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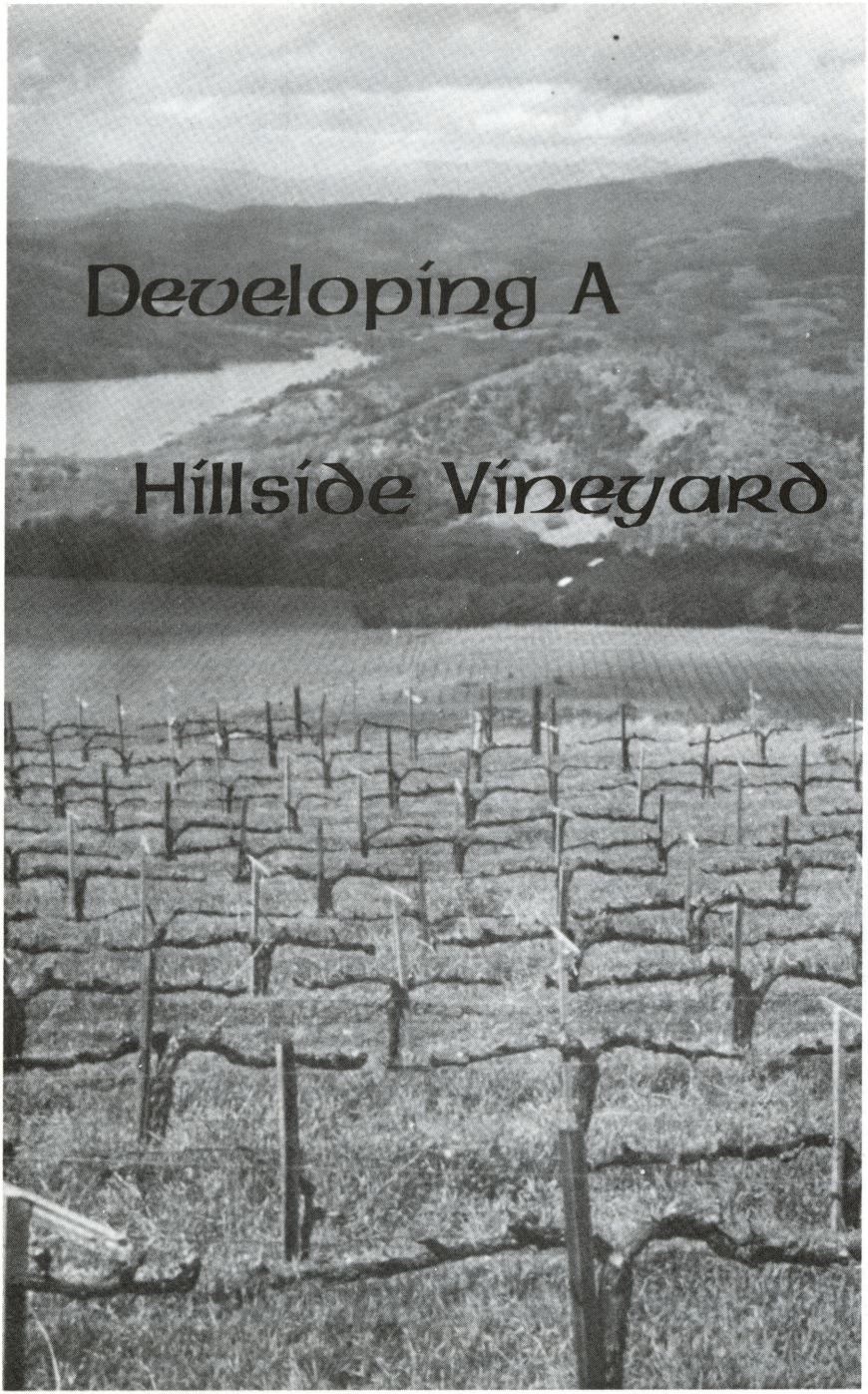


Napa County Resource Conservation District



Gulley formed by inadequate drainage. Improper development of hillside vineyards present serious erosion problems.

Cover - Properly developed hillside vineyard with cover crops and contour planting for optimum erosion control.

