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Soil
Conservation
Service

Water Resources
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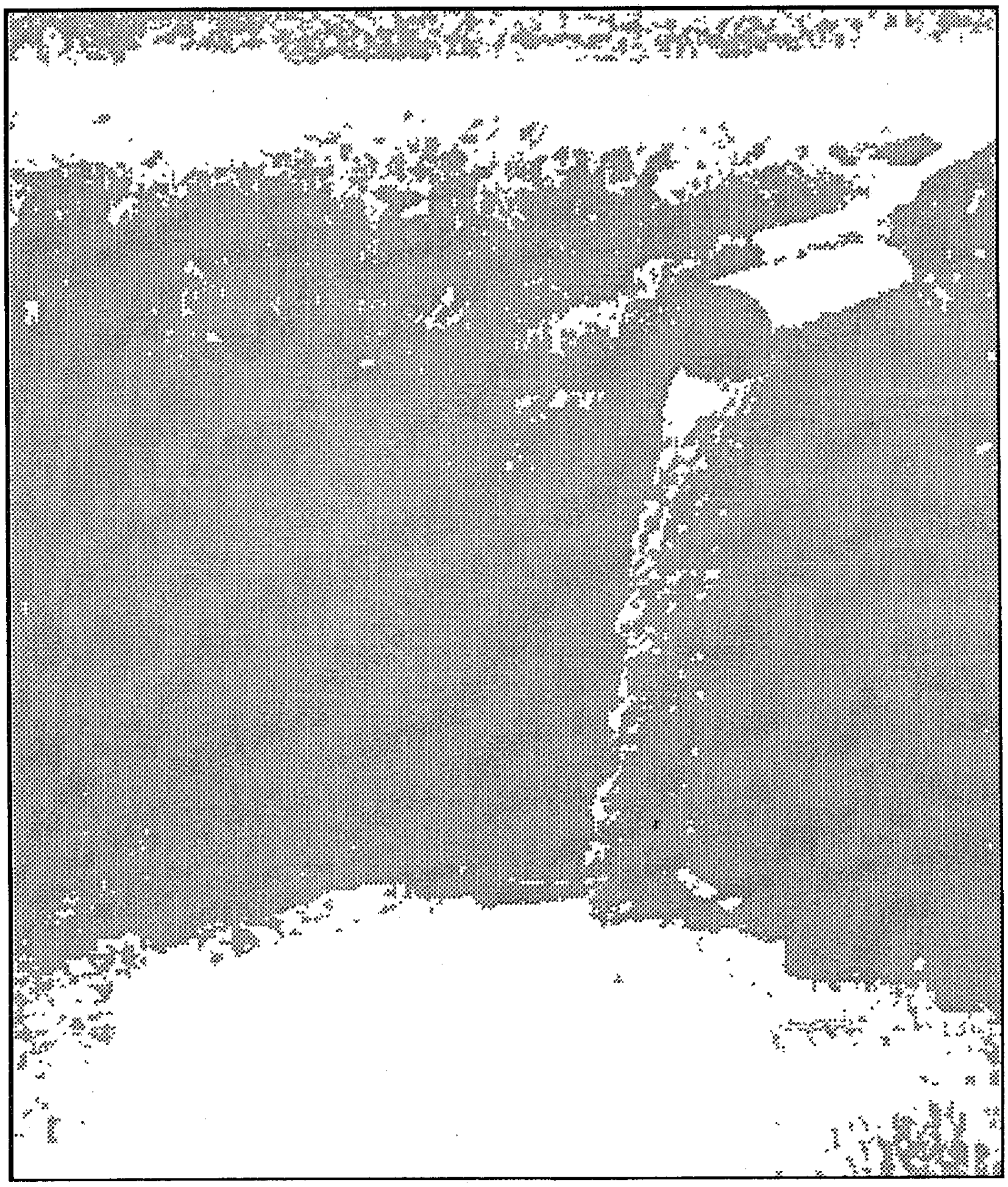
Davis,
California

WEST STANISLAUS

SEDIMENT REDUCTION PLAN

STANISLAUS COUNTY, CALIFORNIA

FEBRUARY 1992



WEST STANISLAUS

SEDIMENT REDUCTION PLAN

Stanislaus County, California

February 1992

Prepared for and in cooperation with

CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD

AND

WEST STANISLAUS RESOURCE CONSERVATION DISTRICT

PREPARED
USDA SOIL CONSERVATION SERVICE
WATER RESOURCES PLANNING STAFF
DAVIS, CALIFORNIA

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EXECUTIVE SUMMARY

The West Stanislaus Resource Conservation District (RCD) and the Central Valley Regional Water Quality Control Board recognized the need for an implementation plan addressing the nonpoint source sediment pollution problems of western Stanislaus County through the use of on-farm management and structural practices. The Soil Conservation Service (SCS) Water Resources Planning Staff has developed this local implementation plan to 1) determine levels of potential sediment reduction and the range of costs to achieve these levels; 2) provide practical information to the local growers and SCS Patterson Field Office for implementation of sediment reduction practices: and 3) recommend a strategy for implementation including institutional changes, regulatory needs, funding opportunities, and a time schedule for improvements.

Previous studies identified the West Stanislaus Study Area as the main contributor of nonpoint source sediment problems in the San Joaquin River. Irrigation induced erosion is the main contributor of the sediment, producing an average of 9 tons of sediment to the river per acre per year, or a total of 1,200,000 tons of sediment per year. The sediment from erosion on cropland is carried off the fields in irrigation tailwater. Organochlorine pesticides, such as DDT, are adsorbed to the sediment carried by tailwater and transported to the San Joaquin River. Studies of fish tissue taken from the river show levels of up to 2.2 mg/kg wet weight DDT, greater than the guideline of 1.0 mg/kg wet weight recommended by the National Academies of Science and Engineering for the protection of wildlife.

This report is presented in three sections, or parts. Part I describes the study organization and study area, discusses the problem assessment, describes the factors affecting erosion and sediment, and determines levels of technically feasible sediment reduction and the cost ranges required to achieve these levels.

It was discovered in Part I that the majority of farms in the study area are relatively small compared to the corporate farms farther south in the valley. While society as a whole sees a great benefit in protecting the San Joaquin River and the Delta, local growers are also interested in reducing off-farm sediment. The cleaner irrigation water produced is of great benefit to growers. Growers prefer to add water to their fields that is not laden with salts, sediment, weed seeds and other contaminants.

There is evidence from past studies within the study area that on-farm conservation practices, singly and in combination, can be effective in reducing sediment loadings into the San Joaquin River and, from there, into the Delta. Economics also plays an important role in addressing the solutions to this problem. Both grower and public perspectives must be taken into account for implementation of sediment reduction practices to be a success. Without an understanding of farm level decision making about conservation practice adoption, public water quality concerns cannot be met in an efficient and socially acceptable manner.

There is a significant diversity in existing farm operations and crops grown in western Stanislaus County. For evaluation and discussion purposes, a "typical" farm operation with "typical" crop rotations was devised with the assistance of the RCD and field office. Estimating potential area wide sediment reduction through the use of the assumed rotations instead of individual crops takes into account that each grower is in a different year of a rotation at any given time. Each field is unique and needs to be evaluated individually before deciding which conservation practices would be most effective.

The conservation practices discussed and evaluated were chosen for their effectiveness in sediment reduction, cost effectiveness, potential grower acceptability, and the fact they are presently being used on farms in the study area. The intent of this report was to demonstrate the wide range of available options and their effectiveness. Interested growers can receive additional information and assistance on other potential practices from the Patterson Field Office.

Critical eroding periods are generally early in the season and following cultivation. A change in management such as reducing the time of set during irrigation during a critical period or eliminating even one cultivation during these times can potentially decrease erosion up to 30 percent.

Conservation practices reduce off-farm sediment by two physical processes: reducing erosion or trapping sediment after erosion has taken place. Irrigation water management is the first step in not only keeping sediment on the field, but also in water conservation. Combined with another practice, such as tailwater tarps, off-farm sediment could be reduced by as much as 80 percent. Proper water management could also reduce the size of sediment basin needed, reducing the cost of installation and maintenance for the basin. Sediment basins were shown in an area study to reduce sediment load up to 95% when properly sized and maintained.

It is important to remember that the success of each practice or system of practices depends on the proper management technique being used. A sprinkler system operated with proper management can have a sediment rate of almost zero, while an improperly managed sprinkler system could be almost as erosive as a furrow system.

The implementation of any of these practices or systems changes the way a grower must operate. Management practices or the cost of doing business may change. Successful implementation will incorporate the new practices into the grower's way of doing things, and growers will choose less costly solutions or supplement more expensive solutions with cost-sharing programs or low cost loans.

It was impossible to calculate costs and sediment reduction for every combination of practices. The practices and combinations of practices that were evaluated were divided into three categories based on effective sediment reduction: moderate (50% or less reduction), significant (89% or less), and near complete (90% to 100%). The significant reduction category compares to the 300 mg/l sediment goal met in the Spanish Grant project, a local demonstration project implemented in the early 1980's.

The costs per acre per year for near complete sediment control in the study area range from $26 for a sediment basin with tailwater tarps and cutback streams to $108 for a sediment basin with a complete surge/gated pipe system. It is important to remember that these are average costs based on a "typical" farm. Costs will vary for each field, crop, grower, and whether cost-share money is available.

The report emphasizes that the best solution is a local solution. Local growers should try and solve the problem with methods that are easy for them to integrate into their existing business and not wait until solutions are dictated by a regulatory agency.

Part II of the report provides practical information to the local growers and SCS Patterson Field Office in the form of conservation practice sheets, a conservation story describing a grower's decision making process working with the SCS Field Office, and a field office toolbox to aid in streamlining the conservation planning process for the field office staff.

In Part II the "typical" farm and crop rotations are diagrammed. The farm size is 160 acres with 152.2 acres in crop production. An earthen head ditch using tarps and siphon tubes was chosen as the present method of irrigation. Average furrow slopes are 0.5 feet per 100 feet and average cross slopes are 0.2 feet per 100 feet. There are five common rotations representing the many crops grown in the study area. Orchards are considered the sixth rotation.

A section is included in Part II describing the factors involved in irrigation water management and how these factors affect furrow erosion.

More information concerning the evaluated conservation practices can also be found in Part II. Advantages and disadvantages, a range of possible installation and maintenance costs, and potential sediment reduction for each practice are supplied for informations. It is recommended that each grower discuss the practices with the RCD or SCS Patterson Field Office to see how potential practices would apply to the grower's particular situation.

A case farm study is included to describe the step by step decision making process a grower encounters when working with the SCS on a farm conservation plan. Emphasized is the value of applying practices incrementally, and to work to develop a plan complementary to the existing farm.

The Field Office Toolbox provides "tools" that can be used to develop individual conservation plans and properly design systems of practices. The computer models FUSED, FURROW, FURROW4, and AGWATER are discussed for use in erosion, sediment, and water management estimates. Engineering nomographs are presented to rapidly estimate the size and costs needed for a sediment basin, based on field size and sediment yield. Example cost data sheets are provided for each individual conservation practice to help the field office staff assist the landowner in evaluating the economic impact of the practice. The figures used are average costs, and each sheet needs to be adjusted for a specific field, crop, and grower. The economic worksheet can be useful to the field office in assisting the grower to evaluate different conservation practices.

Part III presents implementation strategies for three levels of implementation: voluntary action, regulatory-based encouragement, and regulatory action. The role of local agencies and groups is stressed. A timeline provides an annual time schedule for improvements. The time frame is designed to follow the guidelines set up in the new Inland Surface Water Plan. The Inland Surface Water Plan is a new statewide policy adopted in April 1991 to set water quality objectives on all waters of the state. Ideas are also given for the drainage entity that is required under the Inland Surface Water Plan. Financial and technical information sheets are included to provide information on programs already in place that might be able to provide assistance. A question and answer sheet was developed to help highlight important points of the report to growers.

Voluntary strategies include targeting certain groups, establishing a grower network, creating a community progress map, providing a goal for the growers to meet, providing an education and information campaign promoting the adoption of conservation practices, and encouraging the use of the SCS long-term agreement rather than annual plans.

It is stressed that local county groups and irrigation districts can take the lead and work with the Regional Board to establish local goals and a time schedule for implementation. Working with the growers to reduce water use would meet the irrigation districts needs for water conservation as well as being the first step towards erosion and sediment reduction.

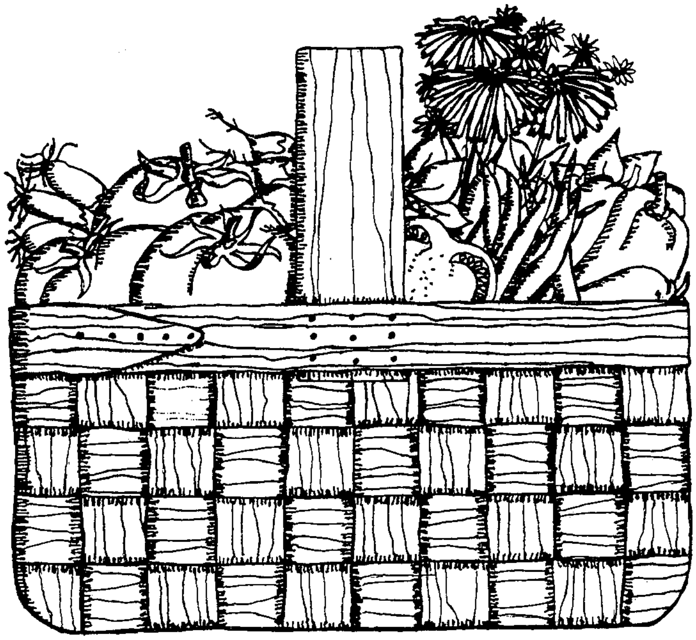
Regulatory-based encouragement strategies include developing a group to oversee implementation in the watershed which could also function as the drainage entity. Irrigation districts are encouraged to adopt price tiering to curtail the use of irrigation water. Districts contracted to the Bureau of Reclamation can utilize the services offered by the Bureau to expand their on-farm assistance. The Agricultural Stabilization and Conservation Service could change their cost-sharing policy and require training on management practices for cost-share eligibility. These institutional changes are possible steps that can be implemented to potentially obtain a waiver that would hold off the regulatory action of a Waste Discharge Permit (WDR).

Regulation is the last step of the three tiered process. The Regional Board has the authority to issue WDRs to regulate discharges into State waters. The WDRs specify the type, amount and concentration of pollutants that may be discharged, sets time schedules for improvement, and requires self-monitoring. If goals are not met, growers could be fined or not allowed to discharge tailwater off-farm. Once a WDR is issued, there is no flexibility for the grower to find solution or time frame that best suits personal needs.

The SCS sociologist estimated a 71 percent participation rate, affecting 81,000 irrigated acres in the study area. This would translate into a 67 percent reduction of sediment reaching the San Joaquin River from the study area. A local long-term monitoring program will be more effective but also needs to meet state and federal objectives. Growers would like to have an attainable goal to reach, and to be reassured they will be given the time needed to meet those goals.

The conclusions reached indicate the problem needs to be solved locally, on a watershed basis. An entity needs to be formed of local agencies and people to encourage a long-term commitment to water shed management. Flexibility of choices available to growers for sediment reduction will encourage voluntary implementation. Incentives to local growers to implement practices include cost-share funds and the potential for cleaner irrigation water in the future.

PART I
SEDIMENT REDUCTION PLAN



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CHAPTER I

STUDY ORGANIZATION AND PURPOSE

INTRODUCTION

The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) in California has developed a five-year Water Quality Action Plan outlining the objectives and nature of SCS's involvement working through Resource Conservation Districts in the prevention and treatment of nonpoint source pollution (NPSP) problems in California. One of the principal roles for SCS is to provide technical data and assistance to agencies and others who are charged with planning and implementing measures necessary to meet both federal and state water quality objectives. The primary focus of SCS water quality efforts in California includes technical recommendations that reduce soil erosion and improve the management of irrigation water.

The West Stanislaus Resource Conservation District (RCD) and the Central Valley Regional Water Quality Control Board (Regional Board) have recognized the need for a plan addressing the NPSP problems of western Stanislaus County through the use of on-farm management and structural practices. This plan:

1. Determines levels of potential sediment reduction and the range of costs to achieve these levels;

2. Provides practical information to the local growers regarding long-term objectives, detailed technical descriptions, and economic evaluations of the on-farm solutions;

3. Recommends a strategy for an implementation plan to control sediment from western Stanislaus County including institutional needs and changes, policy and management needs, funding opportunities, and a time schedule for improvements.

This Sediment Reduction Plan fits into the SCS five-year Water Quality Plan and provides the means for the RCD and the local SCS Field Office to work toward solving NPSP problems using local resources and input.

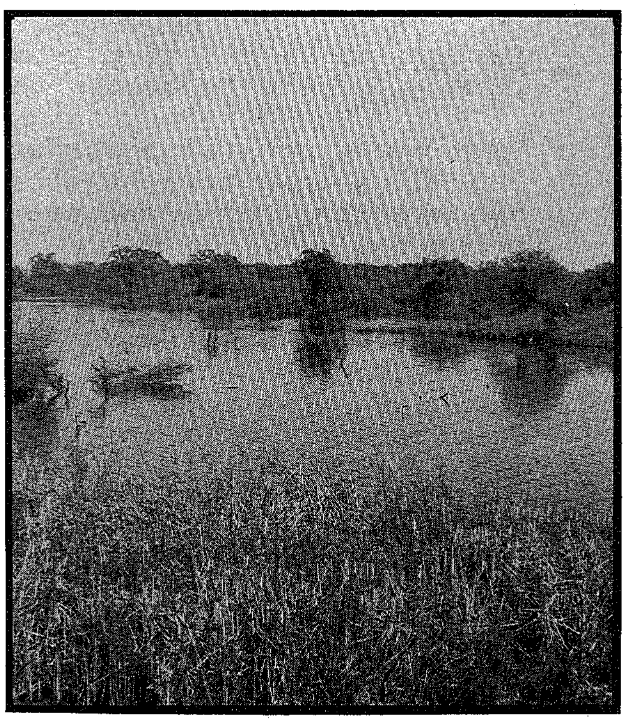
AUTHORITY

The USDA is engaged in Cooperative River Basin Studies in California. Section 6 of the Watershed Protection and Flood Prevention Act, Public Law 566, 83rd Congress, 68 Stat. 666 as amended, authorized the U.S. Department of Agriculture to provide planning assistance to federal, state and/or local agencies. These studies focus on specific water, land, and related resource problems and solutions, and may include erosion and sediment control, flood prevention, irrigation, drainage, water quality, water supply, recreation, fish and wildlife, and other concerns. The Sediment Reduction Plan for the West Stanislaus Study Area is one of several River Basin Special Studies conducted under the current "California Special Studies" authority.

BACKGROUND

In 1984 the U.S. Environmental Protection Agency concluded that NPSP was a leading cause of the nation's remaining water quality problems. In agricultural areas, surface irrigation with tailwater drainage is responsible for the discharge of eroded soil and other agricultural pollutants into public streams and other waterways.

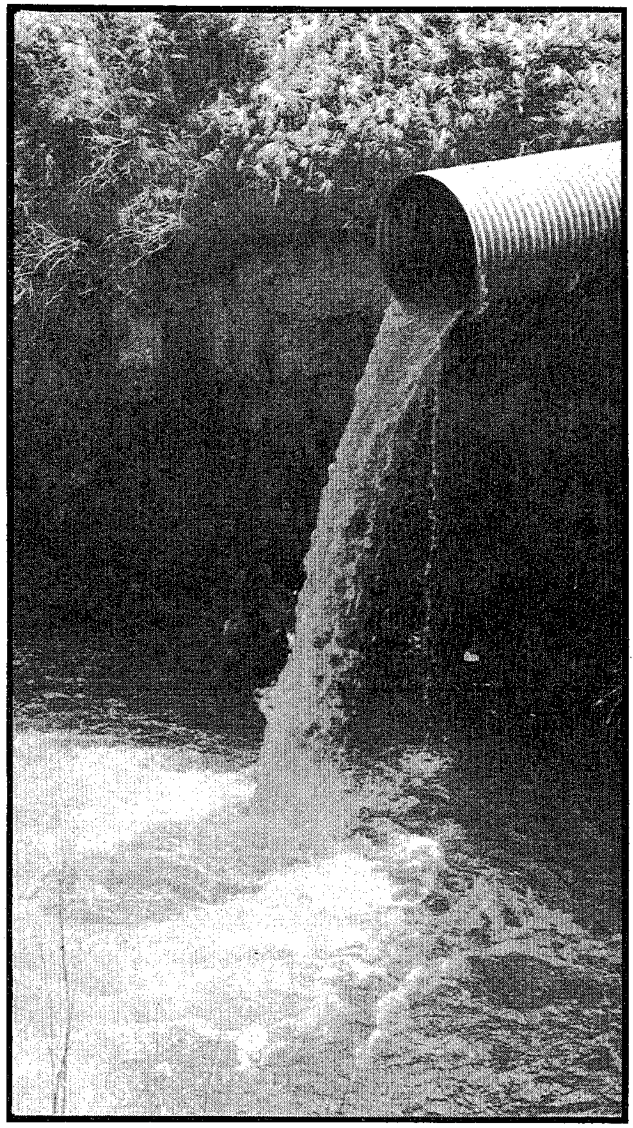
The Federal Water Pollution Control Act of 1972 established the national goal of "fishable and swimmable waters". Recognizing that point source control alone would not achieve this goal, Section 208 of the 1972 Act required the development of area-wide planning programs to involve Federal, State, regional and local governments in a coordinated effort to address NPSP problems. In 1987, Congress shifted from 15 years of NPSP planning and problem identification to a new national NPSP action program. This updated version is called the Clean Water Act. Section 319 of the Clean Water Act requires each state to submit an assessment of its NPSP problems, prioritize them, and submit a management plan to control and reduce the problems. The California State Water Resources Control Board developed the assessment and prioritized three areas of concern in California: acid mine drainage, urban storm runoff, and agricultural drainage.



SAN JOAQUIN RIVER

Currently, 100 miles of the San Joaquin River are included in the list of impaired water bodies in the 1990 California State Water Resources Control Board Water Quality Assessment. Previous studies pinpointed the West Stanislaus study area as the highest contributor of sediment-borne contaminants affecting beneficial uses of the San Joaquin River.

A variety of erosion processes may take place: sheet, rill, gully, streambank, wind, road, and irrigation induced. The amount of eroded soil material delivered to the San Joaquin River depends on the land use, the inherent erodibility of the soils, the type of erosion, the transportability of the soil material, and the distance from the river. Some sediment remains in suspension and some is deposited downstream.



DRAIN OUTFALL INTO SAN J0AQUIN RIVER

The physical and chemical characteristics of the sediment reaching the San Joaquin River are the two principal factors involved in the sediment pollution concerns of this area.

Sediment can physically cause damage to the aquatic habitat, increase maintenance of canals and ditches, increase labor and maintenance costs on-farm, and eventually become deposited on the bottom of the San Joaquin River, reducing its water carrying capacity.

While the background concentration of total suspended sediment in the San Joaquin River is 40 milligrams/liter (mg/l) in the winter, concentrations of 3,600 mg/l have been measured in the drains in West Stanislaus during the irrigation season, creating the concern of what physical impacts may be occurring in the San Joaquin River at this time.

Sediment can also cause damage through chemical means. Some of the fine-grained soil particles reaching the river carry organochlorine pesticide residues. These pesticide residues, primarily of the DDT family, may accumulate in the tissues of organisms high in the food chain from the bottom feeding invertebrates which consume the contaminated sediments.

According to the U.S. Geological Survey, these contaminated sediments have been determined to be the cause of DDT residues in tissue from fish taken from the San Joaquin River [18]. These residues exceed the National Academy of Science recommended safe level of 1.0 milligram/kilogram wet weight.

The West Stanislaus area has been recognized as a consistent NPSP source area due to the combined effects of:

1. The area's physical geography and location immediately adjacent to the San Joaquin River;

2. The extensively altered system of surface and subsurface hydrology;

3. Soils that are derived from coastal range parent material yield fine textured, fertile, and erosive soils;

4. More diversified land use patterns adjacent to the river relative to other areas in the basin.

The area is also considered of importance due to the proximity of the San Joaquin River to the Sacramento/San Joaquin Delta which transfers water for urban and agricultural uses to the southern part of the state. Sediment and other contaminants from the West Stanislaus area may reach the Delta.

OBJECTIVE

The objective of this study was to prepare an implementation plan or framework for reducing the sediment load from western Stanislaus County to the San Joaquin River. This included:

1. A review of presently available data for development of needed technical work;

2. Technical and economic analysis of conservation practices to determine their effectiveness in reducing erosion and sediment, and the impact on farm income;

3. A recommended technical approach for sediment control including cost analysis;

4. A recommended strategy for an implementation plan to control or reduce sediment and a time schedule for improvements.

SCOPE OF THE STUDY

Based on the results of previous studies, several conclusions were drawn for directing the scope of this study.

1. This study used existing data and technology to assess the impact caused by total sediment load. While it has been determined that western Stanislaus County is the major source of organochlorine contamination to the San Joaquin River, not enough information was available to identify specific sources or transport mechanisms. This issue should be addressed by future studies.

2. This study addresses erosion from row crops, field crops and orchards, and sediment delivery to surface drains. While rangeland in this area can produce up to 1.0 ton/acre/year of sediment, sediment loads from cropland can create more problems for receiving water bodies due to use of agricultural chemicals and the seasonal nature of irrigation induced sedimentation. Rangeland therefore was not included in the scope of this study.

ROW CROPS

3. The scope of this study was limited to irrigation induced erosion. The rainfall induced sheet and rill erosion rate on irrigated lands is low (approximately 0.2 tons/acre/year), while the irrigation induced erosion rate is quite high (4.7 to 14.7 tons/acre/crop).

PHASES OF THE STUDY

Phase I of the study consisted of using available data and technology to relate erosion and sediment reducing conservation practices (practices) to economic costs. This was done for various alternative levels of treatment and cropping systems. Alternative levels of treatment range from existing conditions to the effect of a combination of practices for partial control to total sediment control. The cost and effectiveness for each level of treatment at solving total sediment loading was estimated.

Phase II provides a framework for implementation of the needed alternatives. The role of all agencies and groups at the local, county, state and federal level was outlined. Financial incentives and regulatory options were also explored. Recommendations for institutional changes and mechanisms for implementation are described. Cooperation and coordination between agencies will be necessary for successful implementation of this plan.

CHAPTER II

STUDY AREA DESCRIPTION

LOCATION AND SIZE

The West Stanislaus study area is located approximately 70 miles southeast of San Francisco, California. (See Figure 1.) The area is bounded by the San Joaquin River to the east and, for the most part, by Interstate Highway 5 to the west. There are some portions of the study area west of Interstate 5. The Stanislaus/Merced County line and the Stanislaus/San Joaquin County line are the south and north boundaries, respectively.

The study area contains approximately 134,000 acres or 209 square miles. Eight creeks and 18 main agricultural drains convey irrigation runoff and sediment to the San Joaquin River.

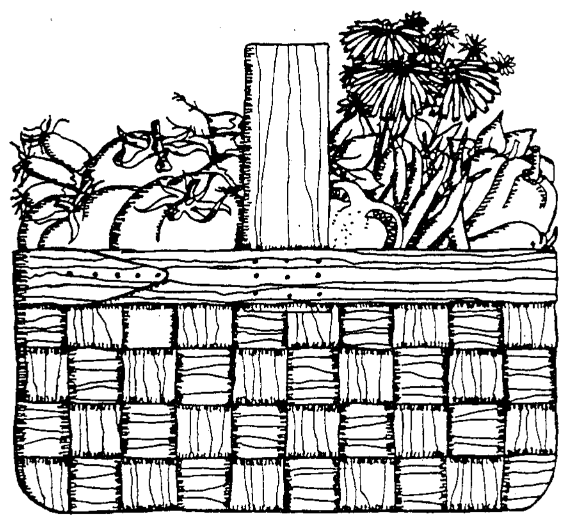
POPULATION AND DIVERSITY

The 1990 Census shows a total of 5,678 people living in the rural areas of the study area, excluding the towns of Patterson and Newman. Of this population, 60 percent identified themselves as White, 0.1 percent as Black, 2 percent as American Indian, 0.4 percent as Asian, and 37 percent chose "Other". Of the total 5,678, 55 percent also indicated they were of Spanish origin. In addition to the rural population, there are 9,298 people living in and around the town of Patterson and 4,656 people living in and around the town of Newman.

Of the 1,823 total employed persons in West Stanislaus over 16 years of age, 833, or 46 percent, worked directly in the agriculture industry. California Employment Development Department Data for 1988 and 1989 indicates that there are approximately 3,500 seasonal farm workers employed on-farm in Stanislaus County every year. The Department estimates that 80 percent of these individuals are Hispanic.

ECONOMIC IMPORTANCE

Stanislaus County, with its favorable climate, deep, well drained soils, and a developed irrigation infrastructure in place, contributes tremendously to California's agricultural output. According to the Stanislaus County Department of Agriculture 1990 annual crop report, Stanislaus County ranks first or second in California in the



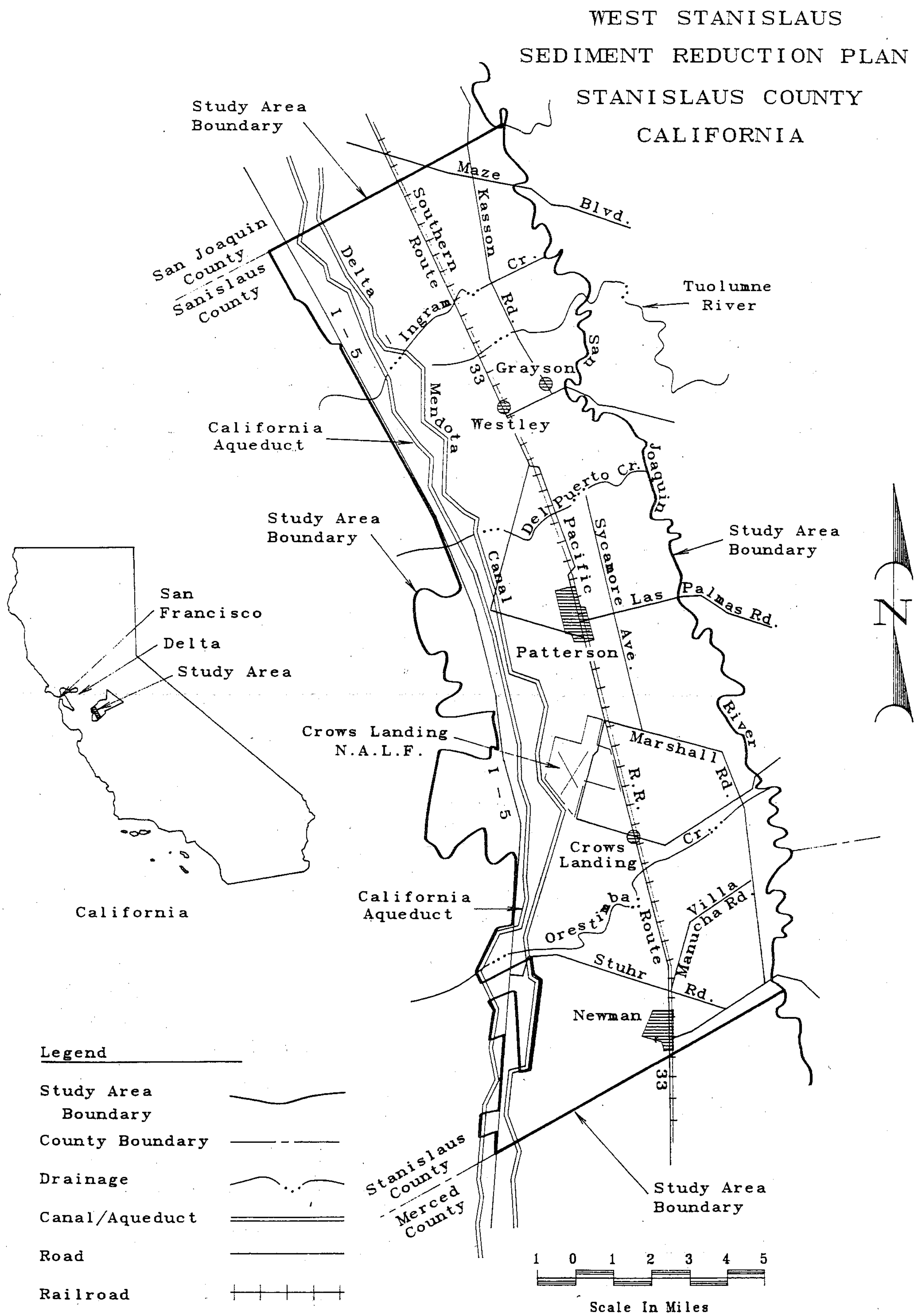

WEST STANISLAUS
SEDIMENT REDUCTION PLAN
STANISLAUS COUNTY
CALIFORNIA
Study Area Boundary
Maze Blvd.
Southern Route
Kasson Rd.
Cr.
San Joaquin County
Sanislaus County
Delta
Ingram
I - 5
Tuolumne River
San Joaquin River
Grayson
33
Westley
Mendota
California Aqueduct
Del Puerto Cr.
Pacific
Sycamore Ave.
Study Area Boundary
Canal
Las Palmas Rd.
N
San Francisco
Delta
Study Area
Patterson
Crows Landing N.A.L.F.
Marshall Rd.
R.R.
Crows Landing
California
California Aqueduct
Orestimba
Route
Villa Manucha Rd.
Stuhr Rd.
Newman
Legend
Study Area Boundary
County Boundary
Drainage
Canal/Aqueduct
Road
Railroad
Stanislaus County
Merced County
Study Area Boundary
1 0 1 2 3 4 5
Scale In Miles

Figure 1

production of dry beans, almonds, apricots, and casaba, crenshaw, and honeydew melons.

Six of the top ten commodities in Stanislaus County are almost exclusively grown in California, indicating the importance of the county's agricultural production to the nation as well. The gross agricultural income in Stanislaus County for 1990 exceeded one billion dollars.

CLIMATE

The climate of the San Joaquin Valley is hot and dry during the summer months and cool and wet in the winter months. Irrigation is necessary to produce nearly all crops.

The mean length of the frost-free period for most of the region is over 250 days annually. This permits a variety of crops to be produced and also allows more than one crop per year. Average annual precipitation for most of the area is in the 10 to 12 inch range, occurring primarily from November to May. The region has been experiencing a drought for five years.

SOILS AND GEOLOGY

The study area is underlain by alluvial fan deposits originating from the marine and non-marine rocks of the Coast Range, and by flood plain and channel deposits along the stream channels. The alluvial fans (90 percent of the study area) are composed of unconsolidated layers of sands, silts, gravels, and clays. Typically, the finer particles are deposited farther from the hills. Channel deposits occur near the San Joaquin River and are composed of chiefly sand and gravel. Flood plain deposits also occur near the San Joaquin River and are smaller grained than the channel deposits, usually comprised of sand and silt.

Different soil series have formed on the different geomorphic surfaces. The Columbia-Bolfar-Merritt association is located on the flood plain. This association includes very deep, poorly and somewhat poorly drained, moderately fine and coarse textured soils. These soils are located on the flood plain and are subject to flooding. The major soils in this unit are suited to irrigated crops. Limitations include depth to high water table in some areas and rare to frequent flooding. Most deep rooted perennial crops are limited by the high water table for this unit.

Six soil associations are found in the interfan basins, on the low alluvial fans or the older alluvial fans. The soils are very deep, poorly to well drained, and have nearly uniform texture with depth. The soil associations include Capay-Vernalis-El Solyo, Vernalis-Zacharias-Salado, Capay, Zacharias-Stomar, Dosamigos-Deldota, and Pedcat.

Capay-Vernalis-El Solyo soils are very deep, moderately well drained or well drained medium and fine textured that are subject to artificial wetness. These soils formed in the interfan basins and low alluvial fans. A high water table has developed at a depth of two to four feet due to the application of irrigation water. The major soils in this unit are used for irrigated crops and some homesites. Limitations include slow permeability and depth to a high water table. Most deep rooted perennial crops are limited by the high water table for this unit.

Vernalis-Zacharias-Salado soils are very deep, well drained moderately coarse and moderately fine textured. These soils formed on the low alluvial fans. The major soils in this unit are used for irrigated crops and some homesites. Limitations include the hazard of wind erosion for Salado soils.

Zacharias-Stomar soils are very deep, well drained moderately fine and fine textured. These soils formed on the older alluvial fans. The major soils in this unit are suited for irrigated crops and some homesites. Limitations include the slow permeability of the Stomar soils.

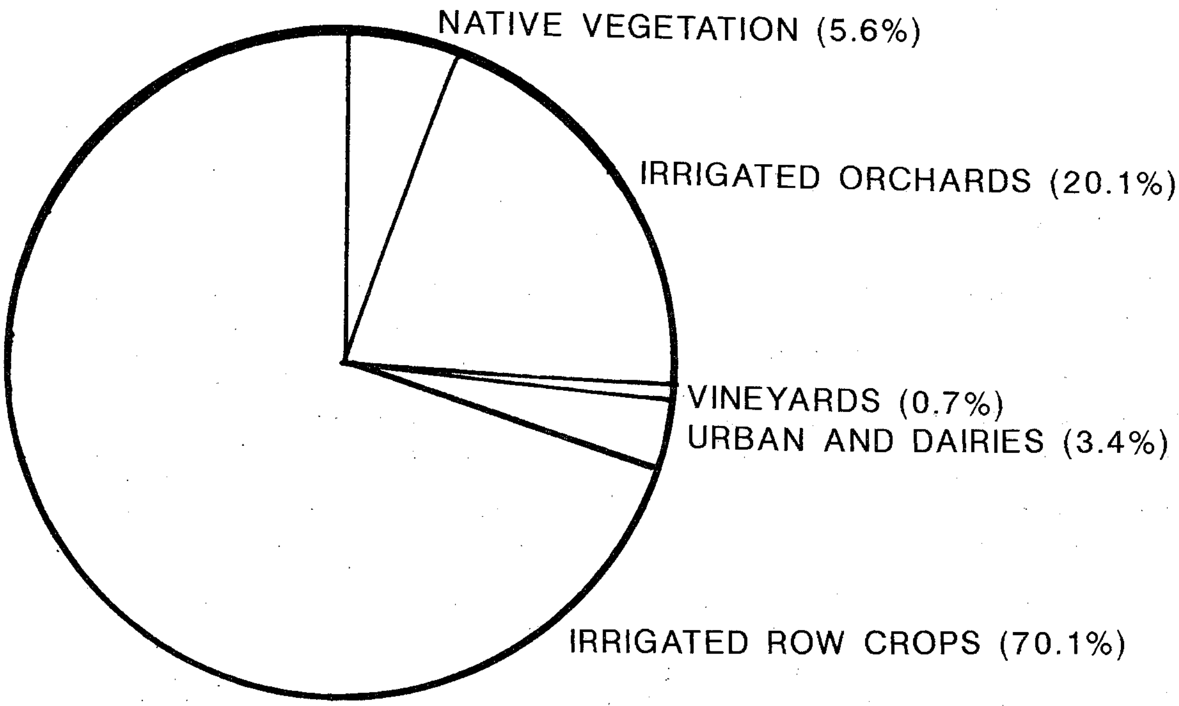
Capay soils are very deep, moderately well drained fine textured soils formed in the interfan basins. The major soil in this unit is suited for irrigated crops with some homesites. Limitations are due to a slow permeability.

Dosamigos-Deldota soils are very deep, somewhat poorly drained fine textured soils that are partially drained on low alluvial fans. The soils are suited for irrigated crops with some homesites. Limitations include saline-sodic conditions of the Dosamigos part, slow permeability, and the depth to a high water table. Most deep rooted perennial crops are limited by the high water table for this unit.

Pedcat soils are very deep, poorly drained fine textured saline-sodic soils on the low alluvial fans. It is suitable for irrigated crops with a few homesites. Limitations include saline-sodic conditions, depth to high water table, and very slow permeability. Intensive management is required to reduce salinity and maintain productivity. Most deep rooted perennial crops are poorly suited for this unit.

LAND USE

There are 134,000 total acres in the study area. Approximately 122,000 acres are irrigated farmland, 94,000 acres are in irrigated row and field crops, 27,000 acres are in irrigated orchard, and 1,000 acres are in irrigated vineyards. Urban land, feedlots, and dairies total 4,500 acres and there are 7,500 acres of natural vegetation occurring along the riparian corridor of the San Joaquin River.



