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ECONOMICS OF CONSERVATION HANDBOOK

SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

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FORWARD

The Economics of Conservation Handbook is intended to be "self help" instructional material. It is prepared primarily for field office personnel to illustrate the use of economic principles and evaluation procedures to assist land users in selecting a conservation practice and in formulating resource management systems. This Handbook may be used as a reference source to reinforce formal training activities on economics of soil and water conservation.

CHAPTER I - INTRODUCTION

How do we decide to spend our money? Normally we compare the benefits of the purchase or investment to its costs. Someone considering the purchase of a new car might see better gas mileage and fewer repairs as benefits. Costs might include higher car payments and higher insurance premiums. Someone wanting a computer might be comparing benefits that a computer would give them in business and at home, to the cost of giving up other activities or items currently enjoyed.

Farmers, when deciding whether or not to purchase or invest in conservation, go through much the same thought process. Will the benefits from conservation outweigh the costs? Because the farmer is the Soil Conservation Service's major client, it is important that we understand the benefits and costs of conservation so we can inform our clientele.

A. Benefits of Conservation

Benefits from conservation are numerous and occur offsite as well as onsite. This Handbook examines onsite benefits in two parts (Productivity Maintenance and Decreased Production Costs) and offsite benefits as a whole.

When we speak of maintaining productivity, we're really referring to maintaining crop yields by protecting the soil from erosion. To maintain yields, crops need sufficient nutrients and water. They also need a soil profile which allows adequate root growth with sufficient tilth and organic matter to allow the passage of nutrients and water.

When erosion occurs, crops are denied these basic needs to some extent. Wind erosion causes loss of soil moisture and degradation of the soil profile through removal of topsoil. Water erosion causes loss of topsoil, which reduces the quality and quantity of the soil, and causes loss of commercial nutrients. Water erosion can also cause onsite crop damage through gullies and sediment deposits within the field. Both voided areas and sediment deposits lower productivity by reducing or even eliminating crop stands in certain areas.

Productivity maintenance occurs as conservation measures are used to reduce soil loss and conserve moisture. Yields are maintained and in some cases enhanced through the use of conservation. These measures serve to sustain the basic needs of the crop by keeping soil, nutrients, and water where they are needed.

Some conservation measures are beneficial to the farmer because they reduce his costs of growing a crop. Certain tillage practices like conservation tillage and no-till reduce the number of trips over the field. This allows farmers to save time, fuel, and machinery wear. Other measures which convert row crops to other land uses permit the farmer to use less fertilizer and chemical inputs on these areas. Examples of this type of measure are field borders and grassed waterways. Both of these measures involve converting sometimes low yielding row crop areas (end rows and watercourses) into grass. The farmer saves production costs because these converted areas usually require less inputs than do row crops.

Offsite damages, which include deposition and reduced water quality, result as eroded sediment is carried off the field by the actions of wind or water. The sediment can fill in ditches, plug culverts, reduce the useful life of ponds, and destroy fences.

Sediment is also a carrier of farm pesticides and fertilizers. These substances travel on their own or with the sediment to creeks, streams, rivers, and lakes. The chemical substances pollute the water and reduce its usefulness for human consumption, recreation, and fish habitat. The most effective way to avoid surface water pollution is to keep the chemicals on the fields where they are applied. This is one way that conservation measures have an offsite benefit. Any measure which helps to reduce soil loss and thus reduce the runoff of sediment and chemical pollutants, is useful in maintaining or improving surface water quality.

B. Costs of Conservation

Given the far reaching benefits of conservation, why isn't its adoption more widespread? One reason is that, as with any investment or purchase, there is a cost involved. Conservation too has costs associated with its use.

The most obvious cost is in installing the measure. This cost includes all material, labor, and equipment needed to get the measure on the ground in accordance with SCS specifications.

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This cost is "up front" as it occurs when the items or services are purchased.

Operation, maintenance and replacement (OM&R) are costs which occur throughout the life of the measure. These costs insure that the measure continues to function properly. Fertilization of a waterway, replacing a pipe, or reseeding a terrace backslope are examples of OM&R.

A third cost of some conservation measures is the cost of lost production. When certain measures are installed, previous production from the area is foregone. Waterways take land away from cropland as do certain types of terraces. If the yields from these areas were low initially, the lost production is small and there might be a production cost savings. But, if previous yields were high, the cost of putting in waterways, for example, would also be high in terms of lost production.

Another cost occurs with some tillage practices. It is possible that applications of fertilizers and chemicals must be increased in some soils when switching to conservation tillage or no-till. Increased production costs must be accounted for in these situations.

C. How The Overall Agricultural Environment Affects Conservation Purchases

Now that some of the benefits and costs of conservation have been discussed, how does the agricultural environment (interest rates, the farm program, politics, etc.) affect a farmer's decision to apply conservation? During times of prosperity, farmers have the ability to invest in long term conservation. In fact, in years of high profit, farmers are searching for ways to reduce their tax burden. Under current tax laws, conservation is an intelligent investment for this purpose. But, in bad times, taxes are not a problem because profits are low. And, since benefits from conservation sometime take time to materialize while most costs are up front, lack of cash flow becomes a big problem for many farmers.

We need to be aware of a farmer`s economic situation as we make our recommendations. Measures with high installation costs, and benefits which take time to materialize, may be a good alternative from SCS's standpoint but not feasible for the farmer. In times of economic stress, applying part of a system, even though it will not completely solve the resource problem, is better than not applying any measures at all. At least the door remains open for the farmer when times

get better to apply remaining practices of the resource management system and reap the full benefit of conservation.

D. Economics And The Planning Process

The National Conservation Planning Manual (NCPM), 506.10, describes planning as an effort where SCS technical knowledge and experience are pooled with the knowledge and experience of others. Effective participation in planning and applying resource management systems on the land follows a logical series of elements. The ten elements in planning and implementation are:

1. Providing information.
2. Requesting assistance.
3. Determining objectives.
4. Providing resource inventory data.
5. Interpreting, analyzing and evaluating resource inventory data.
6. Developing and evaluating conservation alternatives.
7. Making decisions.
8. Documenting decisions.
9. Implementing decisions.
10. Reevaluating and updating.

Economics can and should play an important role in each of these elements.

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CHAPTER II - BASIC CONSIDERATIONS AND ECONOMIC PRINCIPLES

This chapter deals with defining and illustrating economic principles and procedures which can contribute to efficient conservation planning and effective decisionmaking. Emphasis is placed on the identification of basic effects for purposes of comparison and selection. A secondary purpose is to define levels of sophistication in analysis and incorporate consideration of factors which significantly impact the relative attractiveness of alternatives to decisionmakers. Contents of this chapter are based on the belief that economics is inseparable from planning and that the role of economics, like planning, is ultimately aimed at providing responsible information which allows landusers to make informed decisions about: 1) what to implement and 2) how to implement.

A. Future Conditions, Without and With Conservation

The need for conservation planning is based on the premise that some physical situation, such as erosion or yield level, is currently, or is expected to be, at a condition that is undesirable or unacceptable. The effects of present and future situations without taking any action should be compared to those expected with implementation of an action. The difference between the without and with action conditions is the measure of change.

Estimating effects into the future is important; they should neither be overstated nor understated and must be made with reference to time. Consider an example where current mismanagement of resources is causing accumulation of salts in surface soils. Without change in management, continuing accumulations are expected to have a damaging effect on crop yield (line AB in Figure 2-1).

With adoption of a resource management system, salt which has accumulated in surface soils will be reduced and crop yield is expected to increase, (line AC in Figure 2-1). The yield change effects due to adoption of the resource management system is the area ABC when evaluated over the 25 year period. If additional labor is the only cost of implementing the resource management system and yield change is the only gain, determination of the relative worth of adoption is made by comparing the value of the yield gain against the cost of additional labor.

Estimates of future conditions without and with treatment are commonly made by using an inventory of current conditions as a beginning point. Then historical trends are projected while considering current relationships and foreseeable developments (line AC and AB in Figure 2-1). Projections should reflect the views of the decisionmakers, research, and other published data such as soil surveys. Most importantly, expectations of future conditions without and with treatment must be tempered by local judgment.

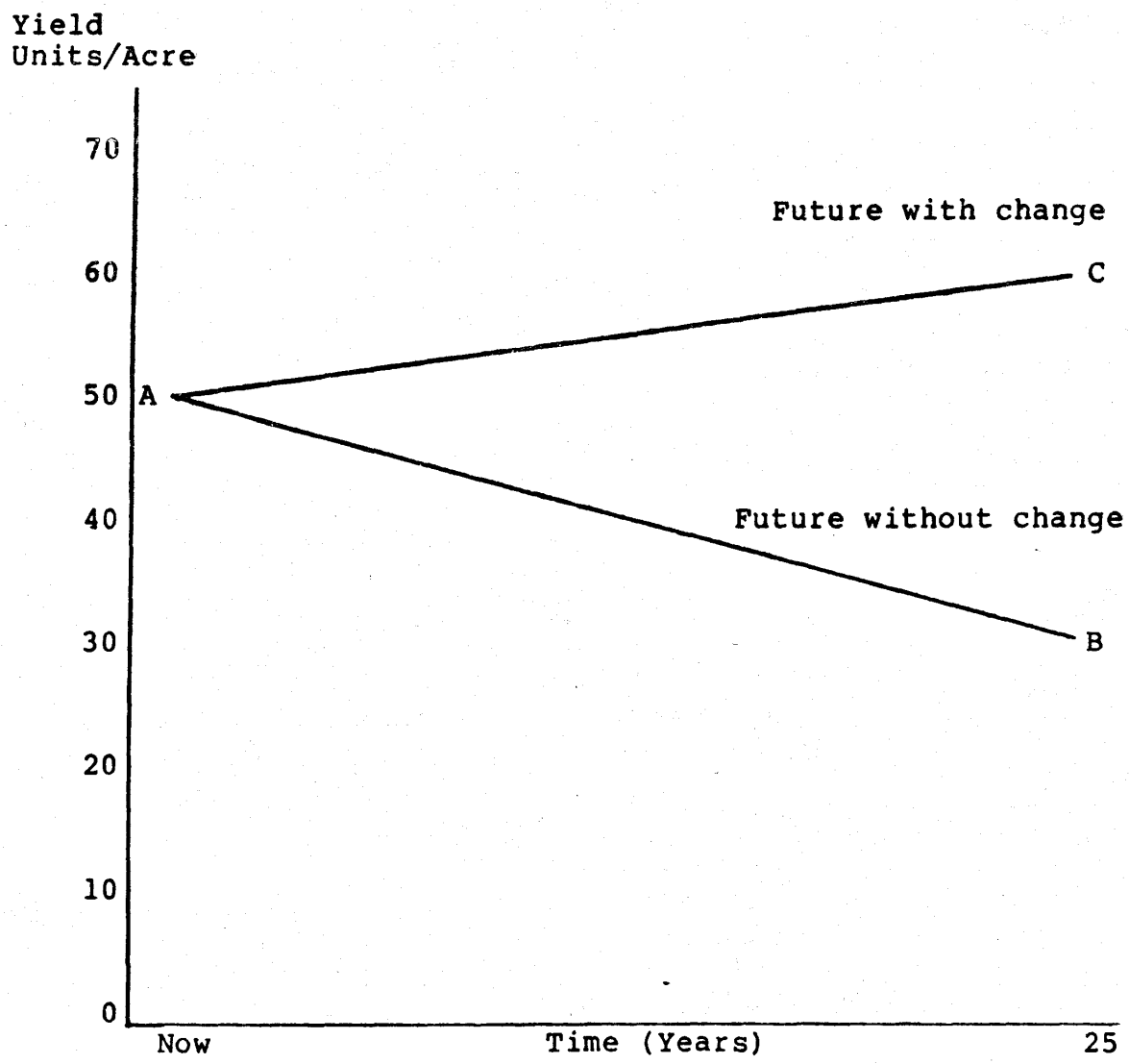

Figure 2-1. Future conditions, without and with conservation.

B. Decisionmaking

Effective conservation planning must have involvement of both the planner and decisionmaker. The decisionmaker must identify the important physical and/or economic factors which should be examined for change between expected future without and with conditions. In addition the decisionmaker must also identify the relevant time horizon.

Ultimately, the decisionmaker must also place relative value on the gains and losses in order to determine their individual weight in the choice.

Balancing gains against losses in decisionmaking often involves comparing factors which are not compatible in kind, place or time. Some effects may have a common denominator, such as a market price, while others do not. Wildlife availability and landscape appearance are two examples where commonly held absolute values do not exist.

C. Levels of Detail

Assistance is normally provided up to the point the landusers can comfortably make an informed decision leading to conservation actions. The kind and amount of information will be different for every individual and every situation.

The simplest level of evaluation may consist only of identifying the most obvious physical impacts stemming from the problem and estimating the costs of the conservation practices which address these problems. A vast majority of the questions posed by owner-operators can be answered with this approach.

An intermediate level of evaluation could be used where more specific questions on the resource problems require more detailed answers. Chapter 5 will discuss these options at length.

Where an individual cooperator requests an advanced level of analysis, field personnel involved may need to request direct assistance from a State Office staff economist.

D. Period of Analysis or Planning Horizon

Two analytical concerns in decisionmaking are determining the length of time over which effects are considered and converting these effects to a common time basis. The length of time over which effects are considered is called the period of analysis or planning horizon. The decisionmaker is responsible for identifying the planning horizon. General factors affecting

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the decisionmaker in the determination of planning horizons are: age of the cooperator, intergeneration transfer (whether the children will farm), etc. Economic factors which determine the period of analysis include physical deterioration of capital investment (i.e., farm equipment, conservation practices, etc.) and obsolescence due to improvements in technology. The planning horizon may exceed the economic life of the alternative. However, if the planning horizon is shorter than the economic life of the alternative, care must be exercised to account for the benefits which will accrue beyond the period analyzed, and any costs which may be recoverable at the end of the period.

E. Least Costly Alternative

From an economic viewpoint, any conservation practice selected for installation should satisfy the requirement that it not be more costly than any reasonable alternative means of accomplishing the same specified objective. Comparison of costs for all alternatives considered is essential and should include the estimate of operation, maintenance and replacement expenditures in addition to the annual equivalent installation costs. Any costs occurring in the future need to be identified and converted to a common time base.

F. Maximization of Net Income (Profit)

The optimum scale of economic output from application of conservation practices is the point at which net income is at a maximum. This occurs when the income added by the last increment of input is equal to the cost of adding that increment. The increments to be considered are those smallest units in which there is a practical choice as to inclusion or omission from the proposed package of conservation practices. This process is best described as equating the marginal returns (income) and the marginal costs.

CHAPTER III - TIME AND MONEY

A. The Time Value of Money and Opportunity Cost

With an inflation rate of zero, is a dollar received today equal in value to a dollar received one year from now? Money can be invested and used to make more money over time. Thus, the dollar received today could be put in a bank or invested elsewhere and be worth more than one dollar a year from now. This concept, called the time value of money, is dealt with everyday in home and business finance. For example: landusers may make decisions about purchasing one piece of equipment versus another, versus no purchase at all based on the use of money over time.

The time value of money can be thought of in two forms. First, if the landuser borrows money for a purchase, the time value of money is the interest paid on the loan. If the landuser uses his own money for a purchase, the time value of money would be the return he gave up from another investment, (savings account, certificates of deposit, IRA, etc.), to make the purchase. In this case he has an "opportunity cost;" that is, the interest he would have gotten from a C.D., for example, is now a lost opportunity because he used that money for a purchase.

When a landuser considers purchasing conservation, the time value of money concept applies. There is a cost above and beyond the purchase of the conservation measure. If the landuser borrows to pay for the measure, that additional cost will be equal to the interest he must pay on the loan. If he uses his own money, the additional cost is equal to the return that money would have earned in some other investment.

B. Simple and Compound Interest

Interest is the earning power or price of money; what someone will pay you for the use of your money or the rent you pay for the use of someone else's money. Interest is usually expressed as an annual percentage rate (APR) and may be either simple interest or compound interest.

1. Simple Interest

Simple interest is money paid or received for the use of money, generally calculated over a base period of 1 year at a set rate.

Formula: $i = (p)(r)(n)$, where i = interest, p = principal, r = interest rate and n = number of periods.

Example: $7,000 is borrowed at 10 percent (.10) interest (APR) for 1 year. How much money will be needed to pay off this loan when it is due?

i = $7,000 x .10 x 1 = $700 of interest will be due
7,000 of principal will be due
$7,700 will be needed to pay off the loan

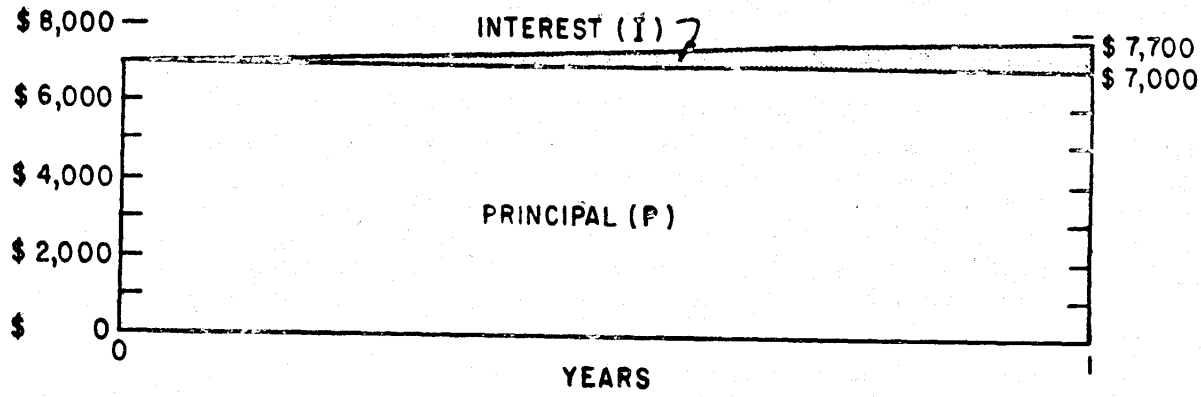

FIGURE 3-1

2. Compound Interest

Compound interest is earned for one period and added to the principal, thus, resulting in a larger principal on which interest is computed for the subsequent period.

Formula: $(1+r)^n$, where n = number of periods, r = periodic rate of interest, and 1 represents one dollar since the formula results in a factor that is multiplied by the principal dollar amount.

If the interest rate is 10 percent (APR) compounded quarterly for 5 years, then r = .10 / 4 (4 payments in a year) or .025; n = 5 x 4 (4 payments in a year) or 20. The factor to be multiplied by the principal amount is (1 + .025)20 = 1.63862.

Example: $2,500 is put into a savings account paying 10 percent interest compounded annually. How much will be in the account of this depositor at the end of 7 years?

$(1 + .10)^7 = 1.9487171$
1.9487171 x $2,500 = $4,871.79 (see Figure 3-2)

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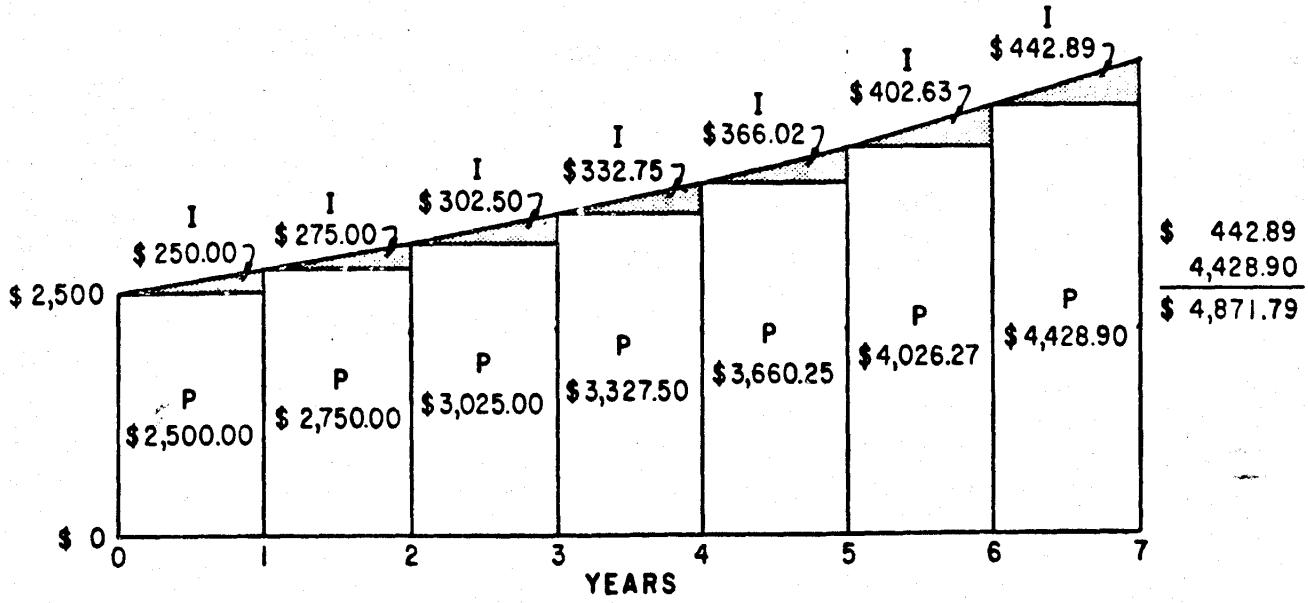

FIGURE 3-2

3. Comparing Simple and Compound Interest

The computational difference between simple and compound interest can best be seen in an example: $7,000 invested for 10 years at 10% interest, simple interest vs. interest compounded annually:

Simple = $7,000 x .10 x 10 = $7,000 interest
+ 7,000 principle
$14,000

Compound = $7,000 x $(1 + .10)^{10}$ = $18,156 interest and principle
The difference of $4156 is due to the difference in interest calculations.

4. Compounding

Compounding determines what money is worth at some time in the future. Table 3-1 shows the formula and amount of money due for more frequent periods of compounding, i.e., semi-annually, quarterly, monthly and daily.

1/ This figure is not to scale. It is meant only as a representative picture of the compound interest process.

Table 3-1 1/ Compounding

Period	Formula	Result (2500 Principal)
Annual	$(1 + .10)^{7} = 1.94872$	$4,871.79
Semiannual	$(1 + .05)^{14} = 1.97993$	4,949.83
Quarterly	$(1 + .025)^{28} = 1.99650$	4.991.25
Monthly	$(1 + .008333)^{84} = 2.00786$	5,019.65
Daily	$(1 + .000274)^{2555} = 2.01370$	5,034.25

1/ 10% for 7 years, principal = $2500.00

C. One-Time Values, Annual Flows (Annuities) and Lags

The benefits and costs of conservation do not necessarily occur at the same time. Certain costs and benefits may occur at one point in time while others occur over a number of years. Some occur today while others occur in the future.

Those values which occur at one point in time are called one-time values. Installation costs are an example of a value which occurs at one-time. Values which occur over time are called annual flows or annuities. Annuities can be generalized into constant, decreasing, and increasing over time, depending on their characteristics. Many of the benefits from conservation fall into the annuity category.

A one-time value can occur today or at some point in the future. If it occurs at some point in the future it is said to be "lagged" or delayed. The replacement cost of a practice is a good example of a lagged one-time value. Annuities too can be lagged. If benefits from a terrace do not start until a year after installation, then those benefits are said to be lagged one year. Deferred grazing following range seeding is another common occurrence of a lagged annuity.

Table 3-2 illustrations examples of one-time values, annual flows, and lags.

Table 3-2

One-Time Value	Annual Flow (Average Annual Equivalent)	Lagged Values
Installation Costs Replacement Costs	Conservation Benefits Average Returns Average Costs O&M Costs	Replacement Costs Any value not starting this year

D. Average Annual Equivalent

Why should we in SCS worry about the timing of benefits and costs of conservation? In order to compare benefits and costs, they must be considered in the same time frame; otherwise we are comparing apples and oranges. A standard form has been developed called average annual equivalents. This term describes an annual flow which is not lagged. In Table 3-2, the middle column gives 4 examples.

The significance of average annual values or equivalents is that most businesses, including farming, have accounting systems which are based on average annual equivalents. Therefore, the costs and benefits of conservation, once converted to average annual values, can be added to the costs and returns of the farm business.

There are two useful tools/guides for converting benefits and costs of conservation into average annual equivalents:

1. Interest and annuity tables (tool for conversions)
2. Amortization key (guide to use I&A Tables)

These are discussed in detail in the following sections.

E. Interest and Annuity (I&A) Tables

The conversion of costs and benefits of conservation to average annual equivalents without the help of I&A tables would involve the use of many difficult formulas and calculations. The tables were constructed to simplify the process by presenting coefficients developed from the formulas for use in much simpler calculations. (For those interested in the formulas, they can be found in the Glossary).

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I&A tables for various interest rates are found in Appendix B. A typical table has seven columns: (1) number of years hence, (2) present value of 1, (3) amortization, (4) present value of an annuity of 1 per year, (5) amount of an annuity of 1 per year, (6) present value of an increasing annuity, and (7) present value of a decreasing annuity.

1. Number of periods hence

This is the number of years in which calculations are considered.2/ There may be many conditions which influence the number of years used in an evaluation: (a) a benefit may last a year or indefinitely (perpetuity), (b) the measures may have a short or long useful life, (c) the period of evaluation may be set by policy, (d) an individual may want to recover his costs in a certain time period, (e) costs or returns may occur over varying time periods or at varying rates for the same period, or (f) the landusers planning horizon may dictate this time period.

2. Present value of 1

The present value of 1 is what $1.00 due in the future is worth today or the amount that must be invested now at compound interest to have a value of $1.00 at some given time in the future. It is also known as the discount factor. Use of present value of 1 determines today's worth of a given amount of money received or paid at some specified time in the future.

Example: What is the discounted or lagged value of $10,000 at 10 percent interest 25 years hence?

The factor of .09230 can be found in the 10 percent interest table in Appendix B, under the "present value of 1" column for 25 years hence.

.09230 (from the table) x $10,000 = $923. Looking at it in another way, if you invested $923 at 10 percent interest compounded annually for 25 years, it will have a value of $10,000 at the end of the 25 years.

Note: To calculate compound interest, the value should be divided by the appropriate present value of 1 factor. For this example, $923 invested at 10 percent for 25 years would be equal to 923/ .09230 or $10,000.

2/ Tables are also available with factors based on months or days, however, for SCS work annual tables are normally used.

3. Amortization

Amortization, sometimes called partial payment or capital recovery, is the payment of a financial obligation in equal installments over time. The interest rate and resulting amortization factor will determine what annual payment must be made to pay the principal and interest over a given number of years. This is also referred to as the average annual equivalent cost. A common example of amortization is the calculation of mortgage payments on a house.

Example: A farmer borrows $7,000 to install a resource management system. The interest rate is 10 percent and the repayment schedule is set up for 10 years. What is his average annual cost, i.e. the amount he must pay each year for 10 years to pay off the loan and interest. The amortization factor of .16275 can be found in the 10 percent table under the column titled "Amortization" and the 10 years hence row. Thus the amount that must be paid each year for 10 years to pay off the $7,000 loan and interest due is 0.16275 x $7,000 = $1,139.25 (Table 3-3). A total of $11,392.50 ($1,139.25 x 10 yrs.) will be paid to amortize (pay off) this loan, of which $7,000 is principle and $4,392.41 is interest. Figure 3-3 displays what occurs each year during the 10 year period.

TABLE 3-3

YEAR	AMOUNT OF LOAN	ANNUAL PAYMENT	PAYMENT PRINCIPAL	PAYMENT INTEREST	BEGINNING BALANCE
1	$7000.00	$1139.25	$ 439.25	$ 700.00	$6560.75
2	6560.75	1139.25	483.17	656.08	6077.58
3	6077.58	1139.25	531.49	607.76	5546.09
4	5546.09	1139.25	584.64	554.61	4961.45
5	4961.45	1139.25	643.11	496.14	4318.34
6	4318.34	1139.25	707.42	431.83	3610.92
7	3610.92	1139.25	778.16	361.09	2832.76
8	2832.76	1139.25	855.97	283.28	1976.79
9	1976.79	1139.25	941.57	197.68	1035.22
10	1035.22	1139.25	1035.73	103.52	0
TOTAL	-	$11,392.50	$7000.00	$4392.50	-

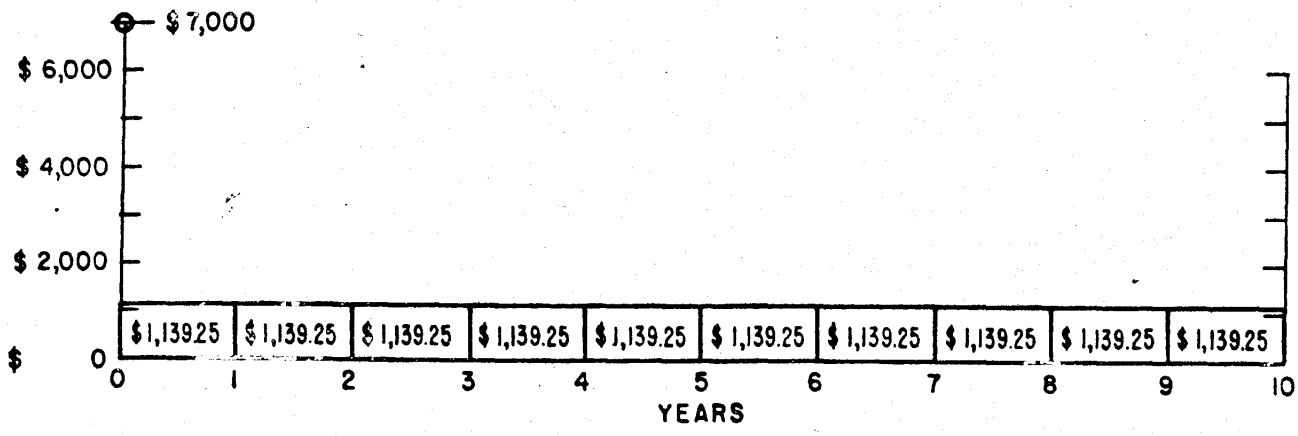

FIGURE 3-3

4. Present value of an annuity of 1 per year

Present value of an annuity of 1 per year is also referred to as the present worth of an annuity or the capitalization factor.

This present value factor represents the present value or worth of a series of equal payments or deposits over a period of time. It tells us what a future annual deposit of $1.00 is worth today. If a fixed sum is to be deposited or earned annually for "n" years, this factor can be used to determine the present worth of those deposits or earnings.

Example: A conservation practice produces a stream of benefits equal to $1,200 a year for 10 years. The interest rate is 10 percent. How much is $1,200 a year for 10 years worth today?

Using the 10 percent I&A table in Appendix B under the "present value of an annuity of 1 per year" column, 10 years hence the coefficient is 6.14457.

6.14457 x $1,200 = $7,373.48; this is the present value of a benefit stream which provides $1200/year for 10 years.

Figure 3-4 illustrates what has occurred in this example.

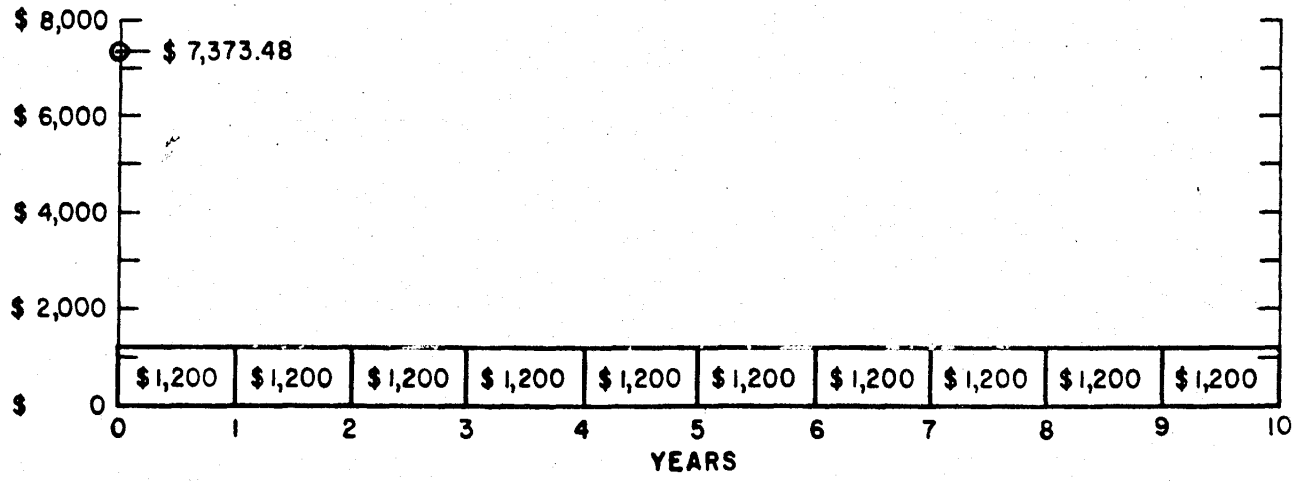

FIGURE 3-4

5. Amount of an annuity of 1 per year

The amount of an annuity of 1 per year is the amount that an investment of $1 per year will accumulate in a certain period of time at compound interest.

Example: $2,000 per year will be invested at the end of each year in an individual retirement account (IRA) for 30 years paying 10 percent interest compounded annually. What will be the value of this account at the end of the 30 years?

Under the "amount of an annuity of 1 per year" column, 30 years hence, is the coefficient 164.49402.

The value of the IRA account at the end of 30 years is 164.49402 x $2,000 = $328,988.04 (Figure 3-5).

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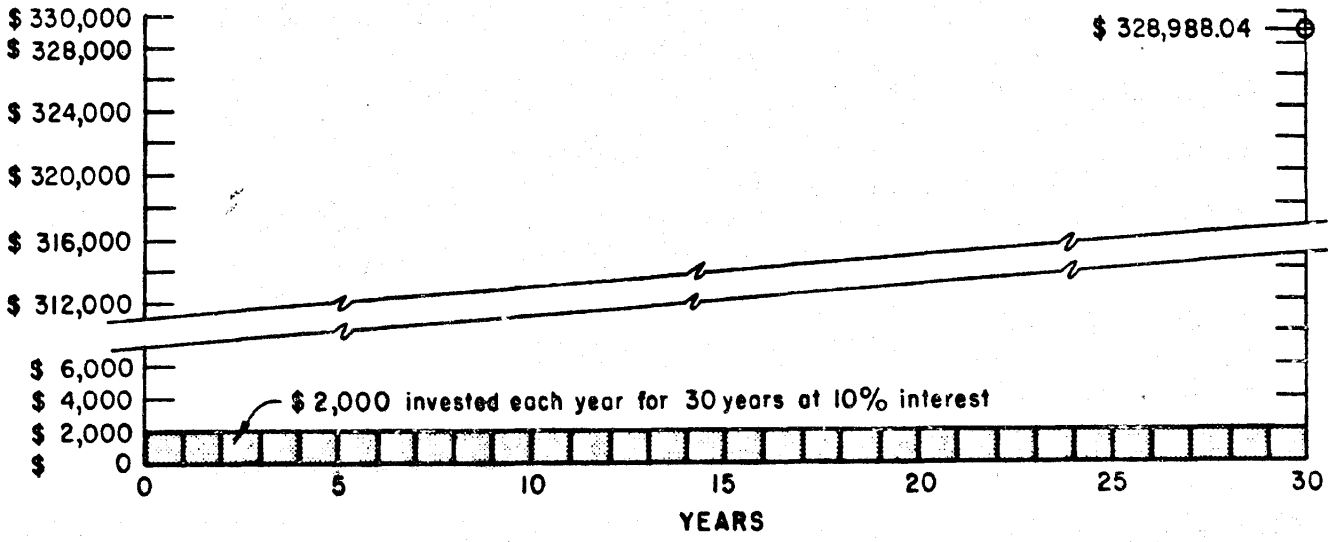

FIGURE 3-5

Note: The sinking fund factor is used to determine what size annual deposit will be required to accumulate a certain amount in a certain number of years at compound interest. The sinking fund factor is not shown in the tables but the same answer can be obtained by dividing by the appropriate "amount of an annuity of 1 per year" factor. The amount of an annuity of 1 per year factor is the reciprocal of the sinking fund factor.

Example: $20,000 is needed in 10 years to pay for a college education. How much should be put into savings at 10 percent interest to accumulate that amount?

$20,000 / 15.93742 = $1254.91/year

6. Present value of an increasing annuity

The present value of an increasing annuity is a measure of an annuity that is increasing at a constant increment over a period of time. When using this factor, it is important to note that the value of $1 (which is multiplied by the increasing annuity factor) is the annual rate of increase and not the total increase during the period.

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Example: A farmer renovates a pasture and estimates that it will reach full production in 4 years. The improvement will increase uniformly over the 4-year period and at full production will improve net income $20 per year per acre. Using an interest rate of 10 percent, what is the present value of this increasing annuity?

In the 10 percent compound interest and annuity table, Appendix B, under the column "present value of an increasing annuity" and the row 4 years hence is the coefficient 7.54798. The annual rate of increase is ($20 / 4) $5 (Figure 3-6). This is because the annuity is not constant or the same each year. He will receive income of $5 the first year, $10 the second year, $15 the third, and $20 the fourth year (increases uniformly at $5 per year). The present value of this increasing annuity or income stream is then (7.54798 x $5) $37.74. This also means that if you deposited $37.74 in an account paying 10 percent interest compounded annually, you could withdraw $5 at the end of year 1, $10 at the end of year 2, $15 at the end of year 3, and $20 at the end of year 4, and there would then be a balance of $0.00.

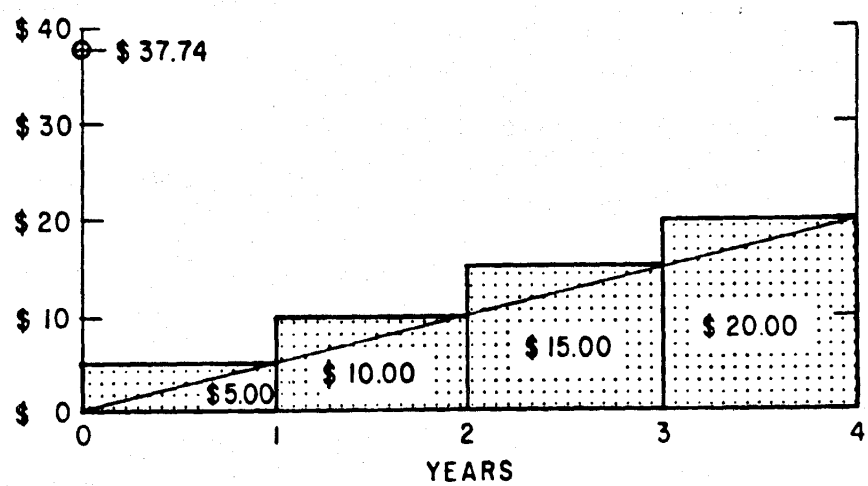

FIGURE 3-6

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7. Present value of a decreasing annuity

This factor is used to determine the present worth of an annuity that decreases uniformly each year. Again, it is important to note that the value of $1 (which is multiplied by the decreasing annuity factor) is the annual rate of decrease and not the total decrease during the period.

Example: A gravel pit is producing $28,000 income annually. Due to a decreasing supply which is costlier to remove, income will drop at a steady rate until it equals zero in 7 years.

At 10 percent interest, what is the present value of the gravel?

The factor 21.31581 is found in the 10 percent compound interest and annuity table, Appendix B, under the "present value of a decreasing annuity" column, 7 years hence.

The annual rate of decrease is ($28,000 / 7) $4,000.00. The gravel pit will produce income of $28,000 the first year, $24,000 the second, $20,000 the third, etc., until income ceases at the end of the seventh year and becomes $0.00 (Figure 3-7).

The present value of this decreasing annuity or income stream is then 21.31581 x $4,000 or <u>$85,263.24</u>.

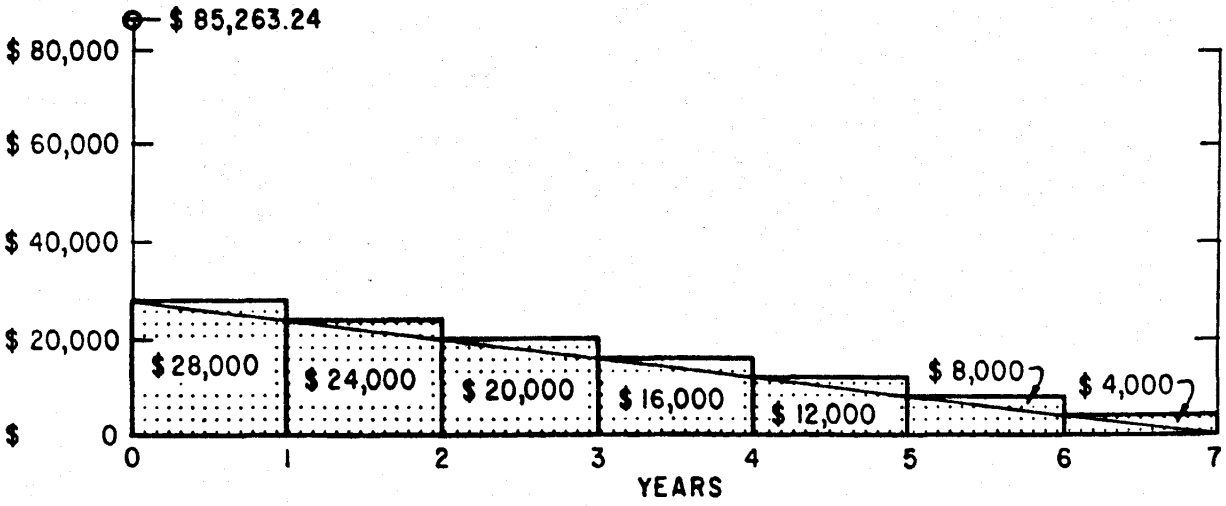

FIGURE 3-7

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F. Amortization Key

In many plant science or botany courses a tool called a "Key" is used to identify plant species by answering a series of questions. This "keying out" process is useful because it allows non-experts to identify species of plants which are unknown to them.

Figure 3-8 is an "Amortization Key". By answering a series of questions, the key serves as a guide for using the interest and annuity tables to convert benefits and costs of conservation to average annual values. The first question on the key is whether the value is an annuity, like benefits from a terrace which flow over time, or if it is a one time value like terrace installation costs.

If it happens to be a one time value, move down the key to the question, "Is it lagged?" A value that will be realized sometime in the future is considered lagged because there is a lag period between now and the time the value takes place. Assuming the value is not lagged, then the only adjustment needed is to amortize it over the life of the project or evaluation period.

This is accomplished by multiplying the amortization factor found in the tables, times the one time value. This results in an average annual value. Had it been lagged, the one time value would first have to be multiplied by the "present value of one" factor for the lag period, then multiplied by the amortization factor to convert to average annual.

To convert an annuity to an average annual equivalent, it is important to decide if the annuity is constant, increasing or decreasing. If the annuity is a constant flow of value, then it should be multiplied by the "present value of a constant annuity" factor for the period (years) of the annuity. This factor is found in the I&A tables under the column called "present value of an annuity of one per year."

The result of this multiplication would then be multiplied by the amortization factor if the annuity was not lagged. If the annuity period was lagged, it would be multiplied by the "present value of one" factor for the lag period prior to being amortized.

For an increasing or decreasing annuity, recall that the value used to multiply all the factors by, is the yearly average increase or decrease. For example: For an increasing annuity that begins at zero and rises to $500 after 5 years, the yearly

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AMORTIZATION KEY

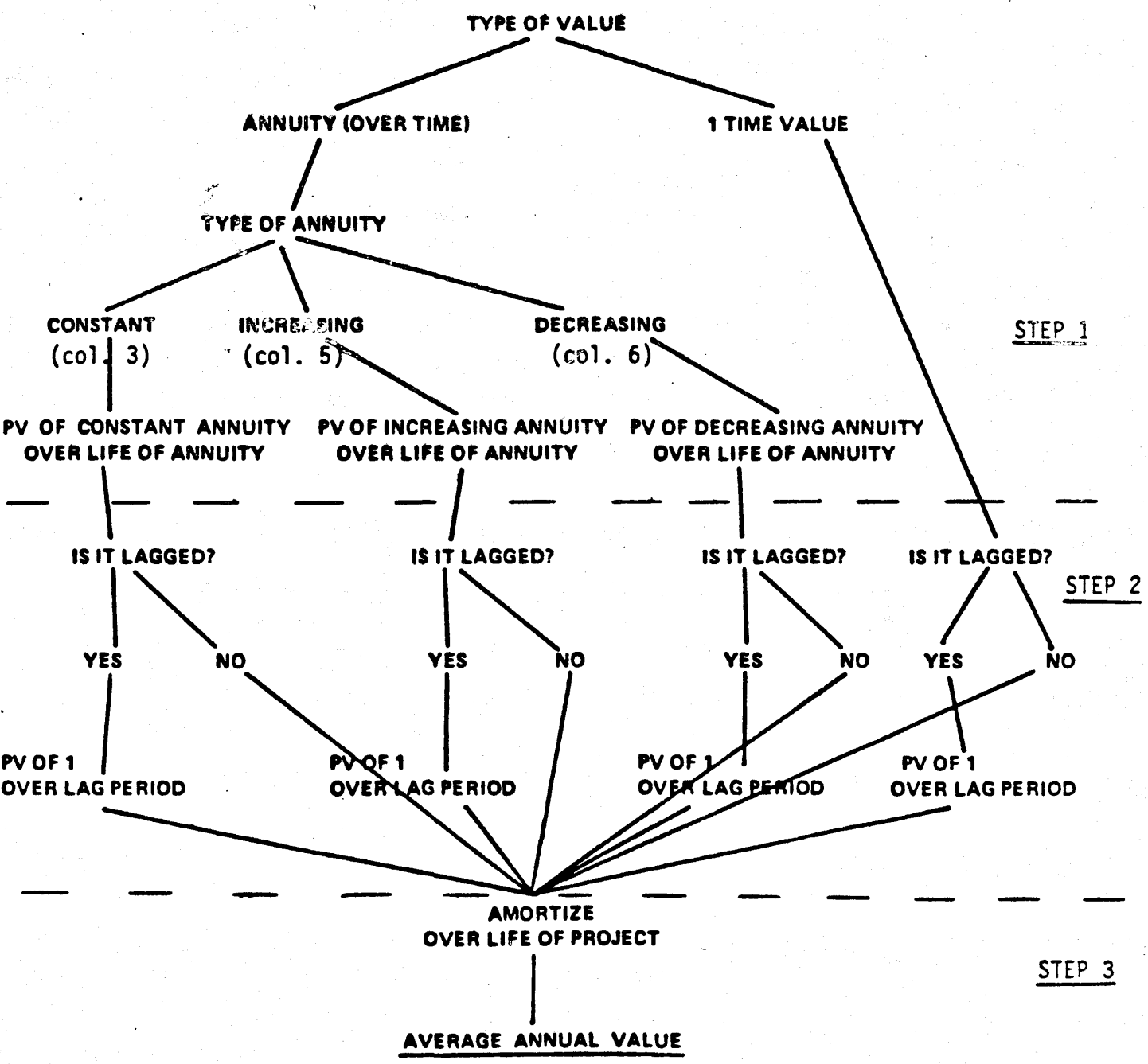

FIGURE 3-8

average increase would be 500 divided by 5, or 100. That value would be taken times the "present value of an increasing annuity" factor 5 years hence, which means you locate the factor in the 5 year row under the present value of an increasing annuity column and take it times 100.

The answer is multiplied by the "present value of one" factor over the lag period then amortized if the annuity is lagged, or just amortized if the annuity begins in the first year. The same steps would be taken for a decreasing annuity using the appropriate factors.

To summarize, the first step in the process is to convert any annuity into a one time value. Then we adjust for any lags which are present. And finally, we amortize. Thus we have three basic steps in our process:

1. Convert annuities to one time values.
2. Adjust for lags
3. Amortize

Note: Not all steps are used each time. The key guides you through the proper process. For example: If a one time value is considered, the key moves you past step 1. If the annuity or one time value is not lagged, the key moves you past step 2. Remember, this process is necessary to convert benefits and costs of conservation into values which can easily be incorporated into a farmer's records and decisionmaking system.

CHAPTER IV - SECTION V, TECHNICAL GUIDE

Effectiveness of conservation practices and systems is best measured through the analysis of field data. The information in Section V includes costs and prices, Section (V-A), response data, Section (V-B), and cost and return estimates, Section (V-C).

A. Section V-A, Information on Costs and Prices

1. Contents

The initial phase of evaluation studies on the effectiveness of conservation practices includes the collection, analysis, and use of current information on costs and prices. Cost and price data are needed by field personnel to determine the beneficial and adverse dollar effects of conservation practices.

Section V-A, Technical Guide should contain current cost information on (1) equipment and power, (2) seeds, fertilizers and other materials used in crop production, (3) labor, (4) irrigation water and assessments, where appropriate, and (5) construction, operation, and maintenance of resource management systems. Section V-A should also contain prices received for commodities produced and services provided by landowners and operators. The information in Section V-A must be reasonably current. It should be expanded to meet new demands within resource planning.

2. Sources of Data

Data for section V-A can be developed and maintained at the State level and/or at the field office. The broader State averages can be developed, maintained and distributed from the State Office. The area or field office personnel will find it desirable to record local conditions which differ from State averages as cost and price data are obtained during their normal day-to-day activities. Data developed at the state or local level should be updated as needed with local data.

Flat rate schedules or average costs lists for conservation practices (Chapter 5) can be prepared at any level of detail, i.e., State, multicounty, MLRA, etc. These schedules provide current estimates of per unit installation costs, length of life, operation and maintenance, and average annual costs of each practice that is being planned and applied within the area of study.

