UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
REGIONAL TECHNICAL SERVICE CENTER
Upper Darby, Pennsylvania 19082

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TSC TECHNICAL NOTE - WATERSHEDS UD-7

To: State Conservationists, Northeast Region

From: Head, Engineering and Watershed Planning Unit

Re: Evaluation of Flood Plain Land Damage

The purpose of this Technical Note is to (1) condense instructions given in the Economics Guide and Technical Releases, and (2) promote uniformity in the procedures used to evaluate flood plain land damages for project developments. It supplements Chapter 5 of the Economics Guide, and Technical Releases Nos. 17 and 32.

INTRODUCTION

Flood plain land damage may be classed as permanent damage or recoverable damage.

Permanent flood plain land damage usually results from land voiding due to gully or streambank erosion and from thick deposits of sterile or relatively infertile soil materials on the more productive flood plain lands.

Recoverable flood plain land damages fall into three categories, based on rates of damage and recovery:

1. The rates of damage and recovery are in equilibrium.

2. The rate of damage is increasing and recovery is taking place.

3. The rate of damage is decreasing and recovery is taking place.

The final determination of representative yield and recovery data used to evaluate land damage will be made jointly by the Economist and the Geologist. The determination will be supported by interview data, boring data, and consultations with farmers, work unit technicians, and other knowledgable technicians.

EVALUATION OF PERMANENT LAND DAMAGE

Permanent damage to flood plain land is not commonly found throughout the Northeast. Where the problem is minor, damages and benefits may be estimated on the basis of preliminary investigation data and procedures. If the damages are

significant to the formulation and evaluation of the project, the evaluation will be based on the average annual physical land loss and the depreciation or loss of use of land adjacent to the voided or sterile area.

Types of Damage

Permanent land damages, in monetary terms, include:

1. Loss of income to farm operators during a 10-year adjustment period. This is the period of years in which farm operators have normally adjusted to alternate uses of that part of their labor, capital, and management made idle because some land on their operating units was voided or severely depreciated.

2. Market value of loss to landowners of a land resource is represented by the difference in the capitalized rental value of the land, after real estate taxes are deducted, for "before damage" and "after damage" conditions.

3. Value of loss to local interests of real estate tax income.

4. Value of the loss to public interests not reflected in the market value of a land resource or its tax base.

Evaluation Procedures

The following steps are recommended to establish the basic data needed to evaluate permanent land damage:

1. The Geologist will determine the average annual acres subject to voiding, using procedures described in Technical Release No. 17, pages 2-26 to 2-30; and Technical Release No. 32.

2. The Geologist and Economist jointly will determine the extent of the area adjacent to the voided areas that will be depreciated in value because of the voiding. Refer to Chapter 5 of the Economics Guide and Technical Release No. 32, pages 15-17.

3. The Economist will:

   a. Combine the physically damaged area and the depreciated area. This is done to reduce steps in the damage evaluation, as suggested in paragraph IIA2, Chapter 5, Economics Guide.

   b. Determine the composite acre based on present or projected land use of the areas subject to permanent land damage.

   c. Determine the composite acre based on expected land use after damage reduction.

   d. Estimate the composite acre gross income for "with project"

conditions in the areas subject to permanent land damage. Estimate the composite acre gross income for "without project" conditions after permanent land damage. See Table 5.1, Chapter 5, Economics Guide.

e. Estimate the variable or cash operating costs for the "with project" and "without project" conditions described in step "d" above.

f. Subtract the cash operating costs from the gross incomes for "without project" and "with project" conditions to determine the adjusted gross income as shown in Table 5.1 of the Economics Guide.

g. Establish the per-acre real estate taxes for "before damage" and "after damage" conditions.

h. Compute the net returns to land by subtracting the per-acre real estate tax from the per-acre rental value of the land for "before" and "after" damage conditions.

i. Estimate the remaining damages to the farm operation by subtracting the real estate taxes and the net returns to the land from the adjusted gross income.

