is one of the most important parameters influencing wine quality.
Verification	Irrigation system maintenance records
References	5, 10, 28, 33, 36, 38

4.6 Flow Meters^F

Purpose	Flow meters provide an accurate measure of the amount of water being applied to the entire vineyard so that proper irrigation and efficient water use is achieved.
Verification	Irrigation system maintenance records
References	5, 10, 28, 36, 38

4.7 Pump Efficiency^V

Purpose	Optimizing pump efficiency is important because it will ensure the best cost/benefit ratio for moving water to the vineyard and also provide the highest energy efficiency.
Verification	Irrigation system maintenance records
References	6, 10, 28, 36, 38

4.8 Soil Water-Holding Capacity ^v

Purpose	Knowing soil water holding capacity and annual rainfall is essential for developing a water budget, proper irrigation initiation in the spring/summer and subsequent irrigation scheduling later in the growing season.
Verification	Water-holding capacity records
References	10, 28, 33

4.9 Irrigation Initiation and Scheduling ^v

Purpose	Timing of irrigation initiation and subsequent scheduling is critical to ensure that irrigation the vines receive water at the right times to ensure the highest winegrape quality.
Verification	Irrigation scheduling records
References	10, 28, 33, 36, 38

4.10 Water Budget ^v

4.10.1 Water Budget for Fully Mature Vines ^v

Purpose	Calculating and using a water budget ensures that the vines receive the amount of water determined adequate to meet the yield and fruit quality goals set for the vineyard. Furthermore, irrigation management has been shown to significantly improve wine quality in many varieties grown in Lodi. This can only be achieved through developing and implementing a water budget.
Verification	Irrigation scheduling records
References	10, 28, 30, 31, 32, 33, 36, 38

4.10.2 Water Budget for Young/Newly Planted Vines ^v

Purpose	For long-term health and productivity of a vineyard it is important that newly planted vines receive adequate water to establish a healthy root system and canopy. Adequate water being defined as giving the vines as much as required to maintain full evapotranspiration.
Verification	Vine and soil water monitoring records and irrigation scheduling records
References	30, 31, 32, 33, 36, 38

4.11 Fertigation ^v

Purpose	Adding fertilizers through the drip irrigation system allows for careful control of the amount of fertilizer provided to each vine as well as the timing of the application, ensuring optimized use of the fertilizer and minimal off-site movement.
Verification	Fertilization and irrigation records
References	10, 28, 30, 31, 32, 33, 36, 38

Chapter 5: Vineyard Establishment

5.1 Soil profile inspection ^v

Purpose	Grapes are deep rooted plants and a compacted soil layer within the potential rooting zone can have significant negative impacts on vine health, vineyard growth and production. It is important to thoroughly inspect the soil profile before planting the vineyard to identify any soil compaction layers that could interfere with vine growth.
Verification	Farm management records.
References	5, 8, 10, 16, 28, 41

5.2 Soil profile modification ^v

Purpose	If a soil compaction layer is identified, it is important to break it up if possible.
Verification	Farm management records.
References	5, 8, 10, 16, 28, 41

5.3 Soil tested for chemical properties and amended pre-planting ^v

Purpose	Soil chemical properties greatly affect the soils ability to hold and transfer nutrients to the vines. If necessary, some of these properties can be made more amenable to vine growth if diagnosed and amended.
Verification	Farm management records.
References	10, 28, 41

5.4 Soil sampled for biological problems pre-planting ^v

Purpose	It is important to identify any significant biological problems in the soil before establishing the vineyard. It may help determine the rootstock that should be used at the site. It may also show that no problems exist so it is not necessary to take any actions.
Verification	Farm management records.
References	10, 13, 28, 41

5.5 Addressing soil biological problems pre-planting (skip and take 3 points if soil sample revealed no problems) ^v

Purpose	If a soil biological problem is identified prior to establishment of the vineyard, it is important that this problem is addressed.
Verification	Farm management records.
References	10, 13, 28

5.6 Rootstocks ^v

Purpose	Matching rootstock to vineyard soil pest problems and soil properties is essential for the long-term sustainability of the vineyard.
Verification	Farm management records.
References	8, 10, 13, 25, 28

5.7 Scion ^v

Purpose	Many virus problems can remain asymptomatic until triggered by some environmental stress. Just because the vines that are going to be used for budwood look healthy, does not mean they are virus-free. Using certified scion material is the best way to minimize future virus problems.
Verification	Certificates from nursery or source of scion material
References	8, 10, 13, 25, 28, 29

5.8 Grafting vines to change varieties ^v

Purpose	Many virus problems can remain asymptomatic until triggered by some environmental stress. Just because the vines that are going to be used for budwood look healthy does not mean they are virus-free. Using certified budwood is the best way to minimize future virus problems.
Verification	Certificates from source of budwood.
References	10, 25, 28, 29, 41

Chapter 6: Pest Management

6.1 Vineyard monitoring for insect, mite, and disease pests ^v

Purpose	Regular pest monitoring and keeping written monitoring records are the foundation of a vineyard IPM program.
Verification	Pest monitoring records.
References	10, 13, 14, 15, 17, 28

6.2 Economic thresholds and natural enemy ratios for insect, and mite pests ^v

Purpose	It is important that a treatment action for an insect or mite pest is only taken if the cost of the action does not exceed the damage that the pest will cause if no action is taken. If important pest natural enemies are present, then their numbers need to be taken into consideration when deciding whether a treatment action should be taken.
Verification	Economic threshold plan on file.
References	10, 13, 14, 15, 17, 23, 28

Use the following guidelines and example to help develop your economic threshold plan.

Background

An economic threshold is the level of a pest population whereby if it is exceeded the economic damage the pest will cause will be greater than the cost of the control used to keep the pest below that level. These guidelines primarily apply to leafhopper and spider mite pests (Willamette and Pacific mite) because their populations can be quantified relatively easily compared to most other vineyard insect pests, and their populations can readily be reduced if necessary. The basic concepts apply to other types of vineyard pests with the exception of most diseases. Diseases are an exception because once they infect grape tissue they cannot be eliminated from this tissue. Therefore the approach to disease management involves doing things to minimize sources of fungal spores and spraying a protective fungicide if conditions are conducive to fungal spore germination.

Elements of an Economic Threshold Plan for Leafhoppers and Mites:

The impact of damage to grape vines and fruit caused by leafhoppers and mites is affected by several things, which should be considered when making a control decision. In other words they should be a part of an economic threshold plan.

Written monitoring record

Keeping a written monitoring record for mites and leafhoppers provides a way to accurately compare the monitoring from one week to another, one scout to another, one vineyard to another, and one year to another. These records are required for the vineyard to be certified.

- Indicate how often you will keep a written record.
- What will you record? Numbers? Population levels?
- Will you include comments?
- What will you record your monitoring with? Paper? PDA? GPS?
- How often will you review your records?

Location of the monitoring

Leafhopper and mite populations tend to be higher on edge vines so to get an accurate measure of their populations throughout the vineyard monitoring should be done at least 5-10 vines in from the edge. If high numbers of mites or leafhoppers exist only on the edge, then these areas can be spot treated.

Leafhoppers and especially mites can be patchy in their distribution. There is no point in treating a whole vineyard for a problem that only occurs in one spot. Therefore pest counts should be made in more than one part of the vineyard. Dividing the vineyard into quarters seems to work well.

For the first half of the season, mites and leafhoppers feed on the leaves on the basal half of the cane with the highest numbers occurring on the 4 to 6 leaves adjacent to the cordon. Monitoring for these pests should be done using these basal leaves to spot any problems early on.

Furthermore, if few or no leafhoppers or mites are present on the basal leaves, one can be confident the vineyard does not have a leafhopper or mite problem.

- Indicate what part of the vineyard you will monitor. Will you divide the vineyard into sections, quadrants, halves?
- What part of the canopy will you monitor at what time of the year?
- Will you pull leaves, pull bark?
- How many leaves per section?

Frequency of monitoring

Monitoring leafhoppers and mites once every week to 10 days from May to August is the best way to identify problems early so they can be watched and acted upon if necessary. More importantly, it provides for a window of time to see if the populations will decline due to factors like natural enemies, thereby making a treatment unnecessary. Monitoring every 14 or more days is not frequent enough to make sound pest management decisions based on economic thresholds because the pest populations could change too much during that period.