Possible sources of secondary data for State and local conditions are: (1) Agricultural Statistics and Census, (2) Marketing News Reports, Statistical Reporting Service, (3) Extension Service and University publications, and (4) localized reports edited by cooperative and marketing associations.

B. Section V-B, Response Data

1. Contents

Evaluations of the economic effectiveness of conservation practices are not complete without estimates of onsite and offsite responses with these practices installed. Responses may be converted to annual monetary values and compared with the annual cost of practices to determine economic feasibility.

Yield data are needed to determine the effects of resource management systems. The collection of yield data must be timely and systematic in order to maintain the appropriate records. Field personnel should be able to relate experiences of others who have applied similar practices or systems. This should help the individuals make informed decisions. Response data should be kept in physical units, i.e., tons, bushels, etc., rather than dollars to avoid obsolescence as prices change.

2. Sources of Data

Because there is limited research data on the quantification of benefits from conservation, it is important to understand how the quantification process works. It is useful information for "selling" conservation.

The benefits of conservation, as discussed in Chapter 1, can come from onsite or offsite sources. Onsite benefits can be derived from productivity maintenance and decreased production costs. Most scientists agree that, in general, as topsoil is removed from an area through natural or accelerated erosion, crop yields decrease. This effect can be seen by viewing a crop growing on a hill. On the sideslope of the hill, the crop has a thinner stand and seems stunted when compared to the crop at the bottom of the hill. This is due in part to the amount and quality of soil. The sideslope has been eroded at a faster rate than the bottomland, thus it cannot produce comparable yields.

In the past, measuring of yield reduction associated with erosion was not considered important. But it is a high priority today because of the emphasis placed on measuring the dollar value of the beneficial effects of conservation.

Many farmers, universities, and government agencies, including SCS, are studying the relationships between erosion and yields. One method currently being used is collecting soil depth and yield data from the same farmer's field within a certain soil type. This assures that the management is identical between sample points. Any differences in yield between sample points is largely due to the soil characteristics themselves. These characteristics, in turn, are shaped in part by past erosion.

Using the data from these sample points, an equation can be developed which will help scientists predict the yield/erosion relationship for that soil in other locations.

Within SCS, the job of defining the yield/erosion relationships of different soils is largely the responsibility of soil scientists and agronomists; those disciplines with the expertise to make such estimates. Given these estimates economists take this information one step further and develop dollar values for the effects of erosion on productivity both on outputs and on inputs. These values are a part of the basis for estimating the dollar benefits of various conservation measures.

Offsite benefits of conservation are real just as offsite damages are real. But unfortunately, offsite damages are sometimes hard to trace to any one source.

Many acres of eroding land can contribute to the same offsite damage. Yet, if the offsite damage can be traced to a specific treatable area, the benefits of applying conservation to that area are usually measurable in terms of the reduced cost of removing sediment.

For example, if a culvert fills with sediment from an adjacent field, the offsite benefit of applying conservation to that field is equal to the reduced cost of removing sediment from the culvert. The same is true with sediment damage to ditches, water supplies, pipes, irrigation facilities, tile outlets, and other facilities which are damaged by sedimentation. The off-site benefit derived by controlling erosion, is equal to the reduced cleanup costs, and repairs which would be incurred if the erosion were allowed to continue.

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An entire course has been designed to teach many aspects of offsite erosion effects. It is the "Water Quality Training Course" and is part of every new conservationist's overall training.

Data based on yield responses to resource management systems may be acquired during day-to-day activities or through specific efforts to acquire such yield estimates. Technicians should be alert to useful information as discussions are held with farmers and ranchers. Local Extension personnel and technicians with Agricultural Experiment Stations are sources of data and observations.

C. Section V-C, Cost and Return Estimates

1. Contents

Section V-C of the Technical Guide is designed to contain current cost and returns estimates (sometimes called enterprise or crop budgets) covering principal crops and livestock production activities pertinent to the area served by the field office. The estimates are to provide reasonably accurate approximations of the costs and returns of production for each of the important farm and ranch enterprises. A cost and return estimate is a systematic listing of the physical resources used, the products produced, and the values of each resource and product. It is prepared on a per acre basis with a specified production condition (soils, size of operation, water supply, etc.).

2. Sources of data

District supervisors, farmers and ranchers play an important role in the acceptance and successful use of cost and return estimates. They should be involved in the development of this planning tool. They, along with SCS technicians, are prime sources of data on items such as: tillage operations performed, ownership and operating costs of farm machinery, and amounts of seed, fertilizer, and irrigation water. Because the data are collected locally, the supervisors, farmers and ranchers develop confidence in the data base as the uses of budgets are demonstrated. Cost and return estimates should be prepared for specific areas where physical conditions and technology of production are similar. They can also be prepared on a Statewide basis by SCS or the Extension Service and then adjusted to local conditions.

Note: A representative budget which is prepared for an MLRA

or some other broad region is very useful for larger studies and as a starting point for preparing site specific (farm) budgets.

C. Preparation and use

Cost and return estimates (crop budgets) are designed to provide a systematic display of all input items used in the production of a crop and to also provide an estimate of the net returns. It is important to understand how these budgets are put together in order to be confident in developing or revising a crop budget for application to a specific conservation planning problem.

Individual farm budgets should start with the inputs the operator has available for use in the farm business. Often the amounts of land and operating capital he has, or can acquire, are limiting factors. Other factors such as buildings, the farmer's managerial skills, and available markets may also be relatively fixed. It is important to start with these fixed elements in planning a budget.

Generally the steps outlined below are followed in the development of a budget:

1. Selection of enterprise(s) to be budgeted.
2. Selection of physical data (inputs) to be used in the production process including machinery, materials, etc.
3. Selection of output levels.
4. Selection of prices to be applied to both inputs and outputs.
5. Calculation of the expected costs and returns.

An example of a typical budget for soybeans is shown in Figure 4-1.

The typical enterprise budget contains 3 major sections of costs and returns.

The first section, "Gross Receipts," lists total production in units, price per unit, quantity and value. The soybean budget shows a yield of 30 bushels per acre and a price of $6.50 per bushel. This gives total expected gross receipts of $195 per acre. If there was any other income from the soybeans (residue, grazing, etc.) it would be added to the grain receipts.

Figure 4-1 Example of Typical Soybean Budget

Dryland Soybeans for MLRA OOO

		UNIT	PRICE OR COST/UNIT	QUANTITY	VALUE OR COST
1.	Gross Receipts				
	Soybeans	Bu.	6.50	30.00	195.00
	Total				195.00
2.	Operating Costs				
	Preharvest				
	Seed	Bu.	12.00	1.00	12.00
	Fertilizer	Cwt.	8.00	2.00	16.00
	Lime	Tons	16.00	0.33	5.28
	Herbicide	Acre	11.75	1.00	11.75
	Insecticide	Appl	4.25	2.00	8.50
	Machinery	Acre	0.99	1.00	0.99
	Tractors	Acre	11.12	1.00	11.12
	Interest on Op. Cap.	Dol.	0.12	29.99	3.60
	Subtotal Pre-Harvest				69.23
	Harvest Costs				
	Hauling	Bu.	0.04	30.00	1.20
	Machinery	Acre	0.93	1.00	0.93
	Subtotal Harvest				2.13
	Total Operating Cost				71.36
3.	Income Above Operating Costs				123.64
4.	Ownership Costs				
	Machinery	Acre	19.26	1.00	19.26
	Tractors	Acre	7.15	1.00	7.15
	General Overhead	Acre	6.50	1.00	6.50
	Total Fixed Costs				32.91
5.	Labor Costs				
	Preharvest Labor (Trac & Mach)	Hour	3.50	1.53	5.35
	Harvest Labor (Trac & Mach)	Hour	3.50	0.33	1.15
	Total Labor Costs				6.51
6.	Total Costs				110.77
7.	Net Returns To Land And Management				84.23

The second section, "Operating Costs," lists the operating inputs necessary to produce 30 bushel beans along with the costs of these inputs to the farm operator. Included in operating costs are those items that require a cash outlay by the producer during the crop year and would not be made if that crop was not produced. Operating costs are broken down into preharvest and harvest components. The soybean budget indicates that it takes $69.23 in cash expenses to get soybeans to the harvest stage. Another $2.13 in harvest costs brings total operating costs to $71.36 per acre. These costs must be covered or else it would have been better not to have planted at all. Operating costs are subtracted from gross receipts to give a residual of $123.64 per acre return to land, labor, capital, machinery and overhead.

The third section, "Ownership Costs," includes such costs as depreciation, interest, insurance and general overhead. Ownership costs are the costs associated with buildings and equipment which are prorated over a period of years. After subtracting ownership costs from the previous residual, the remainder is return to land, labor, and management.

Labor charges may be either ownership or operating but it is difficult to separate the two. Therefore, labor is separated into preharvest and harvest labor only.

Total costs are $110.77 and these must be covered in the long-run to remain in business. Ownership and labor costs are subtracted from the previous residual to give returns to land and management, in this case $84.23 per acre.

These budgets do not include a charge for land. Land values and rental rates vary so much that an average figure would have little meaning.

After all costs are deducted, the residual is "Net Returns." Net returns can sometimes be misleading if not totally understood. This is because some enterprise budgets carry "net returns" to different levels. The net return figure will vary according to what costs are included. For instance, the residual of net returns to land and management would be less than residual of net returns to land, labor and management simply because the labor cost was deducted.

Most farmers have not developed enterprise budgets for their farming operation. It is seldom that the producer has complete information pertaining to the production of a particular

commodity. Also, producers do not have complete information with regard to conditions in the product and input markets. That is why regionalized budgets are developed at the State Office for use in the field.

If a farmer has a different situation or set of resources than those described in the budgets supplied by the State Office, then modifications should be made accordingly. If from his/her records, he/she knows some of the production costs are different or if the age and value of the machinery, equipment or facilities are different than those assumed in the budget, then his/her actual figures should be entered. In doing this, the modified budget will better reflect the costs and returns for the particular situation.

Currently SCS uses the Crop Budget System (CBS) which is a computerized system for creating detailed cost and return estimates. This system operates on a main frame computer in Washington, D.C.. A new system, called the Cost And Return Estimator (CARE) is under development. This system will help the user create and/or adjust cost and return estimates using a microcomputer.

Note: A manually developed cost and return estimate worksheet is included as example Problem F in Appendix A.

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CHAPTER V - EVALUATION TECHNIQUES FOR THE FIELD

This chapter deals with processes and methods to apply the information presented in Chapters 1-4. Different situations call for different levels of analysis as discussed previously. For farmer A, just knowing what the conservation alternatives will cost is all he needs to make a decision. Farmer B may require an estimate of physical benefits to expect when applying various alternatives. Farmer C may want a monetary estimate of the benefits that the conservation alternatives will produce. The following techniques are designed to help the field office provide services for all three levels of detail.

A. Flat Rate Schedule

To simplify the quantification of installation and O&M costs, a format was developed to list these costs, Figure 5-1. The flat rate schedule, sometimes referred to as an average cost list, can be developed quite simply by jotting down costs of practices as they are acquired.

The format also permits the estimation of total average annual costs, that is, average costs developed on a yearly basis.

To investigate the flat rate schedule in more detail we must examine the eight column headings. The Conservation Practice heading is used to record the name of the practice, like waterway, or pond, etc., and the corresponding practice code. Units refer to the normal measures used in describing quantity of the practice component like feet, acres, or number.

The Flat Rate Installation Cost refers to the costs of labor, material and equipment needed to install one unit of the practice according to the standards and specifications shown in Section IV of the Technical Guide. Life Span is the expected life of the practice based on SCS specifications.

The Amortization Factor is a value used to spread out the cost of a practice over the life of the practice. The amortization factor is acquired from an Interest and Annuity (I&A) Table, as discussed in Chapter III and presented in Appendix B.

To choose the proper table, an interest rate must be selected that reflects the farmer's borrowing rate if he will be borrowing to pay for the practice, or his savings rate if he will be using his own money. Matching the interest rate column with the life span row, gives the amortization factor for that practice.

Figure 5-1. Flat Rate Schedule

Conservation Practice	Units	Flat Rate Installation Cost	Life Span	Amortization Factor (%)	Average Annual Installation Cost	Annual O&M	Total Average Annual Cost

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Converting the installation cost into an annual cost is done by multiplying the installation cost by the amortization factor. This result is recorded under the Average Annual Installation Cost Column. The next column is Annual O&M which refers to the cost of maintaining the practice on a yearly basis. The final column is the Total Average Annual Cost, which is the sum of the annual installation cost and the annual O&M cost.

Example: Use I&A Tables to help fill in one line of the Flat Rate Schedule given the following information: A farmer-built terrace system costs .30/ft to install and O&M costs are estimated to be 10% of installation costs annually. The terraces are estimated to last 20 years and the farmer's alternative savings rate is 10%.

Solution: The amortization factor at 10% for 20 years is .117. To convert the installation cost to an average annual value involves multiplying $.30 by .117 which equals $.04. O&M is equal to $.30 x 10% = .03 so total average annual cost equals $.04 + $.03 = $.07 per ft per year (Figure 5-2).

Note: Computer software spreadsheets such as Lotus 1-2-3, Visicalc, Prelude, etc., can make the process of maintaining the flat rate schedule much easier.

B. Cost Analysis

Cost analysis is a method that identifies the costs of practices or systems of practices needed to reach a conservation goal. In cost analysis, the following information can be discussed with the farmer (Figure 5-3):

Problem - 15 tons per acre per year sheet and rill erosion causing decreased production on cropland with offsite sedimentation of a road culvert.

Possible Practices - Individual practices or systems of practices which would control the problem. (Remember, the farmer is entitled to consider all available options and may not be able to afford complete treatment of his problem right away.)

Installation Cost, Life Expectancy, O&M, and Average Annual Total Cost - these come directly from the flat rate schedule and supply the farmer with relevant cost data.

Remaining Problem - Defined as the portion of the damage still present after each practice or system of practices is applied. An example would be 6 tons per acre per year sheet and rill erosion remaining with no offsite damage.

Figure 5-2 - Flat Rate Schedule

Conservation Practice	Units	Flat Rate Installation Cost	Life Span	Amortization Factor (10%)	Average Annual Installation Cost	Annual O&M	Total Average Annual Cost
Farmer-built terrace	ft.	$.30	20	.117	$.04	$.03	$.07

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Figure 5-3 - Cost Analysis for Farmer X
(% interest)

Problem	Possible Practices	Installation cost	Life	O&M	Average Annual Total Cost	Remaining Problem

With information on the initial problem, practice costs, and remaining problem, it is easier for the farmer to make a decision. The farmer will most likely weigh the problem reducing ability of each practice against cost.

Example: Use the data on the flat rate schedule you just completed to fill in one line on the cost analysis sheet.

Solution: Figure 5-4 illustrates the ease of completing a cost analysis given a completed flat rate schedule.

Note: Another appropriate example of cost analysis is contained in Appendix A, under Agricultural Waste.

C. Partial Budgeting

The partial budget is an important tool for SCS conservationists to use as they assist farmers, ranchers, and other landusers in evaluating conservation practices and systems of practices. The partial budget technique is basically a weighing of only the benefits and costs which change as alternatives are considered. This technique simplifies data collection while examining how benefits and costs "stack up."

The partial budget form Figure 5-5 is made up of two sections: Gains to the landuser and losses to the landuser. The gains section contains space to list added returns and reduced costs. This is where the quantified benefits such as productivity maintenance, reduced production costs, and offsite benefits belong.

The losses section has space to list added costs and reduced returns. Here quantified costs can be supplied. These include OM&R, lost production, and added inputs.

The bottom line on the form is truly the "bottom line." It represents the estimated change in income due to the investment in the conservation system. Try the following examples.

Example 1: You want to test conservation tillage for Farmer Brown to see if it would be profitable to apply. In other words, you want to compare the without conservation condition to the with conservation condition. According to your state soil scientist and resource conservationist, with- out the application of any conservation, erosion on Farmer Brown's field would cause yields to drop by 16 bushels per acre in 20 years. But, conservation tillage would reduce erosion enough to maintain

Figure 5-4 - Cost Analysis For Farmer X
(10% interest)

Problem	Possible Practices	Installation Cost	Life	O&M	Average Annual Total Cost	Remaining Problem
Ephemeral Erosion	Farmer-built terrace	$.30	20	$.03	$.07	No problem remaini

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Figure 5-5 - Partial Budget Form
Part A

		$/Acre
1.	Added returns	
	_____	$ _____
	_____	_____
	_____	_____
	Plus	
2.	Reduced costs	
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	Subtotal A (gains to the landuser)	$ _____

Part B

1.	Added costs	
	_____	$ _____
	_____	_____
	_____	_____
	_____	_____
	_____	_____
	Plus	
2.	Reduced returns	
	_____	_____
	_____	_____
	_____	_____
	Subtotal B (losses to the landuser)	$ _____
	Estimated change in income (A minus B)	$ _____

nearly the same yield he is currently getting.

Note: Future yields in this estimate are not rising through time as you might expect, because technology is held constant. This means that no new advances in seed, machinery, or other inputs are predicted. This may be a conservative assumption, but it is very difficult to estimate future technology and its costs.

Assume your state economist has taken the physical data and converted it into an annual dollar figure. For this example, $4/acre/year is the productivity maintenance benefit. Other benefits and costs from conservation tillage were estimated by comparing a conventional tillage budget with a conservation tillage budget. It was found that fuel, labor and machinery costs were $10/acre/year lower under conservation tillage. But, herbicide + insecticide costs were $8/acre/year higher.

The question is, does conservation tillage make economic sense in this particular case? Let's put these figures into a partial budget format and find the change in net returns.

Solution: The productivity maintenance benefit in this case was previously estimated to be $4/acre/year. This figure goes under added returns. If there had been any offsite benefits, they would have been entered here as well.

Reduced production costs include $10/acre/year for lower labor, fuel, and machinery costs. This figure is obviously entered under reduced costs. Thus, the gains to the landuser are $4 + $10 or $14/acre/year. Added costs include the increased costs for herbicide and insecticide at $8/acre/year. If this practice would have had installation and O&M costs, the total average annual figure would be placed under added costs as well.

And, if the practice had taken any land out of production the value of the lost production would be included under reduced returns. In this case there are no reduced returns. The losses to the landuser would be $8/acre/year, leaving an estimated change in income at $14-$8 or $6/acre/year net return to the farmer by practicing conservation tillage. Please realize farmers weigh many things while deciding whether or not to apply conservation practices, but given information like that used in this example, they can make better decisions.

Example 2: Fill in a partial budget form given the following benefit and cost information: The cost of putting in a farmer-built terrace system has been calculated at $60/acre which when amortized is $6.12/acre/year. O&M is $1.75/acre/year. The terrace system will reduce erosion such that the farmer will realize $7.85/acre gain annually in productivity maintenance but his increased costs of farming with the terraces is $1.15/acre/year. Offsite benefits from the terrace system are $2.10/acre/year. Assume no land is taken out of production for the terrace system.

Solution: Figure 5-6 illustrates the use of the partial budget for this example.

D. Breakeven Analysis

Consider the following questions: (1) How much can I afford to spend? (2) How long will it take to get my money back? (3) What rate of return will I get? and (4) How much net gain do I need? All four questions are "breakeven" questions. Each of the questions involve an unknown variable required in any evaluation, i.e. (1) cost; (2) time; (3) interest rate; and (4) change in net returns. Each question can be answered if the other three variables are known. Consider the following example:

An opportunity exists to develop a water source (spring) and improve grazing distribution. This will allow the harvest of 30 AUMS in an area where only 10 are harvested at present.

Breakeven Problems and Their Solutions

Example 1: (Breakeven Cost)
How much can the cooperator afford to spend (capital cost) for the stockwater development if the life is 20 years, the interest rate is 12% and an AUM is valued at $7?

Solution: 20 AUMS (change in yield) x $7 per AUM = $140
$140 x 7.46944 (P.V. of annuity of 1 per yr, 20 yr, 12%) = $1,045.72
The cooperator's breakeven point is a capital cost of $1,045.72. At any cost below the breakeven point the cooperator will profit from stockwater development.

Example 2: (Breakeven time)
What is the period of capital recovery or minimum life expectancy for the proposal if the capital cost is $1,000, an 8% interest rate is used, and the value of the change in AUM's produced is $120 per year.

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Figure 5-6 - Partial Budget Form
Part A

	$/Acre
1. Added returns	
Maintaining productivity	$ 7.85
Offsite benefits (cost of cleaning culverts)	2.10
Plus	
2. Reduced costs	
None	0
Subtotal A (gains to the landuser)	$ 9.95

Part B

1. Added costs	
Farmer-built terrace	$ 6.12
O&M costs	1.75
Added input costs (fuel, time, etc.)	1.15
Plus	
2. Reduced returns	
None	0
Subtotal B (losses to the landuser)	$ 9.02
Estimated change in income (A minus B)	$ .93

Solution: $1000 (Capital Cost) / 120 = 8.333. Using the 8% compound interest and annuity table, Appendix B, read down the column labeled PV of an annuity of 1 per year until a factor close to 8.333 is found. Then read left to time period column. The factor of 8.333 occurs between 14 and 15 years. Conclusion is that the period of capital recovery, minimum life expectancy or breakeven time is about 15 years.

Example 3: (Breakeven interest rate)
What is the breakeven interest rate or internal rate of return when capital cost is $1,000, effects are evaluated over a 20 year time period and the value of the change in AUMS produced is $180/year.

Solution: The PV of an annuity of 1 per year factor for the breakeven interest rate is $1,000/180 = 5.555. Reading across interest tables we find that the PV of an Annuity of 1 per year factor for 20 years at 16% = 5.92884, 17% = 5.62777, and 18% = 5.35275. Since the factor for 17% is closest to but not less than the breakeven factor of 5.55556 we conclude that the breakeven interest rate is slightly greater than 17%.

Example 4: (Breakeven value)
What must an AUM be worth to break even when capital cost is $1,400, evaluation is 20 years, and benefits are discounted at 11%?

Solution: $1,400 x .12558 (amortization factor, 20 years, 11%) = $175.81. 175.81/20 = $8.79 per AUM

Given the level of the other variables an AUM must be worth $8.79 to break even.

Note: Farmers may not adopt practices at breakeven levels because of risk and other factors.

E. Alternative Resource Management System Evaluation (ARMSE)
Methods used for evaluating alternative resource management systems are very flexible. They can be used to evaluate the effectiveness of a single practice or any combination of practices or measures for a field or an entire operating unit. The methods provide for evaluating changes in land use and changes in crops or other products. The basic principle involved is to use identical procedures for evaluating two or more alternative resource management systems for the same land area.

The existing condition should be compared with the alternatives. If data is available, comparisons can also be made for a future condition, assuming various trends or conditions are likely to occur. The predicted annual soil loss (wind and water erosion) and nonmonetary effects (i.e., wildlife, water quality, etc.) should be recorded for each management system.

The difference between the systems is the basis for analysis. This method is not intended nor should it be used to make a complete management analysis of a farm or a ranch. Many factors beyond the scope of this method must be considered to make a complete management analysis. However, this method may be used to help the decision maker select a conservation practice or a resource management system that best fits his/her conservation needs.

The installation costs of conservation practices must be adjusted to a common base in order to evaluate alternative resource management systems. Annual costs are usually selected as a common base to compare with crop and livestock returns realized on an annual basis. If local installation costs are used, they should be converted to annual costs.

Following is an explanation of parts of the worksheets:

1. Existing Condition (Figure 5-7): Identify the kind of soil. Describe land use, cropping system, reasons for developing a resource management system, producer's objectives, etc., as appropriate.

2. Alternatives (Figures 5-7): Describe the alternative systems for accomplishing the objective. Determine the resource area to be evaluated. It may be an acre or two, a field, a farm, or an entire ranch. The area of the competing alternatives must be equal, that is, the same number of acres (or adjusted to a common base.)

3. Gross Returns (Figures 5-7): Determine and record the total production of each product to be produced for each alternative. Multiply acres times yield times price to obtain gross returns. Yields should be current and based on local current data if available, regional data bases, or an educated estimate based on prior experience and/or application. Use current price information. When evaluating a rotation, calculate the gross income for the complete rotation and divide by the number of years to get the average annual gross income.

4. Production Costs (Figures 5-7): Determine and record total production costs for all products for each alternative. Use local cooperator information if available, or refer to crop budgets for your county or MLRA. Do not include land costs in the evaluation because they usually will be constant for each alternative.

When evaluating a rotation, calculate total production costs for the complete rotation and divide by the number of years to get the average annual production cost.

5. Conservation Practice Costs (Figures 5-7): Determine conservation practices and quantity needed for each alternative. Incorporate cost sharing as appropriate in the calculations. Convert installation costs to annual costs by the use of an amortization factor. (See worksheet example.) The interest rate used in the calculations should reflect the current consumer loan rate. Be sure to include a cost estimate for annual operation and maintenance.

6. Other Effects (Figures 5-7): Determine the effects of the alternative which cannot or have not been expressed in dollars. These could include effects on wildlife habitat, water quality, estimated annual soil loss, etc.

Note: These effects should not include impacts already evaluated using dollar values.

7. Summary (Figure 5-7): Record annual gross returns as previously calculated. Add the production costs and the annual conservation practice costs together to obtain total costs. Subtract total costs from gross returns to obtain net return. Record annual soil loss estimate. Record nonmonetary effects or other notes pertaining to the analysis.

8. Analyze the Differences: The significance of these calculations is the difference between the alternatives being considered. Determine the cause for the difference, being careful to consider nonmonetary effects.

Example: Figures 5-8 through 5-9 illustrate a cropland example of ARMSE.

ALTERNATIVE RESOURCE MANAGEMENT SYSTEM EVALUATION (ARMSE)

Landuser's Name: _____ Conservationist: _____ CTU No.: _____ Date: _____

EXISTING CONDITION:

Crop	Years	x	Acres	x	Yield	x	Price	=	Gross Return	x	Cost/Acre	=	Prod. Costs	Practices	Annual Cost
					Total Gross Returns						Total Costs			Ann. Cons. Costs	
Annual Gross Return:					/		years =				Annual Production Costs:		/	years =	

GROSS RETURN — PRODUCTION COSTS — CONSERVATION PRACTICE COSTS

Other Effects: _____

ALTERNATIVE #_____

Crop	Years	x	Acres	x	Yield	x	Price	=	Gross Return	x	Cost/Acre	=	Prod. Costs	Practices	Annual Cost
					Total Gross Returns						Total Costs			Ann. Cons. Costs	
Annual Gross Return:					/		years =				Annual Production Costs:		/	years =	

Other Effects: _____

ALTERNATIVE #_____

Crop	Years	x	Acres	x	Yield	x	Price	=	Gross Return	x	Cost/Acre	=	Prod. Costs	Practices	Annual Cost
					Total Gross Returns						Total Costs			Ann. Cons. Costs	
Annual Gross Return:					/		years =				Annual Production Costs:		/	years =	

Other Effects: _____

SUMMARY MONETARY EFFECTS	Annual Gross Return	Annual Prod. Costs	Annual Cons. Costs	Annual 1/ Returns	Annual 2/ Value of Other Effects	Annual 3/ Soil Loss Est.
Existing Condition						
Alternative #____						
Alternative #____						
Alternative #____						

1/ Annual Gross Returns (-) Costs (Prod. Costs (+) Ann. Cons. Prac. Costs) = Annual Returns.

2/ Reflects value of other effects—may include est. value of nutrients lost (net reduction in tons of soil x value of nutrients lost x acres affected in CTU), cost-sharing practices and other items having a monetary value.

3/ Reflect soil loss calculations.

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FIGURE 5-8
ARMSE: CROPLAND EXAMPLE - CONSERVATION DATA

CALCULATION OF PRODUCER'S ANNUAL COST - PARALLEL TERRACE SYSTEM

FORMULA: PRODUCER'S ANNUAL COST = [INSTALLATION COST X PRODUCER'S COST SHARE % X AMORTIZATION FACTOR] + ANNUAL OPERATION AND MAINTENANCE (O&M) COST

PRODUCER'S COST SHARE %:

PARALLEL TERRACES - 50%; GRASSED WATERWAY - 25%

DATA FOR ALTERNATIVE #2: PARALLEL TERRACES ($.31/ft); GRASSED WATERWAY ($560/ac); O&M (2% OF INSTALLATION COST)

PRODUCER'S ANNUAL COST (TERRACES) = [(13,200 ft)($.31)(.50)(0.13388 1/)] + [(13,200 FT)($.31)(.02)] = $356

PRODUCER'S ANNUAL COST (WATERWAYS) = [(2.5 AC)($560)(.20)(0.13388 1/)] + [2.5)($560)(.02)]

= $47 + 28

= $75

TOTAL PRODUCER'S ANNUAL COST = $356 + 75 = $431

1/ FROM AMORTIZATION TABLE - 12% INTEREST RATE, 20-YEAR USEFUL LIFE

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FIGURE 5 - 9

ALTERNATIVE RESOURCE MANAGEMENT SYSTEM EVALUATION (ARMSE)

Landuser's Name: J. R. Ewing Conservationist: C. Barnes CTU No.: #7 Date: 5/1/86

EXISTING CONDITION: Mr. Ewing wants to continue to crop a 50 acre cotton field of Houston Black Clay

Crop	Years	x	Acres	: x	Yield	x	Price	=	Gross Return	: x	Cost/Acre	=	Prod. Costs	:	Practices	Annual Cost
					GROSS RETURN						PRODUCTION COSTS				CONSERVATION PRACTICE COSTS	
Cottonlint	1		50	:	400 lb		.70		14,000	:	242		12,100	:	None	0
Cottonseed	1		50	:	.33 T		90		1,485	:				:		
				:						:				:		
				:						:				:		
				:	Total Gross Returns				15,485	:	Total Costs		12,100	:	Ann. Cons. Costs	0
Annual Gross Return:			15,485	/	1	years =			15,485	:	Annual Production Costs:		12,100	/	1 years =	12,100

Other Effects: Estimated soil loss is 13.5 T/A/Y under conventional tillage

ALTERNATIVE # 1

Hay production - forage sorghum (sudan)

Crop	Years	x	Acres	: x	Yield	x	Price	=	Gross Return	: x	Cost/Acre	=	Prod. Costs	:	Practices	Annual Cost
Sudan Hay	1		50	:	5 T		55		13,750	:	255		12,750	:	None	0
				:						:				:		
				:						:				:		
				:						:				:		
				:	Total Gross Returns				13,750	:	Total Costs		12,750	:	Ann. Cons. Costs	0
Annual Gross Return:			13,750	/	1	years =			13,750	:	Annual Production Costs:		12,750	/	1 years =	12,750

Other Effects: Estimated soil loss is 4.4 T/A/Y

ALTERNATIVE # 2

Continuous row crops with conservation tillage - 3 year rotation of grain sorghum, cotton, grain sorghum. Cotton yield increased/bale.

Crop	Years	x	Acres	: x	Yield	x	Price	=	Gross Return	: x	Cost/Acre	=	Prod. Costs	:	Practices	Annual Cost
Grain Sorghum	2		47.5	:	38 cwt		4.70		16,967	:	122		11,590	:	Parallel Terraces	356
Cottonlint	1		47.5	:	480 lb		.70		15,960	:	225		10,688	:	(13,200 ft.)	
Cottonseed	1		47.5	:	.35 T		90		1,496	:				:	Grassed Waterways	75
				:						:				:	(2.5 Acres)	
				:	Total Gross Returns				34,423	:	Total Costs		22,278	:	Ann. Cons. Costs	431
Annual Gross Return:			34,423	/	3	years =			11,474	:	Annual Production Costs:		22,278	/	3 years =	7,426

Other Effects: Estimated soil loss is 5.1 T/A/Y. A few rows of sorghum left for wildlife food.

SUMMARY MONETARY EFFECTS	Annual Gross Return	Annual Prod. Costs	Annual Cons. Costs	Annual 1/ Returns	Annual 2/ Value of Other Effects	Annual 3/ Soil Loss Est.
Existing Condition	15,485	12,100	0	3385	-	13.5
Alternative # 1	13,750	12,750	0	1000	-	4.4
Alternative # 2	11,474	7,426	431	3617	-	5.1
Alternative #						

1/ Annual Gross Returns (-) Costs (Prod. Costs (+) Ann. Cons. Prac. Costs) = Annual Returns.

2/ Reflects value of other effects—may include est. value of nutrients lost (net reduction in tons of soil x value of nutrients lost x acres affected in CTU), cost-sharing practices and other items having a monetary value.

3/ Reflect soil loss calculations.

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F. Interactive Conservation Evaluation (ICE)

Interactive Conservation Evaluation or ICE is a "user friendly" software package designed to provide a computerized evaluation process to assist landusers in evaluating and selecting alternative soil conservation measures. The procedure used in ICE is much the same as is done by hand (ARMSE), but calculations are made faster and with greater accuracy on a microcomputer.

The initial step of the ICE procedure is the identification of the area under study, the dominant soil, and the major resource problem. Step two of the process is the determination of physical and economic conditions presently existing without treatment, and changes in these conditions over time. This step produces a summary of land use, acres, yield, net returns, and soil loss for the present condition. These net returns serve as a basis for comparison during subsequent steps. The third step consists of selecting conservation measures to be considered as alternatives in treating the resource problems for the individual landuser. ICE provides summaries of installation costs, life expectancy, O&M, and total average annual costs for each alternative. This summary is really a flat rate schedule which can be quickly printed and used independently.

Once each of the alternatives has been developed and displayed separately, ICE provides a complete summary of the benefits and costs of all alternatives being evaluated. This enables the landuser and the conservation planner to compare the results and consider trade-offs before making the final selection. Again, this procedure is basically a computerized version of current evaluation techniques. It uses data that, once entered, may be stored on disk files for use in many alternative analyses. The entire process is easy to complete as the microcomputer prompts the user throughout each step. Help screens are available at each juncture of the process making ICE a self-help technique. The program requires little training to achieve effective use of the system.

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APPENDIX A - EXAMPLE PROBLEMS

Economic evaluations of alternatives are conducted to develop information to be used by decisionmakers in determining the most desirable alternative. In any evaluation, four variables must be considered: costs, time, interest rate and change in net returns.

One traditional method of economic analysis is to compare benefits and costs over time at a given interest rate to calculate net benefits (benefits minus costs). The feasibility criterion is that net benefits must be positive. The following four examples representing different resource problems illustrate this technique.

A. Erosion

Farmer John Henry Jones has a 20 acre field in which he produces 10 acres of corn and 10 acres of soybeans. The corn and soybeans are presently yielding 85 bushels and 30 bushels respectively. With an 18 ton erosion rate these yields are expected to drop to 75 bushels and 20 bushels in the next 20 years.

In order to maintain present production levels, erosion rates have to be less than four tons per acre. One method of controlling the erosion is to install a tile outlet terrace resource management system with crop residue management and a conservation cropping system. An alternative is a contour farming resource management system with a crop residue management system and a conservation cropping system winter cover. The erosion rates with the terrace system will be 3.2 tons per acre and the rate with the contour system will be 4.1 tons per acre.

Determine if it will be more feasible to keep his present practice or to convert to one of the resource management systems. Use 10 percent interest rate and 25 year life for the tile outlet terrace.

Price:	$2.90 Corn
	$6.10 Soybeans
Production Cost:	$118.78 Corn
	$122.51 Soybeans
Measure Costs:	$ .11 per foot (450 feet per acre) terrace
	$ .70 per foot (50 feet per acre) tile outlet
	$ 2.00 conservation cropping system
	$12.50 conservation cropping system with winter cover
	$ 2.00 contour farming per acre
	$ 1.00 crop residue management
O&M:	$10.00 per acre terrace with tile outlet

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Without Condition

Acres: 10 acres corn
10 acres soybeans

Yield: Now - 85 bu. corn and 30 bu. soybeans
20 years later 75 bu. corn and 20 bu. soybeans

Production Costs: $118.78 corn per acre
$122.51 soybeans per acre

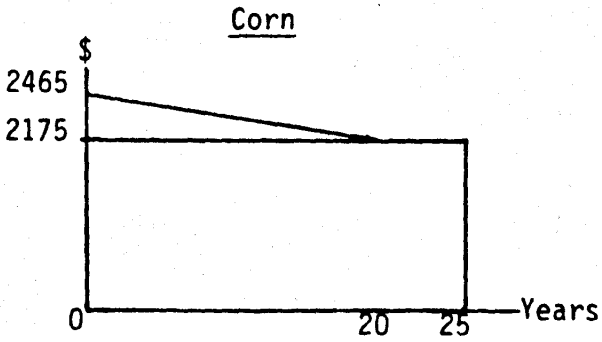
Returns: 85 x $2.90 x 10 = $2465
75 x $2.90 x 10 = $2175
30 x $6.10 x 10 = $1830
20 x $6.10 x 10 = $1220

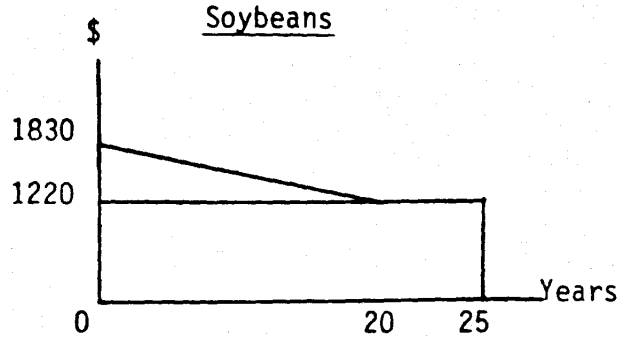
Corn - $2465 - $2175 / 20 = $14.50
$14.50 x 114.86436 1/ x .110172/ = $183.49 + 2175 = $2358.49

Soybeans - $1830 - $1220 / 20 = $30.50
$30.50 x 114.864361/ x .110172/ = $385.97 + $1220 = $1605.97
Gross Return - $3964.46

Production Cost: $118.78 x 10 = $1187.80
$122.51 x 10 = $1225.10
$2412.90 Production Cost

Net Return:
$3964.46 - $2412.90 = $1551.56 net return
$1551.46 / 20 = $77.58





1/ Present value of decreasing annuity 20 years @10%
2/ Amortization factor 25 years

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With Contour Farming System

Acres:	10 acres soybeans 10 acres corn
Yield:	30 bushels soybeans 85 bushels corn
Price:	$2.90 corn $6.10 soybeans
Production Costs:	$118.75 corn per acre $122.51 soybeans per acre
Measure Costs:	$12.50 Conservation Cropping System $ 1.00 Crop Residue Use $ 2.00 Contour Farming
Returns:	$4295 gross returns
Production Costs:	$2412.60
Measure Costs:	$12.50 x 20 = $250.00 $ 1.00 x 20 = $ 20.00 $ 2.00 x 20 = $ 40.00 $310.00 Annual Cost
Net Returns:	$4295 - 2412.60 - 310 = $1572.40 $1572.40 / 20 = $78.62 per acre

With Tile Outlet Terrace System

Acres:	10 acres soybeans 10 acres corn
Yield:	85 bu. corn 30 bu. soybeans
Price:	$2.90 per bu. corn $6.10 per bu. soybeans
Production Costs:	$118.75 corn per acre $122.51 soybeans per acre
Measure Costs:	
	$ .11 per foot (450 feet/acre) terrace $ .70 per foot (50 feet/acre) tile outlet $ 2.00 conservation cropping system $ 1.00 crop residue management
O&M	$10.00 per acre terrace

Returns:

85 x $2.90 x 10 = $2465
30 x $6.10 x 10 = $1830
$4295 gross returns

Production Costs:

$118.75 x 10 = $1187.50
$122.51 x 10 = $1225.10
$2412.60 Production Cost

Measure Cost:

$ .11 x 450 x 20 x .11017 1/	=	$109.06
$ .70 x 50 x 20 x .11017 1/	=	$ 77.11
$ 1.00 x 20	=	$ 20.00
$ 2.00 x 20	=	$ 40.00
$10.00 x 20	=	$200.00
Total Annual Cost	=	$446.17

Net Return:

$4295 - $2412.60 - $446.17 = $1436.23
$1436.23 / 20 = $71.81

1/ Amortization factor 25 years @10%.

Summary

Alternative	Net Return ($/acre)	Change in Net Returns ($/acre)	Erosion (t/a/y)
Without Condition	77.58		18
Contour Farming	78.62	+1.05	4.1
Tile Outlet Terrace	71.81	-5.76	3.2

In summary, both alternatives solve the erosion problem but contour farming does it more economically.

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B. Land Use Conversion

Farmer Billie Bob Brown lives in Montgomery County, Southern State near the community of Rebel. His 300 acre farm consists of 200 acres of cropland, 90 acres of second growth Loblolly Pine and 10 acres of miscellaneous use.

A conservation plan has been developed and planned measures have been applied to the cropland. The cropland use is 140 acres of soybeans and 60 acres of corn. No management practices are being applied on the woodland and Billie Bob has no interest in improving the woodland. He has talked to the District Conservationist about converting 40 acres of woodland to cropland to increase his corn acreage.

The 40 acres are well drained Oktibbeha clay soils with a 1.5 percent slope. Erosion rate of this area is computed to be 4.6 tons per acre with continuous row crop and winter cover. the Loblolly Pine stand is 15 years old with a site index of 60. At present there is no marketable pulpwood volume for the stand. Ten years from now the stand at age 25 will have a diameter of 6.1 inches marketable at $8.00 per cord yielding 27 cords.

Corn yields will average 90 bushels at $2.66 per bushel. Production costs are $150.98. In addition a wheat cover crop will cost $22.00 per acre for bush hogging, disking, or drilling and seed. The cover will be turned under in the spring without any grazing. Clearing costs are $500 per acre.

Determine if it will be more feasible to clear the 40 acres to increase corn production or leave it in pines for pulpwood ten years from now. Compute the economic returns for the without clearing condition to determine the difference in average annual net returns for the next 10 years at 10 percent annual interest.

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WITHOUT CLEARING

Leave in Loblolly Pine now

Clear cut 10 years from now

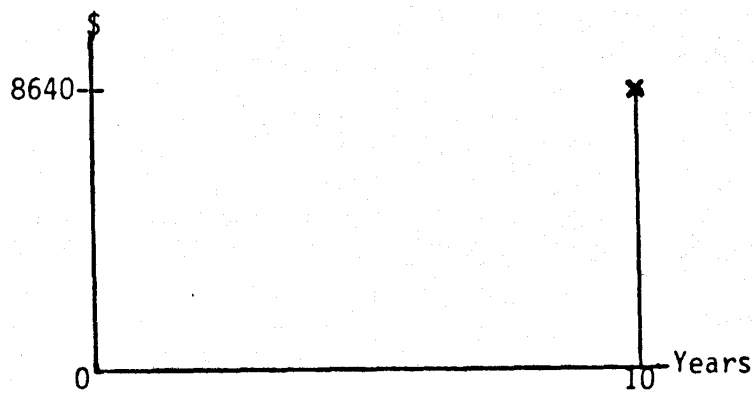
25th growth year 27 cords per acre

$8.00 stumpage per cord

Growth Year	Years Hence	Returns Dollars	Cost Dollars	Present Value of 1	Present Value
25	10	8640	0	x 0.38554	3331

3331 x 0.16275 1/ = $542 Annual Net Return Per 40 Acres

$542 / 40 = $13.55 Annual Net Return per 1 acre



1/ Amortization Factor 10 years @ 10 percent.

WITH CLEARING

Convert 40 acres pines to cropland - corn

Clear 40 acres at $500 per acre

Plant to continuous corn

Apply cover crop each year at $22 per acre

Corn Yield will average 90 bushel per acre

Production cost is $150.98 per acre

40 x $500 = $20,000

$20,000 x 0.16274 = $3255 Annual Clearing Cost

Production Cost $150.98 x 40	=	$6039
Returns 90 BU x $2.66 x 40	=	9576
		$3537
- Clearing		$3255
		$ 282
- Cover 22 x 40	=	$ 880
		$ 598 Loss

-598 / 40 = -14.95 per acre

1/ Amortization Factor 10 years @ 10 percent

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SUMMARY

Alternative	Net Returns ($/acre)	Change in Net Returns ($/acre)	Erosion (t/a/y)
Without Clearing	13.55		1.0
With Clearing	-14.95	-28.50	4.6

By going to the trouble of clearing the field, the landuser is not only going to lose $14.95 on the new crop, but he will be foregoing $13.55 in timber returns for a total of $28.50/acre/year.

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C. Water Management

This problem is related to Lee Fall's cropland and his thoughts about irrigating 50 acres of peanuts. The soils are Lucy loam, 0-5% slope and Orangeburg sandy loam, 2-5% slope. Average yields are peanuts, 3,000 lbs.; corn, 85 bu.; and winter rye for grazing, 6 AUM over a 3-month period. Estimated yields with irrigation are peanuts, 3,500 lbs.; corn, 125 bu. No change in winter rye yields.

The estimated cost of a center pivot irrigation system, including pipe, sprinkler system, pump and other miscellaneous equipment is $35,000. In addition, Lee will have to build a reservoir for water storage at an estimated cost of $15,000. Operation and maintenance costs including system repair and maintenance, reservoir maintenance, irrigation labor and fuel must be estimated.

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Without Condition

Field No. 8 - (Partial) 50 acres

Land use and average yields

peanuts - corn rotation

1st year

peanuts	3,000 lbs.
Winter rye cover crop - 6 AUM/3 months	

2nd year

corn	85 bushels
Winter rye cover crop - 6 AUM/3 months	

3rd year, etc. - repeat cycle

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Without Condition

Production costs per acre - two year period

Peanuts - 3000#		$ 270.98
Winter rye -	$28.00 x 2 =	$ 56.00
Corn - 85 bu. - conventional tillage		$ 118.78
		$ 445.76

Average costs per year = $445.76 / 2 = $ 222.88

Gross returns per acre

Peanuts - 3000# x .205/lb	$ 615.00
Winter rye - 6 AUM x 2 x $12.69	$ 152.28
Corn - 85 bu x 2.90	$ 246.50
	$1013.78

Average returns per year - $1013.78 / 2 = $ 506.89

Average net returns per acre

$506.89 - 222.88 = $ 284.01

Economic Analysis of Irrigation System

Center Pivot 50 Acres

Annual ownership cost

a. Capital for irrigation system - center pivot - 15 year life

1. $35,000

2. $25,000 replacement cost, 15 years hence

25,000 x .239391/ = $5,985

35,000 + 5,985 = 40,985 x .110162/ = $4515

b. Irrigation reservoir - 25 year life

$15,000 x .11016 = $1,653

c. Insurance 350

Total ownership costs $6,518

Average ownership costs/acre $ 130.36

1/ P.V. of 1, 15 years hence, 10%.
2/ Amortization factor, 10%, 25 years.

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Annual Operation and Maintenance Cost

Fuel	$1,200.00
Repair and maintenance	$ 500.00
Reservoir maintenance	$ 100.00
Irrigation labor of .2 hours per acre x 5 times x $2.65 per hour x 50 acres	$ 132.50
Total Annual Operation and Maintenance Cost	$1,932.50

Annual Operation and Maintenance

Cost/acre $1,932.50/50 ac. $ 38.65

Estimated Total Cost Per Acre

$130.36 + 38.65 = $ 169.01

With Condition

Production Costs Per Acre - two year period

Peanuts - 3,500 lbs.	$ 270.98
Winter rye - $28.00 x 2	56.00
Corn - 125 bu.	146.59
	$ 473.57

Average Costs Per Year $473.57 / 2 =	$236.79
Irrigation Cost Per Acre	169.01
Total Costs Per Acre	$405.80

Gross Returns Per Acre

Peanuts - 3,500 lb. x .205	$ 717.50
Winter rye 6 AUM x 2 x $12.69	152.28
Corn - 125 bu. x 2.90	362.50
	$1232,28

Average gross returns per acre 1232 / 2 =	$ 616.14

Average net returns per acre

$616.14 - 405.80 =	$ 210.34

Summary

Average net returns without irrigation	$ 284.01
Average net returns with irrigation	$ 210.34
Estimated loss with irrigation	$ -73.67

By investing in irrigation, net returns will be reduced by $73.67. However, the risk of fluctuating yields in a dryland condition can be stabilized with irrigation. The farmer must decide if the security of a more constant income is worth $73.67 per acre.

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D. Drainage
Farmer Andy Andrews has a 40 acre field on which he produces soybeans. The present yield is 20 bushels. Without the installation of a drainage system, yields are expected to drop to 15 bushels in the next 10 years.

The installation of a drainage system will not only maintain present yields but will result in a 10 bushel per acre increase over the next five years after the system is installed.

Determine if it will be feasible for Farmer Andrews to install a drainage system on his 40 acre soybean field.