LAND USE

The row and field crops are primarily furrow irrigated and are typically grown in 2- to 8-year crop rotations, often double cropped. At any given time, 25 percent of the row and field crop acreage is in alfalfa. The most common crops grown are dry and green beans, peas, tomatoes, broccoli, cauliflower, spinach, and sugar beets. The major orchard crops are almonds, walnuts and apricots. Less predominant orchard crops are cherries, apples, peaches, nectarines, pears and plums. Both furrow and sprinkler irrigation are commonly used on orchards.

WATER USE

There are a total of 18 irrigation districts conveying the water from the sources to the growers in the study area.

Surface irrigation water in the West Stanislaus study area is largely derived from three sources: the Delta Mendota Canal, the San Joaquin River and the California Aqueduct. The Aqueduct and the Canal provide high quality water that is low in salts and suspended sediment. Water from the San Joaquin River must be pumped upslope and gravity fed to farms. This water is often high in suspended sediments, salts, and trace elements. Some ground water is also pumped for use in irrigation and is often high in salts and trace elements.

PREVIOUS AND ON-GOING STUDIES

Local, state and federal agencies and organizations are aware of the NPSP problems affecting the San Joaquin River and have cooperated extensively to find solutions.

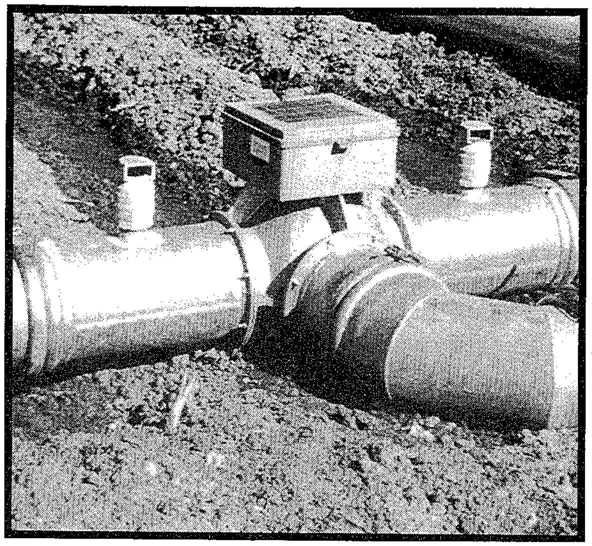
In 1978, the Orestimba RCD (predecessor of the West Stanislaus RCD), the Regional Board, and the SCS sponsored Charles Gustafson, a private consultant, who published "A Water Quality Study for Spanish Grant Drainage District and Crow Creek Watershed". The study focused on the dissolved and suspended solids concentrations of various irrigation sources and drain waters. The study presented the results of laboratory analysis, interpreted the results, and proposed some solutions for the improvement of water quality in the San Joaquin River. The solutions analyzed were sprinkler systems, gated surface pipe, modified drain ditches, sediment basins, and return flow systems.

In 1979, the SCS published a generalized map of eroding areas for the entire Central Valley Region [44]. The map highlighted western Stanislaus County as one of the areas in the region with high potential for water erosion. In that same year SCS published "Sources of Sediment", which focused on sediment and sediment control in eight areas identified on the eroding areas map. One of these areas was the Spanish Grant Drainage District and Crow Creek Pilot Study Area, which is within the West Stanislaus Study Area.

This report calculated the sheet and rill erosion rates in the study area at 0.2 to 0.6 tons/acre/year, relatively low. Streambank and gully erosion rates were also calculated and when divided by the size of the contributing watershed were also found not to be high. Although not a focus of the report, irrigation induced erosion was estimated to range from 1.9 to 7.3 tons/acre/year.

In 1980, utilizing data from previous studies, the West Stanislaus RCD submitted an application to the State Water Resources Control Board for funds from the Clean Water and Water Conservation Bond Act of 1978. The application was approved and the funds were used to provide 50 percent cost share not to exceed $75,000 per landowner in the Spanish Grant area for the installation of conservation practices to control NPSP and for water conservation. During the 1980's, sixteen projects were installed using $350,000 of State Assistance Funds.

In 1985, the University of California Cooperative Extension and the SCS cooperated in a field trial demonstrating surge irrigation, as compared to the more commonly used continuous flow irrigation [35]. Results of the trial indicated that surge irrigation technology can reduce total irrigation runoff by 56 percent and the sediment leaving the field by 44 percent.



SURGE IRRIGATION SYSTEM

In 1987, the West Stanislaus RCD published an evaluation of the 16 Spanish Grant cost share projects titled "Spanish Grant and Crow Creek Watershed Report on Water Quality and Best Management Practices" [33]. They concluded that conservation practices can effectively reduce the concentration of suspended sediment in surface drainwater and achieve a 20 to 90 percent reduction in the total amount of discharged sediment. These practices yielded improvements in water conservation as well. These growers continue to receive annual operation and maintenance inspections and technical assistance on irrigation water management.

In 1987, the U.S. Geological Survey released a report concluding that residues of the DDT family of organochlorine pesticides are widespread in the fine-grained bedload sediments of the San Joaquin River and its tributaries despite "non-use of these pesticides for the past decade" [19]. The highest concentrations were measured in the bedload sediments of the eight Westside tributary creeks. The study indicated that most of the loading is from Western Stanislaus County. The high concentrations of organochlorines in the bed sediments of the tributaries, and most likely in the surrounding soils, are a potential long-term source of these contaminants to the San Joaquin River.

In 1989, the SCS Patterson Field Office completed an assessment for the Regional Board [39]. Weekly measurements were made of drain flow and total suspended sediment. From these measurements, sediment yield for the 18 main drains and eight creeks in the area were estimated. The impacts of alternative methods of pre-irrigation on sedimentation were identified and evaluated.

Current projects include a three year agreement with the U.S. Navy and the SCS Patterson Field Office to study NPSP discharge from 1,100 acres of outlease agricultural fields on the Crow's Landing Naval Auxiliary Landing Field. The SCS will prepare an appropriate NPSP management plan to keep discharges within state water quality standards. The West Stanislaus RCD and SCS recently received approval for funding a demonstration project under Section 319 of the Clean Water Act. Four major elements of the project include: 1) establishing baseline conditions, 2) installing conservation practices, 3) monitoring the effectiveness of the practices on controlling pollutant loads, and 4) transferring the information and technology developed to the local growers.

In 1991, the study area was selected as a Hydrologic Unit Area receiving special U.S. Department of Agriculture (USDA) funds for accelerated assistance for water quality improvements. Under this program, the Patterson Field Office will provide additional technical assistance using additional cost-share funds for conservation practices provided by the Agricultural Stabilization and Conservation Service (ASCS). U.C. Cooperative Extension will provide leadership in the formulation of information and education programs designed to promote understanding and local participation in the project. The West Stanislaus RCD will provide guidance to the USDA agencies and prioritize the projects submitted to the ASCS for cost-sharing. Implementation of these practices will significantly reduce the tailwater flow and water-borne contaminants from reaching the San Joaquin River.

In April 1991, the Inland Surface Water Plan (ISWP) was adopted by the California State Water Resources Control Board. The ISWP will be used to set regulatory controls on the discharge of waste to surface waters. Three approaches for implementation of needed conservation practices are recommended: 1) voluntary implementation of practices; 2) regulatory-based encouragement for implementation of practices; and 3) effluent limitations or discharge prohibitions. Under the ISWP, local drainage entities are established and are responsible for the prioritizing, implementation, and monitoring of local drainages.

CHAPTER III

PROBLEM ASSESSMENT

"Furrow irrigation is an effective means of applying irrigation water to a crop. Unfortunately it can also be effective in removing topsoil." David L. Carter [9]

INTRODUCTION

Irrigation of California's Central Valley has transformed the environment of a once semi-arid valley into a thriving agricultural garden. It has enabled growers to cultivate many crops and supports the economy of many agriculture related industries.

Unfortunately, the primary source of sediment reaching the San Joaquin River comes from eroded soil on furrow irrigated cropland. Much of this sediment comes form the West Stanislaus Study Area. During the irrigation process, water must be available at the end of the furrow long enough to infiltrate the desired amount of water. To achieve this on sloping furrows, which predominate in this area, some runoff is usually necessary. On many fields, water is applied at rates that exceed the infiltration rate of the soil, and generates excessive runoff. The large amounts of excess water running off the ends of the furrows into tailwater ditches can be seen carrying soil particles that have been eroded from the furrows. More soil is eroded as the water moves through the tailwater ditch. By the time the water has reached the drainage ditch, it has become chocolate brown in color.

An assessment was made of the average annual streambank erosion from natural streams and drains into the San Joaquin River. The direct volume method was used based on streambank segments in the study area. Comparing the total tons from bank erosion with total suspended solids (TSS) data collected in July and August, 1988, it was found that the TSS measurement was higher than could be accounted for by streambank erosion alone. Streambank erosion does not appear to be a significant factor in the total erosion and sedimentation problems.

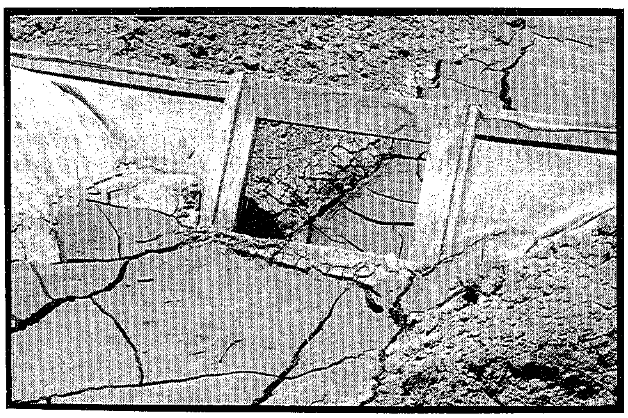
SEDIMENTATION

Sediment in irrigation tailwater impairs water quality and reduces the suitability of the water for other uses. Sediment plays an important role as a pollutant, not only because of the large volume produced, but also because of the agricultural chemicals that may be found attached to the sediments leaving cropped lands. Sediment pollution impairs domestic, industrial, recreation, and fish and wildlife water uses. Sediment is also a significant contributor to the aggradation of the San Joaquin River and reduces its capacity to carry flood waters. Figure 2 demonstrates the process connecting erosion from irrigated cropland and orchards with suspended sediment in the San Joaquin River. Soil eroded from irrigated farmland is carried by tailwater to the river where it remains in suspension or, given time, settles out of the water and is deposited on the river bed. The suspended sediment impairs recreational values, adversely impacts habitat and may carry adsorbed pollutants such as organochlorines. The suspended sediment will eventually settle out and become bedload sediment. Any adsorbed pollutants will be taken up by the benthic organisms and find their way into the food chain.

The greatest concentrations of total suspended solids (TSS) occur in the San Joaquin River from June through August, during the peak irrigation season. At this time, measurements of up to 3,600 mg/l TSS have been taken in area drains discharging into the San Joaquin River. The background level of the river is 40 mg/l in the winter. During the dry summers, inflows to the river are primarily irrigation return flows.

Suspended sediment creates turbidity that can be high enough to kill fish by suffocation. Turbidity also effects organisms by reducing light availability and the production of primary food, limiting visibility for sight feeders, impairing respiration for filter feeders and directly damaging body structures. Sediment can impair reproduction of some fish species. Salmonids are especially susceptible to sediment effects. The National Academy of Sciences and the National Academy of Engineering suggests 80 mg/l to 400 mg/l suspended solids concentration in a stream is unlikely to support good freshwater game fisheries. Levels above 400 mg/l would support only poor quality fisheries [36].

Suspended sediment settling out in drain ditches, canals and tributaries creates maintenance problems for the county, irrigation districts and landowners. Thousands of dollars are spent annually for personnel and equipment to remove sediment from channels. The build up of sediment in the channel bottoms reduces the carrying capacity of the channels and could contribute to increased flooding.



SEDIMENT IN DITCH

Deposited sediment, or bedload sediment, changes stream habitat through scour, abrasion, and deposition.

WEST STANISLAUS
PROBLEM STATEMENT

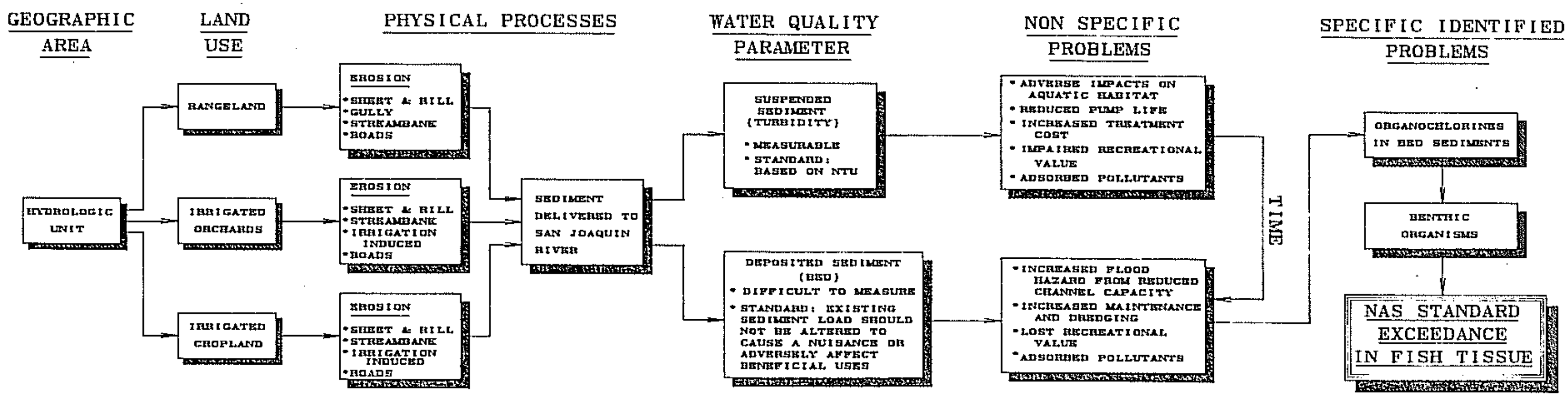


FIGURE 2

SEDIMENT YIELDS FROM IRRIGATED LAND

The FUSED model was used to predict the sediment values in tons/acre for some of the furrow irrigated common crops grown in the study area. The Universal Soil Loss Equation (USLE) was used to predict erosion rates from which sediment values in tons/acre was determined for sprinkler irrigated orchard crops. Off-farm sediment values for orchards average 5.2 tons/acre/year.

TABLE 1
SEDIMENT RATES IN TONS/ACRE FOR
COMMON WEST STANISLAUS CROPS

Crop	Off-Farm Sediment (Tons/Acre/Crop)
Oats	4.7
Tomatoes	12.5
Dry Beans	9.3
Green Beans	11.8
Cauliflower	14.7
Peas	8.3
Sugar beets	10.9
Melons	6.8
Corn Silage	11.1

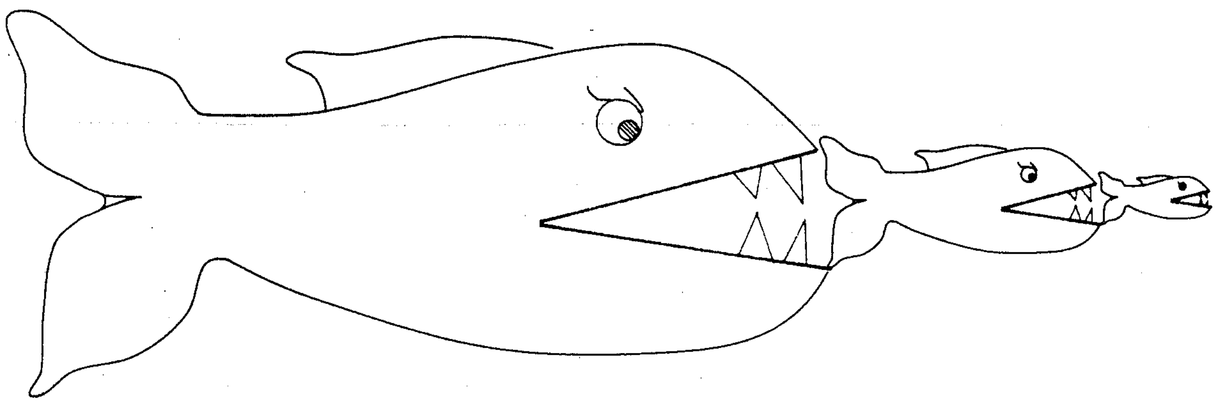
Areawide almost 1,200,000 tons of sediment is produced from irrigated cropland and orchards, in western Stanislaus County every year. Though some sediment is deposited in existing drainage ditches, field observation indicates the field to San Joaquin River sediment delivery ratio is 95 percent. This means most of the 1,200,000 tons of sediment produced finds its way to the river. Each acre of irrigated land in the study area contributes, on an average, 9 tons of sediment to the river each year.

WATER QUALITY CONCERNS

Suspended and deposited sediment in streams degrades the designated beneficial uses of a water body. When tailwater from agriculture contributes to the surface water body, there is also the possibility of pesticide residues being found in the water or attached to the sediment. Some pesticides, such as organophosphate compounds, are highly soluble in water and relatively short-lived in the environment. Organochlorine compounds, such as DDT, are only slightly soluble in water, but their residues may persist in soil, sediment and organisms for many years after they are applied.

The creeks draining into the San Joaquin River from the study area have been determined to be the major source of organochlorine contaminated sediments in the San Joaquin Valley. These contaminated sediments are considered to be the primary cause of levels of DDT residues in fish tissue of up to 2.2 mg/kg wet weight, exceeding the National Academy of Science guidelines of 1.0 mg/kg wet weight. DDT is a pesticide in the organochlorine family that was banned over twenty years ago. The DDT family of pesticides have a tendency to bioaccumulate in the tissues of organisms high in the food chain. In this process, the residues are taken up by the smaller organisms and become concentrated as larger organisms ingest the smaller organisms.

People consuming wild plants and animals such as crayfish, snails, clams, fish and frogs from the river may encounter health concerns. The animals consumed are relatively high in the food chain and tend to bioaccumulate contaminants in their tissues.



BIOACCUMULATION IN FOOD CHAIN

Water soluble nutrients and pesticides also reach the river in the irrigation tailwater. Some of these contaminants are known to cause acute toxicity, fish kills and can be toxic to humans.

During drought years (such as 1988, 1989 and 1990), river flows become low, increasing organic loads in the San Joaquin River. Dissolved oxygen content drops to concentrations low enough to block salmon and other fish species migrating upstream. Low flows also accentuate salinity levels in downstream sections of the river, adversely affecting irrigation water quality.

CHAPTER IV

HOW TO RECOGNIZE FACTORS WHICH MAY BE CAUSING IRRIGATION INDUCED EROSION IN YOUR FIELD

INTRODUCTION

The stream of water applied to each furrow on furrow irrigated cropland in the West Stanislaus Study Area must be large enough to provide sufficient water to irrigate the entire row efficiently. When the stream size is large, erosion in the furrow will usually occur in the upper third of the field. As the water moves downslope in the furrow the stream becomes too small to erode or transport the sediment eroded upslope and the sediment is deposited in the middle of the field. The stream of water is then able to erode sediment off the bottom end of the field.

FURROW EROSION

Observations show that tailwater ditches lower than the furrow ends tend to cause the lower ends of the field to become convex (see Figure 3) as the irrigation season progesses. As the water flows down the furrow on the convex ends of the field, its erosive energy increases, causing the soil in the furrows to erode and be carried away in the tailwater ditch. It has also been observed that many times the flow of runoff water in tailwater ditches is high enough to carry the sediment downstream to creeks and drains and eventually into the San Joaquin River.

Tailwater ditches in the area that carry high volumes of irrigation runoff water are also eroding and adding additional sediment to the San Joaquin River.

EROSION AND SEDIMENTATION PROCESSES

Irrigation induced erosion includes three processes: erosion, sediment transport, and sediment deposition. These three processes are influenced by four factors: 1) physical factors; 2) system factors; 3) water management; and 4) agronomic management.

PHYSICAL FACTORS

SOIL PROPERTIES

The majority of soils in the study area are clays and clay loams which have properties that make these soils potentially very erodible if they are not used and managed properly. When these soils are disturbed by operations such as tillage and cultivation, they become highly susceptible to detachment; especially when large volume, high velocity streams of water move down the furrow. When a field is in this condition, care should be taken to manage the volume and rate of water applied in order to minimize detachment and the resulting sedimentation off the lower end of a field.

IRRIGATION SLOPE

Most furrow irrigation slopes in the study area range between 0.2 ft/100 ft to over 1.0 ft/100 ft. The rate at which soil particles will erode from these furrows is dependent on the relationship between the slope of the furrow, the uniformity of the slope, and the furrow stream size. Low flows on steep slopes can erode. High volumes of flow on flat slopes can also erode. Many fields in the study area do not have uniform slopes or are steeper than average. In order to minimize erosion, management techniques must be employed to insure that the amount of water applied (stream size) does not change the uniformity of the furrow slopes and is not larger than what is needed to sufficiently irrigate the entire row.

WATER QUALITY

The quality of the water you used for irrigation also affects potential erosion. If the irrigation water comes from the Delta-Mendota Canal or the California Aqueduct, the quality of the water is high, being low in salts and suspended sediment. If the irrigation water comes from the San Joaquin River, it will have higher concentrations of salts and suspended sediment. Consequently, the canal water which contains less sediment produces more erosion when used for irrigation than the water containing sediment. Sediment-free water can produce more erosion by its tendency to want to take on a sediment load. The river water, which contains salts and other minerals, can cause the soil to defloculate, making the furrows more susceptible to erosion.

SYSTEM FACTORS

FURROW LENGTH

Many growers in the study area have cut the length of their furrow runs to less than 1,000 feet by adding gated pipe or siphon tube ditches across the width of their fields. This has reduced the furrow stream size needed to irrigate, which in turn has decreased the amount of erosion and sediment produced. Other growers who are still irrigating in furrows longer than 1,000 feet need larger, more erosive streams of water to irrigate the entire furrow.

DEPTH AND SLOPE OF TAILWATER DITCH

The majority of sediment leaving farms in the study area is lost from the lower portion of the field where the outfall of the tailwater ditch is lower than the furrows. This allows eroding headcuts to begin at the bottom of the field and move upstream along the furrow, causing it to become convex shaped at the lower end and increasing the field slope.

An example of a field with a convex end can be seen in Figure 3.

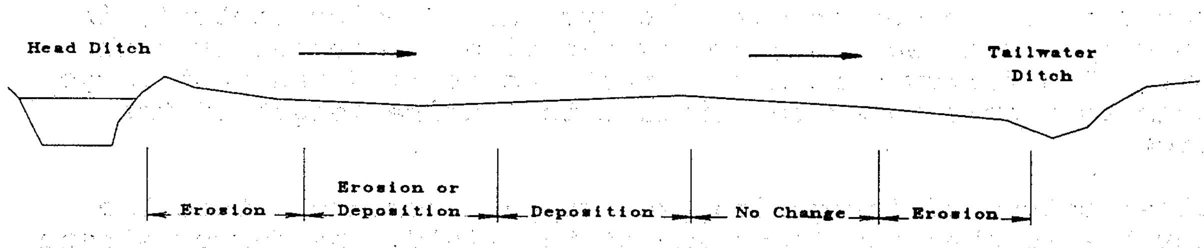


FIGURE 3
SOIL MOVEMENT WITHIN A FURROW

SEDIMENT BASINS, FILTER STRIPS, TAILWATER RETURN SYSTEMS, CONSTRUCTED WETLANDS, ETC.

Although sediment basins and tailwater return systems are used in the study area, many are not properly sized or maintained. Filter strips or constructed wetlands are not widely used in the area as a means of trapping sediment.

While these systems do not affect the erosion process, they trap sediment as it leaves the field and prevent it from entering downstream surface waters. A properly designed sediment basin or filter strip can remove up to 95 percent of the sediment in water, while a filter strip of the proper width at the lower end of the field can remove up to 40 percent of the sediment in water. A constructed wetland can be used to filter out most of the remaining sediment particles from the water before it is reused on the farm or discharged downstream.

IRRIGATION WATER MANAGEMENT FACTORS

Erosion can be minimized if the properly measured stream size is applied for the proper time of set and simply replaces the soil moisture deficit. Good water management requires an irrigator trained on how to apply the water efficiently and to determine the water needs for each crop.

STREAM SIZE

Using too small of a furrow flow will allow too long of an advance time causing poor distribution uniformity and excess infiltration at the upper end of the field. Using too large of a furrow flow can be erosive. The furrow flow must be balanced out to meet all of the factors affecting infiltration and desired irrigation depth.

A field comparison of surge and continuous flow irrigation was conducted in the West Stanislaus Study Area by the University of California Cooperative Extension Service [35]. This comparison showed that the surge system reduced the sediment produced by 44 percent over the continuous flow system. Erosion control, in this comparison, was obtained by avoiding unnecessarily high flows. The furrow stream size that was applied was just large enough to supply water to irrigate the entire length of the furrow.

Another method of irrigation uses cutback streams. Once the water has reached the lower end of the field, the furrow stream size is reduced or cut back to decrease the amount of erosion occurring at that point in the irrigation. Observations also show that the average stream size can vary greatly from furrow to furrow during a single irrigation. Infiltration rates also vary during an irrigation season and can affect water velocity.

FREQUENCY OF IRRIGATION (SCHEDULING)

As shown in field studies conducted in the Spanish Grant Area of western Stanislaus County, with proper water management techniques, water use can be reduced anywhere from 5 to 50 percent.

Proper management requires monitoring the amount of water removed from the root zone by the crop and scheduling an irrigation to replace it. With proper scheduling, you may be able to eliminate an irrigation. Eliminating an irrigation early in the season can very significantly reduce erosion. If not completely eliminated, the irrigation can be scheduled several days after cultivation to reduce the erosion rate.

DURATION OF IRRIGATION (TIME OF SET)

On many fields in the study area the duration or time of irrigation is too long. This can be seen on fields where irrigation water runoff occurs long after the amount of soil moisture required by the crop has been replaced.

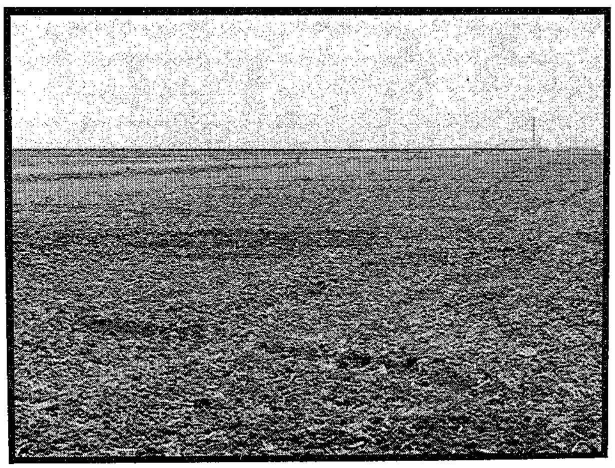
It is important that each grower determine the proper amount of time and volume of water to apply in order to obtain good water management and reduce erosion. Reducing the time of set during critical eroding periods will reduce erosion and conserve water. Critical periods are generally early in the season or following cultivation.

AGRONOMIC MANAGEMENT FACTORS

Every grower in the area should try to plan the cropping rotations and tillage practices in a manner that leaves as much crop residue on the field as possible to protect the soil from erosion and improve soil tilth for good infiltration.

RESIDUE MANAGEMENT

Conservation or reduced tillage leaves a minimum of 30 percent of the field covered with residue after planting. Conservation tillage can be used with grain crops and some row crops. The residue increases the resistance to irrigation water flow, increasing infiltration and reducing erosion. Too much residue can clog furrows, causing streams to cross over to other furrows. Residue alters intake characteristics and requires an adjustment in stream inflow and time of set.



CONSERVATION TILLAGE

TILLAGE OPERATIONS

Analysis of the number of tillage operations done by growers in the study area showed that at least one tillage operation could be eliminated during the growing season for various crops.

Eliminating even one tillage operation can result in a 23 to 30 percent reduction in erosion. Tillage physically breaks the bonds holding the soil particles together and increases the soil erodibility. Tillage also affects crop residue and therefore has a significant impact on erosion.

CROPPING SEQUENCE

Growers in the area should rotate crops in a manner that will maximize the amount of organic residues in fields to maintain and improve soil tilth. This insures better infiltration and reduces erosion. The erosion and sediment rate for any field depends largely on the previously grown crop. Row crop following row crop causes more erosion than a row crop followed by a cereal or legume. The greater the reduced tillage, the greater the effect of the previous crops on future erosion rates.

CALCULATING IRRIGATION INDUCED EROSION

There are different methods to predict furrow irrigation induced erosion. The FUSED (Furrow Sedimentation and Erosion) computer model presently in place at the Patterson Field Office can be used to compare the relative effects various recommended practices have in reducing erosion and sedimentation.

The FUSED computer model was developed by SCS and provides a base sediment rate before evaluating alternative conservation practices on sediment yield and erosion. The average annual sediment yield from a field can be predicted. The model was developed based on actual data from Idaho and Washington for silts and sands, and later expanded by the Agricultural Research Service to include clay soils.

Visual observations of furrow irrigation in the study area show what appears to be sand sized particles saltating (bouncing) down the furrow in the water stream. The water remained clear until midway down the length of the furrow where suspended sediment began to cloud the water. The model underestimated sediment yield rates for the clay and clay loam soils in western Stanislaus County. When the model was calibrated for the clumping activity of the clay, which causes it to act more like silt or sand, the results using the model agreed with measured sediment volumes.

Erosion and sedimentation caused by sprinklers were evaluated using the USLE (Universal Soil Loss Equation).

CHAPTER V

SOLUTIONS FOR SEDIMENT REDUCTION

INTRODUCTION

To successfully implement a sediment reduction plan, the issue must be viewed and understood from the perspective of both the local growers and the public in general.

Growers, like most people operating a business, are interested in maximizing profits. To accomplish this, they must attempt to minimize costs and maximize returns. This is true of the growers in the West Stanislaus area. Irrigation water is relatively inexpensive, and in normal years an abundance of irrigation water flows through the fields. The soils are very deep and productive. The climate is ideal for producing a variety of high quality vegetable and tree crops. Such farming characteristics provide little economic incentive for the individual grower to control sediment movement from the fields. The impacts of the NPSP caused by certain farming activities is faced by the downstream users, or in this case the public and its concern for the San Joaquin River and the Sacramento/San Joaquin Delta.

Water quality of the San Joaquin River and the Delta has been a growing concern over the last few years. Large amounts of DDT-laden sediment and water soluble agricultural chemicals were found in the water which led to several studies. These studies attempted to define the problem and identify ways to improve the water quality. The conclusion has been reached that reduced off-farm sediment could significantly contribute to better downstream water quality. Voluntary reduction of off-farm sediment will delay or reduce the severity of anticipated regulations.

From the grower's perspective, the damage associated with sediment getting into the river was not well recognized and until recently had little influence on the farm operator's decision making process. In the operator's view, the reduction of off-farm sediment may produce cleaner irrigation water, but also yield greater production costs. On the other hand, society as a whole sees a great benefit in protecting the San Joaquin River and the Sacramento/San Joaquin Delta. By providing information that can be used by both the growers and public interest representatives, it is hoped that societal objectives can be met, but in a manner that recognizes the growers' interests and minimizes the impact on the private landowner.

Since the grower often finds it is sometimes actually less costly to erode and discharge excessive tailwater to public surface waters, this report provides direction to the grower in finding compensatory mechanisms, such as cost-sharing, and regulatory based incentives, such as discharge fees. The information provided can lead to mutually agreed upon goals.

ASSUMPTIONS

In order to be able to describe the extent of the current sediment problem in the West Stanislaus study area and to evaluate potential alternatives to reduce this problem, some assumptions were made. They are described below.

TYPICAL FARM OPERATIONS

There is significant diversity in existing farm operations in western Stanislaus County. For evaluation and discussion purposes, some generalizations are required.

Although a varying amount of both owned and leased land is operated in the study area, a typical farm size of 160 acres was established with 152.2 acres actually in production (Figure 5). This farm was divided into six fields. A total of 330 siphon tubes and approximately 14 tarps are required. Land leveling is necessary every eight years with land planing needed annually.

It is assumed the majority of cropland in the study area is furrow irrigated with water delivered from an earthen head ditch using tarps and 1.5 inch siphon tubes. Orchards are evenly divided between sprinkler and furrow irrigation. A tailwater ditch is installed at the bottom of each field that eventually ties into a main tailwater ditch that carries the water off the farm at one centralized location.

These basic assumptions are incorporated in all comparisons of conservation practices (singly and in combination) discussed in this report.

TYPICAL CROP ROTATIONS

The types of practices required to reduce the volume of tailwater and sediment reaching the San Joaquin River will vary with the farming methods and the sequence of crops grown within a crop rotation. The effectiveness of these practices also varies.

Most of the furrow irrigated row and field crops are grown in two to eight year double cropped rotations. The five most common rotations occurring in the study area are used to evaluate the effectiveness of the recommended practices, singly and in combination. Orchards are treated as one rotation. The typical rotations are described in Chapter VI, Table 7. The effects on sediment reduction and economic impacts varies with each crop, each rotation, and the cropping sequence within each rotation.

Each crop rotation, in conjunction with the typical farming operation, results in different sediment delivery rates. A rotation which includes alfalfa produced less sediment over the life of the rotation than a rotation consisting only of row crops. Estimating potential area wide sediment reduction through the use of the assumed rotations instead of individual crops takes into account that each grower is in a different year of a rotation at any given time.

THE CONSERVATION PRACTICES

Soil erosion, transport or deposition can be interrupted at selected points by implementing different conservation practices or systems of practices. Sediment pollution control can be achieved by the grower with management improvements and some capital expenditures.

The conservation practices discussed and evaluated in this report were chosen for their effectiveness in sediment reduction, cost effectiveness, potential grower acceptability, and the fact they are presently being used on farms in the study area. Table 2 describes how the different practices reduce off-farm sediment. Other practices not mentioned may also exist. The intent in this report is to demonstrate the wide range of available options and their effectiveness. It would be impossible to include all possible practices and combinations of practices. No doubt other practices not mentioned may function similarly or be more acceptable to some growers. Interested landowners can receive additional information and assistance on other potential practices from the SCS Patterson Field Office.

COVER CROP IN ORCHARD

To be most effective at addressing the erosion and sedimentation problem, and to make sure that "improvements" do not adversely affect the environment or other farm operations, the selection and implementation of practices must be planned. A system of management and structural practices must usually be applied together. Practices should be designed and installed to eliminate the breeding of vectors such as mosquitoes.

TABLE 2

SEDIMENT REDUCTION PRACTICES DESCRIPTION

Conservation Practice	Process	Effect
Tailwater Tarps (410-Grade Stabilization Structure)	Decrease Slope	Reduces ditch erosion, traps sediment
Land Leveling (464-Irrigation Land Leveling)	Decrease Slope	Reduces water velocity and decreases erosion
Cutback Stream (449-Irrigation Water Management)	Reduce Runoff	Reduce water flow when water reaches end of furrow
Surge Irrigation (449-Irrigation Water Management)	Reduce Runoff	Easier water management, decreases erosion
Sprinkler Germination (442-Irrigation System-Sprinkler)	Reduce Water	Easier water management, decreases erosion
Drip Irrigation (441-Irrigation System-Trickle)	Reduce Water	Easier water management, decreases erosion
Shorten Run (449-Irrigation Water Management)	Reduce Stream Size	Less water needed to reach end of furrow, less erosion
Gated Pipe (430-Irrigation Water Conveyance)	Reduce Runoff	Easier water management, decreases erosion
Sprinkler Irrigation (442-Irrigation System-Sprinkler)	Reduce Runoff	Easier water management, decreases erosion
Filter Strip (393-Filter Strip)	Decrease Water Velocity	Prevents furrow end erosion
Cover Crop (340-Cover Crop)	Decrease Water Velocity	Vegetation holds soil together, less erosion
Grassed Waterway (412-Grassed Waterway)	Decrease Water Velocity	Vegetation holds soil together, less erosion
Conservation Tillage (329-Conservation Tillage)	Decrease Water Velocity	Vegetation holds soil together, less erosion
One Less Cultivation (328-Conservation Cropping)	Binds Soil	Soil not broken up by cultivation, less erosion
Sediment Basin (350-Sediment Basin)	Decrease Water Velocity	Traps sediment

EFFECT OF PRACTICES ON SEDIMENT RATES PRODUCED BY CROPS

The information discussed above was incorporated and used in the analysis of each practice. Without these assumptions, an analysis of the practice effects on an area wide basis would be impossible. The results of an area wide analysis are intended to provide direction for the overall implementation process, as well as provide some tools that can be used to assist individual growers.

The ability to implement each practice varies from farm to farm and from operator to operator. The reduction in sediment each practice produces, for example, will depend on the crop grown or the rotation used. Based on our assumptions, Table 3 shows the erosion or sediment reduction achievable by applying some of the practices to some of the crops grown locally and compared to the baseline or typical farm. Ideally, practices will be combined to make a complete system to reduce the amount of sediment produced to target levels. The effect on sediment by two systems on crops are also shown in Table 3.

EFFECT OF PRACTICES ON SEDIMENT RATES PRODUCED BY ROTATIONS

The baseline or typical farm sediment rate ranges between 5 and 19 tons per acre per year, depending on what crop rotation is assumed. The reason for the variation in rates is primarily a function of the types of crops grown. A rotation consisting of vegetable crops double cropped results in a higher annual sediment rate. Rotations in which a portion of the rotation is in alfalfa produces a lower overall sediment rate. The weighted average sediment rate for the entire study area is nine tons per acre per year. Table 4 shows how effective different practices and systems are in reducing sediment during crop rotations.

Practices and systems reduce off-farm sediment by two physical processes: reducing erosion or trapping sediment.

For example, placing tarps in the tailwater ditch creates a situation like a series of small grade stabilization structures, slowing the water and allowing some of the sediment time to drop out. Tailwater tarps also reduce erosion in the tailwater ditch itself. The sediment can then be respread on the field. The use of tarps alone can result in a sediment reduction of up to 45 percent or produce a reduced sediment rate from 2.5 to 10.5 tons per acre per year if properly installed and operated.

The cutback stream option, or a similar method that reduces the volume of water being applied on the field, can also reduce the amount of sediment leaving a field. By applying less water, a significant reduction in the volume of sediment produced is possible. It is estimated the use of cutback streams can reduce sediment 59 percent or between 2.0 and 7.0 tons per acre per year. The average sediment rate could be reduced to 4.5 tons per acre per year.

TABLE 3

SEDIMENT REDUCTION FROM APPLIED PRACTICE/SYSTEMS BY CROP

Crop	ESTIMATED SEDIMENT RATE W/O PRACTICE (TONS/AC./CROP) (Based on) (Typical Farm)	ESTIMATED SEDIMENT RATE W/PRACTICE (TONS/AC./CROP)				
		CONSERVATION TILLAGE	TAILWATER TARPS	CUTBACK STREAMS	CUTBACK W/TARPS	SURGE AND GATED PIPE
OATS	4.7	1.4	1.2	2.6	0.9	0.7
TOMATOES	12.5	8.9	5.5	4.9	1.9	1.5
DRY BEANS	9.3	6.1	5.6	3.5	1.9	1.6
GREEN BEANS	11.8	8.0	7.1	4.5	2.4	1.9
CAULIFLOWER	14.7	2.0	9.1	5.2	3.0	2.0
PEAS	8.3	3.1	3.8	3.2	1.3	1.1
SUGAR BEETS	10.9	2.9	5.8	4.2	2.3	1.6
MELONS	6.8	5.0	3.1	2.6	1.1	0.9
CORN SILAGE	11.1	8.5	4.2	4.5	1.5	1.2
ORCHARD	5.2	4.0	2.4	2.4	0.9	---

TABLE 4
POTENTIAL SEDIMENT RATE AND REDUCTION
BY APPLYING PRACTICES OR SYSTEMS TO ROTATIONS

Conservation System or Practice	Sediment Rate Range After Implementation By Typical Rotation (Tons/AC./Year)	Average Percent Reduction (All Rotations)
Typical Farm w/row crops	5.0-19.0	
Tailwater Tarps	2.5-10.5	45
Cutback Streams	2.0-7.0	59
Filter Strips	2.5-11.0	45
Conservation Tillage	5.0-18.5	5
Sediment Basin	<0.5	95
Surge w/Gated Pipe	1.0-3.0	80
Tailwater Return System	0.1	99
Tarps w/Cutback Streams	1.0-4.0	80
Cutback Stream w/Gated Pipe	2.0-7.0	59
Tarps w/Gated Pipe	2.5-10.5	45
Tarps w/Cutback & Gated Pipe	1.0-4.0	80
Tarps w/Cutback & Sed Basin	0.5	95
Tarps w/Sediment Basin	0.5	95
Surge w/Sediment Basin	<0.5	95

POTENTIAL SEDIMENT REDUCTION ACHIEVED
BY APPLYING COVER CROPS IN ORCHARDS

	TONS PER ACRE	PERCENT
Permanent Cover Crop	0.4-12 (Sprinkler irrigated on <1 to 7 percent slopes)	95-98
Temporary Cover Crop	0.3-0.5 (Furrow erosion on <1 percent slopes)	13-14

It is technically possible to further reduce the sediment rate by using other practices. Installing a properly sized sediment basin could reduce the off-farm sediment rate by 95 percent or to less than 0.5 tons per acre per year. It would need to be designed to handle a significant volume of sediment and would require regular maintenance. A sediment basin used in conjunction with other practices is another option that would reduce sediment by 95 percent, but would reduce the size of the sediment basin needed.

