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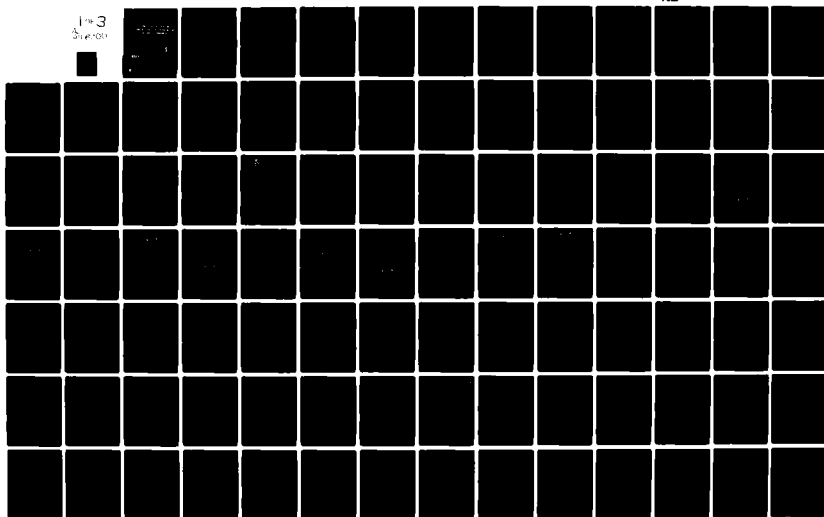
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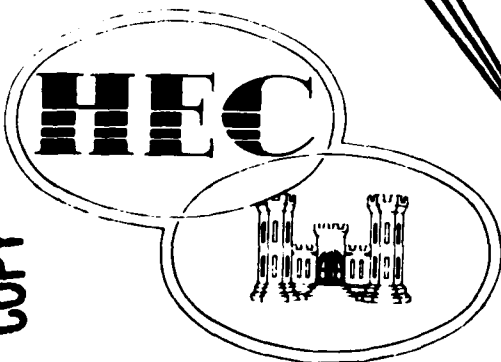
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TRAINING DOCUMENT NO. 7

ANALYSIS OF STRUCTURAL AND NONSTRUCTURAL FLOOD CONTROL MEASURES USING COMPUTER PROGRAM HEC-5C

WILLIAM K. JOHNSON AND DARRYL W. DAVIS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The authors illustrate how various flood control measures can be analyzed using the HEC-5C computer program. Basic principles in flood control planning and damage reduction are examined. Flood plain management measures include those designed to control hydrology and those designed to reduce susceptibility of property to damage. Hydrologic and economic relationships are examined and the affects of different types of flood control measures are presented. Of the eight control methods, levees or floodwalls were found to affect the stream's stage-discharge. (CONTINUED)		

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stage-damage, discharge-damage, and damage frequency relationships. Diversion and flood forecasting affected these relationships the least, but all the methods affected the damage frequency. The HEC-5C program was used to develop systems which maximize net economic benefits. Given an existing system and an array of flood control measures, the strategy proceeds by computing expected annual damages for the existing system; adding any one of the flood control measures and computing expected annual damages; then subtracting expected annual damages with or without the control measure. Finally, the best measure was chosen based upon its final net benefit yield. A final added strategy recomputed costs and benefits by removing one of the control measures to determine if a better net benefit figure would be yielded. The Fall River System of California was used to illustrate how the program functions.

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TRAINING DOCUMENT NO. 7

ANALYSIS OF STRUCTURAL AND NONSTRUCTURAL
FLOOD CONTROL MEASURES
USING COMPUTER PROGRAM HEC-5C

William K. Johnson and Darryl W. Davis

November 1975

The Hydrologic Engineering Center
Corps of Engineers, U.S. Army
609 Second Street
Davis, California 95616

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Appendix I - HEC-5C Selected Output

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ANALYSIS OF STRUCTURAL AND NONSTRUCTURAL
FLOOD CONTROL MEASURES
USING COMPUTER PROGRAM HEC-5C

by William K. Johnson and Darryl W. Davis

INTRODUCTION

This training document is intended to illustrate how a variety of structural and nonstructural flood control measures can be analyzed using computer program HEC-5C, "Simulation of Flood Control and Conservation System." Originally developed in 1973 by Bill S. Eichert, the program has undergone several significant changes to make it a more useful tool in the formulation and assessment of flood control systems. A major addition was the development, by Darryl Davis and Harold Kubik, of an economic routine to compute average annual damages at specified damage centers within the system. This in turn leads to damages reduced or inundation reduction benefits. Its full computational capabilities are described in references 1 and 2.

This document is divided into three parts and illustrates how this model can be used in planning to formulate and assess alternative systems of both structural and nonstructural measures. The first part is a discussion of some basic principles of flood control planning; part II illustrates the application of many of the principles described in part I; the third part contains supportive computer output developed as part of the application in part II.

PART I

FLOOD CONTROL AND DAMAGE REDUCTION

A variety of flood plain management measures are available to reduce flood damage. Their primary purpose is to protect damageable property, both existing and future, and they do this in one of two ways. Either they are designed to control the hydrology, that is, the magnitude or frequency of flooding, or they are designed to reduce the susceptibility of property to damage. The tabulation below shows typical measures of each type (see also reference 5).

Flood Plain Management Measures

<u>Those Designed to Control the Hydrology</u>	<u>Those Designed to Reduce the Susceptibility of Property to Damage</u>
Reservoirs	Flood Proofing
Levee or Floodwall	Relocation
Channel Modification	Flood Warning
Diversion	
Flood Forecasting	

Measures designed to alter the hydrology, either locally or throughout a system, can alter various hydrologic relationships which exist at specific locations. Similarly, measures designed to modify the susceptibility of property to damage can, through the protection they provide, alter economic relationships which exist. Because both hydrologic and economic relationships are used to compute the magnitude of damage

caused by inundation, it is important to understand what these relationships are, and how they can be altered by the various measures.

Hydrologic and Economic Relationships

Stage-Discharge Relationship (Figure 1)

This is a basic hydraulic function which has many uses in water resources engineering. In river channels or flood plains it expresses, for a specific location, the fact that under most conditions, as the river stage increases, the river discharge increases.

Stage-Damage Relationship (Figure 3)

This is the economic counterpart to the stage-discharge function and represents, at a specific location, the magnitude of dollar damages which may occur in a river reach, at a given river stage. Usually the damages represent an aggregate of damages which occur some distance upstream and downstream from the specified location.

Discharge-Damage Relationship (Figure 4)

Stage is a common parameter to both the stage-discharge and stage-damage functions and as such may be used to develop a function relating discharge to damage.

Discharge-Frequency Relationship (Figure 2)

Using historic streamflow records, the exceedance frequency of various magnitudes of annual peak flow can be estimated using statistical techniques. Because exceedance frequency expresses the frequency with which certain events occur over time it is used for computing damages

on an average annual basis, and for determining the degree of protection and risk of various measures. It is developed for a specific location in the system.

Damage-Frequency Relationship (Figure 5)

The common parameter in both the discharge-damage and discharge-frequency relationships is river discharge. By selecting a range of discharges a function relating damages to exceedance frequency can be developed. The integration of this function, that is, determining the area beneath a graphical representation of the function, is the expected annual damages at that location. When various measures are considered in planning the reduction in damages is measured as the difference between the expected annual damages without the measures (existing conditions) and the expected annual damages with the flood control measures in place (modified conditions). Any changes which occur in the stage-discharge, stage-damage, or discharge-frequency relationships will be reflected in the damage-frequency function, and therefore in the magnitude of the expected damage reduction.

Generally, from a national viewpoint, the economic benefits of implementing flood control measures are the economic contributions which result from improving the net productivity of flood-prone land. This improvement may come about by reducing damages to the land under its present and anticipated future use, by allowing for more intensive use, and by attracting new uses. Detailed principles and procedures for computing these benefits are discussed in reference 4. The hydrologic and economic

relationships discussed previously are used to compute damage reduction which is the economic benefit resulting from preventing inundation. Throughout this document economic benefit refers to the damage reduction benefit.

Effects of Flood Control Measures

Reservoirs

The function of a flood control reservoir is to store flood waters during storm periods and release them during periods of lower flow. Because the flow of the stream upon which the reservoir is located is interrupted, the flood frequency at all locations downstream can be altered, that is, the magnitude of flow can be reduced for a given frequency of event. The magnitude of this flow reduction may be small or large depending upon the size of the reservoir, the magnitude and centering of the storm, and the location of the reservoir in relation to the downstream point. Upstream from the reservoir, the streamflow remains unaltered except for any backwater effect which may exist where the stream enters the reservoir pool. A discharge-exceedance frequency relationship at a point immediately downstream would be altered to reflect lower flows for a given exceedance frequency, or alternately for a given magnitude of flow the occurrence is less frequent. This is the direct hydrologic effect of controlling the flow. The economic effect is a reduction in expected annual flood damages brought about by a lessening of the expected magnitude and frequency of flooding.

Because reservoirs can be operated to make releases at desired times, locations and in desired amounts their effect can extend beyond immediate downstream points to other locations in the system. This influence, or system effect, can take many forms, for example,

Timing - the timing of flood peaks at a particular location can be affected with reservoir regulation. Peaks may be made to occur before, after or coincident depending upon operating criteria.