Production costs:

Present condition - $122.51 per acre

With system condition - $132.51 per acre

Soybean price: $6.10

Evaluation period: 25 years

Interest rate: 10 percent

Measure costs: Subsurface drainage system - 40 acre field

A. 2,000 feet of trunk line -

600' of 6" @$2.50 per foot

600' of 8" @$3.00 per foot

800' of 10" @$3.50 per foot

B. 3,500 feet of 4" laterals at $1.60 per foot

C. Annual Operation and Maintenance Cost $1.00 per acre per year

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Without Condition

Acres: 40 acres soybeans

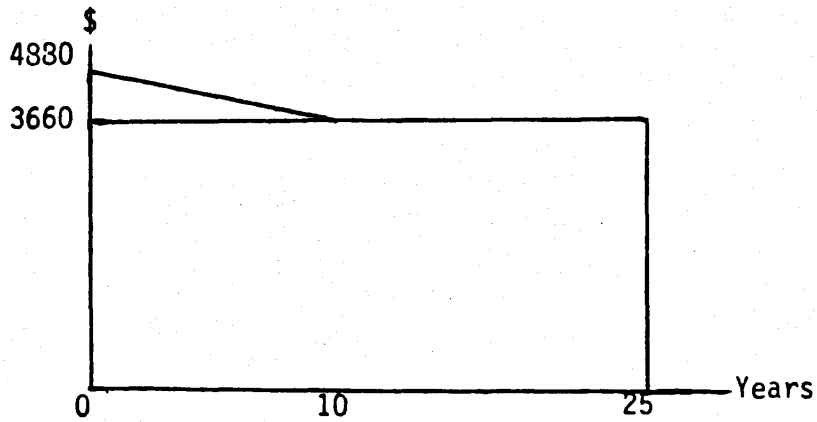
Yield: Now - 20 bushels soybeans
10 years later-15 bushels soybeans

Price: $6.10 per bushel soybeans

Production costs: $122.51 per acre

Returns: 20 x $6.10 x 40 = $4880
15 x $6.10 x 40 = $3660

$4880 - $3600 = $1220
$1220 / 10 years = $122
$122 x 38.554331/ = $4703.63
$4703.63 x .110172/ = $518.15
$3660 + $518.15 = $4178.15



Production cost: $122.51 x 40 = $4900.40
Net returns (Loss): $4178.15 - 4900.00 = -$722.25
-$722.25 / 40 acres = -$18.06

1/ Present value of decreasing annuity, 10 years, 10 percent interest
2/ Amortization factor 25 years, 10 percent interest

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With Subsurface Drainage System

Acres: 40 acres soybeans

Yield: 20 bushels per acre increasing to 30 bushels 5 years after installation

Price: $6.10 per bushel soybeans

Production Costs: $132.51 per acre

Measure Costs: A. Trunk lines

600' of 6" line at $2.50 per foot = $1500.00
600' of 8" line at $3.00 per foot = 1800.00
800' of 10" line at $3.50 per foot = 2800.00
Total-trunk lines $6100.00

B. Lateral lines

3500 feet of 4" lateral line at $1.60 per foot = $5600.00

Total system cost $11,700.00

$11700.00 x .110161/ = $1288.87

$1288.87 / 40 acres = $32.22 per acre
$32.22 + $1.00 O&M = $33.22 per acre annual cost

Cost returns: A. 20 bushels at $6.10 = $122.00 x 9.077042/ = $1107.40

B. 30 bushels at $6.10 = $183.00
$183.00 - 122.00 = $61.00
$61.00 / 5 years = $12.20 a year
$12.20 x 10.652593/ = $129.96

C. $61.00 x 8.513564/ x .620925/ = $322.46

D. $1107.40 + $129.96 + $322.46 = $1559.82

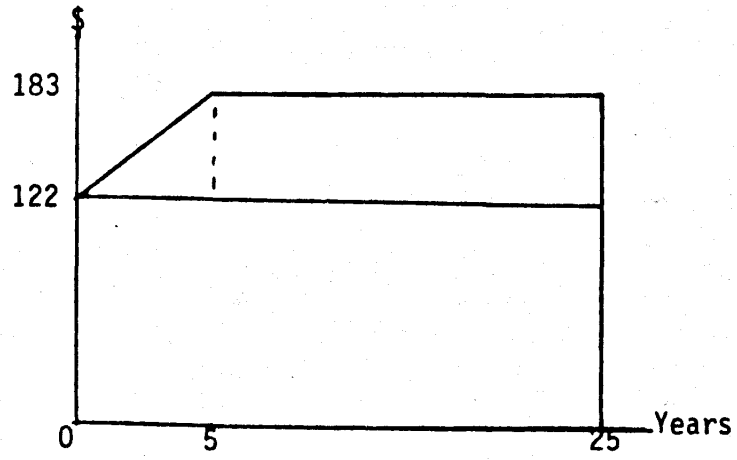
E. $1559.82 x .110171/ = $171.82

Net returns:

Production costs:	$132.51
System cost:	33.22
Total	$165.73

$171.82 - $165.73 = $6.09 return per acre

1/ Amortization factor, 25 years, 10 percent interest
2/ Present value of an annuity of 1 per year, 25 years, 10 percent interest
3/ Present value of an increasing annuity, 5 years, 10 percent interest
4/ Present value of an annuity of 1 per year 20 years, 10 percent interest
5/ Present value of 1, 5 years, 10 percent interest



Summary

Alternative	Net Returns ($/acre)	Change in Net Returns ($/acre)
Without drainage	-18.06	
With drainage	6.09	+24.15

The change in net returns from - $18.06 to $6.09 demonstrates a $24.15 increase to the landuser for installing a drainage system.

E. Agricultural Waste Management

Farmer L. Champlain owns a 250-acre dairy farm on which he maintains a herd of 100 cows. Currently he spreads manure on a daily basis except when winter conditions prevent spreading. When he can't spread he stacks the manure next to the barn.

Not only does Mr. Champlain lose much of the manure phosphorus content due to runoff from his barnyard and from his field, but most of the nitrogen is volatilized because he is unable to incorporate the manure into the soil. Furthermore he has noticed unattractive green algae blooms in his farm pond and in the nearby lake where his farm ultimately drains. As such, he would like to evaluate the economic feasibility of an alternative waste management system. The system he is interested in is based on a liquid in-ground pit with 180 days of storage.

Use the following information to determine the economic feasibility of installing an alternative waste management system.

Item	Daily Spread	Storage
Manure Managed	1,397 tons	1,397 tons
Manure N	3,038 lbs	9,723 lbs
Manure P	1,132 lbs	2,037 lbs
Manure K	3,283 lbs	5,909 lbs
Commercial N	12,500 lbs	7,152 lbs
Commercial P	6,000 lbs	5,276 lbs
Commercial K	13,500 lbs	11,399 lbs
Labor to storage	--	10 hrs
Labor to field	388 hrs	259 hrs
Electricity ($.08/kwh)	--	$296
Fuel & Lubrication	$1,049	$851
Repair for transfer	$500	$257

Labor = $4.00 hr

Assume that commercial fertilizer application will be reduced by 80 percent of the increase in manure nutrients.

Price: N = $.31/lb
P = $.30/lb
K = $.18/lb

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Assume that the old solid manure spreader is kept and used for occasional use. The period of analysis is 25 years.

Interest Rate = 10 percent.

Assume that yields are held constant.

Equipment:

Equipment	Life	Cost
Piston Pump	15 yrs	$10,000
Manure Pit	25 yrs	$14,000
Liquid Spreader	10 yrs	$ 9,000
Loader	15 yrs	$ 4,000
Solid Spreader	5 yrs	$ 5,000

Using the above we compute the following:

1. Installation Cost:

Pump	$10,000
Pit	14,000
Spreader	9,000
Loader	4,000
TOTAL	$37,000

2. Replacement Cost:

a. Piston Pump: PV of 1, 15 yrs hence = .23939
.23939 x $10,000 = $2,394

Less salvage value: assume straight line depreciation,
(15-10) / 15 x 10,000 = $3,333
PV of 1, 25 yrs hence = .09230
.09230 x $3,333 = $307

$2,394 - $307 = $2,087

b. Spreader: PV of 1, 10 yrs hence = .38554
.38554 x $9,000 = $3,470

PV of 1, 20 yrs hence = .14864
.14864 x $9,000 = $1,338

Less salvage value: assume straight line depreciation,
5/10 x $9,000 = $4,500
PV of 1, 25 yrs hence: .09230
.09230 x $4,500 = $415

$3,470 + $1,338 - $415 = $5,223

c. Loader: PV of 1, 15 yrs hence = .23939
.23939 x $4,000 = $958
Less salvage value: assume straight line depreciation,
5/15 x 4,000 = $1,333

PV of 1, 25 yrs hence = .09230
.09230 x $1,333 = $123

$958 - $123 = $835

d. Solid Spreader: PV 1, 5 yrs = .62092
PV 1, 10 yrs = .38554
PV 1, 15 yrs = .23939
PV 1, 20 yrs = .14864

.62092 x 5,000 + .38554 x 5,000 + .23939 X 5,000
+ .14864 x 5,000 = $6,972

3. Amortized Installation Cost: Amortization Factor for 25 yrs = .11017

.11017 x 37,000 = $4,076

4. Amortized Replacement Cost:

Pump	.11017 x 2,087	= $230
Spreader	.11017 x 5,223	= $575
Loader	.11017 x 835	= $ 92
	TOTAL	= $897

Solid Spreader .11017 x 6,972 = $768

5. Summary:

Summary Comparison

Costs	Daily Spread	Storage
Amortized Purchase	--	$4,076
Amortized Replacement	$ 768	$ 897
Labor	$1,552	$1,076
Electricity	--	$ 296
Fuel & Lubrication	$1,049	$ 851
Repair for Transfer	$ 500	$ 257
Commercial N	$3,875	$2,217
Commercial P	$1,800	$1,583
Commercial K	$2,430	$1,938
TOTAL	$11,974	$13,191

Therefore, according to our assumptions, it will cost Mr. Champlain $1,217 more per year to change to the storage system. However, notice that we have not considered the benefits to his pond, income tax deductions, the effect of increased organic matter on yields, or the convenience of not having to spread daily. If the farmer can place a value on such benefits, then the storage system may easily pay for itself.

F. Crop Budget Development

The following example illustrates the information needed to create a cost/return estimate. The cost/return estimate worksheet, the worksheet to determine costs on powered equipment, and the worksheets to determine costs on nonpowered equipment are the basic tools used as building blocks for the final estimate. (The numbers used are examples and will not necessarily fit the situations in your location.)

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COST-RETURN ESTIMATE WORKSHEET

TITLE: _____

_____

Yield_____, Price_____, Gross Return Per Acre $_____

Price Base_____, Date_____, Author_____

Item	Acres Per Hour	No. Times Over	Costs per Acre: Power Unit Own.	Power Unit Oper.	Implement Own.	Implement Oper.	Labor	Material and/or Services	TOTAL
( )( )									
( )( )									
TOTAL PRODUCTION COST									

Gross Return Per Acre $_____

Net Return Per Acre $_____

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COST-RETURN ESTIMATE WORKSHEET

TITLE: Corn, No Till, 130 bu. yield MLRA XXX

Average Management, Soil Loss at 4 T/A/Y

Yield 130 bu , Price 3.20 , Gross Return Per Acre $ 416.00

Price Base _____ , Date _____ , Author _____

Item	Acres Per Hour	No. Times Over	Costs per Acre: Power Own.	Power Unit Oper.	Implement Own.	Implement Oper.	Labor $5/hr	Material and/or Services	TOTAL
Plant	5.5	1	1.69	1.58	10.00	0.44	0.91	--	$15.06
Spray	12.5	2	1.49	1.39	1.20	0.32	0.80	--	5.20
Cust.Fert.App								3.25	3.25
Cust.Combine								23.00	23.00
Cust.Hauling								10.40	10.40
Drying								9.75	9.75
Seed								19.34	19.34
Lime								5.00	5.00
Fertilizer								45.00	45.00
Chemicals								44.00	44.00
TOTAL PRODUCTION COST			3.18	2.97	11.20	1.20	1.71	159.74	180.00

Gross Return Per Acre $ 416.00

Production Cost Per Acre $ 180.00

Return To Land, Overhead, Risk and Management $ 236.00

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(EXAMPLE WORKSHEET TO DETERMINE OWNERSHIP AND OPERATING COSTS ON POWERED EQUIPMENT)

DATE_____ PRICE BASE_____

1. Tractor, 2 WD, 100 HP — 10 Year Life

A. OWNERSHIP COST — 700 Hrs. Annual Use (Crop and Noncrop)

New Cost	$40,000			
Trade-In Value	5,000	@ 10 %		$500
Depreciation	35,000	@ 10 %	(.163)	5,705
Annual Taxes				-
Annual Insurance & Housing				295
Ownership Cost Per Year				$6,500

OWNERSHIP COST PER HOUR $9.29

B. OWNERSHIP COST
REPAIRS DURING THE LIFETIME ESTABLISHED

Major Overhaul	1 @ $2,000	$2,000
Tires	2 @ $1,000	$2,000
Batteries	4 @ $75.00	$ 300
Misc. $170 Per Year x 10 Years		$1,700
TOTAL REPAIRS		$6,000
Repair Cost Per Year		$ 600
Repair Cost Per Hour		$ 0.86

Fuel And Oil
Fuel 7 Gals. Per Hr. @ $1.10 = Fuel Cost Of $7.70 Per Hour

ANNUAL FILTER AND OIL EXPENSE

Oil Filters 8 @ $5.00 = $40.00
Oil 60 Qts. @ $0.80 = $48.00
TOTAL = $88.00

$88.00 / 700 Hrs. = $0.13 Per Hour
Fuel And Oil Cost Per Hour = $7.83

Operating Cost Per Hour $8.69

Total Ownership And Operating Cost Per Hour $17.98

(EXAMPLE WORKSHEET TO DETERMINE OWNERSHIP AND OPERATING COSTS ON NONPOWERED EQUIPMENT)

DATE 1/1/86 PRICE BASE 1986

2. No till planter, 6 row — 10 Year Life

300 Acres Annual Use

A. OWNERSHIP COSTS

New Cost	$18,000		
Trade-In Value	2,000 @ 10 %	$ 200	
Depreciation	16,000 @ 10 % (.163)	2,608	
Taxes		-	
Insurance & Housing		192	
Ownership Cost Per Year		$3,000	
OWNERSHIP COST PER ACRE			$10.00

B. OPERATING COSTS

Repairs $ 250 Per Year		
Repair Cost Per Acre	$0.83	
Other Operating Cost Per Acre	0.05	
Operating Cost Per Acre		$ 0.88
Total Ownership And Operating Cost Per Acre		$10.88

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(EXAMPLE WORKSHEET TO DETERMINE OWNERSHIP AND OPERATING COSTS ON NONPOWERED EQUIPMENT)

DATE 1/1/86 PRICE BASE 1986

3. Sprayer 30' 10 Year Life

1,000 Acres Annual Use

A. OWNERSHIP COSTS

New Cost	$ 3,700		
Trade-In Value	500 @ 10 %	$ 50	
Depreciation	3,200 @ 10 % (.163)	522	
Taxes		-	
Insurance & Housing		28	
Ownership Cost Per Year		$ 600	
OWNERSHIP COST PER ACRE			$ 0.60

B. OPERATING COSTS

Repairs $ 150 Per Year

Repair Cost Per Acre	$0.15	
Other Operating Cost Per Acre	0.01	
Operating Cost Per Acre		$ 0.16
Total Ownership And Operating Cost Per Acre		$ 0.76

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Appendix B - Interest and Annuity Tables

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COMPOUND INTEREST AND ANNUITY TABLES FOR
4.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.96154	1.04000	.96154	1.00000	.96154	.96154
2	.92456	.52020	1.88609	2.04000	2.81065	2.84763
3	.88900	.36035	2.77509	3.12160	5.47764	5.62272
4	.85480	.27549	3.62990	4.24646	8.89686	9.25262
5	.82193	.22463	4.45182	5.41632	13.00649	13.70444
6	.79031	.19076	5.24214	6.63298	17.74838	18.94658
7	.75992	.16661	6.00205	7.89829	23.06780	24.94863
8	.73069	.14853	6.73274	9.21423	28.91333	31.68138
9	.70259	.13449	7.43533	10.58280	35.23661	39.11671
10	.67556	.12329	8.11090	12.00611	41.99225	47.22761
11	.64958	.11415	8.76048	13.48635	49.13764	55.98808
12	.62460	.10655	9.38507	15.02581	56.63280	65.37316
13	.60057	.10014	9.98565	16.62684	64.44027	75.35880
14	.57748	.09467	10.56312	18.29191	72.52492	85.92193
15	.55526	.08994	11.11839	20.02359	80.85388	97.04031
16	.53391	.08587	11.65230	21.82453	89.39642	108.69261
17	.51337	.08220	12.16567	23.69751	98.12376	120.85828
18	.49363	.07899	12.65930	25.64541	107.00907	133.51758
19	.47464	.07614	13.13394	27.67123	116.02727	146.65152
20	.45639	.07358	13.59033	29.77808	125.15501	160.24184
21	.43883	.07128	14.02916	31.96920	134.37052	174.27100
22	.42196	.06920	14.45112	34.24797	143.65354	188.72212
23	.40573	.06731	14.85684	36.61789	152.98524	203.57896
24	.39012	.06559	15.24696	39.08260	162.34816	218.82592
25	.37512	.06401	15.62208	41.64591	171.72608	234.44800
26	.36069	.06257	15.98277	44.31174	181.10400	250.43077
27	.34682	.06124	16.32959	47.08421	190.46804	266.76036
28	.33348	.06001	16.66306	49.96758	199.80541	283.42342
29	.32065	.05888	16.98371	52.96629	209.10430	300.40713
30	.30832	.05783	17.29203	56.08494	218.35386	317.69917
31	.29646	.05686	17.58849	59.32834	227.54413	335.28766
32	.28506	.05595	17.87355	62.70147	236.66599	353.16121
33	.27409	.05510	18.14765	66.20953	245.71109	371.30886
34	.26355	.05431	18.41120	69.85791	254.67187	389.72006
35	.25342	.05358	18.66461	73.65222	263.54141	408.38467
36	.24367	.05289	18.90828	77.59831	272.31348	427.29295
37	.23430	.05224	19.14258	81.70225	280.98246	446.43553
38	.22529	.05163	19.36786	85.97034	289.54331	465.80339
39	.21662	.05106	19.58448	90.40915	297.99151	485.38788
40	.20829	.05052	19.79277	95.02552	306.32308	505.18065
41	.20028	.05002	19.99305	99.82654	314.53447	525.17370
42	.19257	.04954	20.18563	104.81960	322.62262	545.35933
43	.18517	.04909	20.37079	110.01238	330.58485	565.73013
44	.17805	.04866	20.54884	115.41288	338.41889	586.27897
45	.17120	.04826	20.72004	121.02939	346.12282	606.99901
46	.16461	.04788	20.88465	126.87057	353.69506	627.88366
47	.15828	.04752	21.04294	132.94539	361.13434	648.92660
48	.15219	.04718	21.19513	139.26321	368.43969	670.12173
49	.14634	.04686	21.34147	145.83373	375.61040	691.46320
50	.14071	.04655	21.48218	152.66708	382.64603	712.94538

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COMPOUND INTEREST AND ANNUITY TABLES FOR
5.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.95238	1.05000	.95238	1.00000	.95238	.95238
2	.90703	.53780	1.85941	2.05000	2.76644	2.81179
3	.86384	.36721	2.72325	3.15250	5.35795	5.53504
4	.82270	.28201	3.54595	4.31012	8.64876	9.08099
5	.78353	.23097	4.32948	5.52563	12.56639	13.41047
6	.74622	.19702	5.07569	6.80191	17.04369	18.48616
7	.71068	.17282	5.78637	8.14201	22.01846	24.27253
8	.67684	.15472	6.46321	9.54911	27.43317	30.73574
9	.64461	.14069	7.10782	11.02656	33.23465	37.84357
10	.61391	.12950	7.72173	12.57789	39.37378	45.56530
11	.58468	.12039	8.30641	14.20679	45.80525	53.87172
12	.55684	.11283	8.86325	15.91713	52.48730	62.73497
13	.53032	.10646	9.39357	17.71298	59.38148	72.12854
14	.50507	.10102	9.89864	19.59863	66.45243	82.02718
15	.48102	.09634	10.37966	21.57856	73.66769	92.40684
16	.45811	.09227	10.83777	23.65749	80.99747	103.24461
17	.43630	.08870	11.27407	25.84037	88.41452	114.51868
18	.41552	.08555	11.68959	28.13238	95.89389	126.20826
19	.39573	.08275	12.08532	30.53900	103.41283	138.29358
20	.37689	.08024	12.46221	33.06595	110.95062	150.75579
21	.35894	.07800	12.82115	35.71925	118.48841	163.57695
22	.34185	.07597	13.16300	38.50521	126.00911	176.73995
23	.32557	.07414	13.48857	41.43048	133.49725	190.22852
24	.31007	.07247	13.79864	44.50200	140.93888	204.02716
25	.29530	.07095	14.09394	47.72710	148.32145	218.12111
26	.28124	.06956	14.37519	51.11345	155.63371	232.49629
27	.26785	.06829	14.64303	54.66913	162.86561	247.13933
28	.25509	.06712	14.89813	58.40258	170.00824	262.03745
29	.24295	.06605	15.14107	62.32271	177.05368	277.17853
30	.23138	.06505	15.37245	66.43885	183.99500	292.55098
31	.22036	.06413	15.59281	70.76079	190.82615	308.14379
32	.20987	.06328	15.80268	75.29883	197.54186	323.94647
33	.19987	.06249	16.00255	80.06377	204.13766	339.94902
34	.19035	.06176	16.19290	85.06696	210.60972	356.14192
35	.18129	.06107	16.37419	90.32031	216.95488	372.51611
36	.17266	.06043	16.54685	95.83632	223.17055	389.06297
37	.16444	.05984	16.71129	101.62814	229.25467	405.77425
38	.15661	.05928	16.86789	107.70955	235.20567	422.64215
39	.14915	.05876	17.01704	114.09502	241.02244	439.65919
40	.14205	.05828	17.15909	120.79977	246.70427	456.81827
41	.13528	.05782	17.29437	127.83976	252.25081	474.11264
42	.12884	.05739	17.42321	135.23175	257.66208	491.53585
43	.12270	.05699	17.54591	142.99334	262.93837	509.08176
44	.11686	.05662	17.66277	151.14301	268.08027	526.74453
45	.11130	.05626	17.77407	159.70016	273.08861	544.51860
46	.10600	.05593	17.88007	168.68516	277.96446	562.39867
47	.10095	.05561	17.98102	178.11942	282.70907	580.37969
48	.09614	.05532	18.07716	188.02539	287.32389	598.45684
49	.09156	.05504	18.16872	198.42666	291.81052	616.62557
50	.08720	.05478	18.25593	209.34800	296.17071	634.88149

COMPOUND INTEREST AND ANNUITY TABLES FOR
6.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.94340	1.06000	.94340	1.00000	.94340	.94340
2	.89000	.54544	1.83339	2.06000	2.72339	2.77679
3	.83962	.37411	2.67301	3.18360	5.24225	5.44980
4	.79209	.28859	3.46511	4.37462	8.41062	8.91491
5	.74726	.23740	4.21236	5.63709	12.14691	13.12727
6	.70496	.20336	4.91732	6.97532	16.37668	18.04459
7	.66506	.17914	5.58238	8.39384	21.03208	23.62698
8	.62741	.16104	6.20979	9.89747	26.05137	29.83677
9	.59190	.14702	6.80169	11.49132	31.37846	36.63846
10	.55839	.13587	7.36009	13.18079	36.96241	43.99855
11	.52679	.12679	7.88687	14.97164	42.75707	51.88542
12	.49697	.11928	8.38384	16.86994	48.72070	60.26927
13	.46884	.11296	8.85268	18.88214	54.81561	69.12195
14	.44230	.10758	9.29498	21.01507	61.00782	78.41693
15	.41727	.10296	9.71225	23.27597	67.26680	88.12918
16	.39365	.09895	10.10590	25.67253	73.56514	98.23508
17	.37136	.09544	10.47726	28.21288	79.87834	108.71234
18	.35034	.09236	10.82760	30.90565	86.18452	119.53994
19	.33051	.08962	11.15812	33.75999	92.46427	130.69806
20	.31180	.08718	11.46992	36.78559	98.70037	142.16798
21	.29416	.08500	11.76408	39.99273	104.87763	153.93206
22	.27751	.08305	12.04158	43.39229	110.98274	165.97364
23	.26180	.08128	12.30338	46.99583	117.00408	178.27702
24	.24698	.07968	12.55036	50.81558	122.93156	190.82737
25	.23300	.07823	12.78336	54.86451	128.75653	203.61073
26	.21981	.07690	13.00317	59.15638	134.47159	216.61390
27	.20737	.07570	13.21053	63.70577	140.07052	229.82443
28	.19563	.07459	13.40616	68.52811	145.54817	243.23060
29	.18456	.07358	13.59072	73.63980	150.90031	256.82132
30	.17411	.07265	13.76483	79.05819	156.12362	270.58615
31	.16425	.07179	13.92909	84.80168	161.21552	284.51523
32	.15496	.07100	14.08404	90.88978	166.17415	298.59928
33	.14619	.07027	14.23023	97.34316	170.99830	312.82951
34	.13791	.06960	14.36814	104.18375	175.68729	327.19765
35	.13011	.06897	14.49825	111.43478	180.24098	341.69589
36	.12274	.06839	14.62099	119.12087	184.65964	356.31688
37	.11579	.06786	14.73678	127.26812	188.94399	371.05366
38	.10924	.06736	14.84602	135.90421	193.09507	385.89968
39	.10306	.06689	14.94907	145.05846	197.11423	400.84876
40	.09722	.06646	15.04630	154.76197	201.00312	415.89505
41	.09172	.06606	15.13802	165.04768	204.76360	431.03307
42	.08653	.06568	15.22454	175.95054	208.39775	446.25761
43	.08163	.06533	15.30617	187.50758	211.90783	461.56378
44	.07701	.06501	15.38318	199.75803	215.29622	476.94697
45	.07265	.06470	15.45583	212.74351	218.56548	492.40280
46	.06854	.06441	15.52437	226.50812	221.71822	507.92717
47	.06466	.06415	15.58903	241.09861	224.75716	523.51620
48	.06100	.06390	15.65003	256.56453	227.68508	539.16622
49	.05755	.06366	15.70757	272.95840	230.50482	554.87380
50	.05429	.06344	15.76186	290.33590	233.21924	570.63566

COMPOUND INTEREST AND ANNUITY TABLES FOR
7.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.93458	1.07000	.93458	1.00000	.93458	.93458
2	.87344	.55309	1.80802	2.07000	2.68146	2.74260
3	.81630	.38105	2.62432	3.21490	5.13035	5.36691
4	.76290	.29523	3.38721	4.43994	8.18193	8.75412
5	.71299	.24389	4.10020	5.75074	11.74686	12.85432
6	.66634	.20980	4.76654	7.15329	15.74492	17.62086
7	.62275	.18555	5.38929	8.65402	20.10416	23.01015
8	.58201	.16747	5.97130	10.25980	24.76024	28.98145
9	.54393	.15349	6.51523	11.97799	29.65564	35.49668
10	.50835	.14238	7.02358	13.81645	34.73913	42.52026
11	.47509	.13336	7.49867	15.78360	39.96515	50.01894
12	.44401	.12590	7.94269	17.88845	45.29330	57.96162
13	.41496	.11965	8.35765	20.14064	50.68784	66.31928
14	.38782	.11434	8.74547	22.55049	56.11728	75.06474
15	.36245	.10979	9.10791	25.12902	61.55397	84.17266
16	.33873	.10586	9.44665	27.88805	66.97372	93.61931
17	.31657	.10243	9.76322	30.84022	72.35549	103.38253
18	.29586	.09941	10.05909	33.99903	77.68104	113.44162
19	.27651	.09675	10.33560	37.37896	82.93469	123.77721
20	.25842	.09439	10.59401	40.99549	88.10307	134.37123
21	.24151	.09229	10.83553	44.86518	93.17485	145.20675
22	.22571	.09041	11.06124	49.00574	98.14054	156.26799
23	.21095	.08871	11.27219	53.43614	102.99232	167.54018
24	.19715	.08719	11.46933	58.17667	107.72384	179.00951
25	.18425	.08581	11.65358	63.24904	112.33007	190.66310
26	.17220	.08456	11.82578	68.67647	116.80715	202.48888
27	.16093	.08343	11.98671	74.48382	121.15227	214.47559
28	.15040	.08239	12.13711	80.69769	125.36353	226.61270
29	.14056	.08145	12.27767	87.34653	129.43985	238.89037
30	.13137	.08059	12.40904	94.46079	133.38087	251.29941
31	.12277	.07980	12.53181	102.07304	137.18683	263.83123
32	.11474	.07907	12.64656	110.21815	140.85854	276.47778
33	.10723	.07841	12.75379	118.93343	144.39729	289.23157
34	.10022	.07780	12.85401	128.25876	147.80475	302.08558
35	.09366	.07723	12.94767	138.23688	151.08295	315.03325
36	.08754	.07672	13.03521	148.91346	154.23423	328.06846
37	.08181	.07624	13.11702	160.33740	157.26115	341.18548
38	.07646	.07580	13.19347	172.56102	160.16651	354.37895
39	.07146	.07539	13.26493	185.64029	162.95326	367.64388
40	.06678	.07501	13.33171	199.63511	165.62447	380.97559
41	.06241	.07466	13.39412	214.60957	168.18335	394.36971
42	.05833	.07434	13.45245	230.63224	170.63315	407.82216
43	.05451	.07404	13.50696	247.77650	172.97719	421.32912
44	.05095	.07376	13.55791	266.12085	175.21884	434.88703
45	.04761	.07350	13.60552	285.74931	177.36144	448.49255
46	.04450	.07326	13.65002	306.75176	179.40838	462.14257
47	.04159	.07304	13.69161	329.22439	181.36299	475.83418
48	.03887	.07283	13.73047	353.27009	183.22860	489.56465
49	.03632	.07264	13.76680	378.99900	185.00848	503.33145
50	.03395	.07246	13.80075	406.52893	186.70587	517.13220

COMPOUND INTEREST AND ANNUITY TABLES FOR
8.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.92593	1.08000	.92593	1.00000	.92593	.92593
2	.85734	.56077	1.78326	2.08000	2.64060	2.70919
3	.79383	.38803	2.57710	3.24640	5.02210	5.28629
4	.73503	.30197	3.31213	4.50611	7.96222	8.59841
5	.68058	.25046	3.99271	5.86660	11.36514	12.59112
6	.63017	.21632	4.62288	7.33593	15.14615	17.21400
7	.58349	.19207	5.20637	8.92280	19.23059	22.42037
8	.54027	.17401	5.74664	10.63663	23.55274	28.16701
9	.50025	.16008	6.24689	12.48756	28.05498	34.41390
10	.46319	.14903	6.71008	14.48656	32.68691	41.12398
11	.42888	.14008	7.13896	16.64549	37.40462	48.26295
12	.39711	.13270	7.53608	18.97713	42.16999	55.79902
13	.36770	.12652	7.90378	21.49530	46.95006	63.70280
14	.34046	.12130	8.24424	24.21492	51.71652	71.94704
15	.31524	.11683	8.55948	27.15211	56.44514	80.50652
16	.29189	.11298	8.85137	30.32428	61.11539	89.35789
17	.27027	.10963	9.12164	33.75023	65.70996	98.47952
18	.25025	.10670	9.37189	37.45024	70.21444	107.85141
19	.23171	.10413	9.60360	41.44626	74.61697	117.45501
20	.21455	.1 185	9.81815	45.76196	78.90794	127.27316
21	.19866	.09983	10.01680	50.42292	83.07971	137.28996
22	.18394	.09803	10.20074	55.45676	87.12640	147.49070
23	.17032	.09642	10.37106	60.89330	91.04365	157.86176
24	.15770	.09498	10.52876	66.76476	94.82844	168.39052
25	.14602	.09368	10.67478	73.10594	98.47888	179.06530
26	.13520	.09251	10.80998	79.95442	101.99413	189.87528
27	.12519	.09145	10.93516	87.35077	105.37417	200.81044
28	.11591	.09049	11.05108	95.33883	108.61976	211.86152
29	.10733	.08962	11.15841	103.96594	111.73226	223.01992
30	.09938	.08883	11.25778	113.28321	114.71358	234.27771
31	.09202	.08811	11.34980	123.34587	117.56607	245.62751
32	.08520	.08745	11.43500	134.21354	120.29247	257.06251
33	.07889	.08685	11.51389	145.95062	122.89581	268.57640
34	.07305	.08630	11.58693	158.62667	125.37935	280.16333
35	.06763	.08580	11.65457	172.31680	127.74656	291.81790
36	.06262	.08534	11.71719	187.10215	130.00104	303.53509
37	.05799	.08492	11.77518	203.07032	132.14651	315.31027
38	.05369	.08454	11.82887	220.31595	134.18675	327.13914
39	.04971	.08419	11.87858	238.94122	136.12558	339.01772
40	.04603	.08386	11.92461	259.05652	137.96681	350.94233
41	.04262	.08356	11.96723	280.78104	139.71428	362.90957
42	.03946	.08329	12.00670	304.24352	141.37178	374.91627
43	.03654	.08303	12.04324	329.58301	142.94303	386.95951
44	.03383	.08280	12.07707	356.94965	144.43173	399.03658
45	.03133	.08259	12.10840	386.50562	145.84149	411.14498
46	.02901	.08239	12.13741	418.42607	147.17582	423.28239
47	.02686	.08221	12.16427	452.90015	148.43818	435.44666
48	.02487	.08204	12.18914	490.13216	149.63189	447.63579
49	.02303	.08189	12.21216	530.34274	150.76021	459.84796
50	.02132	.08174	12.23348	573.77016	151.82627	472.08144

COMPOUND INTEREST AND ANNUITY TABLES FOR
9.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.91743	1.09000	.91743	1.00000	.91743	.91743
2	.84168	.56847	1.75911	2.09000	2.60079	2.67654
3	.77218	.39505	2.53129	3.27810	4.91734	5.20784
4	.70843	.30867	3.23972	4.57313	7.75104	8.44756
5	.64993	.25709	3.88965	5.98471	11.00070	12.33721
6	.59627	.22292	4.48592	7.52333	14.57830	16.82313
7	.54703	.19869	5.03295	9.20043	18.40754	21.85608
8	.50187	.18067	5.53482	11.02847	22.42247	27.39090
9	.46043	.16680	5.99525	13.02104	26.56632	33.38615
10	.42241	.15582	6.41766	15.19293	30.79043	39.80380
11	.38753	.14695	6.80519	17.56029	35.05329	46.60899
12	.35553	.13965	7.16073	20.14072	39.31971	53.76972
13	.32618	.13357	7.48690	22.95338	43.56003	61.25662
14	.29925	.12843	7.78615	26.01919	47.74948	69.04277
15	.27454	.12406	8.06069	29.36092	51.86755	77.10346
16	.25187	.12030	8.31256	33.00340	55.89747	85.41602
17	.23107	.11705	8.54363	36.97370	59.82571	93.95965
18	.21199	.11421	8.75563	41.30134	63.64160	102.71528
19	.19449	.11173	8.95011	46.01846	67.33690	111.66539
20	.17843	.10955	9.12855	51.16012	70.90552	120.79394
21	.16370	.10762	9.29224	56.76453	74.34318	130.08618
22	.15018	.10590	9.44243	62.87334	77.64718	139.52861
23	.13778	.10438	9.58021	69.53194	80.81615	149.10881
24	.12640	.10302	9.70661	76.78981	83.84987	158.81542
25	.11597	.10181	9.82258	84.70090	86.74907	168.63800
26	.10639	.10072	9.92897	93.32398	89.51527	178.56698
27	.09761	.09973	10.02658	102.72313	92.15068	188.59356
28	.08955	.09885	10.11613	112.96822	94.65804	198.70968
29	.08215	.09806	10.19828	124.13536	97.04052	208.90797
30	.07537	.09734	10.27365	136.30754	99.30165	219.18162
31	.06915	.09669	10.34280	149.57522	101.44524	229.52442
32	.06344	.09610	10.40624	164.03699	103.47526	239.93066
33	.05820	.09556	10.46444	179.80032	105.39588	250.39510
34	.05339	.09508	10.51784	196.98234	107.21130	260.91294
35	.04899	.09464	10.56682	215.71075	108.92581	271.47976
36	.04494	.09424	10.61176	236.12472	110.54370	282.09152
37	.04123	.09387	10.65299	258.37595	112.06923	292.74452
38	.03783	.09354	10.69082	282.62978	113.50663	303.43534
39	.03470	.09324	10.72552	309.06646	114.86004	314.16086
40	.03184	.09296	10.75736	337.88245	116.13355	324.91822
41	.02921	.09271	10.78657	369.29187	117.33111	335.70479
42	.02680	.09248	10.81337	403.52813	118.45658	346.51816
43	.02458	.09227	10.83795	440.84566	119.51372	357.35611
44	.02255	.09208	10.86051	481.52177	120.50612	368.21661
45	.02069	.09190	10.88120	525.85873	121.43727	379.09781
46	.01898	.09174	10.90018	574.18602	122.31052	389.99799
47	.01742	.09160	10.91760	626.86276	123.12908	400.91559
48	.01598	.09146	10.93358	684.28041	123.89604	411.84916
49	.01466	.09134	10.94823	746.86565	124.61432	422.79740
50	.01345	.09123	10.96168	815.08356	125.28675	433.75908

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COMPOUND INTEREST AND ANNUITY TABLES FOR
10.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.90909	1.10000	.90909	1.00000	.90909	.90909
2	.82645	.57619	1.73554	2.10000	2.56198	2.64463
3	.75131	.40211	2.48685	3.31000	4.81593	5.13148
4	.68301	.31547	3.16987	4.64100	7.54798	8.30135
5	.62092	.26380	3.79079	6.10510	10.65259	12.09213
6	.56447	.22961	4.35526	7.71561	14.03943	16.64739
7	.51316	.20541	4.86842	9.48717	17.63154	21.31581
8	.46651	.18744	5.33493	11.43589	21.36360	26.65074
9	.42410	.17364	5.75902	13.57948	25.18048	32.40976
10	.38554	.16275	6.14457	15.93742	29.03501	38.55433
11	.35049	.15396	6.49506	18.53117	32.89136	45.04959
12	.31863	.14676	6.81369	21.38428	36.71491	51.86308
13	.28966	.14078	7.10336	24.52271	40.48055	58.96644
14	.26333	.13575	7.36669	27.97498	44.16719	66.33313
15	.23939	.13147	7.60608	31.77248	47.75807	73.93920
16	.21763	.12782	7.82371	35.94973	51.24013	81.76291
17	.19784	.12466	8.02155	40.54470	54.60349	89.78447
18	.17986	.12193	8.20141	45.59917	57.84095	97.98588
19	.16351	.11955	8.36492	51.15909	60.94760	106.35080
20	.14864	.11746	8.51356	57.27500	63.92048	114.86436
21	.13513	.11562	8.64869	64.00250	66.75822	123.51306
22	.12285	.11401	8.77154	71.40275	69.46083	132.28460
23	.11168	.11257	8.88322	79.54302	72.02943	141.16782
24	.10153	.11130	8.98474	88.49733	74.46604	150.15256
25	.09230	.11017	9.07704	98.34706	76.77344	159.22960
26	.08391	.10916	9.16095	109.18177	78.95498	168.39055
27	.07628	.10826	9.23722	121.09994	81.01448	177.62777
28	.06934	.10745	9.30657	134.20994	82.95609	186.93433
29	.06304	.10673	9.36961	148.63093	84.78424	196.30394
30	.05731	.10608	9.42691	164.49402	86.50349	205.73086
31	.05210	.10550	9.47901	181.94342	88.11855	215.20987
32	.04736	.10497	9.52638	201.13777	89.63415	224.73624
33	.04306	.10450	9.56943	222.25154	91.05502	234.30568
34	.03914	.10407	9.60857	245.47670	92.38587	243.91425
35	.03558	.10369	9.64416	271.02437	93.63131	253.55841
36	.03235	.10334	9.67651	299.12681	94.79588	263.23492
37	.02941	.10303	9.70592	330.03949	95.88399	272.94083
38	.02673	.10275	9.73265	364.04343	96.89992	282.67349
39	.02430	.10249	9.75696	401.44778	97.84779	292.43044
40	.02209	.10226	9.77905	442.59256	98.73159	302.20949
41	.02009	.10205	9.79914	487.85181	99.55512	312.00863
42	.01826	.10186	9.81740	537.63699	100.32206	321.82603
43	.01660	.10169	9.83400	592.40069	101.03587	331.66002
44	.01509	.10153	9.84909	652.64076	101.69988	341.50911
45	.01372	.10139	9.86281	718.90484	102.31724	351.37192
46	.01247	.10126	9.87528	791.79532	102.89095	361.24720
47	.01134	.10115	9.88662	871.97485	103.42385	371.13382
48	.01031	.10104	9.89693	960.17234	103.91861	381.03074
49	.00937	.10095	9.90630	1057.18957	104.37776	390.93704
50	.00852	.10086	9.91481	1163.90853	104.80368	400.85186

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COMPOUND INTEREST AND ANNUITY TABLES FOR
11.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.90090	1.11000	.90090	1.00000	.90090	.90090
2	.81162	.58393	1.71252	2.11000	2.52415	2.61342
3	.73119	.40921	2.44371	3.34210	4.71772	5.05714
4	.65873	.32233	3.10245	4.70973	7.35264	8.15958
5	.59345	.27057	3.69590	6.22780	10.31990	11.85548
6	.53464	.23638	4.23054	7.91286	13.52775	16.08602
7	.48166	.21222	4.71220	9.78327	16.89935	20.79822
8	.43393	.19432	5.14612	11.85943	20.37077	25.94434
9	.39092	.18060	5.53705	14.16397	23.88909	31.48139
10	.35218	.16980	5.88923	16.72201	27.41093	37.37062
11	.31728	.16112	6.20652	19.56143	30.90105	43.57713
12	.28584	.15403	6.49236	22.71319	34.33114	50.06949
13	.25751	.14815	6.74987	26.21164	37.67883	56.81936
14	.23199	.14323	6.98187	30.09492	40.92675	63.80123
15	.20900	.13907	7.19087	34.40536	44.06182	70.99209
16	.18829	.13552	7.37916	39.18995	47.07449	78.37126
17	.16963	.13247	7.54879	44.50084	49.95825	85.92005
18	.15282	.12984	7.70162	50.39594	52.70905	93.62167
19	.13768	.12756	7.83929	56.93949	55.32492	101.46096
20	.12403	.12558	7.96333	64.20283	57.80560	109.42429
21	.11174	.12384	8.07507	72.26514	60.15219	117.49936
22	.10067	.12231	8.17574	81.21431	62.36690	125.67510
23	.09069	.12097	8.26643	91.14788	64.45283	133.94153
24	.08170	.11979	8.34814	102.17415	66.41375	142.28967
25	.07361	.11874	8.42174	114.41331	68.25395	150.71141
26	.06631	.11781	8.48806	127.99877	69.97810	159.19947
27	.05974	.11699	8.54780	143.07864	71.59114	167.74727
28	.05382	.11626	8.60162	159.81729	73.09814	176.34889
29	.04849	.11561	8.65011	178.39719	74.50429	184.99900
30	.04368	.11502	8.69379	199.02088	75.81477	193.69279
31	.03935	.11451	8.73315	221.91317	77.03475	202.42594
32	.03545	.11404	8.76860	247.32362	78.16927	211.19454
33	.03194	.11363	8.80054	275.52922	79.22331	219.99508
34	.02878	.11326	8.82932	306.83744	80.20167	228.82440
35	.02592	.11293	8.85524	341.58955	81.10899	237.67964
36	.02335	.11263	8.87859	380.16441	81.94976	246.55823
37	.02104	.11236	8.89963	422.98249	82.72825	255.45787
38	.01896	.11213	8.91859	470.51056	83.44854	264.37646
39	.01708	.11191	8.93567	523.26673	84.11453	273.31212
40	.01538	.11172	8.95105	581.82607	84.72991	282.26317
41	.01386	.11155	8.96491	646.82693	85.29816	291.22809
42	.01249	.11139	8.97740	718.97790	85.82259	300.20548
43	.01125	.11125	8.98865	799.06547	86.30629	309.19413
44	.01013	.11113	8.99878	887.96267	86.75220	318.19291
45	.00913	.11101	9.00791	986.63856	87.16304	327.20082
46	.00823	.11091	9.01614	1096.16880	87.54140	336.21695
47	.00741	.11082	9.02355	1217.74737	87.88967	345.24050
48	.00668	.11074	9.03022	1352.69958	88.21010	354.27072
49	.00601	.11067	9.03624	1502.49653	88.50480	363.30695
50	.00542	.11060	9.04165	1668.77115	88.77570	372.34861

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COMPOUND INTEREST AND ANNUITY TABLES FOR
12.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.89286	1.12000	.89286	1.00000	.89286	.89286
2	.79719	.59170	1.69005	2.12000	2.48724	2.58291
3	.71178	.41635	2.40183	3.37440	4.62259	4.98474
4	.63552	.32923	3.03735	4.77933	7.16466	8.02209
5	.56743	.27741	3.60478	6.35285	10.00179	11.62686
6	.50663	.24323	4.11141	8.11519	13.04158	15.73827
7	.45235	.21912	4.56376	10.08901	16.20802	20.30203
8	.40388	.20130	4.96764	12.29969	19.43909	25.26967
9	.36061	.18768	5.32825	14.77566	22.68458	30.59792
10	.32197	.17698	5.65022	17.54874	25.90431	36.24814
11	.28748	.16842	5.93770	20.65458	29.06655	42.18584
12	.25668	.16144	6.19437	24.13313	32.14665	48.38021
13	.22917	.15568	6.42355	28.02911	35.12591	54.80376
14	.20462	.15087	6.62817	32.39260	37.99059	61.43193
15	.18270	.14682	6.81086	37.27971	40.73104	68.24280
16	.16312	.14339	6.97399	42.75328	43.34098	75.21678
17	.14564	.14046	7.11963	48.88367	45.81694	82.33641
18	.13004	.13794	7.24967	55.74971	48.15765	89.58608
19	.11611	.13576	7.36578	63.43968	50.36368	96.95186
20	.10367	.13388	7.46944	72.05244	52.43701	104.42130
21	.09256	.13224	7.56200	81.69874	54.38076	111.98331
22	.08264	.13081	7.64465	92.50258	56.19890	119.62795
23	.07379	.12956	7.71843	104.60289	57.89602	127.34639
24	.06588	.12846	7.78432	118.15524	59.47719	135.13070
25	.05882	.12750	7.84314	133.33387	60.94778	142.97384
26	.05252	.12665	7.89566	150.33393	62.31332	150.86950
27	.04689	.12590	7.94255	169.37401	63.57944	158.81205
28	.04187	.12524	7.98442	190.69889	64.75178	166.79648
29	.03738	.12466	8.02181	214.58275	65.83590	174.81828
30	.03338	.12414	8.05518	241.33268	66.83724	182.87347
31	.02980	.12369	8.08499	271.29261	67.76109	190.95845
32	.02661	.12328	8.11159	304.84772	68.61257	199.07005
33	.02376	.12292	8.13535	342.42945	69.39657	207.20540
34	.02121	.12260	8.15656	384.52098	70.11779	215.36196
35	.01894	.12232	8.17550	431.66350	70.78067	223.53747
36	.01691	.12206	8.19241	484.46312	71.38944	231.72988
37	.01510	.12184	8.20751	543.59869	71.94809	239.93739
38	.01348	.12164	8.22099	609.83053	72.46036	248.15839
39	.01204	.12146	8.23303	684.01020	72.92978	256.39142
40	.01075	.12130	8.24378	767.09142	73.35965	264.63519
41	.00960	.12116	8.25337	860.14239	73.75306	272.88857
42	.00857	.12104	8.26194	964.35948	74.11289	281.15051
43	.00765	.12092	8.26959	1081.08262	74.44181	289.42009
44	.00683	.12083	8.27642	1211.81253	74.74232	297.69651
45	.00610	.12074	8.28252	1358.23003	75.01673	305.97903
46	.00544	.12066	8.28796	1522.21764	75.26718	314.26699
47	.00486	.12059	8.29282	1705.88375	75.49566	322.55981
48	.00434	.12052	8.29716	1911.58980	75.70401	330.85698
49	.00388	.12047	8.30104	2141.98058	75.89390	339.15801
50	.00346	.12042	8.30450	2400.01825	76.06691	347.46251

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COMPOUND INTEREST AND ANNUITY TABLES FOR
13.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.88496	1.13000	.88496	1.00000	.88496	.88496
2	.78315	.59948	1.66810	2.13000	2.45125	2.55306
3	.69305	.42352	2.36115	3.40690	4.53040	4.91421
4	.61332	.33619	2.97447	4.84980	6.98367	7.88668
5	.54276	.28431	3.51723	6.48027	9.69747	11.40591
6	.48032	.25015	3.99755	8.32271	12.57939	15.40346
7	.42506	.22611	4.42261	10.40466	15.55481	19.82607
8	.37616	.20839	4.79877	12.75726	18.56409	24.62484
9	.33288	.19487	5.13166	15.41571	21.56005	29.75650
10	.29459	.18429	5.42624	18.41975	24.50594	35.18274
11	.26070	.17584	5.68694	21.81432	27.37361	40.86968
12	.23071	.16899	5.91765	25.65018	30.14208	46.78733
13	.20416	.16335	6.12181	29.98470	32.79622	52.90914
14	.18068	.15867	6.30249	34.88271	35.32569	59.21163
15	.15989	.15474	6.46238	40.41746	37.72405	65.67401
16	.14150	.15143	6.60388	46.67173	39.98799	72.27788
17	.12522	.14861	6.72909	53.73906	42.11670	79.00698
18	.11081	.14620	6.83991	61.72514	44.11132	85.84688
19	.09806	.14413	6.93797	70.74941	45.97453	92.78485
20	.08678	.14235	7.02475	80.94683	47.71018	99.80960
21	.07680	.14081	7.10155	92.46992	49.32295	106.91115
22	.06796	.13948	7.16951	105.49101	50.81814	114.08067
23	.06014	.13832	7.22966	120.20484	52.20146	121.31032
24	.05323	.13731	7.28288	136.83147	53.47887	128.59321
25	.04710	.13643	7.32998	155.61956	54.65642	135.92319
26	.04168	.13565	7.37167	176.85010	55.74018	143.29486
27	.03689	.13498	7.40856	200.84061	56.73615	150.70342
28	.03264	.13439	7.44120	227.94989	57.65018	158.14462
29	.02889	.13387	7.47009	258.58338	58.48795	165.61470
30	.02557	.13341	7.49565	293.19922	59.25490	173.11036
31	.02262	.13301	7.51828	332.31511	59.95624	180.62864
32	.02002	.13266	7.53830	376.51608	60.59692	188.16693
33	.01772	.13234	7.55602	426.46317	61.18161	195.72295
34	.01568	.13207	7.57170	482.90338	61.71471	203.29465
35	.01388	.13183	7.58557	546.68082	62.20036	210.88022
36	.01228	.13162	7.59785	618.74933	62.64242	218.47807
37	.01087	.13143	7.60872	700.18674	63.04449	226.08679
38	.00962	.13126	7.61833	792.21101	63.40991	233.70512
39	.00851	.13112	7.62684	896.19845	63.74181	241.33197
40	.00753	.13099	7.63438	1013.70424	64.04306	248.96634
41	.00666	.13087	7.64104	1146.48579	64.31631	256.60738
42	.00590	.13077	7.64694	1296.52895	64.56403	264.25432
43	.00522	.13068	7.65216	1466.07771	64.78847	271.90648
44	.00462	.13060	7.65678	1657.66781	64.99170	279.56325
45	.00409	.13053	7.66086	1874.16463	65.17565	287.22412
46	.00362	.13047	7.66448	2118.80603	65.34205	294.88860
47	.00320	.13042	7.66768	2395.25082	65.49250	302.55628
48	.00283	.13037	7.67052	2707.63342	65.62848	310.22680
49	.00251	.13033	7.67302	3060.62577	65.75133	317.89982
50	.00222	.13029	7.67524	3459.50712	65.86226	325.57506

