Scientifically Defensible Compensation Ratios For Wetland Mitigation

by

Dennis M. King
University of Maryland
Center for Environmental and Estuarine Studies
Chesapeake Biological Laboratory
Solomons, Maryland 20688-0038
(301-326-4281)

and

Kenneth J. Adler
U.S. Environmental Protection Agency
Office of Policy, Planning and Evaluation
Washington, D.C. 20460
(202-260-2755)

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U.S. Environmental Protection Agency
Office of Policy, Planning and Evaluation
Washington, D.C. 20460

ABSTRACT

Some economic development projects cannot be designed to completely avoid adverse wetland impacts. In at least some cases, Federal and State resource agencies will allow such projects to proceed as long as the permit applicant agrees to provide compensatory mitigation in the form of wetland creation, restoration or enhancement projects. Engineering standards are emerging that will determine how these mitigation projects should be designed and implemented. However, there are no generally accepted methods for establishing how much mitigation should be required. The compensation ratio - the number of created or restored acres required per acre of lost natural wetland - is still determined on the basis of best professional judgement, negotiations among government agencies, business and environmental interests, and the permit applicant's ability to pay.

In this paper, a scientifically-based framework is developed for determining compensation ratios for wetland mitigation projects on the basis of the expected performance of the proposed mitigation project. Using this framework, a mitigation project is characterized in terms of four simple parameters: A, the level of wetland performance at the mitigation site prior to the project; B, the expected level of performance at the mitigation site after the project has had its full effect; C, the number of years required for the mitigation project to have its full effect; and, D, the number of years mitigation is initiated in advance of the fill activity. The before and after measures of wetland performance at the mitigation site, A and B, are expressed in relative terms using the performance of the natural wetland as a reference. The expected stream of annual wetland benefits from the 'replacement' wetland is compared with the stream that was expected from the lost natural wetland in nominal and present value terms to generate a compensation ratio that achieves no net loss of wetland functions and values.

As state and Federal agencies develop more detailed mitigation

guidance for wetland regulation programs, the proposed technique may help improve program consistency, predictability and scientific merit. The method can be applied using whatever structural or functional standard of wetland equivalency is deemed to be appropriate by wetland scientists, ecologist, and economists. The method is objective and defensible on scientific and economic grounds. It also focuses public attention in a very direct and understandable way on the critical aspects of any proposed mitigation project: the <u>speed</u> and <u>level</u> of functional replacement.

I. Background

Despite earnest efforts to protect wetlands, unavoidable losses will continue due to intentional and unintentional acts of man and natural forces such as sea level rise and subsidence. In some cases, wetland restoration and creation projects provide opportunities to offset these losses.

One significant source of wetland loss is the discharge of dredged or fill materials, which is regulated under section 404 of the Clean Water Act. A Memorandum of Agreement (MOA) between the two federal agencies that administer the Section 404 Regulatory program (EPA and Army) states that the program will employ a three stage process to "strive to achieve a goal of no overall net loss of wetland values and functions." [1] When evaluating permit applications the MOA establishes that the Corps will ensure first that adverse wetland impacts are avoided wherever there is a "practicable" alternative.[2] Impacts that cannot be avoided must then be minimized to the maximum extent "practicable." Finally, any residual wetland impacts must be fully mitigated through "compensatory actions such as the restoration of existing degraded wetlands or the creation of man-made wetlands." [3] According to the MOA "the determination of what level of mitigation constitutes appropriate mitigation is based solely on the values and functions of the aquatic resources that will be impacted." [4]

II. Historical Problems

If wetland creation and restoration projects could fully and immediately replace the functions and values of natural wetlands there would be no need to conserve natural wetlands. The 'appropriate' level of mitigation, in such a world, would be easy to determine, and in most situations would be one acre of created or restored wetland for each acre of lost natural wetland -- a compensation ratio of 1:1. Unfortunately, created and restored wetlands take time to develop, sometimes many years, and may never provide all of the functions and values of natural wetlands.

Because the speed and level of functional replacement is never known with certainty, it is difficult to determine an 'appropriate' amount of mitigation. 'Appropriate' mitigation is generally thought to require a compensation ratio greater than 1:1. However, at the present time, there is no scientifically-based method for determining what the compensation ratio should be in each case.

A review of the literature related to the Section 404 permit program indicates that the compensation ratio for any given project has been based upon a combination of factors that include: [5]

1) historical precedence (what the ratio has been for similar projects),
2) the permit applicants ability to pay (the net worth of the applicant or the anticipated profitability of the proposed development),
3) the type of mitigation (whether it is creation or restoration, in-kind or out-of kind or will take place on-site or off-site),
4) the timing of the mitigation (whether it takes place in advance of or concurrent with the loss of the natural wetland,
5) a rough comparison of biological indices by wetland scientists, and
6) a good deal of negotiating by resource agencies based on information provided among civic, business and environmental interests.

The importance attached to these factors differs from case-to-case and from jurisdiction-to-jurisdiction.

III. New Problems

There are many reasons why this system for establishing compensation ratios needs to be replaced with a more consistent and scientifically structured system. The recent NAS report on wetland restoration, for example, highlights the uncertainty surrounding wetland mitigation activities. [6] In addition, increasingly stringent quality standards for wetland creation and restoration projects and mandatory follow-up and monitoring work have significantly increased mitigation costs per acre. For these reasons, compensation ratios proposed by permitting agencies are being challenged more frequently. In the courts, when the compensation ratio cannot be defended on a scientific basis, they are not being upheld. [7]

In order to make wetland regulations more predictable, less time consuming and more equitable, and to reduce costly litigation, there is a growing need for an objective, scientifically-based method for determining 'appropriate' compensation ratios for wetland mitigation projects.