An explanation and illustration of the procedure used to evaluate permanent land damages are given on pages 4, 5, and 6 of Chapter 5 of the Economics Guide. The columns "With Project" and "Without Project" in Table 5.1 represent "before damage" and "after damage" conditions, respectively, for the areas that have not been damaged at the time of project evaluation.

Special attention should be given to situations when the damages will occur only during a portion of the evaluation period, or only partial protection will be provided by project measures. Instructions for application of the procedure for these situations are given on pages 7-9, Chapter 5, of the Economics Guide.

EVALUATION OF RECOVERABLE LAND DAMAGE

Recoverable land damages to flood plains are found in urban areas, parks, and roadsides as well as agricultural land. The damages to nonagricultural lands are most frequently evaluated as part of the floodwater damages. The damage to agricultural lands affects the productive capacity of the soil which may reduce farm income for many years. Where the damage to agricultural problem areas is minor, damages and benefits may be estimated on the basis of preliminary investigation data and procedures. If the agricultural damages are significant to the formulation and evaluation of the project, the evaluation will be based on the average annual reduction in crop production, the amount of recovery, and the recovery period.

COLLECTION OF DATA

The two basic situations most frequently encountered are (1) where new damages are approximately in equilibrium to recovery and (2) where damages are increasing and recovery is taking place. The infrequent situation, where a decreasing rate of damage and recovery is taking place, is likely to be found in a watershed which is becoming more stabilized either by vegetative management or completion of urbanization.

Before the geologic field data is collected, both the Geologist and the Economist should make a joint inspection of the damage areas and review the Economist's interview data regarding land use, treatment, and yields on damaged lands.

Geologic Studies

The Geologist will provide the Economist data on (1) kinds of sediment and erosion damage, (2) areas of damage, (3) extent of potential recovery, and (4) project effects in reducing land damages, as obtained by procedures given in Technical Release No. 17, pages 2-6 to 2-26 and 2-39 to 2-40.

Kinds of sediment and erosion damages - Sediment and erosion damages due to infertile overwash, swamping, flood-plain scour, streambank erosion, valley trenching, and upland gullying will be obtained.

Areas of damage - Areas of damage may be delineated by either the mapping or range method. Mapping of damaged land is the preferred method where damaged areas are generally small and scattered throughout the flood plain. The range method is more useful where damaged areas are large and generally continuous in the flood plain.

Extent of potential recovery - Recovery is defined as the regaining of lost productive capacity of damaged soils. Recovery may result from natural processes or special land treatment measures; it may be total or partial. The Geologist will estimate the time in years over which the recovery will occur under flood-free conditions, and the percent of damage remaining after recovery. The damage remaining after recovery is considered as "non-recoverable".

The Geologist will describe the type of recovery associated with the above time of recovery as either natural or accelerated. If it is accelerated, the special measures employed to accelerate recovery will be described in sufficient detail for the Economist to compute the annual costs of such measures. Special treatment measures include extra deep plowing, bulldozing or scraping, extra applications of lime and fertilizers, etc.

Project effects in reducing land damage will be estimated for each kind of damage, by reaches, considering land treatment measures as the first increment; and thereafter for the project measures. The Geologist will estimate the effects of project measures in (1) reducing sediment damages, based on

the percent of damaging sediment stabilized at its source and/or trapped in detention structures; and (2) reducing erosion damages based on its relative percent effectiveness in eliminating all damaging erosive forces.

Joint Geologic and Economic Studies

The Geologist and Economist will jointly determine (1) the land use in the damage areas, and (2) the percent of damage.

Land use in the damage areas - will be determined by considering the following information:

1. The original and present broad land uses (cropland, permanent hay and pasture, woodland, and idle) as recorded by the Geologist on his field sheets.

2. The expected "without project" land use and cropping pattern employed to evaluate crop and pasture floodwater damages.

3. The final land use and cropping pattern used to represent the damage area should be in accordance with the use capability standards of the Service.

Percent of damage will be determined for each separable area of damage. Damage to land causes a loss in crop yields. This loss is reported as a percentage of the yields obtained from undamaged soils and is determined by comparing known or estimated yields from damaged soils to those of undamaged soils of the same soil type or another type in the same Land Capability Unit. Crop yield data will be obtained by the Economist and the Geologist from farmer interviews; and consultations with leading local farmers, district supervisors, work unit conservationists, or other agricultural technicians.