- How often will you monitor?
- Are you monitoring frequency dependent on the time of year or level of pest pressure?
- When will you start or stop monitoring during the year?

Level of the pest population

The best measure for leafhopper populations is number of nymphs (wingless immatures) per leaf. Since grape leafhopper and variegated leafhopper cause the same type of damage their counts do

not need to be kept separate. Keep in mind that the shed skin of the final nymphal stage remains attached to the leaf. So when counting nymphs, be sure you are counting a live insect and not a shed skin! It can also be important to assess the number of adults (fliers) present. A high population of adults can cause significant leaf damage within a few days.

The best measure for spider mite populations is percent leaves with mites on them (i.e. a presence/absence measure). Some people use numbers of mites per leaf as a measure using categories like <1; 1-10; >10.

- Indicate your method for estimating pest population.
- What life stage will you count? Nymphs? Adults? Eggs? Larvae?
- Will you measure presence/absence or count the number of individuals observed?

Presence of natural enemies

Anagrus wasps are very effective at keeping grape leafhopper populations in check. If a moderate leafhopper population exists early to mid-season (e.g. 5-8 nymphs per leaf) but many leafhopper eggs in the leaf tissue are parasitized (>30%), it is probable that the level of the next generation of leafhoppers will be very low.

The western predatory mite is very capable of reducing moderate mite populations and preventing them from becoming serious problems. If 50% or more of the leaves have mite predators present, then it is likely that the mite population will decline.

- Will you count natural enemies? How?
- What will you count?

Amount of leaf damage present

This is particularly important for leafhoppers. A moderate number of nymphs per leaf (say 5-10) on vines with very low leaf damage will likely not cause significant economic damage whereas this same number of nymphs on vines with moderate to high leaf damage will likely significantly affect the vines and fruit.

Research on Thompson seedless grapes has shown that 20% leaf damage (20% of the leaves removed) does not affect yield, indicating that vines can sustain some damage without be adversely affected.

- Will you record damage? To leaves? Fruit? Canopy? Canes? Roots?
- Indicate the level of damage that you won't accept.
- How will damage level influence your decision to take a control measure?
- Does it matter what time of year the damage is occurring?

Time of year

A moderate to high level of leafhopper nymphs or mites just before harvest are much less of a problem than the same levels early or mid-season.

Size of vine canopy

This is particularly relevant to vertically shoot positioned vineyards with good vine balance. There are fewer leaves adjacent to bunches in a VSP vineyard so significant damage to any of these leaves increases the likelihood of sunburn. Furthermore, if a vine is balanced, it has less leaf surface area and pest damage can occur before the fruit is affected. So, a mite or leafhopper economic threshold would be lower in a VSP vineyard, or a vineyard with another trellis type with good vine balance, when compared to a vigorous vineyard with another trellis type.

- How do canopy vigor and size influence your decisions?
- How does the trellis influence your decision?
- How does worker comfort influence your decision?

Variety

It is possible some varieties are more affected than others by leafhopper and mite damage, although there is no research to back this up. A more certain effect is time of ripening. A moderate mite or leafhopper population in July is much less threatening to an early harvested variety like Chardonnay or Zinfandel going to a white program, as compared to a late ripening variety like Cabernet Sauvignon.

- Does variety play a roll in your decision to make a control measure? If so, how?
- Does price or tonnage? If so, how?

Treatment timing

In general, leafhoppers are most susceptible to pesticides when they are in their early nymphal stages (1 and 2) and least susceptible when they are adults or in the egg stage. Therefore, the optimum time to treat is when there are the fewest number in the adult and egg stage.

In general, mites are least susceptible to miticides in the egg stage, unless the material acts as an ovicide (egg killer). Therefore, if there are more eggs than adults present, it is best to wait until these eggs hatch before treating.

-
- Will you target the most susceptible stage of the pest population? If so, in what way?
- Will you base your control decision on the life stage of the pest? If so, in what way?
- How will natural enemy populations influence your decision making process?

Example Economic Threshold Plan

Note: This example plan is based on the knowledge gained during 8 years of weekly monitoring for leafhoppers and mites in the 70 Biologically Integrated Farming Systems (BIFS) vineyards in the Lodi region. Assume that the vineyard is a bilateral cordon on a T trellis system.

Economic Threshold Plan Goals:

- To make pest management decisions based on quantitative data collected on a timely basis.
- To make sound pest management decisions based on knowledge of the vineyard, the pests and, where appropriate, their natural enemies.

- To help me choose control strategies that minimize economic, environmental and health risks.

Frequency, timing, locations and counting:

I begin monitoring my vineyard every 7 to 10 days after budbreak for leafhoppers and mites. I divide the vineyard into 4 quadrants (northeast, northwest, southeast and southwest) and take 10 basal leaves from vines at least 10 vines in from the vineyard edge in each of these quadrants. I take each leaf from a different vine. Using the same leaves for mites and leafhoppers I count the number of leafhopper nymphs on each leaf and record the average over the 10 leaves. I note what percentage of the 10 leaves have mites on them a record this number. If I don't feel comfortable with the counts obtained from the 10 leaves I do 10 more.

When mites are present I also look for mite predators and if found, record their numbers in percent leaves with mite predators. If there are 5-10 leafhopper nymphs per leaf in the first leafhopper generation (May-June), I use a hand lens to look for leafhopper eggs parasitized by *Anagrus*. If I see any, I make note of this.

I also sample some leaves along the vineyard edges in each quadrant looking for edge hot spots making a note of their location if found.

Treatment Thresholds and Timing- Leafhoppers

1. I only treat leafhoppers in the first generation (May – June) if numbers exceed 10 nymphs per leaf and significant leaf damage is occurring.
2. I do not treat at any time of the season if there are 5 or less leafhopper nymphs per leaf with the following exceptions:
 - a. There are 4-5 nymphs per leaf and moderate to high leaf damage and it is more than 3 weeks to harvest.
 - b. There are 4-5 nymphs per leaf, moderate leaf damage and the vine canopy is in balance with minimal leaf area available to lose to damage.
 - c. There is moderate to high numbers of leafhopper adults and it is more than 3 weeks to harvest.
3. If adult leafhopper numbers are high and significant leaf damage is occurring I treat regardless of the time of year or time to harvest.
4. I treat vineyard edges in areas where leafhopper nymphs per leaf exceed 10 and/or leafhopper adult numbers are high and significant leaf damage is occurring.
5. If only a portion of the vineyard exceeds the above thresholds and I can treat only that portion of the vineyard then I do so.
6. When a treatment is made I time it so that nymphs are the most abundant life state and few adults are present to maximize the efficacy of the spray.

Treatment Thresholds and Timing – mites

1. I do not treat for mites if 50% or less of the basal leaves have mites.

2. I do not treat for mites if 60% or less of the basal leaves have mites and mite predators are present on at least 20% of the leaves.
3. I treat for mites if 70% or more of the basal leaves are infested, mites are occurring on leaves on the outer half of the canes, significant leaf damage has occurred, and there is more than 2 weeks to harvest.
4. I wait a week if 70% or more of the basal leaves are infested with mites and little leaf damage has occurred yet.
5. I treat vineyard edges if mite numbers exceed 70% infested leaves and significant leaf damage is occurring on edge vines.
6. If only a portion of the vineyard exceeds the above thresholds and I can treat only that portion of the vineyard, then I do so.
7. When a treatment is made I time it so that as few eggs are present as possible to maximize the efficacy of the spray.

Other insect pests:

During the regular monitoring of the vineyard for leafhoppers and mites I also keep an eye out for other less common pests such as omnivorous leafroller and grape leaf folder and make a note of what I do or do not see. My vineyard does not normally have an OLR problem. If bunch rot is a problem, I examine bunches to look for evidence of OLR activity.

Review and Update:

Every year I will review and, if necessary, update my economic threshold plan. I will also review the following questions:

1. Which control methods were effective?
2. Which control methods were not effective and why?
3. Did any unanticipated events affect the outcome?
4. Were there any surprise successes?
5. Were there any side effects?
6. What were the costs and benefits?

