United States Department of Agriculture

Conservation Security Program (CSP)

Proposed Rule

Benefit Cost Assessment

November 14, 2003

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Executive Summary

Implementation of CSP presents an unprecedented challenge. The 2002 farm bill directs USDA to offer CSP as an entitlement program, yet requires that CSP expenditures remain within the Congressionally mandated limit of $3.8 billion over 10 years. The analytical approach developed here is designed to provide insight on ways to limit program expenditure and on the implications of various limitations for net benefit that can be expected from CSP.

Analytical Model. The Conservation Security Program (CSP) has been designated as an entitlement program. Therefore, eligible producers who meet the requirements to participate must be enrolled. The model is based on a series of composite farms, replicating the process of "penciling out" the CSP participation decision. For each of the modeled alternatives, it was assumed that producers will choose to participate in CSP when the private benefits outweigh the private cost. Given farm-level estimates of participation, enrolled acreage, payments, and costs, the model calculates onsite and environmental (offsite) benefits, net economic costs, government costs, government to producer transfer payments, net benefit to society and the benefit-cost ratio.

CSP Payments. The model calculates the overall CSP payment by calculating each of several payment components separately: the base payment, cost-sharing for installation of new structural practices and adoption of new management practices; cost-sharing for maintenance of existing structural and management practices, and enhancement payments. The net present value (NPV) of each payment is determined by a payment rate per acre, the number acres to which the payment applies, contract years in which the payment is made (i.e., whether the payment is made on a one-time or annual basis), and the producer's discount rate. Practice payments were calculated using similar methodology used for the *Environmental Quality Incentives Program Benefit Cost Analysis, Final Report, May 9, 2003*.

Benefits of CSP. Consistent with the EQIP analysis, the resource concerns addressed in this analysis are limited by the availability of estimates of the benefits that accrue to the application of conservation practices. Benefits are obtained from the installation/adoption of practices or from the maintenance of practices beyond what would typically occur without maintenance payments. Benefits as the result of CSP participation are expressed as either onsite (those that accrue to the producer) or environmental (those that accrue to society).

Costs of CSP. Two cost figures are of particular interest. First, **government expenditure** includes all government expenditures relating directly to a specific CSP contract. These include:

- financial assistance to the producer including base payments, cost sharing, maintenance and enhancement payments; and,
- technical assistance costs.

The second cost item of interest is the **net economic cost** to society. Net economic costs include:

- total practice implementation costs (cost-share and producer cost);
- total practice maintenance costs; and
- technical assistance costs.

Effects of Regional Rental Rates and Conservation Practice Costs. There are many questions that a producer may attempt to answer when making a participation decision regarding CSP. "What will be the out-of-pocket cost?" and "What will be the financial reward?" are just two such questions. Regionally, the answers to these questions may differ due to the differing commodities and topographies between regions. For example, rental rates in the West for irrigated cropland will be significantly higher than in other regions due to the large number of irrigated cropland acres in the region, which is directly related to the prevalence of high value commodities grown in the region. If rental rates constitute a major component of CSP, producers in the Midwest and the West would be more likely to participate in CSP than other regions of the country. However, this is not the only consideration.

A producer also considers what the out of pocket expense will be for implementation and/or maintenance of conservation practices. The cost of conservation depends on a number of factors. The size of the area to be treated and the topography of the land may impact the complexity of the practice, whether a structural or a management practice, thus increasing or decreasing the cost of implementing and maintaining the practice. Just as per-unit costs of production may decrease with the increase in the size of operation, the per-acre cost of installation may decrease with an increase in acres treated or impacted. The resource concern being treated also impacts the cost of implementation and maintenance depending on the region. This is due to the different practices that can be used to address a resource concern in a given region. Producers in one region may be more willing to implement a given practice on their operation than producers in another region. For example, no-till is a widely accepted practice in some area of the country to address soil erosion and is relatively inexpensive. However, in other regions, producers are very hesitant to implement no-till due to differing soil types, and climate and weather patterns. Producers may be less likely to participate if they are forced to implement practices that they see as too expensive or not cost effective. Furthermore, participation may vary in regions where the cost of implementation is higher, hence lowering participation rates, than in regions where the cost of implementation is lower, where it could be expected that participation rates would be higher.

It is difficult to say that regions with higher rental rates will have higher practice implementation costs because it depends greatly on the practice and which resource concern is being addressed. It is also important to remember that just as regions have different levels of costs of production for commodities, regions also have differing levels of costs of conservation practice implementation thus causing the participation rate to fluctuate depending on the level of costs associated with a practice and/or region.

Program Net Benefits and Benefit-Cost Ratios. Program net benefits are the sum of all CSP-related benefits received by society less all CSP-related costs incurred to society. CSP-related benefits include:

- onsite and environmental benefits that accrue from practice installation, adoption, and maintenance; and,
- payments to producers.

CSP-related costs include:

- payments to producers
- the cost of practice installation, adoption, and maintenance; and,

- the cost of technical assistance provided to producers.

The net benefit of CSP to society is CSP-related benefits less CSP-related costs. Note that payments to producers cancel as they are a benefit to producers but a cost to society. Thus, transfer payments received by producers (payment above CSP-related conservation costs) also cancel out of the net benefit calculation.

Discussion of Alternatives

General issues for analysis were identified and a range of methods for limiting the CSP to stay within budgetary constraints, or "ramp-up" options were analyzed. Questions raised in the Advanced Notice of Proposed Rulemaking (ANPR) are the basis for the important decision points for NRCS that can be analyzed in different ways, given existing data resources. The identified alternatives include:

1) The full CSP program as defined in Title II of the 2002 Farm Bill, with full cost share.
2) The full CSP program as defined in Title II of the 2002 Farm Bill, with minimal cost share.
3) The CSP program limited by resource concern with minimal cost share.
4) The CSP program limited by geography with minimal cost share.

Since the full CSP program alternative indicated that cost share had little effect on participation rates, the remaining alternatives were run assuming minimal cost share. All alternatives calculate enhancement payment as ten percent of the adoption cost of management practices needed to treat the resource(s) of concern, except for one sub-alternative that investigates the option of decreasing base payments, and increasing enhancement payments from 10% to 20%.

Results

The following section will summarize the results associated with each of the four alternatives and how they relate to producers' participation decisions. Also, a sensitivity analysis of potential benefits and costs of intensive management activities level of treatment is included. All monetary results are expressed in net present value terms, using a 7% discount rate.

Although the analysis provides estimates of the social net benefits of each alternative examined, its primary value is to illustrate the relative order of the identified alternatives, rather than provide accurate estimates of the costs and benefits. NRCS based its estimates on a number of assumptions because of substantial data gaps. There is, for example, no available information on the benefits associated with major program elements, such as enhancement activities above and beyond the non-degradation level. Instead, the RIA used estimates generated from experience with EQIP, CRP, and other USDA conservation programs. NRCS also assumes that producers would enroll in CSP if the program provided any positive net benefit to them (i.e., even as small as $1). This assumption does not take into consideration producers' cash flow constraints, which along with other factors could affect participation. Since the analysis does not have information on the behavioral response of producers to the incentives provided by CSP, the benefits analysis provided in the RIA is largely a hypothetical construct and does not reflect the benefits of the proposed program and the identified alternatives. NRCS intends to refine the analysis for the final rule. NRCS welcomes comments and additional data that may assist in this refinement.

A key requirement of CSP implementation is keeping expenditures within the Congressionally mandated budget of $3.8 billion over the next 10 years. Doing so is likely to require limiting the program in a variety of ways: reducing payments to cut participation and limit per-farm and per-acre payments; limiting the range of resource concerns that producers can address; restricting participation by tiers; and restricting participation to specific geographic areas (e.g., counties).

The results presented below show that staying within the budget while also offering CSP as an entitlement, as mandated by the 2002 farm bill, will be difficult. Some combination of eligibility limitations is likely to be needed. The scenarios presented here provide insight into the type of limitations that could be used, how they would affect government payments, producer participation, and program net benefits. While only one of the scenarios actually achieves government expenditures below the budget limit, the model does show that limiting program payments and program options can reduce participation and program expenditures.

Alternative 1 - *The full CSP program as defined in Title II of the 2002 Farm Bill, with full cost share.*
This alternative has the potential to provide producers with sufficient payments for participation in CSP. It includes estimated participation of 1.9 million farms and an average contract payment of $31,400 ($70 per acre). All producers would participate in CSP at either a Tier II or a Tier III level, with 17 percent at Tier II and 83 percent at Tier III. As far as acres, 32 percent would be enrolled in Tier II contracts and 68 percent in Tier III contracts. Onsite benefits would be about $27.6 billion and offsite $76.6 billion, for total benefits of $104.2 billion. By subtracting $42.1 billion net economic costs ($32.3 billion of practice implementation and maintenance costs and $9.8 billion technical assistance cost) from total benefits leaves $62.1 billion net benefits. Transfer payments received by producers would be $27.7 billion, which are payments above CSP-related conservation costs. Total government cost would be $69.8 billion over 10 years, which includes the following: base payments ($33.3 billion), installation costs ($17.1 billion), maintenance costs ($3.4 billion), enhancement payments ($6.2 billion), and technical assistance ($9.8 billion).

Base payments for Tier I are significantly lower than for Tier II and Tier III. Since this alternative allows producers have the choice of Tier level at which to participate and choice of resource concerns, the model assumes that they will choose the Tier level and combination of resource concerns that maximize their financial benefits. Therefore, producers do not select Tier I because of the lower base payments.

Alternative 2 - *The full CSP program as defined in Title II of the 2002 Farm Bill, with minimal cost share.*
This alternative is identical to alternative one except cost share is limited to 5 percent instead of 75 percent. It includes estimated participation of 1.8 million farms and an average contract cost of $21,500 ($48 per acre). Producers would participate at predominantly the Tier III level (78%), with 21 percent at Tier II and 2 percent at Tier I. Nearly 80 percent of the acreage would be enrolled in Tier III contracts and 20 percent in Tier II contracts, while less than one percent of the acreage would fall into Tier I. Onsite benefits would be about $23.8 billion and offsite $83.6 billion, for total benefits of $107.4 billion. Subtracting $33.6 billion net economic costs ($24.3 billion of practice implementation and maintenance costs and $9.3 billion technical assistance cost) from total benefits leaves $73.8 billion net benefits. Transfer payments received by

producers would be $15.4 billion, which are payments above CSP-related conservation costs. Total government cost would be $49 billion over 10 years, which includes the following: base payments ($32.8 billion), installation costs ($846 million), maintenance costs ($212 million), enhancement payments ($5.8 billion), and technical assistance ($9.3 billion).

Tier III is once again the level at which most producers participate and, as with Alternative 1; this is due to higher base payments and changes the resource concerns addressed through participation. It is important to note that producers with high cost practices will participate with limited cost share except in the South Central NRCS Region.

Alternative 3 *- The CSP program limited by resource concern with minimal cost share.*
This alternative requires that resource concerns soil quality, water quality, and wildlife resource concerns be addressed and cost share funds only are available up to 5 percent of the installation costs. Soil quality and water quality were selected because of the emphasis on these resource concerns in the proposed rule. Wildlife resource concern was included because of its prevalence as a resource concern across the entire nation.

This alternative includes estimated participation of 1.6 million farms and an average contract cost of $21,500 ($49 per acre). Most producers would participate at the Tier III level (86%), with 14 percent at Tier II. Nearly 86 percent of the acreage would be enrolled in Tier III contracts and 14 percent in Tier II contracts. Onsite benefits would be about $14.5 billion and offsite $78.8 billion, for total benefits of $93.3 billion. By subtracting $31.2 billion net economic costs ($23 billion of practice implementation and maintenance costs and $8.2 billion technical assistance cost) from total benefits leaves $62.1 billion net benefits. Transfer payments received by producers would be $11.8 billion, which are payments above CSP-related conservation costs. Total government cost would be $43 billion over 10 years, which includes the following: base payments ($29.3 billion), installation costs ($798 million), maintenance costs ($182 million), enhancement payments ($4.5 billion), and technical assistance ($8.2 billion).

Alternative 4 *- The CSP program limited by geography with minimal cost share.*
This alternative limits the program to six composite counties (one for each of the six regions) which lowers government cost due to smaller geographical areas.

This alternative includes estimated participation of 3,750 farms and an average contract cost of $33,000 ($65 per acre). All producers would participate at predominantly the Tier III level (75%), with 25 percent at Tier II. Nearly 58 percent of the acreage would be enrolled in Tier III contracts and 42 percent in Tier II contracts. Onsite benefits would be about $63 million and offsite $144 million, for total benefits of $207 million. By subtracting $93 million net economic costs ($74 million of practice implementation and maintenance costs and $19 million technical assistance cost) from total benefits leaves $114 million net benefits. Transfer payments received by producers would be $50 million, which are payments above CSP-related conservation costs. Total government cost would be $143 million over 10 years, which includes the following: base payments ($66 million), installation costs ($39 million), maintenance costs ($7 million), enhancement payments ($12 million), and technical assistance ($19 million).

Table 1 summarizes the model results for all alternatives:

Table 1. Summary of Total Benefits and Costs by Alternative

Alternative	Net Benefits	Total Offsite Benefits	Total Onsite Benefits	Net Economic Cost[1]	Total Transfer Payments[2]
	(Net Present Value, Billion $)				
1	62.09	76.58	27.57	42.05	27.72
2	73.83	83.57	23.82	33.56	15.44
2a	3.06	7.54	6.28	10.76	-2.13
2b	45.76	55.22	24.06	33.52	4.15
2c	75.14	87.15	21.88	33.89	17.29
3	62.10	78.75	14.53	31.18	11.82
3a	44.40	49.04	9.40	14.04	1.50
3b	50.20	52.73	10.28	12.81	-1.85
4	0.11	0.14	0.06	0.09	50.13

Legislative Authority

Conservation Security Program (CSP) assistance is authorized under the provisions of Title II, Subtitle A, of the Farm Security and Rural Investment Act of 2002, Public Law 107-171. Section 2001 amends Subtitle D of Title XII of the Food Security Act of 1985 (16 U.S.C. 3830 et seq.) by adding Chapter 2, Conservation Security and Farmland Protection, Subchapter A, Conservation Security Program. The Secretary of Agriculture acting through the Chief of the Natural Resources Conservation Service (NRCS) will administer the program.

Need for Action

Consistent with Congressional authorization, there is a need for NRCS to implement the conservation provisions found in the CSP program in a manner that enhances the States' authority and flexibility while ensuring that all statutory requirements of the legislation are met. The few discretionary decisions made at the national level are focused on maintaining program integrity and ensuring consistency and fairness in carrying out the agency's program responsibilities.

[1] Net Economic Cost is total practice implementation costs (cost-share and producer cost); total practice maintenance costs; and technical assistance costs. This is the cost to society at large.

[2] For purposes of this analysis, transfer payments are considered to be payments to producers that are more than the CSP-related conservation costs.

The analysis and disclosure in this Benefit-Cost Analysis is intended to allow the Responsible Federal Official, which is the Chief of NRCS, to determine whether these discretionary items of the CSP regulation adhere to the following principles, as outlined in DR1512-1, in developing the program:

- Identify the problem that NRCS intends to address through the rulemaking process and assess the significance of that problem;
- Examine whether existing regulations (or other law) have created or contributed to the problem that a new regulation is intended to correct and whether those regulations (or other law) should be modified to achieve the regulatory goal more effectively;
- Identify and assess available alternatives to direct regulation;
- In setting regulatory priorities, consider to the extent reasonable, the degree and nature of the risks posed by various activities within agency jurisdiction;
- Design regulations in the most cost effective manner to achieve the regulatory objective when it is determined that a regulation is the best available method of achieving the regulatory objective;
- Assess both the costs and benefits of the intended regulation and propose or adopt a regulation only upon a reasoned determination that the benefits of the regulation justify its costs;
- Base decisions regarding the need for and consequences of a regulation on the best reasonably obtainable scientific, technical, economic, and other information;
- Identify and assess alternative forms of regulation and, to the extent feasible, specify performance objectives that regulated entities must adopt;
- Seek, whenever feasible, views of appropriate State, local, and tribal officials before imposing regulatory requirements that might significantly or uniquely affect those government entities;
- Avoid regulations that are inconsistent, incompatible, or duplicative with other agency regulations or those of other federal agencies;
- Tailor regulations to impose the least burden on society, including individuals, businesses of differing sizes, and other entities (including small communities and governmental entities), consistent with obtaining the regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; and
- Draft regulations to be simple and easy to understand, with the goal of minimizing the potential for uncertainty and litigation arising from such uncertainty.

Precedents and Context

Current Land Use

The Nation’s private lands constitute a tremendous resource that yields food and fiber as well as the livelihood and recreation for private land users.

Major agricultural land uses in the U.S.[3]

Cropland	377 million acres
Pastureland	120 million acres
Rangeland	406 million acres
Hayland	Included in cropland
Forestland	407 million acres
Other lands (homesteads, feedlots, etc.)	84 million acres[4]

Many of these land uses have resource concerns and limitations that decrease their productive use, cause damages, and reduce efficiency in the agricultural sector. While natural resource concerns on private lands are well documented elsewhere, the following three cases illustrate the current problem situation.

The 1997 National Resources Inventory (USDA, 2000a) indicates that a total of 115.5 million acres of cropland, pastureland, and rangeland have annual rates of soil erosion that exceed "T", the soil loss tolerance rate at which the productivity of a soil can be maintained indefinitely. Of this total 4.8 million acres have both sheet and rill (water induced) and wind erosion rates individually exceeding T, 67.2 million acres have only sheet and rill erosion exceeding T and 43.5 million have only wind erosion exceeding T. As a separate calculation, there are 130.5 million acres where the sum of wind and water erosion exceeds T.