Prepared by Lisa Woo Shanks
Napa County Resource Conservation District

March 1982

Developing A Hillside Vineyard

Proper development of a hillside vineyard requires careful selection of the site. To find a highly productive site, the physical and chemical properties of the soil must be evaluated. Water for irrigation during the dry months should also be available.

Once a suitable site has been located, proper development of the land is essential to maintain productivity and to reduce soil erosion. Development considerations generally include contour planting, temporary cover crops, terraces, underground outlets (pipes) for storm runoff, permanent cover crops and access roads.

Timing is very important when developing any hillside. Installation must be completed in the spring and summer before the winter rains. The majority of soil loss occurs on bare slopes during the rainy season, usually October through March.

Many traditional farming practices are not applicable to hillside vineyards. For example, while clean tillage is practiced in valley vineyards where erosion is not a major problem, serious erosion problems result when hillsides are clean tilled. Consequently, many hillside vineyard owners have found permanent cover crops and non-tillage better suited to their situation.

SITE SELECTION

Major considerations in selecting a hillside vineyard site are:

PHYSICAL SOIL PROPERTIES

CHEMICAL SOIL PROPERTIES

WATER SUPPLY

PHYSICAL SOIL PROPERTIES. Many of the soil's physical factors need to be investigated. Suitable physical properties for vineyard development include:

- loam texture
- good soil structure
- adequate rooting depth
- low percentage of rock
- moderate to high water holding capacity
- minimum landslide potential (Figure 1)
- adequate drainage of wet spots

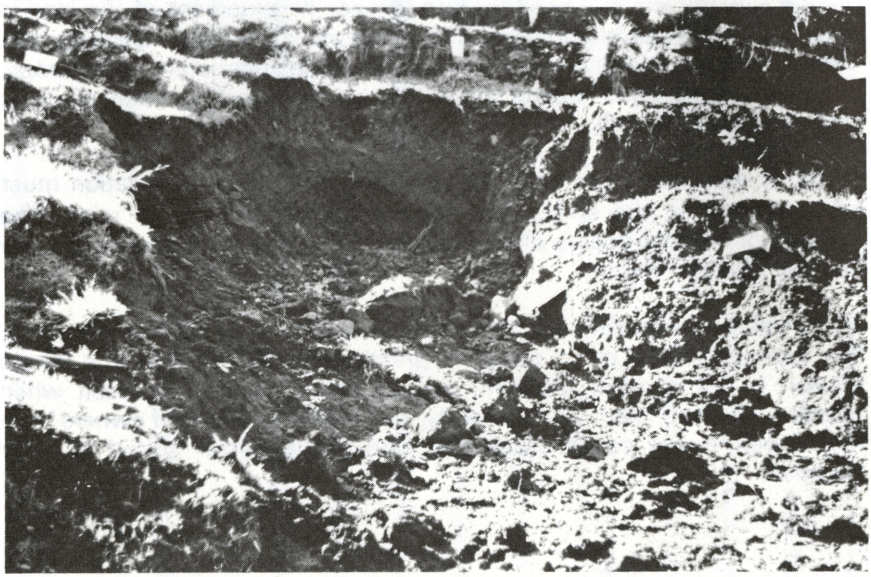


Figure 1. Extensive landslide damage to a newly established vineyard.

Much of this information is available in the Soil Survey for your county, available at your local Resource Conservation District office. A soil map is an excellent starting place when looking for suitable vineyard sites. A trained soil specialist should also visit the site and conduct an in-depth analysis before development begins. Contact your local Soil Conservation Service office for assistance.

CHEMICAL SOIL PROPERTIES. Representative soil samples are taken by soil specialists and are sent to a commercial laboratory for analysis. Specific chemical tests (pH, nitrogen, potassium, magnesium, zinc, boron, sodium, etc.) are run to determine nutrient status and the presence or absence of certain toxic elements. Results are returned in a report along with suggestions to correct any problems.

WATER SUPPLY. In the past, hillside vineyards were typically dry-farmed. Winter rainfall supplied all the water the vines received. Today nearly all hillside vineyards are irrigated for increased productivity. Careful consideration must be given to selecting a water source for irrigation. Typical sources are: seasonal creeks (with storage reservoir), wells, and springs. The water source must be sufficient quantity and quality for irrigation. A water rights permit obtained from the State Water Resources Control Board, Division of Water Rights in Sacramento, will insure your legal right to obtain surface water.