6.3 Economic threshold for leafhoppers^V

Purpose	If a leafhopper spray was not necessary, it means that you created a system in the vineyard that keeps their numbers in check. It is important the if spraying is done for leafhoppers, it only occurs when the economic threshold for this pest is exceeded.
Verification	Pesticide use reporting records.
References	10, 13, 14, 15, 17, 28

6.4 Economic threshold for spider mites^V

Purpose	If a mite spray was not necessary it means that you created a system in the vineyard that keeps their numbers in check. It is important that if spraying is only done, it only occurs when the economic threshold for this pest is exceeded.
Verification	Pesticide use reporting records.
References	10, 13, 14, 15, 17, 28

6.5 Prescriptive spraying^V

Purpose	Significant pesticide use reduction can be achieved by only treating areas of the vineyard where pest problems occur.
Verification	Pesticide use reporting records.
References	10, 13, 14, 15, 17, 28

6.6 Dust abatement for mite management within the vineyard^V

Purpose	Spider mite problems are made worse by dust from vineyard floor management activities.
Verification	Vineyard management records and visual inspection.
References	10, 13, 14, 15, 28

6.7 Dust abatement for mite management for on-farm roads, avenues and equipment yards^F

Purpose	Spider mite problems are made worse by dust from nearby roads.
Verification	Vineyard management records and visual inspection.
References	10, 13, 14, 15, 28

6.8 Dust abatement for mite management for headlands, ditches, roadsides, and avenues^F

Purpose	Spider mite problems are made worse by dust from exposed soil adjacent to vineyards.
Verification	Vineyard management records and visual inspection.
References	10, 13, 14, 15, 28

6.9 Training of employees for pest recognition^F (skip and take 2 points if no employees)^F

Purpose	Vineyard workers see many more vines more often than anyone else on the farm. If they are trained to recognize pest problems, vineyard pest monitoring will improve significantly.
Verification	Meeting agendas and signup lists.
References	10, 14, 17, 28

6.10 Vineyard sanitation for disease inoculum reduction ^V

Purpose	Diseased vine tissue and mummy fruit can produce fungal spores that can then infect healthy plant tissue and fruit in the vineyard. Removing infected tissue therefore, reduces disease inoculum in the vineyard.
Verification	Vineyard management records and visual inspection.
References	10, 13, 14, 25, 28, 29

6.11 Powdery mildew management ^{VF}

Purpose	There are several practices that can be implemented to better manage powdery mildew using an integrated approach.
Verification	Copy of powdery mildew management plan.
References	10, 13, 14, 28, 29

Use the following guidelines and example to help develop your powdery mildew management plan.

Powdery Mildew Preventative Measures:

Describe the cultural techniques that you employ to reduce powdery mildew infection risk. Use the following questions as guidelines to develop your Powdery Mildew preventative measures.

1. What canopy management techniques do you use to reduce powdery mildew infection risk (e.g. open canopy, trellis design, leaf removal, shoot thinning, cane trimming, pruning, vigor management, irrigation management, etc.)?
2. What disease forecasting techniques do you use to reduce powdery mildew infection risk (e.g. Grape Mildew Index from UC IPM, LWWC’s weather web page or a similar model, weather conditions from a local station, etc.)

Powdery Mildew Treatment Decision Factors:

Describe the factors that influence your decision of when to apply a preventative spray (e.g. sulfur, etc.) and when to apply an eradicant spray (e.g. Kaligreen, etc.). Use the following questions as guidelines for developing your treatment decision factors.

1. How often will you monitor your vineyard for powdery mildew? What will you monitor and how will you record the data. Will you have a scoring system for PM infestation?

2. What information do you use to determine whether to extend or shorten your spray intervals?
3. What threshold of powdery mildew infestation do you use to determine when to apply an eradicant spray?
4. How will the information from a disease forecasting model influence a decision?
5. How do your management techniques change with development stages (bud break, pre-bloom, bloom, post-bloom, veraison)?
6. Do you switch materials depending on vine development stage?
7. How does grape variety affect your management thresholds and application timing?
8. How does accumulated experience in the vineyard effect your management decisions?
9. How does the winery you sell to play a role in your decision making process?

Powdery Mildew Treatment Measures:

Describe the measures you will use when your decision factors dictate a treatment is necessary.

1. What chemicals will you use?
2. What time of year will you use certain chemicals?
3. What resistance management techniques will you use (see Table 18 for chemical modes of action)?
4. When will you stop your preventative applications?
5. Make reference to you Sulfur Drift Management Plan if using sulfur and you have developed a plan.

Review and Update

Indicate how often you will review and update your Powdery Mildew Management Plan and stick to this schedule.

Powdery Mildew Management Mission Statement

Your mission statement will go at the beginning of your plan, but it is located at the bottom of these guidelines to aid in developing the statement. Based on the above information, describe the reason for your Powdery Mildew Management Plan and how it will be used to achieve your overall sustainability goals and objectives.

Table 18. Modes of Action for Powdery Mildew Fungicides
<p>Resistance management is the responsibility of every winegrape grower. If the same fungicide is used often and repeatedly against a particular fungus then resistance to this fungicide will eventually occur. Resistance management is practiced by alternating a fungicide in one group of chemicals with others that are in chemical groups with different modes of action. There are several fungicides registered for powdery mildew and several more are in the process of being registered. These fungicides occur in several groups of chemicals with different modes of action. Therefore winegrape growers are in a good position to be able to practice resistance management. Listed below are the groups of powdery mildew fungicides that differ in their modes of action. Using a fungicide in one of these groups followed with a fungicide in another group would qualify as resistance management and should be practiced by every winegrape grower.</p>
<p>Sulfur: Sulfur has been used for 170 years without any signs of resistance and remains an effective, environmentally benign, and economic material for use against powdery mildew. The exact mode of action is not yet determined.</p>
<p>Sterol inhibitors (also known as SI's, DMI's, SBI's and EBI's): This group is represented by Bayleton, Rally, Rubigan, Procure, and Elite. They act by causing weak cell walls in the fungus resulting in fungal mortality.</p>
<p>Contact fungicides: This group is represented by light oils, fatty acids, and formulations of potassium or sodium bicarbonates. Kaligreen, Trilogy, and JMS Stylet Oil are registered products in this category. Water and a good wetting agent in combination with wettable sulfur are often used with these materials to eradicate powdery mildew. These materials kill the fungus by direct contact. The drawback with these materials is their short residual activity and the need for direct contact for control.</p>
<p>Biological Control Agents: This group was represented by AQ-10, which is actually a parasite of powdery mildew called <i>Ampelomyces quisqualis</i>. Early season use, before problems occur, has shown the best results. It is no longer registered for commercial use on winegrapes in California.</p>
<p>Strobilurins: This group is represented by Abound, Flint, and Sovran. Currently, only Abound and Flint are registered for use in California. These compounds are synthetic molecules which are based on extracts of a wood-rotting fungus and operate by inhibiting fungal respiration.</p>
<p>Fermentation products: This group is represented by Serenade. This fungicide is an actual fermentation product of a species of the bacteria <i>Bacillus</i>, which is found in the soil. It affects mildew by preventing spores from germinating, disrupts germ tubes and inhibits mildew from attaching to the leaf.</p>
<p>Systemic Acquired Resistance Elicitors (SAR's): This is a new group of materials that is being tested for use against powdery mildew which operates by stimulating the grapevine's own defenses. The grapevine can produce antifungal enzymes, make thicker cell walls, etc. which reduce the chance of infection by mildew. Messenger, Auxigo and Elexa are materials in this group that are being tested on grapes in California.</p>

Example Powdery Mildew Management Plan

Note: This example is for a typical vineyard in Crush District 11. Your plan may be more or less extensive.

Powdery Mildew Management Plan Goals:

- Provide a guide to help me make sound pest management decisions
- Optimize the cost of my mildew management program
- Prevent the development of resistance to the important mildew fungicides
- Reduce environmental impact of my mildew control program
- Prevent a powdery mildew infestation in my vineyard.