IV. Conceptual Foundations

Wetlands, like other forms of natural capital, are important because of the streams of ecological functions and associated direct and indirect market and non-market values they generate over time [8]. Arguments in favor of compensation ratios greater than 1:1 are based on the following general observations:

1) Created and restored wetlands take time to replace the functions and values of lost natural wetlands.
2) Replaced functions and values provided in the future by a created or restored wetland are not worth as much in 'present value' terms as the near-term functions and values that are lost with natural wetlands.
3) Created and restored wetlands are not always capable of providing full replacement functions and values even when they are successful.
4) Created and restored wetlands do not always function as expected so some margin of safety is required to account for uncertainty about replacement values.

All of these arguments for compensation ratios greater than 1:1 are based on the fact that natural wetlands provide a stream of important functions and values over time, which may not be fully or adequately replaced by a created or restored wetland.

In a few cases, compensation rations of <u>less</u> than 1:1 are also justified; such as:

1) When the created or restored wetland produces greater functions and values than the 'natural' wetland because the 'natural' wetland is severely degraded.

2) When the wetland is created or restored before the natural wetland is filled, the additional wetland value provided prior to the fill activity will reduce the amount of wetland functions and values that must be replace after the fill activity.

The procedure described below for estimating compensation ratios can be used with one of the many measures of wetland performance that have been developed to assess wetland functions and values. [9] Most wetland assessment methods currently used in making 404 permit decisions (WET, HEP, or WREP) could be applied to this procedure. The procedure requires only that the measure be expressed in relative terms using the performance of the lost natural wetland as a reference. It is based on a few key parameters that reflect the most important characteristics of a proposed mitigation project: <u>how much</u> of the lost natural wetland's functions and values will be replaced and <u>how quickly</u> they will be replaced.

V. <u>The Approach</u>

The general approach is depicted in Figure 1, which illustrates the loss of a natural wetland (dotted line) and the <u>concurrent creation</u> on an acre-for-acre basis of a replacement wetland (solid line) beginning at time zero (t=0). The annual functions and values associated with the natural wetland that is being lost (dotted line) is depicted as 100% prior to time zero and 0% thereafter. The annual functions and values associated with the replacement wetland (solid line) is shown to range from A=0% of the reference value before the project to B=70% after the project. The period of time required to reach level B is shown as C=10 years measured from time zero. In section VI, this approach is discussed for other mitigation scenarios, including advanced creation, concurrent and advance restoration, and the creation of a wetland to mitigate for the fill of a degraded wetland.

While Figure 1 depicts the increase in functions of the replacement wetland (solid line) as a linear progression, nature rarely follows a straight line. Wetland recovery patterns may follow other patterns and may not plateau at year C, as shown in Figure 1. However, for our purposes, a straight line recovery pattern to a given functional level that may be higher than the level of the natural wetland (B>100%) or lower (B<100%) is a reasonable characterization. The shape of the recovery curve connecting A and B has very little impact on the compensation ratios developed here.

Using this approach, all that is known about the likely results of a mitigation project is characterized in terms of four simple parameters:

A: the level of wetland function at the mitigation site prior to the project. This is presumed to be zero in the case of wetland creation and greater than zero in the case of wetland restoration;

B: the maximum level of replacement function that is expected after the project has had its full effect;

C: the year when the project is expected to have its full effect; and,

D: the number of years the mitigation occurs in advance of the wetland fill activity.

Lost Functions and Values

The shaded area in Figure 1 shows the difference between the annual functions and values expected per acre of natural wetland and those expected per acre of the created wetland. It represents a net loss in functions and values during and after the restoration period with one-for-one mitigation. The ratio of the shaded area to the entire area represents the percentage loss in functions and values with this hypothetical project. This percentage loss, which we can refer to as L, is determined by the values of A, B and C. The illustration values used in Figure 1 (A=0%, B=70% and C=10 years) generate L = 38%, which means that over a 50 year horizon the created wetland only replaces 62% (100% - 38%) of the natural wetland's functions and values.

Compensation Ratio - Unadjusted

Using a simple transformation of L, it is possible to define a compensation ratio that would result in no net loss in functions and values; it is 1/(1-L). If combinations of A, B and C generate L = 25%, 50% or 75%, for example, the number of created acres required per acre of lost natural wetland to achieve no net loss would be 1.3, 2 and 4 respectively. Using the illustrated values of A, B and C from Figure 1, this would result in a compensation ratio of 1.6, or 1.6 acres of created wetland for every acre of natural wetland lost.

There is one significant adjustment that needs to be made before these compensation ratios are 'appropriate.' This adjustment is necessary to account for the effect of 'discounting' the annual functions and values provided by the natural and created wetlands.

The Effect of Discounting

Discounting is a standard technique that is used universally in economic analysis to reflect the fact that benefits received later are valued less than those received sooner.[10] In the present context, this means that a wetland benefit that accrues in future years, i.e., improved fishing, aesthetics, or wildlife support, is worth less than the same wetland benefit received now. Discounting has a significant effect on the value of L and the 'appropriate' compensation ratio because the stream of benefits generated by a created or restored wetland are delayed at least partially until wetland functions are restored. In other words, assuming concurrent mitigation, the near term values of the natural wetland are being replaced with wetland values that will not accrue until sometime in the future. Discounting reflects the fact that society places a higher value on benefits that accrue earlier rather than later, even if we are confident that the future benefits will actually occur.