The application of these practices on orchards will have similar results to the row and field crops. The sediment rate for the present baseline furrow irrigated orchard is 5.2 tons per acre per year. For orchards, converting to sprinkler or drip irrigation provides the greatest reduction in sediment.

IMPORTANCE OF PROPER MANAGEMENT TECHNIQUES

It is important to remember that the success of each practice or system of practices depends on the proper management technique being used. A sprinkler system operated with proper water management can have a sediment production rate of almost zero, while an improperly managed sprinkler system could be almost as erosive as a furrow system.

The use of proper irrigation water management could reduce the size of sediment basin needed by the grower, for example, and therefore reduce the cost of installation and maintenance for the basin.

IMPLEMENTATION IMPACTS TO THE GROWER

The implementation of any of these practices or systems changes the way a grower must operate. While some of the practices result in relatively minor changes, other practice combinations could result in a major change in the farm operation and significantly impact farm net income. Due to the differences in each individual farm operation, only a potential range of cost associated with practices can be developed. This potential range is based on installing practices on the typical farm using the identified rotations. A grower farming steeply sloped land would probably have higher sediment rates and a higher cost to reduce the rate. A grower growing alfalfa will have little sediment leaving the field and would incur less cost for a solution. This, again, emphasizes the need for each grower to work with the local SCS office to find a plan geared specifically for one's field.

Certain variables tend to be important determinants of what the actual change in the net cost is for each practice or system. These variables are:

- the up-front cost of the practice or system;
- the operation and maintenance costs of the practice;
- any increase or decrease in the amount of labor required;
- any decrease in the amount of irrigation water used;
- any increase or decrease in the amount of land in production;
- any increase or decrease in the cost of other farm operations.

The total net change in cost for each system varies depending on the practices involved. One practice may reduce some costs such as reducing irrigator labor, while a different practice may actually increase irrigator labor. These variables are evaluated for each practice so the net impact on the baseline or typical farm operation is known. The net costs associated with the different practices and systems have been determined over a 20-year evaluation period. The applicable costs or returns that change with each practice have been amortized over this period using a 12 percent interest rate.

Table 5 shows the net average annual cost to install various systems. This net cost represents the estimated additional expense necessary to install and operate the practice compared to the baseline or typical farm operation. It can be seen that net cost varies significantly depending on the system. Additional cost details for each practice are found in Part II.

A relatively low cost practice is to install tarps in a tailwater ditch. For the identified typical crop rotations, it has been estimated the net cost would range from $7.00 to $21.00 per acre averaging $14.00 per acre per year. The cost varies depending on the crop rotation. This practice requires the purchase of tarps for the tailwater ditch, plus some additional labor and equipment use in order to install and remove them each time the crop is cultivated. There is also some cost associated with the respreading of the sediment trapped in the ditch. There are no direct savings for the grower from the installation of the practice. In the long run, however, the grower would be preserving the productivity of the land by reducing erosion and may not have to pay fines for not meeting water quality standards.

Another relatively low cost combination of practices is to use the tarps with the cutback stream method of irrigating. In addition to the cost of using the tarps, there would be additional irrigator time each time the field is irrigated. This results in a slightly higher per acre cost range for the typical crop rotations, and an average annual cost of $17.00 per acre per year for an average 80 percent reduction of sediment.

TABLE 5
Conservation Systems or Practices--Net Cost

Conservation System or Practice	Net Avg. Annual Cost/Acre 1/ 2/ (Row and Field Crops) Range of Values	Weighted Average	Cost for Orchards
Tailwater Tarps	$7-21.00	$14.00	$21.00
Cutback Streams	$4-9.00	$6.00	$9.00
Filter Strips	$2-9.00	$6.00	$12.00
Gated Pipe	$57-89.00	$71.00	
Conservation Tillage	($0-48.00) 3/	($12.00)	
Sediment Basin	$18-95.00	$53.00	
Surge w/Gated Pipe	$78-$117.00	$99.00	
Tailwater Return System	$26-92.00	$55.00	
Tarps w/Cutback Streams	$8-26.00	$17.00	$26.00
Cutback Stream w/Gated Pipe	$42-81.00	$61.00	
Tarps w/Gated Pipe	$72-96.00	$83.00	
Tarps w/Cutback & Gated Pipe	$55-87.00	$70.00	
Tarps w/Cutback & Sed Basin	$12-44.00	$26.00	
Tarps w/Sediment Basin	$16-74.00	$42.00	
Surge w/Sediment Basin	$93-125.00	$108.00	
Orchard Cover Crops			$100.00
Orchard Sprinklers			$200.00

1/ The net average annual cost is determined based on how the practice system changes the typical farm operation. Some changes in the cost are one time costs that must be annualized while other costs or reduced expenses are already in annual values. All changes in costs/returns have been discounted and amortized over a 20 year evaluation period using a 12 percent interest rate.
2/ Note there are no yield improvements factored into these values. Some practices may improve yields depending on the individual farming operation.
3/ Reduced Cost.

SEDIMENT REDUCTION versus NET COST

There are cost implications for the installation of practices to reduce sediment. Tables 6a and 6b shows the range of net costs needed to implement practices for different levels of sediment control. The tables divide the practices and systems into three categories: those producing moderate sediment reduction (<50 percent), those producing significant reduction (51 percent-89 percent), and those that almost completely control off-farm sediment (90 percent-100 percent). In addition, the table shows the annual per acre cost of each practice and system within these three categories. General conclusions can be drawn even though each category shows a fairly large cost range.

The typical type of practice that moderately reduces sediment are the tailwater tarps or filter strips at the end of a field. These have an average cost of less than $15.00 per acre per year. A more significant reduction in sediment would most likely require a combination of more costly practices. Some of the practices with lower sediment reduction potential may be used in combination with a sediment basin to decrease the size and cost of the basin. Sediment basins and tailwater return systems achieve the highest reduction potential but at the highest cost. These systems average over $50 per acre per year.

SEDIMENT REDUCTION versus NET COST IN THE WEST STANISLAUS AREA

Given the information described above, general conclusions and speculations about the West Stanislaus area can be made. Remember the following discussion concerning the entire study area is based on the assumptions described throughout the report. Using these assumptions, it is possible to provide an indication of the relative net cost for different levels of sediment control in the region. These average costs and sediment rates should not be used by an individual in the region as an indication of their particular circumstances.

For the West Stanislaus Study Area evaluation, sediment reduction rates and average per acre costs were grouped into three categories.

1. Moderate sediment control is considered 40 percent reduction and would cost up to $15.00 per acre per year to accomplish.

2. Significant sediment control is considered 80 percent reduction and would cost up to $20.00 per acre per year.

3. Nearly complete sediment control is greater than 95 percent reduction and would cost up to $50.00 per acre per year.

TABLE 6A
Sediment Rate and Net Cost
for Implemented Practices and Systems
for Evaluated Rotations

Sediment Reduction Category	Practice or System	Additional Avg. Net Cost Per Acre/Yr.	Sediment Rate Tons/Acre
Typical Farm			11.0
MODERATE	Gated Pipe-No IWM	$71.00	11.0
50% or less	Conservation Tillage	($12.00)	10.5
	Tailwater Tarps	$14.00	6.0
	Filter Strips	$6.00	9.0
	Gated Pipe w/Tarps	$83.00	6.0
	Cutback Streams	$6.00	4.5
SIGNIFICANT	Surge Irrigation	$99.00	2.0
51-89%	Cutback Stream W/Tarps	$16.00	2.0
	Gated Pipe w/Cutback Stream	$61.00	4.5
	Gated Pipe w/Tarps & Cutback Streams	$70.00	2.0
	Sediment Basins	$53.00	0.5
NEAR COMPLETE	Tailwater Return	$55.00	0.1
90-100%	Sediment Basin w/Tarps	$42.00	0.5
	Sediment Basin w/Surge	$108.00	0.5
	Sediment Basin w/Tarps & Cutback Streams	$26.00	0.5

TABLE 6B

Sediment Rate and Net Cost
for Implemented Practices and Systems
for - Orchards

Sediment Reduction Category	Practice or System	Additional Avg. Cost Per Acre/Yr.	Sediment Rate Tons/Acre
Typical Orchard (Furrow Irrigated)			5.2
MODERATE	Cover Crops	$100.00	4.0
50% or less	Tailwater Tarps	$21.00	2.4
	Filter Strips	$9.00	2.4
SIGNIFICANT	Cutback Streams	$9.00	2.4
51-89%	Cutback Stream W/Tarps	$26.00	0.9
NEAR COMPLETE 90-100%	Sprinkler System	$200.00	0.1

These results suggest that in order for a reduction of sediment in the region, there will be some financial implications. How should this burden be distributed and what mechanisms (cost-sharing, incentives, regulations) are needed in order to successfully implement conservation practices and systems to reduce the amount of sediment reaching the San Joaquin River?

Clearly, there is a need to continue "selling" the growers on the idea that some action must be taken by them in order to avoid outside regulation. The growers themselves must be convinced they want to deal with the sediment problem in their own way rather than be dictated to by an outside regulatory agency.

It seems reasonable to expect some reduction in off-farm sediment with a voluntary based implementation plan. The SCS estimated participation rate of 71 percent affects approximately 81,000 acres of cropland in the study area and would mean at least a 67 percent reduction of sediment reaching the San Joaquin River.

There is enough evidence to indicate there are several sediment control options available to the growers. In most instances, a significant level of sediment control is possible with some relatively minor changes in the typical farm operation. However, it is also true that every grower and field in the West

Stanislaus area is different and will require a site specific conservation plan. Demonstration projects such as the SCS filter strip project in the spring of 1992 and the previous Extension Service surge irrigation project will give the local growers a chance to explore and experiment with the recommended practices before adoption. There must be the time and enough trained technical field personnel available to assist each grower to explore all of their options.

The last increment of sediment control would be near complete control (over 90 percent). This accomplishment would result in a significant per acre annual cost. This effort would require the installation of sediment basins, either on-farm or regional, or tailwater return systems. Much of the farmed land in the West Stanislaus area is leased from non-growers. This means any attempt to reach complete sediment control will require the involvement of non-grower landowners. Complete control practices, when properly sized and operated, can be relatively expensive and growers will require financial as well as technical assistance.

All work to date in the study area indicates that western Stanislaus County is a significant contributor of NPSP to the San Joaquin River and the Delta. In addition, there is evidence that on-farm conservation practices, either singly or in combination, can be effective in reducing sediment loadings into the river. A reasonable but equitable process that will reduce sediment loading into the San Joaquin River and Delta is needed.

LOW MAINTENANCE CONSTRUCTED WETLANDS

Another option for growers in the West Stanislaus Study Area to reduce sediment delivery to the San Joaquin River is the concept of low maintenance constructed wetlands. Individuals or groups of landowners can provide increased benefits to wildlife while achieving their required water quality goals. Surplus tailwater could be used for the enhancement of waterfowl habitat, while improved water quality in the San Joaquin River is accomplished through the use of a properly designed wetland.

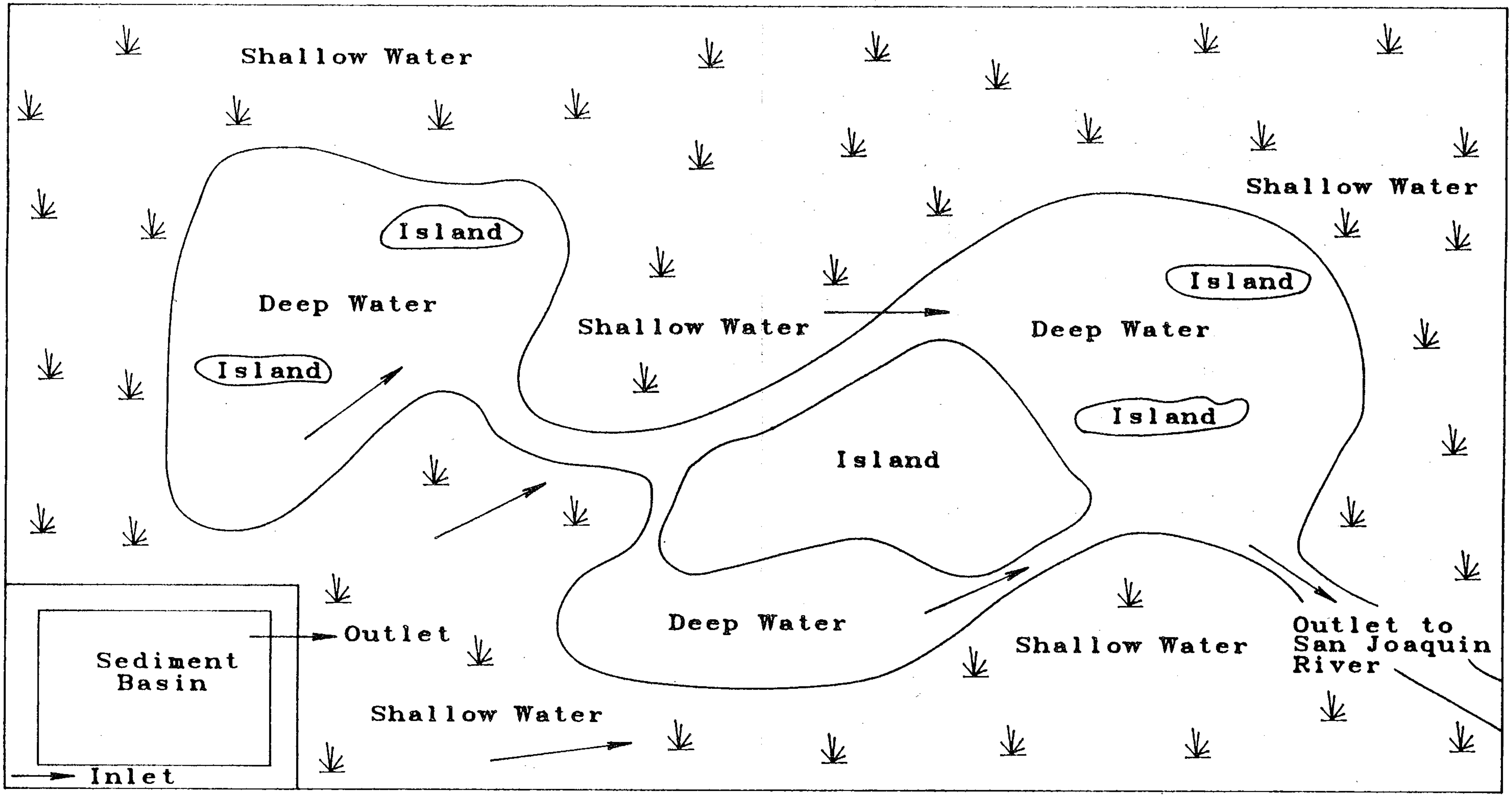
Figure 4 shows how a typical wetland could be designed for the West Stanislaus area. A sediment basin would be required to remove the excessive sediment load and prevent the wetland from filling in. The wetland should be properly designed and constructed to discourage the breeding of mosquitoes. A shallow water area provides further filtering of sediment while also providing valuable nesting and feeding habitat for nesting ducks such as Cinnamon Teal, mallards, pintails, and gadwalls. Many species of birds and animals would take advantage of the habitat offered. Some of the bird species include egrets, Great Blue Heron, Black-crowned Night Heron, White-faced Ibis, and American Bittern.

Growers would be able to apply on-farm conservation practices but could possibly utilize the sediment basin required as part of the constructed wetland instead of installing a basin on-farm. The sediment basin would have the same maintenance requirements as the smaller on-farm basins, such as cleaning out and spreading or stacking the deposited sediment.

There would be several possible advantages to the grower for utilizing a constructed wetland. The elimination of or the need for only a small on-farm basin would decrease the amount of land lost to farming. Non-productive land could be used for the wetland. There would be more time for the smaller soil particles carrying contaminants to settle out and be filtered. Other agricultural chemicals could also be filtered out or have time to disperse. The water may be of good quality after passing through the wetland and could be reused on-farm.

The wetland centralizes the sediment removal efforts and would allow for ease in monitoring as only one outlet would need to be monitored. The U.S. Fish and Wildlife Service may be able to cost-share up to $30,000 in the construction of the wetland.

Since this report is restricted to using existing data, detailed cost and design estimates were not made. Interested growers can contact the U.S. Fish and Wildlife Service or the SCS Patterson Field Office for further information.



Constructed Wetlands
Figure 4

PART II
DECISION-MAKING TOOLS

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PART II - DECISION MAKING TOOLS

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CHAPTER VI

INTRODUCTION

BACKGROUND

This section provides information to the local landowners about selected conservation practices, discusses how the grower can utilize the local SCS field office in the decision-making process, and provides working tools to the field office staff to streamline the planning and implementation process.

Nonpoint source pollution problems such as sedimentation can be managed, controlled or prevented by changing some of the ways the land is used. The Spanish Grant Demonstration Project performed in the West Stanislaus area in the early 1980's proved on-farm conservation practices applied and managed properly can be very effective for reducing sediment being delivered from the area to the San Joaquin river. Systems of conservation practices are more effective at erosion and sediment reduction and can minimize the net economic cost to the landowner more than practices used singly.

The conservation practices reviewed for this report include practices that reduce sediment by preventing erosion (land leveling, shorten length of irrigation runs, sprinkler germination and preirrigation, cutback streams, gated pipe and surge irrigation, conservation tillage, sprinkler and drip irrigation, one less cultivation, and cover crops) and those that prevent sediment from reaching surface water bodies (tarps in tail water ditches, filter strips, grassed waterways, and sediment basins). These practices were chosen because they have been shown to be effective at erosion or sediment reduction, are cost effective, and have been previously used by local growers. The effectiveness and cost of each practice will vary from field to field due to differences in field conditions and management styles.

Remember there are probably other conservation practices that will also provide erosion and sediment reduction and there are many different combinations of the described practices that can be used. Space limitations do not allow detailed information to be provided regarding all the possibilities. It is recommended the grower visit the local SCS Patterson Field Office to discuss specific needs with trained personnel.

TYPICAL FARM

In order to evaluate the impacts of the proposed conservation practices and systems in an area as large and diverse as western

Stanislaus County, a typical farm was chosen. This "typical" farm is based on recommendations from the local RCD, SCS field office and local landowners. Assumptions were also made to create this typical farm.

The typical farm is 160 acres, of which 152.2 acres are for crop production. The fields are 1,115 feet wide and 1,000 feet long. Furrow slopes are 0.5 feet per 100 feet (0.5%) and there is a 0.2 feet per 100 feet (0.2%) cross-slope. See Figure 5 for the layout of the farm and its fields.

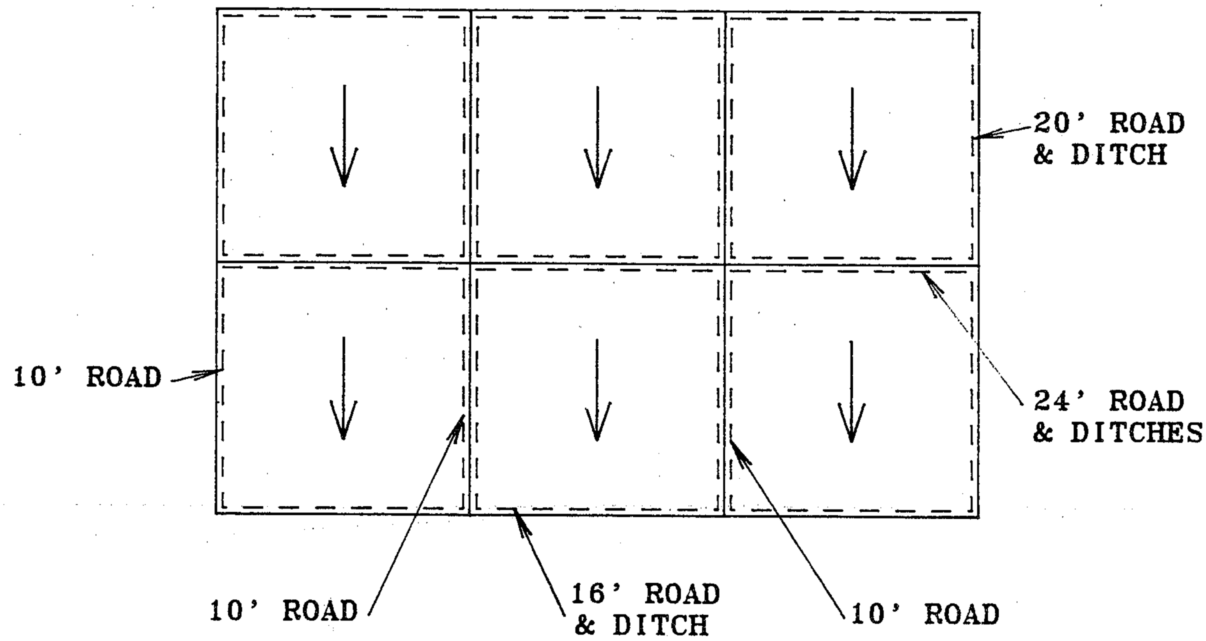


FIGURE 5
TYPICAL FARM FIELD LAYOUT
AREA = 160 Acres

A tailwater ditch is installed across the bottom of each field. All tailwater ditches are connected, and the tailwater eventually leaves the farm at a single point.

An earthen head ditch using tarps and siphon tubes was chosen as the present method of irrigation. These ditches are generally assumed to be removed and replaced for each cultivation.

Cultivations are for weed control and do not include land preparation, land leveling, bedding, or crop removal at the end of a cycle.

This typical farm is used only as a point of reference for baseline erosion and sediment values, economic evaluation of structural and management practices, and predicting the effectiveness of conservation practices. Actual field layout and size will vary depending on crop, management practices, operator preference, shape of parcel, location of access points, buildings and equipment yards, and the location of canals and ditches.

TYPICAL CROP ROTATIONS

As with the typical farm concept, typical crop rotations are used to represent the wide variety of crops grown in the area. Complete rotations are used instead of individual crops because some of the conservation practices will change or provide different results throughout the course of a rotation. Five rotations are used and are described in Table 7. Orchards were evaluated separately and have an average annual sediment rate of 5.2 tons/acre for furrow irrigated orchard crops.

TABLE 7

TYPICAL IRRIGATED CROP ROTATIONS IN THE WEST STANISLAUS STUDY AREA

Rotation Number	Percent of Irrigated Row and Field Crops	Year	Summer	Winter	Average Annual Sediment Rate (tons/acre)
1	25	1	Green Lima Beans	Fallow	18.9
		2	Tomatoes	Cauliflower	
		3	Dry Baby Limas	Fallow	
		4	Tomatoes	Cauliflower	
2	25	1	Dry Baby Limas	Fallow	5.6
		2	Tomatoes	Fallow	
		3	Dry Baby Limas	Fallow	
		4	Tomatoes	Establish Alfalfa	
		5	Alfalfa	Alfalfa	
		6	Alfalfa	Alfalfa	
		7	Alfalfa	Alfalfa	
		8	Alfalfa	Fallow	
3	25	1	Green Lima Beans	Peas	14.7
		2	Dry Baby Limas	Fallow	
4	20	1	Melons/Honeydew	Sugarbeets	4.9
		2	Sugarbeets	Oat hay	
		3	Melons/Honeydew	Sugarbeets	
		4	Sugarbeets	Establish Alfalfa	
		5	Alfalfa	Alfalfa	
		6	Alfalfa	Alfalfa	
		7	Alfalfa	Alfalfa	
		8	Alfalfa	Winter Oats	
5	5	1	Corn Silage	Oat Silage	7.0
		2	Corn Silage	Oat Silage	
		3	Corn Silage	Oat Silage	
		4	Corn Silage	Establish Alfalfa	
		5	Alfalfa	Alfalfa	
		6	Alfalfa	Alfalfa	
		7	Alfalfa	Alfalfa	
		8	Alfalfa	Winter Oats	

CONSERVATION PRACTICES

The conservation practices and systems were evaluated using the typical farm and typical crop rotations. Combinations of practices to evaluate were chosen based on effectiveness and acceptability by growers in the study area.

Installation, operation, maintenance and replacement costs, and the effect on sediment of the systems were calculated over a 20-year life. The economic evaluation of the effects of the systems includes factors such as water use, irrigation and other labor requirements, installation, operation and maintenance costs, equipment requirements, acres of land in production, management practices, and production costs.

For each system, the potential sediment reduction range is expressed as tons per acre per year and as a percent reduction. Standards set by the regulatory agencies are generally expressed in parts per million (ppm) or milligrams per liter (mg/l).

"WHAT CAN THE GROWER DO?"

CHAPTER VII

WHAT THE GROWER CAN DO TO CONTROL EROSION AND MINIMIZE SEDIMENT MOVEMENT FROM THE FIELD

Sediment is carried from the field in irrigation water. Control the irrigation water and erosion and the sediment it produces will be controlled.

FACTORS THAT GROWERS SHOULD CONSIDER WHEN IRRIGATING

Reducing the delivery of sediment will require changes in the way growers irrigate. Some of these changes will be:

1. How to decide WHEN to irrigate. Each time a field is irrigated and tailwater is generated sediment is produced. The opportunity may exist to reduce the number of irrigations each year by irrigating only when the soil is dry enough. Scheduling irrigations based on techniques such as sampling the soil deep in the crop root zone, using devices such as gypsum blocks and tensiometers, and estimating crop water use with weather data will minimize the number of irrigations needed.

2. How to decide HOW LONG to apply water. The longer water runs off the end of the field the more sediment will be removed. The water should be shut off when the crop root zone has been refilled. One of the simplest methods to determine this refill point is to "probe" or sample root zone soil moisture levels periodically throughout the irrigation.

3. HOW MUCH water to apply to furrows, (number of siphons or openings of gates). Relatively high flow rates are necessary to achieve uniform water infiltration along the furrow. Excessively high flow rates, however, causes erosion in the furrow near the top of the field. Flow rates should be set such that furrow erosion is minimized. Reducing or "cutting back" flow rates after the water has reached the end of the furrow can significantly reduce the volume of sediment transport (See Table 8).

4. HOW water is applied to the field. Alternatives to conventional furrow irrigation are surge, sprinkler, and drip. When properly operated, erosion can be significantly reduced or eliminated with these methods. In addition, practices such as the use of gated pipe, land leveling, and shortening furrow runs, can provide more control over how much water is applied and how it is moves down the furrow. The following "Conservation Practices" section provides more information on these methods.

5. <u>How TAILWATER is controlled</u>. Methods are available to eliminate erosion from tailwater ditch bottoms, settle out sediment before it leaves the farm in the tailwater, and contain tailwater for reuse on-farm. The following "Conservation Practices" section provides more information on these methods.

TABLE 8

COMPARISON OF SEDIMENT PRODUCED FOR CERTAIN CROPS WITH AND WITHOUT CUTBACK STREAM IWM OPTION

CROP	WITHOUT CUTBACK SEDIMENT PRODUCED (Tons/Acre/Crop)	WITH CUTBACK SEDIMENT PRODUCED (Tons/Acre/Crop)
Oats	4.7	2.6
Tomatoes	12.5	5.0
Dry Beans	9.3	3.5
Green Beans	11.8	4.5
Cauliflower	14.7	5.2
Peas	8.3	3.2
Sugarbeets	10.9	4.2
Melons	6.8	2.6
Corn Silage	11.1	4.5

<u>Agronomic Practices to Control Erosion and Minimize Sedimentation</u>

Agronomic practices such as conservation tillage, filter strips and orchard cover crops control erosion or minimize soil movement by leaving vegetation on the ground to either help keep the soil in place or to slow the water flow and allow the sediment to settle out. Vegetation on the soil surface helps conserve soil moisture, increases water infiltration, and reduces water velocity.

<u>Changes and Practices Need to be Planned</u>

The grower's decision on where changes need to be made and which practices to apply must be based on a PLAN. Through planning, the grower's objectives are laid out, sources and causes of erosion and sedimentation are identified, proposed changes "fit" the farm operation, and proposed changes and practices compliment each other. For example, a furrow erosion problem should be addressed <u>before</u> a sediment basin is designed because the required size of the sediment basin is based upon the amount of sediment which leaves the field.

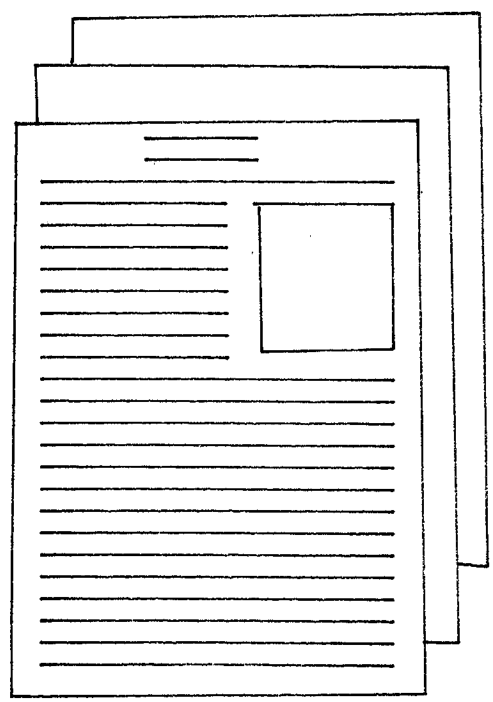
Where Growers Can go for Help

The SCS can help growers develop a plan, implement new practices, and utilize new techniques to address erosion and sediment problems.

CHAPTER VIII

CONSERVATION PRACTICES

This chapter provides basic information about individual conservation practices. Advantages and disadvantages, a range of possible installation and maintenance costs, and potential sediment reduction for each practice are supplied for information. It is recommended that each grower discuss the practices with the West Stanislaus RCD or SCS Patterson Field Office to see how potential practices would apply to the grower's particular situation.



WEST STANISLAUS CONSERVATION PRACTICES

1 - Less Cultivation

This practice is the elimination of one cultivation per crop. It integrates weed control practices in order to maximize the effectiveness of cultivating for weed control, but at the same time minimize erosion and sedimentation.

Advantages

-Reduces erosion.

-Reduces sediment leaving the field.

-Reduces damage to crop roots.

-Reduces cultivation costs.

-Can reduce the size and cost of additional practices such as a sediment basin.

Disadvantages

-May require additional weed control by herbicides or hand labor.

-Requires more management.

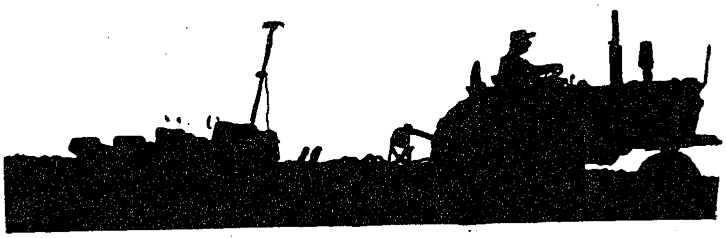
Practice Costs

Installation Cost Range: No Cost Incurred

Annual Operation and Maintenance Cost Range: None unless extra herbicide or hand labor used

Reduced Costs - This practice includes the savings of eliminating at least 1 cultivation.

Reduced Cost Range: $4 - $10 /acre/crop

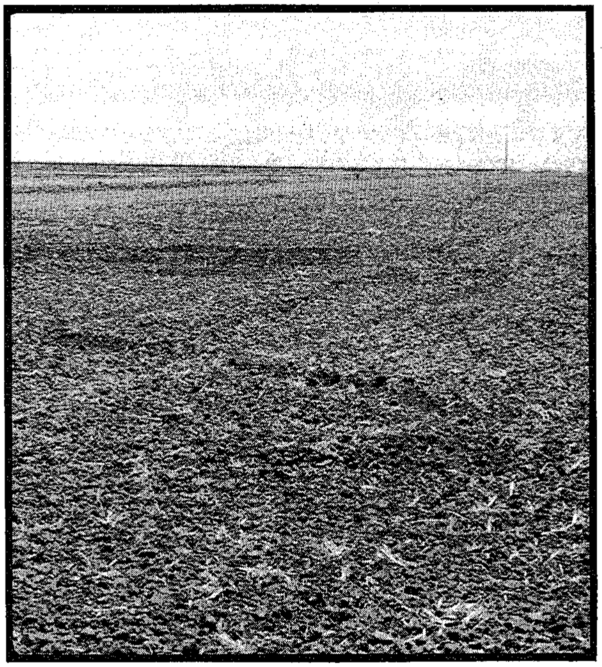


Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
3.5 - 13.4	23 - 35

WEST STANISLAUS CONSERVATION PRACTICES

Conservation Tillage



Conservation tillage is any tillage system which provides a suitable seedbed while leaving at least 30 percent protective crop residue on the soil surface after planting. Crop residues are used to protect cultivated fields during critical erosion periods. Crop residues conserve soil moisture, reduce furrow erosion, increase infiltration, reduce soil loss and improve soil tilth. Crop residue use is only effective in protecting cultivated fields when there are adequate amounts during the erosion period. Growers can alternate crops that produce low amounts of residues with high residue crops to average out the protection. No-till leaves the soil undisturbed prior to planting. Weed control is accomplished primarily with herbicides. Strip-till tills 1/3 of the soil surface at planting time. Reduced-till is any other tillage practice which meets the 30 percent residue requirement.

Advantages

-Reduces potential erosion.

-Minimizes soil loss.

-Better water infiltration

-Higher soil temperature.

-Improves soil tilth.

-Reduces operating cost.

-Profitable long term system.

-Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

-Increases management requirements.

-Potential pest problems.

Practice Costs - Includes the reduction of tillage operations to the required minimum. May include the purchase of no-till seeders and may increase use of herbicides and pesticides.

Installation Cost Range: None - may need to adapt existing equipment

Annual Operation and Maintenance Cost Range: None

Reduced Costs - Costs are usually less because of the reduction in tillage operations. Reductions in cost will vary with the type and sequence of crops grown.

Reduced Cost Range: $0 - $48 /acre

Range of Sediment Reduction - Depends on the cropping sequence.

Tons Per Acre Per Crop	Percent
0.5 - 1.3	2 - 20

WEST STANISLAUS
CONSERVATION
PRACTICES

Cutback Stream Irrigation Method

Relatively high initial furrow flow rates allow water to reach the end of the furrow quickly. Once the water reaches the end of the furrow it is decreased to a fraction of the initial stream size.

Advantages

- -Reduces furrow erosion.
- -Reduces sediment leaving field.
- -Decreases delivered water usage.
- -More uniform water distribution.
- -No installation cost.
- -Can reduce the size or cost for additional practices, such as a sediment basin.

Disadvantages

- -Increased irrigation labor cost.
- -May be difficult to reduce delivery flow rate.
- -Increased management.

Practice Cost - Includes the increased irrigation labor.

Installation Cost Range: None

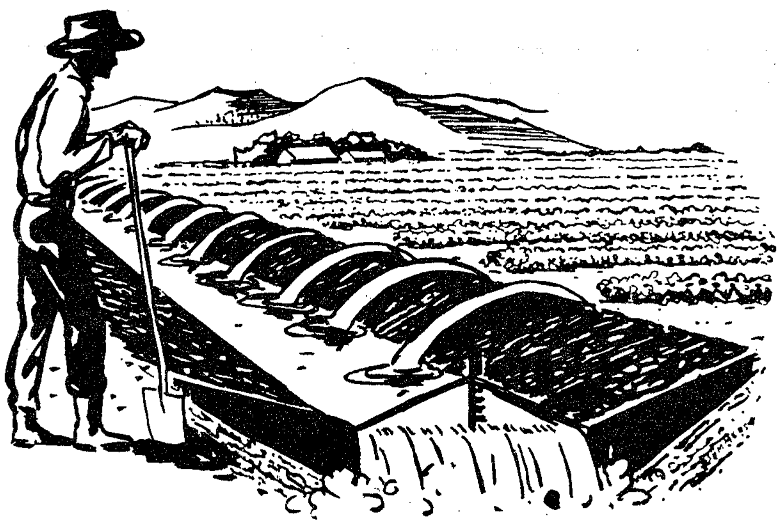
Annual Operation and Maintenance Cost Range:
$4 - $9 /acre/crop

Reduced Costs - Potential water conservation. Reduced sediment basin size.

Reduced Cost Range: Not estimated

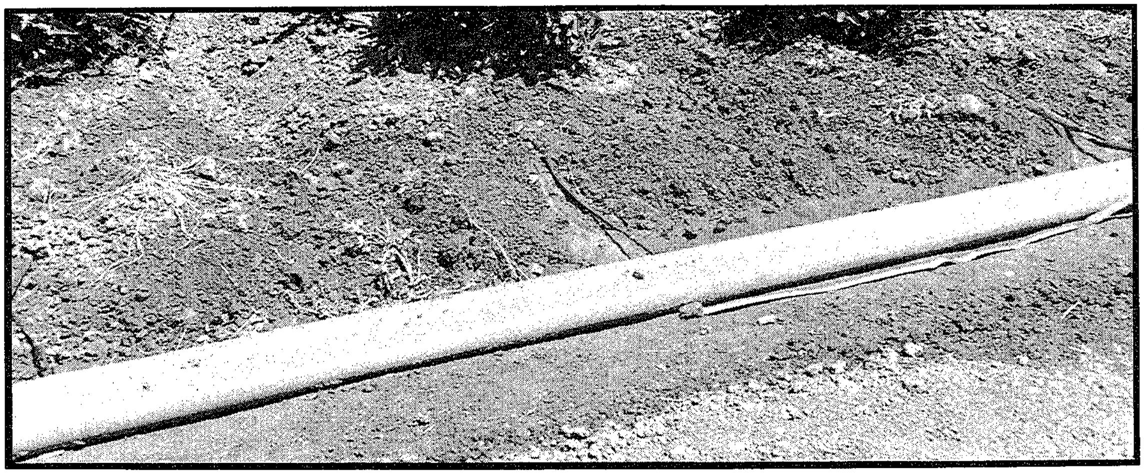
Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
2.0 - 7.1	43 - 63



WEST STANISLAUS CONSERVATION PRACTICES

Drip Irrigation



Drip irrigation consists of a network of pipes and emitters that apply filtered water to the surface or subsurface of the soil in the form of a spray or a small stream. Emitters discharge only a few gallons per day.

Advantages

- Reduces erosion.
- May decrease total labor use.
- Increases production area.
- Efficient water distribution.
- Reduced water applications.
- Possible crop production increase.
- Reduces insect, fungus problems.
- Fewer weeds.
- Less soil crusting.
- Reduces required cultivation.
- Less soil compaction.
- Can reduce the size of or eliminate the need for additional practices, such as a sediment basin.
- Precise chemical application (chemigation).

Disadvantages

- High installation cost.
- Power costs.
- High maintenance requirements.
- May cause salt deposition problems.

Practice Costs - Includes the labor costs, installation, and maintenance (irrigator, flushing tubes, energy cost, maintaining tubing/emitters, pump, filtration facilities).

Installation Cost Range: $1,500 - $2,000 /acre

Annual Operation and Maintenance Cost Range: $75 - $100 /acre

Reduced Costs - Possible production of higher crop yields. In addition, there is a significant reduction in water applied.