Quantity. This can be further broken down into volume and rate. The source must be able to supply the total volume necessary to mature a full crop and the proper amount must be available to meet peak periods of consumptive use.

Quality. Toxic levels of boron may be present in surface and ground water. Careful analysis by a commercial laboratory is necessary since boron is toxic in concentrations as low as 1 part per million.



Sheet and rill erosion on a hillside vineyard, caused by lack of protective cover.

IRRIGATION SYSTEMS

DRIP. This is the most common method of irrigation for hillside vineyards. It applies water efficiently and the operation requires a low volume of water at a low rate (Figure 2). The drip system must be properly designed to insure even water distribution throughout the vineyard.

SPRINKLER. This method of irrigation requires a large volume of water at a high rate. The system itself may be difficult to install on steep slopes and may cause erosive runoff if inadequately designed or if the soil surface is unprotected. A sprinkler system is preferred where frost protection is needed. However, hillside vineyards are relatively frost-free so this protection may not be necessary.



Figure 2. Drip irrigation lines are designed to concentrate water around the roots of each vine without excessive moisture loss to evaporation or runoff.

EROSION CONTROL

Soils on a hillside are quite fragile. Most hillsides will tolerate a soil loss of only 1 to 2 tons per acre annually. The soil will lose much of its productivity if this amount is exceeded (Figure 3). In some hillside vineyards, the annual soil loss is estimated to exceed 70 tons per acre. The combination of steep slopes, high rainfall, and fragile soil can be devastating unless erosion control practices are followed (Figure 4). Four methods to control erosion are:

PERMANENT STRUCTURAL EROSION CONTROL (Figure 5)

TEMPORARY STRUCTURAL EROSION CONTROL

PERMANENT VEGETATIVE EROSION CONTROL

TEMPORARY VEGETATIVE EROSION CONTROL



Figure 3. Productive topsoil is lost through sheet and rill erosion on an unprotected hillside vineyard.

PERMANENT STRUCTURAL EROSION CONTROL

- **Contour planting.** In areas with less than 15% slope (Figure 6), vine rows should be planted along the contour of the hillside.

- **Terraces.** On hillsides with slopes greater than 15%, contoured terraces should be installed on a 2% grade, and backsloped into the hill (Figure 7). Terraces must be installed when the vineyard is laid out if they are to be effective (Figure 8).

- **Diversions.** Surface runoff from around the vineyard site could flow into the vineyard, causing serious erosion problems. A diversion ditch should be constructed to collect this runoff and direct the water away from the vineyard to a safe outlet (Figure 9).

- **Underground outlets** (pipes). Excess surface water converges in natural drainageways and often causes severe gulleying within the vineyard. Underground pipes are laid in natural drainageways (Figure 10) with strategically placed inlets to collect surface runoff (Figure 11). Excess water is then disposed of at a safe outlet.

- **Proper road construction.** Access roads into the vineyard are areas where surface runoff concentrates and serious damage from erosion often occurs (Figure 12). Specific recommendations for erosion control include: proper grading, culverts, water bars (Figure 13), ditches, and surfacing. A relatively level staging area along the road will be needed for harvest equipment.



Figure 4. Gulley erosion is a highly critical problem for a hillside vineyard.



Figure 5. Permanent structural erosion control includes terracing along the contour of the hillside to prevent massive erosion.