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COMPOUND INTEREST AND ANNUITY TABLES FOR
14.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.87719	1.14000	.87719	1.00000	.87719	.87719
2	.76947	.60729	1.64666	2.14000	2.41613	2.52385
3	.67497	.43073	2.32163	3.43960	4.44104	4.84549
4	.59208	.34320	2.91371	4.92114	6.80936	7.75920
5	.51937	.29128	3.43308	6.61010	9.40621	11.19228
6	.45559	.25716	3.88867	8.53552	12.13973	15.08095
7	.39964	.23319	4.28830	10.73049	14.93719	19.36925
8	.35056	.21557	4.63886	13.23276	17.74166	24.00812
9	.30751	.20217	4.94637	16.08535	20.50923	28.95449
10	.26974	.19171	5.21612	19.33730	23.20667	34.17060
11	.23662	.18339	5.45273	23.04452	25.80946	39.62334
12	.20756	.17667	5.66029	27.27075	28.30017	45.28363
13	.18207	.17116	5.84236	32.08865	30.66707	51.12599
14	.15971	.16661	6.00207	37.58107	32.90301	57.12806
15	.14010	.16281	6.14217	43.84241	35.00446	63.27023
16	.12289	.15962	6.26506	50.98035	36.97073	69.53529
17	.10780	.15692	6.37286	59.11760	38.80332	75.90815
18	.09456	.15462	6.46742	68.39407	40.50542	82.37557
19	.08295	.15266	6.55037	78.96923	42.08144	88.92594
20	.07276	.15099	6.62313	91.02493	43.53667	95.54907
21	.06383	.14954	6.68696	104.76842	44.87702	102.23602
22	.05599	.14830	6.74294	120.43600	46.10875	108.97897
23	.04911	.14723	6.79206	138.29704	47.23833	115.77103
24	.04308	.14630	6.83514	158.65862	48.27227	122.60616
25	.03779	.14550	6.87293	181.87083	49.21702	129.47909
26	.03315	.14480	6.90608	208.33274	50.07890	136.38517
27	.02908	.14419	6.93515	238.49933	50.86402	143.32032
28	.02551	.14366	6.96066	272.88923	51.57822	150.28098
29	.02237	.14320	6.98304	312.09373	52.22709	157.26402
30	.01963	.14280	7.00266	356.78685	52.81590	164.26668
31	.01722	.14245	7.01988	407.73701	53.34962	171.28657
32	.01510	.14215	7.03498	465.82019	53.83290	178.32155
33	.01325	.14188	7.04823	532.03501	54.27007	185.36978
34	.01162	.14165	7.05985	607.51991	54.66518	192.42963
35	.01019	.14144	7.07005	693.57270	55.02195	199.49968
36	.00894	.14126	7.07899	791.67288	55.34386	206.57866
37	.00784	.14111	7.08683	903.50708	55.63408	213.66549
38	.00688	.14097	7.09371	1030.99808	55.89553	220.75921
39	.00604	.14085	7.09975	1176.33781	56.13091	227.85895
40	.00529	.14075	7.10504	1342.02510	56.34269	234.96399
41	.00464	.14065	7.10969	1530.90861	56.53309	242.07368
42	.00407	.14057	7.11376	1746.23582	56.70419	249.18744
43	.00357	.14050	7.11733	1991.70883	56.85785	256.30477
44	.00313	.14044	7.12047	2271.54807	56.99577	263.42524
45	.00275	.14039	7.12322	2590.56480	57.11951	270.54845
46	.00241	.14034	7.12563	2954.24387	57.23046	277.67408
47	.00212	.14030	7.12774	3368.83801	57.32990	284.80183
48	.00186	.14026	7.12960	3841.47534	57.41899	291.93143
49	.00163	.14023	7.13123	4380.28188	57.49876	299.06265
50	.00143	.14020	7.13266	4994.52135	57.57017	306.19531

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COMPOUND INTEREST AND ANNUITY TABLES FOR
15.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.86957	1.15000	.86957	1.00000	.86957	.86957
2	.75614	.61512	1.62571	2.15000	2.38185	2.49527
3	.65752	.43798	2.28323	3.47250	4.35440	4.77850
4	.57175	.35027	2.85498	4.99337	6.64141	7.63348
5	.49718	.29832	3.35216	6.74238	9.12730	10.98563
6	.43233	.26424	3.78448	8.75374	11.72126	14.77012
7	.37594	.24036	4.16042	11.06680	14.35282	18.93054
8	.32690	.22285	4.48732	13.72682	16.96804	23.41786
9	.28426	.20957	4.77158	16.78584	19.52640	28.18944
10	.24718	.19925	5.01877	20.30372	21.99825	33.20821
11	.21494	.19107	5.23371	24.34928	24.36262	38.44192
12	.18691	.18448	5.42062	29.00167	26.60551	43.86254
13	.16253	.17911	5.58315	34.35192	28.71837	49.44569
14	.14133	.17469	5.72448	40.50471	30.69697	55.17016
15	.12289	.17102	5.84737	47.58041	32.54039	61.01753
16	.10686	.16795	5.95423	55.71747	34.25023	66.97177
17	.09293	.16537	6.04716	65.07509	35.82997	73.01893
18	.08081	.16319	6.12797	75.83636	37.28446	79.14689
19	.07027	.16134	6.19823	88.21181	38.61950	85.34513
20	.06110	.15976	6.25933	102.44358	39.84150	91.60446
21	.05313	.15842	6.31246	118.81012	40.95725	97.91692
22	.04620	.15727	6.35866	137.63164	41.97366	104.27558
23	.04017	.15628	6.39884	159.27638	42.89767	110.67442
24	.03493	.15543	6.43377	184.16784	43.73610	117.10819
25	.03038	.15470	6.46415	212.79302	44.49554	123.57234
26	.02642	.15407	6.49056	245.71197	45.18234	130.06290
27	.02297	.15353	6.51353	283.56877	45.80252	136.57644
28	.01997	.15306	6.53351	327.10408	46.36179	143.10995
29	.01737	.15265	6.55088	377.16969	46.86547	149.66082
30	.01510	.15230	6.56598	434.74515	47.31857	156.22680
31	.01313	.15200	6.57911	500.95692	47.72569	162.80592
32	.01142	.15173	6.59053	577.10046	48.09113	169.39645
33	.00993	.15150	6.60046	664.66552	48.41884	175.99691
34	.00864	.15131	6.60910	765.36535	48.71244	182.60601
35	.00751	.15113	6.61661	881.17016	48.97525	189.22262
36	.00653	.15099	6.62314	1014.34568	49.21031	195.84575
37	.00568	.15086	6.62881	1167.49753	49.42039	202.47457
38	.00494	.15074	6.63375	1343.62216	49.60800	209.10832
39	.00429	.15065	6.63805	1546.16549	49.77544	215.74637
40	.00373	.15056	6.64178	1779.09031	49.92477	222.38814
41	.00325	.15049	6.64502	2046.95385	50.05787	229.03317
42	.00282	.15042	6.64785	2354.99693	50.17643	235.68102
43	.00245	.15037	6.65030	2709.24647	50.28198	242.33132
44	.00213	.15032	6.65244	3116.63344	50.37590	248.98376
45	.00186	.15028	6.65429	3585.12846	50.45942	255.63805
46	.00161	.15024	6.65591	4123.89773	50.53366	262.29395
47	.00140	.15021	6.65731	4743.48239	50.59963	268.95127
48	.00122	.15018	6.65853	5456.00475	50.65821	275.60980
49	.00106	.15016	6.65959	6275.40546	50.71021	282.26939
50	.00092	.15014	6.66051	7217.71628	50.75635	288.92990

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COMPOUND INTEREST AND ANNUITY TABLES FOR
16.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.86207	1.16000	.86207	1.00000	.86207	.86207
2	.74316	.62296	1.60523	2.16000	2.34839	2.46730
3	.64066	.44526	2.24589	3.50560	4.27037	4.71319
4	.55229	.35738	2.79818	5.06650	6.47953	7.51137
5	.47611	.30541	3.27429	6.87714	8.86010	10.78566
6	.41044	.27139	3.68474	8.97748	11.32275	14.47040
7	.35383	.24761	4.03857	11.41387	13.79956	18.50897
8	.30503	.23022	4.34359	14.24009	16.23976	22.85256
9	.26295	.21708	4.60654	17.51851	18.60634	27.45910
10	.22668	.20690	4.83323	21.32147	20.87317	32.29233
11	.19542	.19886	5.02864	25.73290	23.02276	37.32097
12	.16846	.19241	5.19711	30.85017	25.04431	42.51808
13	.14523	.18718	5.34233	36.78620	26.93226	47.86041
14	.12520	.18290	5.46753	43.67199	28.68499	53.32794
15	.10793	.17936	5.57546	51.65951	30.30390	58.90340
16	.09304	.17641	5.66850	60.92503	31.79255	64.57190
17	.08021	.17395	5.74870	71.67303	33.15607	70.32060
18	.06914	.17188	5.81785	84.14072	34.40067	76.13845
19	.05961	.17014	5.87746	98.60323	35.53321	82.01590
20	.05139	.16867	5.92884	115.37975	36.56091	87.94474
21	.04430	.16742	5.97314	134.84051	37.49117	93.91788
22	.03819	.16635	6.01133	157.41499	38.33130	99.92921
23	.03292	.16545	6.04425	183.60138	39.08847	105.97346
24	.02838	.16467	6.07263	213.97761	39.76958	112.04608
25	.02447	.16401	6.09709	249.21402	40.38122	118.14318
26	.02109	.16345	6.11818	290.08827	40.92958	124.26136
27	.01818	.16296	6.13636	337.50239	41.42048	130.39772
28	.01567	.16255	6.15204	392.50277	41.85935	136.54976
29	.01351	.16219	6.16555	456.30322	42.25120	142.71531
30	.01165	.16189	6.17720	530.31173	42.60064	148.89251
31	.01004	.16162	6.18724	616.16161	42.91193	155.07975
32	.00866	.16140	6.19590	715.74746	43.18894	161.27565
33	.00746	.16120	6.20336	831.26706	43.43521	167.47901
34	.00643	.16104	6.20979	965.26979	43.65394	173.68880
35	.00555	.16089	6.21534	1120.71295	43.84804	179.90414
36	.00478	.16077	6.22012	1301.02703	44.02015	186.12426
37	.00412	.16066	6.22424	1510.19135	44.17265	192.34850
38	.00355	.16057	6.22779	1752.82197	44.30766	198.57629
39	.00306	.16049	6.23086	2034.27348	44.42712	204.80715
40	.00264	.16042	6.23350	2360.75724	44.53274	211.04064
41	.00228	.16037	6.23577	2739.47840	44.62606	217.27642
42	.00196	.16031	6.23774	3178.79494	44.70848	223.51415
43	.00169	.16027	6.23943	3688.40213	44.78122	229.75358
44	.00146	.16023	6.24089	4279.54648	44.84539	235.99447
45	.00126	.16020	6.24214	4965.27391	44.90196	242.23661
46	.00108	.16017	6.24323	5760.71774	44.95181	248.47983
47	.00093	.16015	6.24416	6683.43257	44.99572	254.72400
48	.00081	.16013	6.24497	7753.78179	45.03438	260.96896
49	.00069	.16011	6.24566	8995.38687	45.06840	267.21462
50	.00060	.16010	6.24626	10435.64877	45.09833	273.46088

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COMPOUND INTEREST AND ANNUITY TABLES FOR
17.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.85470	1.17000	.85470	1.00000	.85470	.85470
2	.73051	.63083	1.58521	2.17000	2.31573	2.43992
3	.62437	.45257	2.20958	3.53890	4.18884	4.64950
4	.53365	.36453	2.74324	5.14051	6.32344	7.39274
5	.45611	.31256	3.19935	7.01440	8.60400	10.59208
6	.38984	.27861	3.58918	9.20685	10.94303	14.18127
7	.33320	.25495	3.92238	11.77201	13.27539	18.10365
8	.28478	.23769	4.20716	14.77325	15.55365	22.31081
9	.24340	.22469	4.45057	18.28471	17.74429	26.76138
10	.20804	.21466	4.65860	22.39311	19.82466	31.41998
11	.17781	.20676	4.83641	27.19994	21.78057	36.25639
12	.15197	.20047	4.98839	32.82393	23.60426	41.24478
13	.12989	.19538	5.11828	39.40399	25.29286	46.36306
14	.11102	.19123	5.22930	47.10267	26.84713	51.59236
15	.09489	.18782	5.32419	56.11013	28.27045	56.91655
16	.08110	.18500	5.40529	66.64885	29.56807	62.32183
17	.06932	.18266	5.47461	78.97915	30.74646	67.79644
18	.05925	.18071	5.53385	93.40561	31.81287	73.33029
19	.05064	.17907	5.58449	110.28456	32.77498	78.91478
20	.04328	.17769	5.62777	130.03294	33.64057	84.54255
21	.03699	.17653	5.66476	153.13854	34.41738	90.20730
22	.03162	.17555	5.69637	180.17209	35.11294	95.90368
23	.02702	.17472	5.72340	211.80134	35.73446	101.62708
24	.02310	.17402	5.74649	248.80757	36.28876	107.37357
25	.01974	.17342	5.76623	292.10486	36.78227	113.13980
26	.01687	.17292	5.78311	342.76268	37.22094	118.92291
27	.01442	.17249	5.79753	402.03234	37.61030	124.72043
28	.01233	.17217	5.80985	471.37783	37.95541	130.53029
29	.01053	.17181	5.82039	552.51207	38.26090	136.35067
30	.00900	.17154	5.82939	647.43912	38.53102	142.18006
31	.00770	.17132	5.83709	758.50377	38.76958	148.01715
32	.00658	.17113	5.84366	888.44941	38.98005	153.86081
33	.00562	.17096	5.84928	1040.48581	39.16557	159.71009
34	.00480	.17082	5.85409	1218.36839	39.32894	165.56418
35	.00411	.17070	5.85820	1426.49102	39.47267	171.42238
36	.00351	.17060	5.86171	1669.99450	39.59903	177.28408
37	.00300	.17051	5.86471	1954.89356	39.71003	183.14879
38	.00256	.17044	5.86727	2288.22547	39.80747	189.01606
39	.00219	.17037	5.86946	2678.22379	39.89294	194.88552
40	.00187	.17032	5.87133	3134.52184	39.96786	200.75686
41	.00160	.17027	5.87294	3668.39055	40.03350	206.62979
42	.00137	.17023	5.87430	4293.01695	40.09097	212.50409
43	.00117	.17020	5.87547	5023.82983	40.14126	218.37957
44	.00100	.17017	5.87647	5878.88090	40.18524	224.25604
45	.00085	.17015	5.87733	6879.29065	40.22369	230.13337
46	.00073	.17012	5.87806	8049.77006	40.25728	236.01143
47	.00062	.17011	5.87868	9419.23097	40.28661	241.89011
48	.00053	.17009	5.87922	11021.50024	40.31222	247.76932
49	.00046	.17008	5.87967	12896.15528	40.33456	253.64899
50	.00039	.17007	5.88006	15089.50167	40.35404	259.52905

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COMPOUND INTEREST AND ANNUITY TABLES FOR
18.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	.84746	1.18000	.84746	1.00000	.84746	.84746
2	.71818	.69872	1.56564	2.18000	2.28383	2.41310
3	.60863	.45992	2.17427	3.57240	4.10972	4.58737
4	.51579	.37174	2.69006	5.21543	6.17287	7.27743
5	.43711	.31978	3.12717	7.15421	8.35842	10.40461
6	.37043	.28591	3.49760	9.44197	10.58101	13.90221
7	.31393	.26236	3.81153	12.14152	12.77849	17.71374
8	.26604	.24524	4.07757	15.32700	14.90679	21.79130
9	.22546	.23239	4.30302	19.08585	16.93590	26.09432
10	.19106	.22251	4.49409	23.52131	18.84654	30.58841
11	.16192	.21478	4.65601	28.75514	20.62765	35.24441
12	.13722	.20863	4.79322	34.93107	22.27428	40.03764
13	.11629	.20369	4.90951	42.21866	23.78602	44.94715
14	.09855	.19968	5.00806	50.81802	25.16571	49.95521
15	.08352	.19640	5.09158	60.96527	26.41845	55.04679
16	.07078	.19371	5.16235	72.93901	27.55087	60.20915
17	.05998	.19149	5.22233	87.06804	28.57053	65.43148
18	.05083	.18964	5.27316	103.74028	29.48548	70.70464
19	.04308	.18810	5.31624	123.41353	30.30393	76.02088
20	.03651	.18682	5.35275	146.62797	31.03405	81.37363
21	.03094	.18575	5.38368	174.02100	31.68372	86.75731
22	.02622	.18485	5.40990	206.34479	32.26051	92.16722
23	.02222	.18409	5.43212	244.48685	32.77154	97.59933
24	.01883	.18345	5.45095	289.49448	33.22344	103.05028
25	.01596	.18292	5.46691	342.60349	33.62236	108.51719
26	.01352	.18247	5.48043	405.27211	33.97396	113.99762
27	.01146	.18209	5.49189	479.22109	34.28338	119.48951
28	.00971	.18177	5.50160	566.48089	34.55531	124.99111
29	.00823	.18149	5.50983	669.44745	34.79399	130.50094
30	.00697	.18126	5.51681	790.94799	35.00324	136.01774
31	.00591	.18107	5.52272	934.31863	35.18648	141.54046
32	.00501	.18091	5.52773	1103.49598	35.34678	147.06819
33	.00425	.18077	5.53197	1303.12526	35.48687	152.60016
34	.00360	.18065	5.53557	1538.68781	35.60918	158.13573
35	.00305	.18055	5.53862	1816.65161	35.71589	163.67435
36	.00258	.18047	5.54120	2144.64890	35.80891	169.21555
37	.00219	.18039	5.54339	2531.68570	35.88992	174.75894
38	.00186	.18033	5.54525	2988.38913	35.96044	180.30419
39	.00157	.18028	5.54682	3527.29918	36.02176	185.85100
40	.00133	.18024	5.54815	4163.21303	36.07507	191.39916
41	.00113	.18020	5.54928	4913.59137	36.12138	196.94844
42	.00096	.18017	5.55024	5799.03782	36.16157	202.49868
43	.00081	.18015	5.55105	6843.86463	36.19645	208.04973
44	.00069	.18012	5.55174	8076.76026	36.22669	213.60146
45	.00058	.18010	5.55232	9531.57711	36.25291	219.15378
46	.00049	.18009	5.55281	11248.26098	36.27562	224.70659
47	.00042	.18008	5.55323	13273.94796	36.29528	230.25983
48	.00035	.18006	5.55359	15664.25859	36.31230	235.81341
49	.00030	.18005	5.55389	18484.82514	36.32702	241.36730
50	.00025	.18005	5.55414	21813.09367	36.33975	246.92144

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Appendix C - Glossary

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GLOSSARY

Alternative cost. Expenditures for achieving a like goal or objective by some other means.

Amortization. Converting capital or initial cost to annual cost by determining the size of annual payments needed to pay off a debt over a given time period at a given interest rate.

Formula: $\frac{i(1 + i)n}{(1 + i)n-1}$ or $\frac{i}{1- \frac{1}{(1 + i)n}}$

Amount of an annuity of 1 per year. How much an annuity invested each year will grow over a period of years.

Formula: $\frac{(1 + i)n-1}{i}$

Annuity. A series of equal payment made at equal intervals of time. An annuity may be a benefit or a cost.

Assessed valuation. The estimated worth of property for general property tax purposes.

Average annual cost. Annual equivalent cost of conservation measure(s) plus necessary operation, maintenance and replacement costs.

Average annual equivalent. A uniform yearly sum of money, i.e., costs, spread over the life of a facility so it is equal to its initial cost plus interest (see also amortization).

Average product. The ratio of total output (a total product) to the quantity of input used in producing that amount.

Base period. The point in time with which other index numbers are compared.

Benefit-cost ratio. A mathematical computation whereby benefits accruing from some alternative action are divided by the costs of installing such an alternative.

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Breakeven point. Where the proceeds from total output of an alternative plan equals the costs of all inputs associated with that alternative.

Capital. All resources except land and labor which contribute toward the production of goods and services.

Capital-investment. Monetary expenditures for initial installation of an alternative practice or system.

Capital-recovery period-(see also evaluation period). The length of time an individual or group may chose to retire a debt.

Cash-outlay. Direct expenditures for purchase of farm supplies, hired labor, services, etc., during the growing season.

Competitive enterprise. An activity which decreases the production of another as its own production increases.

Complementarity. Where an increase in the production of one activity will cause an increase in production in another.

Composite acre. A weighted unit showing the percentage or proportion that each crop is of the total cropland acreage.

Compound interest. Interest that is earned for one period and immediately added to the principal, thus resulting in a larger principal on which interest is computed for the following period.

Compound interest and annuity tables. A collection of factors used to express the functions of interest rate and time.

Cost and return estimator (CARE). A software program designed for use on a microcomputer to create and adjust cost and return estimates (crop budgets).

Crop budget. A systematic listing of resources used, their cost for specified yield levels, and the value of the output by individual crops or enterprise.

Crop Budget System. A computerized system designed to create and adjust cost and return estimates.

Custom rate. The usual fee for farm services rendered, generally for machine hire.

Demand. The quantity of a good (or service) which consumers will buy at a certain price.

Depreciation. A decrease in the value of property through wear, deterioration or obsolescence.

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Diminishing returns. A condition where each successive unit of input adds less to total output than the previous unit.

Economics. Allocation of limited resources among unlimited human wants.

Economies of scale. Ability of business firms to spread their fixed costs over larger quantities of output.

Effective economic life. The point in time where the present worth of expenditures for extending the life of a facility or replacing it exceed the present worth of the benefits.

Efficiency. Provides a "measuring stick" for evaluating choices. in general, efficiency refers to the ratio of output to input.

Evaluation period. Beginning at the end of the installation period with the time period based on the expected useful economic life of the facility or facilities.

Factors of production. Resources, either human (labor) or non-human (capital) used for producing goods which in turn are used to satisfy wants. The four factors of production commonly identified are land, labor, capital, and management.

Fair market value. The price at which an owner would sell to a willing buyer.

Family labor. Non-hired manpower inputs from an individual or from his household.

Fixed costs. Expenditures which would be incurred even if no output were produced.

Gross returns. Total production in units multiplied be the price per unit.

Interactive Conservation Evaluation (ICE). A software program designed for use on a microcomputer to make economic analyses of the costs and benefits of conservation.

Interest. The earning power of money or the price for the use of money.

Interest rate. The cost of using borrowed capital or the value placed on using owned capital, either determined by demand, time and risk.

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Internal rate of return. The interest rate money will earn as the total investment is repaid by its revenues.

Lagged. A value which takes place sometime in the future is referred to as lagged.

Land voiding. A stage of land deterioration, generally through gully erosion, where the remaining productive capacity of the land is almost zero.

Least costly alternative. The lowest expenditure for installing, operating, and maintaining a system or systems of conservation measures to achieve a specified objective.

Linear programming. A technique to predict an optimum level of production or the best combination of production activities, given specific linear relationships and mathematical inequalities.

Management. A decisionmaking process of determining how land, labor, and capital will be combined into an enterprise or organization for the purpose of obtaining maximum continuous net returns.

Marginal analysis. Determining the level of production where marginal costs are equal to marginal benefits and net benefits are maximized.

Marginal benefits. The additional benefit of producing one more unit of output.

Marginal costs. The additional cost of producing one more unit of output.

Marginal rate of substitution. The amount of one commodity or product a consumer is just willing to give up in order to get an additional unit of another commodity or product.

Maximum net benefit. The level of development where the value of total output minus the value of total required input is the greatest.

Mean. Mathematical average.

Median. Designating the middle number or the middle between two numbers in a long series of ordered numbers or values.

Net returns. The residual value of production after total costs of production are subtracted from the gross returns.

Number of years (or periods) hence. Number of years (or periods) into the future for which the calculations are being made.

Objective. Qualified goals or achievements to answer or solve projected needs as expressed by a person or group persons.

Off-site benefits. Benefits accruing to areas or person outside the problem-controlled area.

On-site benefits. Benefits accruing at the general location of the control measure.

Operating cost. Expenditures for machine operation which generally include lubrication, repairs, and fuel (not applicable to all machines).

Operation, maintenance, and replacement. Actual expenditures and donated services to insure proper functioning of the facility or measure throughout its intended life.

Opportunity cost. The earning capabilities of money for use in alternative investments having similar risk and time frames.

Overhead costs. Expenditures associated with the farm organization, not generally influenced by levels of production or kinds of crops grown. Examples include most utilities, machine shop and related shop tools, accountant or management fees, etc.

Ownership costs. Costs unrelated to rate of annual use, such as expenditures for depreciation, taxes, interest on investment, insurance and housing.

Partial budgeting. A technique where only the relevant changes in income and production costs are identified, listed, and used in the analysis.

Perennial crops. Those having a life cycle of more than two years.

Performance rate Rate of accomplishment based on machine width, tractor speed and the percent efficiency.

Perpetuity. An indefinite or extremely long period of time.

Planning horizon. The time period within which a businessman, farmer, or rancher formulates his activities for accruing maximum, continuous net returns.

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Present value (or present worth). Future costs or benefits discounted or lagged to show their current value.

Present value of a decreasing annuity. Today's value of an annuity that is not constant but decreases uniformly over a period of time.

Formula: $$\frac{n(i)-1 + \frac{1}{(1 + i)^n}}{(i)^2}$$

Present value of an annuity of one per year. The discounted or lagged value of a series of equal payments to be covered over a period of years.

Formula: $$\frac{(1 + i)^n-1}{i(1 + i)^n}$$

Present value of an increasing annuity. Today's value of an annuity that is not constant but increases uniformly over a period of time.

Formula: $$\frac{(1 + i)^{n+1} -(1 + i)-n(i)}{(1 + i)^n (i)^2}$$

Present value of one. The amount that must be invested now at a compound interest to have a value of 1 in a given length of time or what one dollar due in the future is worth today. Also known as the discount factor or the reciprocal of the compound interest factor.

Formula: $$\frac{1}{(1 + i)^n}$$

Price. The exchange value for commodities usually determined through the market system.

Price base. A common level of prices generally adjusted through the use of price indexes.

Price index. A procedure to reflect changes in prices relative to prices in some base period.

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Principal. The initial investment exclusive of interest.

Production costs. Expenditures, both fixed and variable, for all items required for specified levels of crop or livestock production.

Projections. Best estimates of future development, based upon historical trends, analysis of current relationships and an evaluation of foreseeable conditions.

Quality differential. Changes achieved through resource improvement in quality of harvested crop which affects per unit prices received.

Rent (pure economic). The price paid for the use of land and other natural resources which are completely fixed in total supply.

Salvage value. The monetary value of an investment at the end of its economic life, usually the trade-in value as new equipment is purchased.

Simple interest. Money earned on the principal only and not on accumulated interest.

Sinking fund. A program for capital accumulation over a period of years. The factor indicates how much needs to be invested annually to accumulate a given amount over a given number of years at a specified compound interest rate (reciprocal of the amount of an annuity of 1).

Standard of living. The necessities of personal consumption which can be provided by current disposable family income.

Substitution of capital. The continuing application of new technological innovations to improve production efficiencies over what could previously be provided.

Supplementary enterprise. Production from one enterprise is increased without increasing or decreasing production of another enterprise.

Supply. The quantity of a good or service a firm is willing to produce to sell at a given price.

Value added. The increase in value resulting from doing something to or with the product.

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Variable costs. Costs relevant to production or those occurring only as production takes place.

Unit cost. Monetary value or charge per unit, e.g., cost per cubic yard of concrete, cost per acre of owning an 18-foot self-propelled combine, etc.

With condition. The anticipated situation which is projected to occur in the future if the proposed conservation measures are installed.

Without condition. The anticipated situation which is projected to occur in the future, if the proposed conservation measures are not installed.

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(200-VI-EHWR, September 1968)

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PART 620 - ECONOMIC ANALYSIS

SUBPART A - FRAMEWORK AND STANDARDS

620.01(a)(1)

§620.00 Objective.

(a) The Federal objective of water resource planning is to contribute to national economic development while protecting the Nation's environment (see Ch. 1, Principles and Guidelines). The Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies were issued March 10, 1983 by the Water Resources Council. This document will be referred to throughout this handbook as the P&G.1/

(b) Economic analyses of SCS projects affecting water and related land resources are designed to quantify the contribution of each project to national economic development (NED). National economic development as defined in the P&G, and as used in this manual, is the increase "in the net value of the national output of goods and services, expressed in monetary units."

(c) Water resource projects, which protect watersheds, reduce flooding, and provide for conservation, development, utilization, and disposal of water, contribute to NED in two ways: first, they alleviate problems affecting water and related land resources, and second, they enhance opportunities to use these resources more intensively.

§620.01 Planning water resource projects.

(a) Specifying the problems.

(1) The initial step in planning is to understand clearly the resource conditions in the project locale. The economic significance of resource problems should be described in terms of the specific state and local concerns as well as the Federal objectives. Resource conditions meriting project action may include:

1/ Water Resource Council. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Studies. Washington, D.C. 1983.

620.01(a)(1)

-- Severe erosion causing a loss in long-term soil productivity;

-- Significant damage from sediment deposition and/or pollutant runoff;

-- Inefficient water use in an existing irrigation project;

-- Land use limitations and low yield levels on poorly drained agricultural land;

-- Inadequate water supply in irrigated areas and other agricultural water management problems; and

-- Opportunities to develop or improve municipal and industrial water supplies, recreational facilities, and fish and wildlife habitat.

(2) Project plans should describe resource problems and opportunities so that potential benefits can be readily recognized and quantitatively estimated. This description should specify problems and desired effects that are identified by groups and individuals affected by the planned project. It should also identify resource objectives declared to be in the national interest by the Congress and Executive Branch.

(b) Inventory and forecasting.

(1) The second step in planning is collecting information and data on those resource conditions within the planning area that are relevant to identified problems and opportunities.

(2) This handbook examines specific resource inventories and forecasts as they relate to flood damage, both agricultural and urban; reduction of erosion and sediment damage; agricultural water management; recreation; and municipal and industrial water supplies.

(c) Preparing alternative plans. Economic analysis plays a critical role in the systematic formulation of alternative plans for water resource development. Each alternative plan may consist of a system of structural and/or nonstructural measures, land treatment, and other strategies or programs to alleviate specific problems or take advantage of specific opportunities associated with water and related land resources of the project area. One alternative plan is developed to maximize NED benefits. Other alternative plans may be formulated which reduce net NED benefits in order to further address other federal, state, and local concerns not fully addressed by the NED plan. These additional plans should be formulated in order to allow

the decisionmaker to judge whether these other beneficial effects outweigh the corresponding NED losses. To do this, each plan requires an economic analysis. Alternative plans, including the NED plan, are formulated in consideration of four criteria: Completeness, effectiveness, efficiency, and acceptability (See Ch. 1, P&G).

(d) Evaluating alternative plans. Four accounts are used to record the effects and to facilitate comparison of alternative plans. The NED account shows effects on the national economy. The environmental quality (EQ) account shows effects on ecological, cultural, and aesthetic attributes of significant natural and cultural resources that cannot readily be measured in monetary terms. The regional economic development (RED) account shows the regional incidence of NED effects, income transfers, and employment effects. The other social effects (OSE) account shows urban and community impacts and effects on life, health, and safety.

(e) Comparing alternative plans and plan selection. The final two steps in planning are comparing alternative plans and plan selection. The comparison of plans focuses on the differences among the alternative plans as determined in the evaluation phase. By comparing the changes that occur in the various accounts, the decisionmaker will be aware of the tradeoff between alternative plans. After consideration of the various alternative plans and receiving public comments, the agency decisionmaker selects a plan.

§620.02 Evaluation standards.

The following discussion reviews basic assumptions and standards that underlie fundamental procedures in project evaluation, and benefit-cost analysis. Aspects covered include: concepts and basic assumptions; pricing of goods and services; interest and discount rates; and period of analysis. The basic objective in economic evaluation is to compare the values produced or conserved with the cost of materials used for the project. Ideally, this comparison is made after full account is taken of all project effects. In order to make valid benefit-cost comparisons among water resource projects, and among alternative plans for an individual project, it is necessary that uniform standards be used for pricing goods and services. It is also important that consistent assumptions about the general economic setting be used. The effects of projects should be estimated in a uniform manner and should be ascribed to beneficiaries in a consistent way.

620.02(a)

(a) Concepts and assumptions.

(1) Expression in monetary terms.

(i) Beneficial and adverse effects take many physical forms, they accrue at different times, and they may be temporary or permanent. Economic analysis evaluates a particular effect, characterizes it as beneficial or adverse, and estimates to what extent it contributes to or detracts from project goals.

(ii) In a market economy, the price system is the principal device for allocating resources among competing uses. Theoretically, prices reflect the scarcity and importance of resources and services. They provide a practical means of expressing diverse physical outputs on a common value scale.

(iii) However, it must be recognized that values attached to goods and services by the market may not always accurately reflect values from a public viewpoint, and vice versa. The intervention of public policy often creates "imperfect markets"--ones that are influenced by factors such as subsidies, tariffs, and price supports. While it is extremely difficult to give precise quantitative expression to certain of these considerations, the general principle that project services or products have value only to the extent that they are needed is inherent in any economic evaluation. Despite limitations of market prices as a measure of public value, they are essential for evaluating water resource projects.

(iv) Benefits and costs that cannot be expressed in terms of market prices also warrant consideration. Physical, biological, cultural, and aesthetic considerations that defy monetary measurement need to be weighed and described in a way that indicates their importance and influence on project formulation and evaluation.

(2) Evaluation Perspective. Evaluation must be made from a perspective that is consistent with the public intent of SCS projects. A broadly inclusive accounting of beneficial and adverse effects is warranted when evaluating projects that involve substantial Federal investment. That is, the evaluation must go beyond the perspective of those individuals who will be directly affected, for better or worse, by the project action. The effects of a project on individuals and on the public can seldom be evaluated completely. Comprehensive evaluations usually encounter problems of inadequate information or imperfect evaluation techniques. The task of the analyst is to determine the likely effects of a project, identify the private and public interests in each project, and evaluate these circumstances a rigorously as analytical techniques and information allow.

(3) Least cost alternative. Within the limits set by legislation, policy, engineering standard, or other constraints, project measures included in any plan should be the most cost-effective. Practical options need to be tested. For example; concrete and steel pipe are often substitutes for each other, therefore the total cost and benefits of each option need to be determined and the most efficient used. Total cost includes not only installation but also operation and maintenance. When the effective life of project options differ, discounting will be done to provide a valid base for comparison of costs.

(4) Ascribing effects to a project.

(i) Using standard procedures for attributing effects ensures that projects are evaluated in a consistent and systematic manner. Comparing economic and other effects "with" the project to the effects "without" the project provide the basis for identifying and quantifying the achievements of alternative plans.

(ii) Costs are computed using market prices for materials and labor required. Market prices normally provide an adequate measure of the values these goods and services would provide in other uses.

(iii) Benefits of an alternative plan are the difference in the value of goods and services available from using the project area resources "with the project" and the values from using these same resources "without the project."

(iv) Frequently, the with-project use of the resource will require the beneficiaries install supplemental onfarm associated measures to achieve the benefits. In these instances, the cost of these associated measures is subtracted from the project benefits.

(v) A project will have only one without-project condition. Each alternative plan will generate a with-project condition.

(5) Economic trends and resource use.

(i) Evaluation standards and procedures will utilize consistent assumptions about economic trends and expected levels of resource use. The assumption of a continuously expanding economy for both "with" and "without" conditions is reasonable for estimating future prices and requirements for goods and services. Under this assumption, increasing amounts of goods and services are required to satisfy the needs of an expanding population and provide for higher material standards of living.

620.02(a)(5)(ii)

(ii) At the same time, it would be expected that other, competing uses would arise for the goods and services required by the project. As a result, these project resources should be considered "scarce," in that all of them would have alternate uses either with or without the project.

(b) Pricing project products and services.

(1) The price of goods and services used for evaluation should reflect the real exchange rates expected to prevail while the project is being implemented and over its economic life. The general level of prices for outputs and inputs prevailing during or immediately preceding planning should be used for the entire period of analysis.

(2) When changes in agricultural production are expected as a consequence of a planning effort, normalized prices prepared by the Department of Agriculture are to be used. These normalized prices are updated annually.

(3) To date, the Department of Agriculture's current normalized prices have been developed and issued for only the principal crops grown in the U.S. For those crops not covered, statewide average prices over the previous three years should be used.

(c) Discounting and interest rates.

(1) Discounting is necessary to convert economic values--such as benefits and costs--that have been estimated as of the time of accrual to a common time basis. (See Subpart E, Interest and Annuity). Evaluations must take into account the interest rate and the time lapse between the project expenditure and the realization of project benefits. Project feasibility can be determined using either the capital values as of a common point in time or the average annual equivalent of these values. The Soil Conservation Service (SCS) uses average annual equivalents for comparison and feasibility determination.

(2) Project benefits and costs will be converted to a common time basis by the use of the current federal interest rate. This rate is determined annually in accordance with Public Law 93-251 using basic interest rate information furnished by the Department of Treasury. Compound interest and annuity tables for the current federal interest rate are issued by the SCS's Economics and Social Sciences Division.

(d) Period of analysis.

(1) SCS describes period of analysis as the installation period plus the time period for project benefits.

(2) As stated in the P&G the period of analysis is the time required for implementation plus the lesser of--

(i) The period of time over which any alternative plan would have significant beneficial or adverse effects, or

(ii) A period not to exceed 100 years.

(3) The period of analysis is to be the same for each alternative plan.

(4) The economic life of projects is limited by such factors as deterioration, obsolescence, depreciation, changing needs, and improvements in technology. Discounting for time, risk, and uncertainty also limit economic life. The limit of effective economic life is established at that point where the present worth of costs for extending the life of the project exceeds the present worth of the resulting benefits.

(5) Project benefits and costs are expressed in average annual equivalents for the period of analysis. These annual equivalents are the amortized present values of implementation costs, operation and maintenance costs, replacement costs, and the benefits. Present values are referenced to the beginning of project installation.

SUBPART B - APPLICATION OF ECONOMIC ANALYSIS IN PROJECT FORMULATION

620.12

§620.10 Introduction.

(a) Measurement of benefits and cost is essential in formulating and evaluating projects that will alleviate problems and realize opportunities. In the formulation stage, the analysts must evaluate the need for project development, determine the physical possibilities for project action, and establish the most practical means available for realizing the desired objectives.

(b) Project formulation and evaluation, within the framework of the legal and policy constraints, is largely a process of weighing alternatives. The overall planning objective is to select the measures or combination of measures that will meet watershed needs and yield the greatest possible gain at least cost.

§620.11 Legal constraints.

The Secretary of Agriculture is authorized to assist local organizations in the preparation of plans for preserving, protecting, and improving the Nation's land and water resources and the quality of the environment. Watershed project plans are formulated within the confines of a number of legal constraints. The important legal constraints are limits on the size of watersheds, size of floodwater retarding structures, and flood prevention storage capacity in individual structures (reference: Watershed Projection and Flood Prevention Act, Public Law 83-566, as amended).

§620.12 Economics of project formulation.

During project formulation, it is necessary to evaluate the potential physical effects of project measures so that cost-benefit comparisons can be made. Evaluation procedures discussed below illustrate the use of some of the important economic principles in project formulation.

620.12(a)

(a) Determining watershed problems.

Project formulation depends upon a clear statement of significant watershed problems. This step involves answers to a series of questions, such as: Is there a problem with flooding in the watershed? What is the magnitude of this problem in terms of reduced income and property damage? How does the problem limit future economic development? Is there a sediment damage problem? Where are the sediment source areas? What is the magnitude of sediment damages in dollars? Is there a need for irrigation or drainage, for recreation development? What is the dollar value of economic loss sustained by agriculture because of irrigation shortages or excess surface or groundwater? What are the costs facing the local community for development of future water supplies? What is the unmet or potential recreational demand in the area? These and other economic and physical determinations will suggest solutions to watershed problems. At this state, possibilities for the various physical solutions and their economic effects are evaluated in a preliminary way and the obviously infeasible means eliminated.

(b) Level of development needed.

Economic analysis can help identify the resource needs of a given area and the potential for developing water and related land resources. The degree of development needed is directly associated with the potential of the area to be developed. In flood prevention, for example, the degree of protection will not be the same for all watersheds. Analysis of flood prevention should be tailored to the values to be protected and the cost of such protection.

(c) Evaluation unit.

An evaluation unit is the analytical framework within which a solution to a water resource problem is developed. As such, it may be a watershed with a floodwater damage problem, or a conservation treatment unit with an erosion problem. Being the analytical framework, it becomes the basic accounting unit for cost-benefit comparison and reporting.

(d) Incremental analysis for maximizing net benefits.

(1) From an economic viewpoint, the optimum scale of project development is the point at which the net benefits are at a maximum. Net benefits are maximized when the benefits added by the last increment of scale or scope of project development are equal to the cost of adding that increment. The increments to be considered in this way are the smallest increments for which there is a practical choice as to inclusion in or omission from the project. In watershed projects these increments usually occur as steps rather than as smooth-curve increases.

(2) This is illustrated by the data shown in Table 1. In the illustration, it has been determined that structure numbers 1 and 2 are the most cost-effective means of providing the initial level of flood prevention for an annual cost of $12,800 and will provide annual net NED benefits of $6,200.

Table 620-1.--An example of incremental analysis.

Structure	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1 and 2	$12,800	-	$19,000	-	$ 6,200
3	14,300	$ 1,500	20,700	$ 1,700	6,400
4	20,300	6,000	26,700	6,100	6,500
5	27,000	6,700	31,800	5,000	4,800

To establish the point where net benefits are at the maximum, further increments are added to the basic system of two structures and their incremental costs and benefits determined. Adding structure number 3 increases the net benefits by $200. Structure number 4 increases net benefits by 4100. By adding struccture 5, costs are increased $6,700, but benefits only increase by $5,000. Thus, the last addition has gone beyond the point of maximized net benefits. The four-structure system maximizes net benefits and would be the upper limit that could be included on the basis of NED benefits alone.

(e) Order in which increments are to be considered.

(1) To ensure that net benefits are maximized, measures must be considered in a logical and consistent manner. This requires that the most cost-effective of the appropriate measures be added in turn. To determine the most cost-effective, each measure's costs and contribution to the problem solution are calculated with it as the first increment of development; the second increment then estimates these parameters for the remaining measures on the remaining problem. The procedure is continued using the remaining measures against the remaining problem until it is no longer possible to increase net benefits.

620.12(e)(2)

(2) The approach described above will be followed in formulating systems of land treatment practices.

(3) Planners can use either of two alternative approaches to determine the order in which different structures are considered in incremental analysis. The first, and preferred, method is to run the ECON 2 computer program (See 621.08(b)) for each structure individually. This will develop a ranking system for the structures as separate installations. The assumption that the relative value of individual structures will remain unchanged will be accepted when structures are grouped (as outlined in the following paragraph) and the order for the incremental analysis is established.

(4) The second approach involves bringing individual structures into the incremental analysis on the basis of the cost per unit of area controlled. This cost-effectiveness figure will be estimated by dividing capital installation cost by the area controlled. The structures will then enter the incremental analysis either individually or by group, beginning with those with the lowest cost and proceeding on the basis of increased cost per unit of area controlled.

(5) In water resource projects where three or fewer floodwater or multipurpose locations exist, all possible comtinations of structure will be evaluated; where four to eight structural locations exist, a combination of two structures can be considered as an increment; when nine or more structural locations exist, the groupings may be increased to three structures. Strucutres will be grouped in accord with the principle above.

(6) Some water resource projects have the potential for many small structural locations. In these projects, larger groups may be formed with the concurrence of the national technical center (NTC) economist and other concerned staff. grouping

(f) Economic analysis of a multiple purpose structure.

In evaluating multiple-purpose structures, it is necessary to confirm that the structure is feasible in total and that each purpose meets the test of economic feasibility. The feasibility test for the structure is satisfied if benefits exceed cost. The Determination of feasibility for the indivudal purposes requires that the benefits to a specific purpose exceed the separable cost of adding that purpose as the last increment to the proposed structure.

SUBPART C - PRICES AND YIELDS

620.22(a)(2)

§620.20 Introduction.

Soil Conservation Service project plans for water and related land resource developments are evaluated using current prices. Agricultural components of these plans are evaluated using current normalized prices prepared by the Department of Agriculture. Instructions on crop yield levels and yield projections are stated in Section 2.3.3 of the P&G.

§620.21 Conceptual basis.

The evaluation process should produce reasonable estimates of the aggregate benefits and costs of the project. Estimates of this type require the use of a set of relative price relationships representative of the period over which costs are incurred and benefits accrue. The P&G suggest that current price relationships should generally be used. Therefore price relationships observed in a recent time period are assumed to be the best estimate of future prices. In selecting the appropriate time period for price relationships, care should be taken to account for what may have been short-term abnormalities. Agricultural prices and costs are always influenced by highly variable factors such as weather, insect infestations, sudden demand changes, and inflationary forces. An analytical procedure such as the one described in the next section corrects somewhat for the short-term effects of these factors.

§620.22 Agricultural prices.

(a) Current normalized prices.

(1) Current normalized prices are to be used in all economic evaluations of agricultural productivity covered by the P&G, such as evaluations of beneficial or adverse effects of alternative projects and programs under consideration, and appraisals of economic impacts expressed in terms of value of production or income.

(2) Estimates of current normalized prices are available from SCS's Economics and Social Sciences Division in the form of an annual National Bulletin to supplement this handbook.

(b) Other agricultural prices.

(1) Special circumstances will require further price estimation, such as:

--Pricing commodities not included in the price tables,
--Determining price differentials within States,
--Determining price differentials to reflect product quality differences from the average represented by published price data, and
--Adjusting to reflect the impacts of project or program actions on market prices.

Approaches to these and other special price problems must achieve consistency with the published estimates of current normalized prices.

(2) Commodities not covered in price tables. If price data for one or more specific commodities are needed, they may be developed by using a 3-year state average for each of the desired commodities.

(3) Price differentials within states. Current normalized prices for a specific area within a state may be derived by computing the average local area to state price ratio for the previous 3-year period and multiplying by the state normalized price.

(4) Price differential to reflect product quality. Published data rarely provide a basis for deriving price estimates for particular quality attributes of a given agricultural product. Procedures for estimating such price differentials will vary from one set of circumstances to another. Since a standard procedure cannot be specified, analysts confronted by such a problem should consult with the NTC economist. The basis used for estimating such price differentials should be fully documented in review reports.

(5) Price impacts. As specified in the P&G, whenever implementation of a plan is expected to influence price significantly, the use of a price about midway between those expected with and without implementation may be justified. Special consideration should be given to price adjustments where a program induces an area to shift from deficit to surplus production.

(c) Forest product prices.

Information on current prices for forest products can be obtained from the latest issue of The Demand and Price Situation for Forest Products, Forest Service, U.S. Department of Agriculture. The user

should be cautioned that to be consistent with the current normalized agricultural prices in the P&G, the stumpage prices should be adjusted to reflect value added from harvesting.

§620.23 Price for pasture.

(a) Current normalized pasture price is not developed by the Department of Agriculture. Pasture prices are seldom reported in crop statistics publications at the state level.

(b) According to P&G, pasture should be valued at the first opportunity to market. The first opportunity to market pasture is for a per acre or per animal unit month cash lease. Therefore, in all cases (except those noted in Chapter II (2.3.3.(e)) of the P&G) the adjusted price will be issued annually by the SCS's Economics and Social Sciences Division and this price will be used unless prices documented by actual data on pasture leases are available.

§620.24 Crop yields.

(a) Crop yields used in project evaluation will be current yields based on average management except in the case of paragraph (b) below.

(b) Current yields may be projected by future time frame to reflect relevant physical changes resulting directly from problems addressed by the project. Adjust future yields to reflect relevant physical changes in soil and water management conditions.

(c) Changes in yields, with and without the project, should be projected consistently with water management and production practices accounted for in the crop budgets.

(d) The base for yield levels used in project evaluation will be the average yield for the previous 5 years as compiled by the Statistical Reporting Service in cooperation with state agencies. These county average yields will be adjusted to specific areas (floodplains, upland areas, etc.) based on yield data for soils in these areas.

SUBPART D - ANNUAL EQUIVALENTS

§620.30 Introduction.

(a) In SCS water resource and watershed protection projects the installation of structural measures and land treatment systems is scheduled over several years to permit effective and efficient use of the resources of SCS and the sponsors. This results in individual measures or systems becoming operative before all component parts of the plan are complete. Benefits gradually increase as additional measures and systems are completed. Discounting procedures (see Part 620, Subpart E) are used to convert actual costs and benefits to present value or average annual equivalents.