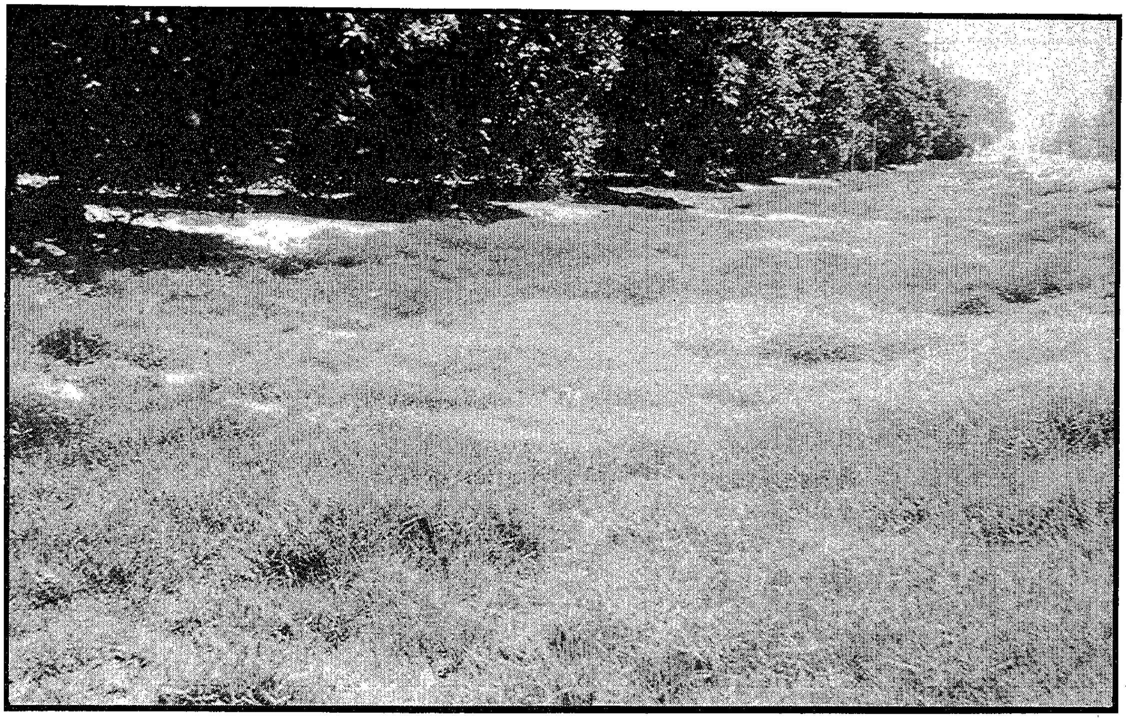
Reduced Cost Range: - Variable

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
0.1 - 18.9	90 - 95

WEST STANISLAUS
CONSERVATION
PRACTICES

Filter
Strips



Filter strips remove sediment and other pollutants from irrigation runoff water by filtration, infiltration, absorption and adsorption, and reduced water velocities in return flow ditches. Filter strips are established by planting grain, sudan grass, sorgum sudan or alfalfa on the lower edge of the field where the filter outlets into streams, ditches, or channels. If vegetable crops are planted in the summer, sudan grass or sorgum sudan can be drilled into the stubble of the previous winter grain filter strip. If vegetables are to be planted in the following winter, then winter grain can be drilled into the sudan grass stubble. Filter strips should be of adequate width and length to reduce the amount of sediment reaching drains and waterways from sheet, rill, gully and furrow irrigation induced erosion.

Advantages

-Reduces sediment runoff.

-Reduces pollutant runoff.

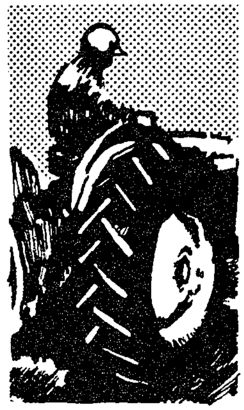
-Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

-Takes farmland out of production.

-Requires different management than adjacent cropland.

Practice Costs - Includes the cost of planting 30 foot wide filter strips and the associated maintenance. If the rotation is from alfalfa into winter vegetables, leave the alfalfa in a 30 foot strip at the lower end of the field. If grain is the Fall crop then there is no additional cost for planting the grain filter strip. A strip 30 feet or wider will be removed from crop production, except grain, to install filter strips.



Installation Cost Range: None - $0.04/lineal/foot

Annual Operation and Maintenance Cost Range:
$0.04/lineal/foot - $.25 /lineal/foot

Reduced Costs - Installation of this practice may reduce the size and extent of other practices that need to be combined to meet sediment discharge requirements.

Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
2.0 - 8.0	40 - 64

WEST STANISLAUS

CONSERVATION

PRACTICES

Gated

Pipe

Gated pipe has closely spaced gates for distribution of water into furrows. Gated pipe can be used to "split" irrigation runs.

Advantages

- -Facilitates other soil and water conservation practices.
- -Can reduce tailwater.
- -Small, easily adjustable gates.
- -Easily placed, connected, and moved.
- -Increases irrigation management options.
- -Can reduce the size and cost of additional practices, such as a sediment basin.
- -Allows more land in production.

Disadvantages

- -Installation cost.
- -Maintenance required.
- -Moving pipes for cultivation practices.
- -Vandalism.
- -May increase management.

Practice Costs - Includes installation of one run of gated pipe per 20 acres, underground supply line and valves.

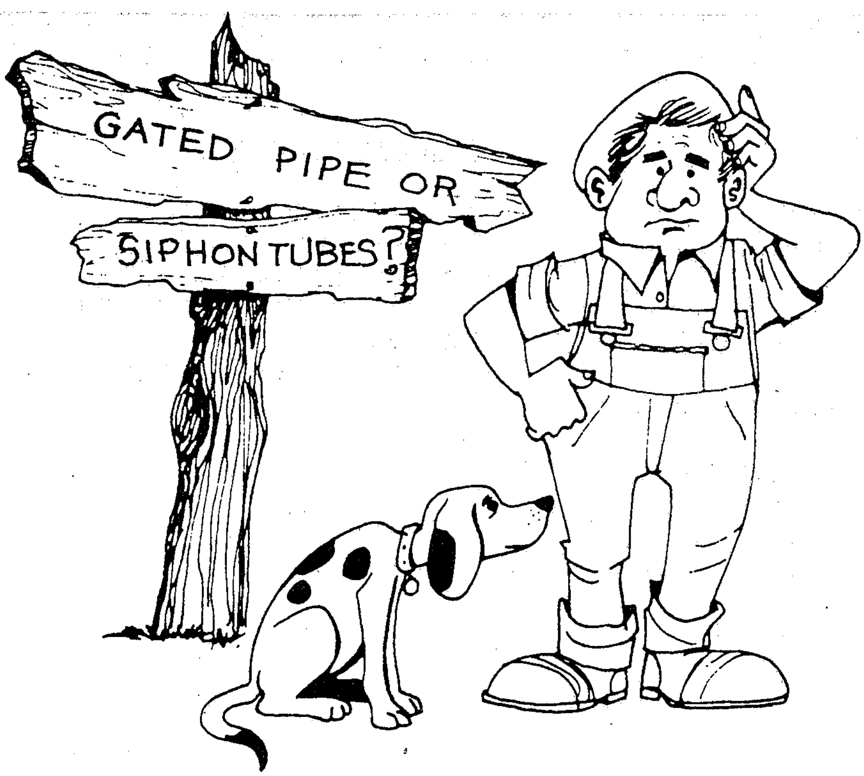
Installation Cost Range: $200 - $400 /acre

Annual Operation and Maintenance Cost Range: $10 - $20 /acre

Reduced Costs - Gated pipe uses less space than ditches and leaves more land in production. Combining gated pipe with other conservation practices can result in significant sediment reduction benefits and savings of water applied. Irrigation water application can also be more uniform.

Reduced Cost Range: Variable

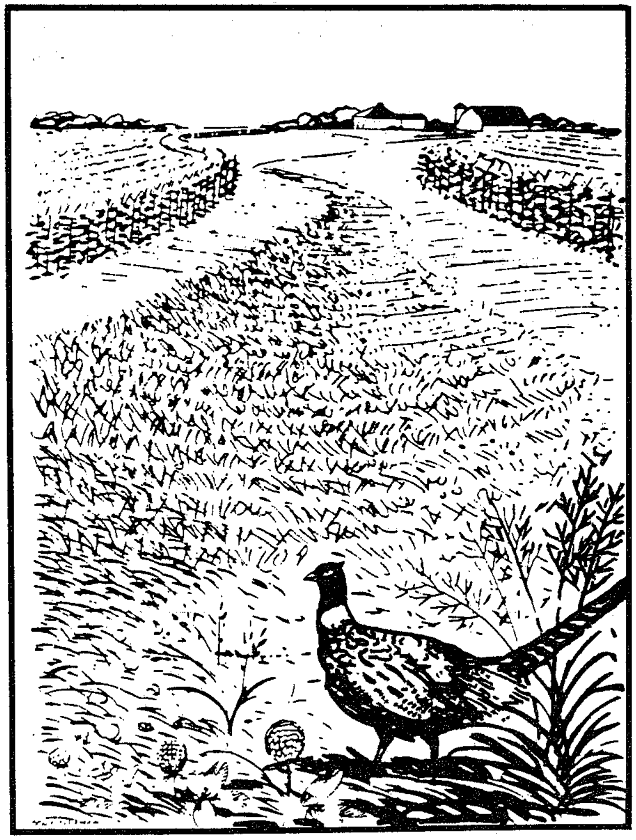
Range of Sediment Reduction - Is not significant unless combined with other management practices such as irrigation water management.



WEST STANISLAUS CONSERVATION PRACTICES

Grassed Waterway

Grassed waterways are wide, shallow, low velocity channels used for disposal of irrigation runoff water down stream of sumps. Grassed waterways replace earthen drainage ditches to reduce erosion and the amount of sediment reaching receiving waters down stream that would otherwise be caused by the flow of irrigation drainage water in the drainage ditch. Large waterways have a 10 foot bottom width with 4:1 side slopes. Small waterways have a 6 foot bottom width with 4:1 side slopes. Grassed waterways only reduce erosion caused by drainage water flowing through the ditch and does not affect erosion coming off the furrow irrigated fields.



Advantages

-Reduces ditch erosion.

-Protection from overland flow.

Disadvantages

-Annual maintenance.

-Acreage out of production.

-Possible pest infestation.

Practice Costs - Includes cost of installation (shaping and planting) plus annual maintenance (mowing, fertilization, and needed irrigation). Grassed waterways require more land areas than ditches. Grassed waterways are usually planted to a mixture Zorrow Annual Fescue, Rose Clover and Blando Brome and have an expected life of 10 years if properly maintained by fertilization and mowing.

Installation Cost Range:
$0.05/lineal/foot - $0.50/lineal/foot

Annual Operation and Maintenance Cost Range:
$0.03/lineal/foot - $0.15/lineal/foot

Reduced Costs - There is typically no reduction in costs.

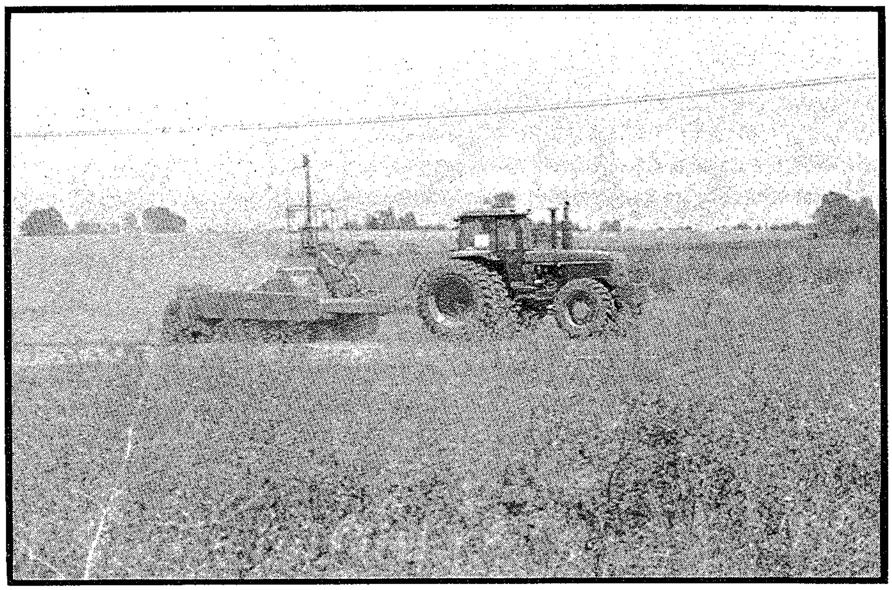
Reduced Cost Range: None

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
10 - 14	13 - 47

WEST STANISLAUS
CONSERVATION
PRACTICES

Land Leveling



The practice of land leveling can basically be divided into three categories:

1. Land leveling or planing is used when cultural practices, erosion and sedimentation patterns creates high and low spots in the field. Land planing re-establishes a desired uniform slope to allow steady water advance down the furrows.

2. Land leveling can be used to flatten steep slopes where erosive velocities in furrows are a problem.

3. Land leveling can change the slope of the head ditch/pipe or tailwater ditch slope (See zero cross slope practice sheet).

Advantages

-Reduces erosion.

-Improved irrigation water distribution.

-Improved crop uniformity.

-Reduced irrigation water use.

Disadvantages

-Cost, dependent on the amount of soil movement required.

-May require changes in cultural operations.

-May require changes in existing irrigation system.

Practice Costs - Includes contractor costs to accomplish land leveling. The cost varies depending on the amount of soil movement that is required.

Installation Cost Range: $100 - $450 /acre

Annual Operation and Maintenance Cost Range: $12 - $30 /acre

Reduced Costs - Depending on the extent of land leveling there would be irrigation water savings, labor savings, and potential yields improvements.

Reduced Cost Range: Not estimated

Range of Sediment Reduction - The amount of sediment reduction is based upon proper management practices. The individual farmer's management practices must be known in order to determine an appropriate range of sediment reduction. Local Spanish Grant area farmers indicate that slope is the number one factor of erosion control on irrigated ground.

Tons Per Acre Per Crop	Percent
0.1 - 18.9	10 - 50

Zero Cross Slope

Zero cross slope is land leveling to a flatter cross slope to eliminate tailwater ditch erosion. With flatter cross slopes, tarps are not necessary. Zero cross slope at the top of the field allows for simpler surge irrigation operations.

Advantages

- -Potential erosion reduction.
- -Potential reduction of sediment leaving field.
- -Better irrigation water distribution potential.
- -Improved crop uniformity.
- -Reduced irrigation water use.
- -Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

- -Cost, dependent on a amount of soil movement required.
- -Increased management.
- -Increased land planing costs.

Practice Costs - Includes contractor costs of leveling. The cost varies depending on the amount of soil movement that is required.

Installation Cost Range: $100 - $450 /acre

Annual Operation and Maintenance Cost Range: $18 - $40 /acre

Reduced Costs - Depending on the extent of land leveling that is required, irrigation water savings, labor savings, and potential yield improvement are probable.

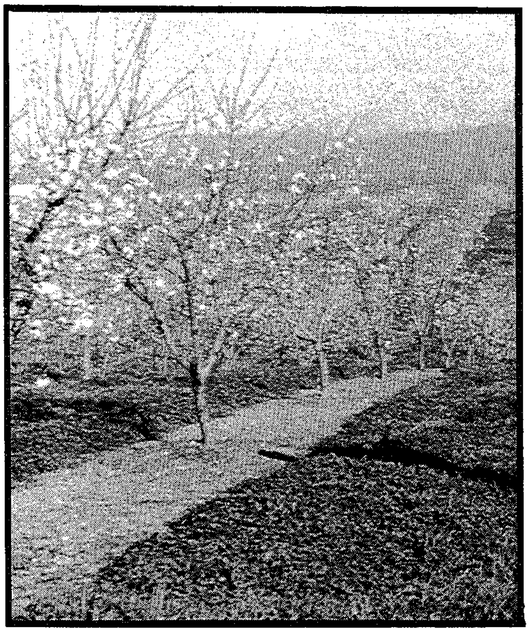
Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
2.2 - 8.5	55 - 67

WEST STANISLAUS CONSERVATION PRACTICES

Orchard Cover Crop



Permanent cover crops are reseeding winter annuals planted between tree rows and form a protective cover. Permanent cover crops will last 10 to 20 years when properly maintained. Permanent cover crops can be maintained by mowing and/or disking operations timed to minimize frost danger and enable the crop to reproduce itself.

Temporary cover crops are short-lived annual grasses which are usually planted in the fall after furrow irrigated orchards have been harvested. Temporary cover crops remain throughout the winter to reduce storm runoff induced erosion. In the spring the cover crop is incorporated into the soil and, if furrow irrigation is used, furrows are reshaped before the next irrigation season.

Advantages

- -Minimizes soil erosion.
- -Easy to install and maintain.
- -Reduces soil compaction.
- -Reduces cultural operation costs.
- -Reduces water runoff.
- -Reduces tillage.
- -Reduces herbicide applications.
- -Reduces down stream sediment.
- -Reduces insect infestations in trees
- -Minimizes root damage from cultivation.
- -Can reduce size and cost of additional practices, such as a sediment basin.

Disadvantages

- -Increases rodent infestation.
- -May reduce surrounding temperature.

Practice Costs - Includes cost of cover crop installation and fertilization. Cover crops should be fertilized at least every other year. Additional cost to install sprinkler systems is not included here. (See sprinkler irrigation system.)

Installation Cost Range:	
Permanent Cover	$145 - $232 /acre/crop
Temporary Cover	$84 - $102 /acre/crop
Annual Operation and Maintenance Cost Range:	
Permanent Cover	$68 - $81 /acre/crop
Temporary Cover	none

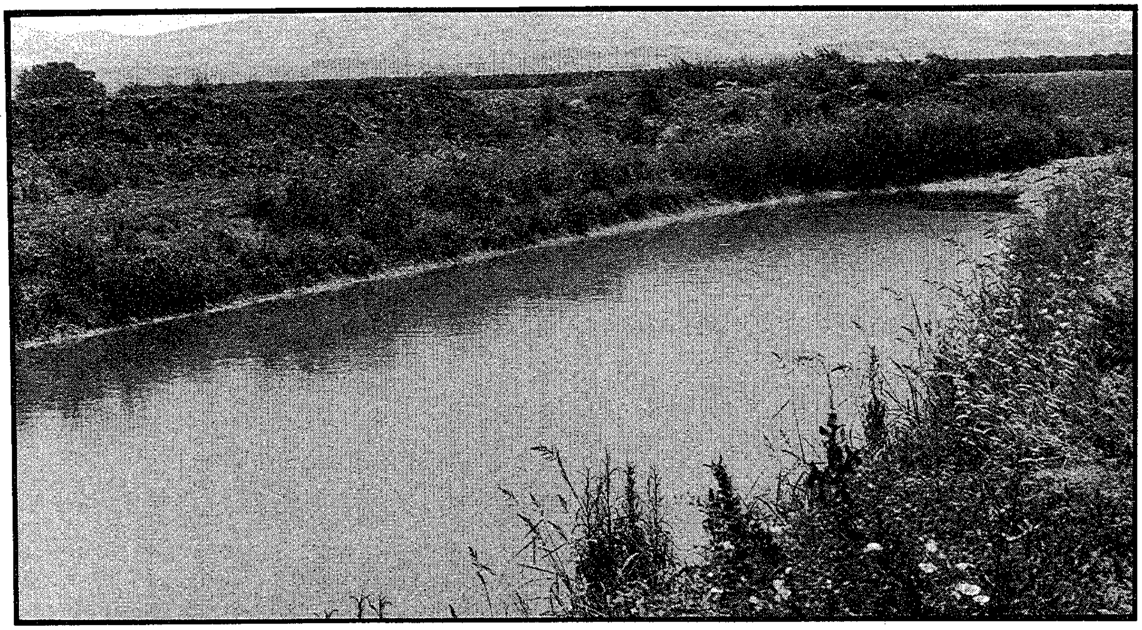
Reduced Costs - Maintaining cover crops by mowing operations usually costs less than conventional tillage operations (disking) in orchards.

Range of Sediment Reduction

	Tons Per Acre Per Crop	Percent
Permanent Cover (Sprinkler on <1 to 7 percent slopes.)	0.4 - 12.0	95 - 98
Temporary Cover (Furrow irrigated on <1 percent slopes.)	0.3 - 0.5	13 - 14

WEST STANISLAUS CONSERVATION PRACTICES

Sediment Basin



Sediment basins are located at the end of the tailwater ditches. The purpose of the basin is to prevent sediment from surface irrigation runoff water from getting into rivers, streams, and other waterways. Sediment basins should be long and narrow so that sediment carried in the water has sufficient time to settle out before the tailwater passes through. The basin also needs to store the annual volume of sediment. A drying area is needed so the accumulated sediment can dry after it is removed. Wet sediment cannot be easily spread in the field.

Advantages

- Reduces sediment leaving property.
- Enhances downstream water quality.
- Possible pollution reduction.
- Can provide near complete off-farm sediment control.

Disadvantages

- Requires frequent clean out.
- Sediment mounds must be respread on fields.
- Loss of farmable acreage.
- For large quantities of off-farm sediment, it can be expensive to install and maintain.

Practice Costs - The cost is directly proportional to the field size and sediment yield. Reducing sediment yield will reduce the cost significantly. Therefore, it is strongly recommended that other conservation practices be installed in conjunction with a sediment basin. The construction cost is a one time expense. Annual maintenance is a continuous cost to keep the sediment basin properly operating. Cost does not include loss of land from production.

Installation Cost Range: $18 - $ 200 /acre

Annual Operation and Maintenance Cost Range: $6 - $62 /acre

Reduced Costs

Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
0.1 - 18.9	90 - 95

WEST STANISLAUS CONSERVATION PRACTICES

Shorten Furrow Length

Shortening the length of furrow irrigation runs should reduce the need for erosive flow rates. The shorter furrows provide better water distribution. This practice requires an increase of gated pipe, irrigation ditches, and tailwater ditches.

Advantages

- -Reduces erosion.
- -Reduces sediment leaving the field.
- -Better water distribution.
- -Potential irrigation water savings.
- -Can reduce the size and cost of additional practices, such as sediment basins.

Disadvantages

- -Increases capital cost for gated pipe required.
- -Less land in production.
- -Increases management and labor requirements.

Added Costs - Gated pipe cost includes the expense of moving the pipe. Ditches include the cost of dredging. Ditches use up more acreage, but are less expensive and do not have to be moved.

Installation Cost Range:

Ditches	$20 - $40 /acre/crop
Gated Pipe	$75 - $150 /acre

Annual Operation and Maintenance Cost Range:

Ditches	Included in Installation Costs
Gated Pipe	$3 - $20 /acre/crop

Reduced Costs - Potentially less water applied with proper management (0.4 - 1.5 acre feet/acre/crop).

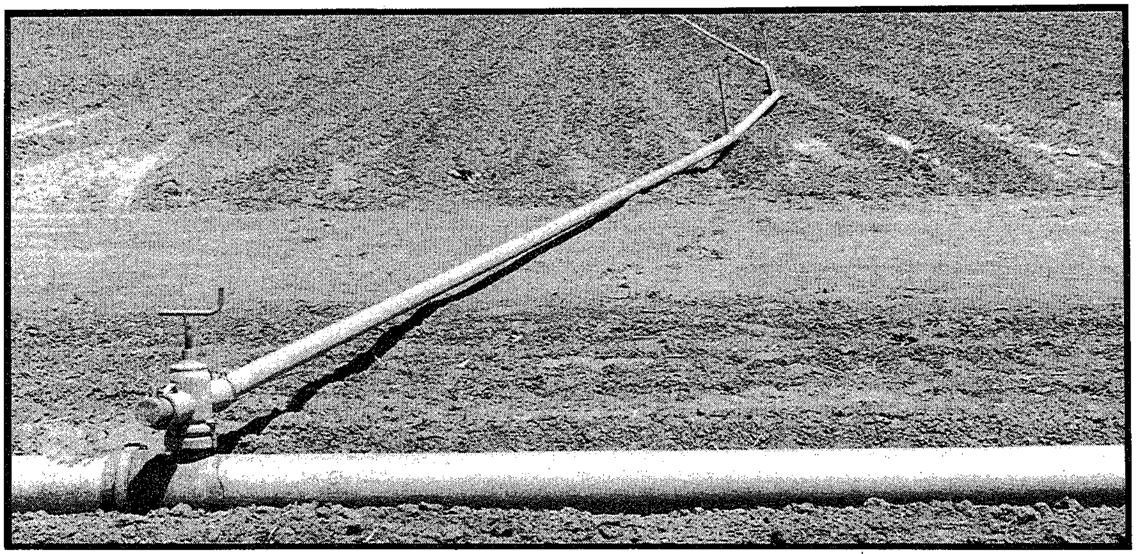
Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
2.0 -9.5	25 - 30

WEST STANISLAUS CONSERVATION PRACTICES

Sprinkler Germination or Pre-Irrigation



Sprinkler germination or pre-irrigation uses less water than furrow irrigation to obtain seed germination. It is also less erosive.

Advantages

-Reduces sediment leaving field.

-Reduces erosion.

-Less irrigation water applied

-Better seed germination

-Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

-Cost of sprinkler system.

-Labor associated with the installation and removal of the system.

- May increase pumping costs.

Practice Costs - Includes the rental cost of the irrigation system. The relative cost of a sprinkler system for a smaller field may be more expensive compared to costs for a larger field.

Installation Cost Range: None if rented

Annual Operation and Maintenance Cost Range: $25 - $120 /acre/crop

Reduced Costs - The amount of water applied is decreased.

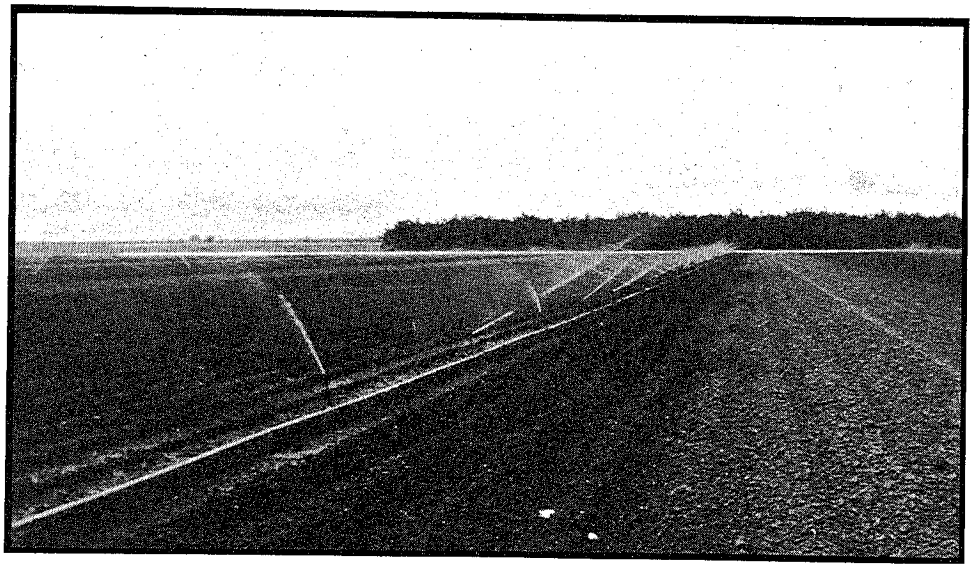
Reduced Cost Range: Water - $15-35 /acre/crop

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
3.5 - 13.4	23 - 35

WEST STANISLAUS CONSERVATION PRACTICES

Sprinkler Irrigation System



Designed, operated and maintained properly, a sprinkler system can efficiently and uniformly apply water by means of a perforated pipe or nozzles under pressure. It maintains adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

Advantages

- Reduces erosion.
- Simple equipment.
- No runoff if properly managed.
- Efficient water usage.
- Less labor during operation
- Reduces sediment loss from the field.
- Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

- Good quality water needed.
- Equipment maintenance.
- High installation costs.
- Energy costs.
- Vandalism.
- Increases management.
- Increases labor between sets (hand move systems)

Practice Costs - Included are underground service lines and valves and two lines of wheelroll sprinkler line per 20 acres. Sprinkler irrigation systems are versatile and productive if properly applied and managed.

Installation Cost Range: $200 - $700 /acre

Annual Operation and Maintenance Cost Range: $15 - $40 /acre

Reduced Costs - Significant reduction of sediment coming off the field. Potential increase in yields for some crops. This irrigation system saves labor and water.

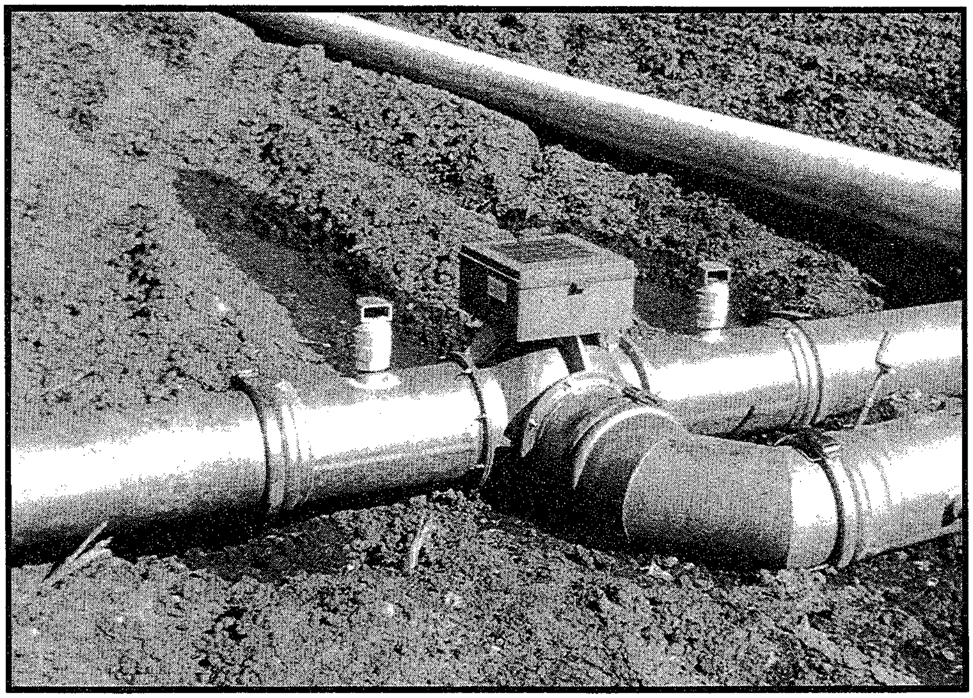
Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
0.1 - 18.9	90 - 95

WEST STANISLAUS CONSERVATION PRACTICES

Surge Irrigation



In surge irrigation a special valve diverts water back and forth through gated pipe between two sets of furrows. This causes the water to advance down furrows in a series of pulses with drying periods between pulses. The surge valve controls water in two important ways: 1)The wetting and drying of the soil during pulses allows the water to advance down the furrow as quick or quicker than traditional continuous but sometimes requires only half the volume of water, and 2) surge valves can minimize the volume of runoff by splitting the onflow between the two furrow sets after water reaches the end of the field.

Advantages

-Reduces furrow erosion.
-Uniform irrigation water application.
-Minimal runoff.
-Irrigation water savings.
-Reduces deep leaching.
-Potentially higher crop yield.
-Potential labor saving.
-Reduces sediment loss.
-Automated system.
-Improved irrigation efficiency.

Disadvantages

-High installation cost.
-Requires moving pipes for cultivation practices.
-Requires trained irrigators.

Practice Costs - Includes the cost of possible re-leveling and the maintenance and installation of gated pipe and surge valves.

Installation Cost Range: $700 - $1,200 /acre/crop

Annual Operation and Management Cost Range: $15 - $35 /acre/crop

Reduced Costs - Reduces labor costs due to semi-automatic operation and water use because of alternating sets, reduces the amount of tailwater, and reduces size and costs of sediment basin required.

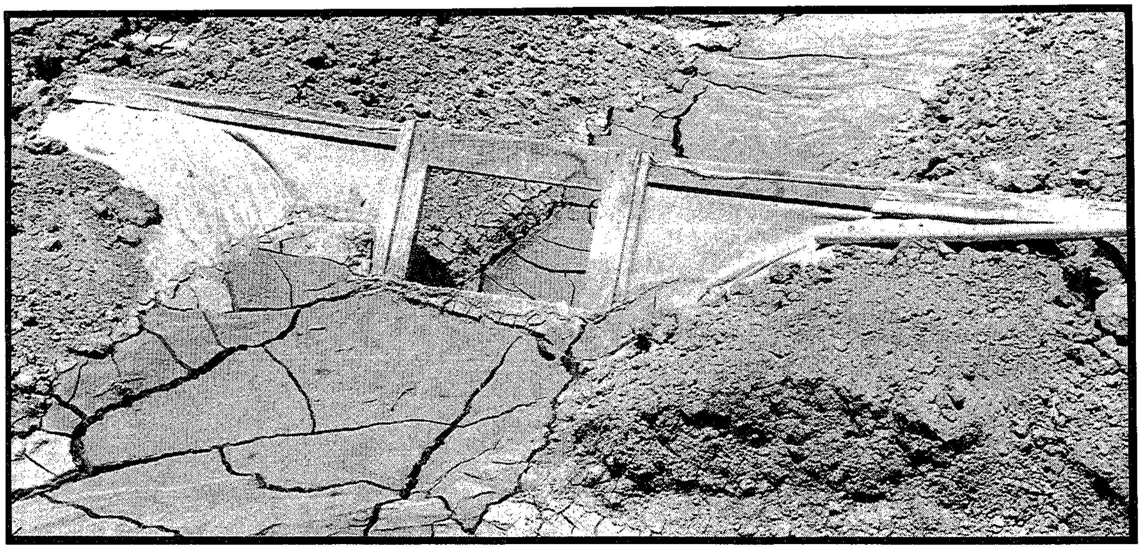
Reduced Cost Range: Not estimated

Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
0.8 - 2.9	80 - 87

WEST STANISLAUS CONSERVATION PRACTICES

Tailwater Ditch Tarps



Tailwater tarps are portable check dams placed at intervals in the tailwater ditch. This prevents the sediment from being deposited into rivers, streams, and other waterways. Tarps serve three major functions: 1) Water velocity is controlled eliminating erosion in the tailwater ditch. 2) These lower velocities encourage sediment from furrow erosion to begin settling out. 3)High water levels in the checked tailwater ditches reduces erosion at the end of the furrows.

Advantages

- -Reduces off farm sediment.
- -Reduces ditch erosion.
- -Low cost.
- -Long term productivity of land protected by respreading sediment.
- -Amount of land in production not reduced.
- -Can reduce the size and cost of additional practices, such as a sediment basin.

Disadvantages

- -Increases maintenance cost.
- -Must be put in/taken out each time field is cultivated.

Practice Costs - Includes cost of tarps, installation and removal of tarps, and spreading of trapped sediment. The life of tarps is 3 years.

Installation Cost Range: $5.00 - $10.00 /acre/crop

Annual Operation and Maintenance Cost Range:
$4.00 - $7.00 /acre/crop

Reduced Costs - There is typically no change in yields or any reduction in costs other than some long term reduction in cost to relevel fields.

Reduced Cost Range: Not estimated

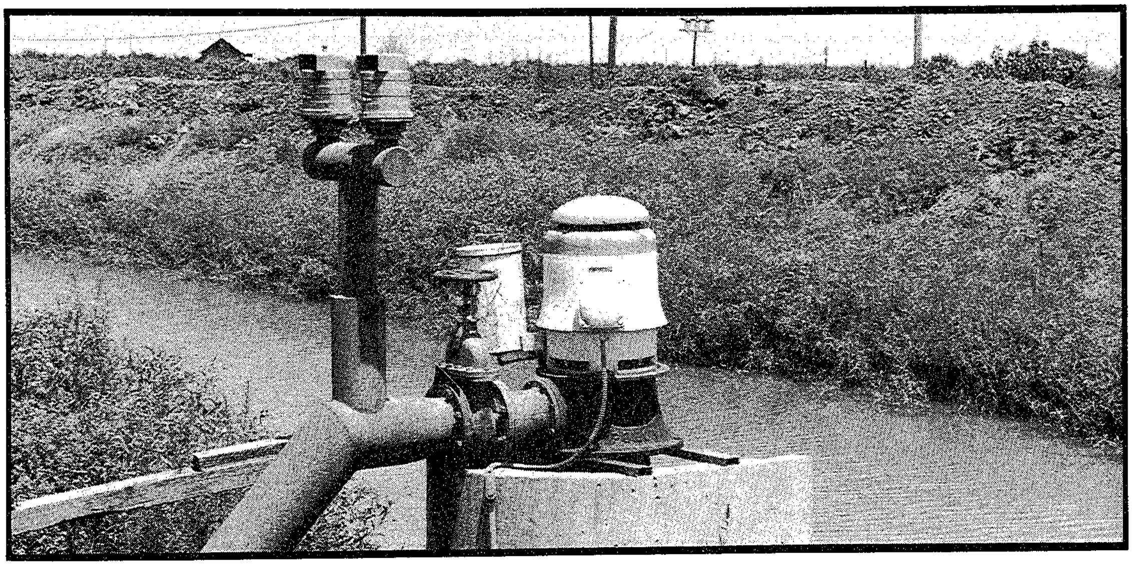
Range of Sediment Reduction

Tons Per Acre Per Crop	Percent
2.0 - 6.0	40 - 60

Note: Tarps in the tailwater ditch serve as grade control. This slows the water down, so that sediment drops out of the water, reducing sediment leaving the field. The percentage reduction varies depending on the crops grown and what rotation they are in.

WEST STANISLAUS CONSERVATION PRACTICES

Tailwater Return System



Tailwater return systems are designed to collect irrigation runoff water that would normally discharge into a drain. Water that flows off the low end of a field is collected in a sump and re-used for irrigation purposes on the same or adjacent fields.

Advantages

- -Eliminates sediment leaving field.
- -Eliminates agricultural drainage.
- -Conserves irrigation water.
- -Potentially recycles all tailwater.
- -Preserves down stream water quality.
- -Reduces weed seeds, insect downstream water supply.
- -Recirculates silt (deposits on field).
- -May eliminate the need for additional conservation practices to meet off-farm sediment standards.

Disadvantages

- -More management needed.
- -Cost to construct.
- -Possibly higher labor cost.
- -May increase salt deposition.
- -Land out of production.
- -May increase pumping costs.
- -Recirculates silt (reduce soil intake rate).
- -Potentially reduces pests

Practice Costs - Includes the installation cost of a lift system and a holding pond.

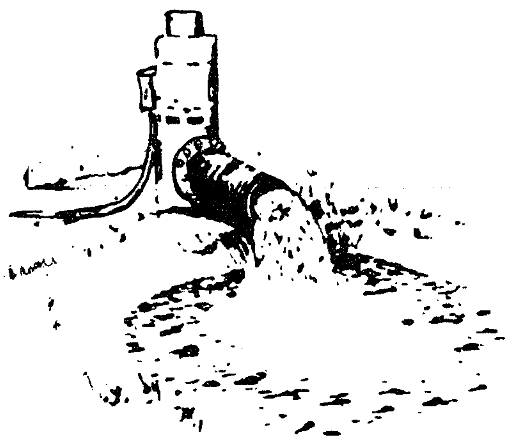
Installation Cost Range: $300 - $500 /acre

Annual Operation and Maintenance Cost Range: $28 - $60 /acre

Note: The costs shown do not include the loss of land in production.

Reduced Costs - There is reduction of sediment loss and of water pumped or purchased with proper management.