Location - Reservoirs in a system usually operate to reduce flooding at one or more locations. When one location is removed, by providing flood control through some other measure, for example, relocation, it allows the reservoir to operate more effectively for those locations remaining.

Magnitude - The magnitude of flow released from one reservoir in a system influences how much is released from the others and can therefore influence the flood storage remaining.

Levees and Floodwalls

Levees and floodwalls are designed to prevent flooding in areas adjacent to a river or flood plain. They provide a direct means of flood protection in that they can be located where needed and can act to confine flood waters to the channel up to the design discharge. In cases where the levee or floodwall prevents flood flows from occupying areas in the flood plain or channel that normally would be occupied, the river stage will be higher for a given flow. This is caused by a

reduction in cross-sectional area available to carry the flood flow. Downstream, higher flood peaks can occur because valuable flood plain storage was eliminated upstream increasing the concentration of runoff. So while levees and floodwalls have the local effect of increasing the height of the channel's sides and reducing flooding at that location, they can, at the same, have the system effect of increasing flooding downstream.

These changes can alter the hydrologic and economic relationships which exist at a given location by raising the stage-discharge function (assuming less cross-sectional area for a given flow) and by truncating the lower portion of the stage-damage function (assuming no damages will occur below the top of the levee or floodwall). If the reduction in flood plain storage is substantial this could alter the discharge-frequency function downstream, much in the way reducing the storage in a small unregulated reservoir would. The magnitude of these changes depends upon the specific circumstances.

Channel Modifications

Channel modifications are usually designed to increase the carrying capacity of a reach of river. This is often accomplished by increasing the cross-sectional flow area by enlarging the channel; decreasing surface roughness by clearing and snagging or lining the channel; and reducing the energy loss by straightening a channel reach. All of these actions are aimed at passing flows more efficiently, that is, the conveyance area is reduced and velocity increased, resulting in a lowering of river stage

for a given flow, and therefore altering the stage-discharge function. Downstream from the channel modification the magnitude of flow may be greater than without the modification, that is, the magnitude of flow may increase for a given exceedance frequency event. This occurs because the lowering of stage upstream causes less water to be stored in the channel, thus the attenuation effect is less, which again is analogous to the storage effect of reservoirs - less storage, less attenuation. Actual magnitudes of change depend upon the modification and length of river reach.

Diversion

A flow diversion is intended to take water out of the river during high stages and divert it away from the main channel. This has the immediate effect of reducing the amount of flow at all locations below the diversion either by decreasing the magnitude of flow or altering the timing in the case of return flow. At all points below the diversion, the discharge-frequency function will be altered - usually lowered - except where return flow coincides with peak flow in the main channel in which case the total channel flow could be higher than without the diversion. Therefore, two factors - magnitude of diversion and timing of return flow - can influence the manner in which the discharge frequency function is altered.

Flood Forecasting

Knowing in advance where and how much runoff will occur allows flood control measures, such as reservoirs and diversions, to be operated in a

manner such that flows are better controlled at critical damage centers, resulting hopefully, in lower damages than without forecasting. Knowing what flows to expect 12, 18, 24 hours in advance is better than taking them as they come. Knowledge of future flood events usually comes from a real-time flood forecasting network which includes rainfall and stream-flow measuring equipment located throughout the basin with data fed into a central control which forecasts estimates of runoff and regulates reservoirs and diversions to minimize flood damage downstream. In terms of the hydrologic functions, the regulated discharge-frequency relationship downstream from reservoirs and diversions may be modified in that information which alters the operating decisions may result in different magnitudes of flow downstream. There would be no change in the stage-damage function.

Flood Proofing

As the name implies flood proofing is the protection of damageable property from flood waters. This usually means protecting individual structures and its contents. A variety of construction methods and materials are available to provide this protection, their use being determined by the type, location and susceptibility to damage of structure and contents. When protection is provided and a structure or group of structures are 'flood proofed' the relationship between stage and damages is modified since it is expected that less damage will occur for a given stage, up to the elevation of flood proofing. How this function will look will depend upon the type and extent of flood proofing. The hydrology will remain unchanged unless the flood proofing measures

result in a significant change to the flow area. In the context of system operation the existence of flood proofing lessens the need for control at that location, thus operation can be focused on other locations with higher damage potential.

Relocation

From the standpoint of strictly preventing flood damage, relocation can be completely effective if the structures are moved to a location free of potential flood damages. By removing damageable property from areas susceptible to floods there is no need for control or protection and no damage occurs. Unfortunately, this is not always a feasible alternative, however, it does play an important role as an alternative in some cases. The effect of relocation is to modify the stage-damage function by removing damageable property. If all damageable property is removed there would be no expected damages, if only a portion of the damages were removed the function would be modified accordingly.

Flood Warning

A reasonable advance warning can allow temporary measures to be implemented to protect or remove damageable property. For example, the evacuation of movable property or the raising or sandbagging of property which must remain. Flood warning is a combination of flood proofing and evacuation, and while it is not as dependable as the permanent measures it can help to reduce potential damages. Only the economic functions are altered as described in the sections on flood proofing and evacuation.

Summary

A summary of the direct effects of all the measures on each of the hydrologic and economic relationships are shown below. Each relationship is assumed to be at or downstream of the respective measure, for example, for a reservoir the direct effect is downstream, for a levee it is at the site.

Direct Effects of Flood Plain Management Measures on Hydrologic and Economic Relationships

Hydrologic and Economic Relationships
(at or downstream from the measure for existing conditions) NC = No Change M = Modified

<u>Measure</u>	<u>Stage-discharge</u> ^{1/}	<u>Stage-damage</u> ^{2/}	<u>Discharge-damage</u>	<u>Discharge-frequency</u> ^{3/}	<u>Damage Frequency</u>
Reservoir	NC	NC	NC	M	M
Levee or Floodwall	M	M	M	NC	M
Channel Modification	M	NC	M	NC	M
Diversion	NC	NC	NC	M	M
Flood Forecasting	NC	NC	NC	M	M
Flood Proofing	NC	M	M	NC	M
Relocation	NC	M	M	NC	M
Flood Warning	NC	M	M	NC	M

1/ Where a reservoir or diversion significantly modifies the channel flow, deposition or erosion of channel material could alter the channel cross-section and thus the stage-discharge relationship. Also, removal or placement of damageable property in the floodplain could result in modifying the function.

2/ Along river reaches which have no floodplain regulation measures, such as a reservoir, could induce development onto the floodplain thus increasing the amount of damageable property and altering the stage-damage

function.

3/ Levees or channel modifications which reduce channel storage will probably not have an appreciable effect on the discharge-frequency relationships at their location, but could alter this relationship downstream.

SYSTEM FORMULATION

The major problem of system formulation is determining what combination of measures will produce the 'best' system. Three pieces of information can be useful in answering this question. First, information which provides an understanding of what each measure can do and under what conditions it is effective. This subject was discussed in the previous section. Second, a strategy for formulation - a rational, systematic approach which is likely to yield a 'better' system than if the approach were not followed. Third, a means to assess the overall performance of each system so that a 'best' system can be selected. Formulation strategies will be discussed below and the subject of system performance in the section which follows.

Formulation Strategies

At the plan formulation stage a variety of information is available both about the problem, the capability of measures to reduce or eliminate the problem, about public preferences, institutional guidance, and cost sharing capability. This is all important information and will influence not only the formulation of alternative plans, but their selection. How to utilize this information in a rational, systematic manner is the question to which formulation strategies hope to provide answers. A variety of approaches have been used in the past. These are identified and discussed in reference 3. The discussion which follows will utilize the mathematical model approach as a means to formulate alternatives to achieve the national economic development objective. Specifically, this means using simulation

model HEC-5C to develop systems which maximize net economic benefits, the traditional surrogate criterion for national economic development(6). Although there are other approaches which do not use mathematical models for formulation, models are still useful for assessing a system's performance and HEC-5C has the capability of analyzing a system's hydrologic and economic performance regardless of the strategy used to develop the system.

The principle of maximization of net economic benefits is applied by computing for each system or measure the flood damages and costs with and without the measure. The economic benefit derived from inundation reduction is the difference in damages with and without the measure. The difference between the benefits and costs is the net economic benefit. The objective of a strategy using this principle is to identify the system of measures which maximizes the net economic benefit. Two strategies useful for achieving this objective are discussed below:

First Added Strategy

Given an existing system and an array of flood control measures which are to be considered as possible additions to the existing system this strategy proceeds as follows:

- Compute the expected annual damages for the existing system.
- Add one of the flood control measures to the existing system and compute the expected annual damages.
- Subtract the expected annual damages with and without the flood control measure. (This difference represents the expected benefits of implementing the flood control measure.)

- Subtract the cost of the measure from the expected benefits, this difference is the net benefit.
- Remove the measure being considered from the existing system, add another measure to the existing system and repeat the computations. This procedure is repeated until all the measures being considered have been added individually to the existing system and their net benefits computed.
- That measure which provides the greatest net benefits (greatest positive value) is selected for inclusion in the existing system. This new system becomes the base system and the process is repeated by adding each measure one at a time, computing net benefits and selecting the next measure to be added. When no measures yield positive net benefits that is the system with maximum net benefits.