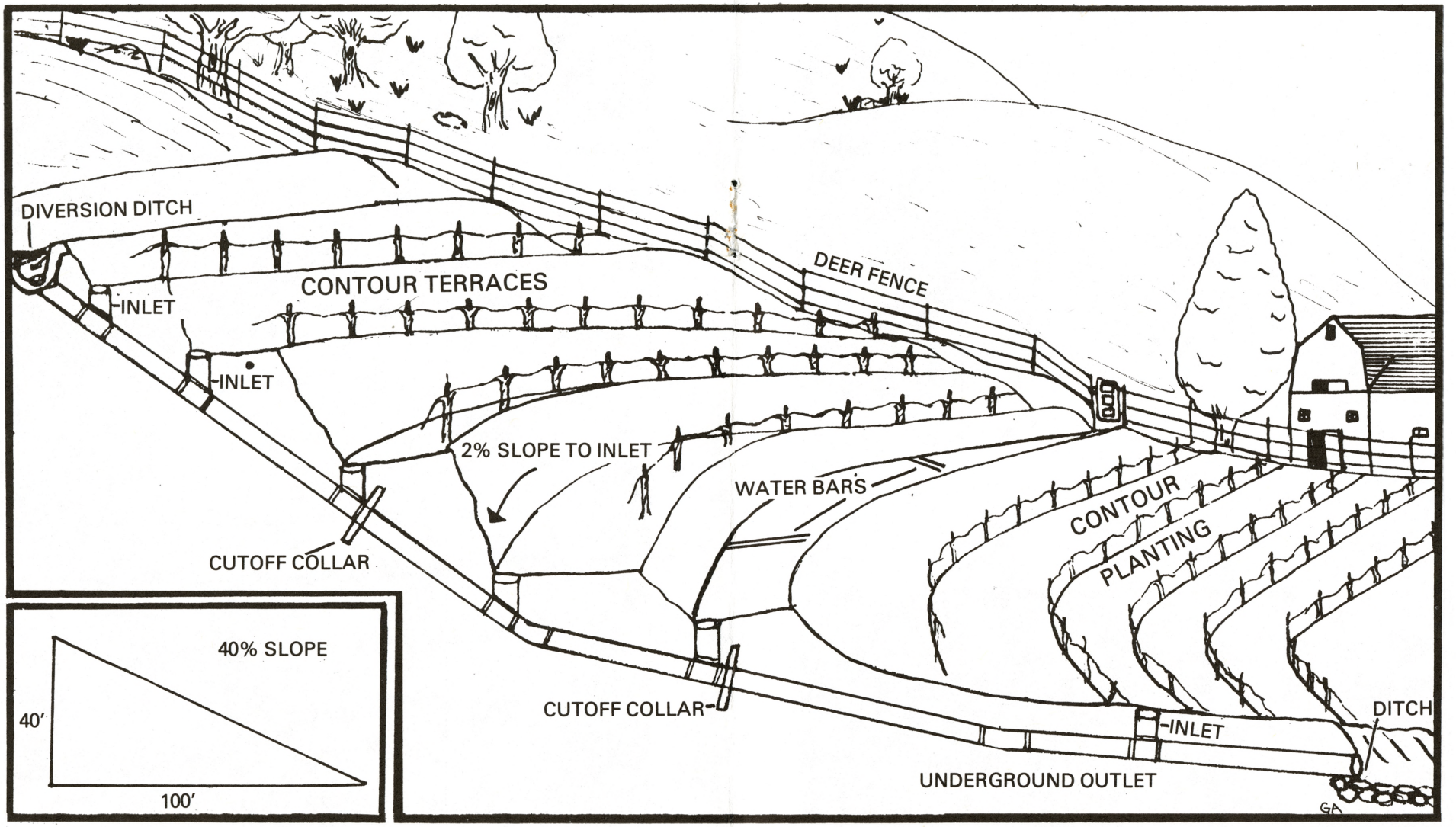


Figure 6. Percent slope is derived by taking a measurement of height divided by the measurment of length, and multiplied by 100%. For example, a 40% slope would have a 40 foot rise in a 100 foot length.

Figure 7. Planting along the contour of the slope minimizes soil loss by reducing runoff between vine rows. In steeper areas over 15% slope, contour terraces should be installed with a 2% slope leading to an underground pipe inlet. Pipe size and installation depth is determined by local conditions such as hydrology, drainage area, slope, etc. Terraces are backsloped to prevent uncontrolled runoff. Cutoff collars prevent movement of water along the outside of the pipe.



Figure 8. Erosion damage to newly constructed terraces. Backsloping the terraces was not done to divert runoff.



Figure 9. Runoff from above the vineyard must be collected in a ditch and diverted around or piped under the vineyard to a safe outlet.