The 2000 EPA Assessment of the Nation's surface water quality indicates that 39 percent of river and stream miles, 45 percent of lake areas, and 51 percent of estuaries area had water quality impairment relative to one or more designated uses (USEPA, 2002). Of these impaired waters, approximately 50 percent were listed as having agricultural non-point source pollution as a major problem.

Significant public policy advancements have been made for the control of agricultural non-point source pollution arising from animal feeding operations (AFOs). In March of 1999 USDA and EPA jointly released "The Unified National Strategy for Animal Feeding Operations" (USEPA, 1999). In 2000, NRCS released the "Comprehensive Nutrient Management Planning and Guidance" (USDA, 2000b). In 2003, EPA finalized the rules for Confined AFOs (CAFOs) and the permitting that would be required under provisions of the National Pollutant Discharge Elimination Program (Federal Register, 2003). NRCS estimates that 257,000 AFOs will need financial and technical assistance in developing comprehensive nutrient management plans, which are required for the CAFOs and strongly encouraged for smaller AFOs (NRCS, 2003). This assistance will be provided through the EQIP program, the CSP program, and through the general conservation technical assistance program of the NRCS. State and local agencies are also expected to provide assistance to producers.

[3] USDA-NRCS, 1997 National Resources Inventory; Revised December 2000
[4] Includes lands in the CRP that are not cropped and currently under vegetative cover.

CSP Description and Features
Overview

The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance for the conservation, protection, and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. The program provides payments for producers who practice good stewardship on their agricultural lands and incentives for those who want to do more. In short, intent of CSP is to "reward the best and motivate the rest".

Eligible producers who own or control agricultural land may participate by entering into an agreement with USDA. The participant must maintain or establish conservation treatment to specific levels of natural resource conservation protection on their land in exchange for annual and other payments. Under certain conditions, participants would be eligible for renewal of the agreement in subsequent years. NRCS, or any other USDA-approved source, will provide technical assistance to the participant on the required conservation measures. Innovation and the use of new technologies are to be encouraged.

Conservation achieved through the CSP will help ensure the sustainability of farms and ranches, help optimize environmental benefits, ensure non-degradation of natural resources on farms and ranches, and improve the conditions of natural resources on the Nation's working lands.

CSP may provide technical assistance, base payments, cost share payments, maintenance payments, and enhancement payments to producers who enter into 5 to10-year contracts based on a CSP inventory and/or a conservation plan. The program is available to all eligible producers in the United States, Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Marianna Islands. The program provides equitable access to benefits to all producers regardless of size of operation, crops produced, or geographic location.

NRCS has overall leadership for the program and is responsible for establishing polices, priorities, and guidelines for CSP.

Eligible Producer

An eligible producer is an owner, operator, landlord, tenant, or sharecropper who shares in the risk of producing any crop or livestock and is entitled to share in the crop or livestock available for marketing from a farm/ranch (or would have shared had the crop or livestock been produced).

Eligible Land

Private agricultural land (including cropland, grassland, prairie land, improved pasture land, and rangeland), agricultural land under the jurisdiction of an Indian tribe, and forested land that is an incidental part of the agricultural operation is eligible for enrollment in CSP. Land enrolled in the Conservation Reserve Program, Wetlands Reserve Program, Grassland Reserve Program, and land converted to cropland (cropped less than four of six years prior to 2001) after the enactment of the CSP legislation (May 13, 2002) is not eligible.

How CSP works

An inventory will be conducted to identify significant resource concerns, determine the extent of conservation treatment that is being applied and maintained on the land, and to identify opportunities for further conservation treatment. This inventory may be completed by self-certification, interview, or onsite visit.

Documentation for the CSP contract will be developed. The documentation will, to the extent practical, use existing conservation plans, plan maps, contracts, and other documentation. Quality criteria and guidance documents in Section III and Practice Standards and Specifications in Section IV of the NRCS Field Office Technical Guide (FOTG) and procedures contained in other handbooks of NRCS will be used.

The documentation will include:

- Identification of the resource concerns to be treated. Resource concerns include, but are not limited to:
  - Soil erosion
  - Water quality, Water quantity
  - Air quality: Wind Erosion (dust)
  - Animal: Grazing Productivity
  - Animal: Wildlife
- A map that indicates the boundaries, acreage and land use of the property to be included in the CSP Contract;
- Examples of acceptable acreage calculations include: program acres (FSA), Customer Service Toolkit (CST)/ArcView calculations, GPS, land survey/plat map, measurements taken from scaled maps or photographs.
- A description of the Tier and minimum number, type, extent, and scope of conservation practices to be implemented, maintained, or improved;
- Decisions made during the conservation planning process will be documented in a conservation security plan. Documentation will include practices and a schedule for the implementation, maintenance, or improvement of the conservation practices. Documentation will also reflect if the producer desires to implement practices to enhance the current Tier or move up to the next Tier;
- Practices must be listed in the National Handbook of Conservation Practices and meet the requirements of the FOTG or be approved for pilot testing through the use of interim standards.

Payments

Payments may include base payments, practice installation payments (structural and management), maintenance payments (structural and management), and enhancement payments.

Base Payments

A three-Tiered approach is used when determining base payments.

Tier I level of treatment addresses at least one significant natural resource concern to a non-degradation level on part of the agricultural operation. The base payment is 5 percent of the average national rental rate, or appropriate rate. Tier I contracts are limited to 5 years.

Tier II level of treatment goes a step further; it must treat at least one significant natural resource concern to a non-degradation level and involve the entire agricultural operation. The base payment is 10 percent of the average national rental rate, or other appropriate rate. Tier II contracts range from 5 to 10 years, as determined by the producer.

Tier III level of conservation management must treat all natural resource concerns to a non-degradation level and involve the entire agricultural operation. The base payment is 15 percent of the average national rental rate, or other appropriate rate.

Section 1238C.(b)(1)(ii) of the CSP legislation allows for base payments to be determined from "another appropriate rate for the 2001 crop year that ensures regional equity." Therefore, for the proposed rule, base payments are derived from the average NASS regional rental rates for the 2001 crop year for the specific land use.

Practice Installation and Maintenance Payments

If a producer desires to move to a higher Tier, cost share payments for needed structural and management practices may be available through the CSP for up to 75 percent of the 2001 county average cost of the new practice, or up to 90 percent in the case of beginning farmers or ranchers. Participants may contribute to the cost of the new practice through in-kind sources, such as personal labor, use of personal equipment, donated labor or materials, and use of on-hand or approved used materials. Other NRCS conservation programs require cost shared practices are to be maintained for the life of the practice. To be consistent, this analysis assumes that no maintenance payments will be made for practices cost shared through CSP.

Participants may also receive a maintenance payment up to 75% (up to 90 percent for beginning farmers and ranchers) of the 2001 county average costs of conservation practice maintenance for previously installed practices. However, if a federal or state agreement exists that provides reimbursement for maintenance of structural practices, then such maintenance is not eligible for cost share under CSP.

Cost of equipment is not eligible for cost-share and is not included as part of the CSP payment. Payments for waste storage or treatment facilities are not eligible under CSP. All needed practices and management must be in place and maintained before a producer can move to the next Tier.

Enhanced Payments

Enhancement payments are intended to ensure and optimize environmental benefits. At the discretion of the Secretary of Agriculture, enhancement payments may be added for:

- Applying practices that exceed the minimum requirements for the Tier.
- Addressing local conservation priorities in addition to the concerns for the agricultural operation.

- Participating in research and demonstration projects.
- Cooperating with other producers to implement watershed or regional resource conservation plans that cover at least 75 percent of the targeted area.
- Carrying out assessment and evaluation activities relating to practices included in a conservation security plan.

Payment Limitations

The contract limitations are $20,000 for Tier I, $35,000 for Tier II and $45,000 for Tier III. The base payment portion cannot exceed $5,000 for Tier I, $10,500 for Tier II or $13,500 for Tier III.

Technical Service Providers

The law allows producers to utilize technical service providers (TSP). Although it is presumed that technical assistance funds will increase to service the financial assistance provided to producers, it is not clear, especially in the short run, that trained staff with suitable expertise can be either redirected or acquired to provide technical assistance where it is needed. This provision will enable producers to meet technical assistance needs through the utilization of private vendors in a timely manner.

Beginning Farmers and Ranchers

The EQIP program and CSP proposed rule, cost sharing is limited to up to 75 percent nationally, except the legislation allows States the flexibility to cost share up to 90 percent for **beginning farmers and ranchers**. USDA has undertaken an activity to provide a definition of beginning farmer and rancher to be used uniformly within the Department. The Beginning Farmer and Rancher definition as stated in the final EQIP rule is:

Beginning Farmer/Rancher: an individual or entity who:

(a) Has not operated a farm or ranch, or who has operated a farm or ranch for not more than 10 consecutive years. This requirement applies to all members of an entity, and

(b) Will materially and substantially participate in the operation of the farm or ranch.

  (i) In the case of an EQIP contract with an individual, individually or with the immediate family, material and substantial participation requires that the individual provide substantial day-to-day labor and management of the farm or ranch, consistent with the practices in the county or State where the farm is located

  (ii) In the case of a contract made to an entity, all members must materially and substantially participate in the operation of the farm or ranch. Material and substantial participation requires that each of the members provide some amount of the management, or labor and management necessary for day-to-day activities, such that if each of the members did not provide these inputs, operation of the farm or ranch would be seriously impaired.

Beginning farmers and ranchers have financial limitations of low cash reserves and low equity positions that prevent their expenditures on conservation practices. Many have the education and technology available to practice good conservation, but their current loan payments are so large that they do not have the available cash. Providing qualified beginning farmers and ranchers with the higher cost share may obtain more conservation on the ground.

The 'all members of the entity' in subsection (2) disallows younger farmers being brought up within well-establish extended family farms, whether in partnerships or family corporations. This is following long-term 'beginning farmer' program rules in other USDA programs. It is likely that the extended family farms have enough resources to meet their necessary cost share for these conservation practices. These multi-generation family farms also tend to already provide better conservation on their lands because of their extended planning horizon.

Quality Assurance

Quality assurance will be performed by the State or District Conservationist as a part of the on-going quality assurance programs where technical assistance is provided. The State Conservationist, with advice from the State Technical Committee, shall develop a long-term monitoring program that includes the development of a CSP assessment procedure for the State. The monitoring information shall be used to:

- Assess workload conditions.
- Streamline contracting procedures.
- Streamline program delivery.
- Compile baseline data from states.
- Compile program accomplishments.
- Provide information to the Secretary to report to Congress no later than December 31, 2005.

Expanded Participation

At all levels, program managers will compile information concerning the outreach to, and participation of, producers by ethnic background and gender. This information will be used to assess whether satisfactory efforts have been made to ensure that limited resource producers, minorities, and others who may not have historically participated in previous conservation programs are being equitably served in the CSP.

Termination

A producer may request termination of a CSP contract if termination will not defeat the purpose of the CSP contract. Such justification could be, but is not limited to:

- Natural disasters
- Other documented hardships
- In the public interest

If a producer is required to modify a contract, the producer may terminate the contract in lieu of modification if the producer has fully complied with all terms and conditions of the contract prior to the termination**.** Total funds previously paid may be retained unless the producer is in violation of the terms and conditions of the contract as of the date of the termination.

The CSP contract shall be terminated after 60 days unless the buyer (transferee) provides written notice to the State Conservationist or designee that all duties and rights under the contract have been assumed by the buyer (transferee).

Relationship of CSP to Other Farm Bill Conservation Programs

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary conservation program that promotes agricultural production and environmental quality as compatible National goals. Through EQIP, farmers and ranchers may receive financial and technical assistance to install or implement structural and management conservation practices on eligible agricultural land. EQIP was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill). The Natural Resources Conservation Service (NRCS) administers EQIP.

State Technical Committees, Tribal representatives, and local working groups convened by the conservation district advise NRCS on implementation of the program to address identified resource needs and concerns. NRCS evaluates each producer's EQIP application using a state and locally developed evaluation process. Higher priorities are given to applications that encourage the use of cost-effective conservation practices, address National conservation priorities, and optimize environmental benefits.

EQIP may pay up to 75 percent of the costs of certain conservation practices important to improving and maintaining the health of natural resources in the area. Incentive payments may be made to encourage a producer to adopt land management practices, such as nutrient management, manure management, integrated pest management, irrigation water management, and wildlife habitat management, or to develop a CNMP and components of a CNMP. Both beginning farmers (like CSP) and limited resource farmers (unlike CSP) may be eligible for up to 90 percent of the cost of conservation practices. Efforts will be made between the EQIP and CSP programs to insure the cost share structures complement each other.

EQIP offers contracts with a minimum term of one year after implementation of the last scheduled practice and a maximum term of ten years. These contracts provide incentive payments and cost share payments for implementing conservation practices.

EQIP may be used by some producers to enable them to move to greater levels of resource protection, and allow the producers to receive greater payments under the CSP program. The interaction of these two programs will benefit each and succeed in obtaining more conservation on the ground.

In this case, USDA will avoid any double counting of benefits between the CSP program and the EQIP program. Since the rules of CSP were not written, the EQIP Cost/Benefit analysis did not consider any impacts of the CSP. In particular, the environmental and economic benefits of EQIP are based on the longer of either the particular conservation practice life or 10 years. This EQIP rule states "The participant shall operate and maintain the conservation practice for its intended purpose for the life span of the conservation practice(s) installed with the program, as determined by CCC."

The CSP Benefit Cost Analysis was written after and in relation to the *Environmental Quality Incentive Program Benefit Cost Analysis, Final Report, May 9, 2003.* This CSP analysis takes a similar approach to the EQIP analysis for those practices installed with CSP funded technical or financial assistance. It claims benefits for environmental and economic benefits from continuing conservation practices over a longer term. In particular, if the practices are installed with EQIP funds, benefits from these particular EQIP funded practices will not occur in the CSP analysis unless payments on maintenance effectively extend the benefits beyond the benefits claimed in the *Environmental Quality Incentive Program Benefit Cost Analysis, Final Report, May 9, 2003.*

Conservation Reserve Program (CRP)/Conservation Reserve Enhancement Program (CREP)

The CRP and CREP are land idling programs, designed to idle existing cropland for varying amounts of time. The intent of the program is to retire marginally productive lands that also contribute significant amounts of pollutants to surface waters or provide significant wildlife benefits, or both.

The impact of these programs is to somewhat reduce the amount of crops produced in the United States, provide a source of steady reliable income to owners of the enrolled cropland, reduce agricultural non-point source pollution, and provide habitat for wildlife species.

Land enrolled in CRP/CREP will not be eligible for CSP until after the CRP/CREP contract expires.

Wetland Reserve Program (WRP)

This program offers incentives to landowners to enhance and restore wetlands in exchange for retiring land from agricultural production. A limited amount of adjacent land can be included as a buffer. Land enrolled in WRP is eligible for EQIP to install conservation practices if the WRP cannot address the resource concern.

The program offers landowners three options including a permanent easement, a 30-year easement, and a restoration cost share agreement only. The financial assistance offered to landowners varies with each of the options. A permanent easement offers 100 percent of the value of an easement (development rights are not included in the valuation of the easements) and 100 percent of the restoration costs. A 30-year easement offers 75 percent of the value of the same easement along with 75 percent of the restoration costs. A cost share agreement only provides 75 percent of the costs of restoration. There is no easement involved with this option, however the cost share agreement is normally for a period of ten years.

Impacts of the program include an immediate payment to the successfully enrolled landowner, a reduction in the production of agricultural commodities, and improved wildlife habitat, especially for those species specifically associated with wetland environments.

Land enrolled in WRP will not be eligible for CSP after the WRP contract expires, however the 30-year easements will not start expiring until 2032.

Wildlife Habitat Incentives Program (WHIP)

The purpose of the WHIP program is to create high quality wildlife habitats. Special priority is given to projects that support wildlife species of Federal, state, local, or tribal importance.

All types of land are eligible, however this program is not primarily a land idling program, since very little cropland is directly impacted by WHIP projects.

The major impact of the program is the creation of habitat for species of importance in each state. The majority of projects have been involved with improving upland wildlife habitats. It is not expected that CSP funds will be used in addition to WHIP funds on the same acreage.

Farm and Ranchland Protection Program (FPP)

The intent of the FPP is to help farmers keep their land in agricultural production. The program achieves this aim by purchasing conservation easements that essentially buy up development rights from the landowners. The landowners also agree to implement a conservation plan for any highly erodible land contained in the easement area. Landowners needing assistance to address specific practice needs and maintain conservation on these lands could potentially use CSP.

Eligible lands are currently part of a farm or ranch that is large enough to be a viable agricultural enterprise, include prime, unique, or other productive soil, and be under threat of development for non-agricultural uses.

This program not only retains farmland in agricultural uses, but also maintains green space in areas subject to development pressures.

Grassland Reserve Program (GRP)

The GRP is a new program authorized under the Farm Bill. NRCS and FSA will be responsible for administering the program, in cooperation with the USDA Forest Service. However, final rules have not been determined. The information provided here regarding GRP should be considered preliminary and subject to change. The information is current and is the best available at this time.

The GRP is targeted towards protecting grassland and shrub land under threat of conversion to other uses. Landowners may enroll in permanent or 30-year (or the maximum allowed under state law if different) easements or the landowner may enroll in a rental agreement for 10, 15, 20, or 30 years. With a permanent easement, the landowner is offered the appraised value of the land, less the grazing value. Thirty-year easements, or the maximum allowed under state law, receive 30 percent of the appraised value, less the grazing value. The rental agreements receive up to 75 percent of the grazing value in an annual payment for the length of the contract.

The program does provide for the installation of conservation practices as needed, however the available funding is such that other programs may be looked to in order to fulfill any needs for additional conservation practices.

Eligible lands may be in any current land use, if the land was historically grassland, and capable of being restored to a grassland use. Grasslands may be grazed when enrolled in the program. As such, this is not primarily a land idling program.