Table 1 contains information adapted from a recent study and illustrates this strategy. Flood control measures A-J are proposed for inclusion within the system. Measures A, C, and E have already been implemented. Stage 1 represents the 'first added' value of proposed measures. The incremental value (net benefits added) by measure F is the largest so it is selected for inclusion in the system. Stage 2 represents the 'first added' value of the measures with the base system now comprised of measures A, C, E, and F. Note that many of the values change because of system effects. Measure J is selected for addition to the system. The remainder of the table contains the analysis through to completion.

TABLE 1
FIRST ADDED FORMULATION STRATEGY

Measure	First Added Value (\$1000 per year) ^{1/}				Formulated System
	Stage 1	Stage 2	Stage 3	Stage 4	
A*	--	--	--	--	A
B	20	5	-2	-3	
C*	--	--	--	--	C
D	16	16	16**	--	D
E*	--	--	--	--	E
F	35**	--	--	--	F
G	-10	0	0	0	
H	6	-12	-12	-15	
I	-2	-2	-2	-2	
J	15	18**	--	--	J

^{1/}First added value is system net benefits with the measure added minus system net benefits without the measure added.

* Signifies existing system

**Signifies system addition

The name 'first added' is derived from the fact that each measure is considered as being the only or 'first' measure added to the existing or base system. The objective of this strategy is to identify that measure which will be the most help in reducing flood damages, add it to the existing system then seek out the next most effective measure and so on. Being able to identify the most effective measures is the advantage of this strategy. Unfortunately this is only a partial advantage. As measures are added the base system changes and a different base system may yield

different expected annual damages. For example, in Table 1 suppose that at stage 1 measure B was added instead of F, this would change the net benefits of all measures at stage 2 and perhaps D instead of J would yield the higher value. One might argue that it's improper to select B over F since F is a more effective measure. This would be correct if only one measure or a given level of damage reduction were sought, but as long as the sole criterion is maximization of net benefits it's the final system which is sought not the method by which one gets there. If by adding B before F in the strategy the final system included measures I and yielded more benefits then it would be a better system. The point is that one cannot be sure that by formulating a system using the 'first added' strategy the system with the maximum net benefits will result - there will always linger the feeling that there may be another combination of measures that may be better. In practice this problem may be more imaginary than real.

Last Added Strategy

As one might surmise from the name, this strategy considers all proposed measures added to the existing system and removes them individually one at a time, hence the name 'last added'. The procedure is as follows:

- Add to the existing system all proposed measures and compute the expected annual damages.
- Remove one of the measures from the system and compute the expected annual damages.
- Compute the difference in expected annual damages with and without the measure. This is the expected annual benefit of implementing the measure, i.e., adding it to the system.

- Subtract the cost of the measure from the expected benefits, this difference is the net benefits of adding the measure.
- Add the measure back into the system and remove another measure and repeat the computations. This procedure is repeated until all measures have been removed individually from the system and their net benefits computed.
- That measure which provides the least net benefits (greatest negative value) is removed permanently from the system. This new system becomes the base system and the process is repeated by subtracting each measure one at a time, computing net benefits, and selecting the next measure to be deleted. When all measures exhibit positive net benefits that is the system with the maximum net benefits by this strategy.

Table 2 contains information adapted from a recent study and illustrates the strategy. Flood control measures K through T are candidates for inclusion within a system. Measures L, P, and R have already been implemented. Stage 1 represents the 'last added' value of the measures. The incremental value (net benefits) lost by adding measure Q in the last position is the greatest (-30) so it is selected for deletion from the system. Stage 2 represents the 'last added' value of each measure with the base system now excluding component Q. Note that a number of the values have changed because of system effects. Measure K is selected for deletion. The remainder of the table contains the analysis through to completion.

TABLE 2
LAST ADDED FORMULATION: STRATEGY

Measure	<u>Last Added Value (\$1000 per year)^{1/}</u>				Formulated System
	<u>Stage 1</u>	<u>Stage 2</u>	<u>Stage 3</u>	<u>Stage 4</u>	
K	-20	-10**	--	--	
L*	--	--	--	--	L
M	10	0	-4**	--	
N	6	6	6	8	N
O	3	3	3	12	O
P*	--	--	--	--	P
Q	-30**	--	--	--	
R*	--	--	--	--	R
S	0	-6	12	10	S
T	-2	0	0	2	T

^{1/}Last added value is system net benefits with the measure in the system minus system net benefits without the measure added.

* Signifies existing system.

**System measure that is dropped.

The 'last added' differs from the 'first added' strategy by the base system which is used to build upon and by its basic objective. The 'last added' begins with the existing system plus all proposed measures; the 'first added' begins with the existing system. Because each strategy will result in the formulation of different combinations of measures each strategy could arrive at a different system. However, as was mentioned in connection with the 'first added' strategy the realities of using other information and approaches in formulation, and the

gap between authorization and appropriation may minimize any significant differences. The 'last added' strategy does, however, introduce some complexities to the analysis where more than one measure at a location affects the same hydrologic or economic relationship. In this situation caution must be exercised to insure that the proper hydrologic and economic relationships are used. For example, a levee project has associated with it a particular stage-discharge relationship. Similarly, a channel modification project creates a unique stage-discharge relationship. When both are considered as alternative measures at the same location it would be necessary to develop a combined stage-discharge function when both are included in the 'last added' strategy. When one measure is removed the combined function would be replaced by the function for the measure remaining. A similar problem develops when considering flood proofing and relocation as alternative measures. If both are added to the system, as would be required for the 'last added' strategy, one may be redundant. For example, if all damageable property were removed there would be no need to flood proof. If, however, only a few structures were relocated and the remainder flood proofed both measures could be included provided a combined stage-damage function were developed. Combining relationships and avoiding redundant measures is not necessary when using the 'first added' strategy since each measure comes into the system one at a time.

While the objective of the 'first added' is to find the most effective measure to add, the objective of 'last added' is to find the least effective measure to delete. A reasonable strategy combining the two is

to apply the first and last added strategies through sufficient stages to identify those components that are obviously good, and to screen out those that are obviously inferior and zero in on the system to be selected by analyzing logical combinations of the remainder.

ASSESSMENT OF SYSTEM PERFORMANCE

Once alternative flood control systems have been formulated their performance should be assessed as the next step towards evaluation and selection. Assessment means an impartial, objective, factual display of the system performance. System performance refers to how a system functions. Whether this behavior is good or bad depends upon how it is supposed to function, and this in turn depends upon the purpose for which it was designed. The purpose of a flood control system is to reduce flood damages and its performance is measured by the extent to which this purpose is achieved and the manner by which it is achieved. Several measures of performance are described below and summarized on page 26.

Degree of Protection and Risk

Degree of protection is a measure of the hydrologic effectiveness of a system, expressed as the exceedance interval of the event that can be controlled to nondamaging flows. For example, 50-year protection means that, at a specific location, the peak flow of a flood with an exceedance interval of 50 years is not expected to exceed the nondamaging channel capacity at that location. Theoretically the flood peak and nondamaging

channel capacity are just equal; thus a flood with an exceedance interval of 51 years would exceed the nondamaging flow. It is important to recognize that degree of protection is associated with a specific location and discharge-frequency relationship. It is tied to location in the sense that it measures the protection, at a particular damage center, provided by measures either at that location or at other locations in the basin. It depends upon the discharge-frequency relationship because it is from this relationship that the exceedance interval is determined; and the frequency relationship itself is developed for a specific location.

Often the procedure for developing the modified function is to select hydrologic events with peak flows over the range covered by the unregulated frequency curve. The system's response to each event is then simulated and the resulting modified peak flow determined. Assuming the same exceedance frequency as the unregulated flow the regulated flow is then plotted to produce a modified frequency curve. Centering an event where a particular flood control measure will be effective in reducing peak flow will produce a different modified curve than if the centering were in a part of the basin where the measure could not be effective. Therefore, care must be exercised when selecting the events to be simulated so the relationship is as unbiased as possible. This is more a problem for large basins where the geographic differences between centerings can be large, than for small basins where there is less latitude for centering. Once a modified discharge-frequency relationship is developed the degree of protection is determined by finding the exceedance

interval for the nondamaging flow. The degree of protection for unregulated or existing conditions can be determined in the same manner using the appropriate frequency relationship.

Risk is defined as, "the probability that one or more events will exceed a given flood magnitude within a specified period of years." How does this differ from exceedance frequency and degree of protection? Both exceedance frequency and degree of protection, in their normal usage reflect the probability of an event being exceeded during any one year. Risk on the other hand usually refers to a probability not in any one year, but in some other specified time period. For example, to say a location has a 100-year level of protection is also to say that there is a 1% (1/100 year) chance that a flood will exceed that given level of protection during the next year. Or, put another way, there is a 1% risk. However, if instead of any one year we want to know the risk or percent chance of exceedance during the next 30 or 50 years, these values are 25% and 40%, respectively (see the data on next page). The graph on page 24 shows in graphical form the percent risk of one or more flood events being exceeded for a range of annual exceedance frequencies and periods of time. Risk is important as a hydrologic effectiveness criterion because it reflects the higher probability associated with a period longer than next year. And this is important because it conveys a more realistic picture of probable future conditions.