Compensation Ratios - Adjusted

Even though we cannot monetize most wetland values, we can measure the effect of discounting on the relative annual stream of values -- an annual value of 100 'units' in the case of the natural wetland and annual values ranging from A to B for the replacement wetland. By discounting the relative annual value of each wetland [11] to their 'present value,' we produce an adjusted 'L' which is the percentage loss in the 'present value' of the expected annual wetland benefits with one-for-one replacement. The compensation ratio based on this discounted value of L, then, is one that results in no net loss in the 'present value' of the stream of wetland functions and values. We propose that this is the 'appropriate' compensation ratio. Applying a discount rate of 10% and again using the illustration values of A, B and C in Figure 1, the 'appropriate' compensation ratio is 2.3. This is higher than the unadjusted ratio of 1.6, which puts equal weight on current and future wetland functions and values.

VI. Additional Mitigation Scenarios

The method described above for estimating compensation ratios can be applied to other mitigation scenarios including advanced mitigation, and the replacement of a degraded wetland with a wetland of a higher expected value.

Wetland Creation (advanced)

Advanced wetland creation, which is commonly associated with mitigation banks, is depicted in Figure 2. In this case, wetland creation is initiated 5 years prior to the loss of the natural wetland. For purposes of illustration, let the value of C equal ten years (Table 1) but consider also an additional variable D, which equals -5 years, the number of years the creation is initiated in advance of the fill activity. In this case, the project is given additional credit for the wetlands created in advance of the fill activity. The unadjusted compensation ratio generated using the illustrated values of A, B, C and D (Table 1) is 1.4. After discounting at 10%, the 'appropriate' compensation ratio also equals 1.4 (Table 2). While this may not appear intuitive, the wetland values produced during the five years prior to the fill activity reduce the number of wetland acres that must be created after the fill activity, in order to achieve no net loss.

Wetland Restoration (concurrent and advance)

The calculation of compensation ratios for concurrent wetland restoration is similar to wetland creation; however, as shown in Figure 3, the area below the line at A = 20 is also shaded to show that it represents a loss. This is because the area below A represents the functions and values at the mitigation site prior to mitigation, and is not credited to the mitigation effort. This area needs to be added to the shaded area above the 'restoration curve' to account for the full loss with one-for-one mitigation. The values of A, B, C and D for wetland restoration (Table 1) generate L = 55%. In this case, the transformation of L produces an unadjusted compensation ratio of 2.2, which after discounting at 10% would produce an 'appropriate' ratio of 3.2 (Table 2).

Wetland restoration that occurs in advance of fill activities is depicted in Figure 4. In this case, the values of A, B, C and D (Table 1) generate L = 50%. As shown in Table 2, this produces an unadjusted compensation ratio of 2.0 and an 'appropriate' ratio of 2.0. Similar to advance creation, initiating restoration 5 years in advance of the fill activity tends to offset the effect of discounting future wetland values.

Degraded Wetland

Figure 5 depicts the situation where the created wetland exceeds the functions and values of the natural wetland it is replacing. This may occur where the 'natural' wetland is already severely degraded. Since the value of the degraded 'natural' wetland is depicted as 100%, the created wetland, in this example, exceeds 100% of the 'natural' wetland's functions and values (B > 100%). This may occur, for example, where the fill activity is occurring in cropped wetland. For illustration purposes we have set B equal to 140%. Applying a discount rate of 10% and using the illustrated values of A, B and C in Table 2, the 'appropriate' compensation ratio is 1.2 acres of wetland created for each acre of degraded wetland filled.

VII. Method of Application

The numbers provided in Tables 3a and 3b can be used to apply the method to five basic types of mitigation activity (advanced and concurrent creation, advanced and concurrent restoration, and a degraded 'natural' wetland).

1) The first step in each case is to estimate values of A, B, C and D using appropriate wetland assessment methodologies and best professional judgement. For any particular geographic region, it may be more useful and less costly to estimate typical values of A, B, C and D for more common mitigation projects, instead of estimating them on a case-by-case basis.
2) The second step is to refer to Table 3a or 3b and locate the estimated value of A along the column headings.
3) The third step is to read down the A column to the estimated value of B.
4) The fourth step is to read across the same row to the frame located under the estimated value of C. The number in this frame is the appropriate compensation ratio.

For illustration purposes, consider our wetland creation example (Figure 1) where A = 0, B = 70, and C = 10. Referring to Table 3b, start at the column where A = 0, go down to the row where B = 70, and then go across to the column where C = 10. The 'appropriate' compensation ratio is 2.3 created acres for each acre filled. For concurrent wetland restoration (Figure 3), start at A = 20, go to the row where B = 70, and go across to the column where C = 10. The 'appropriate' compensation ratio is 3.2.

Dealing With Uncertainty

In many cases, it will be difficult to arrive at a point estimate for the values of A, B, C and D. It may also be that because of the uncertainty surrounding an individual creation or restoration project, it is desirable to apply a safety factor to the compensation ratio. The framework provided here can account for uncertainty, without sacrificing the simplicity of the model. Assume, in the case of Figure 1, that the best point estimate of C (years to maximum function) is uncertain, but most experts agree it is between 10 and 15 years. This would result in an 'appropriate' compensation ratio between 2.3 to 2.7. The parties involved in this case may come to some agreement within the 2.3 to 2.7 boundary. The 'appropriate' range of compensation ratios can be determined in this way using the 'best available' estimates of A, B, C and D, and reasonable expectations about the uncertainty surrounding those estimates.