Figure 10. Installing an underground outlet in a hillside vineyard. The depth of the pipe is determined by local soil conditions.



Figure 11. Inlet to underground pipe. Local conditions will determine the size of the inlet.



Figure 12. Access roads must be properly built to prevent damage from erosion such as this.

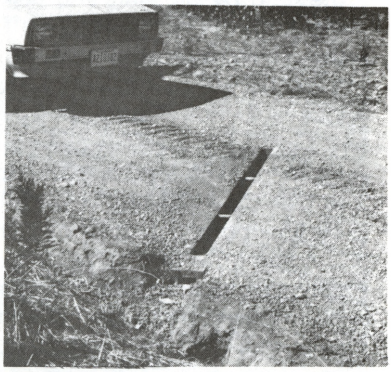


Figure 13. Water bars divert runoff to the side of the road.

TEMPORARY STRUCTURAL EROSION CONTROL

- **Lined waterway**. New gulleys that are forming in the vineyard need immediate attention before more severe soil loss occurs. Plastic sheeting is anchored securely to provide temporary protection of the soil underneath (Figure 14).

- **Filter fabric**. Check dams made of filter can be designed to temporarily reduce erosive runoff. Fabric is usually attached to fenceposts to act as a barrier to sediment and slow down runoff (Figure 15).

- **Straw bales.** A temporary measure to slow runoff in a gulley is to make a series of check dams from bales of straw. Loose straw can also be placed over the bare ground as a temporary groundcover. Both methods will filter out some sediment.

- **Rock piles.** The use of rock piles is similar to the use of straw bales. Rock piles are placed in a gulley to temporarily reduce erosion by slowing excess runoff.

PERMANENT VEGETATIVE EROSION CONTROL

- **Cover crop** (nontillage). Traditional farming practices consist of tilling the land by plowing and disking. Disking is done to remove weeds, break up the soil and even off the plowed ground. This process leaves the vineyard ground bare. In a valley vineyard, this practice is acceptable because of minimal erosion problems. However, on a hillside vineyard, bare ground is very susceptible to erosion.

  Permanent cover crops and nontillage are combined to prevent erosion on a hillside vineyard (Figure 16.). Under a nontillage system the cover crop is mowed instead of being disked into the ground. The vine row is commonly kept clear by a herbicide application. Nontillage reduces soil compaction from heavy equipment, and increases water infiltration. Cover crops favorable modify the summer micro-climate in the vineyard. The soil surface is cooler, air temperature is lower, and moisture stress is decreased. In the winter, the vegetation increases water penetration and slows runoff during heavy rains.

  Two excellent cover crops are Zorro annual fescue (Festuca megalura) and Blando brome (Bromus mollis). Both are drought tolerant grasses that provide soil stabilization. In order to perpetuate themselves, the ground cover must be allowed to mature and produce a crop of seed for next year's stand before being mowed (seed is produced by June 15). Initially, seed is hand broadcast (due to their light weight), fertilizer is applied, and the seedbed is lightly covered with a drag or roller.

- **Stream buffer zone.** Vineyards adjacent to streams require buffer zones of undisturbed natural vegetation. This vegetation acts as a filter to reduce sediment and slow runoff during heavy rains.

TEMPORARY VEGETATIVE EROSION CONTROL

- **Cover crop.** Temporary cover crops are primarily used to minimize erosion between clearing and the land and planting the vines. Barley provides the quickest cover, and it is easy to chemically eradicate. Seed mixed with fertilizer is commonly broadcast by helicopter and then lightly covered with a drag.