Estimated Risk*
Exceedance Frequency = 1% Annually

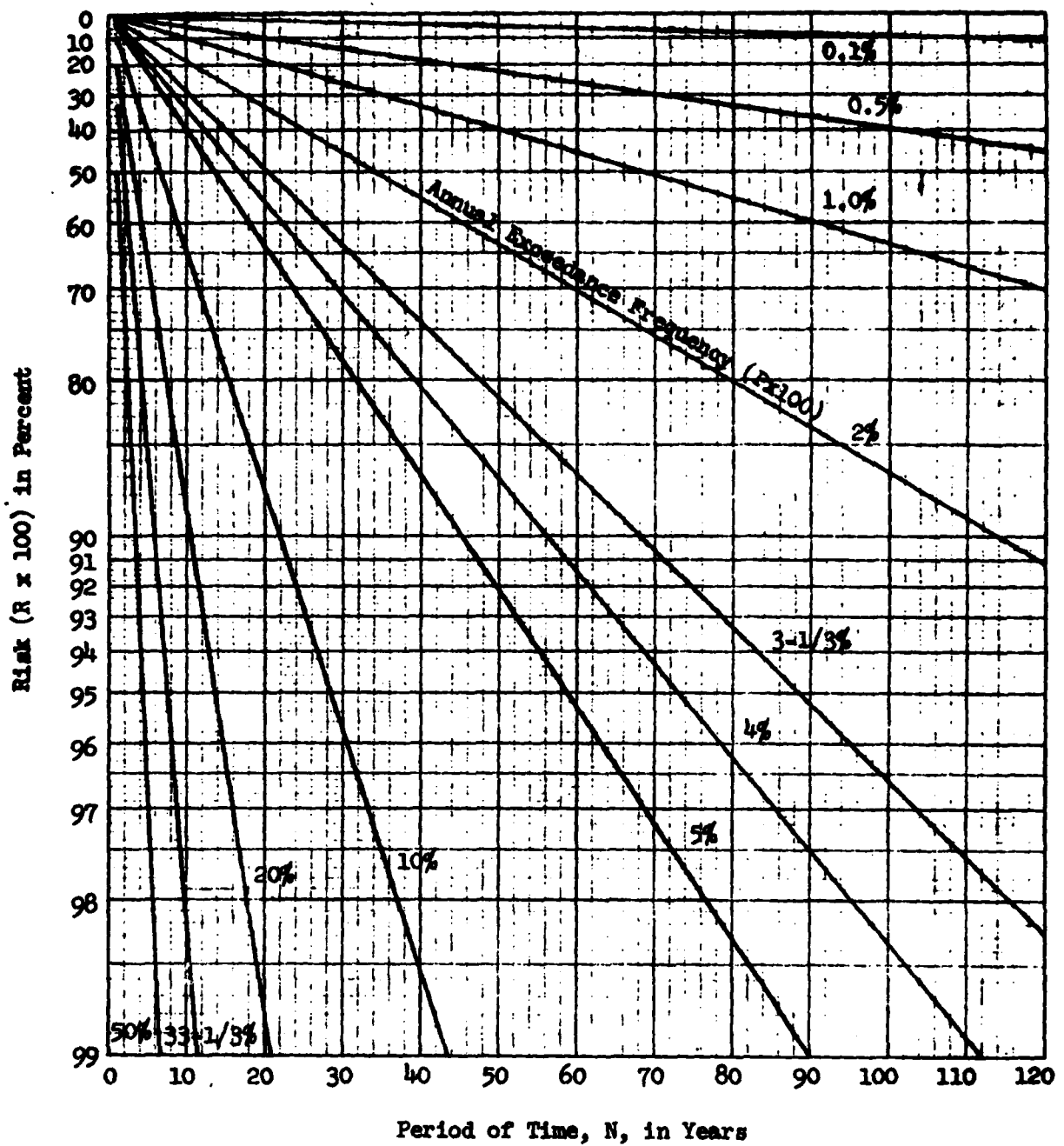
<u>Period of Time In Years</u>	<u>Risk (in percent) One or More Events</u>
30	26
50	40
70	50
100	63

*From Appendix 10, "A Uniform Technique for Determining Flood Flow Frequencies (Draft)," U.S. Water Resources Council, 3 December 1974.

When assessing system performance using degree of protection or risk criterion the effectiveness of alternative measures or systems is determined by comparing these criterion at each location with each measure. While it is not likely that one degree of protection or one percent risk can be assigned to the system as a whole, it is still useful to assess effectiveness by looking at each location within a system. Used in this way degree of protection and risk provide a useful hydrologic criterion to complement the economic measures of performance.

Damage Reduction

Damage reduction is a measure of economic effectiveness, usually expressed as the actual dollar value of the difference in expected annual damages with and without proposed flood control measures or as a percentage of the total expected annual damages. Expected annual damages are computed as described previously and the reduction represents the flood control benefit of the measure or system being considered. As a measure of performance it tells how well a measure or group of measures is achieving



RISK OF ONE OR MORE FLOOD EVENTS EXCEEDING
A FLOOD OF GIVEN ANNUAL EXCEEDANCE FREQUENCY WITHIN A PERIOD OF YEARS

From Appendix 10, "A Uniform Technique for Determining Flood Flow
Frequencies (Draft)," U.S. Water Resources Council, 3 December 1974.

its intended purpose, i.e., reducing damages caused by flooding. Because this reduction is expressed in average annual terms it is representative of the average damages likely to occur over a full range of hydrologic events.

Benefit-Cost Ratio

The most common measure of economic efficiency is the benefit-cost ratio, that is, dollar benefits per unit cost. As a measure of system performance it represents the capability of a system or measure to achieve its desired purpose (reduce flood damages) with a given amount of resources (capital, O&M and replacement costs). It is computed by dividing the total reduction in damages by the total cost of those measures required to achieve that reduction. Unlike damage reduction alone the benefit-cost ratio accounts for cost. This is important because it indicates how much must be committed to obtain that level of economic performance.

Net Benefits

Another measure of economic performance is net benefits. Usually expressed as average annual dollar benefits minus average annual dollar costs. In flood control planning it is an economic objective of formulation to maximize the net benefits. Flood control measures are added as long as each measure's net benefits are positive, or alternately the incremental benefit-cost ratio is positive. This insures a benefit-cost ratio equal to or greater than one (the minimum acceptable level of efficiency). Net benefits complement the other two economic performance criteria, damage reduction and benefit-cost ratio; damage reduction being

a measure of the expected reduction in economic loss, benefit-cost ratio the measure of economic efficiency and net benefits the total dollar contribution of the plan.

TABLE
Summary of
System Performance Criteria

<u>Criteria</u>	<u>Units</u>	<u>Measures</u>
Degree of Protection	exceedance interval, years	hydrologic effectiveness
Risk	percent chance	hydrologic effectiveness
Damage Reduction	average annual dollars	economic effectiveness
Benefit-Cost Ratio	dollar benefits per dollar cost	economic effectiveness
Net Benefits	average annual dollars	economic effectiveness

REFERENCES

1. The Hydrologic Engineering Center, U.S. Army, Corps of Engineers, "HEC-5C, Simulation of Flood Control and Conservation Systems," Users Manual, November 1974.
2. Eichert, Bill S., "HEC-5C, A Simulation Model for System Formulation and Evaluation" in Proceedings of a Seminar on Analytical Methods in Planning, The Hydrologic Engineering Center, U.S. Army, Corps of Engineers, March 1974.
3. Johnson, William K., "Approaches for Developing Alternatives in Planning," Water Resources Bulletin, American Water Resources Association, Vol. 10, No. 5, October 1974.
4. U.S. Army, Corps of Engineers, Engineering Circular 1105-2-12, "Evaluation of Economic Benefits for Flood Control and Related Water Resources Planning," 28 June 1974.
5. Hagen, Vernon K., "Formulating Flood Control Capability of Water Resource Projects," in Proceedings of a Seminar on Hydrologic Aspects of Project Planning, The Hydrologic Engineering Center, U.S. Army, Corps of Engineers, March 1974.
6. U.S. Army, Corps of Engineers, Engineering Pamphlet 1165-2-1, "Digest of Water Resources Policies," January 1975, page A-35.

PART II

FALL RIVER: AN EXAMPLE USING HEC-5C

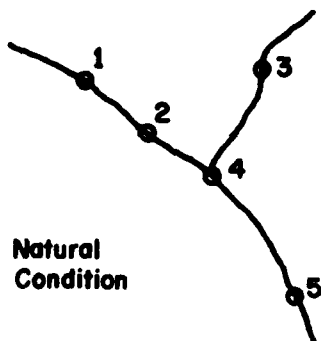
If it were desired simply to provide flood protection at a single location and assess the performance of alternative measures, computer simulation may not be necessary. But where many locations are involved and these locations are interrelated such that what happens at one location influences another, then computer simulation can make a significant contribution to both formulation and assessment. HEC-5C is a simulation model which simulates the operation of flood control systems and can accommodate all of the flood plain management measures discussed previously. It has the capability to compute net benefit information for use with the 'first' and 'last added' formulation strategies. Once formulated, a system's performance can be assessed using hydrologic and economic information output by the model.