While the GRP can fund any needed conservation practices under its existing authority, the funding for the program is somewhat limited. The easements to maintain lands in a grassland use may be relatively costly and control the bulk of the funds available to the program. Currently, it is predicted that there will be little interaction between the GRP and the CSP since both programs are in their infancy.

Forest Lands Enhancement Program (FLEP)

The U.S.D.A. Forest Service will administer FLEP. Landholders of private, non industrial forestlands are eligible to use FLEP to assist them in enhancing timber production in a sustainable manner and provide additional residual benefits to water quality and wildlife.

Primary practices included in the program are expected to be tree planting, site preparation, timber stand improvement, as well as forest riparian buffers and other practices suitable for providing resource benefits and improving overall forest health and resource management. Eligible practices may receive up to 75 percent cost share.

In order to receive cost sharing the landowner must have a forest management plan developed which is also eligible for cost share. The plan must at a minimum address the site enrolled in the program, but may treat additional acreage on the tract as well.

CSP is allowed on 'forested land that is an incidental part of an agricultural operation'. It is expected that CSP (the 2002 Farm Bill also allows EQIP to address private non-industrial forest lands) will have little or no overlap with the FLEP program. Most of the landholders with primarily forested tracts will tend to enroll in FLEP. Farmers and ranchers with a portion of their lands in forested uses will be more likely to enroll in CSP.

Many of the conservation programs contained in the new Farm Bill are essentially land idling programs. Included in this category are CRP/CREP, WRP, and to a lesser extent, WHIP. FPP, GRP, FLEP, and EQIP along with CSP are oriented towards working agricultural lands.

Analytical Model

As an entitlement program, eligible producers who want to participate in CSP must be enrolled. Thus, analysis of CSP benefits and costs begins with an estimate of program participation. A simulation model was developed to assess producer participation and the overall benefits and costs to society associated with that participation. The model is based on a series of composite farms[5], replicating the process of "penciling out" the CSP participation decision. It was assumed that producers will consider the benefits and costs of all CSP participation option available to them, and choose to participate or not based potential net return. Given farm-level estimates of participation, enrolled acreage, payments, and costs, the model calculates onsite and

[5] A "composite farm" incorporates regional average acreages for all three land types.

environmental (offsite) benefits, net economic costs, government costs, government to producer transfer payments, net benefit to society and the benefit-cost ratio.

Modeling Producer CSP Participation

It was assumed that the producer (1) participates in CSP if at least one participation option produces a positive net return and—if more than one option is produces a positive net return—(2) selects the participation option with the highest net return. Individual producers may have numerous participation options through the selection of Tier level, resource concern(s) to be addressed, enhancements (if any), contract length, and for a Tier I contract, the portion of the farm enrolled. For each participation option, the model is designed to replicate the producer's calculation of the costs and expected onsite (private) benefits of participation. For any given participation option, the producer's net return to participation is equal to the net present value (NPV) of:

CSP Payments + Expected Onsite Benefits – Conservation Costs

over the life of the CSP contract. Payments and costs occurring in the out years of the contract are discounted at a rate of 7 percent. For this initial version of the model, it was assumed that as long as the producer's net return is positive, they would participate in the program. Future model refinements will most likely include criteria that will make this assumption more stringent, as it assumes no consideration for potential producer cash flow constraints. Consideration may be made as to a threshold positive net return that may be needed in order for a participant to enroll.

The range of options available to producers and the net return to any given option depends largely on (1) USDA program design decisions—which determine the available payment—and (2) the characteristics of specific farms—which determines the producer's willingness to accept payments for taking prescribed conservation actions. Farm characteristics that are critical to determining the producer's willingness to accept payments and, therefore, the CSP participation decision, include:

- Farm size (acreage);
- Mix of land types (dry cropland, irrigated cropland, grazing land);
- Acres needing treatment for each resource concern;
- Acres already treated for each resource concern;
- Cost for installation, adoption, and maintenance of conservation practices.

Program design decisions, which are critical to the level of payment and costs incurred by producers include:

- The rate (i.e., land rental rate) underlying the base payment;
- Cost-share rates for installation, adoption, and maintenance of practices;
- The definition of enhancements and enhancement payment rates;
- Payment limitations;
- Resource concerns to be emphasized;
- Resource conservation standard to be met (e.g., non-degradation).

To facilitate development of the model and producers' participation options, the following assumptions about producer participation were made:

- Contracts will be for the maximum possible length: 5 years for Tier I and 10 years for Tiers II and III. Implicitly, it is assumed that producers will choose to lock in CSP payments for the longest possible period of time.
- Producers will enroll all of one land type (e.g., dry cropland) for a Tier I contract, while producers enrolled in Tiers II and III must enroll all land in all three land types. Because Tier I participants can enroll a proportion of their farms in CSP, varying the acreage included in the contract could produce a particularly wide range of participation options.
- Each farm will address up to 3 resource concerns. While six resource concerns were modeled, not every resource concern will exist on every farm.

Even with these assumptions, producers could still face a wide range of participation options in terms of Tier level and resource concerns to be addressed.

Composite Farms: Composite farms included in the model vary in terms of:

- Farm size (acreage) and the acreage of principal land types (dry cropland, irrigated cropland, and grazing land);
- The extent to which various resource concerns are present on the farm and the degree to which these resource concerns have already been addressed; and,
- The cost of installing/adopting and maintaining conservation practices.

These characteristics are used to define composite farms because of they help determine both the level of CSP payment available to producers and the producer's cost of participation.

A total of 30 composite farms are included in the model, five for each of six NRCS regions. Combining one cost level with the acreages from one region creates one composite farm. Thus, each region contains five composite farms which vary only by the conservation costs level. Each farm represents one-fifth of the farms within the region, so model results are extrapolated to regional or national totals by multiplying the farm-specific result by one-fifth the number of farms in the region.

This methodology allowed for the development of a working model within a limited timeframe. However, it also likely produces skewed results, such as an overestimation of producer participation, as well as producing results that makes it very profitable for producers to participate at a Tier 3 level. NRCS is in the process of refining these farms and intends to provide more reliable estimates prior to actual program implementation.

Farm Size and Acreage by Land Type. Farm size is an important determinant of the overall level of CSP payment, particularly the base payment, and the effect of payment limitations. Farm acreages are based on data from the 1997 Census of Agriculture. Acreages, by land type, are the same for all five farms within each NRCS region. Acreages are the region-wide average per farm for three basic land types: dry cropland, irrigated cropland, and grazing land. Thus, each model farm is a composite of farms located in the region.

Acres Previously Treated and Acres Needing Treatment. The extent to which resource concerns exist on farms and the extent to which they are treated are significant determinants of the cost of participating in various CSP tiers. A portion of the land in each composite farm is assumed to have been previously treated for one or more of the six resource concerns: soil erosion, water quality, water quantity, wind erosion (dust), grazing productivity, and wildlife. The extent of previously treated land is estimated using data from the 2002 NRCS agency Performance and

Results Measurement System (PRMS). Using PRMS, the frequency of conservation treatments applied that addresses resource concern components (i.e. ground water quality under water quality, soil quality under soil, etc.) at a non-degradation level by land type was summed for each of the six resource concerns by NRCS region. A conversion factor was then applied to the summed frequencies to represent percent treated acres by land type by resource concern by region. Having estimated the percentage of previously treated acreage for each composite farm, the remaining proportion of each type of land was assumed to require treatment for one or more of the six resource concerns. Applying these percentages to Census data and excluding CRP and WRP acreage, resulted in estimates of acreage previously treated and acreage needing conservation treatment by land type by resource concern by region.

Practice installation or adoption cost by resource concern. Cost is a key determinant of a producer's willingness to accept CSP payment in exchange for undertaking the conservation activities prescribed by CSP. In other words, cost is a key determinant of the level of conservation effort producers are willing to supply for various levels of payment. Five discrete levels of cost for each resource concern were specified.

Cost estimates were developed from the EQIP database. While EQIP is the best available source of data on practice installation and adoption costs, it does represent a self-selected group of producers who are likely to have relatively low conservation costs. Some producers, with relatively high conservation costs, may have elected not to apply for EQIP funding, given that bidding competition in the pre-2002 program reduced cost-share rates to an average of about 50 percent. Thus, estimates based on EQIP data may be biased downward, resulting in relatively low estimates of producer willingness to accept payment and relatively high estimates of producer participation. Because the total NRCS estimated cost is used, rather than the actual payment which is a function of the cost-share rate which was set by bid, therefore the downward bias is minimized.

The cost of addressing each of the six resource concerns are calculated from the costs of addressing the basic physical process that create the resource concerns. For example, addressing the soil resource concern requires farmers to address soil erosion. On a given farm, that may involve addressing water-caused erosion, wind erosion, or both. Likewise, addressing water quality concerns would involve addressing both water-caused erosion and nutrient loss to water.

Following the methodology developed in the *EQIP Benefit Cost Analysis, Final Report, May 9, 2003*, practices are bundled according to the physical processes they affect. Six basic processes were addressed: USLE (sheet and rill) erosion, wind erosion, non-waste nutrient management, irrigation water savings though more efficient irrigation practices, increases in grazing productivity, and wildlife habitat. Consistent with the EQIP analysis, all practice units were converted to acres using the same conversion factors developed for the EQIP analysis. Also consistent with EQIP, it is assumed that in order to reach the non-degradation level, on average, producers use 1.5 practices to address each physical process. Higher, or more intensive levels of treatment that may be applied to meet the 'intensive management activities' were addressed through a sensitivity analysis. More precise information regarding the level of resource attainment as a result of intensive activities is needed in order to provide further quantification of those benefits.

To estimate the cost of addressing each resource concern, the cost of addressing the physical processes that contributed to degradation of the resource are added up. To address the water quality resource concern, for example, producers must address USLE erosion, and chemical runoff (through nutrient and/or pest management). Thus, the cost of addressing the water quality concern is the sum of the cost of addressing USLE erosion and the cost of nutrient/pest management.

Addressing two or more resource concerns simultaneously will result in some cost savings if some practices address more than one concern. For a producer addressing both the soil quality and water quality concerns, for example, practices that address USLE erosion would address a large portion of both concerns. Thus, the overall cost of addressing both concerns is less than the sum of the costs of addressing the concerns individually. These savings were accounted for by calculating the cost of addressing concerns in combination where some practices can address more that one concern, making savings possible.

With the cost of addressing each resource concern (or combinations) defined, the next step is to calculate a regional average cost per acre to address each resource concern. These regional-average costs are classified into five cost levels by grouping the county average costs for addressing each resource concern (or combinations) within each NRCS region into five groups with a roughly equal number of acres in each group. The acreage-weighted average for each group is the estimate for low, low-medium, etc. costs of addressing the resource concerns or combinations of resource concerns. To facilitate modeling of program alternatives, the cost estimates were split into components resulting from the application of structural and management practices, respectively.

Finally, practice maintenance costs are assumed to be a percentage of practice installation or adoption costs. This assumption is necessary because no data on maintenance costs is available. It is assumed that the annual cost of maintaining structural practices is 5 percent of installation cost. Management practices, on the other hand, typically have a one-year life (e.g., nutrient management must be applied every year). While initial adoption costs may be higher than the cost of continuing the practice in subsequent years, costs may continue to be a substantial portion of initial adoption cost. It is assumed that the annual cost of maintaining management practices is 50 percent of initial adoption cost.

CSP Payments. The model calculates the overall CSP payment by calculating each of several payment components separately: the base payment, cost-sharing for installation of new structural and adoption of new management practices; cost-sharing for maintenance of existing structural and management practices, and enhancement payments. The net present value (NPV) of each payment is determined by a payment rate per acre, the number acres to which the payment applies, contract years in which the payment is made (i.e., whether the payment is made on a one-time or annual basis), and the producer's discount rate. Payment rates are calculated on a per acre basis to facilitate model calculations, even for practices delineated in units other than acres. As noted above, for practices not delineated in acres, units are converted to acreage equivalents using conversion factors developed for the EQIP benefit-cost analysis. Table 2 provides an overview of the payment types, payment rates, acreages, and the frequency and timing of payments.

Base Payment. The base payment is calculated, by land type, as the base payment percentage multiplied by the "corresponding rate" and by the number of acres to which the base payment applied. The base payment percentage is 5 percent, 10 percent and 15 percent for Tier I, Tier II, and Tier III, respectively. The statute stipulates use of a corresponding rate that maintains regional equity. Region-wide average rental rates have been used to calculate base payments for the analyzed alternatives. Region-wide average rates were calculated from state-average rates reported by NASS (Table 3). The region-wide average rate is an acre-weighted average NASS-reported values for 2001. Base payment acreage is the acreage of cropland and grazing land included in the CSP contract. Acreage for dry cropland, irrigated cropland, and grazing land, by state, were obtained from the 1997 Census of Agriculture.

"Regional equity" is a key issue in the selection of the "corresponding rate" from which base payment is calculated. While this term is not defined in the statute, selection of the appropriate rate could have a large affect on the regional distribution of CSP payments. Differences in payments, in turn, could result in uneven income and wealth (land value) effects.

Using national average rental rates (by land type) to calculate base payments would produce nationally uniform Tier payments, but wide variation in per-farm payments. For 2001, the national average dry cropland rental rate was roughly $57 per acre, resulting in a Tier II payment of $5.70 per acre. In Illinois, where the average farm contains 372 acres of cropland, the Tier II payment to that average farm would be $2,120. In Montana, where farms include an average of 2,415 cropland acres, the average farm would be eligible for a Tier payment of $10,500 (the payment would be $13,765, except for the limitation on the Tier II payment).

Using more localized rental rates to calculate Tier payments (e.g., state average) would lead to a large variation in per acre payments, but smaller variation in per-farm payments. Based on state-average cropland rental rates, the Montana producer's Tier II payment would be $1.80 per acre per year (10 percent of $18 average per acre land rental), leading to a per-farm payment of $4,347 on 2,415 acres. The Illinois producer's Tier II payment would be $11.90 per acre per year (land rents for an average of $119), an annual payment of $4,426 on 372 acres.

A more localized rate is used for several reasons. First, it is more equitable on a per-farm basis. Farm size tends to be inversely related with the overall level of expected return per acre of land. Other farm programs reflect this general relationship. For example, commodity programs provide payments in relation to program yields, which are related to historical yields for the specific farm or region. Second, nationally uniform per acre base payments may lead to large transfer payments in areas where land rents are low. In Montana, for example, the $5.70 Tier II payment is nearly one-third of the $18 per acre average rental rate. The potential for capitalization of payments in both commodity and conservation programs is well documented (Barnard *et al*., Shoemaker).

Cost-Sharing for installation/adoption and maintenance. Practice installation and adoption cost-share payments are calculated as a percent of per-acre costs multiplied by the acreage on which practices and installed or adopted. It is assumed that practices are installed in the first year of the CSP contract. The statute provides for cost-share rates of up to 75 percent. CSP can also provide cost-sharing of up to 75 percent for annual practice maintenance costs. To reward good

stewards, only existing practices are eligible for maintenance payments beginning in the first contract year. Maintenance payments are made in each year of the contract.

Enhancement Payments. Enhancement payments could be extended to producers on the basis of 5 criteria specified in the statute. While data limitations prevent modeling of all 5 criteria, model allows producers to enhance contracts by addressing an additional resource concern. The annual enhancement payment is a percentage of the cost of installing or adopting practices needed to address the additional resource concern. If the annual enhancement payment is 10 percent of installation or adoption costs and the discount rate is 7 percent, the NPV of the stream of payments over the ten year life of a contract is about 70 percent of installation or adoption costs.

Payment Limitations. The statute specifies overall payment limitations by Tier: $20,000 for Tier I, $35,000 for Tier II, and $45,000 for Tier III. Base payments are also limited to no more than 25 percent of the overall payment limit for Tier I, and 30 percent of the overall payment limit for Tiers II and III. These percentages translate to base payment limits of $5,000 for Tier I, $10,500 for Tier II and $13,500 for Tier III. Once producer payments are calculated using the formulas defined above, payment levels are checked against the payment limitations and adjusted as necessary to stay within the payment limitations. Note, however, that conservation requirements and, therefore, conservation costs, are not adjusted.

Summary of CSP Model Assumptions

The overall model assumptions are highlighted below:

- *Producer's cash flow constraint.* As stated above, the model assumes that the producer (1) participates in CSP if at least one participation option produces a positive net return. If more than one option is produces a positive net return then the model; (2) selects the participation option with the highest net return. This assumption would likely overestimate the number of producers that would sign up for CSP (especially limited resource farmers), and would also tend to overestimate the tier producers would enroll in. Future model enhancements will attempt to address this bias.
- *Acres needing treatment.* It is assumed that producers would undertake limited conservation treatment without federal assistance. The extent of previously treated land is estimated using data from the 2002 NRCS agency Performance and Results Measurement System (PRMS). Using PRMS, the frequency of conservation treatments applied that addresses resource concern components (i.e. ground water quality under water quality, soil quality under soil, etc.) at a non-degradation level. Since CSP may require producers to treat acres above the non-degradation level, the expected amount of acres needing treatment may be a low estimate. Producers whose acres were previously treated in other programs may still enroll to receive maintenance payments, but if the acres previously treated do not meet the CSP standards, they may also receive installation payments as well.
- *Average number of practices per CSP contract.* To meet a non-degradation level of treatment, the model assumes that 1.5 practices would be used to address each physical process. This is consistent with the assumptions used in the *Environmental Quality Incentive Program Benefit Cost Analysis, Final Report, May 9, 2003.* If more stringent requirements are used in the program, more practices may be needed to be implemented to meet program criteria. This may increase the cost to producers to enroll in CSP, and may reduce participation as well as the tier producers choose.
- *Composite Farm Size and Acreage by Land Type*. Farm size is an important determinant of the overall level of CSP payment, particularly the base payment, and the effect of payment

limitations. Farm acreages are based on data from the 1997 Census of Agriculture. Acreages, by land type, are the same for all five farms within each NRCS region. Acreages are the region-wide average per farm for three basic land types: dry cropland, irrigated cropland, and grazing land. Thus, each model farm is a composite of farms located in the region. This may overestimate the total participation rate, as well as the tier that producers choose.