EVALUATION OF DATA

Economic Studies

Using the methods given in the Economics Guide, the Economist will compute the dollar value of the land damage based on the loss of net income. He will take into consideration the land use, cropping pattern, and yields of the land subject to damage, as follows:

1. Determine composite acre gross returns for undamaged conditions and for each "percent damage" to be evaluated.

2. Determine costs of production for each of the above damage conditions, taking into account the annual cost of any special measures employed to accelerate recovery. Costs for special measures employed to accelerate recovery, which are not incurred every year, will be con-

verted to an average annual value based on the cost incurred, the number of years involved, and the frequency of occurrence throughout the evaluation period. For example, a bulldozer or scraper is used to remove sediment deposition following 25-year flood events or greater at a cost of $100 per acre. Amortize the $100 cost over 25 years at 6 percent (use local interest rates). The annual cost is $100 x .07823, or $7.82.

3. Determine the net income for each of the above damage conditions.

The composite acre loss for each percent damage is the difference between the net income for undamaged conditions and the net income with that percent damage. The following table illustrates this principle:

Per Acre Cost, Returns, and Loss on Damaged Land

Yield Reduction	Gross Production	Cost of Production		Net Return	Loss
		Fixed	Variable		
(Percent)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
Undamaged	80.00	22.00	23.00	35.00	0
10	72.00	22.00	20.00	30.00	5.00
30	56.00	22.00	16.00	18.00	17.00
50	40.00	22.00	9.00	9.00	26.00
70 1/	22.00	12.00	6.00	4.00	31.00
90 2/	7.00	4.50	1.00	1.50	33.50

1/ Shifted to lower value crops.

2/ Shifted to low grade pasture.

Several methods have been developed to evaluate land damages subject to equilibrium or recovery. Any of these methods is acceptable as long as it follows the basic economic principles set forth in Chapters 1 and 2 of the Economics Guide.

Damage and Recovery in Equilibrium

The various steps used to evaluate the damages and the effects of project measures are described on pages 11 to 15 of the Economics Guide. The

attached worksheet (Table 1) has been developed to consolidate the steps and show the evaluations for conditions where damage and recovery are in equilibrium.

Damage Increasing, with Recovery

The suggested evaluation method, where the rate of damage is increasing and recovery is taking place, is described on page 12 of Chapter 5 of the Economics Guide.

A shortcut procedure also is discussed on page 13. The increasing damage is added to the equilibrium damage to determine the total damage. As pointed out in the Guide, appropriate adjustments must be made in the damageable values and in the estimates of crop and pasture floodwater damage to prevent double counting of damage. The method for making the adjustment is described on pages 13 and 14, Chapter 5, of the Economics Guide.

Damage Decreasing, with Recovery

The evaluation procedure for decreasing damage described below is an adaptation of the method for increasing damage described in the Economics Guide.

When the rate of damage is decreasing and recovery is taking place, it is suggested that the damage at the time of the appraisal be evaluated, using the procedures for damages and recovery in equilibrium. This evaluated damage should be reduced on the basis of the expected decrease in area and intensity of damage. The following steps are suggested:

1. Evaluate existing damages on the area, using the method for equilibrium of damage and recovery ($26,195 - page 11, Chapter 5 of Economics Guide).

2. Estimate the annual rate of decrease and the total decrease:

Percent Damage	Decrease Damage Per Year	Damage Per Acre	Annual Rate of Decrease	Years of Decrease	Total Decrease
	(Acres	(Dollars)	(Dollars)		(Dollars)
10	10	5.00	50.00	10	500.00
30	5	17.00	85.00	10	850.00
50	5	26.00	130.00	10	1,300.00
Total	20	xxxxx	265.00	xx	2,650.00

3. Compute the level of damage which remains constant:

   $26,195 - $2,650 = $23,545

4. Compute the average annual value of the decreasing increment of damage: ($2,650 ÷ 10 years = $265)

   $ 265 x 47.22761 = $12,515

   $12,515 x 0.04081 = $ 511

5. Add the annual value of the decreasing increment to the constant damage to determine the total damage:

   $23,545 + $511 = $24,056

6. Adjust the crop and pasture floodwater damages to account for the increased damageable value brought about by the reduced area damaged by sediment.