CONCLUSIONS AND RECOMMENDATIONS

The method of analysis described here incorporates the essential factors that should determine an 'appropriate' compensation ratio - namely the level and speed of functional replacement. It is objective and scientifically-based and is easy to apply using the 'best available' scientific evidence or expert consensus.

Using this approach, all that is known about the expected results of a creation or restoration project needs to be expressed in terms of the four parameters A, B, C and D. This may require some reinterpretation of available scientific information and some deliberate focus on fundamental measures of project performance by wetland scientists. However, developing usable estimates of these values for sets of 'typical' mitigation projects in various geographic regions will not require any more information than would be required to evaluate wetland mitigation projects on any other basis. In fact, if the best available scientific evidence and expert opinion cannot be used to develop reasonable approximations of the potential level and speed of functional replacement -- the approximate values of A, B, C and D -- there can be little scientific basis for establishing compensation ratios.

Table 1. Simplified Project Evaluation

Project Type	Performance[1] A	B	C	D	Percent Loss L
Concurrent Creation	0%	70%	10 years	0 years	38%
Advanced Creation	0%	70%	10 years	-5 years	31%
Concurrent Restoration	20%	70%	10 years	0 years	55%
Advanced Restoration	20%	70%	10 years	-5 years	50%
Degraded Wetland	0%	140%	10 years	0 years	-25%

Table 2. Compensation Ratios for Wetland Mitigation Projects

Project Type	Percent Loss	Compensation Ratio	
	L	0% Discount Rate	10 % Discount Rate
Concurrent Creation	38%	1.6	2.3
Advanced Creation	31%	1.4	1.4
Concurrent Restoration	55%	2.2	3.2
Advanced Restoration	50%	2.0	2.0
Degraded Wetland	-25%	0.8	1.2

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[1]A: the level of wetland function at the mitigation site prior to the project;
B: the maximum level of replacement function that is expected after the project has had its full effect;
C: the year when the project is expected to have its full effect; and,
D: the number of years the mitigation occurs in advance of the wetland fill activity.

1. Memorandum of Agreement between EPA and Army concerning the Determination of Mitigation under the Clean Water Act, Section 404(b)(1) Guidelines February 6, 1990.

2. Under the Section 404(b)(1) guidelines "The term practicable means available and capable of being done after taking into consideration costs, existing technology and logistics in light of overall project purpose" (see Section 230.3(q)).

3. According to the MOA "compensatory action should be undertaken when practicable in areas adjacent or contiguous to the discharge site (on-site mitigation). If this is not practicable offsite compensatory mitigation should be undertaken in the same geographic area." (MOA, Section 3.)

4. (Section IIB. pg. 3).

5. A review of the factors affecting compensation ratios and alternative approaches for estimating compensation ratios is contained in Environmental Protection Agency, Region IV, 1990, Kruczyncki, W.L. "Alternative Approaches to Establishing Mitigation Ratios", by EPA, Region IV. Atlanta, 1991.

6. Restoration of Aquatic Ecosystems: Science, Technology and Public Policy. National Academy Press: Forthcoming April 1992.

7. During 1990, for example, a New Jersey Appeals Court rejected a proposal by state and federal agencies for a 7:1 compensation ratio for a wetland mitigation project because of inadequate scientific evidence that this level of effort was required to replace lost wetland function. (See The Environmental Reporter, Spring 1990.

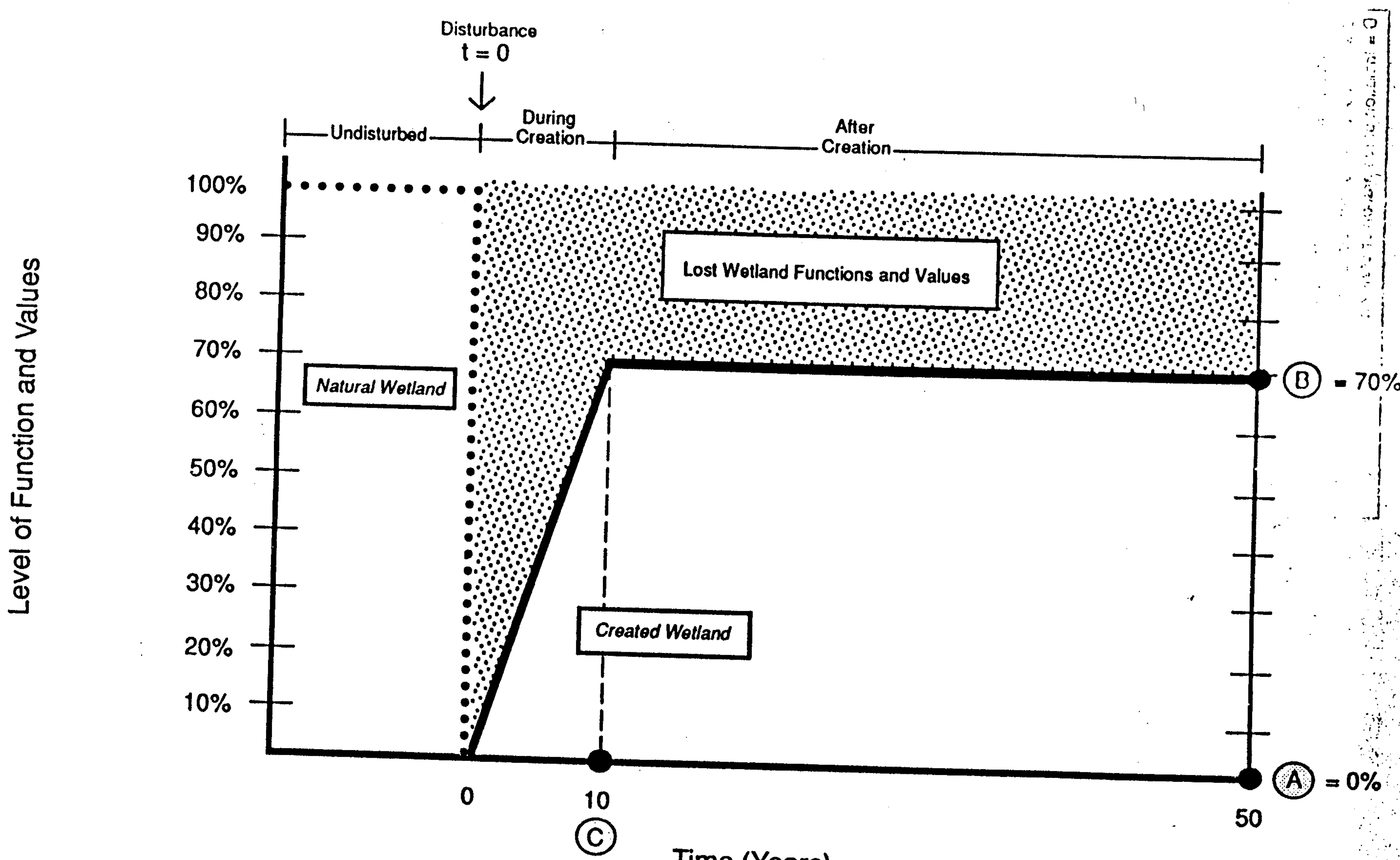
8. The treatment of wetlands and other material resources as natural (as opposed to man-made) capital that generate streams of benefits is described in Costanza, Robert, Ecological Economics, Colombia Press, New York, 1991. The use and nonuse values associated with wetlands and methods of measuring them are discussed in Scodari, Paul, and Dennis King, The Benefits of Wetland Protection, Environmental Law Institute Working Paper, Washington, D.C. February 1992.