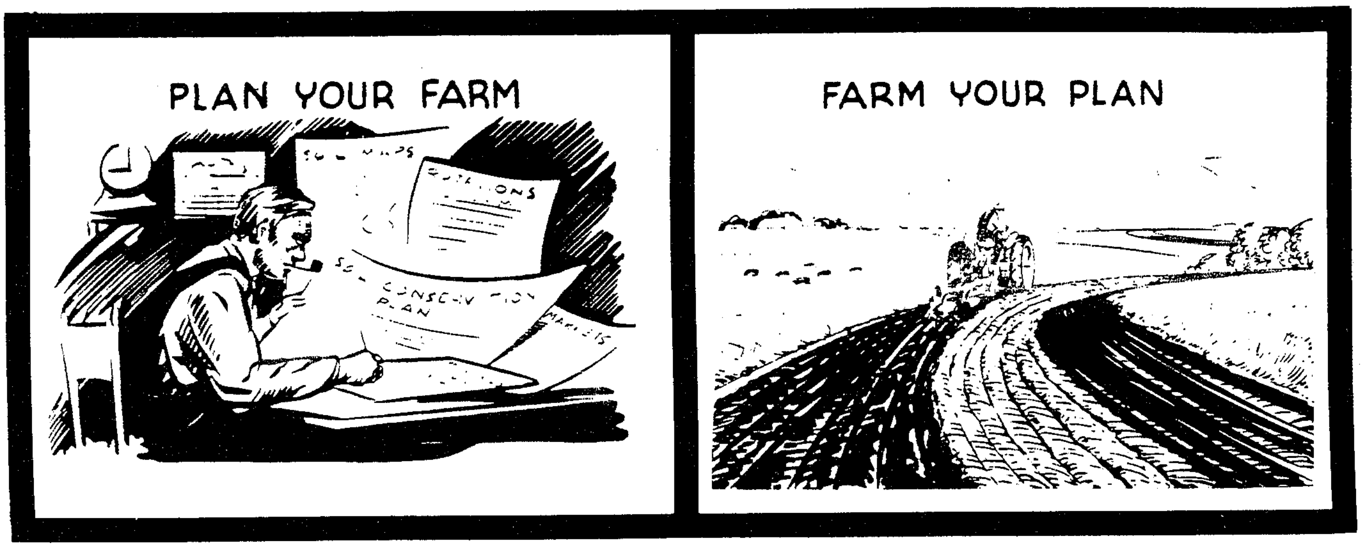
Reduced Costs: Not estimated



Range of Sediment Reduction

Tons Per Acre Per Acre	Percent
0.1 - 18.9	90 - 95

A CONSERVATION STORY



CHAPTER IX

CASE FARM STUDY - IMPLEMENTING CONSERVATION PRACTICES

Introduction

This section is an example farm study intended to show the voluntary process that needs to take place when planning the installation of conservation practices in the West Stanislaus area. Growers are faced with increasing pressures to reduce the amount of sediment and other pollutants leaving their fields, or face the prospect of government regulation. The option preferred by all is to develop alternatives that are viable for the growers to voluntarily implement, and also satisfy the everyone's need for improved water quality. Fortunately, a voluntary approach can work. Table 9 shows the steps in a voluntary approach.

TABLE 9

STEPS TOWARD DEVELOPING AND IMPLEMENTING AN ON-FARM CONSERVATION PLAN

1. Become informed about current and potential future water quality regulations and laws and how your farming operation can affect off-farm water quality.
2. Consider how this information would impact your operation, presently or in the future.
3. Determine the options that are available, such as the installation of conservation practices.
4. Evaluate the impacts of the options on your operations, such as the costs and amount of sediment reduction.
5. Determine the best choices for your operation by developing a conservation plan.
6. Develop a strategy to implement the conservation plan that meets your goals, over time.
7. Explore the availability of technical and/or financial assistance.
8. Start slowly and try the practices out.
9. Review and modify the conservation plan as needed.

The following narrative tells how a hypothetical West Stanislaus grower follows the nine steps in Table 9 to apply conservation practices to his farm.

The Soil Conservation Field Office

Mike, the Soil Conservation Service (SCS) District Conservationist, received a letter from the local Irrigation District telling him that they were going to use his name in a series of letters and articles as a source for assistance. The California Inland Surface Water Plan (ISWP) had recently been published, and growers would be faced with a lot of pressure to reduce off-farm sediment and pollutants. Mike knew that there would be many calls and visits from local growers who would be concerned about how this would impact their farming operations.

He knew that every grower affected by the ISWP needed an individual farm conservation plan in order to meet the goals set out in the ISWP. Mike also knows there are 1,400 farms, 100 soils, and 20 or more crops grown in his area. All the farms have different slopes, soils, crops, rotations, water sources, and other differences which make a single solution impossible.

Interaction Between A Grower and the Irrigation District

Robert, a local grower, came into the Irrigation District office after reading an article in the local paper about sediment and pollutant standards that the Irrigation Districts will need to meet as part of the California Inland Surface Water Plan. The article discussed potential impacts to the District and growers if the potential goal of 300 milligrams/liter (mg/l) of sediment in the water is not reached in the next three years. One option the Districts were considering is to require that growers who receive water from them install sediment control measures which achieve the off-farm sediment rate of 300 mg/l in their irrigation tailwater.

Robert recently purchased 55 acres of cropland in the District and an additional 150 acres in an adjacent Irrigation District. The farming operation is mixed, with tomatoes and winter vegetables being the primary crops. Robert intended to continue the fresh market tomato and winter vegetable rotation of the previous owner. Although he feels there is no problem with the 150 acres in the other District, he was concerned about the quantity of sediment he had observed leaving the 55 acre field.

Robert discussed the regulations the Irrigation Districts in the area were being required to follow and what information the Districts were passing on to the growers. As a result of this discussion and his concern about potential regulations, as well as the long term productivity of his property, Robert decided to become a cooperator with the West Stanislaus Resource Conservation District (RCD). He could obtain technical assistance from the SCS through the RCD.

Interaction Between A Grower and the SCS

The following discussion is about the 55 acre farm owned by Robert in western Stanislaus County. The discussion of possible actions that Robert could take to reduce sedimentation are hypothetical but certainly realistic. It is hoped that this discussion between Robert, the grower, Mike, the District Conservationist, and Chuck, the Field Office Engineer, will provide information to other growers as to how the SCS field office can assist them in protecting their resources through the use of on-farm management practices. To get a handle on his own situation, Robert set up a meeting with the SCS to see how they might be able to help him. They plan to look at several different conservation practices and evaluate their effectiveness in reducing off-farm sediment. They also will look at the costs associated with the adoption of these practices.

The Field

The particular field that Robert and the field office staff decided to evaluate has the following characteristics. It is a 55 acre field with a 3,000 foot frontage road along one side. The depth of the property is 800 feet. The field slopes are 0.2 percent cross slope and 0.7 percent irrigation slope. The furrow irrigation direction is from the road toward the back property line. Fifty-one of the 55 acres are in production. The field is presently in a rotation of fresh tomatoes and winter green vegetables. The tomatoes are transplanted and grown on 48 inch beds and winter vegetables are field germinated on 24 inch beds. The field is diagrammed in Figure 6.

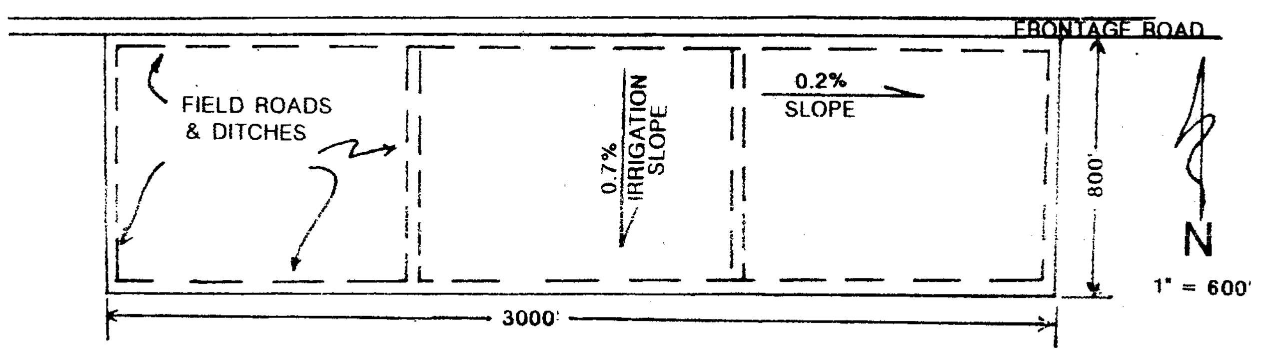


FIGURE 6 FIELD DIAGRAM

Estimating Current Sediment Rate

The first thing that Robert and the Field Office personnel needed to do was obtain some additional information to evaluate the present sediment rate for this particular field. Robert's current irrigation practices include a 24 hour pre-irrigation for the tomatoes and a 12 hour pre-irrigation for the winter vegetables. Five cubic feet per second (cfs) of irrigation water is delivered for five days for the pre-irrigation. Robert feels that these high flows are necessary to fully wet the furrow bed in the time required.

Irrigations during the season are 12 hour sets with 18 gallons per minute (gpm) delivered to each furrow with two siphon tubes. Tomato sets are 75 rows and winter vegetables are 150 rows (10 sets per irrigation). Tomatoes are irrigated eight times and cultivated four times. Vegetables are irrigated and cultivated twice. One irrigator is present during irrigations.

Chuck asked Robert about his field. These descriptions helped Chuck pinpoint possible sources of sediment from the field.

Some of the questions were:

1. How long does it take for the water to reach the end of the furrow?
2. How often is cultivation necessary to reshape the furrow?
3. Does the tail water ditch get deeper through the irrigation season?
4. Does the field slope steepen at the end of the field?
5. Do the furrows get deeper at the beginning of the furrow?
6. Do the furrows get deeper at the end of the furrow?
7. Does the water start out clear and flow off muddy?
8. Where does the water begin to cloud up?

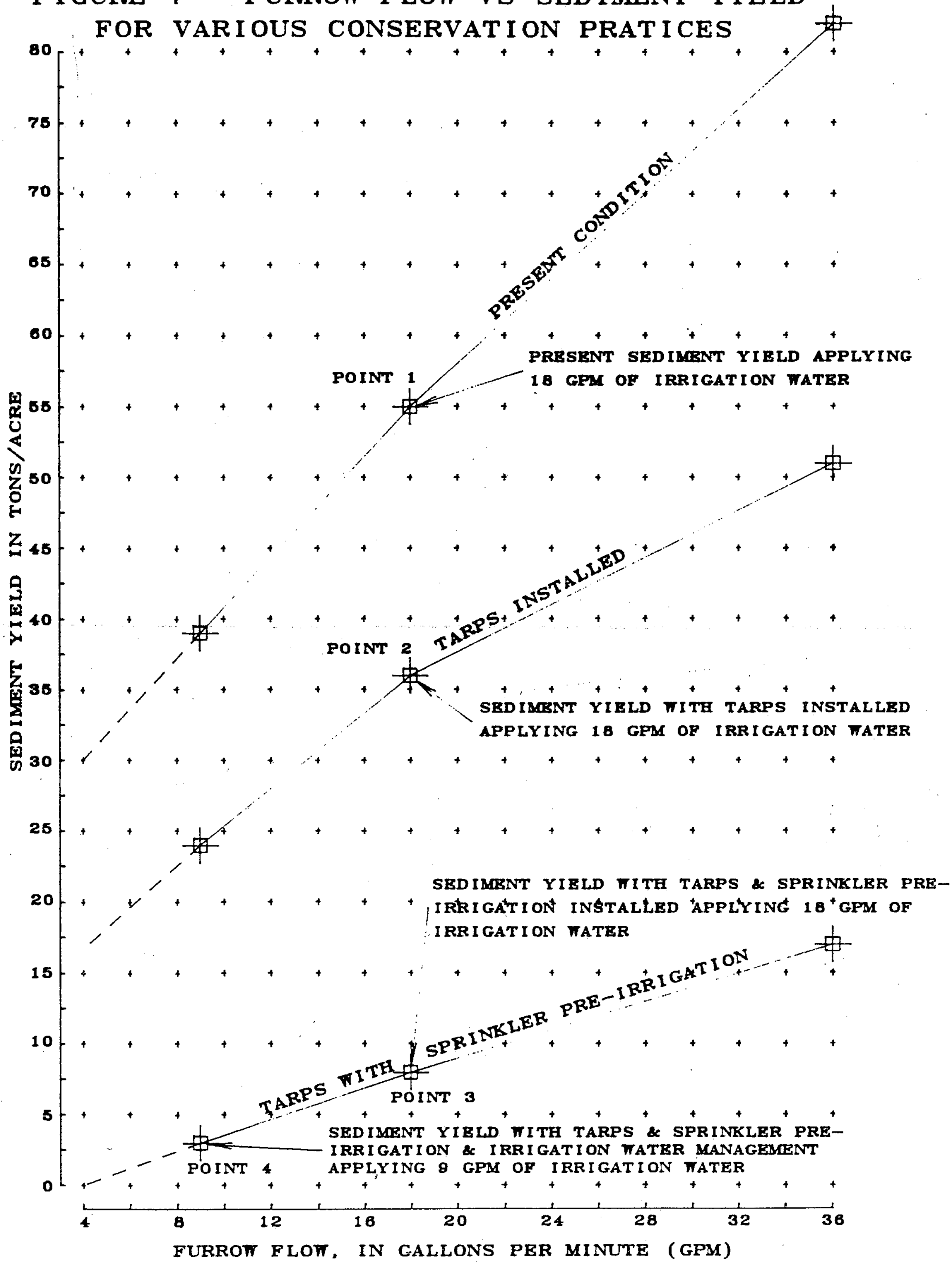
The sediment rate is calculated by the field office using a computer program that incorporates all the information and then calculates the sediment rate in tons per acre. (See Field Office Toolbox for a summary of the computer programs.) The present sediment rate from this field is estimated to be 55 tons per acre per year.

Note that this sediment rate is much higher than what is shown as typical in other portions of this report. This is because the slope is greater and the cropping pattern results in a greater sediment rate. These differences highlight the need for each farm to be evaluated individually. The summary data in other sections of this report is useful to show relative differences between practices, but cannot be used directly for a specific field or farm.

For this particular field and cropping pattern, other furrow stream rates were also run, so that a range of sediment rates for different flow rates is known. Given the present way that Robert farms, Figure 7 displays how the sediment rate compares to different furrow flow rates. The graph is useful in showing how important furrow flow rate is in the resulting sediment rate. The lower the furrow flow rate the less sediment is produced. Point 1 represents the current conditions.

After they established the current sediment rate of the field, Mike showed Robert what methods were available to reduce erosion and sediment from the cropland. They discussed that either a sediment basin or a tailwater return system would be needed to meet the

FIGURE 7 - FURROW FLOW VS SEDIMENT YIELD FOR VARIOUS CONSERVATION PRATICES



300 mg/l sediment rate. Alternatives could be to switch from furrow irrigation to either sprinkler or drip irrigation. They also discussed the fact that there are many other options that would reduce the sediment rate significantly. These practices are part of the 'toolbox' for erosion and sediment reduction from irrigated cropland in Western Stanislaus County. These practices could be combined into a management system which would effectively meet the local goals. The management systems would be recorded in a Conservation Plan.

Size of Sediment Basin for Current Situation

At this point Robert and the field office staff decided to calculate what size sediment basin would be required in order to handle the 55 tons per acre per year. Even before any calculations were made, they suspected the cost would be very high and this would not be a reasonable option. However, they wanted the information to compare with other options. In order to compare options, they needed to decide on an evaluation period and an interest rate. It was estimated that Robert could acquire a loan to install such practices at 10 percent interest. They decided to evaluate the cost impacts of the sediment basin and other options over 20 years using a 10 percent interest rate. This allows them to compare different alternatives.

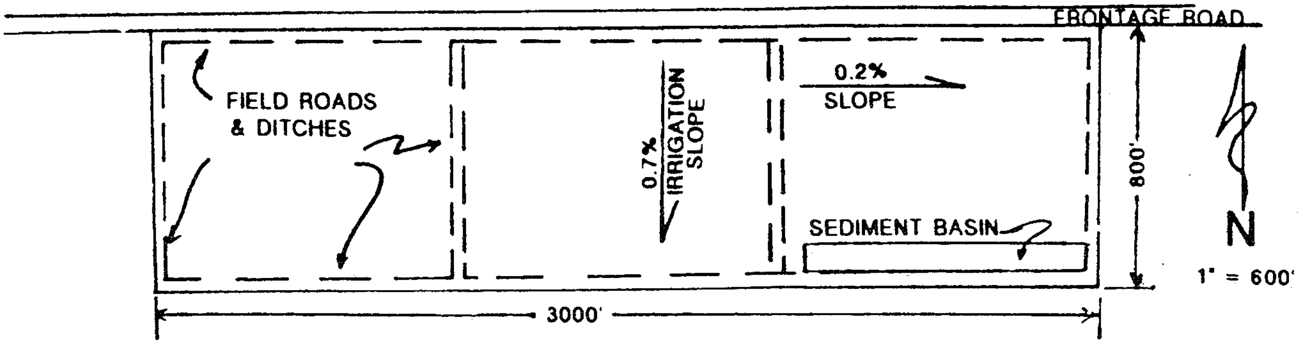
If Robert was leasing the property rather than owning it, then it could be questionable to evaluate the practices without the owner present or approving of the discussions. The costs of installation and maintenance of the long term practices, such as a sediment basin, would have to be worked out between the owner and Robert. Robert's evaluation period to compare the practices would be shorter, perhaps as little as one year, if he leased the land. In this case, Robert owns the land and will evaluate the practices for the long haul.

First they looked at the impacts of the sediment basin. Sediment basins need to be long and narrow so that sediment carried in the water has sufficient time to settle before the tailwater is discharged out of the basin. The basin also needs to store the annual volume of sediment. A drying area is needed so the accumulated sediment can dry after it is removed. Wet sediment cannot be easily spread.

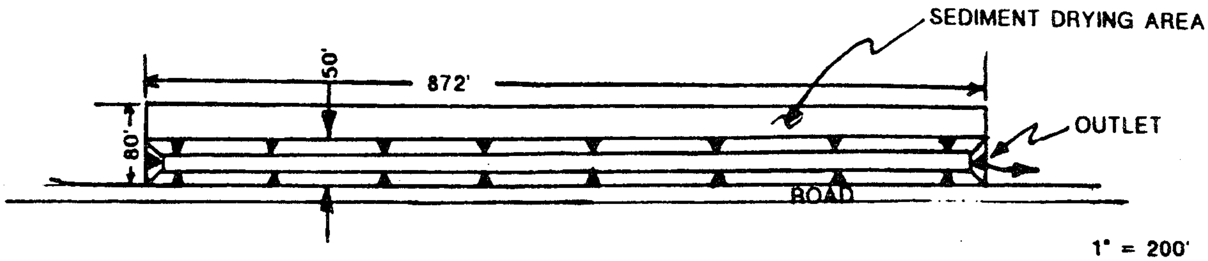
Sediment in the basin settles from the top of the water surface to the bottom. The top one inch of water may contain less than 300 ppm after two hours, but it may take two weeks for the entire depth of the basin to clear. The weir which controls the level of water also improves the efficiency of the basin by reducing the discharge velocity of the water. A 15-foot long level weir will function better than a 24-inch diameter pipe because for equal flows the water is shallower going over the longer weir. A narrow basin is also easier to maintain with a conventional backhoe. A typical sediment basin for Robert's land is shown in Figure 8.

After a bit of calculating, they determined that the sediment basin would need to be a little over 1.6 acres in size to properly function as a sediment trap, including sediment drying area. (See Field Office

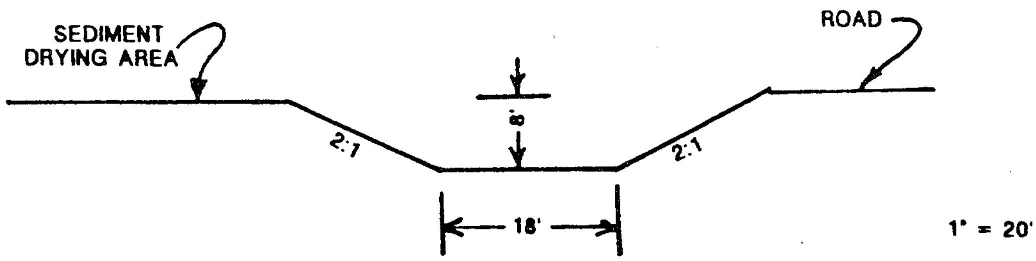
FIGURE 8 · ROBERT'S 55 ACRE SEDIMENT BASIN DETAIL



SEDIMENT BASIN LOCATION ON 55 ACRES



PLAN OF SEDIMENT BASIN (CURRENT SITUATION)



SECTION OF SEDIMENT BASIN (CURRENT SITUATION)

Toolbox for sediment basin nomographs.) This means that 1.6 acres of cropland would have to come out of production. Robert would lose any net income from the crop production on this acreage, plus still have to pay any costs such as land cost and property taxes. Robert estimated that these costs would be about $810/acre with his tomato crop, and about $420/acre on his winter vegetable crop (cauliflower).

To construct this basin and outlet structure it would cost about $15,800. Because of the large volume of sediment it was also determined that it would need cleaning out every year. The estimated cost to clean out and respread the sediment is $10,500 per year.

Table 10 is a summary of what they concluded from this option. The upfront costs are displayed, but in addition these values are shown in average annual terms (amortized) over the 20-year evaluation period using the 10 percent interest rate. Table 10 shows that the net cost associated with installing a sediment basin based on Robert's current farming practices would cost him $14,500 per year, or $260 per acre for 55 acres. Not too surprisingly, these costs caused Robert a lot of concern. Even though this option is technically viable, everyone agreed it wasn't economically feasible. Certainly, there had to be better options that would reduce sediment more economically.

TABLE 10

SEDIMENT BASIN-CURRENT FARMING OPERATION

NET COST SUMMARY

Item	Upfront Cost	Average Annual[1] Cost
Sediment Basin	$15,800	$1,860
Cleanout & Respread Cost	$10,500	$10,500
Reduced Crop Income (1.6 Acre)		
Tomatoes ($810/Ac/yr)	$1,300	$1,300
Winter Veg ($420/Ac/Yr)	$670	$670
Net Average Annual Cost:		$14,330
		$260 per acre (55 Acres)

[1]All values have been converted to an average annual value for the 20-year evalution period using discounting and/or amortization with a 10 percent interest rate.

Chuck, the Field Office Engineer, explained how the cost of construction and maintenance of a sediment basin relates to the amount of sediment leaving the field. Chuck then showed how the installation of other practices, described previously, could reduce the sediment yield from the field. They decided to take a closer look at a few other practices. The tools selected for examination were tailwater ditch tarps, cutback streams, surge irrigation, reducing furrow irrigation streams, and sprinkler pre-irrigation and germination. They also considered releveling the field to reduce the slope, however, at this time, Robert was against the idea, so it was not considered, even though it could significantly reduce the problem.

Tailwater Tarps

The next option considered was installing tarps in the tailwater ditch. They estimated the impact on the sediment rate for various furrow stream flows. The results are shown in Figure 7. Point 2 on Figure 7 shows that if Robert made no change in his present irrigation practices the sediment rate would be reduced to 36 tons per acre. The cost associated with tarps was estimated to be $1,500 per year, or $28 per acre per year. This cost covers the tarps, installation and removal of the tarps, installation and removal of the tailwater ditch and removal and spreading of the trapped sediment.

Tailwater Ditch with Sediment Basin

The lower sediment rate resulting from using the tarps in the tailwater ditch would allow Robert to install a smaller sediment basin, about 1 acre in size. This basin would cost $1,650 to construct and $7,700 a year to clean out and spread the sediment.

Table 11 summarizes the net economic impact of installing tarps in the tailwater ditch and constructing a sediment basin on this 55 acre field. The overall cost of this alternative is somewhat less expensive compared to the option of only installing a sediment basin but is still costly and not a reasonable option.

Pre-irrigation with Sprinklers and Tailwater Tarps

Another tool that Robert wanted to explore was renting sprinklers for pre-irrigation and germination in conjunction with the tailwater ditch tarps. In the past he has used them during droughts, but not on a regular basis. They estimate the rental rate is about $1,275 or $23 per acre, and that the irrigation labor would be about the same as what he is using now. They estimate that about two acre feet of water would be saved per year. Although wind problems are a drawback when using sprinklers in the Western Stanislaus County area, Robert says that in the past he has managed to time irrigations to minimize the impact. The Field Office staff and Robert determined that the overall sediment rate of 36 tons per acre with tarps would be reduced an additional 28 tons per acre per year with the use of sprinklers.

Point 3 on Figure 7 shows the effects of these practices on the sediment rate.

TABLE 11

SEDIMENT BASIN W/TARPS IN TAILWATER DITCH

NET COST SUMMARY

Item	Upfront Cost	Average Annual[1] Cost
Sediment Basin	$11,500	$1,350
Cleanout & Respread Cost	$7,700	$7,700
Tarp Purchase	$240	$30
Install & Remove Tarps	$520	$520
Reinstall Tailwater Ditch	$970	$970
Reduced Crop Income (1.0 Acre)		
Tomatoes ($810/Ac/yr)	$810	$810
Winter Veg ($420/Ac/Yr)	$420	$420
Net Average Annual Cost:		$11,800 $214 per acre (55 Acres)

[1]All values have been converted to an average annual value for the 20-year evaluation period using discounting and/or amortization with a 10 percent interest rate.

Table 12 shows the overall economic impact of this option: tailwater ditch tarps, sprinkler germination and a sediment basin. Although the bottom line cost is better, the cost is still quite high. Robert and the Field Office staff felt there still were other, more cost effective ways to achieve the reduction in sediment rates.

TABLE 12

PRE-IRRIGATION WITH SPRINKLER W/TARPS & SEDIMENT BASIN

NET COST SUMMARY

Item	Upfront Cost	Average Annual[1] Cost
Sediment Basin	$3,300	$390
Cleanout & Respread Cost	$1,900	$1,900
Tarp Purchase	$240	$30
Install & Remove Tarps	$520	$520
Reinstall Tailwater Ditch	$970	$970
Sprinkler Rental	$1,275	$1,275
Reduced Irr. Water (2 Acre-feet savings)	$30	$30
Reduced Crop Income (0.3 Acre)		
Tomatoes ($810/Ac/yr)	$240	$240
Winter Veg ($420/Ac/Yr)	$130	$130
Net Average Annual Cost:		$5,425 $99 per acre (55 Acres)

[1]All values have been converted to an average annual value for the 20-year evaluation period using discounting and/or amortization with a 10 percent interest rate.

Evaluation of Water Management Practices

From the previous discussion Robert could really see the positive impact on sediment rates that reducing the flow of irrigation water in the furrows has. However, he was unsure how changing his water application rate would impact his crop yields. He was also interested in finding out what impact changes in cultural practices such as pest management might have on his yields. To do this Robert and the field office set up some field trials. They decided to evaluate what happens to the tomatoes if the furrow stream size is varied, using the cutback stream practice and the surge irrigation method.

This is what they evaluated:

- Four rows of tomatoes were irrigated using 15 gallons per minute (gpm) for the full irrigation set.

- Four rows were pre-irrigated using 15 gpm and planting the tomatoes in an alternating pattern in the bed closer to the furrow, and 15 gpm for the irrigation set. This creates a double row of plants on the bed. Each row is spaced at twice the present spacing. This allows the germination irrigation to be effective in one half the present pre-irrigation time.

- Four rows were irrigated using 15 gpm and then cut back to 7.5 gpm.

- Four rows were irrigated using a siphon tube surge method.

Chuck and Robert verified the irrigation flows reaching the farm and in the furrow before attempting each method. At the end of the tomato season they checked the yields for the 16 experimental rows. As it turns out the yield was the same as the other portion of the field.

This gave Robert the confidence to try one of these systems on his entire field. The question was which system. Robert discussed these different irrigation systems and the necessary water delivery changes that would be required with the Irrigation District. Both Robert and the District decided that they did not want to deal with the variable delivery to the field resulting from cutback streams. He decided to go with the modified furrow surge system.

<u>Tailwater Tarps with Furrow Surge System, Sprinkler Preirrigation and Sediment Basin</u>

Given what they have learned from the system combinations so far, Robert decided he wanted to pencil out the cost associated with a system with a sediment basin using surge irrigation and pre-irrigation sprinklers with tarps in the tailwater ditch. Just how big would the sediment basin need to be?

Chuck and Robert sat down and figured out what the overall impacts the furrow surge system, tailwater ditch tarps, and sprinkler preirrigation would have on the overall size and cost of a sediment basin. Table 13 is a summary of their work.

They figured that to get the change in irrigation, the irrigator would need some training and it would probably mean an increase in wages for the irrigator ($2.00 per hour). However, there would also be a reduction in irrigation water used (3 ac-ft), and less labor time would be required (50 percent reduction). They also calculated that the sediment basin would be about 0.1 acres in size and cost about

$1,500 to construct and $600 per year to clean out and spread trapped sediment. Point 4 on Figure 7 shows the effect of selecting these practices.

There is still the additional expense associated with more specialized irrigation water management, but over time Robert feels it is to his advantage to incorporate this for a couple of reasons. One, because of the demand for water he has no doubt water costs will continue to escalate, and two, it allows him to minimize the cost of a sediment basin when, and if, the water quality regulations pertaining to sediment become that restrictive and would require such a system.

Robert decided that eventually he would like to work towards the system described in Table 14. He developed a Long Term Agreement to implement the water management changes over the next few years. He also decided to experiment with ways to improve irrigation, weed, and pest management in order to reduce sediment and minimize the size of the sediment basin that he eventually may need. Over the next few years, both Chuck and Robert will be working together in improving his system.

TABLE 13

MODIFIED FURROW SURGE W/PRE-IRRIGATION WITH SPRINKLER, TARPS, & SEDIMENT BASIN

NET COST SUMMARY

Item	Upfront Cost	Average Annual[1] Cost
Sediment Basin	$1,400	$175
Cleanout & Respread Cost	$610	$610
Tarp Purchase	$240	$30
Install & Remove Tarps	$520	$520
Reinstall Tailwater Ditch	$970	$970
Sprinkler Rental	$1,275	$1,275
Cost of Improved Irrigator	$760	$760
Reduced Irr. Water (2 Acre-feet)	($45)	($45)
Reduced Irr. Labor (50 percent)	($2,100)	($2,100)
Reduced Crop Income	(0.1 Acre)	
Tomatoes ($810/Ac/yr)	$80	$80
Winter Veg ($420/Ac/Yr)	$40	$40
Net Average Annual Cost:		$2,525 $46 per acre (55 Acres)

[1]All values have been converted to an average annual value for the 20-year evaluation period using discounted and/or amortization with a 10 percent interest rate.

TABLE 14

PRACTICE/SYSTEM COMPARISON OF SEDIMENT REDUCTION VERSUS COST

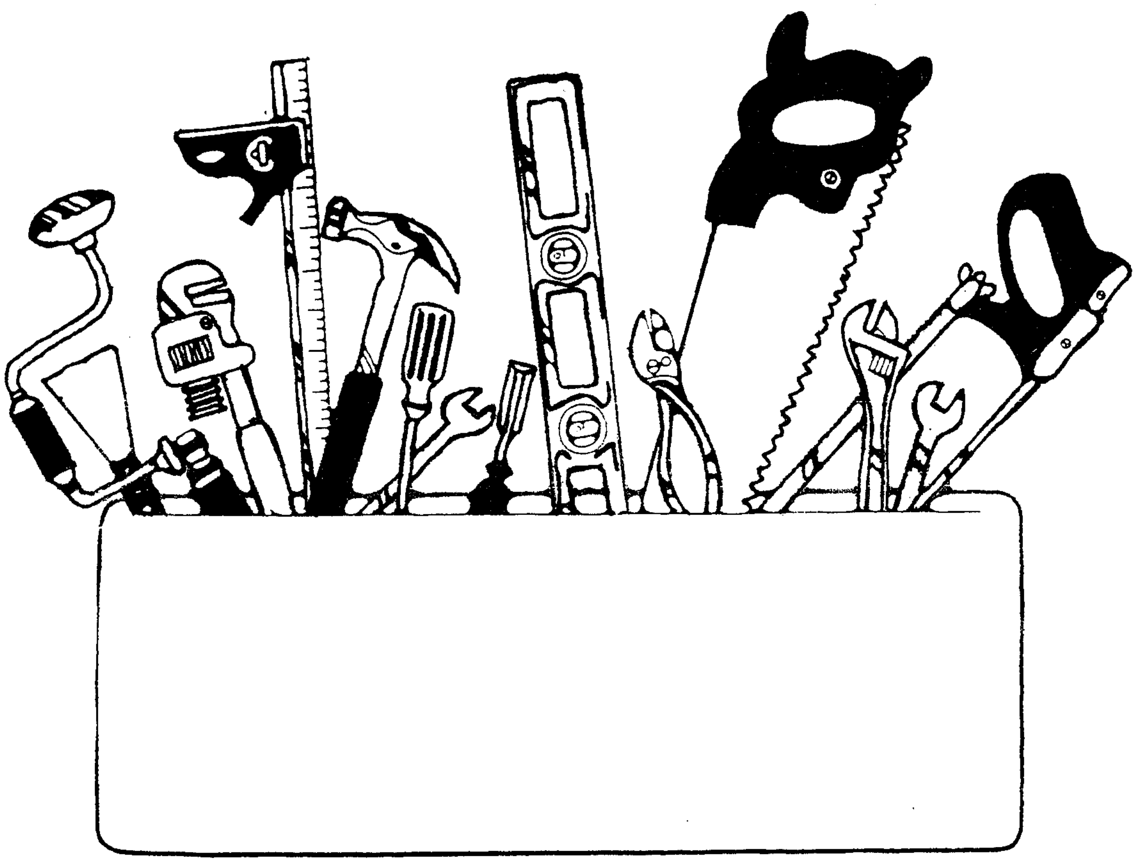
Practice	Sediment Rate (Tons/Acre)	Percent Reduction	Cost ($/Acre/Yr)
Current Farm Conditions	55	-	Soil Loss and Future Regulation & Fines
Tailwater Tarps	36	35	$28
Pre-Irrigation Sprinkler	27	51	$23
Pre Irr. Sprinkler & Tarps	8	85	$57
Modified Furrow Surge w/ Pre-Irr. Sprinklers & Tarps	5	91	$32
Sediment Basin	0.5	99	$260
Sediment Basin & Tarps	0.5	99	$214
Pre Irr. Sprinkler w/Tarps & Sediment Basin	0.5	99	$99
Furrow Surge w/ Pre-Irr. Sprinkler & Tarps & Sediment Basin	0.5	99	$46

Summary

From this discussion between Robert and the field office it can be seen that there are many options to consider. With each option there are trade offs. What Robert discovered was that there are many practices which will help to minimize the size and cost of a sediment basin. One of the most important variables to consider is reducing the total volume of water in the furrow.

Table 14 is a comparison of the different practices/systems described in this portion of the report. It is a comparison of the net costs in relation to different levels of sediment reduction. Based on Robert's evaluation of these practices/systems, he can see that these are a range of practices that provide significant, if not complete control, of the sediment. Clearly, there are options that are technically possible but economically unfeasible, such as the sediment basin added to the current farm operations. Depending on cost share money that might be available, Robert may want to look at other practices as well. It appears that there are practices that Robert can consider that will help him start addressing off-farm sediment.

FIELD OFFICE TOOLBOX



CHAPTER X

FIELD OFFICE TOOLBOX

INTRODUCTION

In order to provide the proper planning and design work for the landowners of western Stanislaus County, the SCS Patterson Field Office needs working tools to streamline the conservation planning process and help to provide the landowner solutions to their erosion and sedimentation problems.

This chapter is devoted to providing examples of some of the tools available for use in the field planning process. Some of the tools, such as computer models, can be calibrated for the study area with the understanding that assumptions made for the use of the tools need to be verified. These tools can be used for a certain time frame and the results tested and then compared to known values. The current Hydrologic Unit Area (HUA) cost-sharing program and the Crow's Landing Naval Base Monitoring program are two ways to provide the data needed for verification.

Discussed in this chapter are the computer models FUSED, FURROW, FURROW4, AGWATER and CAMPS. These models are described for use in the planning process.

Four nomographs are presented for use in assisting the landowner in evaluating potential costs and sizes for sediment basins. Sediment yield needs to be calculated using one of the computer models, then basin surface area, maintenance cost, construction cost, and drying area needed for sediment can be estimated.

Examples of cost data sheets are available for the suggested conservation practices. These sheets can be used to provide information to the grower to assist in the conservation planning and evaluation process.

A partial budget worksheet has been developed to further assist the landowner in the decision making process. The worksheet will allow the SCS field personnel to calculate the impact a conservation practice will have on the existing farming operation.

COMPUTER MODELS

FUSED

FUSED (Furrow Sedimentation and Erosion) is a computer model developed by the SCS West National Technical Center of USDA-SCS to evaluate the sediment produced by furrow irrigation. It is designed to evaluate conservation practice alternatives and their impacts on sediment production. The program can predict:

1. the average soil particle displacement from the end of the field;
2. the amount of erosion at the upper end of the field;
3. the depth of soil eroded;
4. years to erode a given depth of soil as a result of furrow irrigation;
5. the impacts of a number of applicable conservation practices.

FUSED was used to predict sediment rates produced by irrigating different crops and crop rotations in the West Stanislaus study area both before and after the application of conservation systems. The sediment rates estimated by FUSED were also used to compare practice alternatives.

FUSED requires an 80 character display, DOS 2.0 or greater, 256K of RAM and one double sided diskette or hard drive.

FURROW

The FURROW computer program was developed by the University of California-Davis Cooperative Extension Service to determine irrigation efficiency, distribution uniformity, advance times and depth of infiltration for furrow irrigated fields.

FURROW requires DOS 2 or greater and 256K of RAM.

FURROW4

Developed by the USDA-SCS, FURROW4 is a BASIC computer program used to calculate furrow irrigation erosion. It was used in this study to compute the amount of tailwater ditch erosion.

FURROW4 requires DOS 2 or greater with BASIC.

DATA SHEETS AND GRAPHS

The following data sheets indicate the information needed to use these computer sediment prediction models. Also included is an example of a graph developed to compare the sediment yield for different irrigation slopes using one crop and one soil type. The information to develop this graph came from the FUSED computer runs. Graphs of this type can be developed for different variables to help the landowner visualize how changing one factor of the farm operation, in this case slope, can change the sediment produced by irrigation.

DATA SHEET FOR SEDIMENT YIELD FROM FURROW IRRIGATED FIELDS

LANDOWNER: ______________________________

LOCATION: ______________________________

DISTRICT: ______________________________

ACRES BEING EVALUATED: ____________________

FIELD WIDTH ACROSS TOP OF FIELD: ______________

FURROW INFLOW RATE (GPM): __________________

FURROW LENGTH (FT): _______________________

FURROW SLOPE (%): ________________________

FURROW SPACING (INCHES): ______ (FT): ______

TYPE OF FURROW END: CONVEX--- N
MODERATELY CONVEX--- M
SEVERELY CONVEX--- S

TYPE OF FURROW IRRIGATION: SIPHON TUBE--- S
GATED PIPE--- G
FEEDER DITCHES--- F

ADVANCE TIME (HRS): _______________________

IRRIGATION TIME (HRS): ____________________

DESIRED DEPTH INFILTRATED (IN): ______________

TIME (HRS)	WATER ADVANCE (FT)
______	________
______	________

OPTIONAL

STEADY STATE INTAKE RATE (GPM/FT): ____________

STEADY STATE INTAKE RATE (m^3/meter-min) ________

Note: Use Amoozemeter

PREVIOUS CROP: ______________________________

CURRENT CROP: ______________________________

NUMBER OF CULTIVATIONS: ______________________

NUMBER OF IRRIGATIONS: ______________________

CROP RESIDUE LEFT IN FURROWS (LBS/ACRE): ________

MULCHING APPLIED (LBS/ACRE): __________________

AGRO-TILLAGE (EFFECTIVENESS 50-60%): __________

SEDIMENT REMOVAL PRACTICE
SEDIMENT BASIN (75-95%): ____________________

BURIED PIPE (75-95%): ____________________

VEGETATIVE FILTER STRIP (35-75%): __________

NUMBER OF SOIL SERIES (4 MAXIMUM): ____________

PERCENT OF AREA
SOIL SERIES 1: _______ SOIL SERIES 2: ____

SOIL SERIES 3: _______ SOIL SERIES 4: ____

COHESIVE OR NON COHESIVE

SOIL SERIES 1: C N SOIL SERIES 2: C N

SOIL SERIES 3: C N SOIL SERIES 4: C N

GRAIN SIZE DISTRIBUTION

SOIL D_{50} (mm):

SOIL SERIES 1: ________ SOIL SERIES 2: ____

SOIL SERIES 3: ________ SOIL SERIES 4: ____

OR

SOIL SERIES 1 Sieve	% Passing	SOIL SERIES 2 Sieve	% Passing
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______

SOIL SERIES 3 Sieve	% Passing	SOIL SERIES 4 Sieve	% Passing
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______
______	______ to ______	______	______ to ______

NOTE: For clay soils determine the D_{50} in mm usin a non-dispersed hydrometer test on soil to determine the %sand, silt and clay.