- *Lack of quantification of many non-market benefits*. Many benefits associated with the adoption of conservation practices cannot be quantified. These benefits are primarily off site, or environmental benefits. Exclusion of these benefits would likely not change participation and/or tier selection by producers.

Table 2 summarizes the expected effects of these assumptions upon the model:

Table 2. Summary of model assumptions and expected effects

Assumption	Likely Direction of Effect on Model Participation	Likely Direction on Effect of Tier Selection
Producer's cash flow constraint	-	-
Acres needing treatment	+	+
Average number of practices per CSP contract	+	+
Composite farm definition	+	+
Excluding non-market benefits	**0**	**0**

Benefits of CSP

For purposes of this analysis, it is assumed that CSP's minimum level of treatment would be at the non-degradation level. This would be consistent with the methodology used to derive benefits in the *Environmental Quality Incentive Program Benefit Cost Analysis, Final Report, May 9, 2003.* However, in order to facilitate estimating participation rates within the model, the benefits derived in EQIP were further categorized into onsite and environmental (offsite) benefits. For purposes of this analysis, it is assumed that the producer would recognize a portion of the onsite benefits when considering his/her program options. The remaining portion of the on-site benefits are assumed to be either not a consideration to the producer, or overshadowed by risk and uncertainty that the producer may associate with the adoption of new, unknown practices. Installation/adoption benefits are summarized in Table 3.

For previously treated acreage, benefits were reduced in proportion to the remaining practice life and expected benefit stream over time, assuming that cost sharing for practice maintenance would ensure sustained beneficial effects throughout the contract life. Distribution of benefits over time for practices was adopted from the *Environmental Quality Incentive Program Benefit Cost Analysis, Final Report, May 9, 2003.* This distribution process applied to all previously treated acreage. Therefore, sustained beneficial effects were not considered to be constant for the life of the CSP contract. However, practice maintenance was assumed to ensure beneficial effects as proportioned by the remaining life of the practices.

CSP may make payments for the maintenance of existing conservation practices. This is to ensure that the existing practices provide the maximum environmental benefits throughout the contract period. Consistent the methodology developed in the *EQIP Benefit Cost Analysis, Final Report, May 9, 2003*, each practice has a different expected life and stream of benefits, and a weighted averages of expected practice life for each bundle of conservation practices was calculated.

For purposes of this analysis, it is assumed that maintenance payments would extend the effectiveness of the practices in the CSP contract. Therefore, although existing practice benefits were not credited towards CSP, the difference between the practice's normal expected effectiveness and full effectiveness that would be assumed to be required for a maintenance payment were accounted for through CSP. This analysis did not account for benefits that would undoubtedly occur beyond the life of the CSP contract.

Following is a brief description of benefits per unit, onsite and environmental. For a more detailed description of benefits, see *EQIP Benefit Cost Analysis Final Report, May 9, 2003*.

Expected Onsite Benefits. In addressing some resource concerns, producers may also generate benefits that accrue onsite. The value of these onsite benefits can be captured by the producer and may be considered in the CSP participation decisions. The EQIP benefit-cost analysis identifies several sources of onsite benefit. These include:

- *Soil Erosion Reduction:* Determining the estimated benefit for the USLE reductions required interpretation of available literature. Studies by Feather et. al (1999) and Claassen et. al (2001) were used to develop water induced erosion control benefit estimates for this assessment. Those studies were based primarily on the erosion control benefits obtained from the Conservation Reserve Program (CRP) and Conservation Compliance (CC). The CRP removed land from agricultural production for a period of 10 years and protected it with a vegetative conservation cover while the CC required that farmers receiving government benefits reduce the soil erosion rates on Highly Erodible land that they were continuing to crop, though not necessarily to the erosion loss tolerance (T) level. Note that these benefit studies included only a partial estimate of the variety of possible program benefits; therefore this analysis remains an underestimate of the total benefits available from erosion reduction. Each program enrolled different land with different inherent erodibility. In the early CRP years, erosion reduction was the primary goal, while in later years more weight was given to wildlife and other environmental considerations

  Feather et al. (1999) were concerned with optimal targeting for CRP enrollments for generation of environmental benefits. They followed a three-step methodology:

  1. CRP acreage creates physical effects;
  2. Physical effects translate into biological effects; and
  3. Biological results affect consumer welfare.

  Feather et. al's benefits were mostly accounted for by the following three components, all calculated for a 10-year program, NPV at 4 percent discount rate:

1. Public works cost reduction for sediment based on a 45 million acre CRP with soil erosion reductions of 750 million tons per year, $3029 million;
2. Air quality, $548 million; and
3. Recreation, $8,676 million, estimated partially based on CRP enrollments of 45 million and 34 million acres, depending upon the type of recreation benefit derived.

Of those three categories of benefits, the first and the third were added together ($3,029 plus $8,676 equals $11,705, all in millions). Air quality benefits of soil erosion reduction were accounted for in a different CSP benefit category. The $11,705 million benefit NPV was then converted to an equivalent 10-year stream of benefits with a 7% discount factor (divide $11,705 by the composite 10 yr discount factor of 7.515 from Table 2), resulting in annual benefits of $1,558 million. The annual benefits were then divided by tons (750 million) and acres (45 million) to arrive at an annual per-ton value of $2.08 and an annual per-acre value of $34.74 (Table 1).

In a study of alternative ways of providing incentives to farmers for environmental improvements, Claassen et al. (2001) estimated benefits for both the CRP and for Conservation Compliance. For CRP they found 406 million tons of erosion reduction annually, but this they explained was likely an underestimate for several reasons. If the mid-point of the range of 30 to 36 million acres enrolled since program inception is used, 33 million acres, the per-acre reduction is 12.3 tons per acre. The estimate of erosion reduction in the Feather study was higher since it was based on original program estimates when enrollment priority was given to erosion reductions. Claassen reported benefits of $694 million per year for reduced soil erosion and $704 million per year for improved wildlife habitat. The total of $1,398 million annual benefits is equivalent to $3.44 per ton of rate reduction, or $42.31 per acre (see Table 1).

Claassen et al. (2001) also estimated a partial estimate of the economic benefits due to Conservation Compliance. The estimate was said to be partial, not only because of not counting all the benefits, but also a likely underestimate of the acres treated due to Conservation Compliance requirements. The estimated soil erosion reduction on HEL lands was 323 million tons per year. There were 91 million acres with approved CC plans, for a rate reduction of 3.5 tons per acre per year. The estimate of annual non-market benefits for that soil erosion reduction was $1,400 million, or $4.33 per ton and $15.16 per acre.
For on site productivity losses, two major components were included. First, the loss in productive value as the topsoil is eroded away. Secondly, the value of the lost nitrogen and phosphorus fertilizer carried away with the topsoil. In the ERS Agricultural Resource and Environmental Indicators (AREI, 1997) publication a methodology for valuing productivity losses from erosion is given. In general terms, that method assumes linear productivity decreases as the topsoil layer of is eroded away. For instance, a typical plow layer 7 inches deep weighs 1000 tons and so a topsoil layer of 10.5 inches deep weighs 1500 tons. If annual rent from the land is $150 per acre, then the annual value of each ton of soil is ($150/1500) or $0.10 per ton. Obviously, there are two main problems with this argument: 1) the decrease in productivity value from the loss of the first ton to the loss of the last ton is obviously not linear (Benson et al, 1989); and 2) both product and input prices would be expected to change as the soil was lost on some proportion of total acres. Calculations like this would be

very site specific, varying tremendously across the U.S. according to soil, climate, management, etc. For this assessment, the $0.10 per ton per year estimate was used. As a supporting argument for this small value to the productivity loss, a comprehensive RCA in 1987 found that if the then current farming practices were to continue for 100 years, the loss in productivity due to erosion would be approximately 3 percent (USDA, 1989).
That RCA study also estimated the value of fertilizer nutrients lost with erosion. Some more general assumptions based on data from Miller et al. (1998) were made. On average topsoil consists of two percent organic matter, or 1.16 percent carbon. That organic matter would have, on average, a carbon nitrogen ratio of 10 to 1. Consequently, each ton of soil that is eroded contains 2.32 pounds of nitrogen that the farmer would need to replace. The soil also contains 0.05 percent phosphorus, or 1 pound per ton of soil. With phosphorus and nitrogen prices of $0.25 and $0.15 per pound, the lost nutrients in each ton of soil erosion are valued at $0.60.

Analyses of historical EQIP data indicate USLE reductions of 8.6 tons per acre per year can be attributed to the program. This estimate results in a large Benefit/Cost ratio, but it is assumed that EQIP funds would be targeted to situations where the largest erosion reductions would occur. Analysis of National Resource Inventory (NRI) data and EQIP data indicate that in the period since 1992, several million acres of farmed cropland have had USLE reductions exceeding 10 tons per acre per year. Analysis of the 1997 NRI in appendix 2 shows that the new program can easily maintain that 8.6 tons per acre though the life of the farm bill.

With the data from the two studies and other assumptions summarized here, the per-acre benefit estimate for USLE reductions is calculated as shown in Table 1. The results in per-acre annual benefits are $0.86 for saved soil productivity, $5.16 from reduced loss of nutrients, and $36.98 from improved water quality, for a total of $43.00.

Table 3. Estimate of per-ton benefits from reduced sheet and rill erosion

Item	Annual Erosion Rate Reduction (tons/acre)	Annual Benefits ($/ton)	Annual Benefits ($/acre)
Offsite benefits:			
CRP, early program years	16.7	2.08	34.74
CRP, program average	12.3	3.44	42.31
Conservation Compliance	3.5	4.33	15.16
Used for this CSP analysis[a]	8.6	4.30	36.98
On-site benefits:			
Soil productivity	8.6	0.10	0.86
Nutrients saved	8.6	0.60	5.16
Used for this CSP analysis[a]	8.6	0.70	6.02

[a]Historical EQIP data for 2001 showed a reduction from 11.5 to 2.9 tons per acre per year on 371 thousand acres, where one state was excluded because its reduction was clearly a data error, with a rate of 50 times the average of other states.

For on site productivity losses, two major components were included: the loss in productive value as the topsoil that is eroded away and the value of the lost nitrogen and phosphorus fertilizer that is carried away with the topsoil. The results in per-acre annual benefits are $0.86 for saved soil productivity and $5.16 from reduced loss of nutrients, for a total of $6.02.

Even if soil conservation helps producers to retain nutrients, however, producers may be reluctant to reduce fertilizer application. Producers may be uncertain about the level of nutrient actually retained with soil particles. Moreover, the rate of soil erosion and associated nutrient loss will vary from year-to-year depending on weather conditions. Over a period of years, a significant portion of soil erosion can occur during a relatively few major rainfall events. It is assumed that producers consider 25 percent of the onsite benefit in calculating returns to CSP participation. Because producers addressing the soil concern will not necessarily be undertaking nutrient management as well, it can not be assumed that producers will actually achieve more fertilizer use reduction than they expect when signing up for CSP.

- *Nutrient Management:* Since most producers not using proper nutrient management techniques tend to over apply fertilizers, producer may realize cost savings through the reduction of purchased mineral fertilizer inputs. Crop yield loss will not occur if fertilizer usage already exceeds the minimum needed to produce the expected yield. Adoption of nutrient management practices could save U.S. producers an average of $6.70 per acre per year.

  In reality, however, producers may be uncertain about the yield effects of reducing fertilizer application, and may factor risk into fertilizer application decisions. Research shows that assumptions about the relationship between nutrient uptake and crop yields can significantly affect calculation of an optimal fertilizer application rate (Grimm *et. al.*, 1987; Larsen *et. al.*, 1996), possibly leading to over fertilization or lower than expected crop yields. Even if nutrient application could be reduced without reducing crop yields, producers may be unaware of the level of nutrient application as which yield would begin to decline. Year-to-year variation in growing conditions may also encourage over application of nutrients. Because crop nutrient needs are higher in years with good growing conditions, it may be profitable to use more fertilizer in anticipation of getting peak yields in particularly good years (Babcock, 1982; Dai *et. al.*, 1993). In short, producers may view over application of fertilizer as cheap insurance against yield loss in both average and peak years.

  Limited adoption of nutrient management practices tends to support the view that producers significantly discount potential cost savings. Use of annual soil tests and post-planting nutrient applications (split application) are modest (Padgett *et al*.). To the extent that risk aversion explains producer behavior, they may be reluctant to adopt nutrient management practices, even though cost savings from adoption would be realized. To account for these issues, it is assumed that producers' *a priori expected* benefit to application of nutrient management is 25 percent of the benefit defined above. Once nutrient management practices are adopted and outcomes are observed, however, producers will achieve full benefits of

fertilizer savings. Thus, 100 percent of onsite benefits were used in program benefits calculations.

- *Water Quantity:* Presumably, any water saved would be available for alternative uses such as by municipalities, utility generation, and wildlife habitat enhancement. Therefore, a possible value that could be assigned to the saved water is the price that competing uses would be willing to offer. Since those prices are not available, the saved water was valued conservatively at the average that the farmers have paid or expended to obtain the water. It is assumed that the farmers could achieve a net reduction in irrigation water used by any or all of the following three methods:
    - Convert from irrigation to dryland production;
    - Convert to a crop or land use requiring smaller applications of water; and
    - Maintain the same crop, but improve irrigation efficiency.

  The ERS AERI publication[6] reported 29.8 million acres irrigated with groundwater having acquisition cost of $32/acre foot and 15.1 million acres irrigated with off-farm surface water at $41/acre foot, including supply cost and variable cost. The weighted average value of the water is then $35.03. Updating for four years of inflation at 2% to update, from 1998 to 2002, results in an estimated cost of $37.91/acre foot. Given the 5.41 acre-inch savings per year and assuming a 20 percent loss in storage and transmission, this results in an annual per-acre benefit of $13.68. It is assumed that producers will understand and expect the full benefit of water savings. Thus, it is assumed that 100 percent of the benefit is included in the producer's participation calculation and the program benefit calculations.

- *Grazing Productivity:* Namken and Flanagan[7] report estimates of current forage production for various types of pasture and range land. An acre-weighted average of forage yield is 910 lbs. per acre. It is assumed that conservation treatment for grazing productivity will increase forage yields by 20 percent. Assuming that one animal unit month (AUM) requires 740 lbs. per acre of forage, treatment increases grazing land carrying capacity by .25 AUM. At a rate of $11.01 per AUM, the benefit per acre is $2.73. Adjusting for inflation, a benefit of $2.84 per acre was used. It is assumed that producers will understand and expect the full benefit of enhancements to grazing productivity. Thus, it is assumed that 100 percent of the benefit is included in the producer's participation calculation and the program benefit calculations.

Expected Offsite Benefits. Consistent with the EQIP analysis, the resource concerns addressed in this analysis are limited by the availability of reliable estimates of the benefits that accrue to the application of conservation practices. Benefits are obtained from the installation/adoption of practices or from the maintenance of practices beyond what would typically be assumed without maintenance payments. Benefits as the result of CSP participation are expressed as either onsite (those that accrue to the producer) or environmental (those that accrue to society). Since CSP is a voluntary program, the model estimates the value of benefits that do not affect program

[6] Economic Research Service. 2002. Agricultural Resources Environmental Indicators, 2000. U.S.D.A. Economic Research Service.
[7] Namken, Jerry C., and Mitch L. Flanagan. 2000. "Conservation of Private Grazing Lands Program: Benefit-Cost Analysis." Staff Report, U.S. Dept. Agriculture, Natural Resources Conservation Service

participation, as well as the value of benefits that the producer would gain (thus affecting participation) through adoption/installation and maintenance of conservation treatment.

Because of the similarities between CSP and the EQIP, benefits per unit are assumed to be consistent with EQIP. However, in order to facilitate estimating participation rates, the benefits were categorized as being onsite or offsite (environmental). For purposes of this analysis, it is assumed that the producer would recognize half of the onsite benefits when considering his/her program options. The other half of the benefits are assumed to be either not a consideration to the producer, or overshadowed by risk and uncertainty that the producer may associate with the adoption of new, unknown practices. Installation/adoption benefits are summarized in Table 2. For previously treated acreage, benefits were reduced in proportion to the remaining practice life and expected benefit stream over time, assuming that cost sharing for practice maintenance would ensure sustained beneficial effects throughout the contract life. Following is a brief description of benefits per unit, onsite and environmental. For a more detailed description of benefits, see *EQIP Benefit Cost Analysis Final Report, May 9, 2003*.

Onsite benefits are discussed in detail above. In some cases, producers will realize more benefit than they expect *a priori*. For example, producers may be uncertain about net gains to nutrient management, but could realize cost savings without diminished yields. It is assumed that full onsite benefits accrue to producers even if these benefits are not expected by producers.

Environmental (Offsite) benefits are not captured by the producer, but accrue to society at large. These benefits include:

- *Water Quality:* Water quality benefits, as discussed in the onsite benefit section of this document, were estimated based on water induced erosion reduction. The public gains when soil erosion is decreased. Reductions in sheet and rill erosion have improved surface-water quality, which increases the public's enjoyment of water-based recreation and decreases the costs to municipalities, industry, and other public and private sectors. The results in per-acre annual benefits from improved water quality are $36.98 (Tables 1 and 2).