9. Adamus, P.R. 1983. A Method for Wetland Functional Assessment: Volume II: The Method. U.S. Department of Transportation, Federal Highway Administration. Office of Research, Environmental Division. Washington, D.C. (No. FHWA-IP-82-24); and Adamus, P.R., E.J. Clairain, Jr., R.D. Smith and R.E. Young. 1987. Wetland Evaluation Technique (WET): Volume II: Methodology. Operational Draft Technical Report, U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS. 1987.

10. "Discounting" is used universally in economic analysis to account for the difference in value of benefits that accrue at different points in time. In the simplest case a dollar received today is worth more than a dollar received in one year because the dollar received today could be invested to yield more than one dollar next year. Most individuals also have a "rate of time preference" that is independent of opportunity cost considerations which renders benefits that accrue sooner more "valuable" than those that accrue later. For a discussion of "discounting" as it applies to market and non-market values and conservation, refer to any basic textbook in natural resource economics.

11. In this case, the "annual relative value" of the created wetland is measured relative to the functions and values of the natural wetland. Therefore, in year 1, the created wetland would have a value of zero, relative to the natural wetland. By year 10, however, the value of the created wetland would equal 70, to reflect the fact that it has achieved 70% of the natural wetland's functions.

Figure 1 - Creation (Concurrent)



A = Level of ecological function prior to restoration
B = Maximum level of ecological functions after restoration
C = Number of years required for restoration to reach Level B

Figure 2 - Creation (Advanced)