(b) The P&G requires that NED costs be converted to an annual equivalent value over the period of analysis. The period of analysis is the equivalent of the installation period plus the evaluation period, (see section 620.02(d)). Installation, operation, maintenance, and replacement costs, and benefits will be handled in an identical manner to maintain consistency in the handling of both costs and benefits in project evaluation.

(c) The following procedure will be used to prevent an extension of the project life beyond that which has been used in estimating costs. All costs and benefits will be discounted from the year that they are incurred or accrued to the beginning of the period of analysis by converting them to present value equivalents. This will provide identically discounted benefits and costs in terms of present values. When the present values have been determined, they will be amortized over the period of analysis to establish average annual equivalents.

(d) Two methods for implementing this procedure are described. The first method uses a worksheet when calculations are done with a hand-held or desk calculator. The second uses a microcomputer and an electronic spreadsheet, i.e., LOTUS 1-2-3.

(e) It is necessary to calculate annual equivalent values for each evaluation unit. The worksheet for at least one identified evaluation unit, specifically for a multistructure unit when there is one in the plan, will be included in the Investigation and Analysis (I&A) report. Annual equivalent calculations for all evaluation units are to be included with other project documentation.

§620.31 Method 1--Worksheet.

Step 1. On the worksheet (see §620.32) develop a schedule of installation costs, operation, maintenance, and replacement (OM&R) costs and benefits for the evaluation unit.

(a) For installation cost this schedule must correspond to the Schedule of Obligations shown in the plan report. Installation cost will be the annual increment of capital expenditures--OM&R costs and benefits will be average annual amounts. Cost and benefits figures are the corresponding amount for the specific year. Computations on all evaluation units will be for the full period of analysis.

(b) This will complete columns 1, 4, and 5 of the worksheet. Where benefits have been determined for more than one benefit category it will be necessary to construct columns 5a, 5b, 5c, etc.

Step 2. Determine the present value equivalent at the beginning of the period of analysis for installation costs; operation, maintenance, and replacement costs; and benefits.

(a) Installation costs are converted to present value equivalents by discounting to the beginning of the period of analysis. OM&R costs and benefits are converted to present value equivalents by first determining the present value of the annuity they represent and then discounting to the beginning of the period of analysis. All computations are done using the project discount rate. All annuities are for the useful life of the improvements or 100 years, whichever is less.

(b) This will complete columns 3, 8, and 9 of the worksheet. Depending on Step 1, column 9 may be 9a, 9b, 9c, etc.

Step 3. The present values are amortized over the period of analysis to determine average annual equivalent values for the plan report.

§620.32 Annual equivalent worksheet for costs and benefits.

EVALUATION UNIT 3, 8 1/8 % INTEREST, 55 YR PERIOD OF ANALYSIS

	Installation Expenditures			O&M&R Cost and Benefits					
Year	Annual Increment of Capital Expenditures (Col. 1)	PV of 1 yrs. hence (Col. 2)	Present Value of Capital Expenditures (Col. 3) (Col. 1 × Col. 2)	Annual Increment of O&M&R Accrual (Col. 4)	Annual Increment of Benefit Accrual (Col. 5)	P.V. of an Annuity of 1 for ___ years (Col. 6)	PV of 1 yrs. hence 1/ (Col. 7)	P.V. of O&M&R Cost (Col. 8) (Col. 4 × Col. 6 = Col. 8)	P.V. of Benefits (Col. 9) (Col. 5 × Col. 6 = Col. 9)
1	10000	.92486	9249						
2	10000	.85536	8554	418	2000	12.06002	.92486	4662	22307
3	10000	.79108	7911	418	2000		.85536	4312	20631
4	10000	.73164	7316	418	2000		.79108	3988	19081
5	10000	.67666	6767	418	2000		.73164	3688	17647
6				418	2000		.67666	3411	16321
7									
⋮									
55									
Sum			39797					20061	95987
Ave. Ann. Equivalent 3/			3278					1652	7906
				B:C Ratio =		1.60 : 1			

1/ The calculation of a present value (Col. 4, 5 or 6) will determine that value at the beginning of the year, therefore the PV of 1, years hence must be adjusted to account for this by shifting forward one year.

3/ Amortize for period of analysis.

§620.33 Method 2 - PVCSTBEN.

The steps that follow are for using LOTUS 1-2-3 template PVCSTBEN, to determine the present value of benefits and cost over a specified period of analysis. A sample printout derived from Method 2 is shown in §620.34.

Step 1. Load PVCSTBEN template by /F(file), R (retrieve), filename PVCSTBEN.

Step 2. Enter value of appropriate discount rate in cell B3, e.g. 0.08125.

Step 3. Enter number for the appropriate period of analysis in cell B4, e.g. 60.

Step 4. In columns C, E, and B, enter values for installation cost, OM&R costs and benefits, respectively, in each row (year) they are incurred or received.

Step 5. When all values (Step 4) are entered, press F9 to instruct the IBM-PC to complete all calculations down to cell D134, the benefit-cost ratio.

Step 6. Save the contents of the new file, /F(file), S(save), enter your new file name and press RETURN.

Step 7. Print the worksheet in two phases.

(a) First, /P(print), P(printer), O(options), P(page-length), set lines per page at 100.

(b) Second, /P(print), P(printer), R(range), A1.H_ (enter numeric value designating the last year in the period of analysis), RETURN, G(go).

NOTE: This will print only the information for the appropriate period of analysis as specified in cell B4.

(c) After the printer has stopped, enter Q/(quit), /P(print), P(printer), R(range), A129.H134, RETURN, G(go). This will add the three summary lines on the printed copy.

Step 8. You may want to print these instructions before you begin your own PVCSTBEN worksheet.

Step 9. You may also want to load and print file PVEXAMPL. This is a sample worksheet for a 10-year installation period, a 60-year period of analysis, and a discount rate of 8.125 percent.

(NOTE: Copies of the LOTUS 1-2-3 template can be secured by the SCS, Economics and Social Sciences Division. The Lotus 1-2-3 program was developed for an IBM-PC microcomputer.)

§620.34 Printout from PVCSTBEN.

PRESENT VALUES--BENEFITS AND COSTS

0.08125 Percent (Discount Rate)
55 Years (Period of Anaylsis)

YEARS	PV FACTOR	COSTS	PV COSTS	OM&R	PV OM&R	BENEFITS	PV BENEFITS
1	0.92486	10000	9249		0		0
2	0.85536	10000	8554	400	342	2000	1711
3	0.79108	10000	7911	800	633	4000	3164
4	0.73164	10000	7316	1200	878	6000	4390
5	0.67666	10000	6767	1600	1083	8000	5413
6	0.62581		0	2000	1252	10000	6258
7	0.57878		0	2000	1158	10000	5788
8	0.53529		0	2000	1071	10000	5353
9	0.49507		0	2000	990	10000	4951
10	0.45787		0	2000	916	10000	4579
11	0.42346		0	2000	847	10000	4235
12	0.39164		0	2000	783	10000	3916
13	0.36221		0	2000	724	10000	3622
14	0.33499		0	2000	670	10000	3350
15	0.30982		0	2000	620	10000	3098
16	0.28654		0	2000	573	10000	2865
17	0.26501		0	2000	530	10000	2650
18	0.24509		0	2000	490	10000	2451
19	0.22668		0	2000	453	10000	2267
20	0.20964		0	2000	419	10000	2096
21	0.19389		0	2000	388	10000	1939
22	0.17932		0	2000	359	10000	1793
23	0.16584		0	2000	332	10000	1658
24	0.15338		0	2000	307	10000	1534
25	0.14186		0	2000	284	10000	1419
26	0.13120		0	4000	525	10000	1312
27	0.12134		0	4000	485	10000	1213
28	0.11222		0	4000	449	10000	1122
29	0.10379		0	4000	415	10000	1038
30	0.09599		0	4000	384	10000	960
31	0.08877		0	2000	178	10000	888
32	0.08210		0	2000	164	10000	821
33	0.07593		0	2000	152	10000	759
34	0.07023		0	2000	140	10000	702
35	0.06495		0	2000	130	10000	650
36	0.06007		0	2000	120	10000	601
37	0.05556		0	2000	111	10000	556
38	0.05138		0	2000	103	10000	514
39	0.04752		0	2000	95	10000	475
40	0.04395		0	2000	88	10000	439
41	0.04065		0	2000	81	10000	406
42	0.03759		0	2000	75	10000	376
43	0.03477		0	2000	70	10000	348
44	0.03216		0	2000	64	10000	322
45	0.02974		0	2000	59	10000	297
46	0.02750		0	2000	55	10000	275
47	0.02544		0	2000	51	10000	254
48	0.02353		0	2000	47	10000	235
49	0.02176		0	2000	44	10000	218
50	0.02012		0	2000	40	10000	201
51	0.01861		0	2000	37	10000	186
52	0.01721		0	1600	28	8000	138
53	0.01592		0	1200	19	6000	96
54	0.01472		0	800	12	4000	59
55	0.01362		0	400	5	2000	27
56	0.01259		0	0	0	0	0
SUM OF PRESENT VALUES			39795.90		20326.63		95987.91
AVERAGE ANNUAL EQUIVALENTS			3278.052		1674.337		7906.678
BENEFIT-COST RATIO			1.596537				

SUBPART E - INTEREST AND ANNUITY

§620.40 Introduction.

(a) Compound interest and annuity tables are used in benefit-cost analysis when benefits are delayed for a significant period after costs are incurred; when benefits are not constant over the evaluation period; and when costs, expressed as capital or principal amounts, must be converted to an average annual cost. §620.46 presents the Interest and Annuity Table for the 8 percent interest rate.

(b) Compound interest and annuity factors are functions of the interest rate and time. In the following examples and discussion, it is assumed that the interest rate is 8 percent and the evaluation period is 50 years. A longer or shorter evaluation period is used where appropriate.

§620.41 Definitions.

(a) Present value of 1. This is the amount that must be invested now at compound interest to have a value of $1 in a given length of time. The interest on $92,593 at 8 percent for one year is $7,407 and the interest plus principal at the end of one year hence is $100,000. Thus, the present value of $100,000 one year hence is $92,593, or the present value $1 is .92593, ($92,593 divided by $100,000). (Column 2 in §620.46.)

(b) Compound amount of 1. This is the amount that will accumulate when a given amount is invested at compound interest for a given period of time and the interest is not withdrawn. The compound amount of $1 in one year is $1.08000, in two years $1.1664, etc. It is the reciprocal of the present value of 1. Hence, to determine the compound amount of 1 in 25 years, if the appropriate factor is not known, it can be calculated by dividing 1 by .14602 = 6.8484. Thus, the compound amount of $1 in 25 years is $6.8484. (The compound amount factor is not shown in §620.46.)

620.41(c)

(c) Amortization. Extinguishing a financial obligation in equal installments is called amortization. The amortization factor, column 3 of §620.46, is the amount of the installment required to retire a debt of $1 in a given length of time. For example, if one were to borrow $1,000 at 8 percent for 3 years, it would be necessary to pay $388.03 per year on the note as follows:

Loan repayment schedule.

Year	Payment	Interest Charge	Payment on Principal	Unpaid Balance
0	--	--	--	$ 1,000.00
1	$ 388.03	$ 80.00	$ 308.03	691.97
2	$ 388.03	$ 56.36	$ 332.67	359.30
3	$ 388.03	$ 28.74	$ 359.30	0.00
	$1,164.09	$ 164.09	$1,000.00	

(d) Sinking fund. A sinking fund is the amount accumulated for the purpose of paying a debt or for accumulating capital. It is the principal component of $1,000 in the foregoing example (as distinguished from the interest component). Hence, the sinking fund factor is equal to the amortization factor minus the interest factor (interest rate). The annuity necessary to accumulate a sinking fund of $1,000 in three years at 8 percent interest is $1,000 x (.38803 - .08000) = $308.03. Hence, the investment of $308.03 per year at 8 percent interest will have a value at the end of three years of $1,000. (The sinking fund factor is not shown in §620.46.)

(e) Present value of an annuity of $1 per year. The present value of $1 per year is the reciprocal of the amortization factor. It is a measure of the present value or worth of equal income amounts over a period of time. For example, the present value of an annuity of $1,000 per year for 10 years is $6,710 at 8 percent because $6,710 invested now will yield an annual income of $1,000 for ten years ($6,710 x .14903). Since the present value of an annuity of $1 per year is the reciprocal of the amortization factor, their product must always equal 1. (The present value of an annuity of 1 per year is shown in column 4 of §620.46.)

(f) Amount of an annuity of $1 per year. This is the amount that an investment of $1 per year will accumulate in a certain period of time at compound interest. It is the reciprocal of the sinking fund factor. The investment of $1,000 per year at 8 percent for ten years has a value at the end of 10 years of $14,487, ($1,000 x 14.48656).

The present value of $14,487 ten years hence is $6,710 ($14,487 x .46319). This is the same value as obtained by multiplying the annuity ($1,000) by the present value of $1 per year (6.710). (The amount of an annuity of 1 factor is shown in column 5 of §620.46.)

(g) Present value of an increasing annuity. This is the measure of present value of an annuity that is not constant but increases uniformly over a period of time. In using this factor it is important to note that the value of $1 (which is multiplied by the factor) is the annual rate of increase and not the total increase during the period. For example, an annuity increases uniformly over a ten-year period at which time it amounts to $1,000 per year. Hence, the annual rate of increase is $100. At the end of the first year, the amount of the annuity is $100, ($200 at the end of the second year, etc.). The present value of such an annuity is $3,269 ($100 x 32.69). The increasing annuity factor is applicable only to the portion of an annuity that is increasing. For example, if there is an increase in annuity from $500 to $1,500 over 10 years, the increasing annuity would be applied only to the $100 annual increment. The original $500 would be treated as a constant annuity. The sum of the two calculations would be the total value (see §620.44, problem 5). (The present value of an increasing annuity is shown in column 6 of §620.46.)

(h) Present value of a decreasing annuity. This is the reverse of an increasing annuity and is handled in the same way. It should be noted that the present value of a decreasing annuity is greater than the present value of increasing annuity of an equal amount. The reason for this is that a decreasing annuity has a high initial value whereas an increasing annuity has a high terminal value and when reduced to present value is subject to a greater discount. (The present value of a decreasing annuity is shown in column 7 of §620.46.)

§620.42 Discounting for lag in accrual of benefits.

(a) Any significant lag in the accrual of benefits should be appropriately discounted. Discounting is necessary to convert one-time or annual values to equivalent annual values over the project evaluation period. Discounting for lag may be done for either a one-time value (cost or benefit) or for a series of such annual values. The two most common procedures of discounting for lag in accrual of benefits in evaluating watershed projects are (1) complete lag, and (2) straight-line lag. Other procedures may be necessary in some instances. (See §620.45, Benefit lag examples.)

(b) The following discounting procedures are recommended.

620.42(b)(1)

(1) Complete lag (with no buildup).

(i) For a one-time value occurring in the future--

Multiply the given value by the "present Value of 1" factor for the appropriate years of lag. Thus, the future value is converted to a present value. The present value is converted to an annual equivalent value by amortizing it over the period of analysis.

(ii) For annual values occurring in the future--

(A) Convert the annual values to a present one-time or capital value. This is its capital value at the year when the annual values begin to accrue, which is also at the end of the lag period.

(B) Discount the present capital value for the period of lag.

(C) Convert the discounted value to an annual equivalent value by amortizing it over the period of analysis.

(2) Straight line lag. This should be used where there will be a uniform buildup of benefits until a full level is reached. Determination of annual equivalents in these cases involve increasing annuities and probably a constant annuity as a base. (See §620.44, Problems 3 and 5).

(3) Variable rate lag discounting. In some instances the lag in accrual of benefits will not be uniform over the entire buildup period. Benefits may build up rapidly after installation and then taper off until full level is reached, or benefits may build very slowly for several years and then increase rapidly to full level. Situations such as this require that the problem be structured to deal with the various straight line and constant annuity segments. Care must be taken to properly account for each deferred component.

§620.43 Significant digits.

Although the examples in this handbook are shown to four or five significant digits, remember that outputs must reflect only the level of significance of the least precise input. For example, if inputs are accurate to the nearest $100, then the output should also be stated to two significant digits.

§620.44 Example interest problems.

The following problems illustrate the use of annuity factors:

PROBLEM 1. Floodwater damage under present flood plain conditions is estimated to be $1,000 annually. However, streambank erosion (not evaluated as a floodwater damage, see problem 2) is gradually destroying the land on which the floodwater damage occurs. Hence, the average annual floodwater damage will not be as great 50 years from now as it is at present. The problem is to determine how much the average annual floodwater damage should be discounted to reflect this condition. In this example it is assumed that the average annual floodwater damage 50 years hence will be $750.

Solution. The normal equivalent floodwater damage is made up of two annuities: (1) a constant annuity of $750 per year, and (2) a decreasing annuity of $250 in 50 years ($5/year).

The present value of a decreasing annuity of $5 per year for 50 years is $2,360 ($5 x 472.08144). The annual equivalent value of the decreasing annuity is $193 ($2,360 x .08174). This is added to the $750 constant annuity and the answer, $943, is the adjusted average annual floodwater damage.

Similar problems may be solved in a similar manner but the following shortcut may be helpful. The rate of discounting a decreasing annuity is equal to:

$$\frac{\text{Present value of a decreasing annuity}}{\text{(No. of years)(Present value of an annuity of 1 per year)}}$$

For this example, the discount factor equals:

$$\frac{472.08144}{50 \times 12.23348} = .77179$$

It will save considerable time to calculate other factors for the most frequently used interest rates and time periods.

PROBLEM 2. The streambank erosion, mentioned in Problem 1, is destroying land at the rate of 5 acres per year. The reduction in net income due to this loss is $25 per acre or $125 per year. This amount ($125) is not a constant annuity but an increasing annuity; e.g., $125 the first year, $250 the second year, and $6,250 the 50th year. What is the annual equivalent streambank erosion damage?

Solution. The present value of an increasing annuity of $125 per year for 50 years is $18,978 ($125 x 151.826).

The annual equivalent value of $18,978 is $1,551 ($18,978 x .08174), which is the average annual damage caused by streambank erosion.

From the foregoing it is determined that the annual equivalent value of an annuity increasing at a uniform rate for 50 years is equal to the annual rate of increase x 12.410 or the value in the 50th year x .24821.

PROBLEM 3. A benefit increases uniformly over a period of years and thereafter becomes constant. Determine the annual equivalent value (50-year evaluation period). Given: The value of a benefit will amount to $3000 annually after 15 years. During the first 15 years the annuity will increase at the rate of $200 per year.

Solution. The present value of an increasing annuity of $200 per year for 15 years equals $200 x 56.445 = $11,289.

The present value of a constant annuity of $3,000 for 35 years deferred 15 years equals $3,000 x 11.655 x .31524 = $11,022.

Total present value ($11,289 + $11,022) = $22,311.

Annual equivalent value equals $22,311 x .08174 = $1,824.

If the annuity increased the same as above but thereafter continued in perpetuity, the annual equivalent value may be determined in the following manner: Multiply the present value of an annuity of 1 per year for the increasing period minus 1 year (in this case 14 years), add 1, and multiply by the rate of increase. For this example, the computation is: (8.24424+1) x $200 = $1,849.

PROBLEM 4. A measure yields no benefit for a few years and then yields a continuing and constant benefit for the remainder of the evaluation period. What is the annual equivalent benefit? Given: The value of forage from seeding idle bottomland to pasture is estimated at $1,000 per year after the grass becomes established and is ready for use. It is estimated that 3 years are required for successful establishment. What is the annual equivalent benefit (25 year evaluation period)?

Solution. The present value of an annuity of 1 per year for 22 years times $1000. ($1000 x 10.20074 = $10,200.)

Deferred for 3 years. ($10,200 x .78383 = $8,097.)

Amortized over 25 year life. ($8,097 x .09368 = $759.)

PROBLEM 5. The average annual floodwater damage under present conditions is estimated to be $1,000 annually. A study of sediment problems indicates that channel aggradation will increase this floodwater damage to $1,500 per year in 50 years. What is the average annual damage due to channel aggradation?

Solution. The increase in damage in the 50th year is $500. From problem 2 we know that the annual equivalent value of an increasing annuity is .24821 x the value in the 50th year ($500) equals $124. Hence, the average annual sediment damage is $124. The floodwater damage is still considered to be $1,000 per year.

PROBLEM 6. Installation costs are usually expressed in lump sum capital amounts and must be converted to average annual costs for benefit-cost comparison. How this is done for some typical situations is illustrated by the following. Given: A structure costs $10,000 and its life is at least 50 years.

Solution. On the basis of an interest rate of 8 percent, the amortization factor for 50 years is .08174. Then $10,000 x .08174 = $817.40. Hence, the annual equivalent value of the installation cost of $10,000 is $817.40.

If a shorter or longer economic life than 50 years is involved, the amortization factor corresponding to the years of life should be used. For example, if the structure will last only 25 years, the answer would be $10,000 x .09368 = $936.80. If 100 years, the answer is $10,000 x .08004 = $800.40.

Given: A structure costs $10,000, will last 50 years, and will be replaced at that time. The replacement will cost 50 percent more than the initial installation and will last 50 years.

Solution. First, determine the present worth of the second installation. The present value of $1, 50 years hence is .02132. Then $15,000 x .02132 = $320. The present value of the second installation is added to the initial cost and then amortized over 100 years as follows:

$ 320 + 10,000 = $10,320
$10,320 x .08004 = $826 annual equivalent cost.

§620.45 Benefit lag examples.

(a) Complete lag (with no buildup).

(1) For a one-time value occurring in the future--If a 5-year lag is expected in a specific cost or benefit of $100, the factor .68058 (present value of 1, 5 years hence, at 8 percent interest) is applied to determine the present value, or $68.06. To convert to an annual equivalent value over a 50-year evaluation period, using 8 percent interest, multiply the above present value by the appropriate amortization factor, or .08174 x $68.06 = $5.56.

(2) For annual values occurring in the future--

(i) If a 20-year lag is expected in an annual cost or benefit of $100 that will continue to accrue during the remaining 30 years of a 50-year evaluation period, determine the capital value of the 30 annual amounts by multiplying the factor for present value of an annuity of 1 per year for 30 years (11.25778) by the annual amount ($100), or $1,126.

(ii) Discount the capital value of $1,126 to present value by applying to it the 20-year discount factor of .21445 (present value of 1, 20 years hence, at 8 percent interest), or .21455 x $1,126 = $242.

(iii) To convert this amount to an annual value over a 50-year evaluation period, using 8 percent interest, multiply the present value ($242) by the appropriate amortization factor (.08174), or .08174 x $242 = $20.

(b) Straight Line Lag. The following is an example of straight line discounting of annual benefits: Net returns per acre at full level = $20. Acres to be benefitted = 1,000. 500 of the 1,000 acres will have benefits accruing at full level upon installation and no discounting is required for these benefits. It is estimated that it will take 10 years for the benefits on the remaining 500 acres to reach full level and that this benefit will build up at a uniform rate over the 10-year period. This discounting may be done on either the total annual monetary benefits, or on an annual per-acre basis. If done on a per-acre basis, the discounted per-acre benefit must be multiplied by the number of acres involved (in this example 500) to determine the total discounted benefits. This example uses the total benefits.

(1) For the 500 acres where benefits are at full level upon installation.

500 acres x $20 = $10,000 annual benefit at full level.

(2) For the 500 acres where benefits will build up over a 10-year period.

(i) The first step is to determine the capital value for the first 10 years:

$10,000 10 years = $1,000 increase per year.

$1,000 x 32.68691 1/ = $32,687 capital value for first 10 years.

(ii) The second step is to determine the capital value of $10,000 annually for the last 40 years of the 50-year evaluation period:

$10,000 x 11.92461 2/ = $119,246 capital value delayed 10 years.

$119,246 x .46319 3/ = 55,234 capital value delayed 10 years.

(iii) The third step is to amortize the total capital values obtained in steps 2 (i) and 2 (ii) to arrive at annual equivalents:

$32,687 + $55,234 = $87,921 total capital value.
$87,921 x .08174 4/ = $7,187 discounted average annual benefit.

(3) Total benefits for 1,000 acres. Add the full level benefits for the 500 acres full level area and the discounted benefits for the 500 acre buildup area to determine total benefits.

$10,000 (full level benefits) + $7,187 (discounted benefits) = $17,187 total annual benefits on the 1,000 acres.

(c) Short-cut straight line method.

(1) The following table provides straight line discount factors that can be used directly. To illustrate, discounting in the above example can be done by selecting the factor for the 10 years at 8 percent from Table (620-2) and applying it to full level benefits. $10,000 x .719 = $7,190 discounted benefits.

$10,000 + $7,187 = $17,187 total benefits on the 1,000 acres. The factors listed in Table 620-2 are based on a 50- & 100-year evaluation period. Similar factors for other years can be calculated by using the procedure referred to in the footnote.

1/ Present value of increasing annuity for 10 years, 8% interest.
2/ Present value of 1 per year for 40 years, 8% interest.
3/ Present value of 1, 10 years hence, 8% interest.
4/ Amortization factor for 50 years, 8% interest.

620.45(c)(2)

(2) Discount factors for other interest rates, evaluation periods, or years of lag may be computed using the following formula:

(((FB ÷ L x PV of an Increasing Annuity for L years at i) + (FB x PV of an Annuity of 1 per year for EP-L years at i x PV of 1, L years hence)) x Amortization factor EP years) ÷ FB.

Where FB = full level annual benefits,
L = years of lag,
i = interest rate,
EP = evaluation period, and
PV = present value.

For example, where--

FB = $10,000,
L = 5 years,
i = 8%, and
EP = 50 years.

$$\frac{((10{,}000 \div 5 \times 11.36514) + (10{,}000 \times 12.10840 \times .68058)) \times .08174}{10{,}000}$$

$$= \frac{(22{,}730 + 82{,}407) \times .08174}{10{,}000} = .859$$

Table 620-2.--Discount factors 1/ at 6 and 8 percent rates for 50 and 100-year evaluation periods.

Years of lag	50-year evaluation period		100-year evaluation period	
	6%	8%	6%	8%
5	.887	.859	.839	.862
10	.768	.759	.780	.725
15	.668	.608	.685	.616
20	.585	.520	.607	.530
25	.516	.449	.541	.461
30	.457	.392	.485	.405
35	.407	.346	.437	.359
40	.364	.307	.397	.322
45	.328	.275	.362	.290
50	.296	.248	.332	.264

1/ These discount factors were developed by dividing discounted benefits by full level benefits. The lag example, §620(b) shows, on the 500 acres with the 10 year buildup period, a full level annual benefit of $10,000 and a discounted annual benefit of $7,187. Thus, $7,187 ÷ $10,000 = .719 the discount factor for a ten year lag, at 8% interest rate for a 50-year evaluation period.

(d) Variable rate lag.

(1) The following example for a 50-year evaluation period shows a rapid initial build-up and then a tapering off of benefits. To illustrate how this type of discounting is done, the following data are assumed: Annual benefits at full level = $10,000. Benefits will reach full level in 10 years. Benefits will build up at the rate of $1,600 per year for the first 5 years and $400 per year during the next 5 years. Straight line build-up is assumed during each 5 year period. During the first 5 years benefits will build-up at a rate of $1,600 per year to a level of $8,000 (5 x $1,600 = $8000). During the next 5 years of the build-up period, benefits will increase by an additional $2,000, a rate of $400 per year (5 x $400 = $2,000) to the full level of $10,000.

(2) In this example it is necessary to measure the capital value of four different rates of benefit accrual as follows:

(i) The value during the 5 year build-up period at $1,600 per year.

(ii) The value during the next 45 years at the $8,000 level, delayed 5 years.

(iii) The value during the last 5 years of the build-up period at $400 per year, delayed 5 years.

(iv) The value of the additional $2,000 (necessary to reach full level of $10,000) over the last 40 years, delayed 10 years.

(3) The following shows the calculation of these values:

(i) Calculation of (2)(i) above: $1,600 x 11.36514 1/ = $18,184.

(ii) Calculation of (2(ii) above: $8,000 x 12.10840 2/ x .68058 3/ =$65.926.

(iii) Calculation of (2)(iii) above: $400 x 11.36514 x .68058 = $3,094.

(iv) Calculation of (2)(iv) above: $2,000 x 11,92461 4/ x .46319 5/=$11,047.

1/ Present value of increasing annuity for 5 years, 8% interest.
2/ Present value of annuity of 1 per year for 45 years, 8% interest.
3/ Present value of 1, 5 years hence, 8% interest.
4/ Present value of annuity of 1 per year for 40 years, 8% interest.
5/ Present value of 1, 10 years hence, 8% interest.

620.45(d)(4)

(4) The four capital values as calculated above are then totaled and amortized to determine the discounted average annual benefit:

Example:

$18,184	capital value of 5 year period increasing at $1,600 per year
$65,926	capital value of $8,000 level for 45 years, delayed 5 years
$ 3,094	capital value of last 5-year period increasing at $400 per year, delayed 5 years
$11,047	capital value of $2,000, for 40 years delayed 10 years
$98,251	Total capital value during 50 year evaluation period

$98,251 x .08174 6/ = $8,031

6/ Amortization factor 50 years, 8% interest.

COMPOUND INTEREST AND ANNUITY TABLES - 8.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
1	0.92593	1.08000	0.92593	1.0000	0.92593	0.92593
2	0.85734	0.56077	1.78326	2.0800	2.64060	2.70919
3	0.79383	0.38803	2.57710	3.2464	5.02210	5.28629
4	0.73503	0.30192	3.31213	4.5061	7.96222	8.59841
5	0.68058	0.25046	3.99271	5.8666	11.36514	12.59112
6	0.63017	0.21632	4.62288	7.3359	15.14615	17.21400
7	0.58349	0.19207	5.20637	8.9228	19.23059	22.42037
8	0.54027	0.17401	5.74664	10.6366	23.55274	28.16701
9	0.50025	0.16008	6.24689	12.4876	28.05498	34.41390
10	0.46319	0.14903	6.71008	14.4866	32.68691	41.12398
11	0.42888	0.14008	7.13896	16.6455	37.40462	48.26295
12	0.39711	0.13270	7.53608	18.9771	42.16999	55.79902
13	0.36770	0.12652	7.90378	21.4953	46.95006	63.70280
14	0.34046	0.12130	8.24424	24.2149	51.71652	71.94704
15	0.31524	0.11683	8.55948	27.1521	56.44514	80.50652
16	0.29189	0.11298	8.85137	30.3243	61.11539	89.35789
17	0.27027	0.10963	9.12164	33.7502	65.70996	98.47952
18	0.25025	0.10670	9.37189	37.4502	70.21444	107.85141
19	0.23171	0.10413	9.60360	41.4463	74.61697	117.45501
20	0.21455	0.10185	9.81815	45.7620	78.90794	127.27316
21	0.19866	0.09983	10.01680	50.4229	83.07971	137.28996
22	0.18394	0.09803	10.20074	55.4568	87.12640	147.49070
23	0.17032	0.09642	10.37106	60.8933	91.04365	157.86176
24	0.15770	0.09498	10.52876	66.7648	94.82844	168.39052
25	0.14602	0.09368	10.67478	73.1059	98.47888	179.06530
26	0.13520	0.09251	10.80998	79.9544	101.99413	189.87528
27	0.12519	0.09145	10.93516	87.3508	105.37417	200.81044
28	0.11591	0.09049	11.05108	95.3388	108.61976	211.86152
29	0.10733	0.08962	11.15841	103.9659	111.73226	223.01992
30	0.09938	0.08883	11.25778	113.2832	114.71358	234.27771
31	0.09202	0.08811	11.34980	123.3459	117.56607	245.62751
32	0.08520	0.08745	11.43500	134.2135	120.29247	257.06251
33	0.07889	0.08685	11.51389	145.9506	122.89581	268.57640
34	0.07305	0.08630	11.58693	158.6267	125.37935	280.16333
35	0.06763	0.08580	11.65457	172.3168	127.74656	291.81790
36	0.06262	0.08534	11.71719	187.1021	130.00104	303.53509
37	0.05799	0.08492	11.77518	203.0703	132.14651	315.31027
38	0.05369	0.08454	11.82887	220.3159	134.18675	327.13914
39	0.04971	0.08419	11.87858	238.9412	136.12558	339.01772
40	0.04603	0.08386	11.92461	259.0565	137.96681	350.94233
41	0.04262	0.08356	11.96723	280.7810	139.71428	362.90957
42	0.03946	0.08329	12.00670	304.2435	141.37178	374.91627
43	0.03654	0.08303	12.04324	329.5830	142.94303	386.95951
44	0.03383	0.08280	12.07707	356.9496	144.43173	399.03658
45	0.03133	0.08259	12.10840	386.5056	145.84149	411.14498
46	0.02901	0.08239	12.13741	418.4261	147.17582	423.28239
47	0.02686	0.08221	12.16427	452.9002	148.43818	435.44666
48	0.02487	0.08204	12.18914	490.1322	149.63189	447.63579
49	0.02303	0.08189	12.21216	530.3427	150.76021	459.84796
50	0.02132	0.08174	12.23348	573.7702	151.82627	472.08144

620.46 (Continued)

COMPOUND INTEREST AND ANNUITY TABLES - 8.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
51	0.01974	0.08161	12.25323	620.6718	152.83311	484.33467
52	0.01828	0.08149	12.27151	671.3255	153.78365	496.60617
53	0.01693	0.08138	12.28843	726.0316	154.68070	508.89461
54	0.01567	0.08127	12.30410	785.1141	155.52697	521.19871
55	0.01451	0.08118	12.31861	848.9232	156.32507	533.51732
56	0.01344	0.08109	12.33205	917.8371	157.07748	545.84937
57	0.01244	0.08101	12.34449	992.2640	157.78660	558.19386
58	0.01152	0.08093	12.35601	1072.6451	158.45472	570.54987
59	0.01067	0.08086	12.36668	1159.4568	159.08401	582.91655
60	0.00988	0.08080	12.37655	1253.2133	159.67656	595.29310
61	0.00914	0.08074	12.38570	1354.4704	160.23436	607.67880
62	0.00847	0.08068	12.39416	1463.8280	160.75931	620.07296
63	0.00784	0.08063	12.40200	1581.9342	161.25322	632.47496
64	0.00726	0.08058	12.40926	1709.4890	161.71780	644.88423
65	0.00672	0.08054	12.41598	1847.2481	162.15468	657.30021
66	0.00622	0.08050	12.42221	1996.0279	162.56543	669.72242
67	0.00576	0.08046	12.42797	2156.7102	162.95152	682.15039
68	0.00534	0.08043	12.43330	2330.2470	163.31434	694.58369
69	0.00494	0.08040	12.43825	2517.6667	163.65523	707.02194
70	0.00457	0.08037	12.44282	2720.0801	163.97544	719.46475
71	0.00424	0.08034	12.44706	2938.6865	164.27616	731.91181
72	0.00392	0.08031	12.45098	3174.7814	164.55854	744.36279
73	0.00363	0.08029	12.45461	3429.7639	164.82362	756.81740
74	0.00336	0.08027	12.45797	3705.1450	165.07244	769.27537
75	0.00311	0.08025	12.46108	4002.5566	165.30593	781.73645
76	0.00288	0.08023	12.46397	4323.7612	165.52502	794.20042
77	0.00267	0.08021	12.46664	4670.6620	165.73054	806.66705
78	0.00247	0.08020	12.46911	5045.3150	165.92331	819.13616
79	0.00229	0.08018	12.47140	5449.9402	166.10409	831.60756
80	0.00212	0.08017	12.47351	5886.9354	166.27360	844.08107
81	0.00196	0.08016	12.47548	6358.8903	166.43251	856.55655
82	0.00182	0.08015	12.47729	6868.6015	166.58147	869.03384
83	0.00168	0.08013	12.47897	7419.0896	166.72108	881.51281
84	0.00156	0.08012	12.48053	8013.6168	166.85190	893.99335
85	0.00144	0.08012	12.48197	8655.7061	166.97447	906.47532
86	0.00134	0.08011	12.48331	9349.1626	167.08930	918.95863
87	0.00124	0.08010	12.48455	10098.0956	167.19686	931.44318
88	0.00114	0.08009	12.48569	10906.9433	167.29760	943.92887
89	0.00106	0.08008	12.48675	11780.4987	167.39194	956.41562
90	0.00098	0.08008	12.48773	12723.9386	167.48027	968.90335
91	0.00091	0.08007	12.48864	13742.8537	167.56296	981.39199
92	0.00084	0.08007	12.48948	14843.2820	167.64037	993.88147
93	0.00078	0.08006	12.49026	16031.7446	167.71283	1006.37173
94	0.00072	0.08006	12.49098	17315.2841	167.78064	1018.86272
95	0.00067	0.08005	12.49165	18701.5069	167.84409	1031.35437
96	0.00062	0.08005	12.49227	20198.6274	167.90347	1043.84664
97	0.00057	0.08005	12.49284	21815.5176	167.95902	1056.33948
98	0.00053	0.08004	12.49337	23561.7590	168.01098	1068.83285
99	0.00049	0.08004	12.49386	25447.6997	168.05958	1081.32671
100	0.00045	0.08004	12.49432	27484.5157	168.10504	1093.82103

(Continued)

COMPOUND INTEREST AND ANNUITY TABLES - 8.0000 PERCENT

NO. OF YRS. HENCE	PRESENT VALUE OF 1	AMORTI-ZATION	PRESENT VALUE OF AN ANNUITY OF 1 PER YEAR	AMOUNT OF AN ANNUITY OF 1 PER YEAR	PRESENT VALUE OF AN INCREASING ANNUITY	PRESENT VALUE OF A DECREASING ANNUITY
101	0.00042	0.08003	12.49474	29684.2770	168.14756	1106.31577
102	0.00039	0.08003	12.49513	32060.0191	168.18731	1118.81090
103	0.00036	0.08003	12.49549	34625.8206	168.22448	1131.30639
104	0.00033	0.08003	12.49582	37396.8863	168.25923	1143.80221
105	0.00031	0.08002	12.49613	40389.6372	168.29172	1156.29834
106	0.00029	0.08002	12.49642	43621.8082	168.32208	1168.79476
107	0.00027	0.08002	12.49668	47112.5528	168.35046	1181.29145
108	0.00025	0.08002	12.49693	50882.5571	168.37699	1193.78838
109	0.00023	0.08002	12.49716	54954.1616	168.40178	1206.28553
110	0.00021	0.08002	12.49737	59351.4946	168.42494	1218.78290
111	0.00019	0.08002	12.49756	64100.6141	168.44658	1231.28046
112	0.00018	0.08001	12.49774	69229.6632	168.46680	1243.77821
113	0.00017	0.08001	12.49791	74769.0363	168.48569	1256.27612
114	0.00015	0.08001	12.49807	80751.5592	168.50333	1268.77418
115	0.00014	0.08001	12.49821	87212.6839	168.51981	1281.27239
116	0.00013	0.08001	12.49834	94190.6987	168.53521	1293.77073
117	0.00012	0.08001	12.49846	101726.9546	168.54958	1306.26920
118	0.00011	0.08001	12.49858	109866.1109	168.56300	1318.76778
119	0.00011	0.08001	12.49868	118656.3998	168.57554	1331.26646
120	0.00010	0.08001	12.49878	128149.9118	168.58724	1343.76524
121	0.00009	0.08001	12.49887	138402.9047	168.59817	1356.26411
122	0.00008	0.08001	12.49895	149476.1371	168.60837	1368.76307
123	0.00008	0.08001	12.49903	161435.2281	168.61789	1381.26210
124	0.00007	0.08001	12.49910	174351.0463	168.62678	1393.76120
125	0.00007	0.08001	12.49917	188300.1300	168.63508	1406.26037
PERPETUITY		0.08000	12.50000		168.75000	

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PART 621 - AGRICULTURE

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SUBPART A - FLOODWATER

§621.00 Introduction

(a) This subpart tells how to estimate floodwater damages to agriculture and how to determine damage reduction and intensification benefits to agriculture from flood protection. For the most part the discussion is confined to the application of economic principles to the problem and to the general methods of accumulating and analyzing data for evaluation purposes. Because of the diversity of conditions found across the Nation no attempt is made to prescribe step-by-step procedural details that must be used in every case.

(b) Methods outlined in this chapter for calculating average annual damage and for benefit adjustments are equally applicable to the appraisal of urban flood damages and benefits (see Part 623).

§621.01 Considerations in damage appraisal.

(a) Damage appraisal for project evaluation involves a comparison of the damage that can be expected without the project and that which will occur after the project is installed. Proper appraisal requires a projection of physical and economic conditions during the life of the project.

(b) Several different methods may be used to project future conditions. The method used will depend upon the given situation, but extrapolation of existing trends generally is not sufficient. The economist will need to gather and evaluate sufficient background data to form a basis for sound projections. Major assumptions and procedures used to project future conditions should be fully documented.

(c) Examples of considerations often encountered in making these projections are:

-- As sediment fills a channel, flooding becomes more severe. It may become so serious that cultivation of most, or all, of the flood plain will be abandoned.

621.01(c)

-- Channel degradation or bank cutting increases the size of the channel. Flooding may then be expected to become less frequent and less severe, but land may be lost from production. (If either of these conditions exists, the economist depends upon both the geologist and hydrologist for projections of physical conditions.)

Good reminder

-- Developing agricultural trends may modify agricultural land use patterns in the project locale.

-- Nonagricultural values are changing constantly. Industrial and residential land use may be replacing agriculture in the flood plain. Urban development in the upper portions of the watershed may result in larger areas being subject to floodwater damage.

§621.02 Frequency method.

The P&G indicates that an estimate of the reduction of damages from water inundation will be made on the basis of the change in frequency, depth, and duration of inundation. This section will present the Frequency Method of evaluation. The Frequency Method uses either of the following kinds of data:

-- Channel and valley cross sections to establish floodwater depth and land area inundated for various peak discharges.

-- Overland flow to establish the relationship between area inundated and floodwater volume.

Other damages estimation methods, Historical Series and Net Income, are discussed briefly at the end of this subpart. These last two methods have been used in past evaluations, and while they do not meet the frequency-depth/duration conditions specified in the P&G, they are mentioned to complete the presentation.

(a) Channel and valley cross sections.

(1) The Frequency Method used in flood damage appraisal establishes relationships between physical and economic flood characteristics and the probably frequency of flood occurrence.

(2) Physical appraisal establishes relationships between the characteristics of floods and frequency of their occurrence. These associations, generally expressed by means of graphs, include the following:

-- Runoff related to frequency of occurrence--developed either by conversion of rainfall to runoff, or from runoff as directly measured by stream gages.

-- Runoff versus discharge in cubic feet per second (cfs).

-- Discharge (cfs) versus frequency (See Figure 621-1).

-- Discharge (cfs) versus flood stage (See Figure 621-2).

-- Flood stage versus area flooded.

The flood stage-frequency relationship is shown in Figure 621-3.

(3) Economic appraisal estimates the monetary values for physical flood characteristics and frequency of flood occurrences:

-- Flood stage versus damage (See Figure 621-4).

-- Discharge (cfs) versus damage.

-- Damage versus frequency of occurrence (See Figuret 621-5).

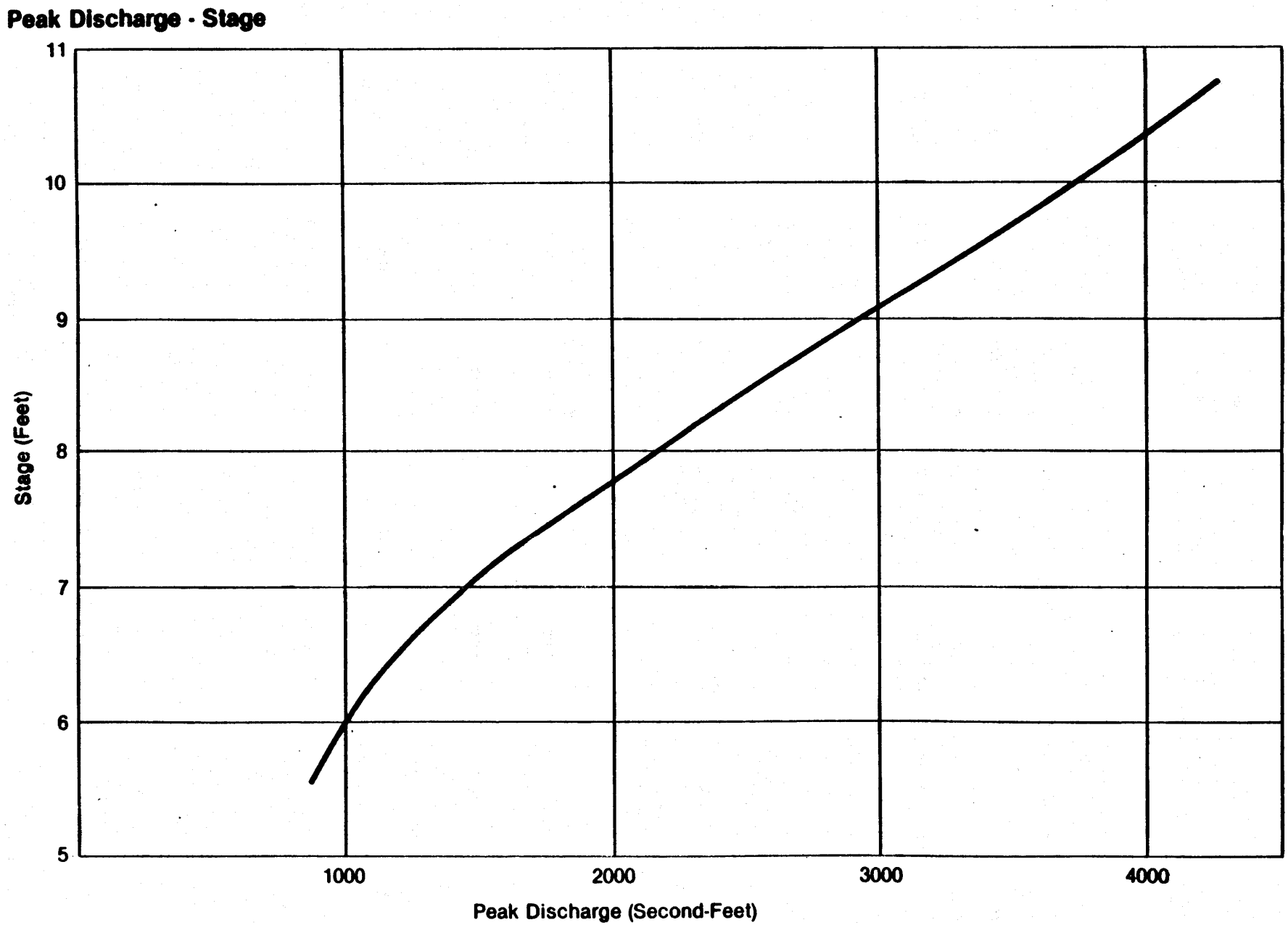

Figure 621-2. Discharge - stage curve.

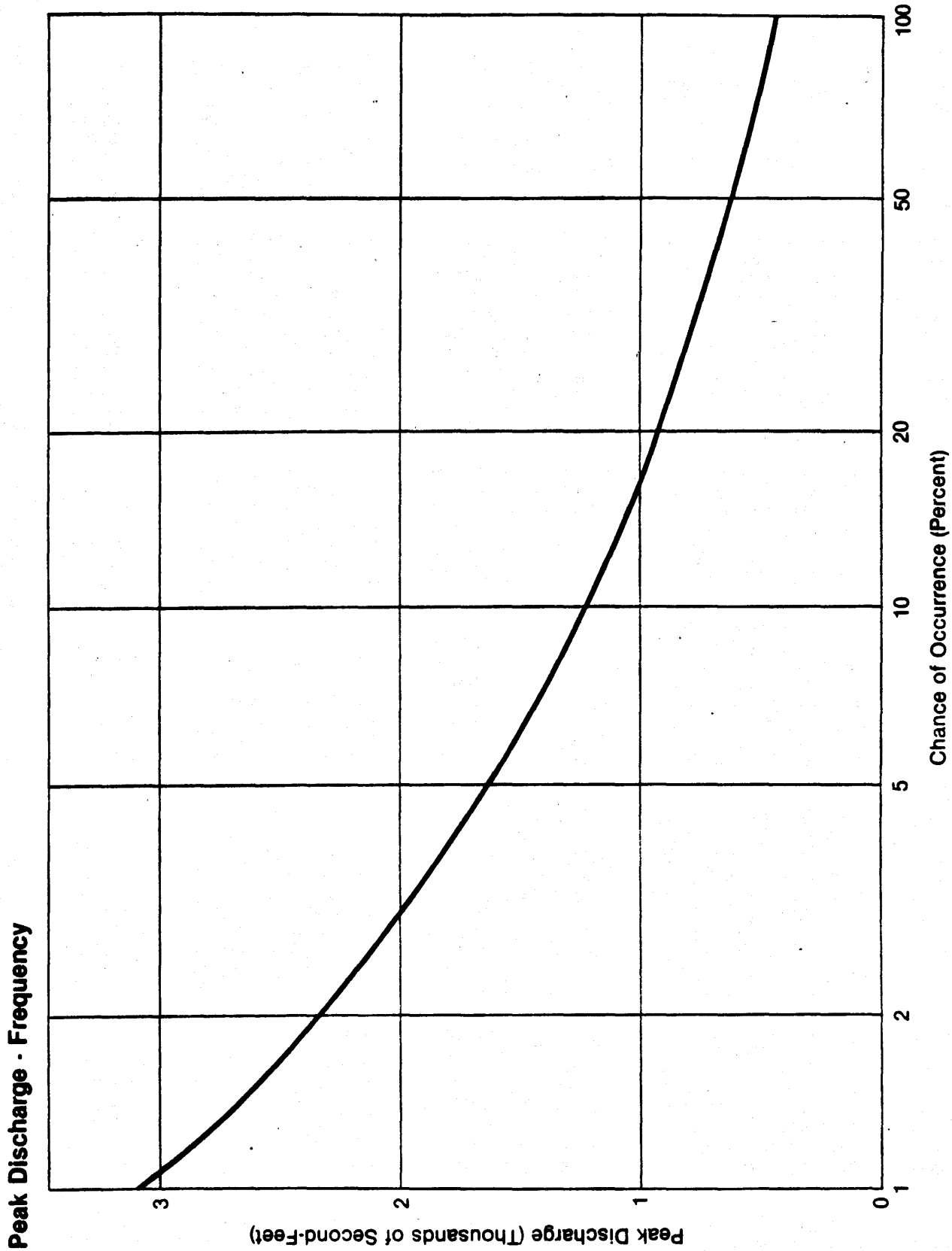

Figure 621-1.--Discharge - frequency curve.