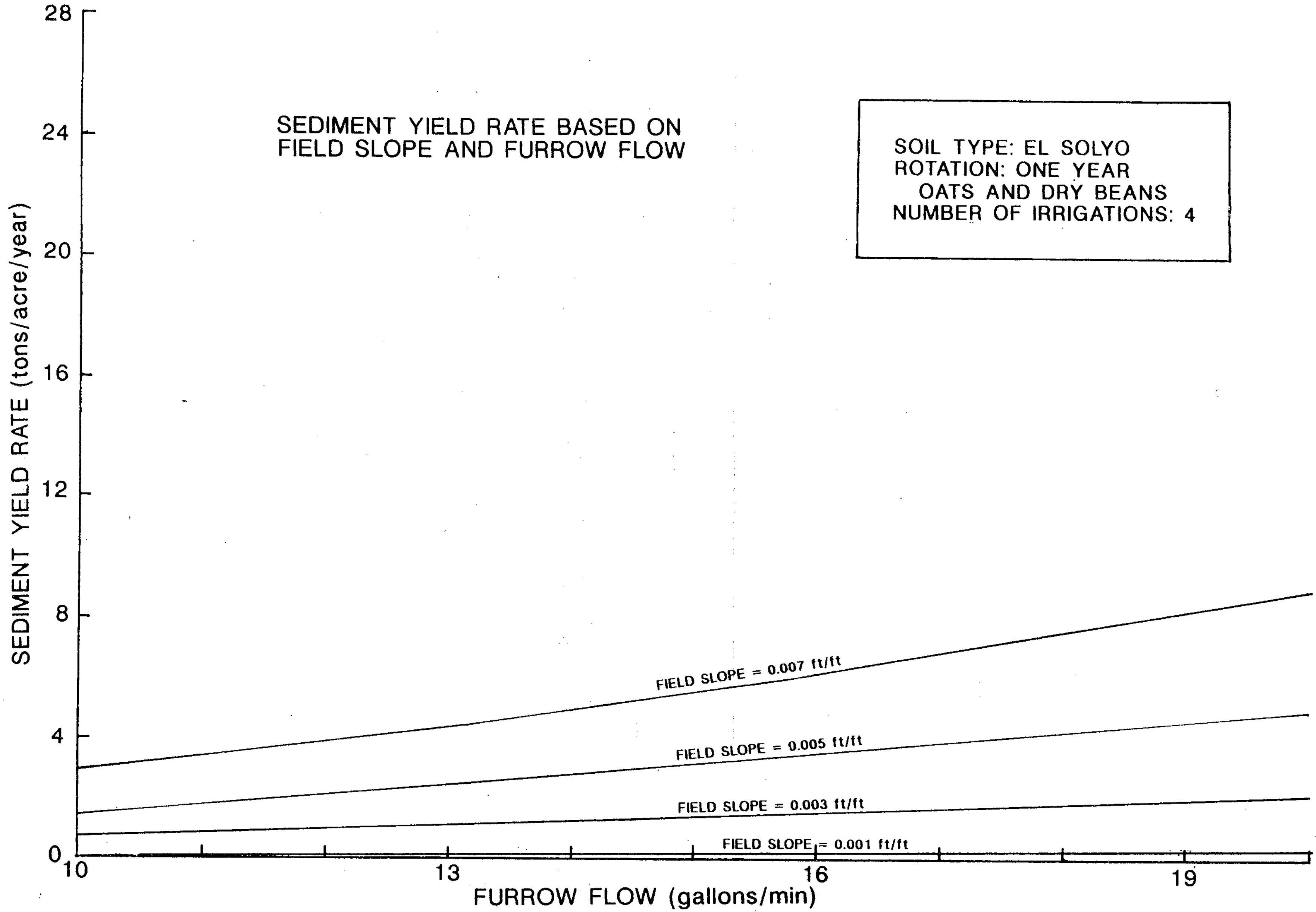
FIELD LAYOUT

FURROWS PER SET: ________ RUNOFF (GPM) PER FURROW: ______

FURROW BOTTOM WIDTH (FT): __________

SETS IN FIELD: __________ CROSS-SLOPE (%): ___________

MAJOR SOIL TEXTURE: ____


SEDIMENT YIELD RATE BASED ON
FIELD SLOPE AND FURROW FLOW
SOIL TYPE: EL SOLYO
ROTATION: ONE YEAR
OATS AND DRY BEANS
NUMBER OF IRRIGATIONS: 4
FIELD SLOPE = 0.007 ft/ft
FIELD SLOPE = 0.005 ft/ft
FIELD SLOPE = 0.003 ft/ft
FIELD SLOPE = 0.001 ft/ft
SEDIMENT YIELD RATE (tons/acre/year)
0
4
8
12
16
20
24
28
FURROW FLOW (gallons/min)
10
13
16
19

AGWATER

The AGWATER computer model was developed by California State Polytechnic University, San Luis Obispo, and co-sponsered by Pacific Gas and Electric, and the Office of Water Conservation of the California Department of Water Resources. The purpose of this expert system is to make growers aware of the existance and magnitude of irrigation related problems and possible solutions. The program roughly analyzes the operation and management of border strip, sprinkler systems, drip systems, micro spray sprinkler systems, and furrows. AGWATER can:

1. Allow a grower to perform a "self-evaluation" of his or her irrigation system and management practices.

2. Illustrate the uniformity of water application and the effects on irrigation scheduling decisions.

3. Illustrate the relationship between how much water the soil holds and how much is applied

4. Tabulate the results and "tips" to solve problems.

5. Provide a normal year irrigation schedule.

6. Allow the grower to perform "what if" comparisons.

Data needed for analysis includes crop root depth, emergence and harvest dates, general soil characteristics, and water contact time. For each irrigation the following information is needed; date, average flow rate, runoff and erosion description, percentage of total time of runoff, advance time, and recession time.

The AGWATER program can be used as a tool in formulating an irrigation water management plan for individual conservation plans. Several irrigation districts are using the program and some SCS field offices are expected to have it in the near future.

The program requires DOS v3.0 or later, 500 kilobytes of available memory, EGA or VGA color with 256 kilobytes of video memory and 2 megabytes of hard disk storage space. The software consists of the AGWATER program with user established databases for climate, soil, crop, and electric power rates.

CAMPS/FOCS

The Computer Assisted Management Planning System (CAMPS), soon to be replaced by the Field Office Computer System (FOCS), can be used by the field office to help growers implement conservation plans and practices designed to reduce the amount of furrow irrigation induced erosion and the resulting sediment from reaching the San Joaquin River.

The program can be used by field office personnel to document a conservation plan which will keep a record of decisions regarding needed practices that have been planned and implemented, and need to be planned and implemented.

CAMPS/FOCS will identify landowners and operators by farm size, location, crops by sequence and rotation on each field, types of irrigation systems, and types of water management and cultural management practices presently used and those being planned. The program will also track progress on the planned installation of practices and their effect on erosion and sediment reduction.

The system can also be used to create mailing lists of people by their location within the watershed. It can list organizations by type of resource management capability and interest. CAMPS/FOCS can be used to create current mailing lists of landowners, operators, other individuals, groups, and organizations in the watershed.

CAMPS/FOCS will be accessible to all SCS Field Offices in the future. The SCS Patterson Field Office will be able to use CAMPS/FOCS to track the successes of implementation of the sediment reduction practices and systems in the area.

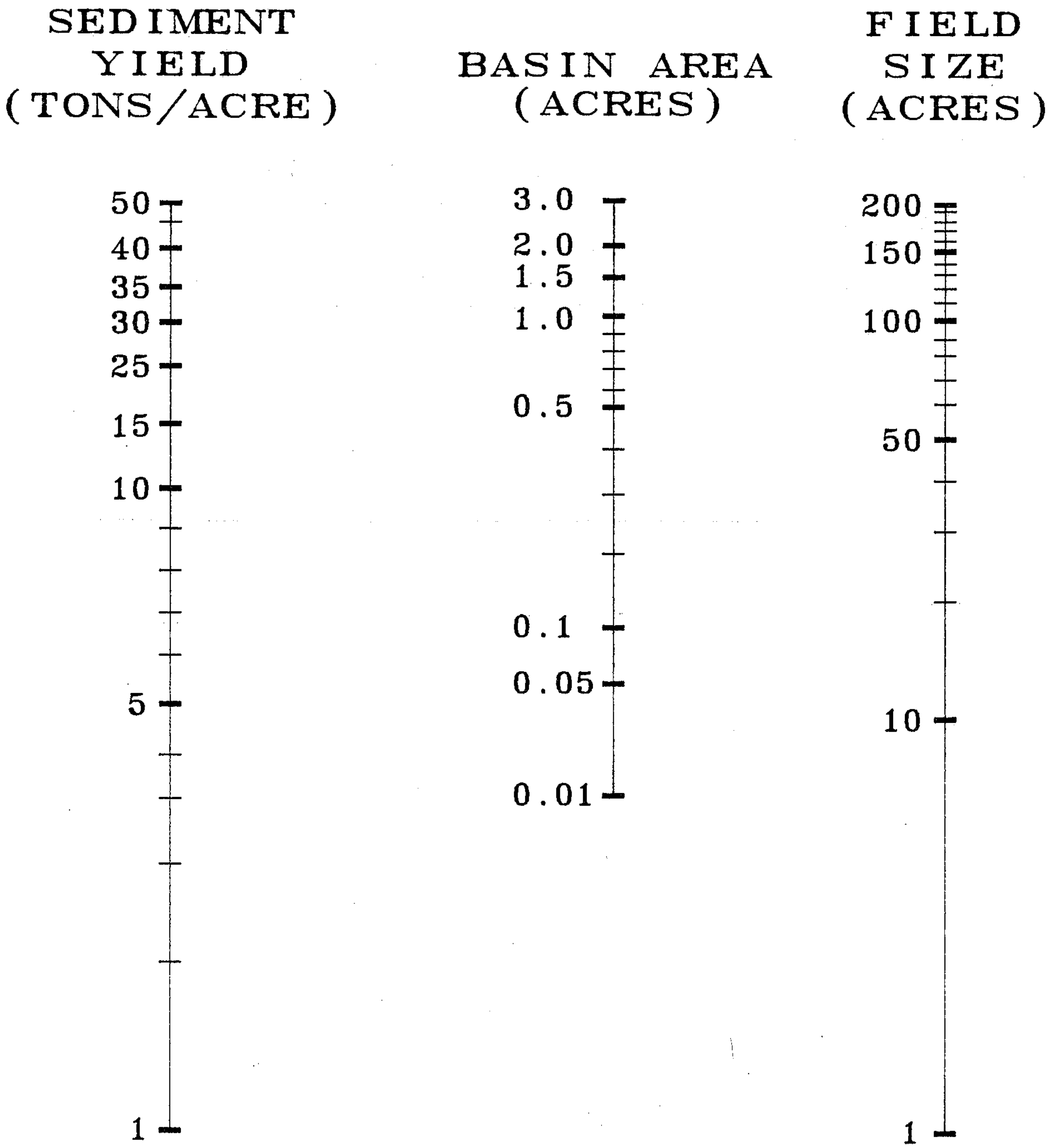
ENGINEERING NOMOGRAPHS

The four nomographs presented here can be used to determine the size and cost of a sediment basin for various sediment yields and field sizes.

The first step is to obtain the data suggested by the computer model data sheets shown earlier. FUSED is run to obtain the present furrow sediment rate. FURROW4 is then run to obtain the tailwater ditch sediment rate. These rates are added together to estimate the present off-field sediment rate.

The first nomograph estimates the sediment basin area needed in acres. This is based on a long narrow basin 10 feet deep with bottom width of 10 feet and 2:1 side slopes. Nomographs 2 and 3 calculate the maintenance and construction costs respectively. The last nomograph estimates the drying area needed to dry the sediment prior to respreading on the field. The total land surface area needed for the basin would be the basin area plus the drying area.

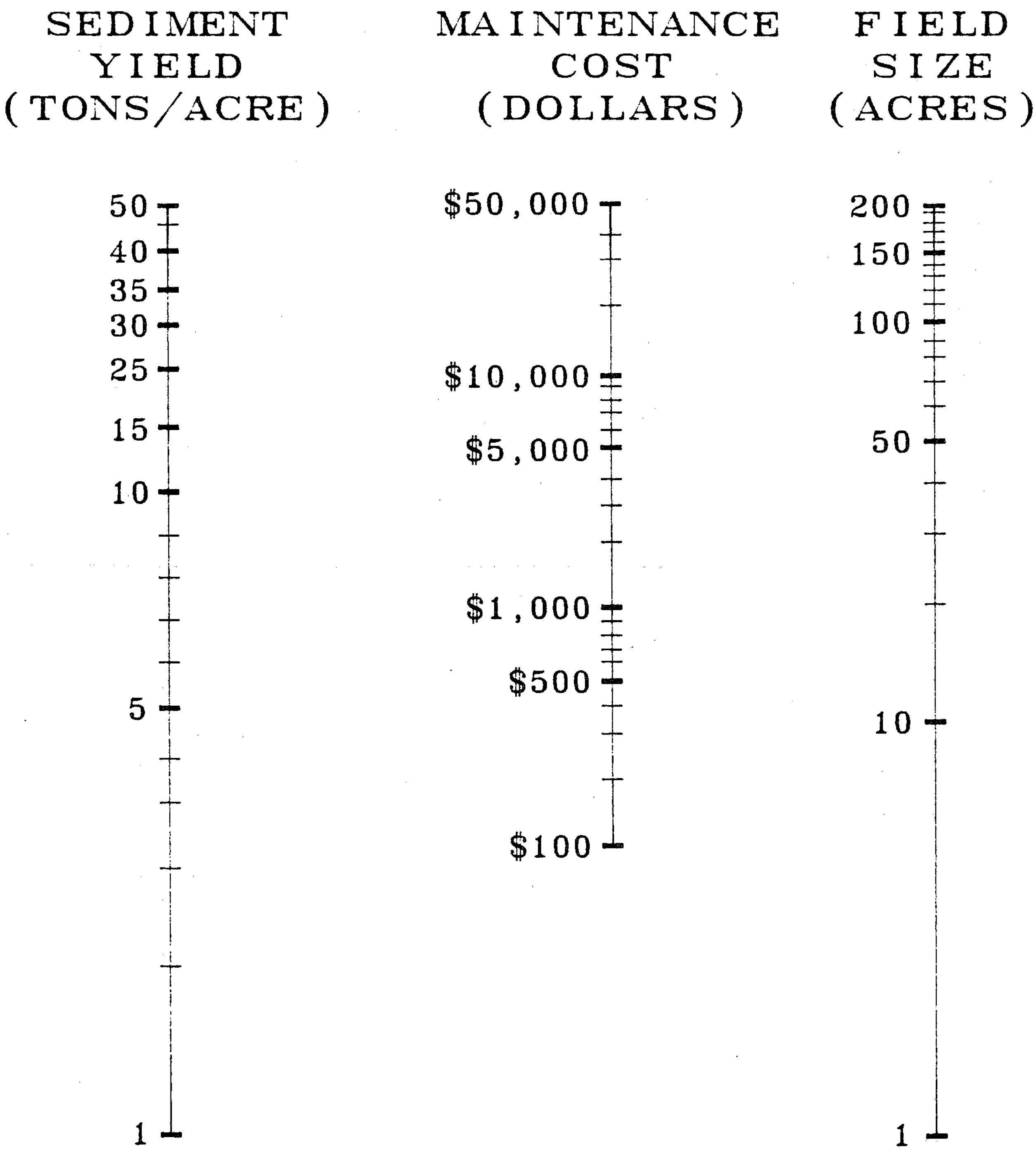
BASIN AREA WORKSHEET



(BASIN AREA) =

0.00037(SEDIMENT YIELD)(FIELD SIZE)

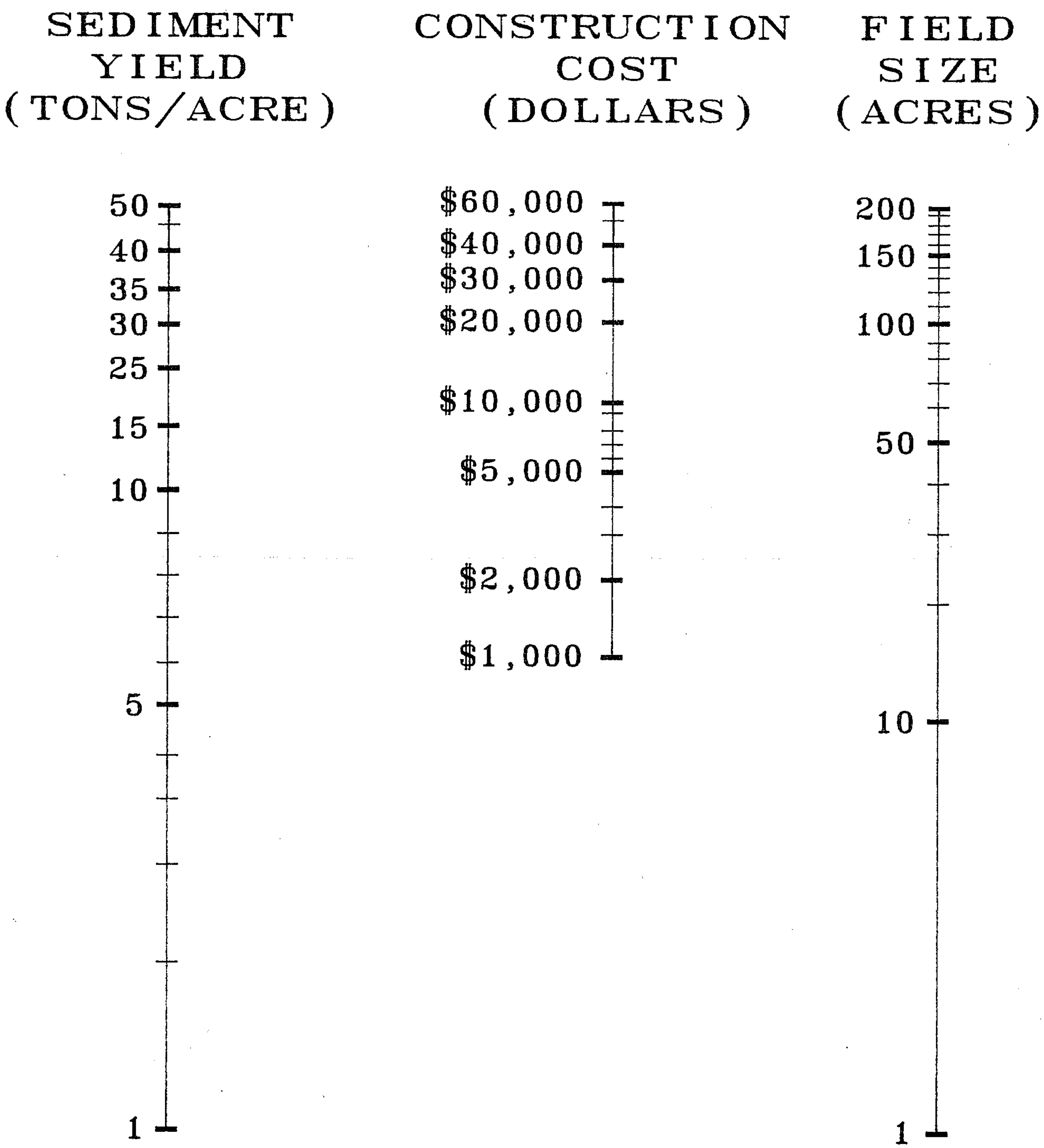
MAINTENANCE COST WORKSHEET



(MAINTENANCE COST) =

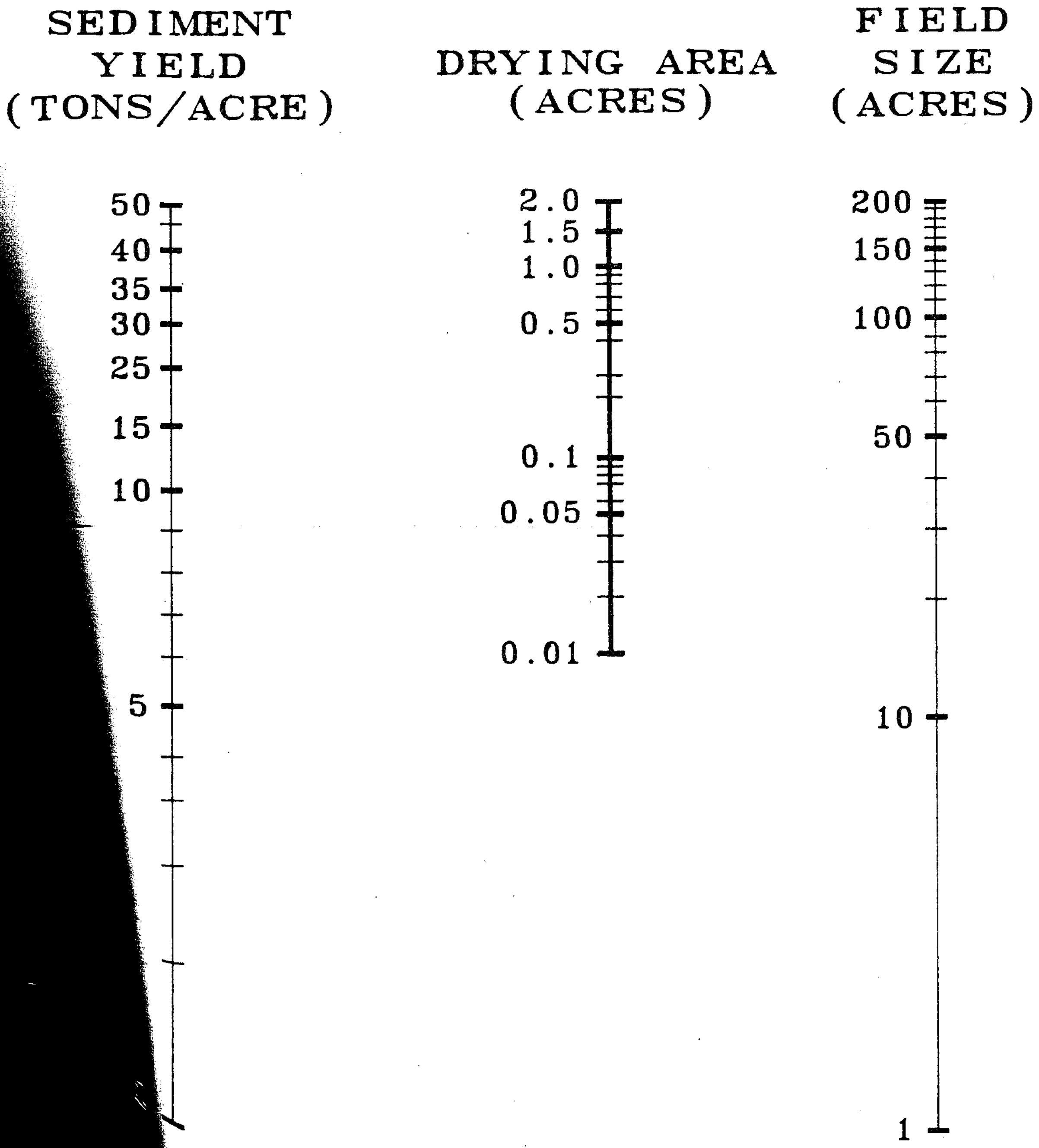
4(SEDIMENT YIELD) (FIELD SIZE)

CONSTRUCTION COST WORKSHEET



(CONSTRUCTION COST) =
7.5(SEDIMENT YIELD) (FIELD SIZE)

DRYING AREA WORKSHEET



(DRYING AREA) =

[illegible] (SEDIMENT YIELD)(FIELD SIZE)

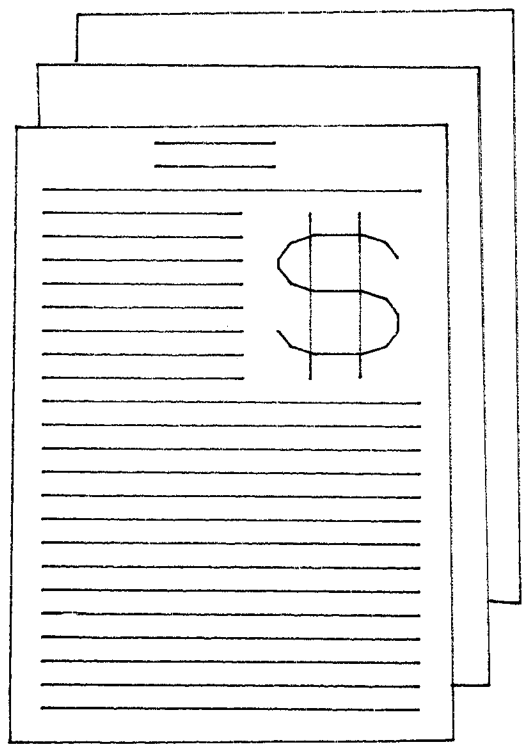
COST DATA SHEETS

Example cost data sheets are provided for each individual conservation practices to help the field office staff assist the landowner in evaluating the economic impact of the practice. The estimated costs are based on a predicted life span for each practice.

Installation and annual maintenance costs are broken down to reflect typical costs per acre for each specific operation. These costs provide an example; any costs that vary from the typical may be entered in the site revised cost column.

The average annual costs are then estimated. This gives the landowner a way to compare the costs of the suggested conservation practice with the existing farming operation.

The data cost sheets are similar to a worksheet and can be prepared to help a landowner decide which conservation practice may be right for his or her individual situation.



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	CONSERVATION TILLAGE - NO-TILL and STRIP TILL[a/]
SUB-SYSTEM:	Soil Management and Erosion Control
EXPECTED LIFE:	1 Year
SELECTED JOB:	Oat hay into melons - After harvest plant melons in beds prepared before previous winter oat hay planting.

NOTE Below is a comparison of the costs of planting melons after oat hay using Conventional and Conservation Tillage (No-Till and Strip Till). No-Till and Strip-till costs are usually less because of reduction in tillage operations.

	CONVT. TILL COSTS (PER ACRE)	NO TILL COSTS (PER ACRE)	SITE REVISED COSTS[b/] (PER ACRE)
INSTALLATION:[c/]			
Disk 2x......................	$ 9.50	$ none	$________
List and Fertilize...........	$ 9.50	$ none	$________
Fertilizer (Fertilize and Apply)	$ 10.00	$ 20.70	$________
Herbicide....................	$ 12.20	$ 12.20	$________
Plant and Fungicide..........	$ 16.25	$ 16.25	$________
Seed.........................	$ 21.00	$ 21.00	$________
Thin Vines...................	$ 32.50	$ 32.50	$________
Cultivate....................	$ 57.00	$ 57.00	$________
Insect Control...............	$ 68.00	$ 68.00	$________
Hand Weed....................	$ 65.00	$ 65.00	$________
TOTAL INSTALLATION COST.......	$305.95	$292.65	$________
ANNUAL MAINTENANCE:	$ None	$ None	$________
AVERAGE ANNUAL COST: Installation Cost Per Acre	$305.95	$292.65	$________

a/ West Stanislaus typical example; July 1991 estimates.

b/ ------------------ ------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE: CONSERVATION TILLAGE - MULCH-TILL[a/]
SUB-SYSTEM: Soil Management and Erosion Control
EXPECTED LIFE: 1 Year
SELECTED JOB: Oat hay into melons - After harvest lightly disk once to leave oat residue covering at least 30 percent of the ground after listing beds and planting melons.
Below is a comparison of the costs of planting melons after oat hay using Conventional and Mulch-Till. Mulch-Till costs are usually less because of reduction in tillage operations.

	CONVT. TILL COSTS (PER ACRE)	MULCH TILL COSTS (PER ACRE)	SITE REVISED COSTS[b/] (PER ACRE)
INSTALLATION:[c/]			
Disk 2x (Disk Once)....	$ 9.50	($ 4.25)	$______
List and Fertilize.........	$ 9.50	$ 9.50	$______
Fertilizer.................	$ 10.00	$ 10.00	$______
Herbicide..................	$ 12.20	$ 12.20	$______
Plant and Fungicide........	$ 16.25	$ 16.25	$______
Seed.......................	$ 21.00	$ 21.00	$______
Thin Vines.................	$ 32.50	$ 32.50	$______
Cultivate..................	$ 57.00	$ 57.00	$______
Insect Control.............	$ 68.00	$ 68.00	$______
Hand Weed..................	$ 65.00	$ 65.00	$______
TOTAL INSTALLATION COST....	$305.95	$295.70	$______
ANNUAL MAINTENANCE:	$ None	$ None	$______
AVERAGE ANNUAL COST: Installation Cost Per Acre.	$305.95	$295.70	$______

a/ West Stanislaus typical example; July 1991 estimates.

b/ ------------------ -------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	COVER CROP (Mowed)[a/]
SUB-SYSTEM:	Erosion Control and Water Quality Control
EXPECTED LIFE:	10 Years
SELECTED JOB:	To control erosion and protect and improve the soil by adding adequate cover in orchards. Establish and maintain a reseeding winter annual cover crop of Zorro Annual Fescue or Blando Brome. Broadcast seeding is used here to represent typical installation. Cover crop will be mowed two times a year and fertilized (40 lbs of nitrogen) as necessary.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
(Zorro Annual Fescue)		
Disk w/8 ft wide harrow using a D-4 Cat. @ 1.5 ac/hr @ $20/hr......................	$ 13.33	$
Cultipack w/D-4 Cat w/8 ft ringrollers @3 ac/hr @ $20/hr........................	$ 6.66	$
Fertilizer, Ammonium Phosphate (16-20-0) 250 lbs/ac @ $0.20/lb....................	$ 50.00	$
Apply fertilizer w/D-4 Cat.w/8 ft fertilizer spreader, 3 ac/hr @ $20/hr................	$ 6.66	$
Broadcast Zorro Annual Fescue @ 12lbs/ac 12 lbs @ $11.90/ lb......................	$142.80	$
Labor to broadcast seed--2 hr/ac @ $6.50/hr..	$ 13.00	$
INSTALLATION COST, per acre..................	$232.45	$
(Blando Brome)		
Installation methods the same as for Zorro Annual Fescue.......................	$ 89.65	$
Broadcast Blando Brome @ 18 lbs per acre 18 lbs @ $3.10/lb........................	$ 55.80	$
INSTALLATION COST, per acre..................	$145.45	$

COVER CROP (Mowed) cont.	TYPICAL COSTS	SITE REVISED COSTS b/
ANNUAL MAINTENANCE:		
Apply fertilizer, Ammonium Phosphate (16-20-0) every other year or 125 lbs/ac/yr @ $0.20/lb..................	$ 25.00	$_______
Labor to spread fertilizer - 2 hrs/ac every other year or 1 hr/ac/yr @ $6.50/hr.	$ 6.50	$_______
Mow 2x with flail or rotary mower, 22 to 40 hp, 540 rpm-pto @ $8/ac (estimated cost).........................	$ 16.00	$_______
Strip spray tree rows w/herbie hand held sprayer using Round-up and spreader in a 30" band (1 Herbie each side of tree) 1 x @ $10.17 per application.............	$ 10.17	$_______
Strip spray tree rows w/herbie hand held sprayer using pre-emergence 1x @ $23/appl.	$ 23.00	$_______
ANNUAL MAINTENANCE COST per acre.............	$ 80.67	$_______
AVERAGE ANNUAL COST: (Zorro Annual Fescue)		
Average Annual Installation Cost Amortized basedon 12 percent interest rate and 10 years (Amort. Factor = 0.17698) $232.45 x 0.17698...........................	$ 41.14	$_______
Plus Annual Maintenance.....................	$ 80.67	$_______
AVERAGE ANNUAL Cost, per acre................	$121.81	$_______
AVERAGE ANNUAL COST: (Blando Brome - Reseeding)		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 10 years (Amort. Factor = 0.17698) $145.45 x 0.17698.........................	$ 25.74	$_______
Plus Annual Maintenance.....................	$ 80.67	$_______
AVERAGE ANNUAL COST, per acre................	$106.41	$_______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ ------------------ ------------------ --------

Cooperator Case File No. Technician Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	CUTBACK STREAM[a/]
SUB-SYSTEM:	Erosion Control and Water Quality Control
EXPECTED LIFE:	1 Year
SELECTED JOB:	Increase of furrow irrigation inlet size so that water reaches the end of the furrow in 1/4 of the set time. The flow is then reduced by 50 percent for the remainder of the set time. Includes training and higher hourly wages for irrigators.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/] None, unless additional siphons needed.		
___" siphons (Life = 5 yrs) (if needed to control flows).............	$___.__	$__________
INSTALLATION COST, per acre.................	$___.__	$__________
ANNUAL OPERATION AND MAINTENANCE:		
Added irrigation cost ($2.00/hour wage increase for irrigator) (48 sets/160 ac. x 10-min/set x 5 irrigations x $8.50/hour)................	$ 2.00	$__________
ANNUAL OPERATION AND MAINTENANCE COST........	$ 2.00	$__________
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 10 year life. (Amort. Factor = 0.17698) (only if needed) $___.__ x 0.17698........	$___.__	$__________
Plus Annual Operation and Maintenance........	$ 2.00	$__________
AVERAGE ANNUAL COST.........................	$___.__	$__________

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ ------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	DEBRIS BASIN (SEDIMENT BASIN) a/
SUB-SYSTEM:	Erosion Control and Water Quality Control
EXPECTED LIFE:	25 Years
SELECTED JOB:	Excavate 9,600 CY for a 6 AF sediment basin. Land surface area is about 2.8 acres, including sediment drying area. Basin depth is 8 feet, bottom width is 12 feet, side slopes are 2H:1V, length is about 720 feet. Spoil spread on fields, within 500 feet of basin. Serves 160 acres, erosion rate of 9 T/A. 25 year life.

	TYPICAL COST (per acre)	SITE REVISED COST b/ (per acre)
INSTALLATION: c/		
Excavate and spread spoil w/20 CY self-loading scrapers and grader. (280 CY/hr = 34 hr @ $165/hr)	$ 35.00	$______
Inlet and Outlet: wooden weirs and plastic chute liners	$ 3.00	$______
INSTALLATION COST, per acre	$ 38.00	$______
ANNUAL OPERATION AND MAINTENANCE:		
Excavate sediment from basin every 2 years	$ 71.25	$______
ANNUAL OPERATION AND MAINTENANCE COST	$ 35.65	$______
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 25 year life. (Amort. Factor = 0.12750) $38.00 x 0.12750	$ 4.85	$______
Plus Annual Operation and Maintenance	$ 35.65	$______
AVERAGE ANNUAL COST	$ 40.50	$______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ Cooperator ------------------- Case File No. ----------------- Technician -------- Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE: FILTER STRIP[/a]
SUB-SYSTEM: Erosion Control and Water Quality Control
EXPECTED LIFE: 1 Year
SELECTED JOB: To remove sediment and other pollutants from furrow irrigation water by filtration, infiltration, absorption and adsorbtion and to reduce velocities on return flow ditches or just upstream of return flow ditches. Establish filter strips by planting of grain, sudan, sorgum sudan or alfalfa on the lower edge of fields where filters outlet into streams ditches or channels. Filter strips will be a minimum width of 30 feet to reduce delivery of sediment to roads, drains, and waterways. The filter strip is planted as part of the crop rotation: (1) Summer annual sudan or sorgum sudan drilled into winter grain stubble, or alfalfa stubble if available at the end of the previous rotation. (2) If the rotation is out of alfalfa into winter vegetables, leave the alfalfa in 30 ft strips at the lower end of fields. (3) If grain is the Fall crop planted then there is no additional cost for planting the grain filter strip. (4) If vegetable crops are planted, the following summer sudan or sorgum sudan can be drilled into the stubble of the previous winter grain filter strip.. If vegetables are planted the following winter than winter grain can be drilled into the sudan stubble.

	TYPICAL COST (per acre of filter strip)	SITE REVISED COST[b/] (per acre of filter strip)
INSTALLATION:[c/] Plant a sudan grass filter strip, 30 ft. wide x 1,260 ft. long (0.9 acres) at the lower end of a 40 acre field being planted from oat hay into green lima beans. Drill sudan grass seed into oat hay stubble (no-till). Costs shown are per acre of filter strip.		
PREPLANT WEED CONTROL: Cost included in 40 acre planting of green lima beans..............................	$ NONE	$ NONE
IRRIGATION: Cost included in 40 acre planting of green lima beans..............................	$ NONE	$ NONE

FILTER STRIP INSTALLATION Cont.:	TYPICAL COST (per acre)	SITE REVISED COST b/ (per acre)
PLANTING AND FERTILIZING:		
Fertilizer: 20 lbs. N/ac using 21-0-0; @ 150 lbs/ac. @ $0.25/lb.	$ 37.50	$__________
Sudan seed: 20lb/ac @ $0.70/lb.	$ 14.00	$__________
Drill seed and fertilize w/ 180 hp tractor & a 16' no-till or modified conventional grain drill: tractor, fuel, maint. & implement @ $12.50/hr. + $6.50/hr labor = $19.00/hr @ 0.25 hr/ac.	$ 4.75	$__________
Fertilizer Application add $3.00/ac	$ 3.00	$__________
INSTALLATION COST Per Acre.	$ 59.25	$__________
INSTALLATION COST PER 0.9 ACRE	$ 53.33	$__________
INSTALLATION COST Per Linear Ft. ($53.33/1200 ft.)	$ 0.04	$__________
ANNUAL MAINTENANCE:	$ NONE	$__________
AVERAGE ANNUAL COST:		
Average Annual Cost per acre of filter strip.	$ 59.25	$__________
Average Annual Cost per linear foot of filter strip.	$ 0.04	$__________

a/ West Stanislaus typical example; March, 1991 estimates

b/ ------------------ ------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	GATED PIPE[a/]
SUB-SYSTEM:	Water Management
EXPECTED LIFE:	10 years
SELECTED JOB:	Install two header pipe lines of 15-inch and 12-inch PVC pipe for 160 acre parcel and one line of 10-inch gated pipe line full width of 3-1,100 foot wide fields; gravity feed from feeder line.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Conveyance System............................	$285.00	$__________
Gated pipe....................................	$145.00	$__________
INSTALLATION COST.............................	$430.00	$__________
ANNUAL OPERATION AND MAINTENANCE:		
O & M Conveyance System.......................	$ 9.10	$__________
Move gated pipe ($2.50/acre/irrigation - 7 irrigations)...	$ 17.50	$__________
ANNUAL OPERATION AND MAINTENANCE COST........	$ 26.60	$__________
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 10 year life (Amort. Factor = 0.17698) $430.00 x 0.17698.........................	$ 76.10	$__________
Plus Annual Operation and Maintenance........	$ 26.60	$__________
AVERAGE ANNUAL COST...........................	$102.70	$__________

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ Cooperator ------------------- Case File No. ----------------- Technician -------- Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	GRASSED WATERWAY (412) (SMALL WATERWAY)[a/]
SUB-SYSTEM:	Erosion Control
EXPECTED LIFE:	10 Years
SELECTED JOB:	To protect irrigation drainage ditches (below sumps) from eroding: Presumed ditch size: 6 ft. bottom width, 4:1 side slopes, 0.50 ft. deep, 1,000 ft. long and a total surface area of 0.2 acres. Shape the entire waterway and compact bottom area; prepare seedbed, fertilize and seed with a mixture of Zorro Annual Fescue, Rose Clover and Blando Brome. Mulch area with straw and anchor straw. Irrigate for establishment as necessary. Control Height by mowing.