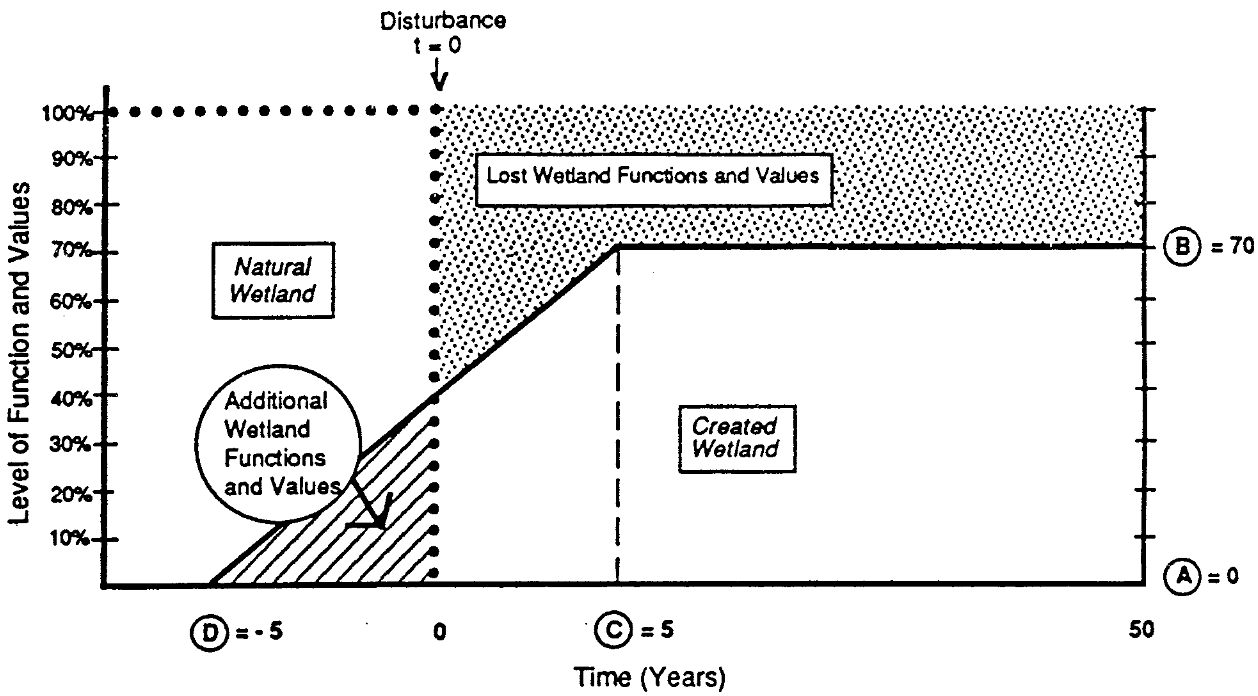
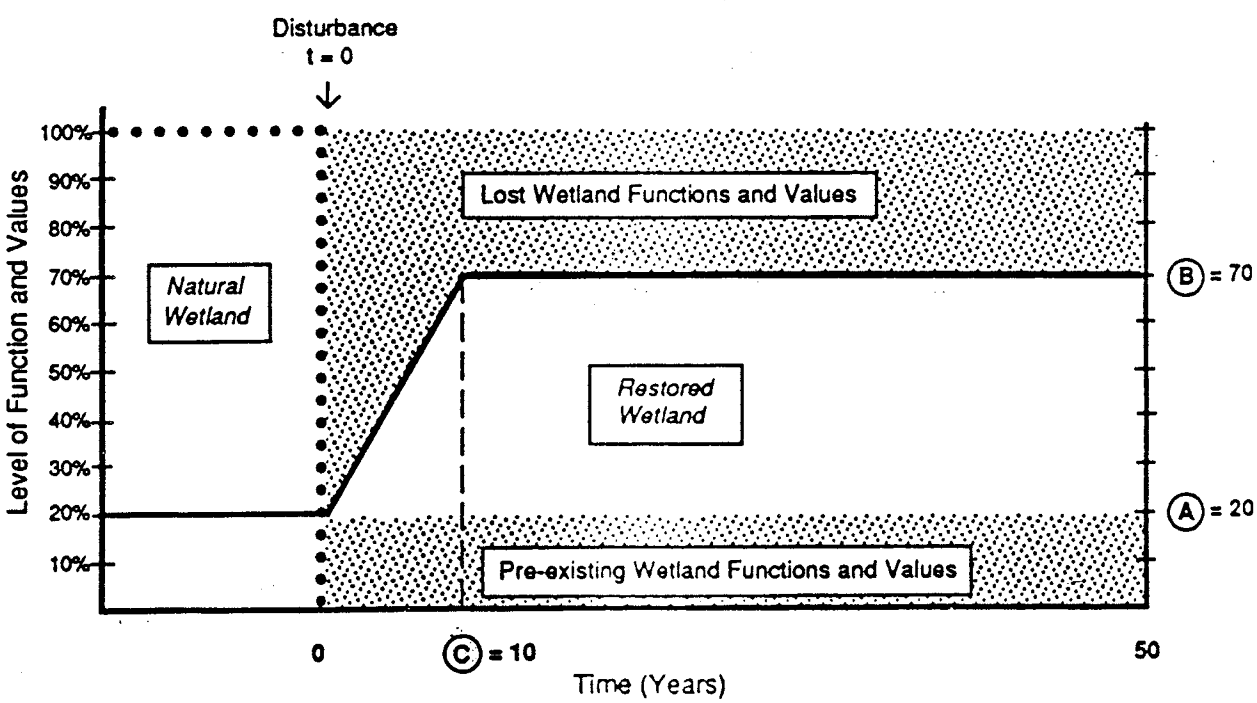


Figure 3 - Restoration (Concurrent)



A = Level of ecological function prior to restoration
B = Maximum level of ecological functions after restoration
C = Number of years required for restoration to reach Level B
D = Initiation of restoration or creation

TABLE 3A

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MITIGATION COMPENSATION RATIOS
CONCURRENT MITIGATION
(using a discount rate of 10%)

Step 1: For the project under consideration, estimate the values of:

A = Initial wetland function as a percent of full natural function (before the project)
B = Maximum restored wetland function as a percent of full natural function (after the project)
C = Years to reach maximum restored wetland function

Step 2: Locate column for the estimated value of A. Read down the A column to the estimated value of B.

Step 3: Read across the B row to the appropriate frame under the value of C to obtain the compensation ratio.