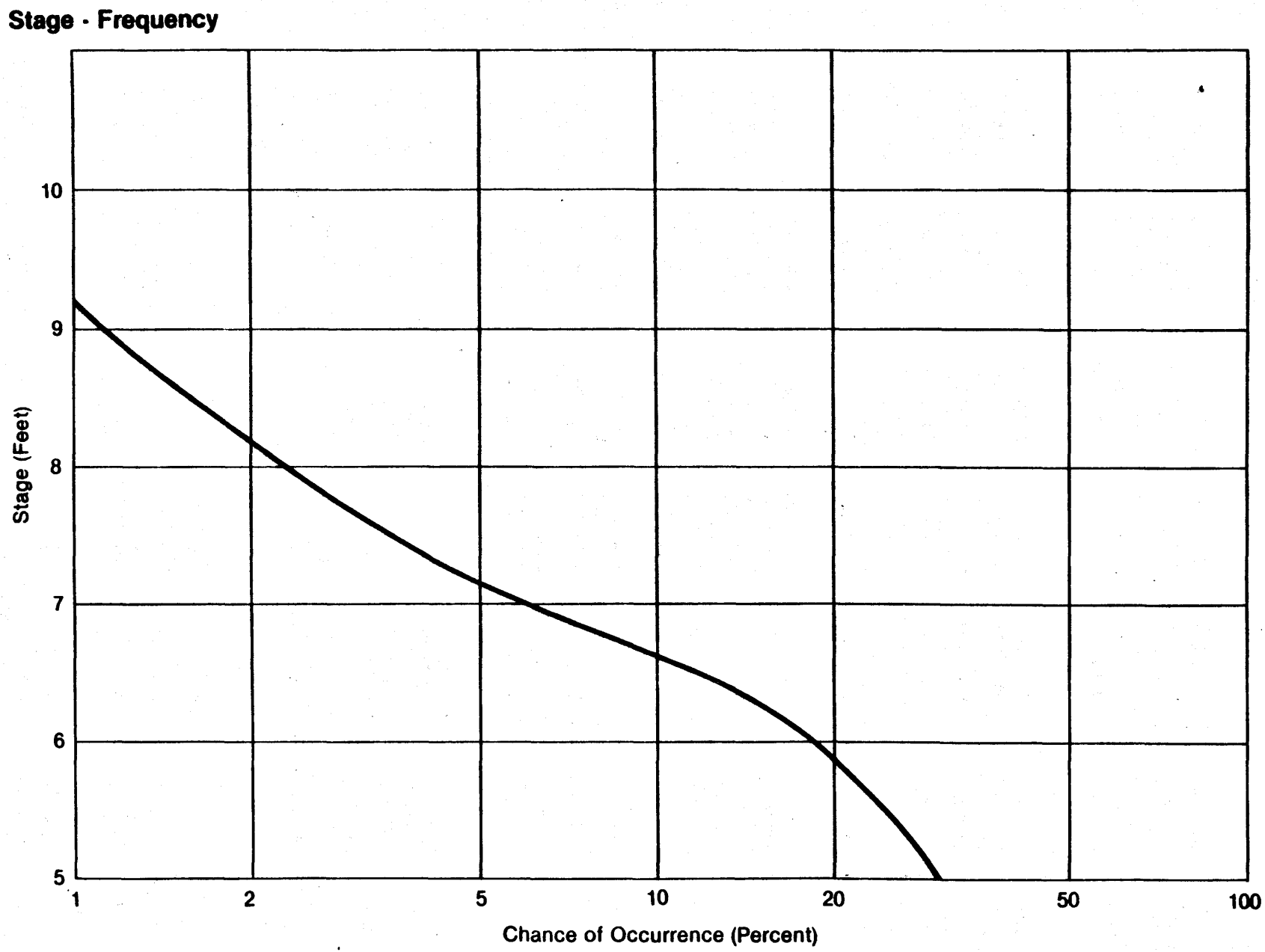

Figure 621-3.--Stage - frequency curve.

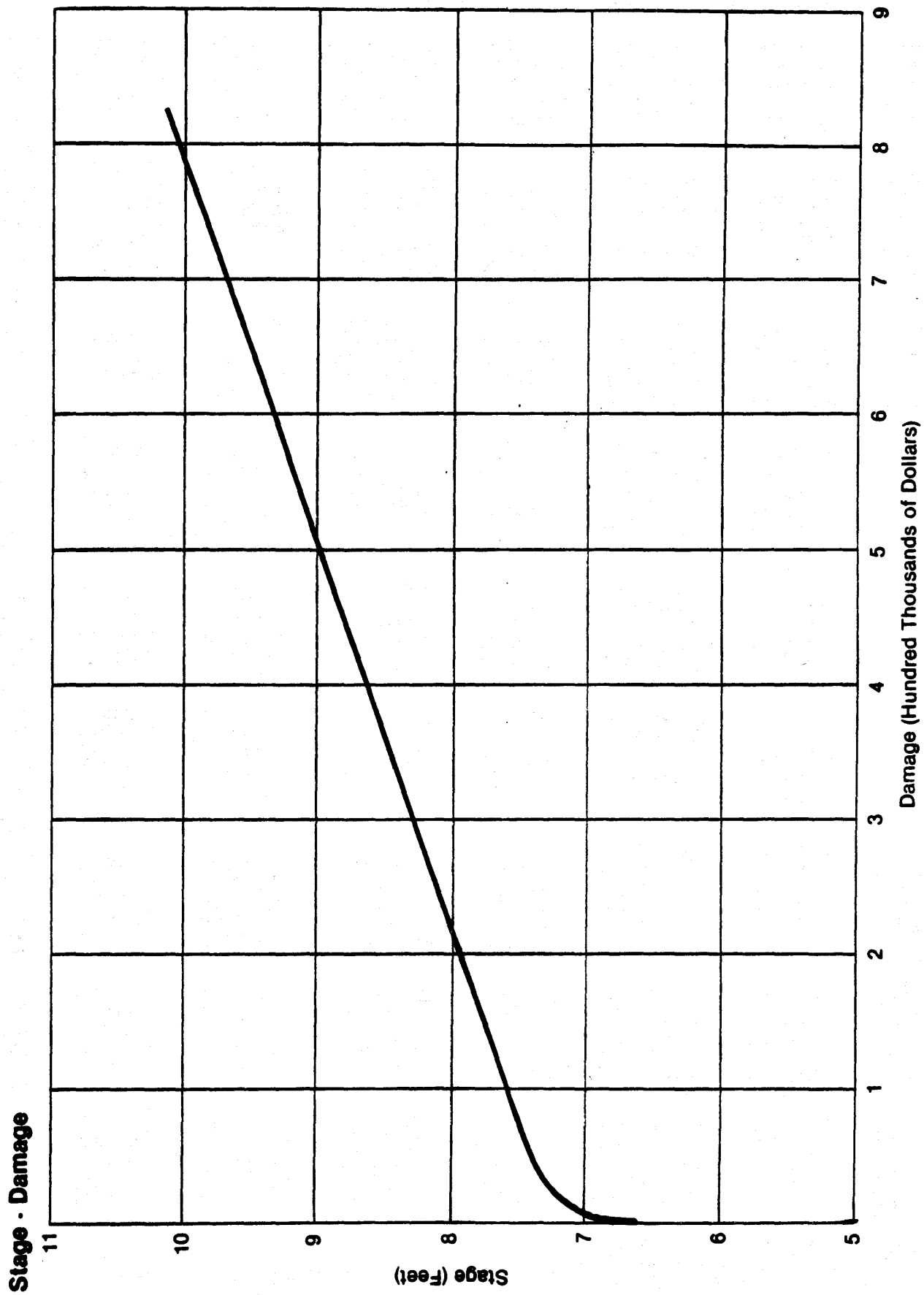

Figure 621-4.--Stage - damage curve.

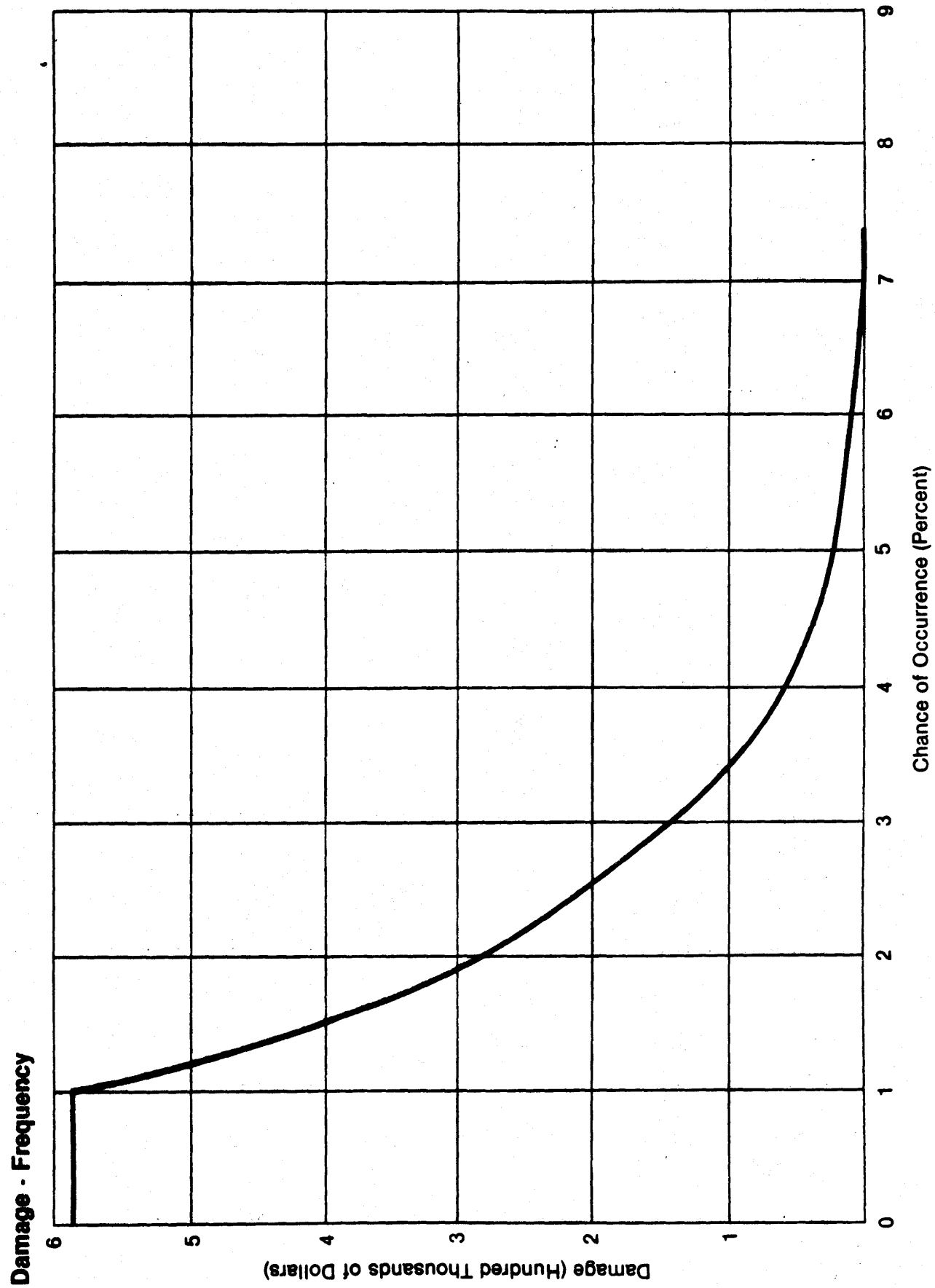

Figure 621-5.--Damage - frequency curve.

621.02(a)(4)

(4) Damage-frequency. The damage-frequency curve, Exhibit 621-5, is drawn through plotted values of corresponding damage and frequency. Average annual damage is determined from the damage frequency curve in this example through the following steps:

(i) Planimeter, in square inches, the area enclosed by the curve.

(ii) Determine the product of the values of the abscissa and the ordinate at the point 1 inch from the point of origin. This value determined from Table 5 is obtained as follows: abscissa one percent, ordinate $100,000, giving a product of $1,000.

(iii) Multiply the area, 13.39 sq. in., measured in step (i) by the unit value per square inch $1,000, determined in step (ii), to calculate the average annual damage, $13,390.

(5) The damage-frequency relationship can be converted to average annual damage by tabular procedures as well as by planimetering the area under the curve. Table 5 is an example using approximate numbers from Figure 621-5.

Table 621-1.--Damage-frequency relationship/average annual damage.

Frequency (Percent chance of occurrence)	Damages ($)	Change in frequency (Probability)	Average damage ($)	Contribution to avg. ann. damage ($)
0	580,000			
		.01	580,000	5800
1	580,000			
		.01	425,000	4250
2	270,000			
		.01	205,000	2050
3	140,000			
		.01	100,000	1000
4	60,000			
		.01	40,000	400
5	20,000			
		.02	10,000	200
7	0			
		Total = Average Annual Damage =		13,700

This tabular procedure is used in the computer programs ECON2 and URB1 (see §621.08 and §623.08).

(6) Because of the difference in flood damage during different periods of plant growth, the seasonal distribution of floods must be taken into account when evaluating damages to crops and pasture. The seasonal difference in flood damages and the relative frequency of flooding by seasons or months furnishes the basis for making an adjustment for crop and pasture damages.

(7) Using the seasonal or monthly distribution of flooding, a composite acre value for each stage is developed and the damage is calculated for each time period, usually by months of the growing season. The composite-acre damage for each time period is then weighted by applying the probability that a damaging flood will occur. The weighted damage by time periods is then totaled to determine the annual composite monetary damage (See Table 621-2). This calculation makes possible damage estimates by flood stages, and permits the construction of a stage-damage curve for the reach.

Table 621-2.--Calculation of cropland and pasture stage-damage relationship at 2' stage for Reach No. 1.

Time period	Damage at 2' stage per composite acre ($)	Percent chance of flood occurrence in any 1 Year (%)	Weighted per acre damages ($)
January	0	5	0
February	0	5	0
March	.48	15	.07
April	1.35	15	.20
May	6.85	5	.34
June	20.00	5	1.00
July	56.00	5	2.80
August	61.00	5	3.05
September	32.00	10	3.20
October	15.00	15	2.25
November	1.80	8	.14
December	0	7	0
TOTAL	--	100 %	$ 13.05

(8) When crops are flooded more frequently than once a year, the damaging effect of the succeeding flood is altered by the effects of the previous flood. Two 100-percent chance events occurring during a given crop year will produce less total damage than if they were to occur in successive years, therefore, it is necessary to adjust the crop damage estimates to account for recurrence of flooding. A method developed to

account for recurrent flooding uses the equation $1/Y = 1.005 + 0.1193(X)$ where:

Y = adjustment in crop damage, and
X = the ratio of average acres flooded annually to the total floodplain acreage.

(9) It is essential that the adjustment for recurrent flooding take into account project effects. For example, if the project is effective, a greater adjustment will be needed for nonproject than for project conditions. The project can be expected to eliminate some recurrent flooding.

(10) When the annual floodplain is greater than 10 percent of the 100-year floodplain, damages on the annual flood plain will be based on a separate composite acre land use.

(11) To ensure that the estimate of damages and benefits do not exceed reasonable limits based on net income from crops in the flood free condition, the estimate will be limited to storms with a recurrence interval exceeding the 200 percent chance (.5 year) storm or greater.

(b) Overland flow.

(1) In some watersheds, tributary ephemeral streams may discharge their floodwater onto alluvial areas that lack a defined channel to the main watercourse. Usually these alluvial areas are flat or only gently sloping in both directions and the floodwater spreads out until the flow eventually is dissipated. This condition, were there is virtually no channel or where the possibility of lateral spreading is great, is called overland flow.

(2) Under natural conditions, these alluvial areas are spreading areas for runoff. Because of favorable topographic and soil characteristics, many of these alluvial areas have been developed into highly productive farming areas and in some cases into urban and suburban areas. The increasing value of property and the susceptibilty of various areas to damage, together with the inability of individuals to protect their property because of the unpredictable path of flood flows, has created serious local flood problems.

(3) Peak discharge and flood stage have little meaning in appraising potential damages from overland floods. When floodwater emerges from a confined section onto the alluvial fan or plain the flood peak quickly flattens. As a result, the area flooded is not a direct function of the peak discharge except as it may overtop diversion dikes built to direct its course away from a portion of the flood plain. More often, the area flooded is related to the flood volume--the greater the volume, the greater is the area flooded.

(4) This relationship is illustrated by the White Tanks Watershed in Arizona. Floodwater from this watershed flows from the White Tanks Mountains onto a highly productive, gently sloping flood plain. Once the floodwater breaks through the highline irrigation canal, it spreads out over the farm land in relatively shallow, sheet-like flows except where it is concentrated or obstructed by railroad and road fills, ditches, or other man-made obstacles. The relationship between flood volume and acreage flooded is shown in the following tabulation:

Table 621-3.--White Tanks Watershed - flood volume and acreage flooded.

Flood Date	Volume Acre-Feet	Acres Crop Land Flooded	Acres Flooded Per Acre-Foot
August 1939	3,500	4,600	1.3
September 1956	7,000	7,500	1.1
September 1949	2,500	3,000	1.2
January 1951	5,500	7,000	1.3
July-August 1951	11,500	14,100	1.2
Total	30,000	36,200	1.2

(5) A large area of cropland in this watershed lies in the flood plain. Not all of the area would be subject to flooding by a single flood (even a 100 year flood would inundate only about a quarter of the area), but most is subject to the flooding with slight changes in the paths of flood flows.

(6) In overland flow situations with relatively little ponding, farm damage per acre flooded appears to be relatively constant irrespective of the number of acres flooded. This is illustrated in the following tabulation for the White Tanks Watershed for two floods, both of which occurred in August.

Table 621-4.--White Tanks Watershed

Type of Damage/Acre	August 1939 Flood	July-August 1951 Flood
Crop	$ 28.75	$ 28.60
Land	8.89	10.14
Farm ditches	3.91	3.60
Miscellaneous farm damage	1.69	3.11
Total farm damage/acre flooded	$ 43.24	$ 45.45

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(7) Because the flood in July and August of 1951 was over three times as large as the August 1939 flood, it was concluded that flood damage was proportional to the acreage flooded, which in turn was proportional to the flood volume. Hence, it was necessary only for the hydrologist to determine a flood volume-frequency series to provide a basis for determining average annual flood damages over a normal hydrologic period.

(8) Overland floods seldom follow the same path. During the interval between floods, even minor changes in the flood plain, such as small dikes, road and railroad fills, irrigation ditches, or even land leveling have been known to alter the course of flood flows. Sediment deposition where there is an abrupt change of grade is also an important factor in altering their course. This unpredictability is not particularly important where there is homogeneity in the flood plain. However, many alluvial fans or other alluvial areas exhibit a wide variety of damage potential because of differences in kind and extent of development. If a flood strikes the developed area of the flood plain, serious damage may result, whereas if it followed a path through an undeveloped area, little or no damage would occur. Hence it is necessary in such situations to determine the mean damage resulting from a flood of certain size, taking into consideration the probability of the flood following any one of several possible paths. This problem is illustrated in the following sketch of the White Tanks area:

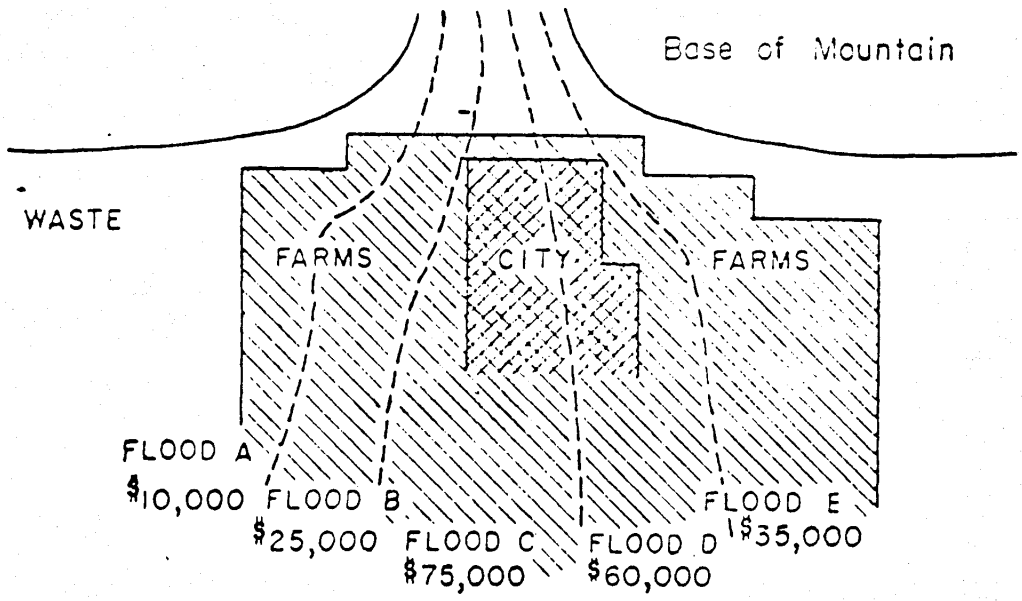


Figure 621-6.--Overland flooding in White Tanks area.

Through the use of topographic surveys, aerial photographs, and maps of historical flood flows, flood paths A, B, C, D, and E are traced through the flood plain. Flood damages are determined from known relationships between damages, flood depths, and velocity. If a flood of the magnitude being studied has an equal chance of following each of the flood paths, then the probable damage from such a flood is equal to the mean value of the five alternatives which in this example is $41,000. Similar studies made for floods of different magnitudes would furnish the basis for damage-flood volume curves.

(9) In arid regions where the overland flow technique has been used most frequently, there are only a few floods in a 20-year period. The few gage records that exist indicate that even where floods are so infrequent, there are generally 2 or 3 years during which more than one flood occurs. However, recurrent flooding during a single year over the same area is unlikely because of the alternative paths the flow can take.

§621.03 Steps in damage appraisal.

The following outline contains steps necessary to appraise floodwater damages. Understanding of the appraisal principles involved will provide the economist with a basis for making adaptations necessary to cope with unusual problems not contemplated by this outline.

(a) Selecting study areas.

(1) To obtain statistically reliable data in watersheds covering only a few square miles, it may be necessary to obtain information on the entire flood plain. However, a sampling procedure should be employed where practical, and certainly should be used on all larger watersheds.

(2) The first step in selecting a sample for detailed investigation is a careful reconnaissance of the area so that major problems or conditions will be sampled. Stereoscopic analysis of flood plain photographs will be useful in this reconnaissance.

(3) The selection and use of appropriate stream and flood plain reaches provide a means for identifying the location of damages and benefits; bringing the evaluation of hydrologic and economic data together for determination of stage-area-damage relationships; and, relating damage reductions or other benefits to works of improvement.

(4) In selecting the sample areas for detailed investigation, appraisers should direct their attention to these points:

-- Important variations in flood plain characteristics and in land use should be considered.

-- Both sides of the stream should be represented.

-- Differences in channel size and valley width from headwaters to bottom reaches should not be overlooked.

-- No portion of the flood plain should be deliberately excluded from the possibility of being drawn in the sample.

-- Sample selection should facilitate evaluation of individual structures or groups of structures.

(b) Collecting basic data.

(1) Maps. Major land use in the flood plain maybe mapped on aerial photos, overlays, or sketches, depending upon the need. The map should show improvements such as roads, buildings, and bridges subject to damage. Where urban and residential areas are subject to flooding, it is desirable to use a detailed map. Many towns and cities have maps that will help fill this need. Land use capability classes and soil delineations also may be shown on the flood plain map. It usually is not necessary to show crop distribution throughout the flood plain, however, it will be desirable to show crop distribution in a few representative sample valley sections. Locations of areas significantly affected by flood plain scour, deposition and streambank erosion may be delineated on the map to complement the investigations of the geologist.

(2) Field Information.

(i) Damage information often may be obtained directly from operators of flood plain land. This information should be recorded on flood damage schedules rather than in separate notes to ensure that comparable information is obtained from all respondents. The approved form (see §621.09) is to be used for collection of agricultural flood damage information.

(ii) This information will furnish basic data for estimating likely or potential damage for all classes of agricultural property or will provide the basis for making adjustments to standard damage data already developed. Many farmers will be able to give information about only one flood. This may be the most recent, the largest, or the most damaging. However, information should be obtained on as many floods as possible.

(iii) The enumerator should obtain as accurately as possible the proportion of cropland in the various crops. Although normal crop rotations will cause different crops to occupy a given field from year to year, the overall distribution should be reflective of crop patterns and sequences in the flood plain. It can be expected that some cropland will be idle. The division of the flood plain among cropland, pasture, woodland, and other uses can in some cases be determined by planimetering recent aerial photos of the floodplain. The data thus obtained represent current land use and cropping patterns. Adjustments are made where these data do not represent future relevant physical and economic changes expected to influence landuse and cropping patterns in the absence of the project.

(iv) Farmer interviews should be conducted primarily to obtain information about physical quantities rather than economic values. For example, farmers should be asked about the tons of fertilizer applied or the number of acres receiving custom field work, rather than the amount of money spent on such items. Otherwise, much time will be used in trying to determine what items the farmer has included in the value estimate, and the price base used.

(3) Cost and price base data.

(i) Production cost data often are available from State Agricultural Universities. Persons knowledgeable of local agriculture can provide information on farming equipment and farming operations common to the area. The Crop Budget System, maintained by the Economics and Social Sciences Division, can provide information on costs of producing various crops. If a given operation, such as combining, is usually done on a custom basis in a community, the custom price may be considered as a cost of operation.

(ii) When cost data are from the various sources, care should be taken to check applicability of the data to watershed planning. The price base should be known so that price levels for production cost can be consistent with current normalized prices. A known price base is also necessary for updating. The economist should find out exactly what items his cost data include. Among these are interest charges and depreciation on equipment, labor (whether hired or unpaid family), and cost of obtaining and applying fertilizer and insecticides.

(c) Analysis of Damage.

(1) Damage estimates are based upon data obtained in the field. Raw data must be analyzed and processed before it can be correlated with information provided by either specialists to obtain an accurate appraisal of the effects of the project.

(2) The planning staff is faced with the problem of balancing the limitations imposed by a small data set with the cost and the time required to obtain and analyze more complete information. It may be necessary to adopt certain reasonable assumptions and to develop abbreviated procedures to keep planning costs within reason. When assumptions are made, they should be explicitly stated and explained in the evaluation.

(3) Crop and pasture damage.

(i) Floodwater damage sustained by crops and pasture depends upon the value of the crop, seasonal occurrence and frequency of flooding, and such characteristics of flooding as depth, velocity of flow, sediment load, and duration. Flood Damage questionnaires can form the basis for estimating many of these factors.

(ii) Estimates of flood-free yields are obviously hypothetical figures. Flood plains of creek watersheds are so small that accurate yield data from secondary sources are seldom available. Basic data on the yields to be expected in the flood plain can be obtained from interviews, but these must be scrutinized carefully. Data obtained from interviews may be biased since other events may have reduced the yield had a flood not damaged or destroyed the crop. Yield levels will need to reflect fertility, farming methods, etc., in the area. Individual farm data on crop acreages and yields often are available from the Agricultural Stabilization and Conservation Service (ASCS). ASCS information may be used to confirm general yield levels for the area. County level yield data is available from the state crop reporting agency.

County average yields will be those reported by the Crop Reporting Service. Yields within the watershed will be adjusted to reflect productivity using base yield levels from the SCS Soils 5 data base.

(iii) Percent damage factors are derived for each crop to relate the damage to the month or season and the depth or duration of flooding. Table 621-5, shows steps required to estimate the percent damage to a given crop at each depth increment of flooding during a given month or season. Similar procedures can be used for other depths or durations of flooding and for other seasons or months. This procedure should be repeated for each of the crops in the flood plain.

Table 621-5.--Example of Crop Damage Assessment by Season and Depth of Flooding: flood damage to cotton 3 feet deep an over, spring flood, village creek.

Schedule No.	Acres Flooded (1)	If No Flood: Est. Yield (2)	If No Flood: Total Production (3)	If No Flood: Price Per Unit (4)	If No Flood: Total Value (5)	After Flood: Actual Yield (6)	After Flood: Total Production (7)	After Flood: Price Per Unit (8)	After Flood: Total Value (9)	Gross Damage (10)	Exp. Saved (11)	Net Value Alt. Crop (12)	Added Exp. (13)	Net Damage (14)
		lbs	lbs	$	$	lbs	lbs	$	$	$	$	$	$	$
72	40	450	18,000	0.386	0,948	0	0	0	0	6,948	2,782	916	0	3,250
121	10	420	4,200	0.386	1,621	0	0	0	0	1,621	262	0	0	1,359
114	8	---	3,440	0.386	1,328	133	1,064	0.386	411	917	212	0	10	715
Total	58	---	25,640	-.--	9,897	---	1,064	-.--	411	9,486	3,256	916	10	5,324

Damage per acre flooded: 91.79

Percent of damage : .54

Procedure:
Column (1) x Column (2) = Column (3).
Column (3) x Column (4) = Column (5).
Column (1) x Column (6) = Column (7).
Column (7) x Column (8) = Column (9).
Column (10) = Column (5) - Column (9).
Column (14) = Column (10) + Column (13) - Columns ((11) and (12)).

(iv) In a single watershed, detailed information usually can be obtained for only a few floods. Therefore, schedules that can be obtained in most watersheds will not furnish adequate information for determination of the percent damage factors for all months or seasons or for all depths or durations. Damage information that previously has been obtained in similar areas may be used to supplement field data on a given watershed to indicate general relationships and to fill gaps where field data are inadequate. It may be necessary, however, to calculate some basic factors on percent damage for each watershed whenever supplemental damage factor data are being used. The supplemental data can then be adjusted to the flood plain under evaluation.

(v) Major land use may be determined from the flood plain map. Present crop distribution in the flood plain can be obtained by summing figures shown in the present acreage column from the questionnaires. It is advisable to let the land use acreage at the year planning is begun represent present conditions. If there are obvious reasons for making adjustments to more nearly reflect normal conditions, the acreage should be adjusted. A final adjustment will be the conversion of existing use to that which can be expected in the future without the project.

(vi) In some watersheds, land use will be uniform throughout the flood plain. In other watersheds, land use between upper and lower reaches of the stream may differ considerably. Where this is the case, different land uses and crop values are to be used for the two (or more) reaches. In a given cross section there may be significant variations in land use with elevation above the bank-full stage. The acreage inundated first may be woods or idle land in which there is little or no damage. This acreage should be evaluated separately from acreage where more substantial damages result from flooding.

(vii) Table 621-6 shows a method of calculating the composite damageable value per acre of flood plain when uniform land use is assumed. The damageable value of each crop, determined as shown in Table 621-6 can be multiplied by its percent-damage factor, and the products added to give the damage from flooding an average acre of flood plain to a given depth during each season, as shown in Table 621-7.

(viii) Damages by depth for each season are then multiplied by the percent chance of flood occurrence for that season to develop weighted per acre damages for the composite acre land use. (See Table 621-2).

(ix) Weighted damages per acre are then multiplied by acreages inundated for representative stages to develop stage damage curves similar to that shown in Figure 621-4. Development of damage curves for seasons rather than one for each month is adequate in most cases.

(4) Duration damage. Table 621-7 illustrates a procedure for watersheds where depth of inundation is more meaningful than duration of flooding. This is the situation on most watersheds. However, when water gathers on a wide, relatively flat flood plain it may remain for a considerable time. If this occurs, duration may be the more important factor. Increments of duration may be handled in a manner similar to that illustrated for depth increments.

(5) Other agricultural damage.

(i) Seasonal curves for other agricultural damages will not ordinarily be needed. Damages of this type may not start until a relatively high flood stage is reached. For example, floodwater probably will need to be at least 2 feet deep before there is much damage to fences. The sampling procedure used for estimating crop and pasture damage should be equally applicable to estimates of other agricultural damage.

(ii) Where irrigation, drainage, or farm levee systems are subject to flood damage, they should be evaluated separately. For example, damage to an irrigation system might be as minor as ditch silting or wash-out of a siphon, but the inability to use the system before repair of such damage could cause loss of a crop.

Table 621-6.--Example of data used to calculate damagable value per acre of flood plain.

Crop Use	Percent in this use	Unit	Yield per acre of crop	Normalized Price ($)	Damageable value per acre ($)1/
Corn	6.3	bu.	70	2.28	10.05
Cotton	6.3	lb.	442	0.386	10.75
Oats	10.5	bu.	48	1.10	5.54
Wheat	6.6	bu.	31	3.09	6.32
Hay	0.3	tons	2.0	41.10	.25
Pasture	67.0	AUM	2.50	5.00	8.36
Noncrop	3.0	---	---	---	---

1/ The damageable value per composite acre from each crop is the product of percent in that use, yield per acre and price, i.e., for corn (.063 x 70 x $2.28 = $10.05).

621.03(c)(5)(ii)

Table 621-7.--Example of composite crop and pasture damage rate, per acre flooded, by depth of flooding.

Crop	Damageable value per composite acre ($)	Net Damage					
		Depth 0-1.0'		Depth 1.1-3.0'		Depth 3.1 & Over	
		%	$	%	$	%	$
Corn	10.05	26	2.61	35	3.52	47	4.72
Cotton	10.75	17	1.83	41	4.41	54	5.80
Oats	5.54	32	1.77	50	2.77	63	3.49
Wheat	6.32	33	2.09	50	3.16	63	3.98
Hay	.25	20	0.05	23	0.06	36	0.09
Pasture	8.36	10	0.84	18	1.50	20	1.67
TOTAL			9.19		15.42		19.75

(6) Rural roads and bridges.

(i) Estimates of road and bridge damage may be obtained from state highway engineers, boards of county commissioners, county engineers, or township trustees. Use only approved forms to collect damage information (see §621.010). These data should be related to specific events and depths of flooding. Often, however, such information is incomplete. A county commissioner may be newly elected and unable to report on the expenditures authorized by his predecessors. Or the commissioner may keep general records that do not distinguish the portion spent for ordinary maintenance from that spent for repairing damage. A road or highway district may phase maintenance and repair, spreading costs over several years. Hence, the record of damages to roads and bridges may be inaccurate because of delayed maintenance or repair. For these reasons, the flood damage schedule tells the enumerator to "Indicate the year repair was made if that year is other than the year damaged occurred." Supplemental information, obtained from farmers and others, will provide a check on data acquired from official sources. Though local residents may have little information on costs, often they can pinpoint the location of major damage to bridges and roads. Furthermore, in some areas farmers cooperatively repair some damage to roads and bridges. When this is the case, the full cost of repairs may not be found in public records.

(ii) In obtaining information on historical damage to a road and bridge, it is necessary to determine the facility's condition at the time it was damaged. Replacements may be better constructed and less subject to flood damage than the original facility. If this appears likely, damage estimates should be based on the new facility.

§621.04 Damage Reduction.

Flood prevention benefits to be used in economic evaluations are derived from damage appraisals. This section describes the determination of flood prevention benefits.

(a) Onsite benefits.

(1) Reductions in damage.

(i) Flood damages are lessened by reducing discharge or increasing channel capacity, which in turn reduces the area, duration, and depth of downstream flooding. Evaluation requires the determination of damages under nonproject conditions, as well as damages expected after installation of successive increments of structural or land treatment practices. The difference between damage without and with installation of any segment of the project constitutes the benefit from damage reduction creditable to that segment.

(ii) In addition to reducing ordinary physical damage, consideration should be given to the possibility that flood prevention measures may reduce the cost of operation and maintenance or lengthen the life of proposed or existing facilities. For example, a heavy sediment load in a stream may cause such extensive channel filling that the channel requires frequent cleaning. In this case, benefits could arise from reducing the cost of cleaning. Economic benefits from reduced dredging must be supported by documentation that dredging is actually being done and adjusted to account for the fact that not all sediment that leaves the project area would be deposited in the dredged channel.

(iii) With-project discharge-frequency curves, prepared by the hydrologist, will enable the economist to prepare with-project damage-frequency curves. Comparing these curves and the without-project or original damage-frequency curves will determine benefits. With-project curves, prepared by the economist and hydrologist are necessary for each kind or combination of measures being evaluated.

(iv) Damage reduction benefits from flood prevention measures generally begin to accrue as soon as the measures are installed; no discounting for time lag is required. If land damage from sediment deposition or flood plain scour preceded installation of flood prevention measures, the analysis should reflect the time required for recovery. Likewise, if frequent flooding has restricted land use or required selection of crops that are less susceptible to flood damage, operators of flood plain lands can be expected to wait until they can judge the effectiveness of their protection before they intensify land use or select different crops. Discounting will be considered for such benefits when time lags exceed 2 years.

(v) When reduction of land damage is used as a benefit, appropriate adjustments in estimates of other types of damage should be made. For example, when flood plain land is destroyed through stream bank erosion, the estimate of crop and pasture damage during the life of the project must be reduced to take into account the smaller area that will remain to sustain damage.

(vi) A technical problem that arises in the evaluation of benefits from waterflow control measures is in determining acreages involved. Flood routing, the procedure used to determine damages under nonproject conditions, may be done before sites for floodwater retarding structure have been determined. When these sites have been finally located, it may be that part of the flood plain on which previous routing has been made will be included within the pool area of the structure or structures. Unless adjustments are made, the difference between damages before and after project installation would include the damage within the pool area as a project benefit. Adjustments of floodplain area may also be needed when channel improvement or flood-ways are planned.

(2) Future development in the absence of a project.

(i) As discussed earlier in this section, project evaluation requires a comparison of conditions that would exist over the evaluation period without the project and those that can be expected with the project in operation. Where the damageable value base from which evaluation is to be made is different from the conditions of present use, the basis for the projected condition must be completely documented.

(ii) The most common approach to this problem is to estimate the eventual degree of change and the period over which the change will occur and to assume that the change will take place uniformly over time. This approach will provide an annual increment of change that can be discounted to present value and used to adjust present conditions to average future conditions.

(iii) A simple average of the existing and eventual values for this purpose is unsound because deferred values are worth less than similar present values. Consequently, when damageable values are increasing, the greatest value will be at the end of the time period and will receive the heaviest discount. The average annual equivalent values after discounting will be less than the simple average of values. The reverse is true if damageable values are declining.

(3) Increased income.

(i) A flood hazard often prevents the highest use of resources. Once the hazard is removed, uses of these resources may be more efficient. For example, flood plain pasture may be lightly used because of the hazard to livestock. "Catch crops" may be grown instead of high value crops in an effort to avoid the season of worst flooding. In these situations protection may allow land to remain in its original use, but income will be increased through more effective use of resources. Increases in net income that occur on protected flood plains as a result of changes in the cropping pattern are reported as intensification benefits. (See P&G and §621.05.)

(ii) Changes of these types usually take place only after some lag in time, so calculated benefits should be discounted accordingly.

(iii) Associated costs required to make such changes possible should be deducted from the gross increase in income.

(b) Offsite benefits.

In general, offsite benefits may be considered as accruing outside the project area to someone who has no control over the source of damage. In the case of a critical sediment-producing area, control of sediment output may result in offsite benefits in the form of decreases in the rate of channel filling and flooding downstream.

§621.05 Intensification.

Intensification benefits occur on lands where there will be changes in the cropping patterns or land use. This section illustrates some of the major types of problems that are likely to be encountered in evaluating these benefits. The discussion here is applicable to projects for flood prevention and agricultural water management.

(a) Agricultural benefits.

Many areas of flood plain land are abandoned or are in low income-producing uses because of adverse effects of flooding. Reduced income from such a condition may be considered a type of flood damage. Installation of flood-prevention measures reduces the flood hazard sufficiently to induce a use more consistent with the land's productive potential. The difference between the net income now generated and that expected under improved conditions is the benefit from intensification. While such benefits are allied conceptually with benefits from damage reduction, the fact that cropping patterns have changed requires that they be reported as intensification benefits.

(b) Nonagricultural Benefits

(1) Intensification-type benefits may accrue because of nonagricultural uses expected as a result of a project. Flood protection may permit commercial, industrial, or residential development of flood plain areas. In some cases, such areas may be level and can be developed with less expense than nearby uplands. The development may take the form of a shift from agricultural to rural residential use or to suburban or urban use. It may involve development of idle land.

(2) The preferred method of evaluating benefits of this type is to estimate the increase in income-producing potential of the land. If data are not available, an alternative method is to use the increase in the appraisal value of the land. These approaches apply when industrial, commercial, or residential development is concerned. In most instances there would be an opportunity for the same type of development elsewhere. If benefits are claimed for the project, development in the benefited area should have advantages over development elsewhere in terms of higher income, lower development costs, or both. Only the difference between the project area value and the other area value (net of developmental costs), can be considered a project benefit. When evaluation is based on land values, it it necessary that these values be determined by qualified appraisers.

(c) Data necessary for evaluation.

(1) Identifying the areas to which benefits may accrue is essential. Physical, social and economic factors govern the amount of change, the type of change expected, and when the expected change will occur. Information on at least the following factors should be obtained and evaluated:

- -- Agronomic potential of the land.
- -- Type of farming.
- -- Width and topography of the flood plain or area to be benefited.
- -- Need for various types of production, whether in agricultural products or in urban and industrial services.
- -- Degree of protection or service afforded by the planned improvements.
- -- The land use change supported by this degree of protection or service.
- -- Willingness, intentions, financial and managerial ability of present and future operators to develop the land.
- -- Availability of markets for new products.
- -- Restrictions imposed by acreage allotments, marketing quotas, or zoning regulations.

(2) For agricultural purposes, the productivity of the land and its responsiveness to production inputs such as fertilization, irrigation, or drainage are highly important. If nonagricultural uses are being considered, such things as drainage, accessibility to transportation, stability as a building site, and cost of correcting any adverse conditions must be determined.

(3) Increased mechanization enhances the desirability of relatively large, level fields for agricultural production. The same characteristics favor large-scale urban development. Hence, other things being equal, a relatively broad and level flood plain is likely to reach a higher stage of development than one that is narrow and uneven.

(4) It may not be physically or economically feasible for a project to meet all of the potential needs of the watershed. For example, an irrigation project probably will not supply full water requirements 100 percent of the time. Correct evaluation requires that sufficient information be obtained and analyzed to determine the proportion of demand that will be met by various levels of development, the production inputs that will be applied under each of these conditions, and the production that can be expected in each case.

621.05(c)(5)

(5) The intentions of present operators do not necessarily indicate the extent of future enhancement. They are helpful, however in determining the lag to be expected in reaching the full level of benefits.

(6) Benefit calculations should be based on the effect of measures in reducing or eliminating existing restrictions on higher uses. For example, determining the area subject to development after flood protection will involve estimating the area flooded in each evaluation reach, with and without the improvement. The relationship of flooding to landuse is now indicated by difference in use under various frequencies of flooding. That is, if land flooded 1 year in 3 is used for pasture at present, it and similar land likely will be used for pasture in the future if flooded at the same frequency. If, however, the frequency is reduced to 1 year in 5, the land now in pasture may be converted to crops.

(7) Calculations of net returns without and with the project take into account flood damages and the cost of conditioning or developing the land for a change in use with the project in place.

(d) Benefits from allotment crops.

From time to time certain crops are under government acreage allotments or marketing quotas. Other crops may be in surplus supply, although not restricted by allotments. Extreme caution should be exercised in claiming benefits from increasing the acreages of these crops as a result of project installation. This applies to all benefits of the intensification-type described in this section.

(e) Adjustments in Benefits.

In nearly all cases of intensification-type benefits, the final benefit creditable to the project can be determined only after consideration of such factors as the rate of benefit accrual and the future with-project flooding. The time lag between project installation and full production requires appropriate discounting.

(1) Adjustments for lag in accrual.

(i) Intensification-type benefits seldom can be expected to reach their full value immediately after project installation. Time will be needed to clear land or otherwise get it in proper physical condition after flood protection is provided. Time may be required for recovery from disturbance occasioned by land leveling and installation of onfarm drainage or irrigation systems.

Is the <2-year issue still holding? (see 621.04(a)(1)(iv)

(ii) In addition to delays caused by physical factors, there are delays stemming from management and financial limitations. Farmers may not have the capital to take immediate advantage of project facilities; and agricultural lenders may be slow to approve loans for new agricultural capital investments. Farmers may need time to discover the best production patterns and inputs needed for most profitable production. This may be especially true for new irrigation development because time is needed to learn when to irrigate and how much water and fertilizer to apply. In addition, a farmer may choose not to expand production during his tenure.

(2) Adjustments for future flood damage to higher value use.

(i) Water resource projects seldom provide complete flood protection to agricultural areas. As a result, future floods cause damage on land that has shifted to higher use as a result of the project.

(ii) Damage can be calculated by evaluating the effect of flooding on the new damageable value with the project installed. The excess of this damage over that found when the original damageable values were used should be deducted from the gross benefit assigned intensification. This correction is important when agricultural values are involved. Nonagricultural enhancement will not ordinarily be undertaken unless a high level of protection is provided.

(3) Other adjustments to be considered.

Adjustments of benefits may be needed when projects are developed for irrigation or drainage. In either case, through capital or other limitations, some potential beneficiaries may fail to take full advantage of the project facilities. A common failure may be that onfarm installations are not maintained at full efficiency. An acceptable method of handling this problem is to examine the operation of similar, nearby area where these improvements are in operation. Based on such analyses, potential benefits from the project are adjusted downward for the expected percentage of participation or the degree of effective maintenance.

§621.06 Historical series method.

(a) Use of the Historical Series Method and the Net Income Method are restricted by the Principles and Guidelines. Therefore, they are discussed here only to complete the presentation of alternative evaluation methods.

(b) The Historical Series Method, uses an evaluation period for which the cumulative annual departures from normal precipitation are minimized. Essentially, this method rests upon the assumption that a sequence of events that has occurred in the past also may occur in the future. Floods of extreme magnitude (usually those with an expected recurrence interval of twice the evaluation period, or longer) should be excluded from the series unless appropriate adjustments are made.

(c) After the various categories of damage have been appraised for each flood during the evaluation period, under future conditions without the project, the damages should be summed and divided by the number of years in the period. The result is the unadjusted average annual damage. The figure is then adjusted for recurrent flooding, or otherwise as needed, to obtain the average annual damage. One method of calculating the adjustment is by making a flood-by-flood analysis.

(d) Caution should be observed with regard to the evaluation period. It often happens that the period of record of stream gages or rain gages involves fractional parts of a year. Evaluation periods should comprise complete years, dropping all fractional periods from consideration. Unless floods occur annually, an error may be introduced by starting and ending the evaluation period with floods. For example, flood damages may be estimated for a period of 20 years (1937 - 1956 inclusive) during which time 7 floods occurred. An examination of the record (or other reliable sources) shows that the last flood previous to 1937 occurred in 1934. Hence the flood period covers more than 20 years.

Void discount table.

(e) The flood series should be adjusted by dropping from consideration small floods that occur so near in time to larger ones that restoration of damageable values would not have been possible in the interim.

(f) Stage-damage curves are developed when the Historical Series Method is used. With the dates and sequence of flooding available, separate curves usually are developed by months or seasons. When depth of flooding is the chief determinant of the rate of crop damage from a given flood, the hydrologist may develop curves that relate the acreages flooded at different depths to the flood stage.

(g) The acres flooded at different depths for each flood stage are multiplied by damage rates to provide the basis for development of the stage damage curve.

(h) Using the Historical Series Method, it is possible to develop a single stage-damage curve for the entire year by weighting the damage factors by the seasonal occurrences of flooding. However, this procedure results in little, if any, savings in time.

(i) When using the Historical Series Method it is generally found that several floods occur during a single year while non occur in other years. In such cases it is incorrect to add the unadjusted damage to crops and pasture for each flood in the evaluation series and use the sum as the total damage. The first flooding during the year will reduce the value of the crops somewhat, reducing the potential for damage by a second flood in the same year. Some portion of the value may be restored between floods through replanting, but the yield of the late crop will usually be reduced. One method of calculating these changes in value, and in resulting damage, is a flood-by-flood analysis. These calculations are laborious when an evaluation series includes a considerable list of floods.

(j) The Historical Series Method requires somewhat more work for the hydrologist and economist than does the frequency method. However, when flooding is frequent and the major damage is to crops and pasture it allows a more precise approach to the adjustment of damages from recurrent flooding.

§621.07 Net income method.

(a) A method which theoretically is sound, but which is likely to have practical difficulties, is the evaluation of flood damage and the benefit from its reduction using the estimated change in net income after project installation. This procedure is applicable where nearly all damage is to crops and pasture and the control of flooding after project installation will be almost complete. It is also used in most cases where benefits of flood prevention and agricultural water management are difficult to estimate separately.

(b) The procedure consists of determining the land use, average crop yields and net return without the project and comparing these with the flood-free yields, extent of cropping intensification, and net returns under project conditions. The difference in net return constitutes the flood damage. The increase in net return as a result of project installation constitutes the project benefit.

(c) A major difficulty with this approach is estimating the average crop yield after project installation. How closely does it approximate the flood-free yield when protection is incomplete? Another problem is the determining of additional production costs under these circumstances.