Powdery Mildew Preventative Measures:

- I have trained my vines to a modified quadrilateral with 36 inch cross-arms at cordon height (56 inch) and 42 inch cross-arms for the catch wires. This system allows the Syrah canopy to be open and the vigor is under relative control. I keep irrigation under check but don't overly stress the vines. I mechanically pre-prune the vineyard and later, I will go through with a hand crew and clean up the vines to two bud spurs. I do no leaf removal but thin out the weak shoots. I try to allow the clusters to be 50% exposed to sunlight
- I use the grape powdery mildew model (PMM) and calculate the risk index daily. I also note weather forecasts and plan ahead for any cooling or warming trends

Powdery Mildew Treatment Decision Factors:

- I begin monitoring my vineyard every 7 to 10 days after budbreak for the presence of powdery mildew. I divide the vineyard into 4 quadrants (northeast, northwest, southeast and southwest) and take 10 basal leaves from vines at least 10 vines in from the vineyard edge in each of these quadrants. I take each leaf from a different vine. I also scan the canopy for any leaf yellowing or other signs of powdery mildew damage as I walk. After berry set, I'll also examine the clusters more closely. I record the presence or absence of powdery mildew, the date and location in my PDA and later upload this information onto my pest monitoring database in my computer at home.
- **Spray Interval:** I will base my decision on whether to shorten or extend my spray interval on the PMM, the forecasted weather, and past experience.
 - Pre-bloom: I will only apply a fungicide after three consecutive days with six consecutive hours or more of temperatures between 70 and 85 F. Once this threshold has been met I will use only 21 day sprays even if PMM predicts shorter interval.
 - Bloom: just before bloom I will apply a different mode of action 21 day fungicide spray which should carry me through to berry set.
 - Post bloom: I will go to a 10-14 day wettable sulfur program based on the PMM risk prediction.
 - I will stop my fungicide applications at veraison or 12 degrees Brix.

• **Powdery Mildew Treatment Measures:**

- If powdery mildew is found in small scattered amounts on the exterior leaves and not the berries or interior leaves and the weather is predicted to be above 100 degrees F, I will wait to apply an eradicant, but watch the vineyard closely. For all other times when powdery mildew is found, I will apply an eradicant.
- I will rotate modes of action from one spray to the next within a year.
- I will also reference my Sulfur Drift Management Plan when making a sulfur application.

Review and Update: Every year I will review and update my Powdery Mildew Management Plan. I will also review the following questions:

1. Which control methods were effective?
2. Which control methods were not effective and why?
3. Did any unanticipated events affect the outcome?
4. Were there any surprise successes?
5. Were there any side effects?
6. What were the costs and benefits?

6.12 Decision When to Initiate Powdery Mildew Treatments for the Season^V

Purpose	Powdery mildew does not begin to develop spores in the spring until there has been 3 consecutive days with 6 or more hours of temperatures between 70 and 85 degrees F. At that point you have a week before the first spores are released.
Verification	Pesticide use reporting records.
References	10, 13, 14, 28

6.13 Timing of Powdery Mildew Treatments^V

Purpose	Powdery mildew development is driven by temperature. The Powdery Mildew Model indicates whether the disease pressure is light, moderate or severe. This information suggests whether the treatment interval is shortened or lengthened.
Verification	Pesticide use reporting records.
References	10, 13, 14, 28

6.14 Choice of powdery mildew fungicides for resistance management^F

Purpose	Rotating fungicides with different modes of action reduces the chances of powdery mildew developing resistance to a specific fungicide.
Verification	Pesticide use reporting records.
References	10, 13, 14, 28

6.15 Soil-borne pests^V

6.15.1 I have a written management plan for soil-borne pests, particularly nematodes and Phylloxera, that contains the components specified in the *Companion Document for Lodi Rules Appendix H*, and my vineyard practices are consistent with the plan.

Purpose	Soil-borne pests are best managed using integrated pest management.
Verification	Copy of soil-borne pest management plan and vineyard management records.
References	10, 13, 14, 15, 28, 29

Use the following guidelines and example to help develop your soil-borne pest management plan.

Management Goals

Begin by listing your soil-borne pest management goals. These are statements that generally describe the conditions you are trying to create on your property related to soil-borne pests and diseases. These goals describe the purpose and use of the property and what you are trying to achieve. Having clear management goals are key to developing a soil-borne pest management plan. (A management goal may be to reduce Phylloxera damage by using resistant rootstock. Another management goal may be to improve the soil ecosystem to prevent soil-borne pest outbreaks.)

Describe generally how soil-borne pests interfere with your overall farm management. Use this section to justify the use of labor and resources to eliminate or control certain soil-borne pest species in terms of your management goals, as well as legal requirements. Briefly describe how these species degrade the property, or could do so if allowed to proliferate.

Site Description

Include a site description and map of your vineyard site (you may use a site description from your Sustainability Vision Plan, Soil Conservation Plan, Nutrient Management Plan, Spray Drift Management Plan, or Environmental Survey).

- When planting or replanting, indicate in your site description what crop or vegetation, if any, previously existed on the site.
- Based on your soil analysis, indicate on your map areas of special concern or where any biological problems like Phylloxera or high nematode populations occur.

Soil Sampling Pre-Plant

Because parasitic nematodes are among the most common vineyard pests in the Lodi region, Armillaria root disease can remain in the soil for many years after trees have been removed, and there are indications of more virulent populations of Phylloxera, it is of primary importance to get a good soil analysis of all pest species and population levels present in your vineyard site before planting. It is especially important to have your soil analyzed if your proposed vineyard site has had a perennial crop in the past five years or it has recently lain fallow.

- Indicate when your last soil sample for biological problems occurred.
- What was found?
- What crop or vegetation was on the land before you decided to plant winegrapes?
- Do you have any high risk areas or problem areas (e.g. sandy spots, areas of a former perennial crop, etc.)?
- What management steps did you take to reduce your soil biological problems?
- What rootstock will you use?
- How often will you monitor your soil for pests?
- Review the viticulture chapter of the *Lodi Winegrowers Workbook* for guidelines to follow when taking a soil sample.
- Describe what preventative measures you have taken to reduce soil-borne pests from establishing in your soil.

Soil Sample Post-Planting

Because nematodes populations often recolonize quickly following incomplete fumigations, Armillaria root disease can remain undetected in decaying roots in the soil for many years even after planting a new crop, and any new Phylloxera problems need to be determined early, it is important to routinely get a good soil analysis of all pest species and population levels present in your vineyard site.

- If you didn't take a soil sample prior to planting your vineyard, indicate when you will take a soil sample.
- What was found?
- Are the new pests actually having an effect on your yield, quality, vines, or harvest date? Can you justify taking a management action?
- If control action is justified, what techniques will you use to manage the problem?
- What cultural practices do you employ to reduce or eliminate soil-borne pests?
- Indicate how often you will monitor your soil for soil-borne pests.

Resources

Statewide IPM Program, Agriculture and Natural Resources, University of California, 2004.
<http://www.ipm.ucdavis.edu/PMG/r302700111.html>

Example Soil-Borne Pest Management Plan

Management goals:

- To have healthy well drained soil that naturally resists pest outbreaks
- To maintain non-damaging levels of nematodes, Phylloxera, and other soil-borne pests and diseases
- To encourage beneficial soil organisms by increasing my soil organic matter

Soil pests can reduce the vigor of my winegrapes to a point where they are not producing a sustainable crop. Up to this point I have not dedicated any labor to my soil-borne pest problems after planting, but my tests indicate that a problem doesn't exist and I haven't noticed an abnormal reduction in my vine vigor or yeild. I have planted a cover crop of perennial native grasses and apply varying amounts of compost every year to increase soil fertility and organic matter.

Site Description:

See information from my environmental survey and the attached map.

Soil Sampling Pre-Plant:

See attached Soil Analysis.

From each quadrant of the vineyard, I took 5 core samples which were then combined and thoroughly mixed into one sample per quadrant. The cores were taken at a depth of three feet. I also took a few samples at the top and bottoms of the hill running through the vineyard and kept these separate from the other samples to see if there were any differences. My vines are planted on 5BB rootstock. Because the vineyard was planted into grazing land, composed mostly of annual grasses, I had relatively low soil biological problems so I decided not to fumigate. I left a buffer around the oak trees to reduce the spread of Armillaria root disease.

Soil Sampling Post-Planting:

I will take soil samples every three years in the same manner as described above to monitor my soil biological problems or more often if a suspected problem develops. I will justify management action based on whether I am receiving damage at an economic level. I will use the economic threshold table found the Grape Pest Management manual produced by the UC IPM program.