	— VALUE of A —											— VALUE of C —													
	100	90	80	70	60	50	40	30	20	10	0	2	4	6	8	10	15	20	25	30	35	40	45	50
											150	.7	.8	.9	1.0	1.1	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.5
										150	140	.8	.9	1.0	1.1	1.2	1.4	1.7	2.0	2.3	2.7	3.0	3.4	3.7
									150	140	130	.9	1.0	1.1	1.2	1.3	1.5	1.8	2.2	2.5	2.9	3.2	3.6	4.0
								150	140	130	120	.9	1.0	1.1	1.2	1.4	1.7	2.0	2.3	2.7	3.1	3.5	3.9	4.4
							150	140	130	120	110	1.0	1.1	1.2	1.4	1.5	1.8	2.2	2.5	3.0	3.4	3.8	4.3	4.8
						150	140	130	120	110	100	1.1	1.2	1.4	1.5	1.6	2.0	2.4	2.8	3.2	3.7	4.2	4.7	5.2
VALUE of B					150	140	130	120	110	100	90	1.2	1.4	1.5	1.7	1.8	2.2	2.6	3.1	3.6	4.1	4.7	5.2	5.8
				150	140	130	120	110	100	90	80	1.4	1.6	1.7	1.9	2.0	2.5	3.0	3.5	4.1	4.6	5.3	5.9	6.5
			150	140	130	120	110	100	90	80	70	1.6	1.8	2.0	2.1	2.3	2.8	3.4	4.0	4.6	5.3	6.0	6.7	7.5
		150	140	130	120	110	100	90	80	70	60	1.8	2.1	2.3	2.5	2.7	3.3	4.0	4.7	5.4	6.2	7.0	7.8	8.7
	150	140	130	120	110	100	90	80	70	60	50	2.2	2.5	2.7	3.0	3.3	4.0	4.8	5.6	6.5	7.4	8.4	9.4	10.[illegible]
	140	130	120	110	100	90	80	70	60	50	40	2.8	3.1	3.4	3.7	4.1	5.0	5.9	7.0	8.1	9.3	10.5	11.8	13.[illegible]
	130	120	110	100	90	80	70	60	50	40	30	3.7	4.1	4.6	5.0	5.4	6.6	7.9	9.3	10.8	12.4	14.0	15.7	17.[illegible]
	120	110	100	90	80	70	60	50	40	30	20	5.5	6.2	6.8	7.5	8.1	9.9	11.9	14.0	16.6	18.6	21.0	23.5	26.[illegible]
	110	100	90	80	70	60	50	40	30	20	10	11.0	12.4	13.6	14.9	16.3	19.8	23.7	27.9	32.4	37.1	42.0	47.1	52.[illegible]

NOTES: 1). Concurrent mitigation occurs when the creation or restoration project is initiated at the time the natural wetland functions are lost.
2). Based on a straight-line recovery (improvement in function) from A in year 0 to B in year C and throughout a 50 year time horizon.

TABLE 3B

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MITIGATION COMPENSATION RATIOS
FOR FIVE YEAR ADVANCED MITIGATION
(using a discount rate of 10%)

Step 1: For the project under consideration, estimate the values of:

A = Initial wetland function as a percent of full natural function (before the project)
B = Maximum restored wetland function as a percent of full natural function (after the project)
C = Years to reach maximum restored wetland function

Step 2: Locate column for the estimated value of A. Read down the A column to the estimated value of B.

Step 3: Read across the B row to the appropriate frame under the value of C to obtain the compensation ratio.

	— VALUE of A —											— VALUE of C —												
	100	90	80	70	60	50	40	30	20	10	0	2	4	6	8	10	15	20	25	30	35	40	45	50
VALUE of B											150	.4	.5	.5	.5	.6	.7	.9	1.0	1.2	1.3	1.5	1.7	1.8
										150	140	.4	.5	.5	.6	.6	.8	.9	1.1	1.2	1.4	1.6	1.8	2.0
									150	140	130	.5	.5	.6	.6	.7	.8	1.0	1.2	1.3	1.5	1.7	1.9	2.1
								150	140	130	120	.5	.6	.6	.7	.7	.9	1.1	1.2	1.4	1.6	1.9	2.1	2.3
							150	140	130	120	110	.6	.6	.7	.7	.8	1.0	1.2	1.4	1.6	1.7	2.0	2.3	2.5
						150	140	130	120	110	100	.6	.7	.7	.8	.9	1.1	1.3	1.5	1.7	2.0	2.2	2.5	2.8
					150	140	130	120	110	100	90	.7	.8	.8	.9	1.0	1.2	1.4	1.7	1.9	2.2	2.5	2.8	3.1
				150	140	130	120	110	100	90	80	.8	.9	.9	1.0	1.1	1.3	1.6	1.9	2.2	2.5	2.8	3.1	3.4
			150	140	130	120	110	100	90	80	70	.9	1.0	1.1	1.2	1.3	1.5	1.8	2.1	2.5	2.8	3.2	3.6	3.9
		150	140	130	120	110	100	90	80	70	60	1.0	1.1	1.2	1.3	1.5	1.8	2.1	2.5	2.9	3.3	3.7	4.2	4.6
	150	140	130	120	110	100	90	80	70	60	50	1.2	1.4	1.5	1.6	1.8	2.1	2.5	3.0	3.5	3.9	4.5	5.0	5.5
	140	130	120	110	100	90	80	70	60	50	40	1.6	1.7	1.9	2.0	2.2	2.7	3.2	3.7	4.3	4.9	5.6	6.2	6.9
	130	120	110	100	90	80	70	60	50	40	30	2.1	2.3	2.5	2.7	2.9	3.5	4.2	5.0	5.8	6.6	7.4	8.3	9.2
	120	110	100	90	80	70	60	50	40	30	20	3.1	3.4	3.7	4.0	4.4	5.3	6.3	7.5	8.6	9.9	11.1	12.4	13.[illegible]
	110	100	90	80	70	60	50	40	30	20	10	6.2	6.8	7.4	8.1	8.8	10.6	12.7	14.9	17.3	19.7	22.3	24.9	27.[illegible]

NOTES: 1). Advanced mitigation occurs when the creation or restoration project is initiated prior to the loss of the natural wetland function(s).
2). Based on straight-line recovery (improvement in function) from A in year 0 to B in year C and throughout a 50 year time horizon.