- *Wind Erosion - Dust:* The key element in the air quality benefits analysis is the estimate by Ribaudo and others (1989) that the CRP program provided a U.S. average of $25 per acre in NPV of benefits due to reduced soil erosion (improved air quality). The estimates ranged from $0 in the Appalachia, Corn Belt, Delta States, and Lake States, up to $52 in the Mountain states. The Ribaudo study included the effects of “particulate-related costs imposed on those who live or work downwind from blowing soil. Such costs include increased cleaning and maintenance for businesses and households, damages to nonfarm machinery, and adverse health effects” (Ribaudo et al., p. 422). For the EQIP program assessment, it was assumed that where applied, the practices listed in Table 10 provide the same level of benefits to air quality (same levels of erosion control and reduction in offsite damages) as did the CRP. The $25 per acre value from Ribaudo et al. is updated with data from the consumer price index for the years of 1988 to 2001. During that period the index increased from 118.3 to 177.1 (a 1982-84 average base), for a percent increase of 49.7. Therefore, the per-acre NPV is $37.43. However, to insert this in the worksheet using the same methodology as for the other categories of benefits, that NPV value of $37.43 was

analyzed assuming a 10-year horizon at a 7.0 percent discount rate, which resulted in $37.43/7.515 or $4.98 per acre per year (Table 2).

- *Animal - Wildlife:* Because of its similarity to EQIP, CSP will address erosion and water quality environmental concerns in areas where significant natural resource problems exist. However, applied practices will have a direct impact on wildlife as the conservation practices often provide or enhance important habitat. The program will also provide opportunities for direct assistance with wildlife habitat management and wetland habitat management. Fish and wildlife benefits will accrue based on the types of practices installed with CSP. For the purpose of this analysis, benefits are calculated based on results from an ERS study described in Feather, et al. Benefits are based on *use values*, or the value derived from directly using the resource. The annual benefits for improved wildlife habitat are based on ERS studies of the CRP program (Feather et al., 1999) and include two components: improved wildlife viewing ($10.02) per acre and improved pheasant hunting ($2.36) per acre. These benefit estimates are reduced by 50 percent to account for factors such as: expected lower per-acre benefits on "working" lands versus retired lands, different spatial proximity of CSP lands than CRP lands, shorter contract length, etc. The result is a per acre benefit of $6.19 (Table 2.).

  Other recreational activities not covered include nature walking and big game hunting. In addition, *nonuse values* are not quantified, or values given to the existence of an environmental resource even though it is not currently used, such as existence value bequest value, or option value (Smith, 1996).

Table 4 summarizes the Onsite and Offsite (Environmental) Benefits used in this analysis.

Table 4. CSP Onsite and Environmental Benefits

Resource Concern	Offsite	Onsite	Source of Benefits
	$/Acre/Year		
Soil Erosion		6.02	Soil productivity and fertilizer savings
Water Quality	36.98	6.70	Reduced sediment and nutrient loads to water and fertilizer savings
Water Quantity		13.68	Irrigation water savings
Wind Erosion (Dust)	4.98		Reduced clean-up and health costs of dust
Animal: Grazing productivity		2.83	Enhanced grazing productivity
Animal: Wildlife	6.19		Improved wildlife viewing/pheasant hunting

Costs of CSP

Two cost figures are of particular interest. First, **government cost** includes all government expenditures relating directly to a specific CSP contract. These include:

- financial assistance to the producer including base payments, cost sharing, and enhancement payments; and,
- technical assistance costs.

Government expenditure for CSP is limited to $3.78 billion for the period 2003-2013.

The second cost item of interest is the **net economic cost** to society. Net economic costs include:

- total practice implementation costs (cost-share and producer cost);
- total practice maintenance costs; and
- technical assistance cost.

Producer payments that exceed the total cost of practice installation/adoption and maintenance are transfer payments and are not included in net economic cost. Transfer payments are a cost to society but a benefit to CSP participants and, therefore, are neither a net cost nor net benefit to the economy at large.

Resource Conservation Standard – Intensive Management Activities. CSP participation will require that producers meet "intensive management activities" that exceeds the resource non-degradation standard, as defined in the NRCS Field Office Technical Guide (FOTG). Previous programs, such as EQIP, have required only that producers meet a non-degradation standard. Rather than simply protect resources from further degradation, intensive management activities would enhance resource quality. Thus, costs and benefits outline above—which are based in large part on experience with programs like EQIP—will not capture the full costs and benefits of the new standard.

Since the intensive management activities have not yet been identified, there is no data with which to calculate the costs and benefits of achieving it. In the absence of data, sensitivity analysis is used to identify a reasonable range of the additional costs that would be incurred for a given increase in benefits that may be obtained by addressing a resource concern through intensive management activities. The analysis does not imply that a specific level of benefits would be achieved from achieving the higher standard. It is designed only to provide a reasonable range of costs, given an assumed level of additional benefits from applying intensive management activities.

It is assumed that achieving additional benefits will entail additional cost. It is also assumed that cost is increasing. In other words, each additional unit of benefit is obtained at a cost that is as much or more than the cost of the previous unit of benefit. Our increasing cost assumption is justified because the effectiveness of individual conservation practices tends to diminish as the number of practices installed to address a particular resource concern is increased. The cost of practice installation or adoption, however, would not be diminished. Moreover, NRCS field staff are directed to encourage installation or adoption of the most cost-effective practices first, indicating that the new benefit will decline as additional practices are installed.

It is assumed that a one percent increase in benefits increases the cost of practice installation and maintenance by between 1 percent (lower bound) and 2 percent (upper bound). As the increase in benefits becomes larger, the upper bound is increases relative to the increase in benefits. For a 10 percent increase in benefits, the cost increase is bounded by 10 percent and 21 percent, or an average of 2.1 percent increase in const per one percent increase in benefits. Further details on the sensitivity analysis can be found in Appendix 2.

Financial Assistance. Farm-level financial assistance costs are discussed in detail above. To obtain national aggregated, the results for each model farm are expanded by the number of farms represented, then summed over these products.

Practice Implementation and Maintenance Costs. Farm-level costs are also are discussed in detail above. To obtain national aggregated, the results for each model farm are expanded by the number of farms represented, then summed over these products.

Technical Assistance. Technical assistance costs for the CSP are based on data from the NRCS Integrated Accountability System, primarily the Workload Analysis (WLA) 2001. The WLA contains detailed estimates of the time necessary to complete conservation-related tasks at the field office level.

The CSP will require the following tasks for program implementation:

Task	**Weighted Average Hours**
Resource Assessment	3.14
Eligibility determination	2.44
Planning	20.02
Application	22.34
1st Year Contract Administration	8.32
Long Term Contract Administration	4.88

Eligibility determinations, planning and first year contract administration will take place in the first year. Application of conservation practices or measures and long term contract administration will take place over the contract life. Determining program eligibility involves all application ranking and scoring procedures. Planning is the process through which NRCS employees work with landowners to develop conservation plans that meet landowners' conservation objectives. Application involves any time spent ensuring that scheduled practices are implemented as planned. Contract administration tasks, both first year and long term, include processing contract documents, and working with landowners to acquire signatures and make changes or modifications if necessary.

The total time to complete basic tasks per contract is multiplied by expected participation generated by the economic cost-benefit model. Tier I participation is assumed to be a five year contract on average, and Tiers II and III assume a ten year contract life. The average staff year cost is based on an estimate from the NRCS Budget Planning and Analysis Division, and is expressed in current dollars.

It should be noted that the per-contract estimate contains time for a resource assessment task. This task was included as time spent by agency personnel to determine what Tier a producer qualifies for. Agency leadership has determined that producers will identify the Tier in which they will participate based on the criteria, and therefore will assess their own baseline condition. This time will be deleted from contract estimates for analysis of the final rule.

Program Net Benefits and Benefit-Cost Ratios

Program net benefit is the sum of all CSP-related benefits received by anyone within the economy less all CSP-related costs incurred by anyone in the economy. CSP-related benefits include:

- onsite and environmental benefits that accrue from practice installation, adoption, and maintenance; and,
- payments to producers.

CSP-related costs include:

- payments to producers
- the cost of practice installation, adoption, and maintenance; and,
- the cost of technical assistance provided to producers.

The net benefit of CSP to the overall economy is CSP-related benefits less CSP-related costs. Note that payments to producers cancel as they are a benefit to producers but a cost to taxpayers. Thus, transfer payments received by producers--payment above CSP-related conservation costs--also cancel out of the net benefit calculation.

The benefit-cost ratio is the ratio of total program benefits to total program costs. In this case, as transfer payments to producers rise, both the numerator and denominator also rise, driving the value of the benefit-cost ratio toward one.

Tables 5 and 6 highlight the regional rental rates by cropland type, and various payment assumptions used in the model. The Alternatives used in this analysis are discussed in detail in the next section of this document.

Table 5. Regional Rental Rates for Base Payment Calculation

Region	Dry Cropland	Irrigated Cropland	Grazing Land
Midwest	93.45	0.00	25.80
Northeast	40.36	0.00	15.77
Northern Plains	38.48	96.99	8.37
South Central	29.65	64.48	7.54
Southeast	49.98	86.31	17.73
West	60.12	205.61	5.45

[1] Regional average rent for grazing land is obtained directly from USDA-NASS: 2001. Agricultural Cash Rents: 2001 Summary. Sp Sy 3 (01), July 2001. Regional averages for irrigated and non-irrigated cropland are calculated as an acre weighted average of state average rental rates reported in Agricultural Cash Rents: 2001 Summary. Acre weights are harvested cropland acreage for dryland and irrigated farms, by state, obtained from the 1997 Agriculture Census.

Table 6. Description of Payments and Payment Options in CSP Model

	Payment Rates	Payment Acreage	Frequency/Timing of Payment
Base Payment	Based on regional average land rental rates, by land type; 5, 10, 15% of rental rate for Tiers I, II, III, respectively. All alternatives[1] **except** Alternatives 3a and 3b assume that the base payment is calculated from 100% of the regional average land rental rates. Alternative 3a assumes the base payment is calculated from 50% of the regional average land rental rate, and Alternative 3b assumes the base payment is calculated from 10% of the regional average land rental rate.	Total for all land types enrolled	Annual
Maintenance of Structural Practices	% of maintenance practice costs; Cost is assumed to be 5% of practice installation cost for all alternatives	Previously treated acres only	Annual
Maintenance of management practices	% of maintenance practice costs; Cost is assumed to be 5% of practice adoption cost for all alternatives	Previously treated acres only	Annual
Installation of structural practices	% of practice installation cost. Alternative 1 assumes 75% cost share, the other alternatives assume limited cost share of 5%.	Acres with practices installed under CSP contract but not cost shared from another source	Paid in 1st year of contract
Installation of management Practices	% of practice adoption cost. Alternative 1 assumes 75% cost share, the other alternatives assume limited cost share of 5%.	Practices installed under CSP contract but not cost shared from another source	Paid in 1st year of contract
Enhancement	% of practice adoption cost. All alternatives **except** Alternative 3b assume that enhancement payment is calculated from 10% of the total cost of implementing the management practices that address the enhanced resource concern. Alternative 3b assumes that enhancement payment is calculated from 20% of the total cost of implementing the management practices that address the enhanced resource concern.	Acres Treated for the enhancement resource concern	Annual

[1] Alternatives used in this analysis are discussed in more detail in the next section of this document.

Discussion of Alternatives

The matrix shown in Table 6 identifies general issues for analysis and a range of methods for limiting the CSP to stay within budgetary constraints or ramp-up options. Questions raised in the Advanced Notice of Proposed Rulemaking (ANOPR) are the basis for the matrix and includes important decision points for NRCS that can be analyzed in different ways, given existing data resources. The identified alternatives include:

- The full CSP program as defined in Title II of the 2002 Farm Bill, with full and minimal cost share.
- The CSP program limited by tier with minimal cost share.
- The CSP program limit by resource concern with minimal cost share.
- The CSP program limited by geography with minimal cost share.

Since the full CSP program alternative indicated that cost share had little effect on participation rates, the remaining three alternatives were run assuming minimal cost share.

All alternatives calculate enhancement payment as ten percent of the adoption cost of management practices needed to treat the resource(s) of concern.

Alternative 1 - Full Program with Full Cost Share

For the full CSP program alternative, the full entitlement program, as outlined by Title II of the 2002 Farm Bill, was analyzed. The assumptions used in the model are as follows:

- 75 percent cost share for the implementation of new structural practices and maintenance of existing practices.
- 75 percent cost share for the implementation of new management practices and the annual management of existing management practices.
- The cost of maintenance of structural practices is calculated as 5 percent of the cost of implementing the structural practice(s).
- Enhanced payments are calculated as 10 percent of the total cost of implementing the management practices addressing the enhanced resource concern. This is an annual payment paid every year of the contract.
- Structural and management practices enrolled in CSP are NOT enrolled in other federal conservation programs, such as EQIP.
- The limitations as defined by the Statue are used in the model. More specifically, base payments are 5 percent, 10 percent, and 15 percent of the regional rental rate by land type for Tier I, Tier II, and Tier III, respectively. Total annual payment limits are set at $20,000 for Tier I, $35,000 for Tier II, and $45,000 for Tier III. Base payments may be no more than 25 percent of total annual payments, $5,000 for Tier I, and 30 percent of total annual payments for Tier II and Tier III, $10,500 and $13,500, respectively.

Alternative 2 (and Alternatives 2a, 2b, 2c) - Full Program with Limited Cost Share

The full program was then analyzed to determine the impact of minimizing cost share for the installation of structural practices, the maintenance of existing structural practices, and the operation of existing management practices. The assumptions for this alternative are as follows:

- 5 percent cost share for the implementation of new structural practices.
- 5 percent cost share for the maintenance of existing structural practices.
- 5 percent cost share for the adoption of new management practices.
- 5 percent cost share for the operation of existing management practices.
- Enhance payments are calculated as 10 percent of the total cost of implementing the management practices addressing the enhanced resource concern.
- The limitations as defined by the Statue are used in the model. More specifically, base payments are 5 percent, 10 percent, and 15 percent of the regional rental rate by land type for Tier I, Tier II, and Tier III, respectively. Total annual payment limits are set at $20,000 for Tier I, $35,000 for Tier II, and $45,000 for Tier III. Base payments may be no more than 25 percent of total annual payments, $5,000 for Tier I, and 30 percent of total annual payments for Tier II and Tier III, $10,500 and $13,500, respectively.

In addition, the effects of limiting to a tier level were analyzed, using the same assumptions as the full program with limited cost share. Alternative 2a constrains the model to Tier I participants only. Alternative 2b constrains the model to Tier II participants only, and Alternative 2c constrains the model to Tier III participants only.

Alternative 3(and Alternatives 3a and 3b) - Limiting By Resource Concern

There are various ways in which the CSP could be targeted. The proposed rule emphasizes soil and water quality as significant resource concerns; therefore this alternative analyzes limiting participation to those producers that will treat those resource concerns. Since the model requires treating three resource concerns, wildlife was chosen as the third resource concern since it is not as affected by regional biases as the other remaining resource concerns could be.

For limiting by resource concern, the model analyzes the impact of choosing soil quality, water quality, and/or wildlife as the primary resource concerns for all Tiers. Limited cost share for the installation of structural practices, the maintenance of existing structural practices, and the operation of existing management practices is also included in the model. The assumptions used in the model are as follows:

- Soil quality, water quality, and/or wildlife are the primary resource concerns addressed in the model.
- 5 percent cost share for the implementation of new structural practices.
- 5 percent cost share for the maintenance of existing structural practices.
- 5 percent cost share for the adoption of new management practices.
- 5 percent cost share for the operation of existing management practices.
- Enhance payments are calculated as 10 percent of the total cost of implementing the management practices that address the enhanced resource concern.

- The limitations as defined by the Statue are used in the model. More specifically, base payments are 5 percent, 10 percent, and 15 percent of the Regional rental rate by land type for Tier I, Tier II, and Tier III, respectively. Total annual payment limits are set at $20,000 for Tier I, $35,000 for Tier II, and $45,000 for Tier III. Base payments may be no more than 25 percent of total annual payments, $5,000, for Tier I and 30 percent of total annual payments for Tier II and Tier III, $10,500 and $13,500, respectively.

Two additional sub-alternatives were analyzed using this alternative's basic assumptions. These scenarios attempt to determine participation based upon the assumption of limited budget constraints, and to illustrate the relationship between payments and program benefits and costs. The first sub-alternative (Alternative 3a), in addition to the above assumptions, assumes:

- The base payment uses 50 percent of the regional rental rate as the basis for calculation, which effectively cuts the base payment in half.

The second sub-alternative (Alternative 3b) addresses the issue of high base payments relative to the rest of the payments. It further reduces the impact of the base payment, hence the impact of land rental rates on the total payments, while increasing the impact of the enhancement payment, hence the impact of conservation costs on the total payments. For this sub-alternative, the above assumptions hold true, except:

- The base payment uses 10 percent of the regional rental rate as the basis for calculation
- Enhance payments are calculated as 20 percent of the total cost of implementing the management practices that address the enhanced resource concern.

Alternative 4 - Limiting By Geographical Area

This alternative explores the effect of limiting the program by geography for all Tiers. Based upon census data, an average county for each region was developed. The impact of limiting cost share for the installation of structural practices, the maintenance of existing structural practices, and the operation of existing management practices was analyzed on an average county in each region. The assumptions used to model this alternative are as follows:

- All resource concerns were addressed in the model.
- 5 percent cost share for the implementation of new structural practices.
- 5 percent cost share for the maintenance of existing structural practices.
- 5 percent cost share for the adoption of new management practices.
- 5 percent cost share for the operation of existing management practices.
- Enhance payments are calculated as 10 percent of the total cost of implementing the management practices that address the enhanced resource concern.
- The limitations as defined by the Statue are used in the model. More specifically, base payments are 5 percent, 10 percent, and 15 percent of the Regional rental rate by land type for Tier I, Tier II, and Tier III, respectively. Total annual payment limits are set at $20,000 for Tier I, $35,000 for Tier II, and $45,000 for Tier III. Base payments may be no more than 25 percent of total annual payments, $5,000, for Tier I and 30 percent of total annual payments for Tier II and Tier III, $10,500 and $13,500, respectively.

Table 7 outlines each alternative's parameters, highlighting which parameter changes within each alternative.