To illustrate the use of the program, the Fall River System shown on the next page will be used. In its natural (unregulated) condition, flooding caused extensive flood damages in the vicinity of control point 4. To reduce flood damages, two reservoirs have been constructed in the basin at control points 1 and 3. Although they have been effective in reducing damages, flooding still occurs and an array of measures are being investigated to help reduce the remaining flood hazard. Each of these systems - natural (unregulated), existing, and those with proposed measures will be analyzed using HEC-5C. A brief discussion of the input data cards

required to model each condition and some of the output results are contained in the text. Appendix I contains selected output.

Natural (Unregulated) Condition

A major storm which occurred 5-10 June 1952 was selected from hydrologic records to be representative of major flood events. Local inflows to the river resulting from this storm were computed at five control points using unit hydrograph techniques. Table 1 summarizes the results in 6-hour time periods. Also, shown in Table 1 are channel capacities and routing criteria for the river system. Figures 1 and 2 show the stage-discharge and discharge-frequency relationships for control point 4, also developed from hydrologic studies.



Damage surveys in the vicinity of control point 4 were conducted in 1952 and have been updated periodically. A stage-damage relationship for control point 4 is shown in Figure 3. Expected annual damages are computed by combining the stage-damage and stage-discharge relationships into a discharge-damage curve (Figure 4), combining this with the discharge-frequency curve to obtain the damage-frequency relationship

(Figure 5) and then integrating under the curve. These data are presented in tabular form in Table 2.

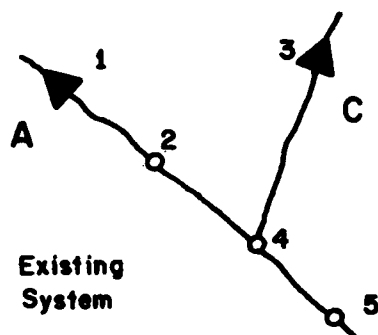
All necessary data to simulate the river system in its natural condition has been developed. These data are arranged according to the input format for HEC-5C. Input data and the simulation output are shown in the Appendix I, pages 2 through 15. Because of a requirement in the HEC-5 program that the control point furthest upstream be a reservoir, it is necessary to put in a dummy reservoir at control points 1 and 3. Thus, two sets of reservoir cards RL, RO, RS, and RQ are included to represent these reservoirs. Since they store no water, they have no effect on the system.

Only the simulation results for flood number 2, ratio 1.0, are shown in the output data. The other flood ratios .3, 1.5, 2.0, 3.0 and 4.0 were computed and printed out, but are not included to keep Appendix I brief.

Results of the simulation indicate that expected annual flood damages for the base (natural) condition are \$1,721,300 (Appendix I, page 12). Since there were no modifications, there is no reduction in damage and all damages result from uncontrolled runoff. The maximum (6-hour average) flow occurring at control point 4 is 194,036 cfs (Appendix I, page 9) for flood 2. The nondamaging channel capacity is 35,000 cfs. From the frequency plot for control point 4 the exceedance interval for the non-damaging flow is approximately 1 year.

Existing System (Reservoirs A and C)

The sketch below shows the Fall River system with flood control reservoirs located at control points 1 and 3. This is the system as it now exists. To simulate the system operation, information is needed about reservoir storage levels, outlet capacity, and operating criteria. A summary of this information is tabulated in Table 3. Input cards J1, J2, RL, RO, RS, RQ and ID are used to carry the data required to describe the two reservoirs. Appendix I, pages 16 through 28, shows both input and output data under this condition.



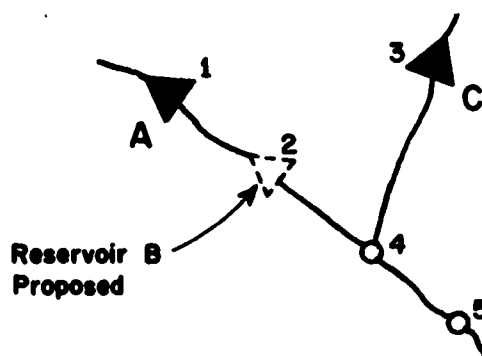
Adding two reservoirs to the natural system results in regulating the river flow below the reservoirs. Local inflow below the reservoirs, however, still remains uncontrolled. A 10% contingency allowance is made for forecasting streamflow two time periods in advance. These data are shown in fields 2 and 3 of the J2 card. The effect of regulation on the basic curves used to compute flood damages is to modify the discharge-frequency curve at all downstream control points. This modified curve is computed internally in the program using results from several simulations for a range of selected flood ratios. See Appendix I, page 27, for

a printer plot of these data. The nondamaging flow is still 35,000 cfs, and from the modified frequency plot the degree of protection is now approximately 2 years.

Simulation results show expected annual flood damages at control point 4 of \$696,320 with the two reservoirs (Appendix I, page 28). This is a reduction in damages from natural conditions of \$1,024,470. Uncontrolled local flow causes an expected \$525,750 in annual damages. For flood 2 the maximum flow occurring at control point 4 is 92,483 cfs (Appendix I, page 23). This is a substantial reduction (101,543 cfs) over unregulated conditions.

Reservoir B at C.P. 2

A reservoir is proposed for control point 2, shown below, as a means to further reduce flood damages at control point 4. The storage, outlet capacity, and operating criteria of Reservoir B were obtained from preliminary design studies and are tabulated in Table 4. The major effects of Reservoir B are to control local runoff between control points 1 and 2, and to store water above the capacity of Reservoir A. This modifies the discharge-frequency relationship at control point 4, and further reduces flood damages.



To simulate the system with Reservoir B added, it is necessary to input at control point 2 the reservoir information shown in Table 4. This is done by using the RL, RO, RS, and RQ cards. The ID card is modified to indicate that a reservoir exists at control point 2. Since any reduction in potential damages brought about by the reservoir must be computed as a reduction from damages anticipated under existing conditions, the damages remaining with the existing system - \$696,920 - are input using the DB card. Appendix I shows the specific input changes.

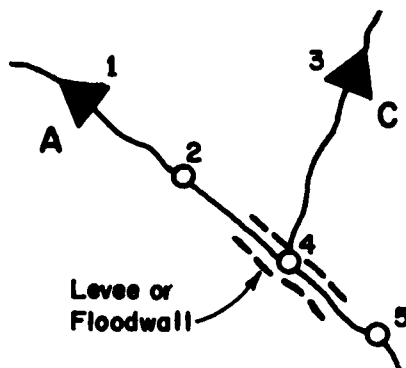
Tabulated on Table 5 are cost data for Reservoir B and other flood control measures. These data are input using the R\$ card for the capital cost, and the CP card for the percentage of the capital cost estimated for operations and maintenance. The capital recovery factor is also input using the CP card.

Results of the simulation show expected annual flood damages with Reservoir B in place to be \$214,550 (Appendix I, page 42). This is an annual reduction of \$482,270. Flood condition number 2 results in a maximum average 6-hour flow of 34,000 cfs at control point (Appendix I, page 36). The degree of protection with Reservoir B is between 10 and 15 years as determined from the modified frequency relationship at the nondamaging flow of 35,000 cfs.

Levee or Floodwall

Another alternative measure is to provide local protection in the form of levees or floodwalls along the main river channel in the vicinity

of control point 4. The primary hydrologic effects of levees or floodwalls is to increase non-damaging channel capacity by raising the channel sides, and to alter the routing criteria in the vicinity of the modification. This results in a change to the stage-discharge, stage-damage, and discharge-damage relationships at the control point.



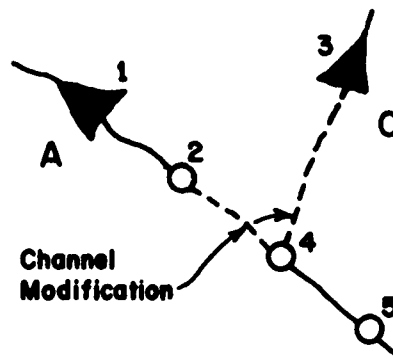
In the simulation model, increased channel capacity is taken into account by changing the maximum value specified on the CP card. The change to the stage-damage relationship may be handled in either of two ways. The first is to specify a design discharge on the CS card corresponding to the maximum nondamaging stage (Figure 6 and 7). No damages would be computed below this value. The second approach is to input on the DC cards, a modified discharge-damage relationship showing zero damages below the nondamaging discharge (Figure 8). Taking this latter approach, two sets of discharge-damage functions - one base condition, one modified condition - are prepared as input. This is shown in Appendix I, page 44. In this example, the routing criteria and stage-discharge relationship were not modified to account for the change in river cross-section because it was

assumed the levee or floodwall would not extend very far either upstream or downstream of control point 4; hence, the hydrologic effect would be small. If it were desired to change these functions it would be necessary to develop storage-outflow relationships for the reach, or based upon experience with similar levee or floodwall measures, make an estimate of what this new criteria might be. Whether or not this would be worthwhile depends upon the extent of the change and the level of detail desired in the study.

The simulation results indicate expected annual damages were reduced \$441,000 (Appendix I, page 56) and that there will remain \$255,020 in damages. The maximum 6-hour flow for flood 2 at control point 4 was 110,411 cfs (Appendix I, page 51). The degree of protection would be 30-40 years and the nondamaging channel capacity 237,000 cfs.