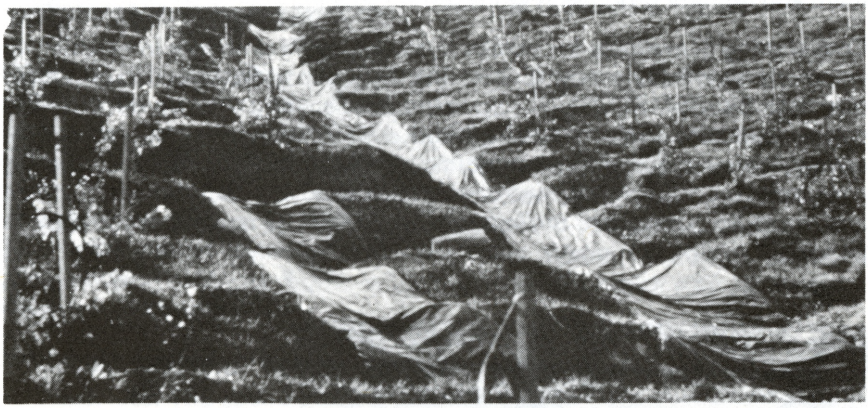


Figure 14. The use of plastic as a temporary measure to line a waterway prevents erosion of the soil underneath.



Figure 15. A check dam made of filter fabric is used to temporarily slow runoff.

ECONOMICS

Hillside vineyards are renowned for the high quality grapes they produce, and wineries pay a premium for them. However, costs for production are higher and yields are less than in valley vineyards. Economic factors must be carefully calculated before undertaking an operation (Figure 17). Any development must follow local county ordinances.

Development ~~Construction~~ costs can be kept down by developing during the spring and early summer months. Soil loss will be minimized because the danger of rain has passed, yet the ground is still moist enough to move easily. A calendar tailored to your schedule will help you visualize vineyard development and monitor progress (Figure 18).

Cost-sharing is available for certain erosion control practices in established vineyards over three years old from the Agricultural Stabilization and Conservation Service (ASCS). Fifty percent cost-sharing may be obtained for certain practices such as underground outlets and permanent vegetative cover if they meet given standards. Applications for the cost-sharing program are accepted only two weeks each year. Contact the ASCS office and ask to be put on their mailing list and you will be notified of the sign-up period.

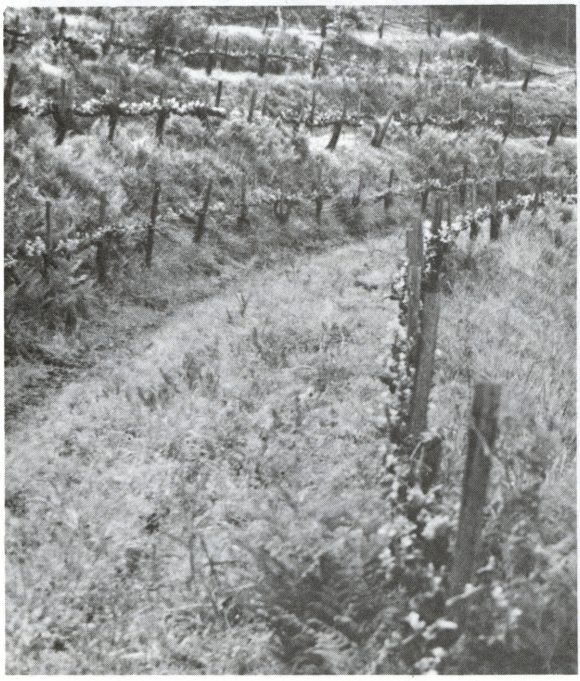


Figure 16. A permanent cover crop holds soil in place by increasing water penetration and reducing surface runoff.

Figure 17. Economic comparisons between valley and hillside vineyards.

ECONOMIC COMPARISONS

	Hillside Vineyard	Valley Vineyard
Land cost	low - moderate	high
Development		
Laboratory tests	yes	yes
Clearing cost	high	low
Fumigation	no[1]	yes
Ripping	yes/no[2]	yes
Irrigation system	yes	yes[3]
Frost protection	no	yes[3]
Deer fence	yes[4]	no
Erosion control	yes	no
Terracing	yes	no
Road cost	high	low
Underground outlet	yes[5]	no
Diversions	yes[5]	no
Temporary cover crop	yes	no
Contour planting	yes	no
Permanent cover crop	yes[5]	no
Maintenance	high	low
Production[6]		
Harvest	hand	hand/mechanical
Pruning	hand	hand/mechanical
Pest control	hand/mechanical	mechanical
Weed control	hand	mechanical
Erosion control	hand	none
Yield	low - moderate	moderate - high

[1]Fumigation on a hillside vineyard is not technologically feasible.