Figure 4 - Restoration (Advanced)

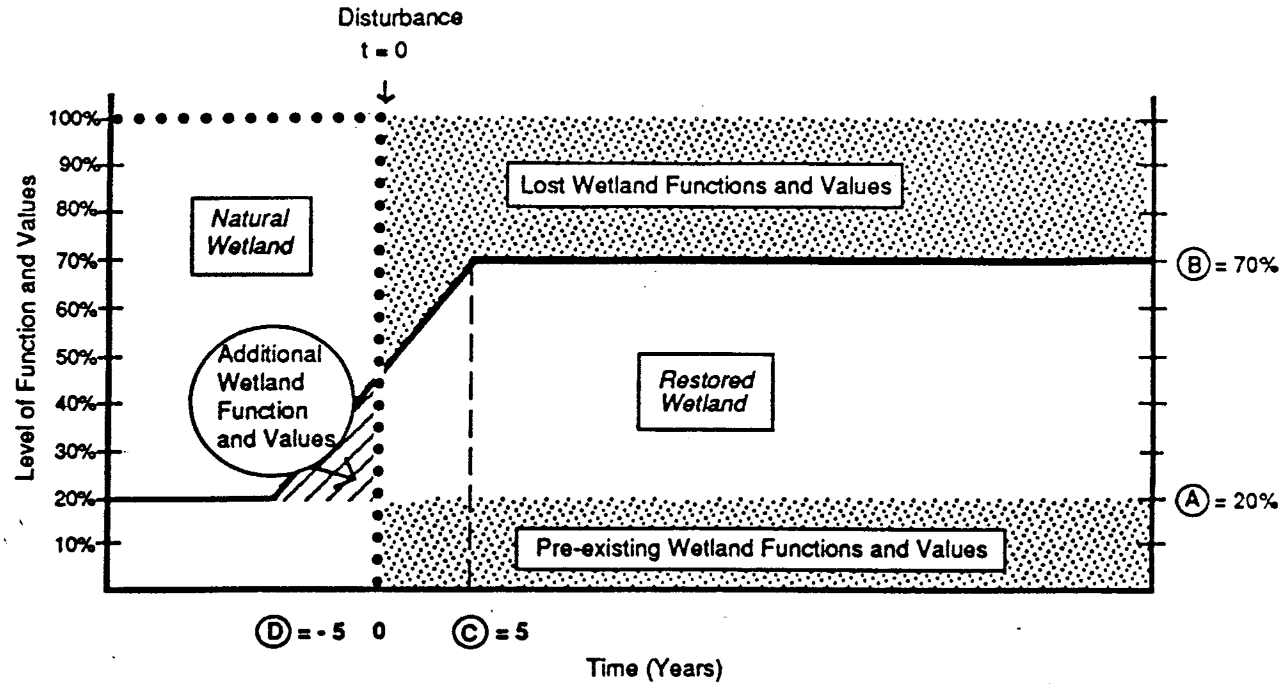
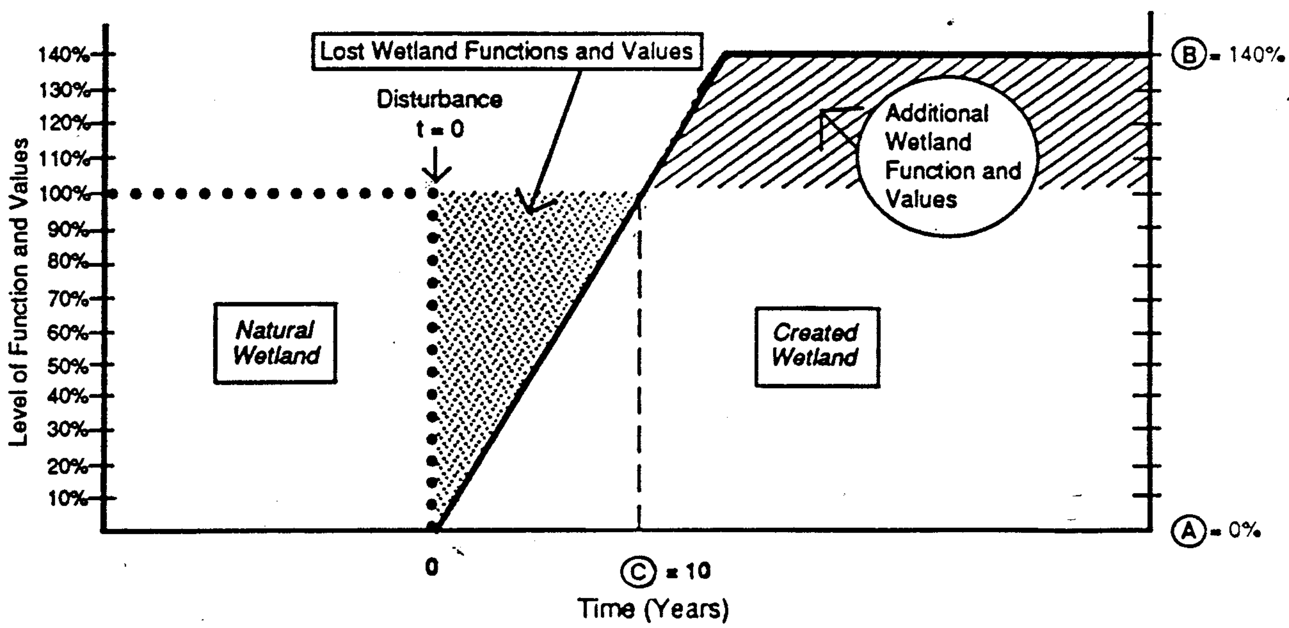


Figure 5 - Degraded Wetland



A = Level of ecological function prior to restoration
B = Maximum level of ecological functions after restoration
C = Number of years required for restoration to reach Level B
D = Initiation of Restoration or creation