Plan Review and Update:

I will review and update this plan every year and make changes as needed.

6.15.2 I monitor my vineyard soil for soil borne pests, particularly nematodes and Phylloxera, at least once every three years, or when a problem exists,.

Purpose	Periodically monitoring the soil for soil-borne pests will prevent a serious problem from going unnoticed until it is well established.
Verification	Vineyard management records
References	10, 13, 14, 15, 28, 29

6.16 Weed management^F

6.16.1 Weed management plan^F

Purpose	Weeds are best managed using an integrated weed management approach.
Verification	Copy of weed management plan and vineyard management records.
References	10, 13, 14, 15, 20, 21, 28, 34

Use the following guidelines and example to help develop your weed management plan

These guidelines are designed to help you discover which weed species you have on your property and develop a plan to manage weeds that are high priorities.

Management Goals

Begin by listing your weed management goals. These are statements that generally describe the conditions you are trying to create on your property related to weeds. These goals describe the purpose and use of the property and what you are trying to achieve. Having clear management goals are key to developing a weed management plan. (A management goal may be to reduce the number of noxious weeds like yellow star thistle from your property. Another management goal may be to restore an area with native vegetation to compete with invading weed species.)

Describe generally how weeds interfere with your overall farm management. Use this section to justify the use of labor and resources to eliminate or control certain plant species in terms of your management goals, as well as legal requirements. Briefly describe how these species degrade the property, or could do so if allowed to proliferate.

Monitoring

The most important, but often overlooked, component of any successful integrated weed management program is monitoring. Early detection of weeds that have escaped previous control efforts or have been introduced from elsewhere can prevent these new weeds from establishing, spreading, shifting to weed species that are more difficult to control, and developing herbicide resistance. Weed monitoring helps evaluate the progress and success of your current weed control management program and whether modifications need to be made to address changes in the weed flora. Routinely scouting fields is also cost-effective (especially when

coupled with other monitoring programs like those for insects and mites) by helping to reduce or eliminate the need for unnecessary treatments.

For weed monitoring to be useful, it is important to be able to properly identify the weeds in and around your vineyard blocks. For assistance in identifying weeds in different stages of growth, consult color photos and descriptions that are available in various publications (i.e., *Grower's Weed Identification Handbook*, *Weeds of the West*, and *Grape Pest Management*). Farm advisors, consultants, PCAs, chemical representatives, other farmers and LWWC staff are also available to help identify the weeds you have. Additionally, it is important to become familiar with the types of weeds you encounter (annuals, perennials, grasses, broadleaves, sedges, etc.) and when they are most susceptible to control with various chemical and non-chemical treatments. For example, annual weeds are easiest to control with chemical or mechanical means prior to or shortly after emergence. Perennial weeds are more vulnerable to control at the early bud stage or during the fall when they begin to go dormant. Herbicides applied at this time will be translocated to the roots or underground rhizomes and provide better control.

Successful weed monitoring depends on four main criteria:

1. Know your farm: Which weeds are known to be present? Where do they grow? When are specific weed problems? How do soil conditions vary? Are there drainage problems in certain areas? Are weeds present on field edges, fence lines, and irrigation canals or ditches? What weed control strategies have been successful in the past?
2. Develop a strategy: What chemical and/or mechanical control approaches are needed to achieve your weed management goals? Are activities timed in relation to the weed stages of growth? Are you considering weed control of surrounding areas?
3. Implement the strategy: Does it meet label and/or timing recommendations? How will you allow for weather conditions? What equipment and manpower will you use to get the job done properly? Are you observant of equipment in operation?
4. Monitor and review the strategy: After harvest, review and update your weed management plan by answering the following questions.
 - a. Which weeds persisted?
 - b. Which methods were effective?
 - c. Did any unanticipated events affect the outcome?
 - d. Were there any surprise successes?
 - e. Were there any side effects (e.g. erosion, vine injury, poor spray coverage)?
 - f. What were the costs vs. benefits?

Monitoring Technique and Record-Keeping

Since a vineyard is a long term investment, it is important to maintain accurate, up-to-date weed records to reflect actions taken for the life of the vineyard. Monitor the vineyard in a thorough and systematic manner. Include areas representing the entire field as well as sandy streaks, field

margins, ditch banks, irrigation canals, and bordering fence lines. The following steps are useful in developing and using a successful weed monitoring program:

1. Have available a list of all weed control efforts used during the year, including mechanical means and herbicide rates and dates applied.
2. Monitoring for weeds every 10 days during the spring and summer and monthly during the late fall and winter is the best way to identify problems early so they can be watched and acted upon if necessary. Monitoring less often is not frequent enough to make sound pest management decisions based on economic thresholds. Walk areas representing the entire field and identify the weeds present. Pay close attention to areas of high moisture like low spots, seeps, around irrigation lines, etc.
3. Rate the level of infestation for weeds found and note if and when specific weeds escape control efforts. Make note of new weeds and/or if a shift to certain weeds is occurring.
4. Map out areas of the field where special weed problems are seen (low ends, sandy streaks, etc.). Look for areas of patchy weeds, which is commonly associated with perennial weed invasion.
5. Compare your current strategy to the weeds escaping control. Make note if particular weeds that have escaped due to poor sprayer coverage, improper timing of mechanical or chemical control (weed size), sub-lethal herbicide rate, not on herbicide label, etc.
6. Maintain records of your observations over the life of the vineyard. Keeping a written monitoring record for weeds provides a way to accurately compare the monitoring from one week to another, one month to another, one year to another, one scout to another, and one vineyard to another. These records are also required for the vineyard to be certified.

Monitor and review the strategy: After harvest review and update your vertebrate pest management plan by answering the following questions.

- Which vertebrate pests persisted?
- Which methods were effective?
- Did any unanticipated events affect the outcome?
- Were there any surprise successes?
- Were there any side effects (e.g. vine injury, non-target harm)?
- What were the costs vs. benefits?

WEED MONITORING RECORD EXAMPLE

Date scouted:	Field # and location:
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Weed	Score	Notes

Score: 1= few present, 2= light infestation, 3= moderate infestation, 4= heavy infestation, 5= very heavy infestation, dominates most other weeds

Other Notes:

Resources

Kurt Hembree and Anil Shrestha, Farm Advisor, Fresno County and IPM Weed Ecologist, Kearney Agricultural Center, Weed Monitoring Field Day Handout, 2004

Statewide IPM Program, Agriculture and Natural Resources, University of California, 2004. <http://www.ipm.ucdavis.edu/PMG/r302700111.html>

Colorado Natural Areas Program. 2000. *Creating an Integrated Weed Management Plan: A Handbook for Owners and Managers of Lands with Natural Values*. Colorado Natural Areas Program, Colorado State Parks, Colorado Department of Natural Resources; and Division of Plant Industry, Colorado Department of Agriculture. Denver, Colorado. 349 pages. http://parks.state.co.us/cnap/IWM_handbook/IWM_index.htm

Example Weed Management Plan

Weed Management Goals:

- To reduce or eliminate the weed pressure on my property
- To eliminate any noxious weeds on my property
- To cover as much soil with beneficial native vegetation as possible to compete with invasive weeds
- To reduce the amount and number of herbicide sprays I apply every year.
- To reduce the amount of time and expenses dedicated to weed removal
- To reduce the amount of hand labor dedicated to removing weeds
- To apply an integrated approach to attacking weeds on my property

Site Description:

See information from my environmental survey and the attached map.