	TYPICAL COSTS (0.20AC)	SITE REVISED COSTS[b/] (PER FOOT)
INSTALLATION:[c/]		
WATERWAY PREPARATION:		
Disk w/10' wide disk & harrow using D-4 Cat. @ 1.5 acres/hr & $45 per/hr (45/1.5 x 0.2)	$ 6.00	$______
Cultipack w/D-4 Cat. and 10' ring roller @ 3 acres/hr & $45/hr (45/3 x 0.2)........	$ 3.00	$______
Fertilizer: Ammonium Phosphate (16-20-0) @ 250lbs per acre @ $0.10 ($200/ton) = $25/ac x 0.2 acres...........	$ 5.00	$______
Apply fert. w/ 60 hp tractor & 10' spreader @ 3 ac/hr & $5/acre x 0.2 acres...........	$ 1.00	$______
SEEDING AND MULCHING:		
Broadcast Seed as follows:		
-Blando Brome: 12lbs/ac @ $2.35/lb x 0.2 ac..	$ 5.64	$______
-Zorro Annual Fescue; 4lbs/ac @ $5.90/ac x 0.2 ac................................	$ 4.72	$______
-Rose Clover; 9lbs/ac @ $1.30/lb x 0.2 ac....	$ 2.34	$______
Labor to broadcast seed @ $6.50/hr & 1hr/ac x 0.2 ac.........................	$ 1.30	$______
Apply straw mulch @ 2 tons/ac @ $50/ton x 0.2 ac................................	$ 20.00	$______
Labor to spread straw; 1hr/ac @ $6.50/hr x 0.2 ac................................	$ 1.30	$______
Labor to anchor straw; 4hrs/ac @ $6.50/hr x 0.1 ac................................	$ 2.60	$______
Total Installation Cost for 0.2 acres........	$ 52.90	$______

GRASSED WATERWAY (412) (SMALL WATERWAY)	TYPICAL COSTS (0.20AC)	SITE REVISED COSTS b/ (PER FOOT)
INSTALLATION cont.:		
Total Installation cost per foot.............	$ 0.05	$
ANNUAL MAINTENANCE:		
Fertilizer: Ammonium Phosphate (16-20-0) @ a rate of 125lbs/ac/yr @ $0.10/lb = $12.50/ac x 0.2 acres.....................	$ 2.50	$
Apply fertilizer w/ 60 hp tractor and a 10' fert. spreader @ 3ac/hr and $5/ac x 0.2 acres.........................	$ 1.00	$
Mow 1x w/ flail or rotary mower w/60hp tractor @ $19/hr and 3ac/hr x 0.2 acres.............	$ 1.30	$
Irrigate: completed w/crop irrigation @ $15/AF and 2.5AF/ac applied (no extra cost for labor) x 0.2 ac..................	$ 7.50	$
Annual Maint. cost for 0.2 ac................	$ 12.30	$
AVERAGE ANNUAL COST:		
Ave Ann. Installation Cost Amortized based on 12 percent interest rate and 10 years (amort. factor = 0.17698) $52.90 x 0.17698........	$ 9.40	$
Plus Annual Maintenance Cost.................	$ 12.30	$
Average Annual Cost per 0.2 acres............	$ 21.70	$
Average Annual Cost per foot.................	$ 0.02	$

a/ West Stanislaus typical example; July 1991 estimates.

b/

Cooperator	Case File No.	Technician	Date

c/ Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	GRASSED WATERWAY (412) (LARGE WATERWAY)[a/]
SUB-SYSTEM:	Erosion Control
EXPECTED LIFE:	10 Years
SELECTED JOB:	To protect irrigation drainage ditches (below sumps) from eroding: Presumed ditch size: 10ft. bottom width, 4:1 side slopes, 0.85 ft. deep, 1,000 ft. long and a total surface area of 0.4 acres. Shape the entire waterway and compact bottom area; prepare seedbed, fertilize and seed with a mixture of Zorro Annual Fescue, Rose Clover and Blando Brome. Mulch area with straw and anchor straw. Irrigate for establishment as necessary. Control height by mowing.

	TYPICAL COSTS (0.4 AC)	SITE REVISED COSTS [b/] (0.4 AC)
INSTALLATION:		
WATERWAY PREPARATION:		
D-4 Cat. work w/ angle blade, ave. of 0.42 cy/ft. for 1,000' and a total of 422 cy moved @ $1/cy....................	$420.00	$______
Disk w/8' wide disk & harrow using D-4 Cat. @ 1.5 acres/hr & $45/hr (45/1.5 x 0.4)....	$ 12.00	$______
Fertilizer: Ammonium Phosphate (16-20-0) @ 250 lbs. per acre @ $0.10 ($200/ton) = $25/ac x 0.4 acres......................	$ 10.00	$______
Apply fert. w/60 hp tractor & 10' spreader @ 3 ac/hr& $5/acre x 0.4 acres...........	$ 2.00	$______
SEEDING AND MULCHING:		
Broadcast Seed as follows:		
-Blando Brome: 12lbs/ac @ $2.35/lb x 0.4 ac..	$ 11.28	$______
-Zorro Annual Fescue; 4lbs/ac @ $5.90/lb. x 0.4 ac................................	$ 9.44	$______
-Rose Clover; 9lbs/ac @ 1.30/lb x 0.4 ac.....	$ 4.68	$______
Labor to broadcast seed @ $6.50/hr & 1hr./ac x 0.4 ac................................	$ 2.60	$______
Apply straw mulch @ 2 tons/ac @ $50/ton x 0.4 ac................................	$ 40.00	$______
Labor to spread straw; 1hr/ac @ $6.50/hr x 0.4. ac...............................	$ 2.60	$______
Labor to anchor straw; 4hrs/ac @ $6.50/hr x .2.................................	$ 10.40	$______

GRASSED WATERWAY (412) (LARGE WATERWAY)[a/]	COSTS (0.4 AC)	COSTS [b/] (0.4 AC)
INSTALLATION: cont.		
Total Installation Cost for 0.4 acres:.......	$525.00	$______
Total Installation cost per foot:...........	$ 0.53	$______
ANNUAL MAINTENANCE:		
Fertilizer: Ammonium Phosphate (16-20-0) @ a rate of 125lbs/ac/yr @ $0.10/lb = $12.50/ac x 0.4 ac......................	$ 2.50	$______
Apply fertilizer w/60 hp tractor and a 10' fert. spreader @ 3 ac/hr and $5/ac x 0.4 ac............................	$ 2.00	$______
Mow 1x w/flail or rotary mower w/60hp tractor @ $19/hr and 3 ac/hr x 0.4 ac............	$ 2.53	$______
Irrigate: completed w/crop irrigation @ $15/AF and 2.5 AF/ac applied (no extra cost for labor) x 0.4 ac......................	$ 15.00	$______
Annual Maint. cost for 0.4 ac................	$ 22.00	$______
Annual Maint. cost per foot..................	$ 0.02	$______
AVERAGE ANNUAL COST:		
Ave Ann. Installation Cost Amortized based on 12 percent interest rate and 10 years (amort. factor = 0.17698) = $525 x 0.17698.......	$ 92.90	$______
Plus Annual Maintenance Cost	$ 22.00	$______
Average Annual Cost per 0.4 acres...........	$144.90	$______
Average Annual Cost per foot................	$ 0.12	$______

[a/]West Stanislaus typical example; July 1991 estimates.

b/________	________	________	____
Cooperator	Case File No.	Technician	Date

[c/]Installation information from UC Cooperative Extension Service crop enterprise budgets and interviews with California growers.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	IRRIGATION LAND LEVELING[a/]
SUB-SYSTEM:	Erosion Control and Water Quality Control
EXPECTED LIFE:	25 Years
SELECTED JOB:	Establish uniform irrigation grade in irrigated field. Leveling in 15-25 acre blocks. 200 CY of cut per acre. Annual landplaning.

	TYPICAL COST (per acre)	SITE REVISED COST [b/] (per acre)
INSTALLATION:[c/]		
Leveling at 200 CY/Acre @ $1.00/CY including surveys and staking............	$200.00	$______
INSTALLATION COST..........................	$200.00	$______
ANNUAL OPERATION AND MAINTENANCE:		
Landplane, 3 directions, 10 acres per hour, equipment O&M @ $65/hour..................	$ 20.00	$______
ANNUAL MAINTENANCE COST.....................	$ 20.00	$______
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 25 year life (Amort. Factor = 0.12750) $200.00 x 0.12750.........................	$ 25.50	$______
Plus Annual Maintenance....................	$ 20.00	$______
AVERAGE ANNUAL COST per acre................	$ 45.50	$______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ ------------------- ------------------ --------
Cooperator   Case File No.   Technician   Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE: IRRIGATION SYSTEM--SPRINKLER[a/]
SUB-SYSTEM: Water Management
EXPECTED LIFE: 20 Years
SELECTED JOB: Hand move sprinkler irrigation system used to efficiently and uniformly apply water on 80 acres of irrigated walnuts. Includes: installing underground pressure line (12-inch PVC) with screw gate outlets, sprinkler lines (4 ea. - 1,320 feet long, 4-inch), 15 HP booster pump, and 6-inch feeder lines. System life about 20 years, with some surface pipe replacement needed.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Underground pipe and handmove sprinkler system..........................	$450.00	$
INSTALLATION COST............................	$450.00	$
ANNUAL OPERATION AND MAINTENANCE:		
Underground pipe and pump O&M................	$ 7.50	$
Pumping Energy Costs.........................	$ 15.00	$
Sprinkler line OM&R	$ 15.00	$
Labor Cost ($6.50/hr x 0.75 hr/irrig./ac. x 11 irrigations).........................	$ 53.60	$
ANNUAL OPERATION AND MAINTENANCE COST........	$ 91.10	$
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 20 years (Amort. Factor = 0.13388) $450.00 x 0.13388.........................	$ 60.25	$
Plus Annual Operation and Maintenance........	$ 91.10	$
AVERAGE ANNUAL COST..........................	$151.35	$

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ -------------------- ----------------- --------

Cooperator	Case File No.	Technician	Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	IRRIGATION SYSTEM--SPRINKLER[a/]
SUB-SYSTEM:	Water Management
EXPECTED LIFE:	20 Years
SELECTED JOB:	Wheel line irrigation system used to efficiently and uniformly apply water on 80 acres of irrigated cropland. Includes: installing underground pressure line (12 and 15-inch PVC) with screw gate outlets, sprinkler lines (4 - 1,320 feet long, 4-inch), 20 HP booster pump, and 6-inch flexible feeder lines. System life about 20 years, with some surface pipe replacement.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Underground pipe and wheel line sprinkler system..........................	$680.00	$______
INSTALLATION COST............................	$680.00	$______
ANNUAL OPERATION AND MAINTENANCE:		
Underground pipe and pump O&M................	$ 8.50	$______
Pumping Energy Costs.........................	$ 18.00	$______
Sprinkler Line OM&R..........................	$ 30.10	$______
Labor cost ($6.50/hr x 0.50hr/irrigation/ac x 7 irrigations)..........................	$ 22.75	$______
ANNUAL OPERATION AND MAINTENANCE COST........	$ 79.35	$______
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 20 year life. (Amort. Factor = 0.13388) $680.00 x 0.13388.........................	$ 91.00	$______
Plus Annual Operation and Maintenance........	$ 79.35	$______
AVERAGE ANNUAL COST..........................	$170.35	$______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ -------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	IRRIGATION SYSTEM, TAILWATER RECOVERY[a/]
SUB-SYSTEM:	Water Management
EXPECTED LIFE:	25 Years
SELECTED JOB:	Excavate 3,700 CY for 2.5 acre-foot sump - 8 ft. deep with 2H:1V sideslopes and 320 ft. by 56 ft. top. Spoil spread on adjacent fields, within 500 feet of sump. Serves 80 acres of irrigated cropland receiving 4 AF of applied water. 25 year installation life.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Excavate and spread spoil w/20 CY self-loading scraper and grader. (140 CY/hr = 26hr @ $95/hr)	$ 15.45	$
Inlet: wooden weir and plastic chute liner	$ 1.50	$
Outlet: Screen, pump stand and vent, 25 hp turbine pump, pump inlet, backflush system and appurtenances	$ 57.50	$
Return Pipe - 12" PVC (5,450 ft. @ $8.60/ft)	$292.95	$
INSTALLATION COST, per acre	$367.40	$
ANNUAL OPERATION AND MAINTENANCE:		
Sump Cleanout and Spreading, annual	$ 20.00	$
Pump and pipeline O&M	$ 10.80	$
Power Costs (5 irrigations)	$ 21.50	$
ANNUAL OPERATION AND MAINTENANCE COST	$ 52.30	$
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amoritized based on 12 percent interest rate and 25 years (Amort. Factor = 0.12750) $367.40 x 0.12750	$ 46.80	$
Plus Annual Maintenance	$ 52.30	$
AVERAGE ANNUAL COST	$ 99.10	$

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ -------------------- ----------------- --------

Cooperator	Case File No.	Technician	Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE: IRRIGATION WATER MANAGEMENT[a/]
SUB-SYSTEM: Water Management
EXPECTED LIFE: 1 Year
SELECTED JOB: Added labor costs to manage applied water to achieve uniform depth of wetting, minimize runoff, and meet water requirements for 80 acres.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
None; may need to buy auger..................	$ 0.00	$
INSTALLATION COST...........................	$ 0.00	$
ANNUAL OPERATION AND MAINTENANCE:		
Added labor costs:		
Extra time for irrigator to check soil moisture between irrigations - 1 auger hole, 3 to 5 feet deep, per 10 acres (8 hole x 7 irrigations x 0.25 hrs/hole x $6.50/hr/irrigation)....................	$ 1.15	$
ANNUAL OPERATION AND MAINTENANCE COST........	$ 1.15	$
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized, based on 12 percent interest rate and 10 year life. (Amort. Factor = 0.17698) (if needed) $0.00 x 0.17698...............	$ 0.00	$
Plus Annual Operation and Maintenance........	$ 1.15	$
AVERAGE ANNUAL COST..........................	$ 1.15	$

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ ------------------- ----------------- --------
Cooperator Case File No. Technician Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	SURGE SYSTEM[a/]
SUB-SYSTEM:	Erosion Control and Water Quality Control
EXPECTED LIFE:	25 Years
SELECTED JOB:	Install surge irrigation system; including: landleveling 160 acres in six fields for zero percent cross-slope, two header pipe lines of 15-inch and 12-inch PVC pipe for 160 acres and one line of 10-inch gated pipe full width of three 1,100 foot wide fields, and surge valves; gravity feed from feeder line.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Zero percent cross-slope, 450 CY/Acre @ $1.00/CY (Life = 25 years)...............	$450.00	$_______
Conveyance System (Life = 25 yrs)............	$285.00	$_______
Surge valves (Life = 10 years), 6 each	$ 56.00	$_______
Gated Pipe (Life = 10 years).................	$145.00	$_______
INSTALLATION COST............................	$936.00	$_______
ANNUAL OPERATION AND MAINTENANCE:		
O & M on cross-slope.........................	$ 15.00	$_______
Move Gated Pipe ($2.50/acre/irrigation - 7 irrigations)...	$ 17.50	$_______
ANNUAL OPERATION AND MAINTENANCE COST........	$ 32.50	$_______
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized based on 12 percent interest rate and 25 year life. (Amort. Factor = 0.12750) $936.00. x 0.12750........................	$119.30	$_______
Plus Annual Operation and Maintenance.........	$ 32.50	$_______
AVERAGE ANNUAL COST	$151.80	$_______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ -------------------- ----------------- --------

Cooperator	Case File No.	Technician	Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PATTERSON FIELD OFFICE

PRACTICE:	TAILWATER TARPS[a/]
SUB-SYSTEM:	Erosion Control
EXPECTED LIFE:	3 Years
SELECTED JOB:	Tarp check in water supply and/or tailwater ditch to control slope and deposit sediment; 160 acres.

	TYPICAL COST (per acre)	SITE REVISED COST[b/] (per acre)
INSTALLATION:[c/]		
Tarp Cost ($/acre)	$ 4.80	$______
INSTALLATION COST, per acre	$ 4.80	$______
ANNUAL OPERATION AND MAINTENANCE:		
Install & remove tarps and tailwater Ditches; $5.80/acre/cultivation for 4 cultivations; ($/acre)	$ 23.20	$______
Respread tailwater ditch sediment ($/acre)	$ 3.00	$______
ANNUAL OPERATION AND MAINTENANCE: COST, per acre	$ 26.20	$______
AVERAGE ANNUAL COST:		
Average Annual Installation Cost Amortized, based on 12 percent interest rate and 3 years (Amort. Factor = 0.41635) $ 4.80 x 0.41635	$ 2.00	$______
Plus Annual Maintenance	$ 26.20	$______
AVERAGE ANNUAL COST, per acre	$ 28.20	$______

a/ West Stanislaus typical example; July, 1991 estimates

b/ ------------------ Cooperator ------------------ Case File No. ------------------ Technician -------- Date

c/ Installation of practice information from UC Cooperative Extension crop enterprise budgets and interviews with Sacramento-San Joaquin Valley Growers

BUDGETING FOR EROSION CONTROL

The following section includes a worksheet that can be useful to the grower in evaluating different conservation practices. The worksheet is useful when the Field Office is working with growers who want to evaluate the effects of different alternatives.

The intent of the worksheet is to assist in the organization of added costs and reduced costs associated with different conservation practices as well as address non-quantified issues that the grower may want to include in the decision-making process. This worksheet will serve as a beginning. As the SCS field office acquires additional and more precise data about the practices, this worksheet should be modified.

Budgeting for Erosion Control:
How much does it cost? Is it worth it?

Purpose:
A planning tool to assist in deciding on appropriate conservation practices.

Objective:
Landowners, farmers, SCS personnel and other agricultural professionals can use this step by step procedure to:
1) calculate the costs of installing alternative Conservation Practices on different farms or fields.
2) identify the cost effectiveness of these practices
3) provide a framework for selecting conservation alternatives that best meet the objectives of the farmer or landowner.

Costs:
The costs of installing Conservation Practices are mainly financial; cash goes out to install a practice and either shows up as an expense or depreciation charge on this year's records. Steps 1 through 5 in the accompanying worksheet attempt to identify and evaluate these financial costs. Costs can also be non-financial, or, at least, very difficult to quantify. Adopting new conservation practices requires effort to learn, has an element of risk, could require negotiations with a landowner or government agency and may use up farm resources (money, labor, equipment or land) that can be used for alternate purposes. Step 6 presents a framework for evaluating some of these costs.

Tenants and Landowners need to share responsibility for many of these costs. In some instances, Tenants will need to inform and educate Landowners about the importance of installing long term land improvements, such as sediment basins.

Benefits:
Financial benefits also arise from the use of conservation practices. Practices that maintain or improve the soil, water and plant resource bases also maintain or increase yields and can decrease production expenses. These long term gains in farm productivity and efficiency often get shortchanged when compared to the short term capital outlays needed by the practices. Typical financial analyses, such as Cost/Benefit or Net Present Value methods, which can account for short and long term benefits, do not help. These methods rely on clearly defined cost and benefit streams; the productivity or efficiency gains from using these practices in West Stanislaus have not been studied and therefore benefit streams can not be fully developed. These financial analyses tools also do not work well in evaluating projects where environmental improvement is the primary goal, as in West Stanislaus.

The full valuation of benefits must include these environmental improvements. But valuing these improvements proves difficult. Many farmers feel that proper land stewardship has intrinsic value, beyond the numbers that appear on their balance sheets. Similarly, many farmers and landowners recognize their responsibility to reduce the sediment leaving their farms and entering neighboring streams and rivers. But how should these intrinsic and community values be measured? How much might a farmer or landowner be willing to pay to improve water quality or prevent forceful environmental regulations that mandate the adoption of expensive conservation practices?

These are questions that farmers and landowners still have the opportunity to answer. They can still voluntarily choose the most efficient conservation practices that meet their personal, financial and environmental goals. The following framework might help in making these valuations and decisions. Government regulations generally prove to be the least efficient and most costly (both to the landowner and society) methods of achieving environmental improvements. Forbearance on the part of government is more likely to occur if the adoption of conservation practices occurs voluntarily (and promptly).

The next two pages show an example of a cost effectiveness worksheet. Following this are three pages dealing with additional selection factors. The last two pages are blank cost effectiveness worksheets.

Name:

Address:

Field or farm identification:

Acres:

Step 1. Rates

a) Go to SCS, find out the present erosion and sediment rate for the selected field, and enter these numbers below:

On-Site Erosion Rate (tons/ac/year)	Off-Site Sediment Rate (tons/ac/year)
14	11

Step 2. Targets

a) Calculate the tolerable erosion and target sediment goals

Tolerable Erosion (tons/ac/year)	Sediment Goal (ppm) = (tons/ac/year)
3	0.5

Step 3. Conservation Practices

a) Review the list of suggested conservation practices (Table 5, page 40 and pages 40-60) with SCS. Select several practices or combination of practices that will fit into the Farmer/Landowner's financial, farm and tenancy circumstances. List these alternatives in the table below.

		Alternative A	Alternative B	Alternative C
Practices	1)	Gated Pipe w/ tarps	Irrigation Water Mngt.	Sediment Basin
	2)		w/tarps	w/tarps
	3)			
	4)			
	5)			

Step 4. Costs and Benefits

Calculate the annual costs for each of the alternatives listed in step 3 by selecting cost estimates for these practices from table 5 on page 40 or by using the costs listed on pages 60 to 80. To develop a "custom" estimate, tailored to a particular field or farm, either find the practice listed on pages 60-80 and complete the column for your farm, or go to table 4(b) on the following page. Line 2, Revenue Gain/Loss, in the table below, is to be completed when you can reasonably estimate the yield or production effects of an alternative.

a) Costs	Alternative A	Alternative B	Alternative C
1) Total Annual Cost/ac	$83.00	$27.00	$42.00
(obtain from Table 5)	--- ---	--- ---	--- ---
2) Revenue Gain/(Loss)			
(obtain from table)	--- ---	--- ---	--- ---
3) Net Cost/Ac.	$83.00	$27.00	$42.00

b) Benefits. Conservation practices that reduce erosion and sediment directly benefit farmers and landowners by maintaining soil tilth and crop yield. Indirect benefits include improved water quality in neighboring rivers and water supplies. Although the targeted resource concern, sediment reduction, is the sole benefit identified in the table below, these additional benefits can be addressed in Step 6.

b) Benefits	Alternative A	Alternative B	Alternative C
1) Net Cost/ac	$83.00	$27.00	$42.00
2) Sediment Reduction (from table 5, p.40)	6	9	10.5
3) % of targeted sed. reduction (1)	55%	82%	95%
4) Cost/ton Sediment Reduced (2)	$13.83	$3.00	$4.00

(1) measure line 4 (the percentage of targeted sediment reduction) by dividing line 3 (sediment reduction) by the targeted sediment reduction figure from step 1
2) measure line 5 (cost/ton of sediment reduced) by dividing line 3 (sediment reduction) by line 2 (net cost/acre).

Step 5. Evaluation

Line 4 from the table above displays the cost effectiveness of each conservation alternative. The least cost conservation alternative may not be the best alternative. Farmers and Landowners may want to consider paying extra for practices that achieve higher sediment reduction levels (line 3 in the above table), that fit well with their operations, or that might have additional positive environmental effects. This table should be considered a starting point for deciding on a sediment reduction strategy. Step 6 should be completed for a more thorough evaluation.

Step 4 (b). Developing cost estimates

This section presents a suggested format for more precisely calculating the costs of installing, maintaining and operating alternative conservation practices.

Alternative D			
1) Practice	Gated Pipe	Laser Level	Sediment Basin
Installation Costs			
2) Units Measured	feet of pipe	cubic yards	cubic yards
3) Cost/unit	$7.30	$0.50	$1.25
4) Units/ac	21	300	75
5) Total Cost/ac	$153.30	$150.00	$93.75
6) Lifespan (yrs.)	15	5	25
7) Annual Amort. 10%	0.13147	0.2638	0.11017
8) Annual cost/ac	$20.15	$39.57	$10.33
Operating, Maintenance and Other Costs (such as foregone costs)			
–Description	Installation and removal of pipe	touch up	Sediment removal 6000 yds./ 8 yrs
–Cost/ac	$4.00	$5.00	$4.50
–Description	Pipe Maintenance (2% of outlay)		One acre foregone production @ $150 net
–Cost	$3.00		$1.00
9) Total Annual Cost/ac	$27.15	$44.57	$15.83

Additional Selection Criteria

The difficulty in valuing conservation costs and benefits has been mentioned. This section presents a framework that might assist in evaluating some hard-to-quantify variables. These additional costs and benefits might be better measured using descriptive terms, such as high, medium and low, or rankings, such as 1 to 10. This framework can also serve as a checklist for identifying bottlenecks or drawbacks in the adoption of new conservation practices. Conservationists might then focus their efforts on discovering ways to overcome these drawbacks. Place the ratings in Step 6 of the worksheet.

COSTS

A. Ease of Use and Learning Curve:
-Rank the time, trouble and effort needed to implement a conservation practice or alternative. Rank the complexity of these practices. Are they difficult for managers or employees to understand?

B. Risk:
-Rank the probability that net farm income per acre would decrease due to yield decreases, cost increases, efficiency losses or other effects associated with conservation alternatives.

C. Other Financial Costs:
-Rank the degree to which the following additional financial factors could interfere with the adoption of a practice: cash flow, large up front costs vs. low annual amortized expenses, cost/share arrangements, credit availability or credit needed, tax consequences, and financial feasibility.

D. Rented vs. Owned Land:
-Rate the degree to which land tenancy arrangements interfere with the adoption of new conservation practices.

E. Other Costs:
-Identify additional costs that might arise from these practices and rate their degree of costliness. For example, each conservation practice requires the use of farm resources (money, labor, equipment or land). Each of these resources might be used in another part of the farm operation. The best alternate use of these resources becomes a cost of implementing a conservation practice. For example, taking land out of production for use as a sediment basin includes the net return/ac. from foregone crop production. Rate the costliness of these alternate uses.

BENEFITS

A. Environmental:

-The conservation practices mentioned in this report will reduce sediment and improve water quality. Identify any additional environmental improvements that could arise from these alternatives. For example, Irrigation Water Management will also improve water conservation. Rate the degree to which these practices result in added environmental benefits.

B. Personal Values:

Personal beliefs, views, values or goals can influence the adoption of conservation measures. Examples include the desire to bequest good quality farmland to children, to prevent added government interference in a farm operation, or simply to improve fishing in nearby rivers. Rate the degree to which these conservation measures fulfill these personal values.

C. Social Values:

A sense of responsibility to a community, country, or to society in general, can motivate persons to adopt conservation practices. Examples include installing soil erosion control practices so that water quality is improved for downstream users or because of complaints from neighboring communities. Rate how important these social factors influence the adoption of new practices.

D. Other Benefits:

Identify additional good that might arise from these practices and rate their benefit.

Step 6. Ranking of Additional Selection Factors

Use the terms high, medium and low to rank conservation practices or alternatives. Remember that costs rated high are bad but that benefits rated high are good.

Rankings	Alternative A	Alternative B	Alternative C	Comments or Reasons for Ratings
Alternative/Practice Description				
Costs				
A. Learning Curve or Ease of Use				
B. Risk				
C. Other Financial Costs				
D. Rented vs. Owned Land				
E. Other:				
Benefits				
A. Environmental				
B. Personal Values or Views				
C. Social Values or Views				
D. Other:				

Step 7. Decisions

Weigh the importance of the selection factors from steps 5 and 6. Select the alternative that best meets the farmer/landowner's objectives.

Cost Effectiveness Worksheet

Name: ______________________________

Address: ______________________________

Field or farm identification: ______________________________

Acres: ______________________________

Typical crops and rotations: ______________________________

Step 1. Rates

a) Go to SCS, find out the present erosion and sediment rate for the selected field, and enter these numbers below:

On-Site Erosion Rate (tons/ac/year)	Off-Site Sediment Rate (tons/ac/year)
__________	__________

Step 2. Targets

a) Calculate the tolerable erosion and target sediment goals

Tolerable Erosion (tons/ac/year)	Sediment Goal (ppm) = (tons/ac/year)
__________	__________

Sediment reduction needed (tons/ac/yr): __________

Step 3. Conservation Practices

a) Review the list of suggested conservation practices (listed in this report) with SCS. Select several practices or combination of practices that will fit into the Farmer/Landowner's financial, farm and tenancy circumstances. List these alternatives in the table below.

		Alternative A	Alternative B	Alternative C
Practices	1)			
	2)			
	3)			
	4)			
	5)			

Step 4. Costs and Benefits

Calculate the annual net costs for each of the alternatives listed in step 3 by selecting cost estimates for these practices as listed in this report. To develop a "custom" estimate, tailored to a particular field or farm, either go to the cost sheets included in this report and complete the column for your farm, or complete table 4(b) on the following page. Line 2, Revenue Gain/Loss, in the table below, is to be completed if you can reasonably estimate a yield change or production effect from an alternative.

a) Costs	Alternative A	Alternative B	Alternative C
1) Total Annual Cost/ac			
(obtain from Table 5)	--- ---	--- ---	--- ---
2) Revenue Gain/(Loss)			
3) Net Cost/Ac.			

b) Benefits. Conservation practices that reduce erosion and sediment provide direct benefits to farmers and landowners by maintaining soil tilth and crop yield. Indirect benefits include improved water quality in neighboring rivers and water supplies. Although the targeted resource concern, sediment reduction, is the sole benefit identified in the table below, these additional benefits can be addressed in Step 6.

b) Benefits	Alternative A	Alternative B	Alternative C
1) Net Cost/ac			
2) Sediment Reduction (from table 5)			
3) % of targeted sed. reduction *			
4) Cost/ton Sediment Reduced **			

* measure line 3 (the percentage of targeted sediment reduction) by dividing line 2 (sediment reduction) by the targeted sediment reduction identified in step 2 (10.5 tons)
** measure line 4 (cost/ton of sediment reduced) by dividing line 1 (Net Cost/ac) by line 2 (Sediment Reduction).

Step 5. Evaluation

Line 4 from the table above displays the cost effectiveness of each conservation alternative. The least cost conservation alternative may not be the best alternative. Farmers and Landowners may want to consider paying extra for practices that achieve higher sediment reduction levels (line 3 in the above table), that fit well with their operations, or that might have additional positive environmental effects. This table should be considered a starting point for deciding on a sediment reduction strategy. Step 6 should be completed for a more thorough evaluation.

Step 4 (b). Developing cost estimates

This section presents a suggested format for more precisely calculating the costs of installing, maintaining and operating alternative conservation practices.

Alternative			
1) Practice			
Installation Costs			
2) Units Measured			
3) Cost/unit			
4) Units/ac			
5) Total Cost/ac			
6) Lifespan (yrs.)			
7) Annual Amort. 10%			
8) Annual cost/ac			
Operating, Maintenance and Other Costs (such as foregone costs)			
–Description			
–Cost/ac			
–Description			
–Cost/ac			
9) Total Annual Cost/ac			

PART III
IMPLEMENTATION OPPORTUNITIES

PART III

CHAPTER XI

IMPLEMENTATION OPPORTUNITIES

INTRODUCTION

While it is important for each landowner to have the knowledge necessary to make decisions for proper conservation planning, an area-wide plan is also needed for successful implementation. It must be realized that to achieve nonpoint source pollution problems (NPSP) control, such as for off-farm sedimentation, will require a bargaining process between interests that are often conflicting. A simple distinction between "voluntary" and "mandatory" approaches to sediment control policy is not useful because all parties must cooperate in order to achieve a successful solution to the problem.

Controlling off-farm sediment will require a long-term commitment. Current sediment producing practices have been applied for years and the farming operations cannot be reversed overnight, even with rapid implementation of conservation practices. Nonpoint source pollution controls are a combination of structural and management measures that must be applied continuously.

In April 1991, the Inland Surface Water Plan (ISWP) was adopted by the California State Water Resources Control Board. The ISWP is an implementation plan structured to require California water users to meet the criteria of the Federal Clean Water Act. Local entities will be formed in each area to develop a plan for NPSP and to implement a plan to monitor voluntary progress. A time line is included in the ISWP to track the progress of these discharge entities.

Since the ISWP will affect the growers of western Stanislaus County, the implementation ideas in this report will follow the guidelines needed to satisfy the ISWP. The State Water Resources Control Board discusses three levels of implementation in the ISWP. These are:

1. Voluntary implementation of conservation practices;

2. Regulatory-based or institutional-based encouragement of practice implementation. An example of this would be a waiver of Waste Discharge Requirements (WDRs) on the condition that practices are implemented;

3. Regulation such as issuance of Waste Discharge Requirements which establish effluent limitations or discharge prohibitions.

This chapter will follow these three suggested implementation approaches to demonstrate the actions necessary to successfully reduce the NPSP sedimentation problem.

1. VOLUNTARY APPROACH

Parts I and II of this report presented information on potential conservation practices and combinations of practices effective in on-farm erosion and sediment reduction. The practices were chosen based on sediment reduction effectiveness, cost effectiveness, and acceptance by local landowners. Many of the practices are already in use in the West Stanislaus area.

Many growers, however, need more information about the practices in order to make the decision that would be best for them. They may need to know where to go for technical or financial assistance. What is the best way not only to get the necessary information out, but also to track successes?

An SCS sociologist visited the area to estimate a public participation rate and to help determine some appropriate strategies for voluntary implementation.

ENCOURAGING THE USE OF THE CONSERVATION PRACTICES

To persuade growers to adopt suggested practices, there are five factors on which the local Field Office staff can focus their discussions with landowners:

1. The relative advantages of the conservation practices over current practices and how they would benefit the grower. An economic analysis of the costs of each practice should be available to compare the financial, time, labor, and convenience-related advantages of each practice over current practices. Additional advantages to using the suggested practices which should be recognized include the appropriateness of the grower acting as a concerned citizen to improve the community's environment, the need to act voluntarily to reduce water pollution before regulatory action is enacted, and other non-monetary advantages that growers view as being important to them personally and professionally.

2. The practices should be designed, planned, and presented so as to be easy to understand and implement. One option might be to arrange with several local consultants or contractors to provide total installation and/or maintenance service for some structural practices; making the new practices as easy for the grower to adopt as signing a contract.

3. The practices should be compatible with the grower's current management practices.

4. The practices should be planned and designed so growers can adopt a practice on a small scale or incrementally. This reduces the risk associated with trying a new or different way of doing something. The estimated annual or seasonal costs of the practice should be presented.

5. Provide the opportunity to observe the results of the practices in the study area. Many of the practices are being used by growers in the area, and potential demonstration sites are available locally for examination and evaluation. Reducing the uncertainty of the results of trying something new is critical to grower adoption of the practices.

VOLUNTARY IMPLEMENTATION STRATEGIES

The purpose of implementing voluntary strategies is to encourage satisfactory progress in the installation of on-farm conservation practices. Voluntary practices are put in place by the local growers and encouraged by the West Stanislaus Resource Conservation District (RCD). A combination of strategies may be necessary to educate, inform and encourage public support and participation.

1. Target Groups. Instead of trying to reach all growers at once, the SCS and Extension Service can break up the task and target different groups. Identify the various groups of growers in the area by similar problems, needs, or agricultural characteristics and focus early efforts to get the practices implemented on the most receptive group of growers. For example, growers with large operations who own their land will have different needs than those large operators who lease most of their land. They will have different needs than that of the absentee landowner. Getting cooperation from each of these land users may take different approaches. Success will be most likely to occur if the focus is on the most receptive growers first. An example of this is the mid- to large-size operation, run by an owner-operator with a family history in the community who has previously installed conservation practices, and whose operation will be passed down to the next family member. Another example would be to create a target group of all growers in one drainage area.

2. Establish a Network. The RCD can create a network of individuals willing to provide assistance to growers considering the voluntary adoption of a practice. The network should include telephone numbers of individuals and agencies who can provide technical and financial assistance, and local growers who can provide useful, positive testimonials. The grower panel at the 1991 spring drought workshop was very effective for informing other local growers about the advantages and disadvantages of some of the conservation practices.

3. Community Progress Map. The RCD and local Water Quality Committee can create a visual community indicator of progress being made in reducing NPSP. This will help turn the project into a community project, and not just a grower or agency project. Since both the short- and long-term impact of a successful program will not be immediately visible, a highly visible display would keep people aware of their progress and maintain interest. A large, brightly colored map, for example, could be used to track where practices have been implemented, what was done, and who has done something. The map could be located in a well visited place such as a library, bank or restaurant.

4. Use of local video. A videotape using prominent local growers to discuss their success with various practices is available. The SCS Patterson Field Office is considering showing the video to growers as they come into the office to sign up for practices or allow a copy to be taken home for viewing. This is an excellent idea that helps meets the criteria for Point 5 listed below.

5. Education and information. The U.C. Cooperative Extension Service provides educational and informational opportunities for growers. They have done extensive work in the West Stanislaus area and are familiar with this study. Through the use of workshops, demonstrations, newsletters, and tours, the Extension Service is able to inform and educate the landowner about the options available.

   The local SCS Field Office can also provide information on the individual practices and assist the grower in the planning and design of complete resource management systems.

6. Provide a goal or standard the growers can meet. It seems while many local growers are aware of the sediment problem and are anxious to assist in solving the problem, there is a lack of a clear goal that needs to be reached. The growers and local agencies should work with the Regional Board to establish water quality goals that are implementable. During the Spanish Grant cost-sharing program, a goal of 300 milligrams per liter (mg/l) total suspended solids (TSS) was arbitrarily set and achieved. A standard of 300 mg/l of total suspended solids does not mean much to most people, however. Pictures or cards printed with photographs of different concentrations of total suspended sediment would allow the grower to visualize what is expected and provide some way to compare the goal to what concentration is now being produced right now. Each local grower could be given one of the cards.

7. Irrigation districts. The local irrigation districts are a vital link in the implementation of any sediment reduction plan. The local districts are concerned about the quality of water being drained into the San Joaquin River because that

water is reused by the districts as irrigation water. Cleaner water means less maintenance time and expense for the districts. All of the local irrigation districts have attended water quality meetings to discuss sediment concerns. There are many ways the irrigation districts can help achieve significant implementation.

The irrigation districts can take a lead role in the local sediment reduction plan. Participation in the local drainage entity being set up should lead to involvement in water quality goals that will meet local as well as state objectives. The local irrigation districts are a vital link in the implementation of any sediment reduction plan.

As water shortages continue, the districts need to ask their growers, "Is the amount of water you're requesting really needed?" Irrigation water management is the first step in not only water conservation, but also in sediment reduction.

The irrigation districts can distribute informational and educational brochures with their regular billing process. CCID recently adopted a policy to require sediment basins for drain pumps in areas where sediment is a problem. Several of the irrigation districts have purchased the AGWATER computer model. AGWATER provides landowners with suggestions for proper irrigation scheduling, distribution uniformity, and irrigation efficiency. The SCS Patterson Field Office also has the AGWATER program available. Due to the nature of fluctuation of flows when some irrigation water management techniques (one example of this would be cutback stream irrigation) are used by operators, some districts may wish to seek assistance in developing more flexibility in water delivery to manage these fluctuating flows. District staff may also want to become involved in grower educational programs.

8. SCS conservation plans. The SCS Patterson Field Office can work with a grower to provide a complete conservation plan for a field or an entire farm. Field Office personnel can plan, survey, design and oversee construction of installation of systems and also provide assistance in irrigation water management and agronomic practices. An LTA (long term agreement) is a 3- to 10-year plan written by SCS with the grower that includes cost-sharing through ASCS. The LTA requires concurrence and a signature by the West Stanislaus RCD. It can provide an incremental approach for installation of practices so as to not create a hardship for the grower. It also encourages follow-up by the SCS Field Office staff for each of the years the LTA is in place.

The Hydrologic Unit Area (HUA) project now in place in the study area allows cost-sharing for the installation of on-farm conservation practices. The conservation plans for all cost-shared HUA conservation practices are written in an LTA format.

THE ROLE OF LOCAL AND GOVERNMENT AGENCIES

Local and government agencies have important roles to play if voluntary implementation in the West Stanislaus Study Area is to be successful.

The West Stanislaus RCD, local RCD Water Quality Committee, U.C. Cooperative Extension, irrigation districts and other county agencies will play a role in providing growers with information about goals and progress. These are the groups having regular contact with a large number of growers. The success of voluntary implementation depends on local commitment. County agencies, irrigation districts, and the West Stanislaus RCD should take the lead role in working with the Regional Board to establish local water quality goals and to also establish the time frame needed for meeting the goals.

Meetings between the local RCD Water Quality Committee and other concerned have taken place quarterly. Recent meetings have focused on ways to implement a sediment reduction plan. A steering committee was formed to provide focussed local input for this report. These meetings have provided a forum for interested parties to work together to find local solutions and need to continue.

The Agricultural Stabilization and Conservation Service provides cost-sharing for most of the on-farm conservation practices. The ASCS is currently providing cost-sharing for the HUA program.

U.C. Cooperative Extension service provides education and information to the local growers concerning the sediment problem and solutions.

The SCS Patterson Field Office provides technical assistance for the implementation of conservation practices. When fully staffed, the Patterson Field Office will attempt to meet the commitments of the local HUA. Each grower applying for on-farm projects will receive a conservation plan that incorporates combinations of practices to reduce erosion and sediment for each field.

The Regional Water Quality Control Board (Regional Board) will continue monitoring agricultural drainages as they flow into the San Joaquin River. All growers discharging into a particular drain are responsible for meeting the established goals. If adequate progress is not being made, the next tier of management is regulatory-based encouragement.

2. REGULATORY BASED ENCOURAGEMENT THROUGH INSTITUTIONAL CHANGES

The general focus of the nation is to strive for cleaner water. The majority of government agencies include some aspect of water quality in their policy or mission statements. The SCS, for example, has developed a five-year Water Quality Action Plan outlining the objectives and nature of SCS's involvement in the prevention and treatment of nonpoint source pollution problems.

As a regulatory agency, the Regional Board issues Waste Discharge Requirements (WDRs) to communities or businesses discharging into State waters. The regulatory-based changes suggested in this report are possible steps that can be implemented to potentially obtain a waiver that would hold off the regulatory action of a WDR.