Channel Modification

Modification of the existing channel between control points 2, 3 and 4 offers another way to reduce flood damages. This measure includes cross-section enlargement, straightening, and clearing and snagging. The objective is to increase the channel carrying capacity to pass the same flow at a lower stage, or alternately, to pass a greater flow at the same stage. The hydrologic effects of channel modifications are similar to those caused by levees and floodwalls - increased nondamaging channel capacity, modified stage-discharge relationship, and modified routing criteria.



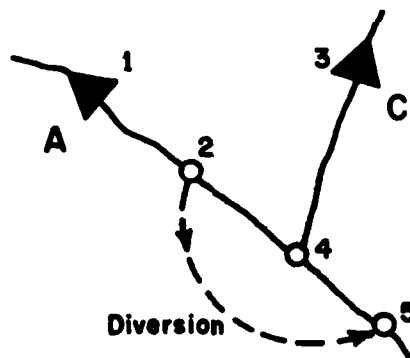
Increased channel capacity is input into the simulation model using the CP card. The change in the stage-discharge (Figure 9) relationship caused by an enlarged channel cross-section must be computed external to the model then combined with the stage-damage relationship (Figure 3) to produce modified discharge-damage data (Figure 17). These data for the modified relationship are then input using a second set of JC cards for corresponding values on the DQ cards. It was estimated that the channel modification would change the Muskingum X from $X = 0.3$ to $X = 0.1$ and K from 6 hour to 5 hour for reaches 2 to 4 and 3 to 4. (A more accurate estimate of routing effects could have been made by computing storage-outflow curves for natural and modified conditions using backwater techniques, and then using the Modified-Puls channel routing method.) The nondamaging channel capacity at control point 4 would be 65,000 cfs. These changes are reflected on the RT and CP cards.

Results shown in Appendix I, page 70, indicate that expected annual damages were reduced \$271,640 due to channel modification. Damages remaining amount to \$425,180 on an average annual basis. The maximum flow at

control point 4 for flood 2 was computed as 91,201 cfs (Appendix I, page 65). Degree of protection is approximately 5 years for a nondamaging flow of 65,000 cfs.

Diversion

Frequently, where the topography is flat and relatively large areas are available to store water temporarily, flow is diverted from the main river around a potential damage center, to re-enter at some point downstream. This measure is illustrated in the sketch below. Flow is diverted at control point 2, routed to control point 5 where it re-enters the main channel. The obvious hydrologic effect is to reduce the peak discharge at location 4 which results in a modified discharge-frequency curve at control point 4 and a corresponding reduction in damages. The amount of this reduction depends upon the amount of water diverted.



To account for this measure it is necessary to input into the model the locations where flow is being diverted and returned, the rate of diversion and return flow, and the routing criteria by which the diversion

flow is to be routed. In this example, the magnitude of the diversion varied as a function of the streamflow as shown below:

<u>Control Point 2</u>						
Streamflow	0	30,000	50,000	70,000	90,000	110,000
Diversion	0	0	22,000	37,500	45,000	51,000
Streamflow	130,000		150,000		190,000	
Diversion	55,000		58,500		62,500	

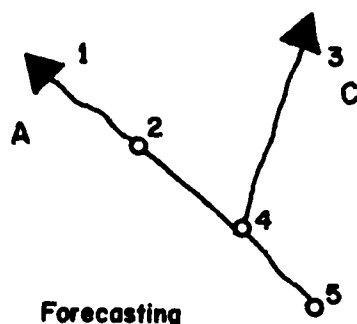
These data were input using the QS and QO cards at control point 2 (see Appendix I, page 72). It was also determined that 90% of the flow would return to the main channel at control point 5, and that the diversion flow would be routed between control point 2 and control point 5 using a Muskingum $X = .15$, $K = 24$ hour and four subreaches. Both of these criteria are input using the DR card at control point 2. The modified discharge-frequency relationship at control point 4 is computed internally by the model using the flood ratios selected earlier (Appendix I, page 83). The degree of protection from this modified curve is approximately 3 years for a nondamaging flow of 35,000 cfs.

Output from the simulation indicates expected annual flood damages were reduced \$278,370, and \$417,950 in expected damages still remain (Appendix I, page 84). The maximum flow at control point 4 is 53,770 cfs during flood number 2 (Appendix I, page 79).

Flood Forecasting

Flood forecasting is intended to provide advance information about rainfall and runoff conditions to assist in more efficient operation of

a flood control system. Hopefully, this advance information will help to minimize flood damages. The usual means of forecasting is with a network of monitoring stations feeding rainfall-runoff data into a central operations center. These raw data are used in analyses to forecast future system conditions. The principal effect of such a system is hydrologic - better data yields better system operation which in turn reduces flooding at damage centers.

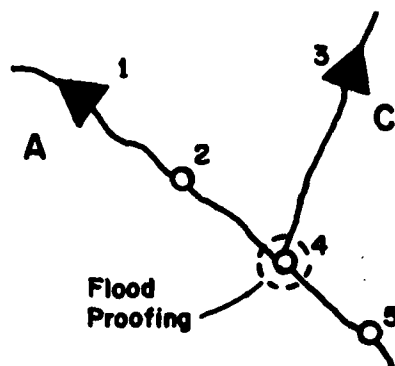


In the Fall River Basin operation of the existing system (Reservoirs A and C) assumes that flood discharges are known two 6-hour periods in advance with a 10% contingency allowance for local flows. To illustrate the effect of a flood forecast system it is assumed that the discharges are known six periods or 36 hours in advance with a 15% contingency factor. This information is input to HEC-5C by simply changing the contingency factor in field 2 and the forecasting period in field 3 of the J2 card (Appendix I, page 86). Results of the system simulation indicate expected annual damages are reduced \$22,850. Damages remaining are \$673,970, Appendix I, page 98, and the magnitude of flood peak is modified for each period (Appendix I, pages 90-91). The degree of protection

exceeds the protection provided by the existing system, although this does not have to be so, but depends upon the magnitude of the change in flow brought about by the forecasting.

Flood Proofing

Flood proofing has the effect of reducing damages below the upper limits of the flood proofing materials. Thus, flood flows below this elevation can be expected to cause limited or no damage; above this elevation expected damages will remain essentially unchanged from conditions without flood proofing. Since this measure is structure specific, the magnitude of the damage reduction depends upon the degree of flood proofing provided specific structures, and the aggregation of all structures. This change results in a modified stage-damage relationship (Figure 11) which produces a modified discharge-damage function (Figure 12) and damage-frequency curve. There is no hydrologic effect of flood proofing unless alterations are made to the flood plain which affect the cross-section of flood flow.



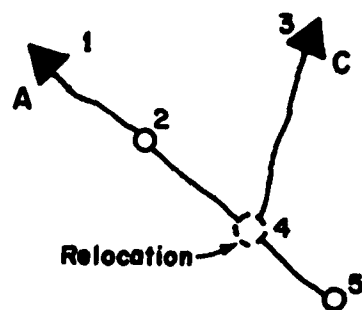
To account for flood proofing in the model it is only necessary to input the modified discharge-damage data (Figure 12). This can be done

by using another set of DC cards. The first set is input to compute expected annual damages under natural conditions. Input changes are shown in Appendix I, page 100.

Output from the simulation shows an expected annual damage reduction of \$233,140 with \$463,630 remaining (Appendix I, page 112). The maximum flow at control point 4 with flood number 2 is 92,483 cfs (Appendix I, page 101). The degree of protection with flood proofing is the same as with the existing system, approximately 2 years, since the measure does not affect the nondamaging flow at control point 4.

Relocation

A direct way to reduce flood damages at control point 4 is to relocate damageable structures out of the flood plain. This relocation results in modifying the stage-damage relationship as shown in Figure 13. This curve represents the situation where structures near the river are relocated out of the flood plain, but structures further away remain, thus the damages are reduced by the value of only those structures removed. When the modified curve is combined with the stage-discharge curve (Figure 1) a modified discharge-damage relationship results (Figure 14). The hydrologic effect of relocation is generally small, but could be significant if major flow obstructions were removed, in which case the channel capacity and routing criteria should be modified.

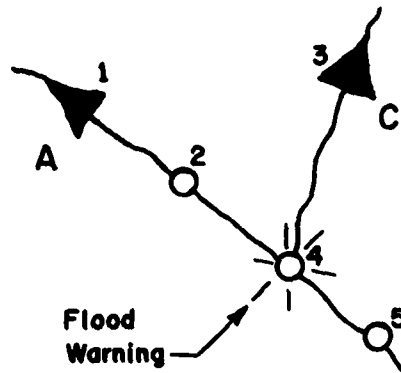


The change in stage-damage data is input into the model by modifying the discharge-damage function. This is accomplished by using a second set of DC cards to reduce damages at lower stages. Appendix I, page 100, shows the cards used. Note that the nondamaging flow is 130,000 cfs.

Simulation results indicate expected annual damages are reduced by \$416,750, with \$280,070 remaining (Appendix I, page 126). Since there is no hydrologic effect the magnitude of the flow at control point 4 remains unchanged from the existing system - 92,488 cfs. The degree of protection is approximately 20 years.