Monitoring:

- **Knowing My Farm:**
 - In the buffer strips surrounding the vernal pools and oak trees, I have a major annual grass weed problem. The annual grasses don't anchor the soil well, provide less beneficial habitat than a native perennial, and it can easily colonize the vineyard.
 - Annual weeds are a problem along the drip line where the water from my underground drip system flows to the surface during the summer. If these weeds are allowed to grow, they will compete with my vines, grow into my vine canopy, and they can harbor pests and diseases.
 - Yellow star thistle (YST) is moving in from my neighbors along the northern border of my property. If YST is allowed to proliferate, my property value will decrease, my employees will have problems working in the vineyard and it will create a fire hazard.
- **Strategy:**
 - Annual grasses: I will spray the annual grasses prior to seed set in the spring. I will overseed the annual grass weeds in my vernal pool and oak tree buffer strips with native perennial grasses in the fall before the first rains. After a few years the perennial grasses should out-compete the annuals.
 - Annual vineyard weeds: I have planted a cover crop to help compete with the weeds. I will mow the weeds under the vines and in the middles before they flower and apply Glyphosate herbicides when mowing doesn't work.
 - Noxious weeds: I will hand weed any noxious weeds that invade my property before they flower. I will also plant as much of my property with vegetation to remove any areas for easy colonization from noxious weeds. This is especially important along my property borders. I will also talk with my neighbors about removing noxious weeds from their property so that we can work together to eliminate the problem.
- **Monitoring Program:**

- I will couple my weed monitoring with the rest of my pest monitoring during the growing season (every 7-10 days).
- I will rate the weed infestation using a score of 1-5 (1= few present, 2=light infestation, 3=moderate infestation, 4=heavy infestation, 5=very heavy infestation, dominates most other weeds).
- Additionally, I will monitor for weeds monthly during the late fall, winter and early spring.
- I will also monitor the non-crop portions of my property for any new weed invasions monthly.
- I will make note of any weeds escaping control.
- I will write my findings down in my PDA and store this information in my computer database at home for future analysis.

Review and Update: I will review and update this plan every year and make changes as needed. I will also review the following questions:

1. Which weed pests persisted?
2. Which methods were effective?
3. Did any unanticipated events affect the outcome?
4. Were there any surprise successes?
5. Were there any side effects?
6. What were the costs and benefits?

6.16.2 Vineyard monitoring for weeds ^V

Purpose	Regular monitoring for weeds will minimize the amount of herbicides used in a vineyard by ensuring that treatments are made in a timely manner.
Verification	Pest monitoring records.
References	10, 13, 14, 15, 21, 28

6.17 Vertebrate Pest Management ^F

6.17.1 Vertebrate management plan ^F

Purpose	The best way to manage vertebrate pests is using the integrated vertebrate management approach.
Verification	Copy of vertebrate management plan.
References	10, 13, 14, 20, 28, 34, 42

Use the following guidelines and example to help develop your vertebrate management plan.

Rodents, coyotes, and birds can all be considered vertebrate pests to vineyards. However, because vertebrate pests can be found in the air or the soil and often migrate between properties and even larger areas as in bird migration, they can not all be managed using the same techniques. Most vertebrate pest problems can be managed by habitat alteration, such as elimination of brush piles for house finches, cleaning of areas around vines for voles, selecting cover crops that do not encourage vertebrates, or by exclusion techniques such as use of bird scares, grow tubes or chicken wire for rabbits. Other management options include using traps that non-target animals cannot access such as cinch traps or Macabee traps in tunnels for gophers or owl boxes and raptor perches that encourage beneficial vertebrates.

Management Goals

Begin by listing your vertebrate pest management goals. These are statements that generally describe the conditions you are trying to create on your property related to vertebrate pests. These goals describe the purpose and use of the property and what you are trying to achieve. Having clear management goals are key to developing a vertebrate pest management plan. (A management goal may be to reduce the number of ground squirrels your property. Another management goal may be to provide habitat for predators by establishing several owl boxes and raptor perches.)

Describe generally how vertebrate pests interfere with your overall farm management. Use this section to justify the use of labor and resources to eliminate or control certain vertebrate species in terms of your management goals, as well as legal requirements. Briefly describe how these species degrade the property, or could do so if allowed to proliferate.

Monitoring

The most important, but often overlooked, component of any successful integrated vertebrate management program is monitoring. Early detection of vertebrate pests that have escaped previous control efforts or have been introduced from elsewhere can prevent these new species from establishing and spreading. Vertebrate monitoring helps evaluate the progress and success of your current vertebrate pest control program and whether modifications need to be made to address changes in the pest species. Routinely scouting fields is also cost-effective (especially when coupled with other monitoring programs like those for insects, mites, and weeds) by helping to reduce or eliminate the need for unnecessary treatment measures.

For vertebrate pest monitoring to be useful, it is important to be able to properly identify the species in and around your vineyard blocks. For assistance in identifying vertebrate pests, consult color photos and descriptions that are available in various publications (i.e. *Grape Pest Management*). Farm advisors, consultants, PCAs, chemical representatives, other farmers and LWWC staff are also available to help identify the vertebrate pests you have.

Successful vertebrate pest monitoring depends on four main criteria:

1. Know your farm:
 - What vertebrate pests are known to be present?
 - When are the specific vertebrate problems? Where are they?
 - Because vertebrate pests are often active at night, you may need to look for signs and tracks that indicate presence of pest populations rather than count specific pest numbers.
 - Are vertebrate pests present on field edges, fence lines, irrigation canals, ditches, junk piles, non-crop vegetation, trees, riparian areas, wetlands, telephone poles or lines, or in adjacent property?
 - What vertebrate management control strategies have been successful in the past?
2. Develop a strategy:
 - What cultural, mechanical, and/or chemical control approaches are needed to achieve your vertebrate management goals?
 - Are activities timed in relation to when the pest population has reached an economic level?
 - Are you considering vertebrate pest control of surrounding areas?
3. Implement the strategy:
 - Does your control choice meet label and/or timing recommendations?
 - How will you allow for weather conditions, non target vertebrates, and neighbors?
 - What equipment and manpower will you use to get the job done properly? Are you observant of equipment in operation?

Monitoring Technique and Record-Keeping

Since a vineyard is a long term investment, it is important to maintain accurate, up-to-date vertebrate pest records to reflect actions taken for the life of the vineyard. Monitor the vineyard in a thorough and systematic manner. Include areas representing the entire field and areas of common pest occurrence like field margins, ditch banks, irrigation canals, bordering fence lines, junk piles, non-crop vegetation, trees, riparian areas, wetlands, telephone poles or lines, or in adjacent property. The following steps are useful in developing and using a successful vertebrate pest management monitoring program:

1. Have available a list of all vertebrate pest control efforts used during the year, including mechanical and cultural means and/or chemical rates and dates applied.
2. Monitoring for vertebrate pests every 10 days during the spring and summer and early fall and monthly during the late fall and winter is the best way to identify problems early so they can be watched and acted upon if necessary. Monitoring less often is not frequent enough to make sound pest management decisions based on economic thresholds. Walk areas representing the entire field and identify the vertebrate pests present. Pay particular attention to the areas of common pest occurrence as mentioned above.
3. Rate the level of infestation for vertebrate pests found and note if and when specific pests escape control efforts and if new pests have arrived.

4. Map out areas of your property where special vertebrate pest problems are seen. Look for areas of heavy damage and extensive activity where dense vertebrate populations may exist.
5. Make note if particular vertebrate pests that have escaped due to poor monitoring, improper timing of mechanical, cultural or chemical control.
6. Maintain records of your observations over the life of the vineyard. Keeping a written monitoring record for vertebrate pests provides a way to accurately compare the monitoring from one week to another, one month to another, one year to another, one scout to another, and one vineyard to another. These records are also required for the vineyard to be certified.

Monitor and review the strategy: After harvest review and update your vertebrate pest management plan by answering the following questions.

1. Which vertebrate pests persisted?
2. Which methods were effective?
3. Did any unanticipated events affect the outcome?
4. Were there any surprise successes?
5. Were there any side effects (e.g. vine injury, non-target harm)?
6. What were the costs vs. benefits?

Example Vertebrate Pest Management Plan

Management Goals:

- To discourage vertebrate pests from living in or near my vineyard
- To encourage vertebrate pest predators to live in or near my vineyard
- To minimize the impact of vertebrate pests on my vineyard

Site Description:

See information from my environmental survey and the attached map.

Monitoring:

- **Knowing My Farm:** Because I have a permanent cover crop, I have many small rodents in my vineyard and I am worried that they will damage my underground drip system. I spend about 4 hours a week trapping and hunting ground squirrels, voles and gophers. I have also had to replace about 5% of my vines from vole damage. I have a few ground/fence squirrels along my southern fence line and they seem to invade the vineyard from there. Because there are a number of other vineyards around, I don't seem to receive extensive bird damage.
- **Strategy:**
 - To reduce the number of rodents in my vineyard I will install two owl boxes on opposite edges of my property. I will also install 3 separate raptor perches, one on the top of the hill and two on opposite edges of the vineyard.