Institutional based encouragement goes one step further than voluntary strategies and may require some institutional changes. The institutions or agencies already in place locally that have regular contact with landowners have the capability to provide information to the public or strongly emphasize to growers what needs to be done.

Some examples of regulatory based encouragement or institutional changes follow:

1. Irrigation districts.
   Districts receiving irrigation water from the Delta-Mendota Canal have a contract in place with the U.S. Bureau of Reclamation (BOR). The BOR requires these irrigation districts, or contractors, to submit a water conservation plan. One of the proposed water conservation opportunities suggests the districts set up an irrigation management program to provide assistance to the growers. One alternative is for the district to retain an irrigation specialist to help growers with year-long irrigation management services, system evaluations, and the adoption of irrigation scheduling through modern technology. Other alternatives include improving water measurement and water use accounting and emphasizing more efficient pre-irrigation techniques.

   The Patterson Water District will begin a policy of requiring tarps to be used in tailwater ditches to decrease the amount of sediment being discharged into their water system. This first step will help the Patterson Water District have cleaner irrigation water to provide to their growers.

2. Price tiering. In the West Stanislaus area, the Central California Irrigation District (CCID) began a price tiering program three years ago. The purpose was to demonstrate to growers how much water they were using. CCID has a three tier system. Of 2.75 acre-feet of water allocated per acre of

land, the first 2.25 acre-feet has a set price. The second tier, or the next 0.50 acre-feet of water, costs almost three times more. When available, additional water for the third tier is priced two and one half times more than the second tier. Landowners under the price tiering system need to better manage their water to avoid paying higher rates.

The extra fees collected under this system can be loaned back to the growers at a low interest rate for the installation of on-farm conservation practices. Another possible use of extra fees is the funding of a Mobile Irrigation Lab that would go from farm to farm, evaluate irrigation systems and techniques, and recommend changes to increase irrigation water management.

3. Another local agency, Stanislaus County Department of Public Works, has become active by sending out a notice of consequences that may occur if voluntary action is not taken. They recommended landowners seek assistance from West Stanislaus RCD, SCS, Cooperative Extension Service, and Agricultural Stabilization and Conservation Service (ASCS). Notices such as these help spread the word to local growers and also provide them with ways of obtaining assistance.

4. <u>ASCS</u> administers the ACP cost-sharing programs for on-farm conservation practices. Implementation of practices is only one part of the total picture, however. Proper management techniques are required for the practices to perform as needed. For example, a sprinkler system operated without efficient water management can become as erosive as a furrow irrigation system. To ensure newly cost-shared projects are operated properly, ASCS could consider requiring attendance by growers/operators at a workshop to be eligible for cost-share money.

5. <u>Develop a local Watershed Trust Fund</u> [50]. A Watershed Trust Fund would provide funds to local authorities from a variety of sources: local taxes and fees, state and federal financing. The Watershed Trust Fund would encourage conservation-oriented land use practices while promoting cost-effective implementation strategies consistent with long-term local and federal water quality objectives for watersheds. It is a plan that can satisfy interests of all parties involved in the NPSP control while positive steps are taken to reduce the off-site impacts of eroding soils.

   The governing authority for the Trust Fund could be an entity formed of local groups already involved in the sediment problem and solutions. The West Stanislaus RCD, irrigation districts, county agencies, and local landowners should all be involved.

   To provide funding for this group, an assessment could be made for agricultural dischargers to be allowed to drain their water off-farm. Financial incentives can be put in place to reward dischargers actively participating in sediment reduction. For instance, if a grower has applied practices or has an approved conservation plan in place, there might be a smaller assessment.

If monitoring is required, a local monitoring plan might be more acceptable to the local landowners. If enough funding is made available, a staff specialist could be hired to perform spot checks of tailwater around the area. The specialist would work one-on-one with dischargers having trouble meeting compliance. Education could be provided to the discharger and suggestions could be made on where to go for financial or technical assistance.

Follow-ups could then be performed to provide stronger encouragement as needed and more informal help. A last step when all else fails and standards are not met could be a fine or loss of tailwater discharge privileges.

If adequate progress is not being made, the next tier of management is regulation.

3. REGULATION

As a regulatory agency, the Regional Board issues Waste Discharge Permits (WDRs) to communities and businesses that discharge wastes into State waters. The WDRs specifies the type, amount and concentration of pollutants that may be discharged, sets time schedules for improvement, and requires self-monitoring. Enforcement actions include cleanup and abatement orders, cease and desist orders, civil monetary penalties of up to $25,000 per day of violations, and criminal prosecutions.

As the Inland Surface Water Plan (ISWP) is enforced in the future, drainages not meeting standards voluntarily may have to obtain permits to allow agricultural tailwater to leave their farm. Landowners would be required to monitor the quality of their tailwater to make sure it meets set standards. Agricultural chemicals found in tailwater may be banned from use if problems persist. In the case of suspended sediment, there may be an mandated maximum allowed concentration such as 300 mg/l or lower. Agricultural dischargers may find themselves facing heavy fines if water quality standards are not met.

The State Board follows a three- step enforcement plan. Voluntary solutions are encouraged first, followed by regulatory based encouragement, then the issuing of Waste Discharge Requirements or prohibition of discharges. As the last step in the three step process, WDRs affect the grower the most seriously. Once a WDR is issued, the grower has no flexibility in finding a solution that meets both the grower's and the state's needs. If water quality goals are not met in the allowed time schedule, the grower can expect monetary fines and loss of off-farm discharge permits. At this step no waivers to the requirements will be issued.

LOCAL DRAINAGE ENTITIES

The ISWP requires a local drainage entity be set up in each area. These entities will establish a priority list of water bodies needing immediate action, assist the Central Valley Regional Water Quality Control Board in financing and establishing a monitoring program, implement conservation practices, and submit progress reports to the State Board. A description of the drainage entity is required to be given to the Regional Board by October 1992.

When the West Stanislaus study area forms a drainage entity, it would be best to have as much local input as possible. The Watershed Trust Fund Authority, as described previously, would have the mechanisms in place to fulfill the need as a drainage entity. Local groups and growers will then be in a position to set goals and develop a time schedule that is feasible for local needs, but also meets the guidelines required by the ISWP.

ESTIMATED PUBLIC PARTICIPATION

The SCS has estimated a high level of public participation is possible in the study area. The sociologist predicted 71 percent of the growers would participate, affecting 81,000 acres. The reason for this encouraging estimate is the large number of growers already aware of the area's water quality problem and the possible solutions. Remarkably, most growers have at one time used, or personally witnessed, one or more of the recommended conservation practices.

A participation rate of 71 percent would reduce the sediment leaving the area farms from 1,200,000 tons per year to 400,000 tons per year. This would mean a 67 percent reduction of sediment reaching the San Joaquin River from the study area.

TIMELINE FOR IMPLEMENTATION

A timeline (Figure 9) is provided to demonstrate how voluntary, institutional, and regulatory alternatives can interact in the future to achieve on-farm sediment reduction.

CONCLUSIONS

The off-site impact of soil erosion is an important resource conservation issue. Ideally NPSP policies should be based on the following principles [50]:

1. NPSP control policies need to be determined through a planning process between growers, the beneficiaries of water quality improvements, and the responsible local, state and federal agencies. Growers should be given some incentive to implement the control policies;

2. NPSP regulations or policies should be addressed at the watershed level;

3. There must be a long-term local, state and federal commitment to NPSP regulation and watershed management. Flexibility for solutions, monitoring progress, and a time schedule needs to be allowed in local watershed management to implement control strategies; and

4. Long-term monitoring and enforcement to achieve explicit water quality improvements consistent with local, state and federal objectives should be required.

The conclusion reached indicate the problem needs to be solved locally. A local drainage entity needs to be formed comprised of local agencies and people to encourage a long-term commitment to watershed management. Flexibility of choices available to growers for sediment reduction will encourage voluntary implementation. Incentives to local growers to implement practices include cost-share funds and the potential for cleaner irrigation water in the future.

In any implementation strategy, one of the most important and cost-effective steps is to work with the individual grower and provide information about the sedimentation problem and low cost solutions. With the information and ideas provided in this report, positive steps in sediment reduction can be taken to reduce the off-site impacts of eroding soils by promoting cost-effective implementation strategies consistent with long-term local, state and federal watershed objectives.

IMPLEMENTATION TIMELINE

VOLUNTARY IMPLEMENTATION

FIGURE 9
SH. 1 OF 4

1992	1993	1994
CONTINUE ON-GOING CONSERVATION PROGRAMS	CONTINUE ON-GOING CONSERVATION PROGRAMS & HUA	CONTINUE ON-GOING CONSERVATION PROGRAMS & HUA
SCS: -ENCOURAGE THE USE OF ON-FARM CONSERVATION PRACTICES EMPHASIZING THE ADVANTAGES, EASE OF IMPLEMENTATION, COMPATIBILITY, ABILITY TO ADJUST THE SCALE OF THE PROJECT AND PRESENTING THE OBSERVED RESULTS -DEFINES GROUPS OF LOCAL GROWERS BY SIMILAR PROBLEMS, NEEDS OR AGRICULTURAL CHARACTERISTICS AND TARGETS ONE OF THESE GROUPS FOR ACCELERATED TECHNICAL ASSIST. -CONTINUES HUA EFFORTS -PREPARES CONSERVATION PLANS FOR HUA, TARGETED GROUP AND ON-GOING PROGRAMS	SCS: -CONTINUE ENCOURAGEMENT OF PRACTICE IMPLEMENTATION, HUA EFFORTS AND ON-GOING PROGRAMS -TARGET NEW GROUP OF LOCAL GROWERS, PROVIDES FOLLOW-UP ON INITIAL TARGETED GROUP -ASSISTS CES AND RCD WITH WORKSHOPS, FIELD TOURS, AND DEMONSTRATION SITES	SCS: -CONTINUE TO TARGET NEW GROUPS AND FOLLOWUP ON PREVIOUS TARGET GROUPS AND PRACTICES
CES: -ASSIST RCD TO ESTABLISH GROWER INFORMATION NETWORK -CONTINUE EDUCATION AND INFORMATION EFFORTS FOR HUA -ASSIST SCS TO DEFINE TARGETED GROUPS AND ACCELERATE EDUCATION AND INFORMATION PROGRAMS TO PRIORITY TARGET GROUP	CES: -PROVIDE ACCELERATED EDUCATION AND INFORMATION EFFORTS TO NEW TARGET GROUPS. ASSIST SCS WITH FOLLOWUP -ASSIST RCD WITH WORKSHOPS, FIELD TOURS AND DEMONSTRATION SITES	CES: -CONTINUE EDUCATION AND INFORMATION PROGRAMS, WORKSHOPS, FIELD TOURS AND DEMONSTRATION SITES
ASCS: -CONTINUE ON-GOING CONSERVATION PRACTICE COST-SHARE PROGRAMS AND HUA COST-SHARE -ESTABLISH WEST STANISLAUS AS A PRIORITY WQ AREA TO RAISE ON-FARM COST-SHARE LIMITS	ASCS: -CONTINUE COST-SHARE PROGRAMS	ASCS: -CONTINUE COST-SHARE PROGRAMS
RCD/WATER QUALITY COMMITTEE: -ESTABLISH GROWER INFORMATION NETWORK	RCD/WATER QUALITY COMMITTEE -WORKS WITH CES AND SCS TO PRESENT WORKSHOPS, FIELD TOURS AND DEMONSTRATION SITES. -ESTABLISH COMMUNITY PROGRESS MAP	RCD/WATER QUALITY COMMITTEE -CONTINUE ON-GOING PROGRAMS, INFORMATION NETWORKS AND PROGRESS MAP
IRRIGATION DISTRICTS: -ENCOURAGE AND EDUCATE GROWERS TO APPLY ON-FARM CONSERVATION PRACTICES	IRRIGATION DISTRICTS: -PARTICPATE IN LOCAL WORKSHOPS, FIELD TOURS AND DEMONSTRATIONS -WORK WITH SCS, BUREAU OF RECLAMATION, DWR OR APPROPRIATE TECHNICAL AGENCY TO DETERMINE HOW ON-FARM PRACTICES WOULD AFFECT DISTRICT OPERATIONS	IRRIGATION DISTRICTS: -CONTINUE ON-GOING PROGRAMS

IMPLEMENTATION TIMELINE

VOLUNTARY IMPLEMENTATION

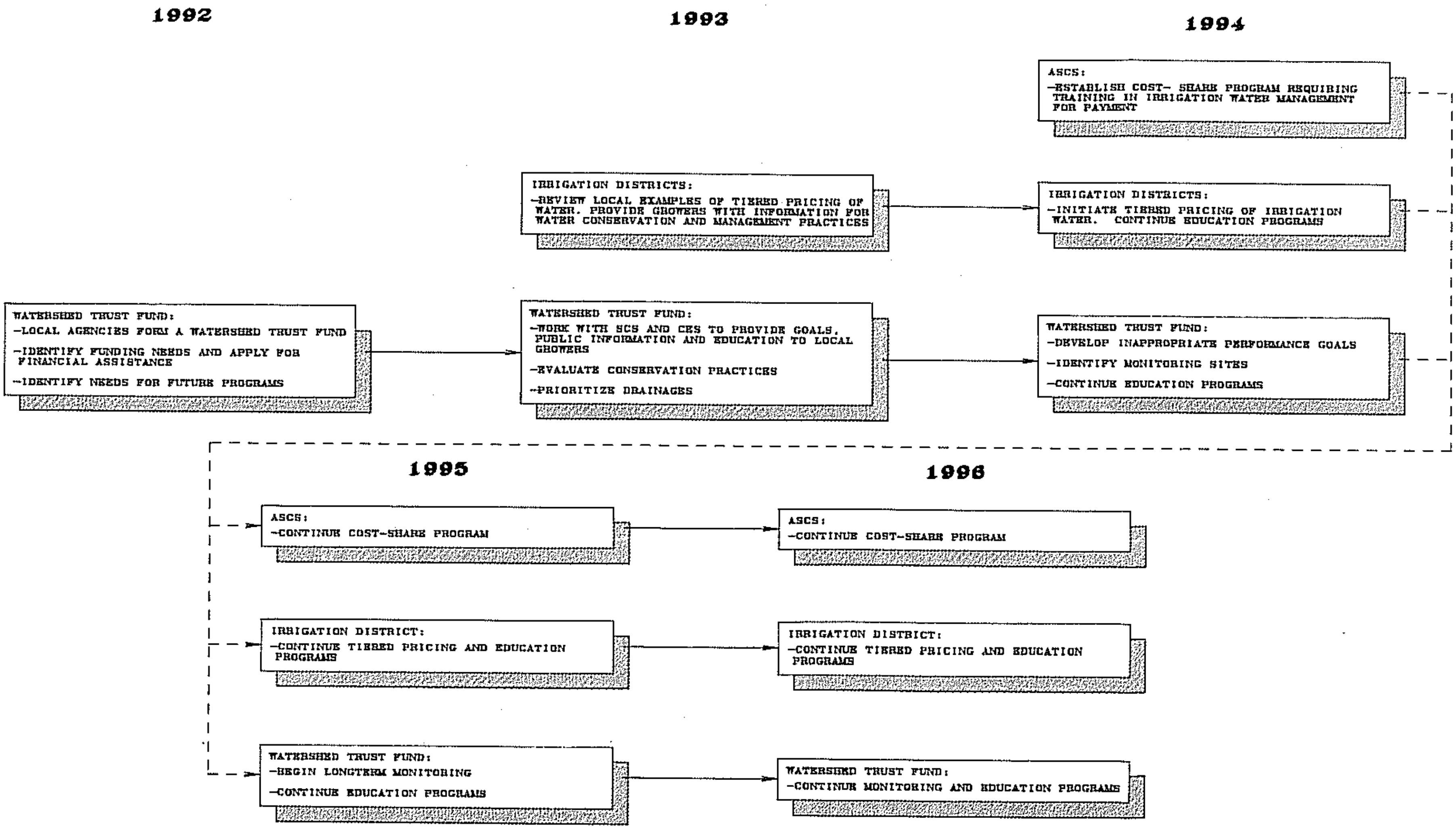
FIGURE 9
SH. 2 OF 4

1995	1996
CONTINUE ON-GOING CONSERVATION PROGRAMS & HUA	CONTINUE ON-GOING CONSERVATION PROGRAMS & HUA
SCS: -CONTINUE TO TARGET NEW GROUPS AND FOLLOWUP ON PREVIOUS TARGET GROUPS AND PRACTICES	SCS: -CONTINUE TO TARGET NEW GROUPS AND FOLLOWUP ON PREVIOUS TARGET GROUPS AND PRACTICES
CES: -CONTINUE EDUCATION AND INFORMATION PROGRAMS, WORKSHOPS, FIELD TOURS AND DEMONSTATION SITES	CES: -CONTINUE EDUCATION AND INFORMATION PROGRAMS, WORKSHOPS, FIELD TOURS AND DEMONSTATION SITES
ASCS: -CONTINUE COST-SHARE PROGRAMS	ASCS: -CONTINUE COST-SHARE PROGRAMS
RCD/WATER QUALITY COMMITTEE -CONTINUE ON-GOING PROGRAMS, INFORMATION NETWORKS AND PROGRESS MAP	RCD/WATER QUALITY COMMITTEE -CONTINUE ON-GOING PROGRAMS, INFORMATION NETWORKS AND PROGRESS MAP
IRRIGATION DISTRICTS: -CONTINUE ON-GOING PROGRAMS	IRRIGATION DISTRICTS: -CONTINUE ON-GOING PROGRAMS

IMPLEMENTATION TIMELINE

REGULATORY–BASED ENCOURAGEMENT

FIGURE 9
SH. 3 OF 4



IMPLEMENTATION TIMELINE

REGULATORY ACTION

FIGURE 9
SH. 4 OF 4

1992

DRAINAGE ENTITY:

- A LOCAL DRAINAGE ENTITY MUST BE FORMED UNDER THE INLAND SURFACE WATER PLAN. IF ALREADY IN PLACE, THE WATERSHED TRUST FUND CAN BE IDENTIFIED AS THE LOCAL DRAINAGE ENTITY
- BY OCT. 1992, THE IDENTIFIED DRAINAGE ENTITY WILL BE DESCRIBED AND REPORTED TO THE REGIONAL BOARD

1993

DRAINAGE ENTITY:

- PERFORM SAME FUNCTION AS WATERSHED TRUST FUND EXCEPT WORK WITH CENTRAL VALLEY REGIONAL BOARD TO PRIORITIZE DRAINAGES

1994

DRAINAGE ENTITY:

- PERFORM SAME FUNCTION AS WATERSHED TRUST FUND EXCEPT MONITORING SITES AND PERFORMANCE ARE CHOSEN BY JUNE

GOAL:

ACHIEVE PARTICIPATION ON 50% OF IRRIGATED ACRES IN STUDY AREA BY YEARS END

1995

DRAINAGE ENTITY:

- CONTINUE ON-GOING PROGRAMS
- BEGIN SITE SPECIFIC OBJECTIVE DEVELOPMENT IN JUNE

1996

DRAINAGE ENTITY:

- CONTINUE ON-GOING MONITORING AND EDUCATION PROGRAMS

GOAL:

ACHIEVE PARTICIPATION ON 71% OF IRRIGATED ACRES IN STUDY AREA BY YEARS END

PART III

CHAPTER XII

FINANCIAL AND TECHNICAL ASSISTANCE SHEETS

The following pages list potential sources of technical and financial assistance available to growers in the West Stanislaus area. Described are types of assistance available, criteria to receive assistance, any fees or costs, and who to notify to apply or obtain further information. Much of the information was taken from The Resource Guide to California Agricultural Irrigation Services provided by the USDA Soil Conservation Service, USDA California Drought Office, California Department of Water Resources, Water Conservation Office, and University of California Cooperative Extension Service.

California State Department of Water Resources

Office of Water Conservation (DWR/OWC)

AB 1658, Isenberg Water Management Planning

Applicable practices:

This bill would enact the Agricultural Water Management Planning Act to require every agricultural water supplier (supplying more than 50,000 acre-feet of water annually for agricultural purposes directly to customers) to prepare a prescribed information report. It would also require those suppliers that determine a significant opportunity exists to conserve water to reduce the quantity of highly saline or toxic drainage water to prepare and adopt, in accordance with prescribed requirements, an agricultural water management plan meeting specified guidelines.

Fees:

The bill would require the Department of Water Resources to reimburse each supplier for the cost of preparing the informational report, not to exceed $ 5,000 per report and to reimburse each supplier preparing an agricultural water management plan, not to exceed $ 25,000 per plan, and would specify that no supplier shall be required to prepare a plan unless funds are appropriated to reimburse the supplier for its costs associated with the plans by the 1990-91 fiscal year.

Qualifications:

Must be agricultural irrigation district.

How to apply:

Contact:
Department of Water Resources
Office of Water Conservation
Arturo Carvajal
916-324-7127

Pacific Gas & Electric Company (PG&E)

Agricultural Direct Rebate Program 1991

Applicable practices:

Low Pressure Sprinkler Nozzles - Need to contact local pump dealer or irrigation specialist to make sure pump operates most efficiently with new low pressure nozzles.

Plastic Gated Pipe - Plastic gated pipe can be used to replace siphon irrigation pipe and high pressure systems. Pump operating efficiency can change when converting to plastic gated pipe. Contact your local irrigation system design expert to make sure your pump is operating at maximum efficiency when gated pipe is used to replace other water application methods. (Can be used for transport).

Aluminum Gated Pipe - Aluminum gated pipe can be used to replace siphon irrigation pipe and high pressure systems. Pump operating efficiency can change when converting to aluminum gated pipe. Contact your local irrigation system design expert to make sure your pump is operating at maximum efficiency when gated pipe is used to replace other water application methods. (Can be used for transport).

Rigid Wall Gated Pipe - Rigid wall gated pipe can be used to replace siphon irrigation pipe and high pressure systems. Pump operating efficiency can change when converting to aluminum gated pipe. Contact your local irrigation design expert to make sure your pump is operating at maximum efficiency when gated pipe is used to replace other water application methods. (Can be used for transport).

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Pacific Gas & Electric Company (PG&E)

Agricultural Direct Rebate Program 1991

Fees:

Agricultural Items: Category Rebate Limit $10,000

Low Pressure Sprinkler Nozzles	$0.50/nozzle
Plastic Gated Pipe (6" and greater)	$0.10/foot
Aluminum Gated/Transport and Mainline pipe (6" and greater)	$1.00/foot
Rigid Wall Poly/Transport and Mainline Pipe (6" and greater)	$0.75/foot
Surge Valves (6' and greater)	$450.00/valve

Qualifications:

Available to agricultural customers only.

How to apply:

Contact your local PG&E Agricultural Representative in the Stanislaus area.
Robert Hondoville 209-576-6674

U.S. Department of Agriculture

Agricultural Stabilization and Conservation Service (USDA ASCS)

Agricultural Conservation Program (ACP)

Applicable practices:

The ACP is a cooperative endeavor by growers, ranchers, government agencies and other groups to solve soil, water, and related pollution problems through cost sharing on enduring conservation practices, including:

IRRIGATION PRACTICES	
WC-4 Irrigation Water Conservation	Pipelines, return systems, some land leveling, and other water saving measures
SOIL EROSION PRACTICES	
SL-1 Permanent Vegetative Cover Establishment	Seeding of farm or ranchland
SL-2 Permanent Vegetative Cover Improvement	Seeding to improve already established cover
SL-5 Diversions	Pipes or ditches to divert runoff causing erosion
SL-7 Windbreak Establishment	Planting trees to protect farmland from wind erosion
SL-11 Permanent Vegetative Cover on Critical Acres	Critical area seedings on gullies, banks or field borders that are subject to excessive erosion

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U.S. Department of Agriculture	Agricultural Conservation Program (cont.)	
Agricultural Stabilization and Conservation Service (USDA ASCS)	SL-14 Reduced Tillage Systems	Cost sharing on chisel plowing or other light tillage implements
	SL-15 No-Till Systems	Cost sharing for planting into old crop residue. Cost sharing on planting operation., range drills, etc.
	WC 1 Water Impoundment	Ponds or reservoirs that provide erosion benefits
	CONSERVATION OR WILDLIFE HABITAT WL-1 Permanent Wildlife Habitat	Establishing trees or shrubs on farmland needing protecti on from erosion and suitably located to the establishment of permanent wildlife habitat
	WL-2 Restoring Shallow Water Areas for Wildlife	Dams, levees, dugouts, dikes, etc.

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U.S. Department of Agriculture

Agricultural Stabilization and Conservation Service (USDA ASCS)

Agricultural Conservation Program (cont.)

Fees:

ASCS will share 50-75% of the costs of the practice. The exact amount varies by county and practice. ASCS's share will not exceed $3,500 per participant per year, unless there is a Long Term Agreement or Pooling Agreement. A Long Term Agreement requires a more extensive conservation plan of operation and a Pooling Agreement requires a pooling of resources between farms. Consult your local ASCS office for details.

Qualifications:

Must be an agricultural producer

How to apply:

Initial sign up dates are announced by county newsletters and usually held from September through January. However, additional sign-ups may occur. Funding is subject to available monies. Typical requirements include the location of the project and water sources, and cost estimates. Call the local ASCS office for details.

U.S. Department of Agriculture

Agricultural Stabilization and Conservation Service (USDA ASCS)

AB 1658, Isenberg Water Management Planning

Applicable practices:

Provide significant additional cost-share assistance to designated area for the purpose of improving surface and groundwater that have been impaired by non-point agricultural sources.

Fees:

None

Qualifications:

Project area must be identified as water quality priorities by local or state agencies.

How to apply:

Contact your local ASCS office for details.

U.S. Department of Agriculture

Soil Conservation Service (USDA SCS)

Hydrologic Unit Areas (HUA)

Applicable Practices:

Accelerate the technical, financial, and educational assistance needed to solve an agricultural non-point source water quality problem for a designated area. Potential projects must be identified in the state's non-point source management program. The West Stanislaus area has been chosen as an identified area.

Fees:

Funding includes additional staff for both Soil Conservation Service and Cooperative Extension in the project area, with cost-share assistance for on-farm conservation practices provided by ASCS.

Qualifications:

Farm operators in the West Stanislaus area.

How to apply:

Contact the Soil Conservation Service Field Office at 209-892-6193

U.S. Department of Agriculture

Soil Conservation Service (USDA SCS)

Public Law 83 - 566 (PL - 566)

Applicable Practices:

Identify all water and related land resource problems within a small watershed and develop solutions to these problems. The areas of concern that can be studied are:

- Watershed Protection
- Flood Prevention
- Agricultural Water Management
  - Irrigation
  - Drainage
  - Other Agricultural Water Management
- Non-agricultural Water Management
  - Public Recreation
  - Fish and Wildlife
  - Municipal and Industrial Water Supply
  - Water Quality Management
  - Energy
- Groundwater Recharge
- Conservation and Proper Use of Land
  - Control of Agricultural Related Pollution
  - Disposal of Solid Waste

Fees:

No charge. The cost sharing percentage varies with the type of project (100 percent for flood control and up to 50 percent - 65 percent for other projects).

Qualifications:

- Local Organizations shall acquire land easements and rights-of-way.
- Local organizations shall be willing to carry out operations and maintenance.
- Conservation plans required on at least 50 percent of the land above retention reservoirs

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U.S. Department of Agriculture

Soil Conservation Service

Public Law 83 - 566 (PL - 566)

- Watersheds may not exceed 250,000 acres.
- Maximum storage capacity in any one structure is not to exceed 25,000 acre-feet.
- Maximum flood storage capacity in any one structure is 12,500 acre-feet.
- Beneficial effects must exceed adverse effects.

How to apply:

Contact the local Soil Conservation Service Field Office in Patterson at 209-892-6193.

U.S. Department of Agriculture

Soil Conservation Service (USDA SCS)

San Joaquin River Management Program

Purpose:

To reduce sediment aggradation from the San Joaquin river floor.

Fees:

The funding would be provided to the Soil Conservation Service and Agricultural Stabilization and Conservation Service by the State of California. These agencies would provide additional erosion control methods under existing programs.

Qualifications:

Must be on the Westside of San Joaquin Valley and using existing erosion control methods.

How to apply:

The proposal is still in its preliminary stage and is being reviewed before an Advisory Council for approval. Contact the West Stanislaus Resource Conservation District or your the Soil Conservation Service Office at 209-892-6193.

California Energy Commission (CEC)

Gypsum Block Demonstration Project

Applicable practices:

The CEC's Farm Energy Assistance Program is providing funding to the California Association of Resource Conservation Districts to demonstrate soil moisture sensors, irrigation system evaluations, and irrigation water management practices throughout the state. Demonstrations are being conducted on farms near USDA Soil Conservation Service field offices in 1991 and 1992. Soil moisture sensors will be used in conjunction with irrigation system evaluations to maximize irrigation system efficiencies. Workshops and field days will be conducted each year to demonstrate the results to area growers and agricultural consultants.

Fees:

No charge.

Qualifications:

Growers have been selected for on - farm demonstrations for 1991.

How to apply:

Contact:

Kathy Summ
California Association of Resource Conservation Districts
3830 U Street
Sacramento, CA 95817
916-662-2037

California Energy Commission (CEC)

Water Management Training and Education Program

Applicable practices:

The CEC's Farm Energy Assistance Program is providing funding to the University of California Cooperative Extension to conduct a state-wide irrigation education and training program. Instructional materials cover pump and irrigation equipment performance, irrigation scheduling, and irrigation system design, evaluation and efficiency. Local area farm advisors will develop instructional materials covering irrigation requirements of specific crops, and will participate in teaching irrigation courses and in the establishment of irrigation applications and irrigation scheduling techniques, and refine crop coefficients for specific crops.

Fees:

A variable fee will be charged to cover costs of instructional materials.

Qualifications:

Available to growers in selected counties.

How to apply:

Contact:

Dr. Blaine Hansen
Irrigation and Drainage Specialist
Department of Land, Air, and Water Resources
University of California
Davis, CA 95616
916-752-1130

California Polytechnic State University (Cal Poly)

Irrigation Management Software

Applicable practices:

Cal Poly along with the OWC/DWR have developed AGWATER. A new sophisticated computer software package. It is user-friendly with graphics and designed to acquaint growers with the concepts such as irrigation scheduling and timing, uniformity, irrigation efficiency, crop stress, and drainage problems.

Fees:

Call Cal Poly or OWC/DWR for fees.

Qualifications:

These services are offered to all interested growers and water districts.

How to apply:

Contact:

California State Department of Water Resources
State Office of Water Conservation
Agricultural Water Conservation Branch
P.O. Box 942836
Sacramento, CA 94236-0001
916-445-9958 or 800-952-5530

Dr. Charles Burt, Professor
Dept. of Agricultural Engineering
Cal Poly
San Luis Obispo, CA 93407
805-756-2379

California Polytechnic State University (Cal Poly)

Short Courses on Irrigation Engineering, Design, Evaluation, and Management

Applicable practices:

In addition to their regular agricultural engineering curriculum, Cal Poly offers short courses to interested individuals in surface irrigation design, advanced surface irrigation, drip irrigation design, pumps, irrigation scheduling, irrigation principals, irrigation evaluation, water conservation, and on-farm irrigation methods. Cal Poly works closely with the OWC/DWR and Irrigation Association to provide these classes. Cal Poly has extensive training and research facilities.

Fees:

A fee is required for the short courses. The regular program fees are in accordance with the State University of California.

Qualifications:

Students can register for Cal Poly's regularly offered classes. Short courses are offered several times a year to professionals and interested persons. A fee is required, please contact Cal Poly for class scheduling.

How to apply:

Contact:

Dr. Charles Burt, Professor
Dept. of Agricultural Engineering
Cal Poly San Luis Obispo, CA 93407
805-756-2379

California State Department of Water Resources

Office of Water Conservation (DWR/OWC)

Agricultural Drought Guidebook

Applicable practices:

The California Department of Water Resources Office of Water Conservation has published the Agricultural Drought Guidebook (Water Conservation Guidebook No. 6). This guidebook has suggestions for water managers in evaluating existing water supplies developing emergency supplies and reducing demands. Many of the suggestions in the Guidebook can be implemented before an actual drought occurs. There are also district office listings to help agencies plan for and respond to droughts.

Fees:

No charge.

Qualifications:

Any interested organization may obtain a copy of the Agricultural Drought Guidebook.

How to apply:

Contact:

The California State Department of Water Resources
Office of Water Conservation
Agricultural Water Conservation Branch
P.O. Box 942836
Sacramento, CA 94236-5530

California State Department of Water Resources

Office of Water Conservation (DWR/OWC)

Short Courses on Irrigation Engineering, Design, Evaluation, and Management

Applicable practices:

These courses are held at the Irrigation Training Center at California Polytechnic State University in San Luis Obispo. They comprehensively covers most aspects of irrigation system operation and evaluation for all common types of irrigation systems.

Fees:

Normal fee is $ 100 per course. Must supply own food and lodging for courses over one day.

Qualifications:

Open to all irrigators, irrigation water managers, and professionals.

How to apply:

These courses are held 3 times a year. For the times, locations and a description of courses contact the office listed below.

Contact:

Office of Water Conservation
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001
Attn: Arturo Carvajal
800-952-5530

Center for Irrigation Technology (CIT)

Irrigation Research and Education

Applicable practices:

Laboratory and field experimentation on irrigation topics. Economic studies, market surveys, software development. Workshops, seminars, and special training by arrangement. Newsletters and publications are available by contacting the Center.

Fees:

No charge for basic inquiries.

Qualifications:

Available to any grower, water district, irrigation dealer, or manufacturer.

How to apply:

Contact:

Center for Irrigation Technology
5370 N. Chestnut Ave.
California State University, Fresno
Fresno, CA 937740-0018
209-278-2066

Center for Irrigation Technology (CIT)

Irrigation Equipment Testing

Applicable practices:

A customized hydraulic laboratory testing facility of irrigation system components offers a range of testing including sprinkler distribution patterns, micro-spray patterns, drip emitter, friction loss versus flow rates in valves and fittings, and computer analysis.

Fees:

Can be a member or supporting member for 15 percent discount off a commercial fee schedule.

Qualifications:

Open to any grower, water district, or manufacturer.

How to apply:

Contact:

Center for Irrigation Technology
5370 N. Chestnut Ave.
California State University, Fresno
Fresno, CA 93740-0018
209-278-2066
Fax: 209-278-4849

University of California Cooperative Extension

General Irrigation Assistance

Applicable practices:

Farm Advisors of the UC Cooperative Extension will help growers evaluate the appropriate irrigation practice for their crop and region. They will also help growers address various irrigation system issues, such as:

- Irrigation Methods and Management
- Pumping Performance Comparison
- Energy Management
- Irrigation Design Evaluation Management
- Pumping Efficiency
- Drainage and Salinity
- Irrigation Scheduling
- Drip Irrigation
- Sprinkler Irrigation
- Surface Irrigation
- Soil Infiltration
- Water Quality

Specific services:
Extension specialist in the areas of soils, water, and agricultural engineering provide technical support for farm advisors and serve as a second level contact. The Land, Air, and Water Resources Department (UC Davis) provides expertise in all of the above areas with emphasis on the irrigation topics. The Agricultural Engineering Department (UC Davis) provides expertise in areas pertaining to power units and energy use/costs.

Fees:

No charge (Except for publications and visual aids).

University of California Cooperative Extension

General Irrigation Assistance, (continued)

Qualifications:

No restrictions.

How to apply:

Contact:

Phil Osterli
UC Cooperative Extension
209-525-6654

U.S. Department of Agriculture

Soil Conservation Service (USDA SCS)

Irrigation Systems:
Planning Assistance

Applicable practices:

The USDA SCS provides the technical assistance to all growers applying for cost-share assistance under the Agricultural Conservation Program administration by the USDA Agricultural Stabilization and Conservation Service.

USDA SCS provides technical assistance in such areas as:

- Identifying Irrigation Related Problems.
- Developing Alternatives to Address Identified Problems.
- Irrigation System Design, Installation and Operation.
- Irrigation Water Management.

Fees:

No charge.

Qualifications:

Available to growers through one of California's more than one hundred Resource Conservation Districts.

How to apply:

Contact the West Stanislaus Resource Conservation District or the Soil Conservation Service Office at 209-892-6193

U.S. Department of Agriculture

Soil Conservation Service (USDA SCS)

Public Law 74-46
Soil and Water Conservation Act

Applicable practices:

The USDA SCS provides the technical assistance through districts to land owners and operators in carrying out locally adapted soil and water conservation programs. Technical assistance is given in the development of conservation plans and application of conservation treatment. At this level, SCS conservationist help land users plan and carry out conservation practices as part of the total resource management system. SCS technical assistance takes the form of basic soil information and interpretations of the potential of the land for various uses; designing, layout and checking construction and maintenance of various land treatment measures; selection of cover crop plants, seeding methods and rates as well as cultural practices; and solving other soil management problems such as irrigation induced erosion in the West Stanislaus Study Area.

Fees:

No charge.

Qualifications:

Most Conservation Districts require that a landowner/operator become a District cooperator in order to receive technical assistance which is usually requested from the local SCS office.

How to apply:

Contact your local West Stanislaus Resource Conservation District at 209-837-4230 or your local Soil Conservation Service Office at 209-892-6193

PART III

CHAPTER XIII

A question and answer handout is provided for use by the West Stanislaus RCD and the Patterson Field Office. The handout poses commonly asked questions concerning the report and can be used to provide information to local growers who would like to know what is happening in their area but do not necessarily care to read the entire report.

QUESTIONS AND ANSWERS

Why Should I Reduce The Sediment Leaving My Field ?

The sediment is causing maintenance problems in ditches and road crossings. Deposition of sediment in the San Joaquin River is raising the channel bottom. The accumulation of sediment is reducing the flood protection of the channel and reducing recreation. Fish and wildlife are also affected. The sediment may also carry pesticide residues. Cleaner irrigation water could be provided to the growers.

Are There Any Other Reasons ?

Yes, the California State Water Resources Control board was required by Section 303(c)(2)(B) of the Federal Clean Water Act to develop water quality objectives. These objectives are in the new Inland Surface Water Plan. If objectives are not met voluntarily, agricultural discharges will be regulated. The West Stanislaus area has been identified as the principal source of organochlorine pesticide residues to the San Joaquin River, contributing to that section of the river being classified as impaired.

What Is Covered By The Inland Surface Water Plan ?

The plan will be used to set regulatory controls on the discharge of waste to surface waters. All return irrigation and drainage water from agricultural operations are waste discharges. They have three management approaches:

1.) Voluntary implementation of conservation practices.

2.) Regulatory-based encouraged of practices or practice enforcement through management agency agreements.

3.) Establish effluent limitations or discharge prohibitions through regulation.

What is 300 mg/l Total Suspended Solids (TSS) ?

This is 300 milligrams of sediment in 1.0 liter of water. The Regional Water Quality Control Board has asked SCS to see if this a feasible level for growers to achieve. A previous cost-sharing program in the Spanish Grant area successfully achieved this goal.

Is 300 mg/l TSS Reasonable For Growers To Achieve ?

SCS has determined that 300 mg/l TSS can be achieved through the use of properly designed conservation practices such as sediment control basins, proper irrigation systems and management or agronomic management.

How Much Will This Cost The Grower ?

Average annual cost to the grower for installation, and operation and maintenance of conservation practices varies from $50 - $400 per acre.

Why Does The Cost Vary So Much ?

Since each farm operation and operator is unique, different combinations of conservation practices are used for each. Every grower needs a conservation plan designed especially for them.

Is There Anything Else That I Must Do ?

Yes, all of the installed practices must be properly maintained and managed for them to be effective. If they are not properly managed, the 300 mg/l TSS limit will not be met.

Where Is Information And Assistance Available ?

The West Stanislaus RCD and Patterson SCS Field Office can provide information about conservation practices and also offer technical assistance in the planning and design of complete resource management systems. The Agricultural Stabilization and Conservation Service (ASCS) has cost sharing programs that may help you finance the installation of your plan. The U.C. Cooperative Extension Service offers many educational and informational services regarding conservation practices.

How Long To I Have To Reach This Goal?

The Inland Surface Water Plan began April 1991. Local people and groups need to form a drainage entity and report to the Regional Board by October 1992 to assist the Board in establishing goals, time schedules, and a long-term monitoring program. How much time you have to meet the set goals will be based on the time schedule agreed upon and how much progress is made toward meeting those goals. Goals not being met will result in Waste Discharge Permits being issued.

What Do I Need To Do ?

Contact the West Stanislaus RCD, SCS (209-892-6193), ASCS, or U.C. Cooperative Extension Office (209-525-6654) for further assistance in developing a complete conservation plan.

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