[2]Old root systems are removed from the site by ripping the soil. On a hillside vineyard, ripping may be combined with terracing.

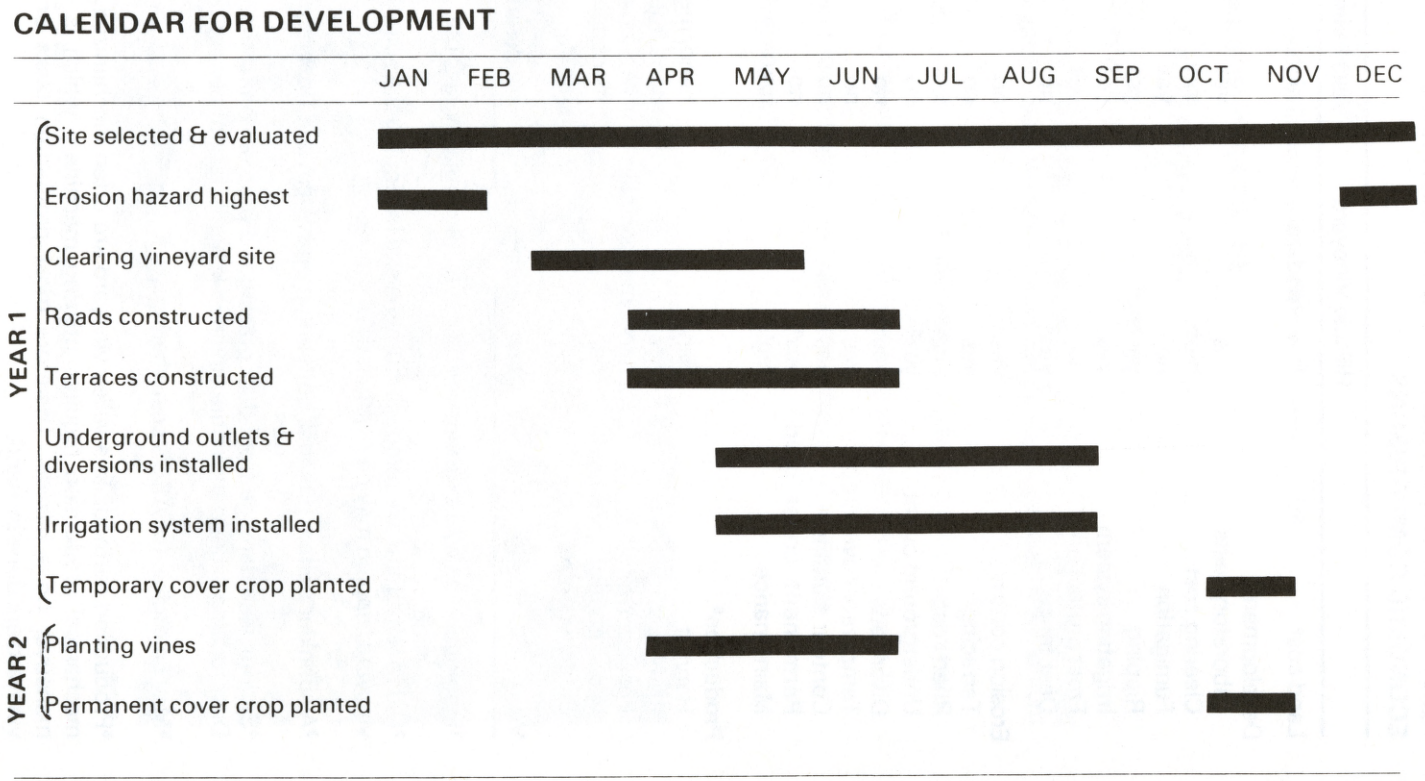
[3]A sprinkler system provides both irrigation system and frost protection.

[4]Serious vine damage from deer grazing is a problem on hillside vineyards. Deer fencing around the entire vineyard is highly recommended.

[5]May be eligible for ASCS cost-sharing.