- I will continue to trap gophers and squirrels if I see no reduction in their population from the raptors.
- To reduce the number of house finches on my property I will remove all of my junk piles around the area.
- I will also let my dogs roam the vineyard to hunt for rodents.
- **Monitoring Program:**
 - I will couple my vertebrate pest/predator monitoring with the rest of my pest monitoring during the growing season (every 7-10 days).
 - I will rate the pest infestation using a score of 1-5 (1= few present, 2=light infestation, 3=moderate infestation, 4=heavy infestation, 5=very heavy infestation, causing extensive damage).
 - Additionally, I will monitor for vertebrates monthly during the late fall, winter and early spring.
 - I will also monitor the non-crop portions of my property for any new vertebrate pest invasions. I will make note of any pests escaping control.
 - I will also make note of the presence of raptor in the sky or on the perches. Once a month I will monitor my owl boxes and every year I will clean and maintain the owl boxes. I will write my findings down in my PDA and store this information in my computer database at home for future analysis.

Review and Update: I will review and update this plan every year and make changes as needed.

I will also review the following questions:

1. Which vertebrate pests persisted?
2. Which methods were effective?
3. Did any unanticipated events affect the outcome?
4. Were there any surprise successes?
5. Were there any side effects?
6. What were the costs and benefits?

6.17.2 Vineyard monitoring for vertebrate pests^V

Purpose	Regular monitoring for vertebrate pests will prevent vertebrate pest problems from getting out of hand.
Verification	Pest monitoring records.
References	10, 13, 14, 20, 28, 34, 42

6.17.3 Predatory birds^F

Purpose	Birds of prey, particularly owls, feed on a large number of rodents which can be pests in some vineyards.
Verification	Vineyard site map and visual inspection.
References	10, 14, 28, 34, 40, 42

6.18 Pesticide application^F

6.18.1 Sprayer/duster maintenance plan^F

Purpose	It is important that sprayers and dusters are properly maintained so they operate at peak performance. This ensures judicious use of pesticides.
Verification	Equipment maintenance records.
References	10, 13, 24, 28

Use the following guidelines to help develop sprayer maintenance plan.

A significant part of sprayer maintenance is regularly and systematically checking the various systems, hoses, gauges, etc. for proper function, wear, and damage and fixing a problem or replacing a worn part for optimum sprayer operation.

Note: A sprayer maintenance plan should have the following components and the text is a guide to the content of each component.

Cleaning

To keep the sprayer in top form, the most important thing is to clean it thoroughly immediately after every use, both internally and externally. A thorough cleaning ensures that everything functions correctly and at the same time prevents spray damage due to unintended mixture of plant protection chemicals.

Together with cleaning, the sprayer should be tested with clean water and all functions and operating valves activated to reveal potential problems and leakages, which should be immediately rectified.

Filters

Many plant protection chemicals leave residues, which may become affixed to the filters. Disassemble the suction filter, self-cleaning filter, operating unit filter, line filters and nozzle filters and clean them with a brush and soapy water.

Check the filter inserts and change damaged ones if any.

Pump

Check the valves for failure and wear. If wear is found, change all valves at the same time. Always use new sealing rings when the valves are reassembled.

Check the diaphragms for cracks. If just one diaphragm has a crack, change all diaphragms at the same time, as those not changed will be functioning on borrowed time, and are likely to fail in the near future.

Finally, grease the pump.

Control Unit

Check the function of the control unit during the test with clean water. The main valve must close completely. If it drips from the nozzles when the main valve is closed, it is likely that the valve ball and the ball seat are worn. Check and change if necessary.

The boom section valves must also close completely. Open the main valve and all section valves with the pump working. When the return hose from the constant pressure valves is removed and the housing drained, no water must appear on the valves. If the section valves are not completely sealed, the valve cone should be replaced.

Finally, all movable parts of the control unit operating handles should be lubricated with oil.

Pressure Gauge

A simple way of controlling the pressure gauge is to mount a completely new set of nozzles, which are known to match the values of the nozzle table. At a fixed working pressure – e.g. 3 bars – the nozzle flow rate is calibrated with a measuring jug. If the flow rate of the nozzles matches the table value at this pressure, the pressure gauge is OK.

Nozzles³

The condition of the nozzles is of critical importance in achieving an even spray distribution across the boom, and consequently a good deposit of the plant protection chemical. Carry out a visual control of the spray pattern of all nozzles when spraying clean water at normal working pressure. The spray pattern must be regular fan-shaped for normal flat fan spray nozzles. Irregularities are a sign of damage or wear.

³ For more detailed discussion of sprayer calibration see pgs. 90 – 91 in the *Lodi Winegrower's Workbook*.

Calibrate the flow rate of the nozzles with a measuring jug. The precision of the nozzles and distribution is acceptable with flow rates of up to 10% above the table values. If the flow rate is above 10% in excess of standard, the nozzles are worn and all nozzles should be replaced.

Remove the turn plate of the TRIPLET nozzle holder and lubricate with a little oil or grease on the plate. This will ensure the TRIPLET is always easy to turn when changing to another nozzle.

The Boom

In order for the spray boom to operate as evenly and quietly as possible, it is important that it has been adjusted and lubricated correctly. The instruction manual should indicate adjustment and lubrication of the various boom types

The PTO

Check that the guard of the P.T.O. shaft is in good condition and lubricate the shaft. It is also important that the profile tubes are well lubricated so that the shaft can move backwards and forwards without hindrance during operation.

Boom Tubes and Hoses

Check all tubes and hoses for damages and fastenings. Change damaged hoses and tighten hoses which may have become loose.

Rust Prevention

Many plant protection chemicals are very aggressive, discolor paint, and can be extremely difficult to wash off when dried on. It is therefore recommended to apply to all metal parts of the sprayer a thin layer of penetrating, water-repellent rust prevention oil before putting the sprayer into service. Many suitable products are available on the market, which after application leave a protective oil film. The sprayer can then be washed completely clean.

6.18.2 Spray/dust calibration ^F

Purpose	For optimum spray efficacy it is important that the prescribed amount of pesticide per acre is actually being applied. Keeping sprayers properly calibrated prevents too little or too much pesticide being applied.
Verification	Calibration records
References	10, 13, 24, 28

6.18.3 Spray coverage ^F

Purpose	For optimum spray efficacy it is critical that the spray is covering the entire target area adequately.
Verification	Vineyard management records.
References	10, 13, 24, 28

6.18.4 Spray/dust drift management plan ^F

Purpose	It is extremely important that pesticides do not drift from the application site.
Verification	Copy of drift management plan and vineyard management records.
References	9, 10, 24, 28

Use the following guidelines and example to help develop your drift management plan.

Drift management practices apply to spraying liquids as well as applying dusts. However, since sulfur dust is the most ‘visible’ problem in vineyards the plan guidelines will emphasize dust drift management.

Is sulfur dust drift really a problem?

As an active ingredient, sulfur is the leading pesticide used in California agriculture. From 1997 to 1999, the Department of Pesticide Regulation found that 86% of drift incidents reported were from sulfur dust. More than 60% of the reported incidents were from applications to grapes.

Include the following components in your own Spray Drift Management Plan and choose the suggested practices under each that can be integrated into your program for managing sulfur dust that achieves powdery mildew control and, at the same time, prevents drift and public complaints. These practices will become part of your overall Sulfur Drift Management Plan and should be appropriate for your own vineyard, circumstances, and “sensitive areas”. Applicators must understand the plan and its relationship to the geography of the vineyard and surrounding areas, because managing sulfur drift is ultimately the equipment operator’s responsibility.

Identify your “Sensitive Areas”

Identify any locations surrounding your vineyards where people, organisms, or structures could be exposed to sulfur dust drift. These areas might include schools, bus stops, busy roadways, residences, other areas of human activity, nearby sensitive crops (pears), natural areas (vernal pools, riparian areas) or waterways.

Being a good neighbor

Sulfur stewardship includes being aware of the concerns of neighbors and local communities. These actions enable mutual understandings and better relations, thus decreasing the probability of complaints.

1. Consider a policy of discussing vineyard actions with neighbors.
2. Speak with community organizations about the importance of sulfur as a relatively benign crop protection tool
3. Form a regional team of growers to serve as the first contact with the public for negotiations and troubleshooting.
4. Take advantage of speaking opportunities with community organizations to explain the importance of sulfur for protecting crops against disease.
5. Periodically call your local county agricultural commissioner to check if sulfur drift incidents have been reported in your area.