§621.08 Agriculture computer programs.

(a) The evaluation procedures described earlier in this subpart have been computerized by SCS. Agriculture related programs have been developed to calculate floodwater damages, land damages, and the value of agricultural production. Handbooks are available to assist in the use of each computer program.

(1) Floodwater damages (ECON2).

ECON2 computes average annual damages to crops and pasture, other agriculture damages, and damages to roads and bridges, urban developments, etc. The program permits the use of either the frequency or historical method. The evaluation may be based on flood depths or duration. Damages and benefits are computed for each cross-section, each reach, and each alternative.

(2) Land damage analysis (LDAMG).

LDAMG computes average annual damage caused by sediment, and scour. It uses the same logic and mathematical procedures as outlined in this handbook (See Part 621, Subpart D). Input requirements for economic and geologic data are the same as those needed for manual calculations.

(3) Value of agricultural production (VAGPR).

VAGPR computes future without-project returns for various crops and compares these with alternative conditions. This program is useful for the evaluating intensification, irrigation, drainage, and erosion benefits for alternative plans.

FLOOD DAMAGE – AGRICULTURE

Respondent _____ Years on Farm _____ Farm Location _____ Watershed _____ Reach _____

Flood Date _____ (Mo.) (Yr.) No. of Acres Flooded _____ How frequently do floods of this size occur _____ No. of Acres Flooded by largest flood _____

Damage to Crops and Pasture From Flood of Above Date

Land Use	No. of Acres	Depth of Flood (Ft.)	Duration of Flood (Hrs.)	Expected Yield/Acre If No Flood	Yield/Acre After Flood	Alternate Crop & Yield/Acre	Additional Production Practices Performed Due to Flood	Production Practices Not Performed Due to Flood

Other Agricultural Property Damage From Flood of Above Date

Item	Type	Quantity	Depth of Flood	Estimated Damage (Dollars)

Estimated Land Damage From Flood of Above Date

Kinds	Acres	Productivity Loss	Remarks

REMARKS

Date of Interview _____

By _____

Agriculture Flood Damage Questionnaire

Instructions

The purpose of this questionnaire is to obtain information from landowners and operators to be used with other data in the evaluation of watershed problems and needs and project effects.

List the name of the person being interviewed, the location of the farm or ranch and the name of the watershed under study.

Give the month and the year of a flood the respondent can remember. Show his estimate of the number of acres on this farm or ranch that were flooded by that flood.

Show the land use by acres of the area flooded when that flood occurred. Show the maximum depth of that flood and length of time flooding occurred. Show the expected yield for each land use if no flood had occurred, and the yield after the flood. If the yield after the flood was caused by delayed planting from a prior flood indicate with a star. Name the alternate crop and yield if applicable. List the additional production practices made necessary by the flood occurrence. List the production practices that did not need to be performed due to crop loss by flood. Use remarks section for additional space if needed.

List the other agricultural property by types damaged by that flood. Show the quantity flooded by depths of flooding. Show the respondent's estimate of damage for each depth, type or item and indicate which is the reference.

List the respondent's estimates of land damages.

List the normal land use of the total flood plain.

List the dates the farmer performs the indicated production practices when flooding is not a problem.

LAND USE IN TOTAL FLOODPLAIN

Crop	No. of Acres	Usual Date for Production Practices				Date too late to Plant
		Land Preparation	Planting	Cultivating	Harvest	

1. What changes in land use have you made due to floods? _____
2. What changes would you make if the frequency of flooding were reduced by half? _____
3. How often do large floods occur? (If the flood described above is a large flood, change this question to small floods.) _____
4. During what seasons are floods most common? _____
5. In addition to the loss in yield described above, was there any damage to quality of crops? _____
6. What damage did this flood do to roads and bridges nearby? _____

Use other side for **REMARKS**.

FLOOD DAMAGE -- TRANSPORTATION -- UTILITIES

Watershed _____ Reach _____ State _____ Interviewer _____ Date _____

Respondent _____ Institution Represented _____

Location of Damage _____ Item Damaged _____

Date of Flood _____

(1)	(2)	(3)	(4)	(5)	(6) Estimated Damages if Floods were:					
					Higher			Lower		
Depth of Water Related to Item Damaged (feet)	Type of Damage	Cost of Repair 1/ (dollars)	Other Damages (dollars)	Total Damages (dollars)	1'	2'	3'	1'	2'	3'

1/ Indicate the year repair made if other than year damaged _____

Bridge Information

(7)	(8)	(9)	(10)	(11)
Location	Size and Kind of Bridge	Estimated Remaining Life of Bridge (years)	Estimated Cost of Replacement (dollars)	Estimated Life of Replacement (years)

Remarks

_____

_____

_____

SUBPART B - DRAINAGE

§621.10 Introduction

(a) This subpart outlines evaluation procedures for drainage. Agricultural drainage involves the removal of surface and/or subsurface water that may inhibit crop production or restrict land use to low-valued crops. Drainage systems are designed to develop a soil-plant-water relationship that permits optimum plant growth and land use.

(b) In some instances flooding and drainage problems are so interrelated that separation of effects and benefits is not analytically possible. Where this occurs, the evaluation should encompass both flood-prevention and drainage with benefits divided evenly between purposes (see section 2.3.8(c) of the P&G). Where physical data permit analytical separation of benefits, benefits should be estimated and reported separately.

§621.11 Drainage benefits.

(a) Damage reduction benefits.

Two frequent results of excessive soil moisture in the root zone are reduced crop yield and reduced efficiency in the use of tillage and harvest equipment. The economic consequences of those damages should be measured as a reduction in net income. To estimate the scope of the problem and to evaluate alternative solutions, the economist should consult agronomists, soil scientists, and engineers. The magnitude of the problem can be defined as the difference between present yield levels and production efficiencies and those that could be achieved in a situation free from water problems. Benefits claimed for a specific alternative plan should reflect the degree to which that plan alleviates the overall problem.

Explanatory Notes

1. Location of damage -- This may be by reach or other meaningful terms to identify where the damage occurs.

2. Respondent -- This would be the individual providing the information.

3. Institution Represented -- This may be the County Highway Department, railroad, utility company, etc.

4. Item Damaged -- Specify item and kind of item such as gravel road, steel bridge, main railroad line, electric generating plant, etc.

5. Column (1) -- This is to reflect the depth of water either over or below item damaged such as road surface, bridge deck, etc.

6. Column (2) -- This is to show whether damage consisted of washing out a bridge, eroding of abutments, gravel washed off road surface, flooding pumps, breaking utility poles, etc.

7. Column (4) -- This includes loss of business, wage loss, rerouting costs, emergency measures, cost of preventing damage, etc. Explain under remarks.

8. Column (6) -- This is not for a specific flood but is related to estimated damages if flood stages were either higher or lower. This estimate may be by respondent or technicians or both.

9. Bridge Information -- This data is to reflect without project conditions. This data may be useful if the replacement period and cost of replacement is affected by project conditions. It is most applicaple to bridges in close proximity of structures.

10. Column (8) -- This is to show size of bridge opening and whether steel, timber, etc.

11. Remarks -- Use to clarify any data obtained or additional information not specifically covered.

(b) Intensification benefits.

Not only does excess soil wetness reduce yields and efficiency of farming operations, they may also limit the kinds of crops that can be grown profitably. We would expect farmers to shift to more profitable crops when water problems have been reduced. Increases in net income that are generated by these cropping changes are reported as intensification benefits. The base for measurement is the net income level determined in the without-plan evaluation.

(c) Adjustment of benefits.

Fully effective drainage normally requires the installation, maintenance and possible future replacement of onfarm systems. The annual cost of these measures is to be subtracted from calculated benefits as an associated cost.

§621.12 Evaluation units and incremental analysis.

(a) Evaluation unit.

An evaluation unit is a drainage channel system which outlets into a waterway that is not being improved by the project. Each unit requires separate evaluation and may also require incremental analysis as part of the evaluation.

(b) Incremental analysis.

Incremental analysis is needed for--

(i) Each segment of an unbranched channel that serves a different land use, e.g., cropland, pasture land, and forest land, etc.;

(ii) Each branch of a system serving hydrologic subareas;

(iii) That segment of a channel which provides initial drainage to an area not now served;

(iv) Multipurpose channels when consideration is being given to increasing capacity above that afforded by minimum SCS regional drainage criteria.

The main channel of a system must be a part of the first increment. This increment may not be feasible by itself but is essential for other increments to function properly. Of course, the system as a whole must be feasible.

§621.13 Productivity.

(a) Land use and cropping system.

Basic data on present and anticipated land use and cropping systems for each major soil grouping are needed to measure the economic effect of various alternative plans and incremental segments. Soil survey information can provide information on drainage characteristics and productive potential of different areas within the project boundaries. Farmer interviews provide data on cropping patterns and yield levels. Interview information should be supplemented with published information, available from state crop reporting agencies, for both cropping patterns and yields. Approved forms must be used to record interview information (See §621.16).

(1) Current land use. Information on current land use is needed to determine without-project conditions. Interviews and field inspections should be used to obtain this information. The economist needs to be careful to identify conditions that are unique to a single year. Deviations in weather patterns can affect land use in areas with wet soils to a greater degree than in areas with adequate drainage. Data must be obtained for more than 1 year. Secondary sources should supplement interview data.

(2) Future land use without the project. Future without-project land use requires substantiation when the analysis indicates a significant shift from current land use. Examples of supporting evidence are continued installation of onfarm drainage measures even though they may be less than totally effective; time series data showing a gradual shift in land use; and continuing deterioration of existing drainage systems, which will necessitate shifts during the evaluation period. These determinations frequently require consultation with other specialists to measure the extent and rate of the change. When changes are projected, the economic analysis and evaluation must consider the rate at which the changes are being made.

(3) Future cropping pattern without the project. Changes in cropping pattern also require substantiation. Cropping pattern changes that occur in modern agriculture often are in response to relative price changes, not changes in natural resource conditions. Agriculture prices used in project planning are current normalized prices, and these prices are used for the evaluation period. As a consequence, using historical cropping pattern to support cropping pattern change is at best risky. Cropping pattern changes should be restricted to expected changes in physical resource conditions within the project area, e.g., increasing salinity and decreasing depth to the permanent water table.

§621.15 Reporting economic effects.

The NED benefits for agriculture are determined and reported as either damage reduction benefits or intensification benefits. Increases in net income resulting from improvement in drainage, or from both drainage and flood prevention, are to be developed and reported as damage reduction benefits for those acres where the cropping pattern with- project is likely to be the same as the cropping pattern without-it project. Increases in net income for areas where cropping patterns are assumed to change should be reported as intensification benefits. When cropping pattern changes are to include crops other than the ten basic crops, a subcategory of efficiency benefits should be estimated within the more general class of intensification benefits. (See §2.3.5, P&G).

DRAINAGE QUESTIONNAIRE

Respondent _____ Farm Location _____ Reach _____

Years on Farm _____ Size of Farm _____

Watershed _____ Interviewer _____ Date _____

Problem Area Land Use

Future Production Without Drainage			Future Production With Drainage			Remarks
Crop	Acres	Yield/Acre	Crop	Acres	Yield/Acre	

1. What are your drainage problems? _____

2. How often are you unable to plant a crop due to lack of adequate drainage? _____

3. How often do you need to make a separate planting due to lack of adequate drainage? _____

4. How often are you unable to harvest a crop due to lack of adequate drainage? _____

5. How much lime do you spread on problem area? _____

6. Would you use a different type and rate of fertilizer with adequate drainage? Yes☐ No☐

7. If yes, what changes would you make? _____

Remarks: _____

SUBPART C - IRRIGATION

§621.20 Introduction.

(a) Irrigation evaluations are concerned with changes in agricultural production and production efficiencies. These translate to changes in agricultural income that can come about because of increased yields, crop quality, cropping systems, and production inputs. Or the evaluation may be reflected in changes in operational efficiencies of the existing system.

(b) For the most part, irrigation projects can be grouped into three categories--new irrigation, supplemental supply, and rehabilitation of an existing system.

(i) New irrigation projects usually intensify farming because of a change from dryland crops to irrigated crops. New onfarm equipment and other changes in farm management and technology required because of the irrigation project enter into the analysis.

(ii) Supplemental supply measures provide more of the full-season water requirements than exisiting irrigation systems. Any changes in cropping systems, required equipment, management, and technology usually depend on the amount of supplemental water provided.

(iii) Rehabilitation projects are intended to sustain crop yields, to avoid damages to crops from system failure, or to reduce costs. Many irrigation projects provide for a combination of the above; for example, they may provide supplemental water and rehabilitate the existing system. Finally irrigation projects may free some water for other beneficial uses, including downstream wildlife habitat or improved water quality through diminution of return flows.

§621.21 Irrigation terminology.

(a) <u>Water supply, water rights, and water quality</u>.

(1) Water supply is the amount of water available for irrigation development. It may vary by season and area, thereby requiring special attention to types of irrigation measures, selection of priority crops, and separate evaluation areas. Water supply is generally the most significant variable affecting land use and yield in irrigation projects. An essential step in the analysis is to determine, for a specified location, the availability of water supply for use with and without a project. Analysis requires data on year to year reliability of the water supply and, when important, monthly variation of the supply within the irrigation season.

(2) Water rights are the legal ownerships of the right to use water. Water rights are of two broad types--riparian and prior appropriation. Water rights are set by state law and are unique to each state. They will limit the amount of water available for a project. Water law that affects the specific project area must be incorporated into the planning process.

(3) Water quality for agricultural use generally depends on the mineral content, sediment load, and temperature of the water, any of which can affect crop yields.

(b) Evapo-transpiration. Plants vary in their demand for water. Evapo-transpiration (consumptive use) includes the vegetative transpiration and surface evaporation losses from lands on which there is vegetation of any kind. Factors that influence consumptive use are climate, temperature, soils, wind, stage of development of the plant, and foliage. Data relating to the consumptive use of crops must be known before determining future land use and crop yields. Production functions relating irrigation water use and crop yields are available for many crops. Care should be exercised to ensure the changes in quantities and timing of the water supply are correctly related to changes in yield.

(c) Irrigation efficiency. Irrigation efficiency can be an important indicator of problems and/or opportunities. However, it is normally defined differently for different parts of the system.

(1) Onfarm irrigation efficiency.

(i) Onfarm, or water-application efficiency is the ratio of the volume of water consumed (transpired or evaporated, or both), adjusted for changes in root-zone storage, to the volume of water delivered at the farm. Many factors such as depth and texture of soil, topography, and type of crop, affect onfarm irrigation efficiency.

(ii) Improvements in efficiency level can be achieved through improved methods of water application and/or other water management practices. Because onfarm irrigation efficiency, crop consumptive use, and water supply are interrelated, each is important in considering project effects. The present level of onfarm irrigation efficiency must be determined. Future efficiency that can be achieved with and without the project must be estimated.

(2) Delivery or Conveyance Efficiency. Delivery (conveyance) efficiency is defined as the ratio of the volume of water delivered to the farm to the volume of water delivered to the system at the source.

(3) System efficiency. System efficiency is defined as the ratio of the volume of water consumed to the volume of water delivered to the system at the source. It is the combined effect of onfarm and delivery efficiency. Impacts of projects on both the onfarm and system efficiency are to be examined to determine their effect on total system efficiency.

§621.22 Planning setting.

(a) With- and without-project concept.

(1) The without-project condition, including conservation measures, is the condition expected to exist in the absence of an alternative plan.

(2) The with-project condition is the condition expected to exist with each alternative plan under consideration.

(3) Agricultural income and production costs are determined for various conditions or levels of irrigation development and/or improvement. Other resources associated with change in land use or acreage, and in water quantity and/or quality, should be included in the evaluation. The level of use to be evaluated initially is the without-project condition.

(b) Problem definition. The magnitude of the irrigation problem is the estimated difference between the net income that would be attained if the water resource problem were solved and the net income being achieved under existing conditions. Making this estimate requires estimates of yield and production costs under both water supply situations. In the with-project condition, project measures need to be considered to the extent they will be included in each alternative plan. For example, if sprinkler or drip irrigation is not considered in the alternative plan, it should not be considered in the problem-free projections.

§621.23 Basic data.

(a) Data needs. Basic data needed in the evaluation of an irrigation project are cropping patterns, crop yields, prices, and crop production costs. Specific guidance on these components is offered in §2.3.3 of the P&G. In irrigation evaluations it is necessary to have this information for the full range of anticipated water supply conditions. In addition, soils data for the present and proposed irrigated area should be collected and grouped according to similarities in crop adaptability and irrigation characteristics.

(b) Sources of data. The basic data required to plan and evaluate an irrigation project will come from a number of sources. A key source of information will be interviews with local residents, physical scientists, and experts from universities and state and federal agencies.

(1) Interviews. Interviews with farmers and other watershed residents are important for most watershed evaluations. Interviews need not be confined to farmers who are recipients of the water supply upon which work is proposed. Data collected in irrigated areas outside (but similar to) the project area can help analysts establish base or potential yields and production inputs for comparison with yields and inputs on project lands. Only forms approved by the Office of Management and Budget will be used for formal interviews, (see §621.210).

(2) Physical scientists. Irrigation agronomists and other physical scientists can often provide data to establish base dryland and irrigated yields for specific soils. Data collected by SCS soil scientists can provide information on crop yields and the relative productive capability of different soils. In addition, SCS Engineering Division Technical Release No. 21 can be used to derive detailed information on irrigation water requirements, by crop, for individual farms or for projects.

(3) Universities and Federal agencies. There are many sources of crop enterprise budgets and production functions that can be modified to reflect crop yields, water use, and production data in the area being studied. Analysts should consult the local college of agriculture, USDA's Economic Research Service, or USDA's Extension Service for information and analytical tools of this kind.

§621.24 Evaluation units.

(a) Evaluation units are the basic elements for the economic analysis. When evaluation units encompass multiple purposes, multiple structures, multiple segments, or multiple practices--or a combination of these--incremental analysis is required.

(b) Historically, arid-area irrigation projects have involved water storage for supplemental irrigation (with the possibility of recreation and flood prevention capacity in the reservoir), conveyance system improvements, and onfarm irrigation water management measures. This interconnected system is an evaluation unit. The different components are to be incrementally analyzed. In these projects, separate hydrologic units interconnected by the conveyance system constitute a single evaluation unit. Where questions exist on the determination of the evaluation unit(s), the planning staff should discuss the situation with their national technical center.

(c) In projects to rehabilitate an existing irrigation system, each separate irrigation system originating at a diversion point is a separate evaluation unit.

§621.25 Incremental analysis.

(a) Incremental analysis of irrigation systems can involve such features as storage structures, either the operation of existing structures or the development of storage; canal structures; and onfarm irrigation practices and measures, including improved management of existing water supplies. As with any incremental analysis the features should be ranked in the order of return per unit of cost.

(b) The first increment within an evaluation unit should be determined by analysis of each project feature as the first element in the system. The feature that returns the highest benefit per unit of cost, will be selected as the beginning of the system. The second increment will then analyze remaining features considering that the first is in place. Again the most feasible is selected as the next feature of the system. This process is continued so long as additional features provide net benefits.

(c) Onfarm measures will be a separate incremental analysis to determine the land treatment package of management and structural practices. This package is then utilized as a single feature along with storage, conveyance, and canal structures in the more general incremental analysis.

(d) When changes in the operation of an existing storage reservoir or the development of a new storage facility is being considered, the effects of other measures already in the irrigation system may change from iteration to iteration. This possibility needs to be examined and appropriate changes made.

621.25(e)

(e) Incremental analysis for rehabilitation of an irrigation system will consider each major structure as a separate increment. In addition to the obvious damage reduction benefit from replacing a structure, there can be an increased net income that results from the capability of the total system to safely handle increased flows. Analysis of the increased system capacity is best handled by considering the acreage uniquely served by each successive structure as we move down the system from the diversion.

§621.26 Changes in crop production inputs.

Changes in the irrigation system can be accompanied by significant change in farming practices in the area served. Costs associated with these changes, either increases or decreases, have an effect on net income. When they occur they must be accurately reflected in crop budgets.

§621.27 OM&R costs of without-project condition.

A projection of OM&R costs should consider the OM&R costs of farm systems and existing irrigation system for the without-project condition. Existing structures that will, in all likelihood, fail before project implementation could begin will be shown as repaired or replaced in the without-project condition.

§621.28 Reporting benefits.

Benefits are reported as either damage reduction or intensification benefits. Where the cropping pattern is expected to be the same with and without the project, increases in net income will be reported as damage reduction benefits. Increased net income from areas where cropping is expected to change will be reported as intensification benefits.

§621.29 Evaluating irrigation system failure--example procedure.

(a) Introduction.

Irrigation systems are subject to periodic failures because of deteriorating structures in the system or because of flooding that originates outside the irrigation service area. This example analyzes an irrigation interruption caused by flooding.

(b) Data needs.

(1) Affected area.

(i) A failure in an irrigation system may affect the entire system or some part of that system. It is critical to establish the irrigated area affected. For example, a siphon failure will affect service area downstream. If a drop-structure fails, it may affect all downstream areas, it may affect areas upstream if its purpose is to maintain water surface elevation for upstream takeouts.

(ii) The extent of the area affected by failures in a specific system should be substantiated from irrigation district records of previous failures. Considerations should include:

-- Stop-gap measures used when a failure occurs. This information should be structure-specific and should be available, again from district records. Information on the cost of these measures as well as their effectiveness is needed.

-- The length of the period the affected area will be without water. Where stop-gap measures are a possibility, this may be a relatively short period. Were these measures have limited effectiveness, the length of the service interruption for some part of the service area may be for the balance of the season or the time required to rebuild the failed structure.

-- District records may indicate that failure is more likely in certain periods. Use this information to modify the seasonal probability. Anything other than a probability of uniform failure throughout the irrigation season would need substantiating.

-- Most crop budget systems would probably limit seasonal breakdown analysis to months. Pre-irrigation and post-irrigation may extend the use season beyond the normal crop season.

(2) Crop damage.

(i) Damage to growing crops is affected by the season of the break and by how long irrigation water delivery is delayed. Crop yield estimates must account for the period of interruption and the possibility that the interruption can occur at any time during the irrigation season.

621.29(b)(2)(ii)

(ii) The cropping pattern on the area served by the system determines the number of crop yield estimates that will be needed.

(iii) The crop yield information should be reviewed with the land users in the irrigation system.

(3) Duration of the interruption of irrigation service.

(i) The economist needs to work with the engineer to determine the length of time needed to restore irrigation water delivery. They will need to agree on the period of interruption for each type of structure in the system.

(ii) Emergency repairs are possible in some instances. Where these are possible they need to be identified. In these situations it may be possible to delay replacement of the structure until after the growing season.

(c) Damage computation. In estimating crop damages caused by interrupted irrigation water delivery, the procedure that follows utilizes the monthly net irrigation requirement,monthly storm distribution, storm frequencies, and number of days required to restore irrigation water delivery. The example shows how this information is used to assess damages:

(1) Specific conditions.

Frequency at which canal loss can be expected = 6%

Number of days required to restore service = 15 days

Monthly storm distribution (percent of annual):

January	0	April	5	July	17	October	3
February	1	May	22	August	10	November	1
March	3	June	33	Sept.	5	December	0

(2) Damageable value.

Land use, yield, and gross income for the area served by the canal:

Crop	Land Use	Yield	Price	Return	Composite Acre Return
	%				
Corn Silage	10	20 ton	$ 7.00	$140	$ 14.00
Sugar beets	20	16 ton	$15.00	$240	$ 48.00
Small grain	10	50 bu.	$ 1.10	$ 55	$ 5.50
Pasture	20	8 AUM	$ 4.00	$ 32	$ 6.40
Alfalfa	40	5 ton	$20.00	$100	$ 40.00
TOTAL					$113.90

(3) Consumptive use requirements minus effective rainfall in inches, by months for the crops in the irrigated area:

Crop 1/	April	May	June	July	August	September
Corn Silage	--	1.52	2.69	4.77	4.65	1.54
Sugar beets	2.00	2.44	1.99	4.01	3.95	2.57
Small grain	--	2.73	2.34	2.20	--	--
Pasture	2.20	2.73	2.34	4.39	4.30	2.82
Alfalfa	2.41	3.03	2.69	4.77	4.65	3.07

1/ Growing season:
Corn Silage: May 15 to Sept. 15
Sugar beets: April through Sept.
Small grain: May to July 15
Pasture : April through Sept.
Alfalfa : April through Sept.

(4) Composite acre water requirement:

Crop	Use %	Apr.	May	June	July	Aug.	Sept.
Corn Silage	10	--	.15	.27	.48	.47	.15
Sugar beets	20	.40	.49	.40	.80	.79	.51
Small grain	10	--	.27	.23	.22	--	--
Pasture	20	.44	.55	.47	.87	.86	.56
Alfalfa	40	.96	1.21	1.08	1.91	1.86	1.23
TOTAL	100	1.80	2.67	2.45	4.28	3,98	2.45

(5) The sum of the monthly composite acre irrigation requirement

= 17.63 inches.

(6) Value added per inch of irrigation water supplied

= $113.90 ÷ 17.63 = $6.46.

(7) Value added per month (in $):

April	May	June	July	August	September	Total
11.63	17.25	15.83	27.65	25.71	15.83	$113.90

(8) Valued added per day (in $):

April	May	June	July	August	September
.39	.56	.53	.89	.83	.53

(9) Damage per composite acre from a 15-day break (in $):

April	May	June	July	August	September
5.85	8.40	7.95	13.35	12.45	7.95

(10) Weighted damage per composite acre:

Month	Damage		Monthly Storm Distribution		Weighted Damage
April	5.85	x	.05	=	0.29
May	8.40	x	.22	=	1.85
June	7.95	x	.33	=	2.62
July	13.35	x	.17	=	2.27
August	12.45	x	.10	=	1.25
September	7.95	x	.05	=	.40
TOTAL					$8.68

(11) Thus $8.68 is the weighted damage per composite acre per failure. The average annual damage from delay in water delivery is equal to number of acres served times damage per acre times the storm frequency required to cause the canal to fail. (This assumes that the breaks from more infrequent storms do not require longer to repair.) If, in the above example this canal serves 1,500 acres, the average annual damages would then be:

1,500 acres x $8.68 x 6% = $781.20

(d) System damage related to erosion or sediment deposition.

Sediment deposition and/or erosion may also adversely affect the operation of certain types of field application systems. This usually occurs when field gradients or field ditches are damaged to the extent that irrigation water cannot be applied. Analysis of losses resulting from lack of water may be evaluated in the same manner as described in the example. In addition, costs of restoring field gradients and ditches should be counted as a damage (also, see §621.38).

(e) System damage related to irrigation structure failure.

For example, erosion may damage a canal as a result of failure of a drop structure. In addition to replacing the structure, certain other work would need to be done to the canal before the system could be returned to operation. However, if with replacement of the structure the normal accumulation of sediment would restore the canal bottom, no damage could be claimed.

(f) Management damage related to irrigation structure failure.

A claimable damage here would be the extra effort and costs incurred by the district to keep the unaffected portion of the system operational.

IRRIGATION QUESTIONNAIRE

Watershed _____ Reach _____ State _____

Respondent _____ Years on Farm _____ Farm Location _____

Interviewer _____ Date of Interview _____

Soil Association or Group _____

1. What is your present method of irrigation? Border ☐ Corrugation ☐ Furrow ☐ Sprinkler ☐ Wild Flooding ☐

2. What crops, including acreages and yields of each, do you normally grow on your farm at present?

Crops	Normal Water Years		High Water Years		Low Water Years		Remarks
	Acres	Yield/Ac.	Acres	Yield/Ac.	Acres	Yield/Ac.	

3. What crops do you give priority consideration when irrigation water supplies are limited? _____

4. How many additional acres of cropland would you irrigate if you had a dependable 80% water supply? _____ (Acres)
(If "None", go to question 7)

5. If a dependable (80%) water supply could be assured, what cropping patterns would you use and what results would you expect:

Crops (by Soil Group or Association)	Acres	Yields/Ac.	Remarks

6. What production practices, such as cultural, fertilization, water management, or other practices, would you need to follow over and above your normal ones, in order to attain these yields? (List each item in the following table)

Practice	Crop	Acres of Use	Remarks

7. What is the average annual operation and maintenance costs of your present irrigation system? $_____

8. What equipment do you now have?

Item Age

General comments and observations.

§621.210 (Continued)

IRRIGATION QUESTIONAIRE

Instructions

Watershed	- Give name of watershed as contained in the watershed application.
Respondent	- This is the person being interviewed and normally will be the person who lives on this farm.
Years on Farm	- Number of years the respondent has lived on or worked this farm.
Location	- Give the mail box address and preferably the legal description of this farm.
Interviewer	- Person conducting the interview.
Date of Interview	- The date this interview is being conducted.
Soil Association or Group	- Denote the soil group or soil association for which these data apply on this farm.
Question #1	- Check the block which denotes the type, or types, or irrigation being practiced on this farm.
Question #2	- Obtain estimates from the respondent on acres farmed and typical yields for normal, high, and low water supply years.
Question #3	- Obtain from the respondent his choices in determining which crops receive preference in rationing a short water supply.
Question #5	- For each soil group or association record the respondent's estimate of acres and yield for each crop.
Question #6	- This information will identify added cost items, over and above project costs, that will have to be incurred by the landowner to realize the full project effects.
Questions #7 & #8	- This information might indicate possible savings in costs as a result of installing the watershed project.
General Comments and Observations	- Specify any other pertinent information which has significance to the evaluation of the project irrigation measures.

PART 622 - WATERSHED PROTECTION

§622.00 Introduction.

(a) This part describes procedures to be used in incremental analysis of land treatment measures included in a water resources project.

(b) The P&G requires identification of one alternative plan that reasonably maximizes national economic development (NED). Procedures used, therefore, are to ensure that only project increments that provide net benefits are included in the NED plan. This requirement applies to land-treatment measures included in a project as well as to structural works of improvement.

(c) The evaluation of land treatment involves the relationship of the reduced physical problems, such as erosion, and their effects on crop yields and production inputs. The relationship between crop yield and soil depth must be determined by agronomists and soil scientists for the soils in the problem area. Crop production inputs must be estimated, and must relate to erosion rates, erosion phase, and change caused by land treatment practices. These relationships must be developed for sheet and rill erosion, wind erosion, and ephemeral gully erosion.

(d) Damage from sheet and rill erosion builds over time; therefore, damage reductions need to be properly discounted.

(e) Runoff from high intensity rainfall can wash soil away from seeds, seedlings, and mature plants, reducing plant populations and crop yields. These damages can occur annually without erosion control practices to protect the soil. Effects of erosion on crop yield and production inputs need to be determined to estimate this damage.

(f) Where ephemeral gully (concentrated flow) erosion causes damage to growing crops, these damages usually occur to some degree each year. Such damage will need to be adjusted to an average annual equivalent if it is established that ephemeral gully development will change over time.

§622.01 Incremental analysis of land treatment.

(a) Although watershed protection projects are not covered by the P&G they should be formulated using incremental analysis. The same concept can be used in dealing with conservation measures in nonproject activities.

(b) The treatment of each evaluation unit will be determined in a practical manner by using incremental analysis techniques. This analysis will not be limited to economic factors, but also will include physical, environmental, and other effects. Independent increments (practices) are to be added in a systematic fashion in order of the greatest return per dollar of cost and contribution to identified problems.

(c) A "practice", as used here, means an independent measure as listed in SCS's National Handbook of Conservation Practices, or a combination of interdependent measures. Measures are considered interdependent when application standards require the simultaneous installation of two or more practices for the unit to function as planned, or to prevent the practice under consideration from creating or magnifying another problem.

(d) All practical land treatment practices that address the problem and are commonly used in the area will be considered in the evaluation. Land treatment practices not adapted to a particular soil, crop, etc., normally should not be included in the analysis. For example, no-till is not appropriate for all crops or on all soils. Land use conversion that would require major changes in farm operation may not be accepted by farmers who historically have grown cash crops. This is not to say that the landowner's desires will govern the evaluation process; rather, common sense will be applied.

§622.02 Procedures for incremental analysis.

(a) The following steps describe accepted procedure for incremental analysis of land treatment measures for SCS watershed protection projects.

Step 1. Make a list of all practices that can reduce the identified problem. Determine the costs and benefits of each. Evaluate one practice at a time as the only applied practice.

Step 2. Select as the first increment the practice that gives the highest benefits per dollar of costs from the array analyzed.

Step 3. Evaluate the remaining practices, in combination with the first practice selected, as they alleviate the remaining problem.

Step 4. Select the system of two practices that gives the highest incremental benefits per dollar of costs.

Step 5. Repeat steps 3 and 4 (beginning the evaluation with the selection just made) until all practices have been included that will provide positive net incremental benefits.

(b) Example:

(1) A 160-acre field, typical of the evaluation unit, has a problem of reduced long-term productivity as evidenced by reduced yields associated with an erosion loss of 30 tons per acre per year. Within this field, 15 acres of land sustains damage from small ephemeral gully formation; 5 acres is affected by large ephemeral gullies; and 900 cubic yards of the eroded soil material is being deposited as sediment in boundary line ditches thus reducing their capacity. The monetary damage associated with sheet and rill erosion is estimated to have a present value of $300 per acre during the evaluation period; the present value estimate of small ephemeral gully damage is $100 per acre; large ephemeral gullies account for $65 per acre in present value terms; and the sediment problem is valued at $55 per acre. Cautionary note - The monetary damages must be expressed in similar terms and per acre of the evaluation unit. In this example, present value amounts are used for damages, benefits, and costs. The example incremental analysis is shown in Table 622-1.

(2) All large ephemeral gullies in this example can be treated with land treatment practices; they do not require water control structures to effect control. As a result, the incremental analysis procedure can account for all the costs and benefits that would occur in treating all causes of the identified problems. If large gullies were present, their treatment would be evaluated and their feasibility determined separately, using procedures for evaluating voiding and depreciation. (See §621.32(a).)

(3) The first iteration shows the incremental effect, both physical and monetary, of each practice separate of other practices. The incremental benefits range from $93 for grass waterways to $353 for the interdependent system of terraces and grassed waterway outlets. The decision criteria for land treatment incremental

analysis is return per unit of cost as shown in the column headed "B/C Ratio". The largest return per dollar of expenditure in this iteration is $9.30 for conservation tillage. Conservation tillage as an applied practice then becomes the starting point for iteration #2.

(4) The first line of iteration #2 displays the extent of the problem that would remain following conservation tillage adoption. The remaining entries in iteration #2 are conservation tillage plus the remaining separate practices. Selection of the second incremental practice is again made on the basis of the B/C Ratio column, in this iteration grassed waterways.

(5) The iterative process is continued so long as the result is a B/C ratio larger than 1.0.

(6) The incremental combining of practices on the basis of the optimum per unit of cost from each successive iteration will result in the NED plan. In this example, the NED plan would be a system that includes conservation tillage, grassed waterways, contour farming, and strip-cropping practices. The net NED benefit in present value amount is $265 per acre of the evaluation unit.

(7) A resource protection plan (RP) for this evaluation would require terracing in addition to the four practices in the NED plan. The net benefits of this plan would be $211 NED benefits plus the environmental quality or other social effects necessary to offset the $54 of excess NED costs.

(8) Table 622-1 should be completed for each evaluation unit in the project.

Table 622-1. Incremental Analysis for Treatment for Treatment Unit No. 2.

CONSERVATION SYSTEM OR PRACTICE	SHEET & RILL EROSION REMAIN (TON)	SHEET & RILL EROSION REDUCT (TON)	SHEET & RILL DAMAGE REMAIN ($)	SHEET & RILL DAMAGE REDUCT ($)	SMALL EPHEMERAL GULLIES EROSION REMAIN (Ac.)	SMALL EPHEMERAL GULLIES EROSION REDUCT (Ac.)	SMALL EPHEMERAL GULLIES DAMAGE REMAIN ($)	SMALL EPHEMERAL GULLIES DAMAGE REDUCT ($)	LARGE EPHEMERAL GULLIES EROSION REMAIN (Ac.)	LARGE EPHEMERAL GULLIES EROSION REDUCT (Ac.)	LARGE EPHEMERAL GULLIES DAMAGE REMAIN ($)	LARGE EPHEMERAL GULLIES DAMAGE REDUCT ($)	SEDIMENT EROSION REMAIN (CuYd)	SEDIMENT EROSION REDUCT (CuYd)	SEDIMENT DAMAGE REMAIN ($)	SEDIMENT DAMAGE REDUCT ($)	INC BEN ($)	INC COST ($)	B/C RATIO	INC NET BEN ($)
Iteration #1																				
No Treatment	30		300		15		100		5		65		900		55					
Cons. Till.	15	15	150	150	13	2	86	14	5	0	65	0	560	340	34	21	185	20	9.3	165
Contour	22	8	220	80	11	4	73	27	5	0	65	0	675	225	41	14	121	30	4.0	91
Strip Crop	18	12	180	120	10	5	66	34	5	0	65	0	610	290	37	18	172	50	3.4	122
Terrace/ww	12	18	120	180	3	12	20	80	1	4	13	52	225	675	14	41	353	170	2.1	183
Waterway	30	0	300	0	15	0	100	0	0	5	5	65	450	450	27	28	93	30	3.1	63
Iteration #2 1/																				
CT	15		150		13		86		5		65		560		34					
CT/CF	11	4	110	40	10	3	66	20	5	0	65	0	400	160	24	10	70	30	2.3	40
CT/SC	8	7	80	70	9	4	59	27	5	0	65	0	360	200	22	12	109	50	2.2	59
CT/TERR.	7	8	70	80	2	11	13	73	1	4	13	52	140	420	9	23	228	170	1.3	52
CT/WW	15	0	150	0	13	0	86	0	0	5	0	65	270	290	17	17	82	30	2.7	52
Iteration #3																				
CT&WW	15		150		13		86		0		0		270		17					
CT&WW/CF	11	4	110	40	10	3	66	20					200	70	12	5	65	30	2.2	35
CT&WW/SC	8	7	80	70	9	4	59	27					180	90	11	6	103	50	2.1	53
CT&WW/TERR	7	8	70	80	2	11	13	73												
Iteration #4																				
CT&WW&CF	11		110		10		66		0		0		200		12					
CT&WW&CF/SC	7	4	70	40	7	3	47	19					135	65	8	4	63	50	1.3	13
CT&WW&CF/TERR	4	7	40	70	2	8	13	53					50	150	3	9	132	140	.9	-8
Iteration #5																				
CT&WW&CF&SC	7		70		7		47		0		0		135		8					
CT&WW&CF&SC/TERR	3	4	30	40	1	6	7	40					35	100	2	6	86	140	.6	-54

1/ The abbreviations used in the table are: conservation tillage (CT), contour farming (CF), strip cropping (SC), Terrace with waterways (TERR), and grassed waterways (WW).

PART 623 - URBAN FLOOD DAMAGE

§623.00 Introduction.

Urban flood damage evaluation is another application of the flood damage analysis presented in Part 621, Subpart A. The evaluation of urban flood damage involves analysis of the physical damage caused by floodwater and net income effects of modifications of floodplain activities, both existing and introduced. NED evaluation procedures in Section IV, Chapter II of the P&G provide the framework for evaluating urban flood damage.

§623.01 Planning.

(a) The evaluation of flood prevention projects involves comparison of without-project and with-project conditions.

(i) The without-project condition is the land use and related condition likely to occur under existing improvements, laws, and policies. Evaluation of the without-project condition must consider existing and authorized plans. It must also consider possible effects of the Flood Disaster Protection act, executive orders on floodplain management and wetlands protection, and individual actions of floodplain occupants.

(ii) The with-project condition is the most likely condition if a specific project is undertaken. There is a with-project condition for each alternative plan.

(b) The magnitude of urban flood damage is defined in terms of damages to residential, commercial, industrial, and governmental occupants of the floodplain. It includes physical damage to buildings and their contents; losses sustained by infrastructure supporting the urban area, income loss by individuals and businesses, and emergency costs necessitated by the flooding. Income losses need to be adjusted to account for activities that are postponed or transferred. Emergency costs should exclude normal operations of such organizations as police and fire departments.

§623.02 Damage factors.

(a) Damage factors express the relationship between structure damage and the value of the structure, or content damage and the value of contents of a structure. Because damage to structure and damage to contents vary with the depth of the flood water, they are stated with reference to specific flood stage above the level at which damage begins.

separate tables for Brick + Frame

(b) The extent to which damages to residences vary by type of construction or the style of structure dictates the number of damage factor tables that may be required in an evaluation. For example, where the damage to frame construction differs from damage to brick contruction, it is necessary to develop damage tables for each of them. Where damages differ between one-story, two-story, and split level residences, it is necessary to have damage tables to reflect each style. The multidimensional matrix (depth, type, style) so defined dictates the number of damage-factors needed.

(c) While records on historical flooding in the project area may reflect both the type and style of houses, it is unlikely that they will represent the various floodwater depth increments. Because of this, standard damage factor tables have been developed. Examples are the Corps of Engineers, (COE), Flood Insurance Agency (FIA), Stanford Research Institute (SRI) and SCS tables. Interviews with occupants of the project area are used to confirm or adjust standard tables to the project area. A summary of these interviews should be included in the I and A report for the project plan. OMB-approved forms must be used for data collection (See Exhibit 623.09).

Standard Tables

(d) It is important that damage factors be developed by house type/style because these variables have a large influence on calculated damages. Damage factors are then input to URB1 computer program damage coefficient (COR-DAMG) tables for each house type/style by stage. Damage coefficient tables use house type/style, value, flood stage, and damage factors as input.

(e) The economist will find it helpful to have a picture of the flood plain, and the properties within it, in the form of a water surface profile sheet. This sheet should show: (1) the stream profile; (2) each cross section; (3) all culverts, bridges and other constrictions; (4) the 100-year water surface profile; (5) each property on the flood plain showing first floor elevation, elevation at which water enters the building and ground elevation; and (6) water surface profiles for the various alternatives under consideration. The horizontal scale should be such that the damage area can be shown on one or two sheets. The vertical scale should be of sufficient magnitude to permit easy reading of water depths above the level at which damage begins for individual buildings.

(f) A stage-damage relationship can now be compiled. Total the damage to all properties at a progressively higher flood stage. Separate relationships should be compiled for residential, commercial, industrial, utility and transportation categories. An example of a stage-damage curve is shown in Figure 621-4.

(g) The following table shows the summation of damage data for various flood depths and related storm frequencies:

Table 623-1.--Reach No. 4, Mauch Chunk Creek

Damages Resulting from Floods of Different Sizes and Frequencies. 1/

Flood stage in relation to flood of 6/15/45	Damage	Peak Discharge	Chance of Occurrence 2/
(feet)	(Dollars)	(c.f.s.)	(Percent)
+ 2	$1,000,000	4,200	Less than 1
+ 1	720,000	3,450	Less than 1
6/15/45	410,000	2,800	1.4
- 1	110,000	2,000	3.2
- 2	10,000	1,500	6.0
- 3	0	1,200	7.5

1/ The procedures illustrated by this table is useful when two conditions exist:

(a) damages to which estimated values apply are normally restored between flood events, and

(b) such damages are only minimally affected by season in which the flooding occurs.

2/ Change of occurrence may be expressed in several ways, each of which may be converted to the other. The term used here should be interpreted to mean the percent chance of a given peak discharge being equalled or exceeded in any one year.

§623.03 Income losses and emergency costs.

(a) Income losses. Damages caused by income loss cannot be based solely on an estimate of physical damage. Interview data are required to estimate floodwater damages resulting from income loss.

623.03(b)

(b) Emergency cost. Damages caused
cannot be based on an estimate of physi
data are required to estimate emergency

§623.04 Commercial and industrial.

(a) Diversity of activity precludes
industrial and commercial damages. Indu
activities in the flood plain require th
establish damage estimates. In additio
recent flood events, it may be necessary
damages from both greater and lesser flo
are to be used (see Exhibit 623.010).

(b) The damage-factor estimate table
by business type. The stage-damage rela
described in the residential section. I
they were house data. Data should be co
property, utility and transportation fac
few properties are involved, the damage-
average annual damages may be establishe

§623.05 Transportation.

See section §621.03 (c)(6) on estimat

(b) In estimating these damages, care must be taken to avoid double counting. For example, if a house is flooded and the family living there loses its clothing, this loss is a damage. The value of substitute clothing supplied by a relief agency would not be an additional damage.

§623.07 Benefit evaluation.

(a) Project evaluation requires a comparison of conditions that would exist over the period of analysis without the project and those that can be expected with the project in operation. Existing properties may (1) deteriorate if repairs are not made following floods, and before succeeding floods occur; (2) be maintained essentially in their current condition over the period of analysis; or (3) be improved. It is important to consider these possibilities in establishing damageable values in the absence of a project. In nearly every project,the damageable value base after project installation will be different from the base at the beginning planning period. In an expanding economy, the values generally will increase; however, adjustments to account for development may involve either increases or decreases in damageable values.

(b) In the Frequency Method, the modified (with-project) discharge-frequency curve, prepared by the hydrologist, enables the economist to prepare a modified damage-frequency curve. The economist can compare this curve and the without-project curve (or original damage-frequency curve) to determine benefits. Modified curves prepared by the economist and hydrologist are necessary for each kind or combination of measure(s) being evaluated.

(c) When substantial improvements are expected in the future without-project situation, it is necessary to consider possible flood plain management regulations. Regulations may require that improvements be protected from a 100-year flood event. In this case, these improvements would not be subject to flood damage even without the project.

(d) Damages to existing properties may be significantly affected by land use changes on areas outside the floodplain. For example, urbanization will cause urban areas and suburban fringes to encroach upon areas now in agriculture or other low intensity use. This will modify the discharge frequency curve and will not only result in more severe damages to properties now subject to damage, but may increase the number of properties subject to damage during the planning period.

(e) A common approach to the problem of estimating changing damages over time is to estimate the eventual degree of change and the period over which the change will occur, and then assume that the change will

take place uniformly over time. This will provide an annual increment of change that can be discounted to present worth and used to adjust average future conditions.

(f) It should be noted that the use of a simple average of current and eventual values is unsound. When damageable values are increasing, the greatest value will be at the end of the time period and will receive the heaviest discount. The average annual equivalent values after discounting will be less than the simple average of values. The reverse is true if damageable values are declining. Also, changes over time may be neither linear nor constant. For example, it would be erroneous to project floodwater problems according to average hydrologic conditions over a 50-year evaluation period if conditions are changing during the period.

(g) It is desirable to show damages and benefits by time frames during the period of analysis if it is determined that changing conditions are better represented by a shorter time frame.

(h) A project alternative that would provide efficient substantial improvement of existing structures is to be credited with benefits equal to the reduced cost of that improvement. Whether floodproofing costs are eliminated or reduced, the benefit to the project alternatives is the difference between the with and without condition.

(i) Flood insurance rates probably would be reduced in such a case. However, the reduction in actuarial estimates of flood damage should be accounted for in the reduced damage analysis. Reduced administrative costs may be claimed as a project benefit.

(j) Project measures may achieve economic efficiencies by providing for orderly urban development at a lower cost than would occur without the project. If new development is to take place in the benefited area with the project installed, that development can take place at a reduced cost of floodproofing. The reduced cost of floodproofing is considered a benefit in those areas where development would have taken place in the problem area even without the project. The remaining damages that would have occurred even with the floodproofing are considered as a benefit.

(k) If new development is expected to take place outside the benefited area without the project, cost savings made possible by locating it in the benefited area are a project benefit. The economic advantages of the flood plain location may include available transportation and communication facilities or a close proximity to associated businesses.

(l) If primary features of a plan are included to achieve efficiencies in urban development, the extent of protection provided by the project should be determined in the economic analysis. It may be assumed that new areas will be protected from the 100-year event in compliance with Flood Insurance Agency regulations whether the project is installed or not. The problem is to find the proper combination of structural measures and floodproofing or land management measures to provide for an urban development that is least costly, least damaging to the environment, and is compatible with existing law. As increments of project measures are added to the plan, the cost of floodproofing is reduced. Plan increments should be added until the cost of floodproofing reduced is less than the cost of the project increment added.

(m) Exclude from benefits the beneficial effects of those nonstructural measures that would exist without the plan and that are not included as plan measures. However, if nonstructural measures are a part of the plan they are evaluated using the same evaluation procedure used to evaluate structural measures; that is, compare the damages with and without the project.

(n) Costs of nonstructural measures for which benefits are claimed should include all foreseeable costs both to individual owners and the public. For example, homes or businesses relocated from the flood plain may be too distant from commercial centers. The increased costs of transportation to the commercial centers for employment, shopping, etc. should be considered. However, these costs should be limited in time to the remaining life of the commercial center. The public service left unused in the old location (schools, streets, utilities, etc.) should also be considered.

§623.08 Computer program.

The evaluation procedures have been computerized for urban floodwater damage determination. The urban floodwater damage economic evaluation (URB1) computer program will compute average annual damages to buildings and contents. The program requires data on damage factors, by flood depth, for buildings and contents of representative houses or other types of buildings.

§623.09 Flood Damage - Residential Properties.

FLOOD DAMAGE - RESIDENTIAL PROPERTIES

Watershed _____ **State** _____

Reach _____ **Interviewer** _____ **Date** _____

Occupant _____

Address _____ **Years lived here** _____

Times residence flooded: No. _____ **Dates** _____

Date of specific flood event _____ **Hrs. of advance warning received** _____

Depth of water in basement _____

Describe source of floodwater (through windows, walls, basement drains, etc.)

Depth of water on or above first floor _____

Depth of water on grounds or lawn _____

Depth of water in garage _____

Depth of water in other buildings _____

Depth of water in automobiles _____

Location of automobiles when flooded

Depth below the above flood at which damages begin _____

§623.09 (Cont'd.)