Flood Warning

Flood warning allows action to be taken to protect or remove damageable property. While flood forecasting is associated with gaining advance information for better system operation, flood warning is associated with advance information for protecting property. The principle effect is economic in that the stage-damage function is altered by lowering potential damages when a warning is effective.



At control point 4 in the Fall River basin it is assumed that a warning system can be implemented and property protected or removed above flood stage. The discharge-damage relationship is modified by assuming a 50% reduction in damages at every flood stage. The new damage data is input to HEC-5C using a second set of DC cards.

The simulation output shows a reduction in damages of \$35,190. There is no reduction in flow at control point 4. The degree of protection is the same as for the existing system.

System Formulation and Assessment

Because of the simplicity of the Fall River system, it is difficult to illustrate all the principles of system formulation discussed in part I. Table 6 summarizes damage, cost and benefit information at control point 4 for each measure. The net benefits represent the net benefits in the first added position. Using the first added strategy, relocation would be selected as the measure contributing most (maximum net benefits) to national economic development and thus, using economic criterion alone, would be added to the existing system. To move to the second stage using this strategy it would be necessary to modify the stage-damage and discharge-damage functions at control point 4 to reflect the annual \$416,750 reduction in damage brought about by the relocation. The new system which includes relocation would then be simulated, damages remaining computed, and each measure added one at a time. This was not done in this example because it was obvious that damage reduction from relocation was sufficiently

large that none of the remaining measures in the 'first added' position could produce positive net benefits. Thus, it was only necessary to complete the first stage computations to make a decision.

The 'last added' strategy is difficult to apply to the Fall River example because all measures except the reservoir at control point 2 and flood forecasting occur at control point 4. This requires that a combined stage-damage and stage-discharge relationship be developed with all measures and with each measure deleted. This is no small task.

The economic performance of all measures is also summarized in Table 6. The most effective measure is a reservoir at control point 2. It is most effective because it does the best job of reducing flood damages - \$432,270. However, it is highly inefficient from the economic standpoint. A very large amount of capital is required to construct the reservoir and as a result the net benefits are negative. Flood warning is the most efficient measure, yielding the greatest dollar benefit per dollar invested - 3.23. Using economic criterion alone the measure which would be added to the existing system would be relocation, not because it is most effective (damage reduction) or most efficient (B/C), but because it adds the most to the national economic development account - \$131,950. Each assessment gives a somewhat different perspective of performance, and together help to describe a measure's total performance in economic terms.

Table 7 presents a summary of the hydrologic performance of each measure in terms of its expected degree of protection. A range of

protection is given because none of the flood ratios were controlled to just the nondamaging flow. As shown a levee or floodwall yields the greatest protection for any single measure.

TABLE 1
HYDROLOGIC INFORMATION
Natural Condition

Control Point Inflows*- June 5-10, 1952 STORM

Date	Time	Inflow to C.P.1 (cfs)	Inflow C.P.1 to C.P.2 (cfs)	Inflow to C.P.3 (cfs)	Inflow C.P.2,3 to C.P.4 (cfs)	Inflow C.P.4 to C.P.5 (cfs)
5 Jun	2400	1,000	2,000	3,000	2,000	1,000
6 Jun	0600	2,000	3,000	6,000	4,000	2,000
	1200	3,000	4,000	27,000	19,000	9,000
	1800	18,000	6,000	60,000	13,000	6,000
	2400	37,000	20,000	105,000	10,000	5,000
7 Jun	0600	42,000	57,000	78,000	7,000	3,000
	1200	50,000	100,000	60,000	4,000	2,000
	1800	27,000	90,000	45,000	1,000	500
	2400	20,000	70,000	33,000	1,000	500
8 Jun	0600	13,000	50,000	24,000	4,000	2,000
	1200	5,000	37,000	18,000	10,000	5,000
	1800	4,000	24,000	12,000	25,000	12,000
	2400	3,000	24,000	12,000	13,000	6,000
9 Jun	0600	2,000	15,000	9,000	7,000	4,000
	1200	1,000	9,000	6,000	4,000	2,000
	1800	1,000	3,000	3,000	2,000	1,000
	2400	1,000	2,000	2,000	1,000	500
10 Jun	0600	1,000	1,500	1,000	500	200

*Average inflow for the period.

Control Point Hydraulics

	C.P.1	C.P.2	C.P.3	C.P.4	C.P.5
Channel Capacity (cfs)	6,000	21,000	12,000	35,000	37,000

Routing Criteria All Reaches

Muskingum Routing

$\Delta t = 6$ hours $K = 6$ hours $X = .3$

TABLE 2
ECONOMIC INFORMATION
Control Point 4, Unregulated Conditions

<u>Exceedence Frequency</u>	<u>Stage (ft)</u>	<u>Discharge (cfs)</u>	<u>Damages</u>
.999	3.6	28,800	0
.900	4.0	35,000	0
.800	4.3	42,000	\$ 180,000
.700	4.5	50,500	380,000
.600	5.5	60,500	500,000
.500	5.8	73,000	630,000
.400	6.4	90,000	900,000
.300	7.2	114,000	1,250,000
.250	7.7	130,000	1,500,000
.200	8.2	150,000	1,930,000
.150	8.9	180,000	2,660,000
.100	10.0	230,000	5,000,000
.050	11.8	323,000	9,900,000
.020	14.5	490,000	12,220,000
.010	16.6	640,000	13,350,000
.005	18.9	840,000	14,150,000
.002	20.2	1,000,000	14,600,000

NOTE: See Figures 1 through 5 for a graphic display of these data.

TABLE 3

RESERVOIR INFORMATION - RESERVOIRS A AND C
Existing System

Reservoir Storage

	<u>Level</u>	<u>Storage (ac-ft)</u>	
		<u>A</u>	<u>C</u>
Top of Surge	4	200,000	1,000,000
Top of Flood Control	3	150,832	755,408
Top of Conservation	2	50,000	100,000
Top of Inactive Storage	1	0	0

Reservoir Outlet Capacity

<u>Reservoir A</u>		<u>Reservoir C</u>	
<u>Storage (ac-ft)</u>	<u>Outlet Capacity (cfs)</u>	<u>Storage (ac-ft)</u>	<u>Outlet Capacity (cfs)</u>
50,000	6,000	100,000	12,000
70,000	7,000	200,000	18,000
100,000	8,000	400,000	30,000
150,832	100,000	700,000	80,000
200,000	200,000	800,000	150,000
		1,000,000	500,000

Operating Criteria

- Two 6-hour periods of foresight on all inflows and local flows will be used in the system operation for all reservoirs.
- Below the top of flood control pool, reservoir releases will be made so as not to exceed the channel capacity at any downstream control point for which the reservoir operates. As soon as it can be determined (using assumed forecasting capability) that the reservoir will exceed the top of flood control pool, releases will be made equal to the channel capacity at the dam site. Above the top of flood control, releases will be made equal to inflow up to the maximum outlet capacity.
- The maximum rate of change of reservoir release is equal to the channel capacity at the dam site.
- There are no minimum flow requirements.
- Each reservoir will be operated for CP 4 only.
- A 10% contingency allowance is made for local flows for the 12-hour forecast period.

TABLE 4

RESERVOIR INFORMATION - RESERVOIR B
Proposed Reservoir

Reservoir Storage

	<u>Level</u>	<u>Storage (ac-ft)</u>
Top of Surge	4	1,000,000
Top of Flood Control	3	654,576
Top of Conservation	2	100,000
Top of Inactive Storage	1	0

Reservoir Outlet Capacity

Reservoir B	
<u>Storage (ac-ft)</u>	<u>Outlet Capacity (cfs)</u>
100,000	21,000
200,000	30,000
400,000	40,000
600,000	100,000
800,000	300,000
1,000,000	500,000

Operating Criteria

- Two 6-hour periods of foresight on all inflows and local flows will be used in the system operation for all reservoirs.
- Below the top of flood control pool, reservoir releases will be made so as not to exceed the channel capacity at any downstream control point for which the reservoir operates. As soon as it can be determined (using assumed forecasting capability) that the reservoir will exceed the top of flood control pool, releases will be made equal to the channel capacity at the dam site. Above the top of flood control, releases will be made equal to inflow up to the maximum outlet capacity.
- The maximum rate of change of reservoir release is equal to the channel capacity at the dam site.
- There are no minimum flow requirements.
- Each reservoir will be operated for CP 4 only.
- A 10% contingency allowance is made for local flows for the 12-hour forecast period.