Table 7. Alternatives and Parameter Assumptions

	Tier Level	Resource Concern	Basis for Base Payment Calculation [1]	Cost Share for Installation of Structural Practices	Cost Share for Adoption of Management Practices	Cost Share for Maintenance of Existing Structural Practices[2]	Cost Share for Operations of Existing Management Practices[3]	Enhancement Payment Calculations
Alternative 1: Full Program	All Tiers	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	***75% of Total Installation Cost for Structural Practices***	***75% of Total Adoption Cost for Management Practices***	***75% of Total Cost of Maintenance for Existing Structural Practices***	***75% of Total Operation Cost for Existing Management Practices***	10% of the Total Cost of Implementing Management Practices
Alternative 2: Full Program with Limited Cost Share	All Tiers	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices
Alternative 2a	***Tier I only***	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices
Alternative 2b	***Tier II only***	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices
Alternative 2c	***Tier III only***	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices

[1] The base payment calculation is what is used to calculate each tier payment. Therefore, 5% of this result is the applicable annual payment for land covered in a Tier I contract, 10% of this result is the applicable annual payment for land covered in a Tier II contract, and 15% of this result is the applicable annual payment for land covered in a Tier III contract.

[2] The cost of maintaining a structural practice is calculated as 50% of the cost of implementing the practice.

[3] The cost of operating (maintaining) a management practice is calculated as 5% of unit cost of adopting the management practice.

	Tier Level	Resource Concern	Basis for Base Payment Calculation [1]	Cost Share for Installation of Structural Practices	Cost Share for Adoption of Management Practices	Cost Share for Maintenance of Existing Structural Practices[2]	Cost Share for Operations of Existing Management Practices[3]	Enhancement Payment Calculations
Alternative 3: Limit by Resource Concern	All Tiers	***Soil Quality, Water Quality and Wildlife (as enhancement)***	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices
Alternative 3a: Alternative 3 with Limited Base Payment Calculation	All Tiers	***Soil Quality, Water Quality and Wildlife (as enhancement)***	***Base Calculation: 50% of Regional Rental Rate***	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices
Alternative 3b: Alternative 3 with Limited Base Payment and Increased Enhancement Payment Calculations	All Tiers	***Soil Quality, Water Quality and Wildlife (as enhancement)***	***Base Calculation: 10% of Regional Rental Rate***	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	***20% of the Total Cost of Implementing Management Practices***
Alternative 4: Limit by Geography **(County)**	All Tiers	All Resource Concerns	Base Calculation: 100% of Regional Rental Rate	5% of Total Installation Cost for Structural Practices	5% of Total Adoption Cost for Management Practices	5% of Total Cost of Maintenance for Existing Structural Practices	5% of Total Operation Cost for Existing Management Practices	10% of the Total Cost of Implementing Management Practices

Results

The following section summarizes the results each of four alternatives and five sub-alternatives. Analysis of two additional program scenarios is included as Appendix 1. First, each alternative is discussed individually. Next, we look across alternatives to compare them in terms of government costs, participation, payments to producers, and net benefits. Finally, we discuss realistic options for constraining the program to meet the 10-year budget limit of $3.8 billion and ways to adjust program parameters to obtain the largest possible net environmental benefit for that level of funding.

Alternative 1 - Full Program

The full CSP program, as outlined in Title II of the 2002 Farm Bill (Alternative 1), could provide payments large enough to make CSP participation profitable for all producers. Model estimates for Alternative 1 show producers participating at a Tier II (17%) or a Tier III (83%) level. In terms of eligible acreage, 32 percent would be enrolled in Tier II contracts and 68 percent in Tier III contracts.

Payments to producers average $31,400, or $70 per acre (NPV over 10 years). Total onsite benefit of $21 per acre, on average, also accrues to producers, resulting in an average total gross return to CSP participation of $92 per acre. Note that more than one-half of all acres enrolled are grazing land and other 6 percent are irrigated cropland. For cropland acres, the average contract value per acre would be significantly higher. Average producer conservation costs are $39 per acre, yielding a net return to producers of $53 per acre and a transfer payment of $32 per acre (NPV over the life of the contract). Thus, the average producer's **net** return ($53) is larger than their conservation investment ($38)—a substantial rate of return on their investment. Note, once again, that these figures are averages over both grazing land and cropland.

The net present value of government cost is estimated to be $70 billion over 10 years: $60 billion in payments to producers and roughly $10 billion for technical assistance costs. Total environmental and onsite benefits are estimated at $104 billion, of which 75 percent are offsite benefits. Net economic costs[12] are approximately $42 billion, yielding a net benefit of $62 billion. The benefit-cost ratio is 1.5:1.0. Total transfer payments to the producer are estimated to be $28 billion.

The high participation rate is driven by the size of the payments relative to conservation costs. The average per acre payment of $70 breaks down to $39 for base payment, $20 for installation cost share, $4 for maintenance, and $7 for enhancements. While the practice installation cost share seem low (average per acre conservation costs are $38), bear in mind that these averages are taken over *all* acres in the CSP contract, not just those acres on which new practices are actually installed. Moreover, only a modest proportion of CSP acres would be treated using structural practices, which tend to be much more expensive than management practices. The contract average maintenance payment is also somewhat lower than would be received for those acres where existing practices are, in fact, maintained. The base payment, on the other hand, is

[12] Net Economic Cost is the cost of installation, maintenance and technical assistance (total enrollment cost and TA). This is the cost to society at large.

paid on every acre including acres where existing conservation practices are maintained—a far less expensive enterprise than installing or adopting new practices.

Given the structure of the model, producers choose not to participate in Tier I. Although producers may find Tier I profitable, the model dictates that in this alternative, producers would not choose Tier I because Tier II or Tier III contracts are more profitable. Tier I base payments are significantly smaller than either Tier II or Tier III base payments. Also, Tier I contracts are assumed to require that producers take some action beyond maintaining previously installed or adopted conservation practices. Thus, producer participation costs, on a per-acre basis, could be similar in Tiers I and II.

Base payments are critical to program participation decisions, accounting for 57 percent of all payments in alternative 1. In terms of the base payment, annual Tier II and III payments are larger than Tier I payments and are paid over a 10 year contract, rather than a 5 year contract, sharply increasing the net present value of the base payment. For example, a land rental rate of $50 per acre translates to a net present value of $10.25 per acre for a Tier I contract, but $35 per acre and $52.50 per acre for Tier II and Tier III contracts, respectively.

Moreover, Tier I contracts are assumed to require that producers address: (1) at least one resource concern on all of one land type (e.g. non-irrigated cropland); and (2) one additional resource concern as a contract enhancement. Thus, Tier I contracts can entail per-acre costs that are similar, on a per-acre basis to Tier II.

Alternatives 2, 2a, 2b, and 2c - Limited Cost-Share

Alternative 2 is similar to Alternative 1 except that cost share is limited to 5 percent instead of 75 percent. Producer participation, however, declines only slightly and tier III continues to be most popular. Participation continues to be high, despite the limitation on cost-share because cost-share accounted for only 26 percent of payments to producers in Alternative 1 and because net returns to producers in Alternative 1 were quite high.

Payments to producers average $21,500, or $48 per acre (NPV over 10 years). The base payment accounts for about 80 percent of all payments in Alternative 2. Total onsite benefit of $16 per acre, on average, also accrues to producers, resulting in an average total gross return to CSP participation of $64 per acre. Average producer conservation costs are $29 per acre, yielding a net return to producers of $35 per acre and a transfer payment of $19 per acre (NPV over the life of the contract). Thus, the average producer's **net** return ($35) is larger than their conservation investment ($29).

The net present value of government cost is estimated to be $49 billion over 10 years: $40 billion in payments to producers and roughly $9 billion for technical assistance costs. Total environmental and onsite benefits are estimated at $107 billion, of which 78 percent are offsite benefits. Net economic costs are approximately $34 billion, yielding a net benefit of $74 billion. The benefit-cost ratio is 2.2:1. Total transfer payments to the producer are estimated to be $15 billion.

Although it may be profitable for a producer to participate at any Tier, the model results signify the *most* profitable solution for the producer. Therefore, forcing the model to only accept participation at particular tiers provides some interesting comparisons. If participation were limited to Tier I (sub-Alternative 2a), participation declines to about 70 percent of farms and only 30 percent of acres. In Tier II, participation (sub-Alternative 2b) is estimated to be 91 percent of farms and about 91 percent of acres. Finally, Tier III (sub-Alternative 2c) participation is estimated to be 96 percent and 96 percent of acres. The results illustrating, as discussed above, that it is more profitable for producers to participate at higher tiers. Average per acre contract cost ranges from $12 for the Tier 1 treatment level, to a high of $51 for Tier III. Net benefits follow a similar albeit steeper trend, ranging from $12 per acre for Tier I treatment, to $91 per acre for Tier III.

Alternatives 3, 3a and 3b - Limit by Resource Concern

In addition to limited cost-share, limiting participation to those willing to treat soil quality, water quality and wildlife resource concerns, would reduce participation to about 85 percent of producers.

Payments to producers average $21,500, or $49 per acre. The base payment accounts for about 84 percent of all payments in alternative 3. Onsite benefit of $6 per acre, on average, also accrues to producers, resulting in an average total gross return to CSP participation of $55 per acre. Average producer conservation costs are $32 per acre, yielding a net return to producers of $23 per acre and a transfer payment of $17 per acre. Thus, the average producer's **net** return ($23) is about 70 of their conservation investment ($32).

The net present value of government cost is estimated to be $43 billion over 10 years: $35 billion in payments to producers and roughly $8 billion for technical assistance costs. Total environmental and onsite benefits are estimated at $93 billion, of which 85 percent are offsite benefits. Net economic costs are approximately $31 billion, yielding a net benefit of $62 billion. The benefit-cost ratio is 1.5:1. Total transfer payments to the producer are estimated to be $12 billion.

Two sub-alternatives to Alternative 3 are reported which effectively cut the base payment: 3a and 3b. In Alternative 3a, the regional rental rates which are used to calculate the base payments are reduced by 50 percent effectively cutting the base payments in half. Producer participation is cut to roughly 50 percent and net, per acre return to participation (for producers who do participate) is reduced to $11. A majority of participants select Tier II over Tier III. While the cost of qualifying for Tier III remains the same, the difference in the Tier II and Tier III base payment is reduced by half.

In Alternative 3b, the rate underlying the base payment is set at 10 percent of land rental rates while the enhancement payment rate is doubled, from 10 percent to 20 percent of adoption costs on the enhanced resource concern. Participation drops slightly from sub-alternative 3a, but shifts entirely to Tier II, as the difference between the Tier II and Tier III base payments shrinks. Tier II is still preferred over Tier I. So long as it is profitable for producers to address resource concerns through CSP, total net return is higher for addressing these concerns on a larger

acreage. Finally, Alternative 3b is the only program option analyzed for which base payments account for less than half of total payments.

Note, however, that producer returns are minimal in these scenarios. Average contract payments per acre (NPV over the contract life) are $26 and $7 for sub-alternatives 3a and 3b, respectively, while the average net returns to participating producers are only $11 and $3, respectively. Although participating producers make a profit, it is not clear that the profit is large enough in absolute terms to entice producers into the program.

Alternative 4 - Limit by Geography

Limiting participation to six composite counties[13] (one per region), with limited (5%) cost share but all resource concerns, would result in very limited participation because very limited geographic eligibility. Per-farm results are generally similar to Alternative 2. The NPV of government cost is $143 million. The lower government cost illustrates a means of targeting an entitlement program with budgetary constraints, by treating a smaller geographical area. Producers would most likely still choose to participate in Tier II and Tier III, assuming profit maximization.

This results in an average contract cost of $65 per acre, with more than 80 percent of the payments being due to the base payment component. Average total contract cost is estimated to be $21,500. Total benefits are calculated at over $100 million, of which 53 percent are offsite benefits. Net economic costs are approximately $93 million. Net benefits are estimated to be $115 million, and total transfer payments to the producer are estimated to be $50 million.

Comparison of Alternatives

Government Program Costs

Government program costs vary widely among the alternatives (Figure 1). Alternative 1 (full, unconstrained program) results in estimated ten-year costs of roughly $70 billion (net present value) while Alternative 4 (limited to 6 counties) is estimated to cost $143 million. Government program cost is a function of participation rates, the tiers that are selected by producers for participation, and the overall level of payments on a per-farm or per-acre basis. These outcomes are, in turn, based on the establishment of program payments and program conservation requirements.

Minimizing cost-share (Alternative 2) would reduce costs to less that $50 billion. In this scenario, most producers continue to participate in CSP and most continue to select Tier III. While participation is still profitable, however, costs are reduced because payments on a per farm and per acre basis decline by 30 percent. Minimizing cost share and limiting producers to 3 resource concerns (soil quality, water quality, and wildlife) reduces costs slightly as some producers who addressed other resource concerns in previous alternatives drop out of the program. On a per-farm and per-acre basis, however, payments are roughly the same as for alternative 2 (limited cost share).

[13] In other words, an average county for each region.

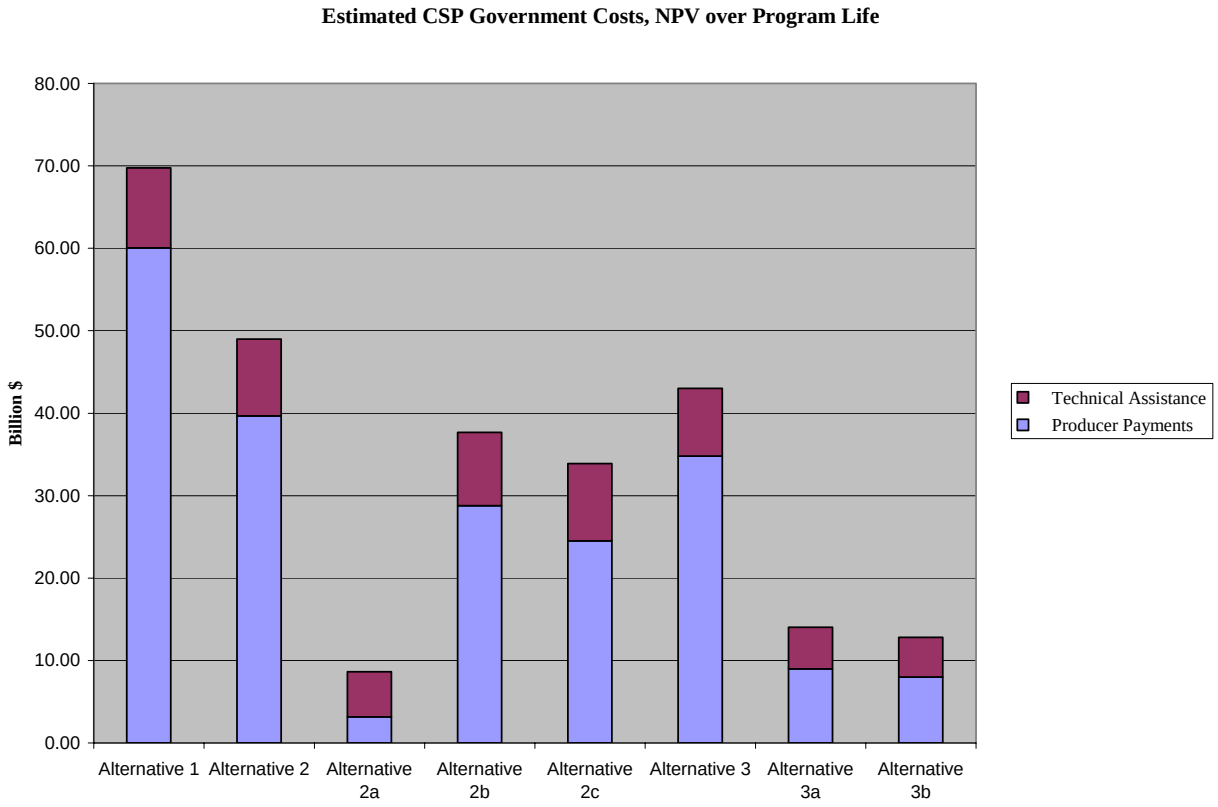
Among alternatives that do not entail geographic limitations, only one (Alternative 2a, limiting participation to tier 1) is estimated to cost less than $10 billion over 10 years. Alternative 2a is less costly for a variety of reasons. First, tier I participation is lower than for most other alternatives because the base payment is low compared with Tier II and Tier III and conservation costs, on a per-acre basis are similar to tier II (see discussion of alternative 1). Second, because only part of the farm must be enrolled, enrolled acreage is only one-third of that for the Tier II or Tier III only alternatives (2b and 2c, respectively). Finally, because the base payments are relatively low, per acre payments are also low relative to other alternatives.

Alternatives 3a and 3b, where base payments are sharply reduced, achieve overall government costs of between $10 and $15 billion. Reducing the base payment reduces the overall participation rate (compared to Alternative 2), shifts participation toward tier II reducing the overall average base payment rate, and generally lowers the per-farm and per-acre contract costs, regardless of the tier level selected.

Keeping CSP expenditures within the Congressionally mandated budget of $3.8 billion over the next 10 years may require limiting the program in a variety of ways: reducing payments to cut participation and limit per-acre payments; limiting the range of resource concerns that producers can address; restricting producers to tier I participation; and restricting participation to well defined geographic areas. Some combination of these limitations could be used to reduce both the per-acre payments to producers and, therefore, the level of transfer payment (payments above producer conservation costs) as well as reducing the overall level of participation. How these various mechanisms are combined to limit government cost will also affect net benefits and other important program outcomes (discussed below).

The simulation model described in this analysis can provide information on the probable effects of various program limitations in determining government cost. Using the model, policy makers can develop insights into the impact of changing the payment structure on the level of payments to producers and probable changes in patterns of participation, benefits and costs, and government expenditures.

Figure 1. Estimated CSP Government Costs.