DETERMINATION OF PROJECT BENEFITS

Benefits based on the reduction in land damages will be estimated as follows:

1. All the damages occurring in areas of the flood plain made flood-free by the project.

2. The reduction in sediment damages occurring in areas of the flood plain still subject to flooding "with project", based on the Geologist's estimate of reduced output of damaging sediment or delivery to the damage area.

3. The reduction in erosion damages occurring in areas of the flood plain still subject to flooding "with project", based on the Geologist's estimate of the project's effectiveness in reducing erosive forces causing damage.

An example of the computations is illustrated on the attached Table 2.

Attachments

Harold M. Kaltz

Distribution:
Northeast States - 6
Clyde W. Graham - 3
C. J. Francis - 3
Erwin C. Ford - 2
John Roehl - 2
Other EWP Units - 2

Watershed _____ Reach _____

TABLE 1. EVALUATION OF LAND DAMAGE Date _____ Completed By _____

	WITHOUT PROJECT			WITH PROJECT (if 100 percent effective)							
Acres Damaged	Percent Damage	Damage Per Acre	Total Damage (Col. 1 x Col.3)	Years to Recover	Percent Damage After Recovery	Damage Per Acre After Recovery	Value of Recovery Per Acre (Col. 3 - Col. 7)	1/ Discount Factors	Discounted Value of Recovery Per Acre (Col. 8 x Col. 9)	Value of Recovery (Col. 10 x Col. 1)	Non-Recoverable Damage (Col. 4 - Col. 11
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1,200	10	5.00	6,000	5	0	-	5.00	.924	4.62	5,544	
600	30	17.00	10,200	10	10	5.00	12.00	.840	10.08	6,048	
300	50	26.00	7,800	15	30	17.00	9.00	.767	6.90	2,070	
60	70	31.00	1,860	20	50	26.00	5.00	.701	3.50	210	
10	90	33.50	335	50	70	31.00	2.50	.436	1.09	11	
T 2,170	xx	xxxxx	$26,195	xx	xx	xxxxx	xxxxx	xxxx	xxxxx	$13,883	$12,312
Remaining recoverable damage with land treatment										$ 9,524	
Remaining recoverable damage with project										$ 4,429	
Total remaining damage with project											$16,741

1/ Employ appropriate straight-line discount factor for the time of recovery given in column 5, evaluation period, and current interest rate approved for discounting.

EWP Unit, SCS, Upper Darby, Pa.
October 1966

Table 2. Computations and Summary of Benefits from Reduction of Damage

Present Damage - Total (over entire flood plain)		$ 26,195
Nonrecoverable Damage		12,312
Recoverable Damage (if project is 100% effective)		$ 13,883

Reduction of Damage After Land Treatment

2% reduction of area subject to flooding x $13,883	=	$ 277
30% reduction of sediment x ($13,883 - $277) or $13,606	=	4,082
Reduction Due to Land Treatment		$ 4,359

Remaining recoverable damage:
$13,883 - $4,359 = $9,524

Reduction with Retarding Structures

25% reduction of area subject to flooding x ($13,883 - $4,359) or $9,524	=	$ 2,381
38% reduction by trapping damaging sediment x ($9,524 - $2,381) or $7,143	=	2,714
Reduction Due to Structures		$ 5,095

Remaining recoverable damage:
$13,883 - ($4,359 + $5,095) = $4,429

SUMMARY OF AVERAGE ANNUAL DAMAGES AND BENEFITS

	Present Damages	After Land Treatment	With Project	Benefits due to Structures
Nonrecoverable	$ 12,312	$ 12,312	$ 12,312	$ -----
Recoverable	13,883	9,524	4,429	5,095
Totals	$ 26,195	$ 21,836	$ 16,741	$ 5,095
Benefits		$ 4,359	$ 9,454	$ 5,095