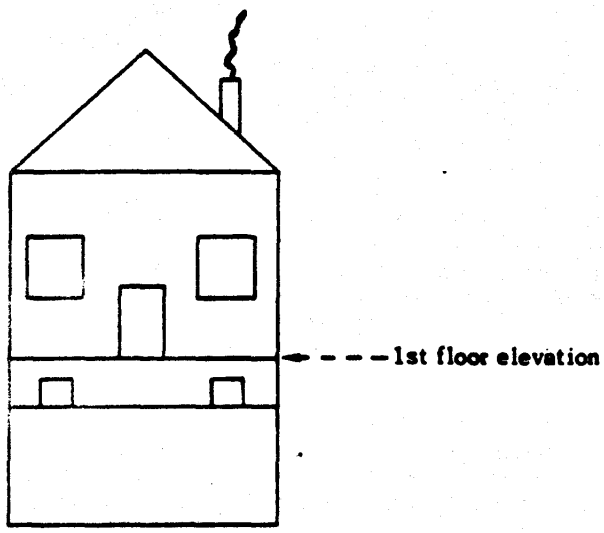
Times residence flooded - **No.** - **Number of times this house has been flooded since you have lived in it.**

Dates - **Month, day, and year of all damaging floods mentioned in the previous**

§623.09 (Cont'd.)

FLOOD DAMAGE – RESIDENTIAL PROPERTIES

Show height of experienced flood stage (depth) on the residence. Denote basement windows and depressed basement entranceways as related to first floor elevation and depth of inundation by specific flood event.



Class of Structure (check one)	Type		
	Frame	Masonry	Other (specify)
Single story, no basement			
Single story, with basement			
Two story, no basement			
Two story, with basement			
Split level			
Mobile home			
Other (specify)			

§623.09 (Cont'd.)

This standard drawing is intended to be used in numerous ways. Any use that can be made of this drawing that serves the enumerator's purpose should be shown. Any penciled modifications, as necessary, should be made.

Class and type of structure (check one)	-	**Check the one block which most accurately describes this residence. If the "other" block under "Type" is checked, specify, by footnote, what this "other" refers to.**

§623.09 (Cont'd.)

FLOOD DAMAGE - RESIDENTIAL PROPERTIES - APPRAISAL

Item	Specific Flood Event and Dates of Stages Above and Below							
	Specific Flood Event							
	Extent of Damage (Dollars)(Specify price base if different from flood year)							
Structure - House								
Outbuildings								
Driveways and walks								
Contents - Basement: Furniture								
Appliances								
Personal belongings								
First Floor: Furniture								
Appliances								
Personal belongings								
Lawn								
Vehicles								
Other (specify)								
Cleanup (Lawns, driveways, basement, floors, etc.)								
Subtotal - Direct Damages								
Emergency measures of evacuation, etc.								
Loss of income								
Other (specify)								
Subtotal - Indirect Damages								
Total Damages								

Size of residence _____ sq. ft.

Market value of residence (do not include lot) $ _____

Replacement value of contents $ _____

Remarks:

§623.09 (Cont'd.)

All information in the body of this table should be in terms of dollar damage estimates. Physical effects should be described in the "remarks" section of the table.

Appraisal of Flood Damages:

Specific flood event and stages above or below	- The specific flood event is the historical flood for which detailed damage estimates are to be recorded in one column of this table. Stages above and below the specific flood event refer to floodwater depths in or at this higher (above) or lower (below) than that experienced from the specific flood event. Stages above and below the specific flood event should, as a minimum, include large, medium, and small flood events. The large flood event should at least equal the 100-year flood. These damage data may be related to the first floor elevation of the house or may be obtained on a frequency-depth of inundation type basis. Use these columns to fit your method of obtaining flood damage for a range of flood frequency events.
Extent of Damage - Dollars	- Give a detailed dollar listing of damage for each identifiable item changed. When damage estimates are obtained from the person being interviewed, it is important to know what year his estimates are related to if other than year of flood.

Indirect Damages:

Emergency measures for evacuation	- Dollar value of labor, equipment, utilities, and time expended in attempting to prevent flood damages from the specific flood event.
Loss of income	- Income lost by occupant and family either to prevent flood damages or for clean-up activities, that has not been accounted for in the direct flood damage estimate above.
Other (specify)	- Name other types of indirect damage which fit under the indirect damage category for this watershed flood plain occupant, such as loss of refrigerated foods due to power failure, added medical costs due to flooding, added travel expenses caused by increased travel route, added living expenses because of flood damage to residence, etc.
Size of residence	- Give approximate living area of home in terms of square feet; e.g., 30′ x 60′ = 1800 sq. ft.
Market value of residence (not including lot)	- Approximate value of house and outbuildings exclusive of the value of the land area (lot) on which they are located.
Replacement value of contents	- Give the approximate cost to the dweller of replacing, with equivalent facilities, the furniture, appliances, and personal belongings normally contained in this home.

§623.10 Flood Damage--Commercial--Industrial.

Watershed _____ State _____ Reach _____

Interviewer _____ Date _____

Type of Business _____ Address _____ Owner _____

Structure:

Construction: Frame ☐ Brick ☐ Metal ☐ Other (specify) _____

Market Value (do not include land) $_____

Size: Basement _____ sq. ft. 1st Floor _____ sq. ft. No. of Floors _____

Value of Contents: (estimated) Basement $_____ 1st Floor $_____ 2nd Floor $_____ Other $_____

1st Floor Storage (per cent stored in relation to elevation):

0.0 - 1.0 ft. _____ % 1.1 - 3.0 ft. _____ % 3.1 - 5.0 ft. _____ % 5.1 ft. and over _____ %

Number of Employees _____ How Often Do Damaging Floods Occur? _____

Date of Flood _____ Type of Flood: Backwater ☐ Flowing ☐

Depth of Flood: Grounds _____ ft. Basement _____ ft. 1st floor _____ ft. 2nd Floor _____ ft.

	Estimated Damages (Dollars)			Remarks
Grounds – Parking lots, walks, signs	XXX	XXX	$	(Loss prevented by evacuation, emergency preparations, etc.)
Lawns, shrubs	XXX	XXX		
Structure – Foundation	XXX	XXX		
Walls	XXX	XXX		
Other	XXX	XXX		
Contents – (Stock)	Basement	1st Floor	Other	
Merchandise	$	$	$	
Equipment				
Records				
Misc. (specify) _____				
Other – Loss of Business	XXX	XXX	$	
Evacuation-Reoccupation	XXX	XXX		
Flood proofing	XXX	XXX		
Employee Wages Lost	XXX	XXX		
Misc.	XXX	XXX		
Totals	$	$	$	
TOTAL LOSS FOR FLOOD				$

Estimated Damages at Higher or Lower Stages Than This Flood

Higher 1' $_____ 2' $_____ 3' $_____ 4' $_____ 5' $_____

Lower 1' $_____ 2' $_____ 3' $_____ 4' $_____ 5' $_____

§623.10 (Cont'd.)

Explanatory Notes

1. Type of Business -- Identify as retail grocery, wholesale drug, lumber yard, music store, toy manufacturing, etc.

2. Market Value of Structure -- This excludes land. Data may be from appraisers, tax records, owners.

3. Value of Contents -- Includes stock, merchandise, equipment, etc. If this varies significantly by season, indicate in Remarks. Prorate by location. Other would include outside or that stored in minor building such as lumber yards.

4. 1st Floor Storage - Percent of contents stored related to elevation -- This should account for 100% of 1st floor contents by height stored above the 1st floor elevation.

5. Number of Employees -- This includes all full and part-time employees. If part-time, identify as such.

6. Damages - Structure -- If repairs not made, estimate damage. If repairs made other than year of flood, indicate year. Includes repainting, redecoration, etc.

7. Damage - Contents -- Other refers to that outside major buildings.

8. Damage - Other -- Evacuation-reoccupation includes moving goods, temporary space leased, etc. Wages lost would be for employee time in which pay was not received. Misc. would include such things as clean-up.

9. Estimated Damage at Higher or Lower Stages -- This to be completed by interviewer, owner or both.

10. Remarks -- Use to clarify any data obtained or additional information not specifically covered.

PART 624 - RECREATION

624.01(b)

§624.00 Introduction.

This part deals with the evaluation of water based recreation provided by resource projects. Evaluations are concerned with the amount of recreation provided and the relative desirability of those experiences in the individual setting and in the general context of alternative recreational opportunities.

Absence of a general market-established price for recreation activities poses problems for the evaluator. Three methods described in the P&G may be used to determine a surrogate value for recreation market prices. They are the Travel Cost Method, the Contingent Valuation Method, and the Unit Day Value Method. The preferred method for SCS use, the Unit Day Value Method, is summarized in this Part.

§624.01 Definition of concepts.

(a) Willingness to pay as a measure of benefits. The P&G specifies that the value of increased output of goods and services is to be measured in terms of willingness of users to pay for each increment of output provided. The concept of "willingness to pay for recreation benefits" concerns payment by participants for the use of specific recreation sites. Willingness to pay includes entry and use fees actually paid. It also includes an estimate of the maximum amount, in excess of these charges, that users could be induced to pay (consumers surplus). It is not appropriate to include payment for costs associated with recreation, such as equipment, food, travel, or lodging that may be made in conjunction with the recreation experience, because these payments are not specifically for use of the site.

(b) Consideration of gains and losses. The addition of recreation facilities to existing lakes, natural areas, or other attractive locations generally will increase recreation use and value. Evaluation procedures must account for recreation gains, and also for recreation losses that may occur as a result of the project. P&G also indicates that recreation gains occurring because of substitution among types of activities or transfer from more distant areas to the project site should be considered.

§624.02 Planning.

(a) With- and without-project concept. Changes in recreation use and value associated with alternative plans should be determined by analyzing the with- and without-project conditions. The with-project condition is the pattern of recreation activity expected throughout the period of analysis with a recreation plan or project. The without-project condition provides the basis for benefit determination of the with-project condition. The without-project condition includes existing water and related land recreation resources, and recreation resources being developed or likely to be developed during this period in the absence of the project.

(b) Criteria for recreation valuation procedures. To provide for the efficient allocation of resources, procedures for estimating the contribution of recreation to national economic development should meet the following criteria:

-- The evaluation should be based on an empirical, objective, and reproducible estimate of demand applicable to the particular project.

-- Estimates of value should be consistent with, and have a level of precision similar to, the estimates of value derived for other goods and services produced by the project.

-- Procedures should be readily applicable to evaluating proposed changes in specific recreation opportunities affected by the project being analyzed. This includes opportunities likely to be created or eliminated by alternative plans.

-- Estimates of recreation demand should reflect socioeconomic characteristics of market populations, qualitative characteristics of resources under study, and characteristics of existing alternative recreation opportunities.

-- Value estimates for existing recreation opportunities are useful if the analysis is used to value a proposed change in the availability of similar opportunities. Valuation procedures should be readily applicable to proposed alternatives involving recreation of differing qualities, for which there may be a range of available substitutes and potential users.

-- Individuals who have access to a rang of highly desirable recreation alternatives will presumably be willing to pay less for use of a particular area than individuals with fewer and less desirable alternatives. Consequently, the values derived should reflect the availability of a number of alternatives.

-- The underlying determinant of recreation value should be willingness to pay projected over time.

§624.03 Evaluation methods.

(1) Three evaluation methods identified in the P&G are the Travel Cost Method, Unit Day Value Method, and Contingent Valuation Method. To determine the appropriate method, see pages 68-69 of the P&G.

(b) For most SCS projects, the unit day value method will generally be used unless:

-- An available regional recreation model may be applicable to the project;

-- Specialized recreation activities are involved;

-- Estimated annual use exceeds 750,000 visitors; or

-- Annual Federal recreation costs exceed $1,000,000.

However, this does not preclude use of the travel cost or contingent valuation methods where they are possible, suitable, and cost effective in the planning process.

§624.04 Recreation evaluation procedures.

(a) The evaluation procedures provide the basis for estimating recreation use, estimating recreation value, and computation and display of recreation benefits.

(b) Four approaches are outlined in the P&G for estimating recreation use for with-project and without-project conditions. They are: regional use of estimating models; site-specific use estimating models; application of information from a similar project; and capacity method of determining use. Use of any other method should conform to characteristics listed in 2.8.2(b) of the P&G. Estimates of use should include the following information:

624.04(b)

-- Delineation of the market area from which most user will originate;

-- Estimates of the socioeconomic characteristics of the market, including the area's population and per capita participation rates;

-- Evaluation of the quality (attractiveness) of the proposed site in comparison to the quantity and quality of similar recreational alternatives available to the population of potential users;

-- Estimates of changes in use at existing recreation sites; and

-- Projected population growth to support benefit estimates that include a buildup over the future.

§624.05 Basic data.

(a) Sources of data. Planning staffs use several methods to estimate recreation use. State staffs may use, for example, the Statewide Comprehensive Outdoor Recreation Plan (SCORP) which frequently provides useful information on visitations, participation rates, population, inventory of sites and facilities, and projected demand. Useful contacts for information are the state or local agency responsible for recreation planning; State university extension specialists or professors who specialize in resource economics; and cooperating agencies such as the Forest Service, Fish and Wildlife Service, Corps of Engineers, National Park Service, or Bureau of Reclamation. In addition, the U.S. Census Bureau has population data that can be arrayed by origin areas with respect to any given point, such as comparable recreation sites.

(b) Problems in estimating recreation use.

(1) Three common pitfalls to avoid in estimating recreation use are: double counting activities, failure to consider the availability of substitute sites, and assuming that recreation use will automatically equal capacity of physical facilities.

(i) When total use estimates are aggregated from specific activity data, it is important to avoid double counting because many users engage in more than one activity. One way to avoid double-

counting is to estimate the total recreation use and then disaggregate to specific activities. Another way is to sum estimates of use by activity and then divide by an empirically based factor of multiple daily activities.

(ii) Lack of consideration of possible shifts from existing facilities is a common problem in recreation evaluation. If recreation use at a proposed reservoir results in less use of existing reservoirs, the loss in value at existing reservoirs must be subtracted from the value of use at the proposed site to derive the net increase in national income benefits. This is only necessary if the method chosen to estimate use does not account for substitute sites. Regional use estimator models generally include this adjustment. Planners making estimates of use at the proposed site must address this problem and evaluate what is likely to happen at existing sites considering the determinants of future net recreation demand for the proposed site; i.e., number and quality of sites, distance, population, etc. The same process is to be used for projects without reservoirs.

(iii) The third problem arises where the planner assumes that physical facilities always generate recreation demand. This problem can be avoided by making a sound analysis of recreation demand in the market area and documenting all cases where excess demand is found to exist. Otherwise, recreation use should be developed using a site specific or similar project use estimating model, as described in the P&G.

(2) Additional details and guidance for estimating recreation use are available from recreation specialists at the national technical centers.

§624.06 Estimating recreation value by the unit day value method.

(a) Advantages and disadvantages

(1) Of the three methods P&G recognized for estimating recreation value, the Unit Day Value (UDV) procedure has been most commonly used in SCS because of the typical size of recreation benefits created or displaced and the nature of activities affected by SCS assisted projects. (Section 2.8.2 of the P&G should be consulted to determine if the UDV method may be used.)

624.06(a)(2)

(2) The UDV method is considered to be the easiest to construct of the three available methods. It does have disadvantages. Two of the more common criticisms of UDV are: (i) ranges of values per user day for generalized and specialized recreational experiences have no empirical basis and (ii) separate use estimates associated with UDV often fail to account for the determinants of recreation demand such as substitute sites and cost of participation.

(3) The UDV method is advantageous because it is easy to use and does not require extensive primary data. However where data or use-estimating models are available, use of the travel cost method should be considered--particularly for larger recreation developments and where recreationists could be expected to come from more distant locations.

(4) The range of unit day values for fiscal year 1982 published in the P&G are shown below:

	P&G
General recreation	$ 1.60 - $ 4.80
Specialized recreation	$ 6.50 - $19.00

The values given in the P&G are to be updated annually in proportion to the change in the consumer price index from the July 1982 base value. The index factor will be published annually by the SCS's Economics and Social Sciences Division.

(5) "General" refers to a recreation day involving primarily those activities that are attractive to the majority of outdoor users and that generally require the development and maintenance of convenient access and adequate facilities. Examples include swimming, picnicking, and fishing. 'Specialized' refers to a recreation day involving activities where opportunities in general are limited, intensity of use is low, and a high degree of skill, knowledge, and appreciation of the activity by the users may often be involved. Whitewater boating and inland salmon fishing are examples.

(6) The planner may have some difficulty in selecting a specific unit value from this range. One means of solving the problem is to use the point assignment matrix in the P&G (page 85-86) where specific criteria and standards are applied to the proposed project.

(b) Point rating system.

(1) The UDV method's point rating system systematically evaluates the proposed project in terms of generally accepted criteria and judgment factors that reflect relative values, thus serving as a proxy for willingness to pay by recreationists.

(2) The criteria and their relative weights as included in the P&G are:

-- Recreation Experience	30
-- Availability of Opportunity	18
-- Carrying Capacity	14
-- Accessibility	18
-- Environmental Quality	20

(3) Recreation experience means the number and quality of the activities available at the site. The availability of opportunity measures the substitutes at various travel time distances that may be available to the recreationist. More alternate opportunities would generally mean less willingness to pay for the site being evaluated. Carrying capacity refers to facilities available at the site. Accessibility means the extent of roads, and access to the site and within the site. Esthetic factors (such as water, vegetation, geology and topography) are measured by environmental quality criteria.

(4) Specialized recreation uses the same criteria and similar judgment factors. However, the recreation experience criterion places a premium on the absence of crowding and interference by others.

(5) Proper application of the point assignment method requires a clear specification of the development being evaluated. It is also necessary for independent reviewers to apply the method using common information about the site, the market area, and other factors. Narrative statements by each reviewer to support judgments would be helpful documentation. It may be possible to involve the public in the value determination process, particularly where local interest is high and where unique resources are involved. The forms shown in §624.09 and §624.010 are handy means for recording individual and summary valuations.

(6) The point assignment matrix, criteria, judgment factors, and point distribution are consistent among the major Federal water and resource agencies. Therefore, when this method is used, changes to the matrix should not be made unless approval is received.

(7) Once points have been tallied,they may be converted into dollar values using a conversion table as shown in the P&G, Table VIII-3-1. This conversion table is update to reflect changes in the consumer price index over time.

§624.07 Incremental analysis.

(a) Incremental analysis of recreation is a six-step procedure:

(1) Estimate recreation use for the indicated mix of recreation activities.

(2) Apply the point rating system recursively for each general and specialized activity. Include activities technically suitable for the site, even ones other than the local sponsors' interests. For example, camping should be considered even though local sponsors may be interested only in fishing, swimming, and picnicking.

(3) Estimate the costs attributable to each activity, using standard procedures for estmating separable costs. Express costs on an annual equivalent basis comparable to the benefits being estimated.

(4) Convert the point rating to a dollar value and apply to the estimated recreation visitor days for each activity. Rank activities in order of highest B/C ratio. Select the activity with the highest B/C ratio as the first increment.

(5) Apply the point rating system to each of the other activities as they might each be paired with the first increment. Convert to a dollar basis and apply to estimated recreation visitor days for the paired activities. Again rank in order to the highest benefit cost ratio. Select the highest as the second increment.

(6) Apply the point rating system for each of the remaining activities, and so on until the mix of activities is exhausted. Each iteration will add another activity to the mix as benefits are found to exceed costs.

(b) While this procedure uses activities as increments, some economies or diseconomies of scale effects may also be evident due to overbuilding or underbuilding an activity.

§624.08 Reporting benefits.

(a) Determination of recreation benefits reported in the plan report requires careful consideration of three additional issues:

(1) Displaced recreation use and diminished value that may result from the project,

(2) Use levels below capacity on existing water bodies, and

(3) Discounting and annualization of recreation benefits.

(b) When recreation is a project purpose, the analyst should project the diminished recreation use due to physical displacement. Examples include inundation by reservoirs and loss of land/water recreation through channel modification. The same procedures used in forecasting recreation use should be used to estimate possible displacement. The value of diminished use is to be determined using the method used to value the recreation experience.

(c) The P&G states that if excess capacity for any recreation activity exists in the study area, benefits must be limited to user costs savings plus the value of any qualitative differences in recreation. Table 2.8.14-1 in the P&G should be used to reveal excess capacity.

(d) Project benefits must be annualized using normal discounting procedures. However, recreation facilities frequently are installed well into the construction phase, so some lag in accrual of benefits is likely. Also, a typical year of recreation use and value is likely to occur only after a buildup period.

(e) NED benefits are the average annual value of recreation less the average annual value of the adjustments determined for (b) and (c).

§624.09 Benefit Evaluation Worksheet.

(UNIT DAY VALUE METHOD)

Site No. _____

Watershed _____

County _____
Recreation

Check one:

_____ General Recreation

_____ Specialized

Criteria

	Point Value Assigned	Basis for Point Value
Recreation Experience	_____	_____
Availability of Opportunity	_____	_____
Carrying Capacity	_____	_____
Accessibility	_____	_____
Environmental Quality	_____	_____

Total Point Value Assigned _____

Remarks _____

_____

_____

_____

Rater

Name _____

Agency _____

§624.010 Benefit Evaluation Summary Worksheet.

(UNIT DAY VALUE METHOD)

Points Assigned by Rates (3 or more) 1/

Criteria	Unit Values 2/				
	1.	2.	3.	4.	Ave.
	G S	G S	G S	G S	G S
Recreation Experience 30 points					
Availability of Opportunity 18 points					
Carrying Capacity 14 points					
Accessibility 18 points					
Environmental Quality 20 points					

Total _____

Rater (name)

1. _____ 3. _____

2. _____ 4. _____

1/ Representatives of Service, USFWS, Sponsors, local agencies, etc.

2/ G - General Recreation - Picnicking, camping, biking, riding, cycling, fishing and hunting of normal quality.

S - Specialized Recreation - Activities that are not common to the region and/or nation and those that are usually of high quality.

PART 625 - MUNICIPAL AND INDUSTRIAL WATER SUPPLY

625.02(a)(1)(i) revised in circular 4

§625.00 Introduction.

Although the SCS does not participate in cost sharing for municipal and industrial (M&I) water supply projects, the service does review evaluations by organizations sponsoring M&I water supply purposes as a part of a project plan. (Comprehensive evaluation procedures for M&I water supply projects are discussed in section 2.2.1-14 of the P&G.)

§625.01 Evaluation responsibilities.

(a) If a project provides for municipal or industrial water supply, sponsors must furnish an estimate of the benefits to be derived from this segment of the project.

(b) Sponsors customarily hire consulting engineers who study the water supply needs and supply alternatives (considering the yield and quality of water supply), estimate costs, evaluate expected benefits, and recommend a solution to the water supply problem.

(c) SCS does not estimate the need for, or the benefits to be obtained from, inclusion of water supply for municipal or industrial use in a project. SCS, however, is responsible for checking estimates provided by local organizations to make sure that benefits are realistic.

§625.02 SCS analysis.

(a) Date requirements.

(1) Data furnished by sponsors.

(i) Sponsoring organizations are responsible for furnishing most of the data necessary to evaluate the need for municipal and industrial water supply. This includes hydrologic, geologic, and economic information. The sponsor is responsible for estimating future demands based on population and industrial expansion and determine water use projections. The projections of water requirements should be provided in a time frame analysis (see tables 2.2.14-1, 2, and 3 of the P&G).

(ii) The adequacy of the sponsor's alternative plan to meet M&I water supply needs can be determined after consideration of water yield, evaporation, and seepage losses at the site of the improvement. Ordinarily, the sponsor's consulting hydrologist prepares a water budget for a critical period to make this determination.

(iii) Sources of watersupply should be examined by the sponsor to determine the least costly alternative to a federally assisted plan that will provide an equivalent water supply, both in quantity and quality to a common delivery point. Normally, one of the alternatives available would be storage at the sites being considered for the federally assisted plan. The alternative cost is usually greater than M&I components of the multipurpose structure being considered.

(iv) Smaller sponsoring communities may not be able to afford development of cost estimates for alternative water supply systems. In those communities, sponsors may analyze the updated cost of water supply systems in municipalities of similar size in the region and estimate alternative costs or willingness to pay using the average of those costs.

(2) Data accumulated by SCS.

(i) SCS must have sufficient data to fulfill its responsibility for checking estimates made by the sponsoring organizations. The water yield at the site should be determined with sufficient accuracy to provide reasonable estimates of the supply, particularly during critical periods.

(ii) Information on water supply needs and the costs and benefits from water supply developments in comparable areas provides a convenient benchmark for SCS appraisal of estimates submitted by the sponsoring organizations.

(b) Benefit determination.

(1) Municipal and industrial water supply is considered to be economically justified if it supplies water at no greater cost than the most likely alternative source that would be used in the absence of the project. If an alternative source is not available or it is not economically feasible, benefits may be estimated by using the average cost of raw water from water supply projects planned or recently constructed in the general area or region. Therefore, the value of water is not necessarily what it costs in that specific community. If the cost becomes too high, further development is handicapped. The cost may become so excessive that it causes

migration to an area where costs are lower. This is especially true of water for industrial use. Information on costs of water in similar situations is helpful in estimating the upper limit of justifiable water costs.

(2) The sponsoring organization's estimate of benefits may include only the benefits from the multiple-purpose development. On the other hand, it may include the benefits from the entire water supply system, including facilities for storage, purification, and distribution. In all cases, SCS must ascertain what is included before it can judge the validity of the estimate. If benefits are dependent upon features other than the project facilities, the cost of providing, operating, and maintaining the additional features must also be included as associated costs.

(3) For communities with a population of 10,000 or less, the alternative cost of providing a water supply may be extremely expensive on a per capita basis because smaller communities lack the efficiencies of large-scale development. Since these communities may not be able to afford an alternative water supply comparable to the federal plan (see 2.2.12 of the P&G), that alternative should not be used as the basis for evaluating the benefits of the federal water supply plan. In this case, the benefit may be considered equal to the cost of the separable M&I facilities plus an appropriate share of the remaining joint cost of the project (See Part 631 - Cost Allocation). This option may require that project cost be allocated using the separable cost-use of facilities method.,

(c) Deferred use of M&I water supply. A watershed project may provide for construction of facilities to meet future municipal or industrial water needs, with repayment deferred for 10 years or until use of the water begins. Under this repayment plan, costs are incurred during project installation but water supply benefits are deferred. Consequently, benefits must be discounted for their lag in accrual.

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PART 626 - OTHER DIRECT BENEFITS

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PART 626 - OTHER DIRECT BENEFITS

626.03

§626.00 Introduction.

Other direct benefits in the NED benefit evaluation of a water resource project are the incidental direct effects that increase economic efficiency but are not otherwise accounted for in the evaluation of a plan. They are incidental to the purposes for which the water resources plan is being formulated and include increases in output of goods and services and reductions in production costs.

§626.01 Planning.

Standard evaluation procedures involve comparison of with-project conditions to the without-project conditions. In considering "other direct benefits," define the boundaries of the plan as they relate to the purposes for which the plan is being formulated. Economic efficiency gains to producing firms and gains to consumers other than those identified as the direct beneficiaries of project purposes should be valued and measured as other direct benefits.

§626.02 Evaluation procedure.

When applicable, compute "other direct benefits" according to procedures for measuring benefits in this Handbook. That is, incidental irrigation is to be evaluated by procedures in Part 621, Subpart C; incidental recreation is to be evaluated by procedures in Part 624. Some benefits, such as reduced costs for water supply treatment can be computed on the basis of reduced cost.

§626.03 Limitations on use.

Other direct benefits are incidental to the purposes for which the plan is being formulated and, therefore, they are not used in plan formulation, nor are they included as beneficial effects in incremental analysis.

§626.04 Problems in application.

A significant problem encountered in estimating other direct NED benefits is identifying businesses and consumers who will be affected by these incidental benefits and costs. It is not practical to attempt to trace all incidental benefits. Determining the relevant context or system within which other direct benefits might occur is a useful first step in delineating measurable incidental impacts.

§626.05 Reporting procedure.

Other direct benefits should be identified individually and compiled as part of the benefit-cost analysis. Methods used to value benefits should be presented and a tabular breakdown provided for all other direct benefits claimed for the project.

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PART 627 - EMPLOYMENT BENEFITS

627.02

§627.00 Introduction.

This part describes evaluation of employment benefits that may be expected from the construction or installation of watershed protection or flood prevention projects.

§627.01 Background.

(a) The use of otherwise unemployed or underemployed resources for the installation of project measures should be treated as an adjustment to costs. The resource has no real opportunity cost to society because it would be unemployed without the project. It is a "free" good to society. However, because this approach leads to difficulties in cost allocation and cost-sharing calculation, P&G permits effects from the use of these resources to be treated as an addition to benefits resulting from the plan.

(b) P&G limits the use of employment benefits to the employment of otherwise unemployed or underemployed labor used for project construction or installation located in an eligible area. Only those people employed onsite in the construction or installation of a project or a nonstructural measure should be counted.

(c) NED benefits for employment of unemployed labor can only be claimed in areas were substantial and persistent unemployment exists at the time the plan is submitted for authorization. (Areas of substantial and persistent unemployment are defined at 2.11.1 of the P&G)

§627.02 Evaluation procedures.

Specific evaluation procedures are detailed in a five-step process in the P&G (See section 2.11.4). When project measures are wholly or partially located in eligible areas, those procedures will be used for the NED benefit evaluation of employment benefits.

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PART 628 - REGIONAL BENEFITS

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PART 628 - REGIONAL BENEFITS

628.02(c)

§628.00 Introduction.

This part discusses the general effects that an alternative project plan may have on a region significantly affected by a water project. Two measures of effects are usually assessed--regional income and regional employment. Regional Economic Development (RED) benefits are reported for only the significantly affected region and the rest of the Nation.

§628.01 Regional benefits.

(a) The positive effects of a plan on a region's income are equal to the sum of NED benefits that accrue to that region, plus transfer of income from outside the region.

(b) The region is defined for the RED account, so that all or almost all of the NED benefits for the plan will accrue to that region.

(c) Income transfers to a region as a result of a plan include income from implementation outlays, transfers of basic economic activity, and indirect and induced effects. In each case income transfers refer to new income within the region rather than to increases in total expenditures.

§628.02 Regional costs.

(a) The negative effects of a plan on a region's income are equal to the sum of NED costs borne by the region, plus transfers of income from the region to the rest of the Nation.

(b) The NED costs of the plan borne by the region should be organized in the same categories used in the cost section of the NED account. Information from the cost allocation and cost sharing sections of the plan will be needed to estimate regional costs.

(c) Income transfers from the region include net income losses from plan-induced shifts of economic activity from the region to the rest of the Nation and losses of existing transfer payments.

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PART 629 - LAND, EASEMENTS AND RIGHTS-OF-WAY

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PART 629 - LAND, EASEMENTS, AND RIGHTS-OF-WAY

629.01(a)(2)(ii)

§629.00 Introduction.

Responsibility for estimating the value of land, easements, and rights-of-way rests with the local sponsoring organization. The SCS only tests the reasonableness of the estimate to ensure that all economic costs of land, whether purchased or donated, are included in the project cost.

§629.01 Landrights.

(a) Fee title.

(1) Fee title is an absolute ownership of property. Landrights, which maybe conveyed to the local sponsoring organization by fee title, are often difficult to evaluate on a fair market basis because of the change in demand and supply of land for sale in project areas, varying land use, the effect of landrights on surrounding land, and other variables. Federal and state laws have established that no private property may be taken for public purpose without payment of just compensation. The courts have held that just compensation means the fair market value of the property rights taken, plus damages, if any, to the remaining property. The courts have also said that the landowner should be in the "same pecuniary position" before and after the taking.

(2) Land obtained in fee title for public purposes may be secured either through negotiation or condemnation proceedings.

(i) Negotiation. Land may be secured through private negotiation between the sponsors and the land owner. Such proceedings normally involve a willing buyer and seller.

(ii) Condemnation proceedings. The right of eminent domain is a power of government to take private property for public use without consent of the owner. When unable to obtain landrights by negotiation, many local governments have the authority to institute condemnation proceedings. Procedures for condemnation of land depend upon applicable statutes, with methods of determining values varying somewhat from one legal jurisdiction to another. The determination of just compensation is generally made by a jury or by the court. Through the years, court decisions have established the meaning of just compensation as being the fair market value.

629.01(a)(3)

(3) Fair market value. Fair market value is the amount that would be paid be a willing buyer, not compelled to buy, and accepted by a willing seller, not compelled to sell.

(b) Easements.

(1) Easements are distinguished from fee title because they do not transfer property ownership. An easement is any of several rights to which one may have ownership. Put another way, an easement is any of several rights which one may have over another's land.

(2) Easements are fractional property rights and involve the transfer of something less than all of the rights inherent in absolute fee ownership. Because some residual value remains with the owner, the value of an easement is some amount less than the market value of the property.

§629.02 Methods of estimating values.

Three basic approaches may be used for evaluating land and allowances for land improvement.

(a) Market data approach

(1) The market data approach is most often applied to determine fair market value of farm land. This method involves comparisons of market values of similar land at current prices. Considered in this method are those factors that affect land prices, such as speculative interest; land zoning regulations; special easements or tax evaluations; and accessibility to farm commodity markets, roads, schools, and related cultural facilities.

(2) Qualified land appraisers, real estate agents, local loan agency officials, etc. are prime sources of assistance in estimating fair market values.

(b) Capitalized value of net income.

The income capitalization method is based on productive capacity of the land and involves an estimate of net income accruing to the land and the choice of a capitalization rate. Where cash rental or leasing is common, this determination is relatively simple. The capitalized rate should be at the average interest rate for real estate mortgage loans and for land sales contracts in a fairly wide area. Caution should be exercised in placing too much emphasis on the capitalized value of land since many uncertainties are involved in its computation.

(c) Cost approach.

(1) The cost approach is a partial analysis where price is determined through the cost of separate components of land. When farm improvements are of such a nature that no sales or income data are available, it may be necessary for them to be evaluated separately from the land by using the replacement cost less depreciation.

(2) Cost estimates of onfarm improvements such as buildings, public utilities, oil or gas pipelines, highways, bridges, and railroads generally can be prepared on the basis of relocation in kind, modification, or salvage costs.

(3) Where land values are determined by potential use of urban-industrial, commercial, or residential use, additional factors must be considered. In the absence of known sales of similar land, values set above those reflecting present land use would have to be based on the early likelihood of changed use, and the location and desirability of the property. The economist may also wish to interview several owners of the land to assess its asking price, or to consult local real estate appraisers.

§629.03 Economic evaluation.

(a) Land, easement, or rights-of-way costs should reflect values of the landrights acquired without adjustment for offsetting benefits. Included would be landrights values based on either market values or income losses, time and travel expense associated with the acquisition of landrights, legal fees, recording fees, and other incidental expenses. (See 2.12.5(b) of the Principles and Guidelines).

(b) Landrights to be evaluated for reservoirs should be limited to the area used by the dam, emergency spillway, storage area, borrow area, and/or areas of siltation above the pool elevation under special circumstances. Where recreational or fish and wildlife development is included as one of the project purposes, additional landrights will be required to ensure public access and enjoyment of associated facilities.

(c) Flowage easements may be needed if release rates from structure or channel improvement cause prolonged submergence or temporary high peaks which induce damage.

(d) In projects formulated for rehabilitation of an existing system, a landrights cost will not be estimated on that land area now serving the purpose for which the project is formulated. Additional lands, beyond those used for or used to service the facility, will be valued at fair market value. These additional lands may be needed for disposition of spoil, as construction easements, or for enlargement of the existing facility.

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PART 630 - COSTS

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PART 630 - COSTS

630.01(a)(3)

§630.00 Introduction.

(a) Economic analysis involves the comparison of costs of a project with the benefits that it produces. This may be done by capitalization of period benefits and costs to place them in the same terms as capital outlays. Alternatively, the comparison may be made by converting capital sums to their annual equivalent through amortization.

(b) Costs may be divided into two main groups-- project costs and associated costs.

(c) See National Watershed Manual, Part 501, Subpart D and P&G, Chapter II, Section XII.

§630.01 Project costs.

These costs include all costs incurred in project installation, operation, and maintenance.

(a) Installation costs.

(1) Included in project installation costs are all costs of construction. These include design, engineering, inspection, and an allowance for contingencies. Also included are the value of lands, easements, rights-of-way, and the cost of relocating facilities that must be moved because of the installation.

(2) At times, sites may be purchased. In such cases funds expended are a measure of cost. In other cases, the value estimated by the local organization, with the concurrence of the SCS, will be used for determining the value of the site. Even when sites are donated, there usually is a cost to someone, although this may be offset in whole or in part by incidental benefits from the new use of the site. Some of the considerations inherent in site cost evaluation are discussed in Part 629, Land, Easements, and Rights-of-Way.

(3) Installation costs are capital expenditures incurred during project installation. To maintain the necessary relationship with prices used for the computation of benefits, current price levels should be used. For purposes of comparison with project benefits, installation

costs are amortized over the period of analysis. Although not usually applicable to flood prevention projects, salvage values are appropriate deductions from the installation cost.

(4) In some cases, project installation my induce damage to fish and wildlife resources. Whenever induced damages are caused, costs are usually incorporated into the project analysis for improvements to mitigate these damages.

(b) Operation and maintenance costs.

The cost of maintaining works of improvement in such a condition that they will deliver the full benefit for which they were designed is another cost component. Maintenance costs may vary from year to year. However, in economic appraisal the best estimate that can be made of average costs over the period of analysis should be used. Normally, the longer the project life, the greater the allowance for project maintenance. Sometimes a project will have facilities that are designed to be replaced during the life of the project. The original cost of these facilities will be included in the project installation cost and amortized over the project life. Provision for replacement will be made by including sufficient funds for this purpose in the maintenance cost of the project.

(2) Another item of annual cost is operation of the works of improvement. Drop inlets for floodwater retarding structures that operate automatically may have minimum operating costs. However, when manually operated gates and similar types of equipment are involved such costs can be considerable.

(c) Other direct costs.

These costs include all uncompensated adverse effects in goods and services associated with the construction or operation of a project.

(1) A typical example would be the loss in production on lands taken for project purposes that is in excess of the payment or estimated easement value. Thus if the estimated amortized easement value is $5,000, but the loss in agricultural production is $6,000 annually, the difference $1,000 annually, is an other direct cost and should be included with project costs.

(2) If channel improvement or other similar waterflow-control measures are terminated so that they cause floodwater, sediment, or erosion damages downstream, such damages should be considered as induced by the project. Sometimes flowage easements may provide a financial measure of these costs. If such costs are not adequate, the excess would be a form of other economic costs of the project.

§630.02 Associated costs.

(a) Associated costs are the value of inputs, over and above project costs, that are required to realize output levels claimed for the project. In the accounting process the value of these inputs usually is accounted for by deductions from benefits.

(b) In agricultural water resource projects, associated costs normally are onfarm measures that allow the use of land and water resources at or near their potential. For example, in irrigation projects the onfarm ditch system that allows delivery of project water to individual fields would be necessary and its cost would be an associated cost.

(c) Where municipal water supply is a project purpose the cost of water treatment facilities needed to filter and purify project water would be an associated cost.

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PART 631 - COST ALLOCATION

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PART 631 - COST ALLOCATION

§631.00 Introduction.

(a) This part discusses procedures for cost allocation in connection with the development of water resource project plans.

(b) Public Law 83-566, as amended, authorizes the Secretary "to make allocations of costs to the various purposes, and to show the basis of such allocations and to determine whether benefits exceed costs." National policy directs that in allocating total project financial costs among the purposes served by the plan, "separable costs will be assigned to their respective purposes, and all joint costs will be allocated to purposes for which the plan was formulated."

(c) It is important to recognize the distinction between cost allocation and cost sharing. Cost allocation pertains to works of improvement serving more than one purpose. It is the process of dividing costs of the structure equitable among the purposes served, with each purpose receiving its fair share of the advantage resulting from multiple purpose installation. Cost sharing is the division of the cost allocated to each purpose to the financing agencies or groups involved.

(d) In SCS water resource projects, costs of the works of improvement are shared between federal and local funds.

(e) The need for allocation stems from cost-share rates that vary among purposes.

(f) Although either annual equivalents or capital costs can be used in allocations, it is SCS policy to use capital costs.

§631.01 Definition of terms.

(a) Financial costs.

Financial costs are implementation outlays, transfer payments (such as assistance payments for replacement housing) and the market value of contributions in kind.

631.01(b)

(b) Separable cost.

The separable cost for each purpose is the difference between the cost of a multiple-purpose project and the cost of the project with that purpose omitted. In calculating separable cost, each purpose should be treated as if it were the last addition of the multiple-purpose project. This calculation will show the added cost of increasing project size, changes in design, or other factors that would be necessary to add the purpose to the project.

(c) Joint cost.

Joint cost is the difference between the cost of the multiple-purpose project and the sum of the separable costs for each purpose.

(d) Alternative cost.

The alternative cost for each purpose is defined as the least cost method of achieving, by use of a single purpose project, the same or equivalent benefits that accrue to that purpose in the multiple-purpose project. The alternative single-purpose plan should be realistically devised, e.g., it should be one that could be built and one that could provide equivalent benefits. However,the physical plan may be entirely different than the multipurpose project.

(e) A cost summary sheet that may be used to organize information for use in cost allocation is presented in §631.03.

§631.02 Cost allocation methods.

(a) Separable Cost - Remaining Benefit (SCRB) method.

SCRB provides for (1) assigning to each purpose its separable cost and (2) assigning to each purpose a share of the joint cost in proportion to the remaining benefits. The method allows for an equitable sharing among the various purposes included any savings that may result from multiple-purpose development.

(1) SCRB will allocate costs to the purposes so that each purpose is economically feasible, provided that three requirements of project formulation are met:

-- the overall benefit-cost ratio is favorable;

-- the separable cost of any purpose does not exceed the benefits of that purpose; and

-- that the sum of the "lesser of the benefits" or the "alternate cost" is equal to or greater than the project cost.

(2) SCRB requires that the following be determined:

-- authorized purposes intentionally served by the plan;

-- financial cost to be allocated;

-- separable cost for each purpose;

-- NED benefit for each purpose;

-- alternative financial cost for each purpose; and

-- joint cost, which is the financial cost less the sum of the separable costs.

(3) Example of SCRB.

Table 631-1. Separable Cost - Remaining Benefit Cost Allocation.

		Purposes			
Step	Item	Flood Prevention	Irrigation	Recreation	Total
1	Benefits	10,000	8,000	4,000	22,000
2	Alternative Cost	8,000	8,000	10,000	26,000
3	Lesser of Step 1&2	8,000	8,000	4,000	20,000
4	Separable Cost	1,000	6,000	3,000	10,000
5	Remaining Benefits	7,000	2,000	1,000	10,000
5a	Percentage of Remaining Benefits	70%	20%	10%	100%
6	Allocated Joint Cost	5,600	1,600	800	8,000
7	Total Allocated Cost	6,600	7,600	3,800	18,000

631.02(a)(3)

Step 1. Report the benefits for each purpose for which the plan was formulated. Benefits are shown in present value terms.

Step 2. The alternative cost is the financial cost of achieving the same or equivalent benefits by a single-purpose project.

Step 3. Record here the lesser of the benefits or the alternative cost, by purpose.

Step 4. Separable cost is the cost of adding each purpose to the — as the last increment multiple purpose project. This figure indicates the minimum cost that will be allocated to the purpose. If the separable cost for a purpose exceeds the amount shown in Step 3, the project contains an infeasible purpose.

Step 5. Remaining benefits are equal to the difference between the amount in Step 3 and the separable cost (Step 4).

Step 5a. Calculate the remaining benefits for a purpose as a percentage of the total remaining benefits.

Step 6. The allocated joint cost in the total column is the difference between project financial cost and the sum of the separable costs for all of the purposes. The total allocated joint cost is distributed to each purpose by the percentage shown for that purpose in Step 5a.

Step 7. Total allocated cost for each purpose is the sum of the separable cost and allocated joint cost for the purpose.

(b) Separable Cost - Use of Facilities method.

(1) The Separable Cost - Use of Facilities method apportions the total joint costs among purposes by substituting the use each purpose makes of the multiple purpose reservoir(s) for remaining benefits. Caution: While the Separable Cost-Remaining Benefit method allocates cost to each purpose so that each purpose is economically feasible, the same is not automatically true of the Separable Cost-Use of Facilities method.

(2) The Separable Cost - Use of Facilities method requires that the following be determined:

-- authorized purposes intentionally served by the plan;
-- financial cost to be allocated;
-- separable cost for each purpose;
-- the NED benefit for each purpose;

-- alternative financial cost for each purpose;
-- the joint cost, which is the financial cost less the sum of separable costs; and
-- for step 5, the use each purpose makes of the multiple purpose facility. (When two purposes make joint use of the same reservoir capacity, that capacity will be equally divided among the purposes.)

(3) Example of Separable Cost - Use of Facilities method.

Table 631-2. Separable Cost - Use of Facilities Cost Allocation.

Step	Item	Purposes: Flood Prevention	Irrigation	Recreation	Total
1	Benefits	8,000	8,000	15,000	31,000
2	Alternative Cost	12,000	8,000	10,000	30,000
3	Lesser of Step 1 or 2	8,000	8,000	10,000	26,000
4	Separable Cost	2,000	5,000	5,000	12,000
5	Use of Facility (Ac.ft.)	2,000	1,000	2,000	5,000
5a	% Use of Facility	40%	20%	40%	100%
6	Allocated Joint Cost	4,800	2,400	4,800	12,000
7	Total Allocated Cost	6,800	7,400	9,800	24,000
8	Net Benefits	1,200	600	200	2,000

Steps 1 through 7 are comparable to the same steps in the Separable Cost-Remaining Benefit method, except for what was previously stated with reference to Step 5.

Step 8 - Net benefits is the in-column difference between the amounts in Step 3 and Step 7. Because purpose feasibility is not automatic in this method, Step 8 is added.

(c) Cost allocation with constituent costs.

(1) So far, the discussion has been limited to the allocation of project installation costs. As mentioned earlier, the need for cost allocation stems from cost-sharing policies that differ among project purposes. Frequently, cost-sharing policies are directed toward variations in the cost-share rate for construction or landrights cost depending on the purpose severed or of differences in the rates for structural as compared to nonstructural measures. Hence, it is often necessary to identify that part of the construction cost, or some other cost constituent, incurred for each specific purpose.

631.02(c)(2)

(2) Cost allocation of constituent costs requires the following be determined:

-- authorized purposes intentionally served by the plan;

-- constituent components of the financial cost to be allocated;

-- the NED benefit for each purpose;

-- constituent components of the alternative financial cost for each purpose; and

-- the joint cost, which is the financial cost less the sum of the separable costs, as calculated by constituent components.

(3) Example of Cost Allocation Using Constituent Costs.

Table 631-3. Separable Cost - Remaining Benefits Cost Allocation Using Constituent Costs.

Step	Item	Flood Prevention	Purpose: Irrigation	Purpose: Recreation	Purpose: Total
1	Benefits	15,000	8,000	12,000	35,000
2	Alternative Cost				
	Construction	11,000	8,000	8,000	27,000
	Land Rights	1,000	1,000	3,000	5,000
	All Other	2,000	1,000	1,000	4,000
3	Lesser of Step 1 or 2				
	Construction	11,000	6,400 1/	8,000	25,400
	Land Rights	1,000	800 1/	3,000	4,800
	All Other	2,000	800 1/	1,000	3,800
4	Separable Cost				
	Construction	2,000	3,000	3,000	8,000
	Land Rights	0	0	2,000	2,000
	All Other	0	0	0	0
5	Remaining Benefits				
	Construction	9,000	3,400	5,000	17,400
	Land Rights	1,000	800	1,000	2,800
	All Other	2,000	800	1,000	3,800

(continued)

Table 631-3. Continued.

Step	Item	Flood Prevention	Purpose: Irrigation	Purpose: Recreation	Purpose: Total
5a	Percentage of Remaining Benefits				
	Construction	51.72%	19.54%	28.74%	100%
	Land Rights	35.71%	28.57%	35.71%	100%
	All Other	52.63%	21.05%	26.32%	100%
6	Allocated Joint Cost				
	Construction	8,792	3,322	4,886	17,000
	Land Rights	714	572	714	2,000
	All Other	526	211	263	1,000
7	Total Allocated Cost				
	Construction	10,792	6,322	7,886	25,000
	Land Rights	714	572	2,714	4,000
	All Other	526	211	263	1,000
	TOTAL	12,032	7,105	10,863	30,000

1/ In this case, where benefits are less than the alternative cost, it is necessary to proportion the benefits to the cost constituents. The cost distribution of the alternative cost is used.

(d) Other cost allocation methods.

(1) Specific Cost - Remaining Benefits Method.

(i) This method differs from the Separable Cost - Remaining Benefit method only to the extent that specific costs are used rather than separable costs. Costs allocated to each purpose are equal to specific costs plus allocated joint cost.

(ii) Specific costs for each project purpose consist of the cost of facilities that exclusively serve only one project purpose. Irrigation outlet works, irrigation water delivery systems, and basic recreation facilities are examples of project facilities that serve a specific purpose.

(2) Use of Facilities Method. This method differs from the Separable Cost-Use of Facilities method in that the cost of individual multiple purpose facilities are allocated proportionate to the use each purpose makes of the facility. In practice, joint costs normally are allocated by use of facilities. Total allocated cost for a purpose is the sum of the allocated joint cost and the specific cost.

§631.03. Cost Summary Sheet for Cost Allocation.

Purpose	MPS 1/ Cost	MPS W/O Purpose	Separable Cost	Alternate Cost
1. _____ Purpose				
Construction				
Engineering Services				
Project Administration				
Landrights				
OM&R (capital equivalent)				
2. _____ Purpose				
Construction				
Engineering Services				
Project Administration				
Landrights				
OM&R (capital equivalent)				
2. _____ Purpose				
Construction				
Engineering Services				
Project Administration				
Landrights				
OM&R (capital equivalent)				

1/ MPS - Multipurpose structure.