Proportion of CSP Payments

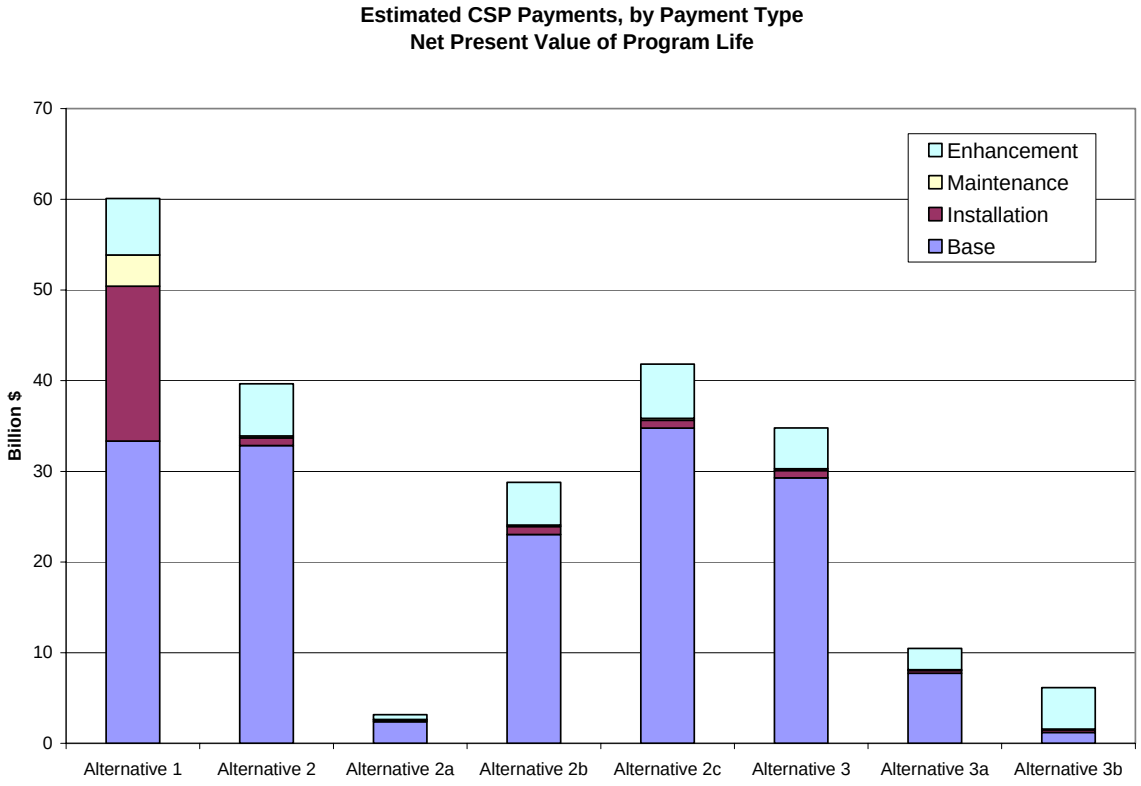
As discussed previously, CSP is comprised of four different types of producer payments. The proportion of the CSP payments for each alternative sheds light on the relationship between the payment types, as illustrated in Figure 1. Producer payments in the full entitlement program (Alternative 1) are primarily comprised of base payments (56%) and installation cost share (28%). Maintenance cost share payments and enhancement payments make up the remaining portion (16%). When cost share is limited to 5 percent (Alternative 2), base payments make up the majority of the payments (83%). Enhancement payments increase slightly with a decrease in installation and maintenance cost share payments, which comprise only 3 percent of the total payments. It is important to note that total producer payments do decrease from Alternative 1 to Alternative 2, however the proportion of base payments and enhancement payment increases, as would be expected. When analyzing each Tier (sub-alternative 2a, sub-alternative 2b, and sub-alternative 2c), the results show that base payments for Tier I only, Tier II only, and Tier III only, are approximately 80 percent of total payments, while enhancement payments are around 16 percent of total payments. Installation and maintenance cost share payments remain a small percentage of total payments.

The proportion of payments for limiting cost share payments, along with limiting participants to addressing soil quality, water quality, and wildlife resource concerns (Alternative 3), is very similar to the proportion of payments in Alternative 2 and its subsets. Since the only change in this alternative is the resource concern limitations, the proportion of payments does not differ

significantly from previous alternatives, with the exception of the full program (Alternative 1). Because of the significant portion of the base payments, it is important to analyze the impact of decreasing the regional rental rate used to calculate the base payments. In Alternative 3a, the analysis included the impact of adjusting the base payment by decreasing the regional rental rate by 50%. The lower rental rate does not significantly impact the base payment portion of total payments. However, keeping the lowered rental rate and increasing the enhancement payment to 20% of the adoption cost of management (Alternative 3b), significantly changes the proportion of payments. In Alternative 3b, base payments comprise 20% of the payments, while enhancement payments total 75% of the total producer payments. These results demonstrate that if the percentage of the regional rental rate used to calculate base payments and the percentage used to calculate enhancement payments are adjusted, it is possible to change the proportion of payments.

Alternative 4 limits the geographical scope of CSP to one county per region and includes limited cost share. The proportion of payments, like Alternative 2, is dominated by base payments (53%) and installation cost share payments (32%). Maintenance payments and enhancement payment comprise the remainder of the producer payments (15%). Alternative 4 is not included in the following graph due to the small nature of payments as compared to the other alternatives.

Figure 2. Estimated CSP Payments by Payment Type.



Net Benefits and Costs

As defined previously, net benefits are the total benefits minus the net economic cost. The net economic cost is the cost to society. Table 8 demonstrates that net benefits in Alternative 2 exceed net benefits in Alternative 1 by $11.7 billion. This is due to a change in the bundle of resource concerns addressed by producers participating in CSP. Total benefits as similar between the two alternatives, but the loss of cost-sharing prompts producers to shift participation toward resource concerns that can be addressed at a relatively low cost. While overall benefits rise modestly, offsite benefits increased by $7 billion from Alternative 1 to Alternative 2, and onsite benefits decreased by $3.8 billion. Thus, a decrease in net economic cost of $8.5 billion paired with the $3.2 billion increase in total benefits led to the increase in net benefits. The decrease in net economic cost is a direct result of limited cost share and a slightly lower participation rate.

As expected, limiting producers to participation in a specific tier affects net benefits relative to Alternative 2. For Alternative 2a, net benefits decline largely because of sharp reduction in the number of acres enrolled in CSP. When producers have the option to enroll their entire operation, as in Alternative 2b, net benefits increase with the increase in enrolled acreage. Net economic costs also increase due to the increase in base payments, installation and maintenance payments, and enhanced payments and are comparable to the net economic cost realized by Alternative 2. Net benefits associated with Alternative 2c (Tier III only) exceed net benefits in Alternative 2 by $1.3 billion (less than 2 percent). An increase in offsite benefits is due to the bundle of resource concerns addressed by producers.

By limiting by resource concern and cost share (Alternative 3), offsite benefits increase by $2.2 billion while onsite benefits decreased by $13 billion when compared to alternative 1. This is due to the requirement that producers address a specific bundle of resource concerns, such as soil quality, water quality, and wildlife. Net economic cost decline by $10.9 billion compared to alternative 1. It is interesting to note that such changes in benefits and costs result in net benefits nearly identical to Alternative 1.

Decreasing the regional rental rate (Alternative 3a) and increasing the enhancement payment (Alternative 3b), decreases both benefits and net economic costs. Compared to alternative 3, net economic cost decline by $17 and $18 billion, respectively, while benefits decline by $35 billion and $30 billion, decreasing net benefits by $18 and $12 billion. The net benefits associated with Alternative 3b are greater than the net benefits for Alternative 3a due to differences in the resource concerns addressed by producers and the Tier level in which they participate.

By constraining the program even further through geographical limits, net benefits and net economic costs are decreased significantly as compared to the other alternatives.

Table 8. Benefits and Costs by Alternative

Alternative	Net Benefits	Total Offsite Benefits	Total Onsite Benefits	Net Economic Cost
	(Net Present Value, Billion $)			
1	62.09	76.58	27.57	42.05
2	73.83	83.57	23.82	33.56
2a	3.06	7.54	6.28	10.76
2b	45.76	55.22	24.06	33.52
2c	75.14	87.15	21.88	33.89
3	62.10	78.75	14.53	31.18
3a	44.40	49.04	9.40	14.04
3b	50.20	52.73	10.28	12.81
4	0.11	0.14	0.06	0.09

Participation Rates

Figures 3 and 4 represent farm participation in CSP by Region and by Tier level. Each region has participation in each alternative at differing degrees. Since the model assumes that participation is based on the option that maximizes producer net return, participation is greatest in Alternative 1 due to the effect of the full entitlement program and the magnitude of payments to the producers. For the other alternatives, participation varied due to changes in cost share, limitations on Tier participation, and limitations on resource concerns.

Figure 3. Estimated CSP Participation, Number of Farms by NRCS Region

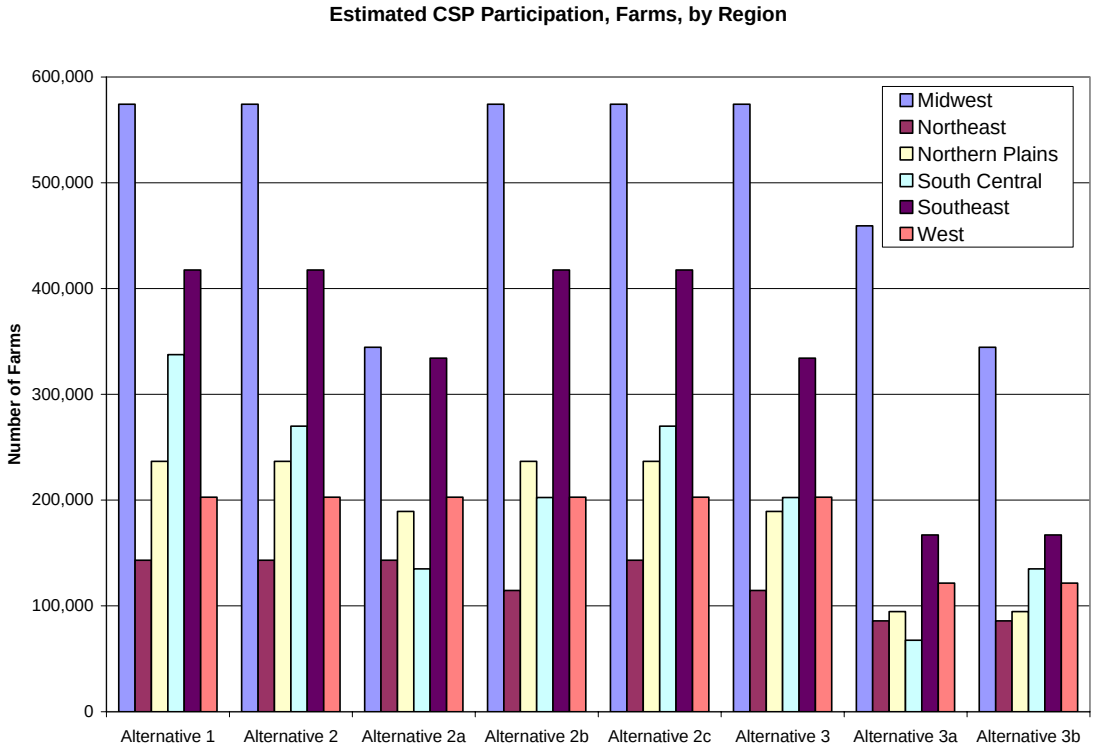
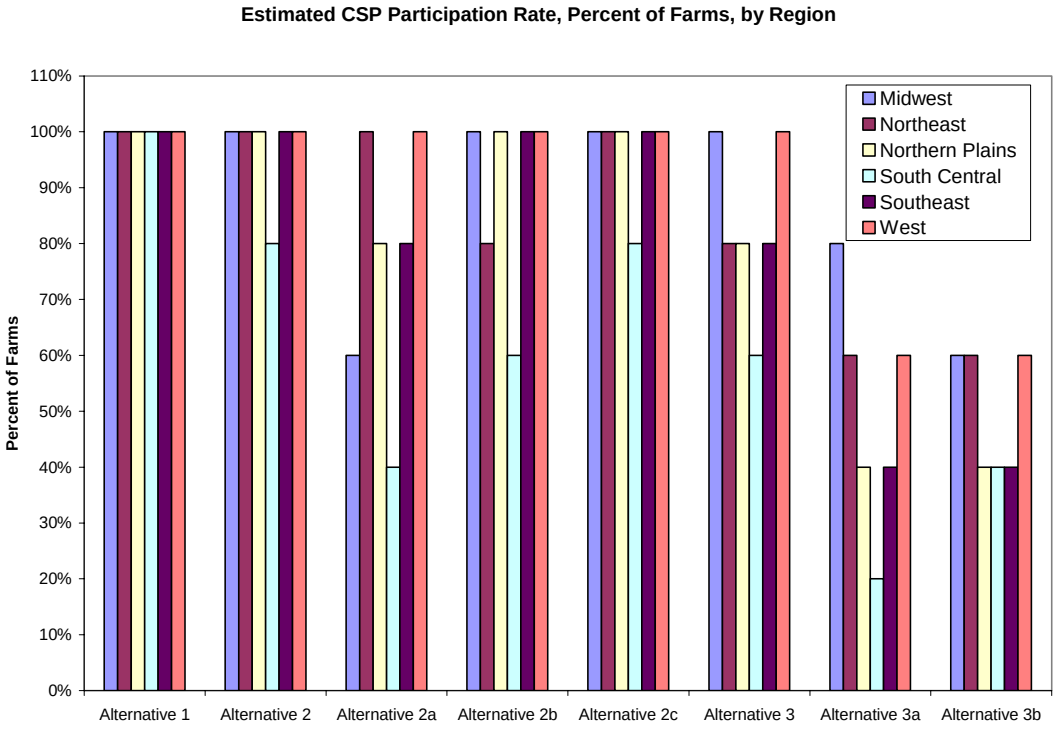
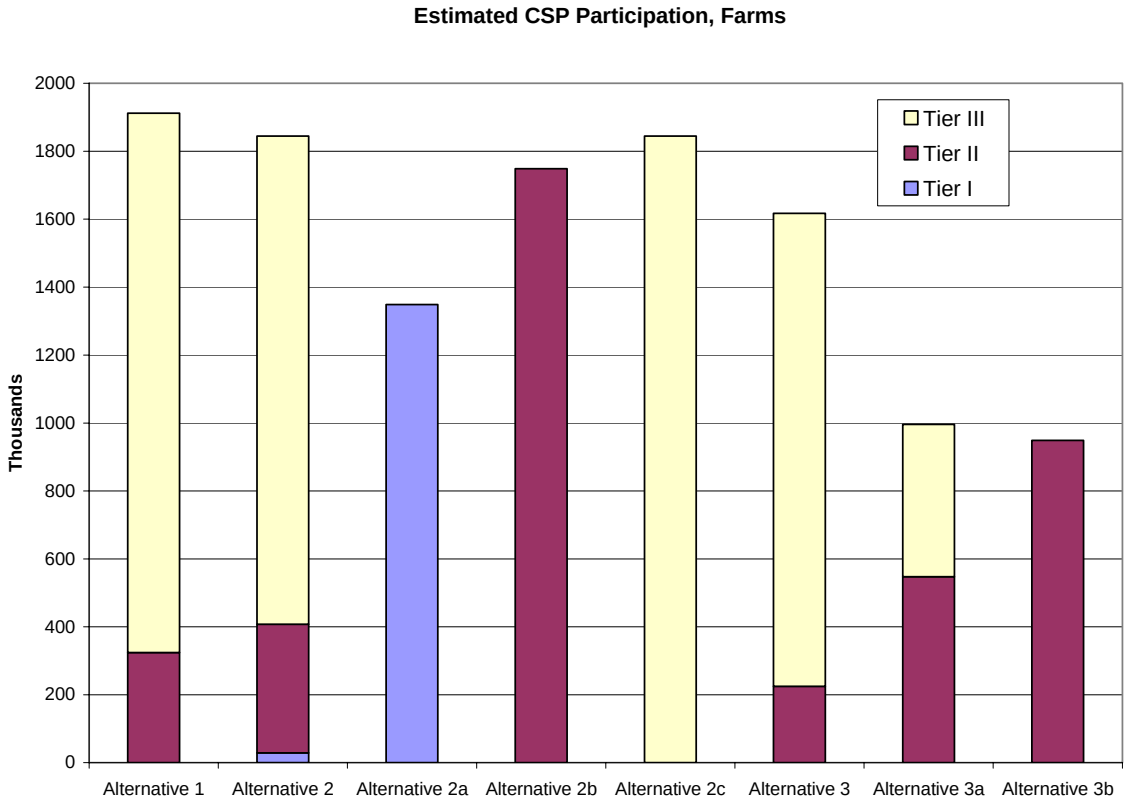


Figure 4. Estimated CSP Participation, Percent of Farms by NRCS Region



The estimated CSP participation by farm by Tier level is show in Figure 5. In Alternatives 1, 2, and 3, where producers are eligible to participate in any Tier, producer participation is greatest in Tier III due to base payments comprising the largest proportion of producer payments. When base payments are lowered as in sub-Alternative 3a, the participation is split almost equally between Tier II and Tier III because as base payments decrease producers receive fewer transfer payments. Due to the lack of profitability associated with addressing a third resource concern, increasing enhancement payments and decreasing base payments, as in sub-Alternative 3b, causes producers to participate solely at the Tier II level. Alternative 4 is not included in the charts due to small participation rate as compared to the other alternatives.