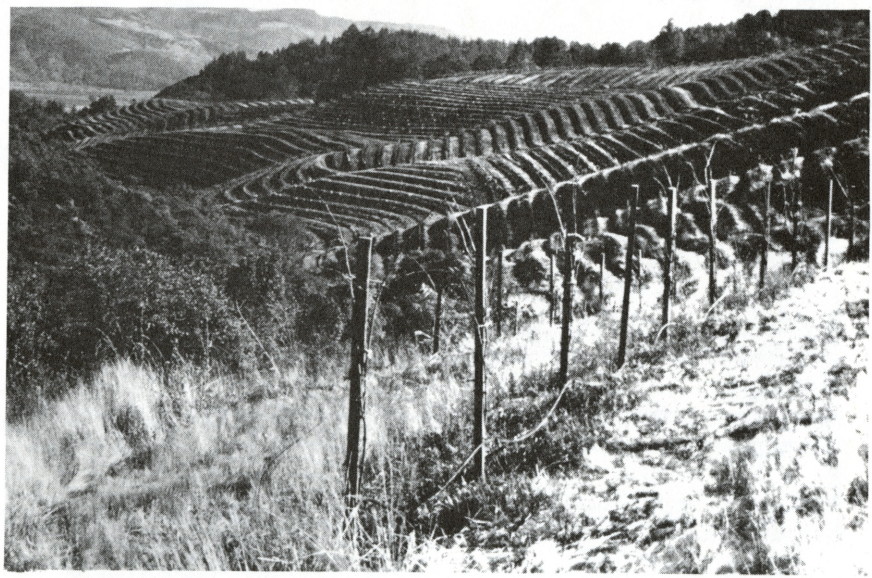
[6]Production methods in a valley vineyard are often mechanized. However, mechanical production requires utilizing machinery which is difficult to maneuver on a hillside. Therefore most production tasks on a hillside vineyard are done by hand.

Figure 18. Careful timing when establishing the vineyard will minimize erosion problems. A personal planning calendar should be devised to insure proper development.



CHECKLIST

- ☐ Vineyard site selection
  - ☐ Soil's physical characteristics analyzed
  - ☐ Soil's chemical composition analyzed by a commercial laboratory
  - ☐ Water quality tested by a commercial laboratory
  - ☐ Water quantity sufficient and water rights permit obtained
- ☐ Irrigation system
  - ☐ Irrigation method chosen
  - ☐ Irrigation system design
- ☐ Erosion control
  - ☐ Erosion control plan
  - ☐ Contour planting
  - ☐ Drainage and erosion control design
  - ☐ Terraces
  - ☐ Diversions
  - ☐ Underground outlets (pipes)
  - ☐ Proper road construction
  - ☐ Permanent cover crop planted
  - ☐ Stream buffer zones undisturbed and waterways left vegetated
- ☐ Economic factors considered
  - ☐ Federal cost-sharing program investigated
  - ☐ Your own calendar for development planned



Contour terraces and cover crops provide optimum erosion control on hillside vineyards.

FOR ASSISTANCE

You can get further information on viticulture, soils, and conservation methods at the office of your local soil and water conservation district.

Napa County Resource Conservation District
925 Lincoln Avenue
Napa, CA 94558
(707) 252-4188
- Soil information
- List of contractors

Soil Conservation Service
U.S. Department of Agriculture
925 Lincoln Avenue
Napa, CA 94558
(707) 252-4189
- Site selection and soil information
- Erosion control

Agricultural Stabilization & Conservation Service
U.S. Department of Agriculture
115 Oak Street
Fairfield, CA 94533
(707)425-5667
- Federal cost-sharing program

Cooperative Extension Service
University of California
1436 Polk Street
Napa, CA 94558
(707) 253-4221
- Vineyard production
- Vine and rootstock selection
- Pest management

Leaflets available:

- Soil Survey of Napa County, California. USDA Soil Conservation Service. Note: Soil Surveys are available for most counties.
- Sample Costs to Establish and Produce Wine Grapes in the North Coast Counties, 1980. Cooperative Extension, University of California.
- How to Appraise Soil Physical Factors for Irrigated Vineyards. Cooperative Extension, University of California.
- Commercial Analytical Laboratories in California Available for Agricultural Testing. Cooperative Extension, University of California.
- Cover Crops in California Orchards and Vineyards. USDA Soil Conservation Service.