Canopy management

1. Refer to your Powdery Mildew Management Plan.
2. If you don't have a plan, then you should use trellis systems and canopy balance techniques (e.g. leaf pulling, shoot thinning, cane cutting, irrigation management, reduced fertilizers, etc.) that produce open canopies and reduce disease incidence.

Establishing buffers

1. Establish reasonable buffer zones to prevent drift onto sensitive areas and human exposure to applications.
2. Buffer distances vary with weather conditions, formulation (dust/wettable), application method (ground/air), presence of barriers (e.g. trees, hedgerows, open fields, etc.), and characteristics of sensitive areas.
3. If buffers determined for dust application overlap some border vine rows, apply separate fungicide sprays (less prone to drift) to these rows or dust border rows during conditions when buffers can be reduced.
4. Buffer Zone Procedures
 - a. Leave an adequate buffer zone to protect sensitive areas.
 - b. An adequate buffer zone is measured as enough distance for dust or spray to settle within the treatment area.
 - c. Make sure applicator clearly understands the field being sprayed or dusted and the environment surrounding the field.

Extra-sensitive areas

Consider applying wettable sulfur or other low-risk fungicide sprays to parts or the entire vineyard near extremely sensitive areas (e.g. schools, neighbors, livestock, etc.).

Selecting rates

1. Adjust rates of sulfur or other fungicides to the lowest effective rate according to the vine growth and development.
2. Higher label rates may not be required early in the season to achieve adequate coverage.
3. Using lower rates decreases the risk of pesticide drift, particularly for dusting sulfur.

Equipment operation: Include as many of the following drift reducing methods in your plan as is feasible for your operation.

1. Calibrate and select application equipment to deliver the intended rate as accurately and quietly as possible.
2. Stop dusting or spraying activities if sulfur drift will potentially move to sensitive areas.
3. Avoid applications when people are active in housing or urban areas bordering a treated field.
4. With sulfur dusters, slow engine RPM at row end to minimize drift potential.
5. If dusting equipment has a blower shut-off, disengage blower when making row turns.
6. When possible, apply sulfur at night or on weekends if near urban areas, roadways or where activity is common.
7. Refer to Sprayer/Duster maintenance plan.
8. Keep dusting equipment well maintained. Indicate how often you will calibrate, clean, and maintain your sulfur dusting equipment.
9. Start dusting or spraying only when the sprayer/duster is adjacent to first plant.
10. Hold trainings for all applicator employees, pointing out sensitive areas surrounding fields being treated and proper precautions to follow.

Weather conditions: Use the following to help you determine what weather conditions will you use to decide when to postpone spraying or dusting?

1. Monitor weather conditions before and during applications.
2. Sulfur should not be applied when the wind velocity exceeds 10 miles per hour and consider using an even lower threshold.
3. Equip each sprayer/duster rig with an anemometer (wind-meter) to measure wind speed.
4. Avoid applications when winds are blowing towards sensitive areas.
5. Applicators should be aware that in some areas of California, “dead calm” conditions are often associated with an inversion situation. In these areas, applying sulfur when there is a minimum air movement of 2 miles per hour will help ensure that an inversion situation does not exist.

Timing applications: The following techniques are suggestions for how to reduce drift problems with application timing.

1. Decrease public visibility and the potential for complaints by making applications during periods of least human activity (e.g. at night, weekends, etc.)
2. Develop a sequence for application that attracts less attention.
3. For nighttime applications, minimize “noise” complaints by treating rows closest to residential areas first.
4. Apply sulfur at times when minimum activity is occurring around your treatment area.

Resistance management

Although mildew resistance to sulfur has never been found, consider rotations with other fungicides as a preventive measure against resistance and sulfur drift.

Equipment operator/applicator management

Applicators must understand the plan and its relationship to the geography of the vineyard and surrounding areas, because managing sulfur drift is the equipment operator’s responsibility.

Provide the following checklist to all applicators to review before each application.

1. Check wind speed and direction
2. Create a buffer zone between applications and sensitive areas
3. Look for people moving around building near application site.
4. Shutoff equipment when making row turns.
5. Never apply in winds above 10 mph.

Spray drift management statement

Based on the information from the above issues, create a statement that outlines the goals of your Spray Drift Management Plan.

Example

By using the best management practices outlined in this Spray Drift Management Plan and my Powdery Mildew Management Plan, I will reduce the number of sulfur applications and minimize the potential for drift especially to surrounding “sensitive areas” while efficiently and effectively treating my vineyards.

Example Spray/Dust Drift Management Plan

Spray Drift Management Goals:

- To reduce the number of fungicide applications per year if possible
- Minimize the potential for drift especially to surrounding “sensitive areas”
- Maintain efficient and effective spray program for vineyard pests

Sensitive Area Identification and Documentation: (taken from my Environmental Survey)

Hillsides: I have a hill running north/south with a 10 degree slope. I have planted a perennial grass cover crop that I mow after seed set and one or two times depending on rate of growth. I minimize the number of tractor passes in the vineyard to prevent soil compaction and erosion problems.

Wetlands: I have vernal pools and wet swales on my property and I have left a 10 meter buffer around the habitat and planted it with a native perennial grass. I have not planted grapes in these areas and minimize vehicle traffic through them.

Plants/Trees: I have seven large blue oak trees (*Quercus douglasii*) near the top of the hill in the vineyard. I have planted grapes outside of the canopy drip line but have planted native perennial grass underneath. Every year, red shouldered hawks build nests in the trees and hunt in the vineyard.

Aquatic species: I have several threatened and endangered species in the vernal pools as mentioned in my environmental survey. I try to mitigate any adverse conditions by not planting grapes through the pools, by leaving a vegetation buffer around the habitat and by not driving in the habitat when water is present.

Neighbors: I have neighbors that live to the south of my property about 50 meters from the property line. I have established a permanent hedge row to help prevent dust and noise from bothering these neighbors. There are no houses closer than a ¼ mile in all other directions. My property is surrounded by vineyards and some grazing land to the north. I have also discussed why and when I use sulfur. Once a month I call the county agricultural commissioner’s office to check if any sulfur drift incidents have been reported in my area.

Roads: The county road runs along the eastern edge of my property.

Canopy Management:

Refer to my Powdery Mildew Management Plan

Establishing Buffers:

See above in Sensitive Areas. I have also started a hedgerow along the main county road but this will take a few years to become established. I always start spraying closest to my neighbors’ property and work away from it. Along the eastern edge, I’ll shut off the sprayer/duster about 10-15 vines before I get to the end of the rows. I’ll then drive down the access road with only the vineyard side nozzles open. I do all the applications myself.

I create a buffer around sensitive areas where I take special precautions not to impact those areas. I never drive through the vernal pools or wet swales when water is present and shut off the spray equipment when the ground is dry and I do drive through.

Selecting Rates:

I use the lowest effective rate according to the vine growth and development to reduce drift and help prevent fungicide resistance. I use the lowest rates at the beginning of the season because the canopy is smaller. I usually increase rates as the season progresses as the canopy increases.

Equipment Operation:

See my sprayer maintenance plan and calibration records. I always start spraying closest to my neighbors' property and work away from it. Along the eastern edge I'll shut off the sprayer/duster about 10-15 vines before I get to the end of the rows. I'll then drive down the access road with only the vineyard side nozzles open. I do all the applications myself. If I notice drift moving into my neighbors property I will stop the application and resume when wind has subsided. I always apply sulfur in the early morning and always shut off the equipment when making turns for any pesticide application.

Weather Conditions:

Before an application, I will monitor the weather conditions. I will check the wind velocity every 30 minutes and if it is over 8 mph I will stop an application. I will not dust if the winds are blowing into my neighbors' yard. If an inversion is present, I will not make any type of pesticide application.

Resistance Management:

See Powdery Mildew Management Plan.

Equipment Operator/Applicator Management:

I am the equipment operator so I check the wind speed, create a buffer around sensitive areas, look for people, shut off the equipment when making row turns, and never apply when winds are above 8 mph.

Review and Update: I will review and update this plan every year and make changes if needed.

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