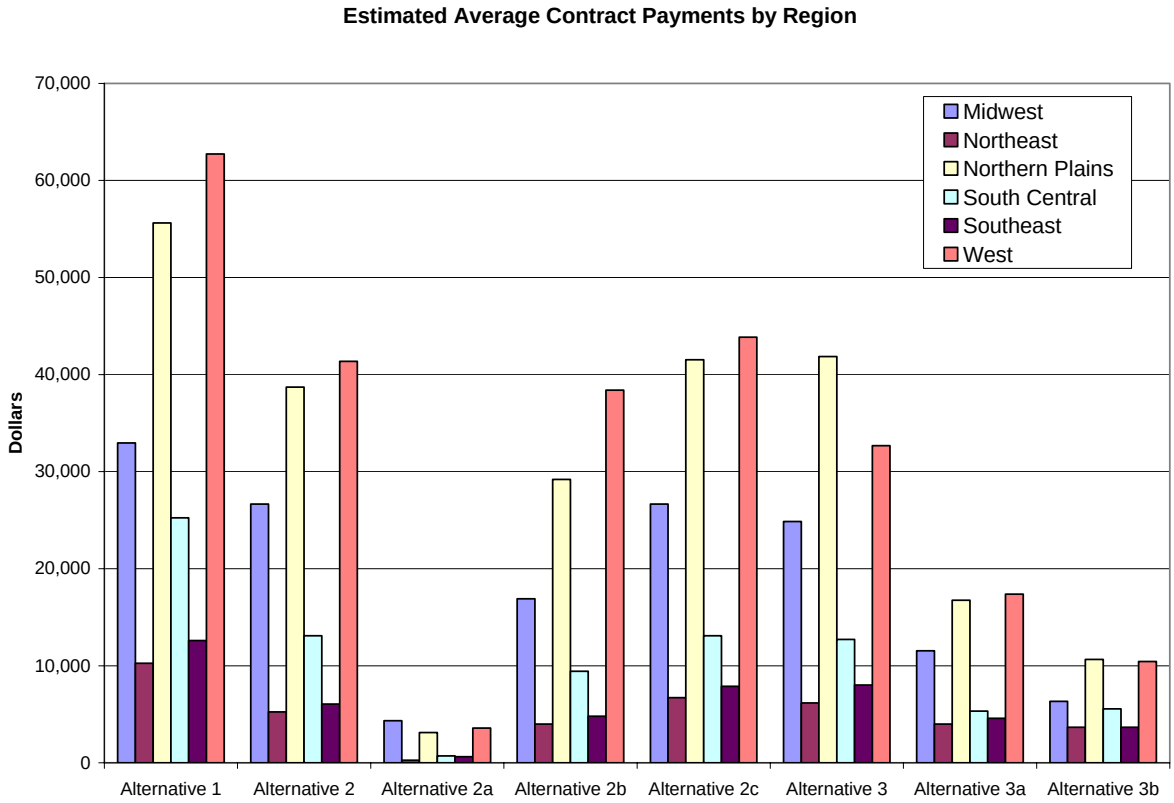
Figure 5. Estimated CSP Participation by Tier



Average Contract Payments by Region

Figure 6 shows the average contract payment by NRCS region. The average contract payment is the total contract payments per region divided by the number of farms participating in CSP per region. In each alternative, except sub-Alternative 2a, the Western and Northern Plains regions have the highest average contract payment. This is due to larger farm size, higher base payment for irrigated cropland, and larger quantity of grazing land. As expected, limiting cost share and decreasing the base payment result in a decrease in average contract payments across all regions.

Figure 6. Average Contract Payments by NRCS Region



Per Acre Comparison

Table 9 lists the per-acre onsite and offsite benefits, net economic and government costs, net benefits, and transfer payments for each alternative.

On a per-acres basis net benefits are $72 for alternative 1. Larger per-acre net benefits are estimated for alternative 2, 2c, 3, 3a, and 3b. Each of these alternatives limits cost-share to encourage producers toward resource concerns that can be addressed at a relatively low cost. When base payments are reduced in alternatives 3a and 3b producers shift participation toward Tier II and focus on resource concerns that can be addressed at least cost, increasing benefits per acre.

Table 9. Per Acre Costs, Benefits and Payments in Net Present Value Terms

Alternative	Average Acres Per Farm	Average Rental Value per Acre	Average Contract Payment per Acre	Benefits			Costs		Net Benefits[3]	Producer Net Return	Transfer Payment
				Onsite	Offsite	Total	Net Economic[1]	Gov't			
1	449	$38.58	$70	$32	$89	$121	$49	$81	$72	$53	$32
2	444	$38.24	$48	$29	$102	$131	$41	$60	$90	$35	$19
2a	196	$34.27	$12	$24	$29	$52	$41	$33	$12	$12	-$8
2b	448	$37.71	$37	$31	$71	$101	$43	$48	$58	$28	$5
2c	446	$38.37	$51	$27	$106	$133	$41	$62	$91	$34	$21
3	440	$38.94	$49	$20	$111	$131	$44	$60	$87	$23	$17
3a	403	$40.35	$26	$23	$122	$145	$35	$39	$111	$11	$4
3b	430	$39.00	$7	$25	$129	$155	$31	$27	$123	$3	-$5
4	505	$38.46	$65	$33	$76	$110	$49	$75	$61	$50	$26

[1] Net Economic Cost is the cost of Installation, Maintenance and Technical Assistance (Total Enrollment Cost & TA). This is the cost to the economy at large

[2] Government Spending includes Producer Contract Payment and Technical Assistance Costs

[3] Net Benefits are Total Benefits - Net Economic Costs, or Benefits to Society. Government Costs include Transfer Payments, which cancel out of the Net Benefit Calculation.

Sensitivity Analysis: Intensive Management Activities

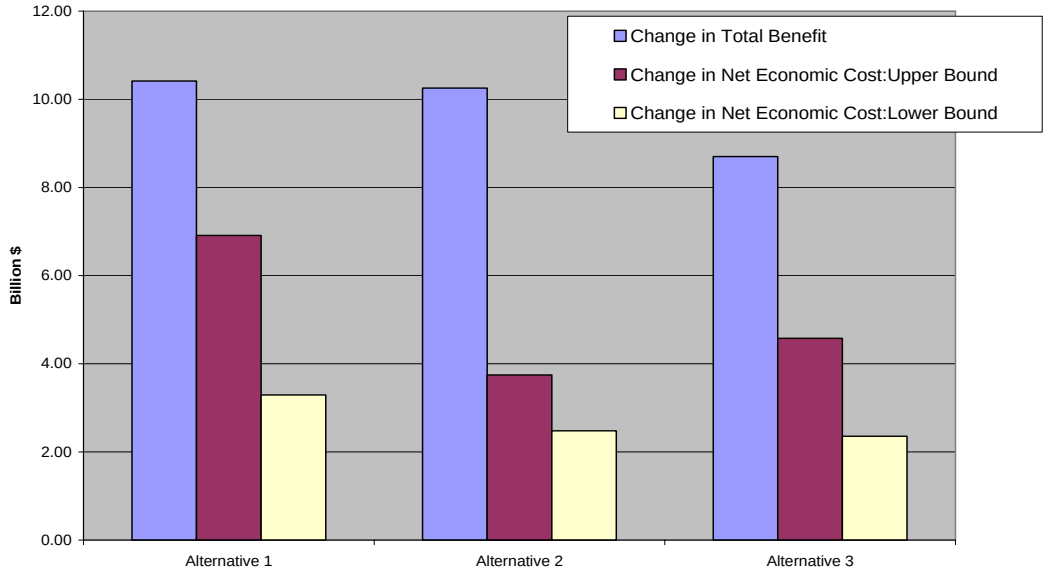
The proposed rule states that CSP participation will require that producers meet a "intensive management activities" level of treatment that exceeds the minimally acceptable level of resource condition. A sensitivity analysis was utilized to identify a reasonable range of the additional costs that would be incurred for a given increase in benefits that may be obtained by addressing a resource concern to the intensive level of treatment. Appendix 2 details the assumptions and methodology used for this analysis.

A one percent increase in benefits is assumed to increase the cost of practice installation and maintenance by between 1 percent (lower bound) and 2 percent (upper bound). As the increase in benefits becomes larger, the upper bound increases relative to the increase in benefits. For a 10 percent increase in benefits, the cost increase is bounded by 10 percent and 21 percent, or an average of 2.1 percent increase in cost per one percent increase in benefits.

If a 10 percent increase in total benefits is realized, the increase in total benefits is just over $10 billion for Alternatives 1 and 2, and more than $8 billion for Alternative 3 (figure 6). For Alternative 1, increased costs range from $3.3 billion to nearly $7 billion, resulting in additional net benefits of $3.5 billion to more than $7 billion. For Alternative 2, increased costs range from $2.5 billion to $3.75 billion for an increase in net benefits of $6.5 billion to $8.25 billion. Using intensive management activity criteria in Alternative 3 would result in additional cost of $2.25 billion to $4.5 billion and increased net benefit of between $4 billion and $7 billion.

Higher cost reduces participation in the high cost scenario for Alternatives 2 and 3. For Alternative 2, participation drops by 80,000 farms for the high cost alternative while the participation decline is 30,000 farms for Alternative 3.

Figure 7. Sensitivity Analysis of Intensive Management Activity Requirement: Total Benefits and Net Economic Costs, Net Present Value over Program Life



Further Analysis: Needed Revisions

The model used in this analysis, although dynamic, still has limitations. Further refinements are planned for policy analysis purposes. Some of these refinements will address:

- Refinement of the composite farms. Currently the model's composite farms are constructed from averages of NASS census information, including total number of farms, and total acres of dry cropland, irrigated cropland and grazing land. A much richer representation of the diversity of farm sizes and types may be obtained though use of Agricultural Resource Management Study (ARMS) survey data. This approach could more accurately reflect the program's impact upon various types of farms and the overall agricultural economy.
- Refinement of the benefit figures. Although costs are calculated from local data, benefits are calculated from national estimates as developed in the *EQIP Benefit Cost Analysis, Final Report, May 9, 2003*. Spatially disaggregated benefit estimates are available and will be used in further work.
- Refinement of participation assumptions. Data exist on historical farm participation in government programs. Further refinement may be possible in this model.
- Refinement of Technical Assistance Cost. Current estimates are preliminary.

These refinements will result in significant improvement in the model's ability to further explore complexities of alternative implementation strategies.

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Appendix 1. Additional Scenarios for Targeting

Effects of a Multi-Tier, Gradual Ramp-up Contract

This scenario assumes that producers enter CSP in Tier I and gradually work up to Tier III. The estimates are derived by interpolating between three other model estimates which restrict participation to Tier I, Tier II, and Tier III, respectively.

Participation is high. Roughly 70 percent of producer and 95 percent of eligible acres are enrolled. The average contract yields a net present value of $13,300 over the life of the contract, or about $21 per acre. Roughly half of the acres are grazing land. Only 6 percent is irrigated cropland. The average contract encompasses 623 acres.

Government costs are $25 billion (net present value) over ten years. Net benefits are $27 billion (net present value over the program life) and the benefit-cost ratio is 1.96.

Programmatic Assumptions:

- Total contract length is 10 years. Producers initially enroll in Tier I, transition to Tier II in year 4, and to Tier III in year 8;
- Base payments are calculated from regional rental rates;
- Cost share is limited to 5 percent of cost for practice installation and maintenance;
- Enhancement requires that producers address an additional resource concern, annual payments are 10 percent of installation cost for practices that address additional resource concern;
- No enrollment beyond year one.
- Any resource concern can be addressed.

Participation Rate (farms)	69%
Participation Rate (acres)	96%
Government Cost (billion $, NPV)	$25.2
Producer Payments	$17.6
Technical Assistance	$7.6
Total Benefits (billion $, NPV)	$49.5
Net Economic Cost	$22.0
Transfer Payments to Producers	$3.2
Average Contract Size ($, NPV)	$13,294
Average Per Acre	$21
Average acres Per Contract	623
Dry Cropland (million acres)	370
Irrigated Cropland (million acres)	52
Grazing Land (million acres)	400
Total Acres (millions)	822
Net Benefits (billion $, NPV)	$27.5

Benefit Cost Ratio	1.70

Effects of Restricting Payments to Meet Funding Limits.

The scenario assumes that producer payments are reduced by 90 percent from Alternative 3 (limited cost share and targeted to soil quality, soil quality, and wildlife) to meet funding limits of approximately $3.8 billion over 10 years.

Roughly 51 percent of producers and 40 percent of eligible acres are enrolled. The average contract yields a net present value of $2,669 over the life of the contract, or about $8 per acre. Roughly half of the acres are grazing land. Only 7 percent is irrigated cropland. The average contract encompasses 350 acres.

Government costs are $7.4 billion (net present value) over ten years. Of the government cost, technical assistance equals $4.8 billion and producer payments equal $2.6 billion. Net benefits are $7.0 billion (net present value over the program life) and the benefit-cost ratio is 1.46.

Programmatic Assumptions:

- Producers are eligible to enroll in any of the Tiers but are limited to addressing soil quality, water quality, and/or wildlife;
- Base payments are calculated from regional rental rates;
- Cost share is limited to 5 percent of cost for practice installation and maintenance;
- Enhancement requires that producers address an additional resource concern, annual payments are 10 percent of installation cost for practices that address additional resource concern

Participation Rate (farms)	51%
Participation Rate (acres)	40%
Government Cost (billion $, NPV)	$7.4
Producer Payments	$2.6
Technical Assistance	$4.8
Total Benefits (billion $, NPV)	$19.8
Net Economic Cost	$12.7
Transfer Payments to Producers	($5.3)
Average Contract Size ($, NPV)	$2,669
Average Per Acre	$8
Average acres Per Contract	350
Dry Cropland (million acres)	129
Irrigated Cropland (million acres)	26
Grazing Land (million acres)	189
Total Acres (millions)	344
Net Benefits (billion $, NPV)	$7.0
Benefit Cost Ratio	1.46

Appendix 2. Methodology for Sensitivity Analysis

We use sensitivity analysis to analyze the potential costs of additional benefits obtained by raising the CSP resource conservation standard to a targeted level of treatment. This appendix provides detail on how the sensitivity analysis was carried out along with underlying assumptions. To develop the analysis we use a common functional form and specify the parameters to be consistent with key assumptions and the rest of our analysis. In this appendix we discuss assumptions and available information, functional specification, and obtaining upper and lower bounds given the assumptions and information.

Assumptions:

1. Conservation cost (C) can be specified as a function of benefits (B): *C=f(B).*

2. Conservation cost can be approximated by a quadratic function: $C = \theta_0 + \theta_1 B + \theta_2 B^2$. The quadratic form can serve as a second-order approximation to any functional form. The use of second order-approximation is common in economic studies and, therefore, well within the range of accepted practice.

3. Zero conservation benefit means zero conservation cost: *0=f(0).* In term of the quadratic approximation, this assumption implies $\theta_0 = 0$. If a producer takes no conservation action, zero conservation cost is incurred and zero benefit is achieved. "Benefit" is usually defined as the reduction in damage when compared to what would have happened without the change in practice leveraged by the government program.

4. Marginal cost is always positive, which implies 1st derivative > 0. If marginal cost is positive for all values of *B* (even for very low *B*), we have $\theta_1 \geq 0$. With positive marginal cost, obtaining additional benefit always means higher cost. One could argue for situations where that isn't true (conservation tillage being the obvious example) but it most cases margin cost will be positive. If it weren't, there would be no need for conservation programs as the farmer's interest (to produce at minimum cost for any given level of output) would be perfectly aligned with environmental interests (to increase environmental benefits or, more accurately, reduce environmental damage).

5. Cost is globally convex, which implies 2nd derivative > 0 and higher order derivatives = 0. Convexity implies that $\theta_2 \geq 0$. Convexity is implied by several arguments:

- NRCS field staff are generally directed to encourage the application of the most cost-effective practice first, so that additional practices yield less environmental gain per dollar of expenditure.
- Adding practices on top of other practices will diminish the marginal effectiveness of the practices added later.
- Once a high level of performance has been achieved, squeezing out additional gains can be very expensive. For example, zero erosion and/or zero nutrient runoff are impossible to achieve at any reasonable cost. Likewise, very low erosion or runoff rates will also be expensive. In contrast, moving from clean tillage to a residue management system is inexpensive and can save a significant amount of soil.

Given the assumptions listed above, it can be shown that:

$$\theta_2 = \left(\frac{\partial C}{\partial B} - \frac{C}{B}\right)\frac{1}{B} \qquad \theta_1 = \frac{2C}{B} - \frac{\partial C}{\partial B}$$

and that:

$$\frac{C}{B} \le \frac{\partial C}{\partial B} \le \frac{2C}{B}$$

The first inequality always holds for convex functions; selection of a convex function means that marginal cost is always greater than average cost. With marginal cost at the lower bound, the function is linear so that a 5 percent increase in benefits yields a 5 percent increase in cost. Thus, the assumption of convexity yields the *lower bound* estimates: at minimum, a 1 percent rise in benefits requires a 1 percent increase in cost.

The second inequality is due to the quadratic form. It is simply the steepest slope that can be attained by the quadratic form at point (B^*, C^*) given that the function passes through both (0,0) and (B^*, C^*). The *upper bound* estimate is obtained by setting $\partial C / \partial B = 2C^* / B^*$ which implies $\theta_1 = 0$ and $\theta_2 = C^* / (B^*)^2$. For an x percent increase in benefits, the levels of benefit and cost would be:

$$B = B^*(1+x))$$

$$C = \left(\frac{C^*}{(B^*)^2}\right)\left(B^*(1+x)\right)^2$$
$$= C^*(1+x)^2$$

Putting the cost change in percentage terms, we have:

$$\frac{C}{C^*} - 1 = (1+x)^2 - 1$$

So, for a 5 percent change in benefits, the lower bound is a 5 percent cost increase while the upper bound is a 10.25 percent cost increase. Likewise, bounds for a 10 percent change in benefits are 10 percent and 21 percent. Note that when stated in percentage terms, costs can increase "more" than benefits at the margin while the absolute increase in benefits is larger than the increase in cost (and therefore, marginal benefit exceeds marginal cost). But this is only true, of course, if benefits are higher than cost before intensifying conservation effort.