TABLE 5
COST INFORMATION

<u>Measure</u>	<u>Capital Cost</u>	<u>Percentage O&M Cost of Capital Cost</u>	<u>Annual Average O&M Cost</u>	<u>Total Average Annual Cost*</u>
Reservoir at CP 2	59,150,000	1.2	709,800	4,199,650
Levee or Floodwall	5,510,000	1.0	55,100	380,190
Channel Modification	3,420,000	2.0	68,400	270,180
Diversion	10,520,000	0.8	84,160	704,840
Flood Forecasting	120,000	1.6	1,920	9,000
Flood Proofing	3,480,000	0.7	24,360	229,680
Relocation	4,450,000	0.5	22,250	284,800
Flood Warning	100,000	5.0	5,000	10,900

*Discounted at 5-7/8%, 100 yr., capital recovery factor $(\frac{A}{P}) = .059$

TABLE 6
SUMMARY OF SYSTEM ECONOMIC PERFORMANCE

<u>Measure</u>	<u>Annual Damage with Proposed Measure</u>	<u>Expected Annual Damage Reduction</u>	<u>Annual Cost*</u>	<u>Annual Net Benefit*</u>	<u>B/C</u>
Existing System Reservoirs A and C	\$696,820	-	-	-	-
Reservoir at CP 2	214,550	482,270	4,199,650	-3,717,380	0.11
Levee or Floodwall	255,820	441,000	380,190	60,810	1.16
Channel Modification	425,180	271,640	270,180	1,460	1.01
Diversion	417,950	278,870	704,840	-425,970	0.40
Flood Forecasting	673,970	22,850	9,000	13,850	2.54
Flood Proofing	463,680	233,140	229,680	3,460	1.02
Relocation	280,070	416,750	284,800	131,950	1.46
Flood Warning	661,630	35,190	10,900	24,290	3.23

*Discounted at 5-7/8%, 100 yr., capital recovery factor $(\frac{A}{P}) = .059$

TABLE 7
SUMMARY OF SYSTEM HYDROLOGIC PERFORMANCE

<u>Measure</u>	<u>Nondamaging Flow at CP 4 (cfs)</u>	<u>Approximate Degree of Protection* (exceedance interval, years)</u>	<u>Risk of Nondamaging Frequency Flood Being Exceeded in Next 10 Years (percent chance)</u>
Natural (Unregulated)	35,000	1	-
Existing System Reservoirs A and C	35,000	2	> 99%
Reservoir at CP 2	35,000	12	~ 56%
Levee or Floodwall	287,000	35	~ 26%
Channel Modifications	65,000	5	~ 89%
Diversion	35,000	3	> 98%
Flood Forecasting	35,000	3	> 98%
Flood Proofing	35,000	2	> 99%
Relocation	180,000	20	~ 40%
Flood Warning	35,000	2	> 99%

*Obtained from interpolation between events with known frequencies (flood ratios) using the modified frequency curve computed and plotted for each measure.

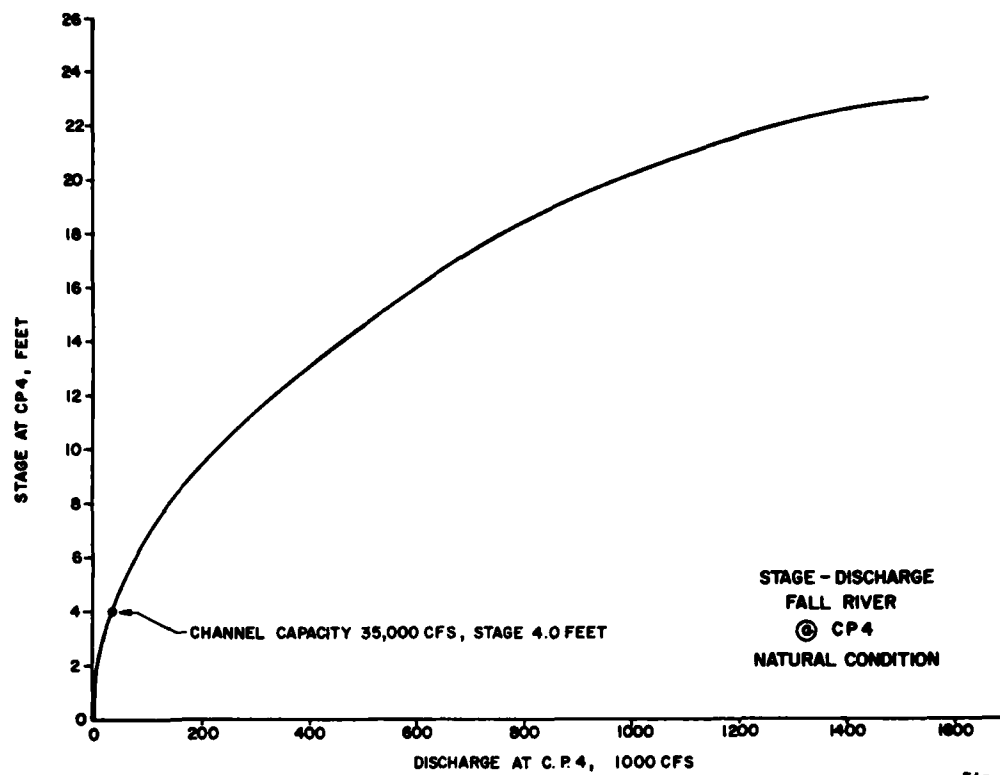


Figure 1

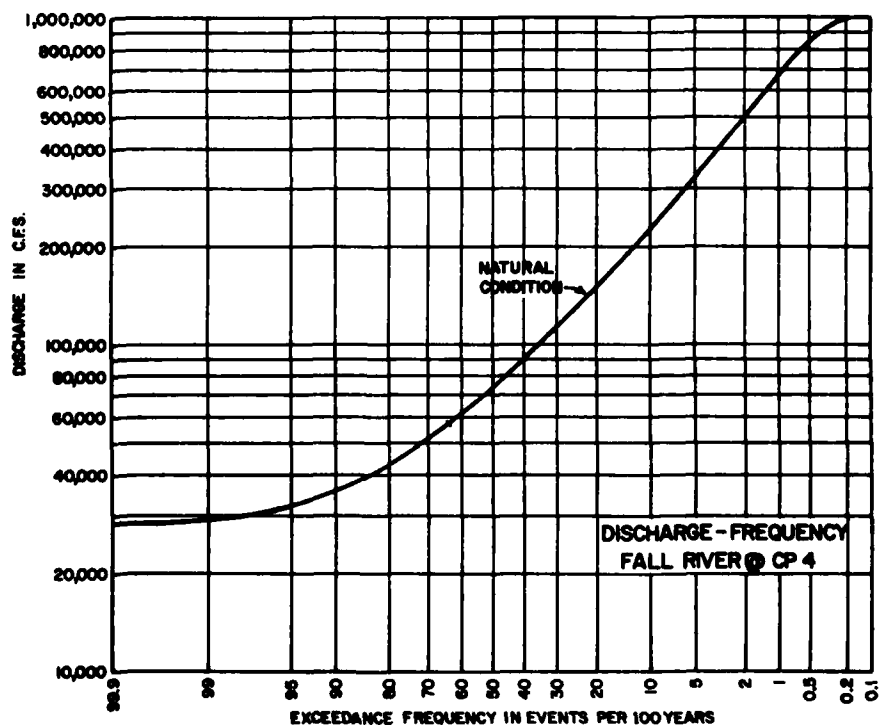


Figure 2

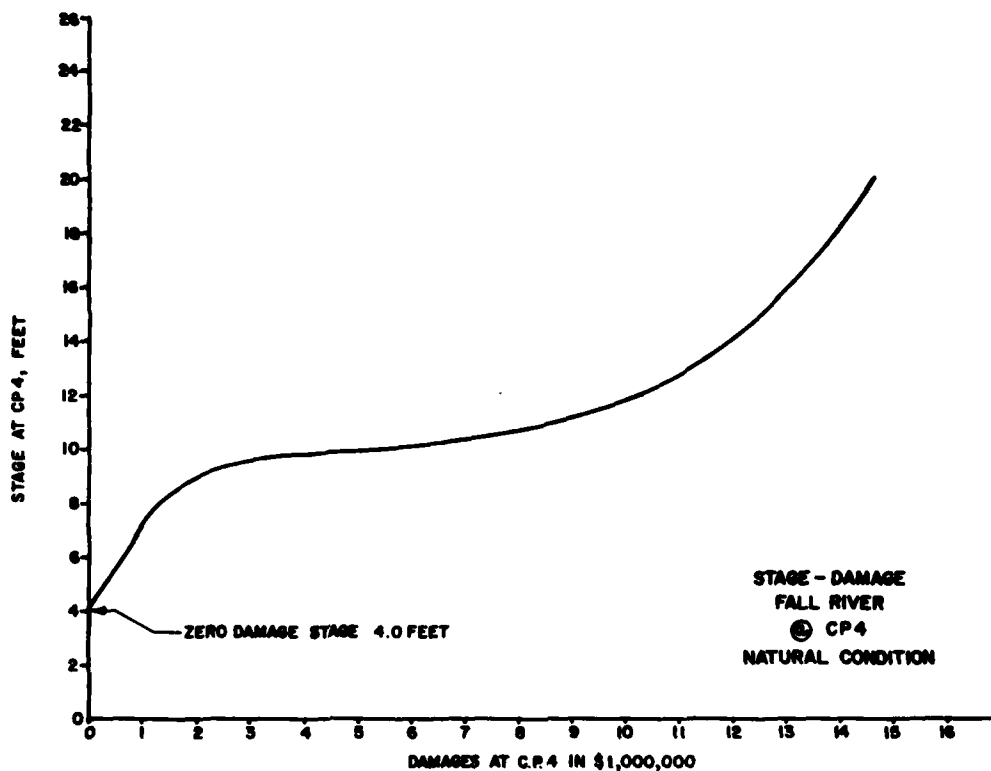


Figure 3

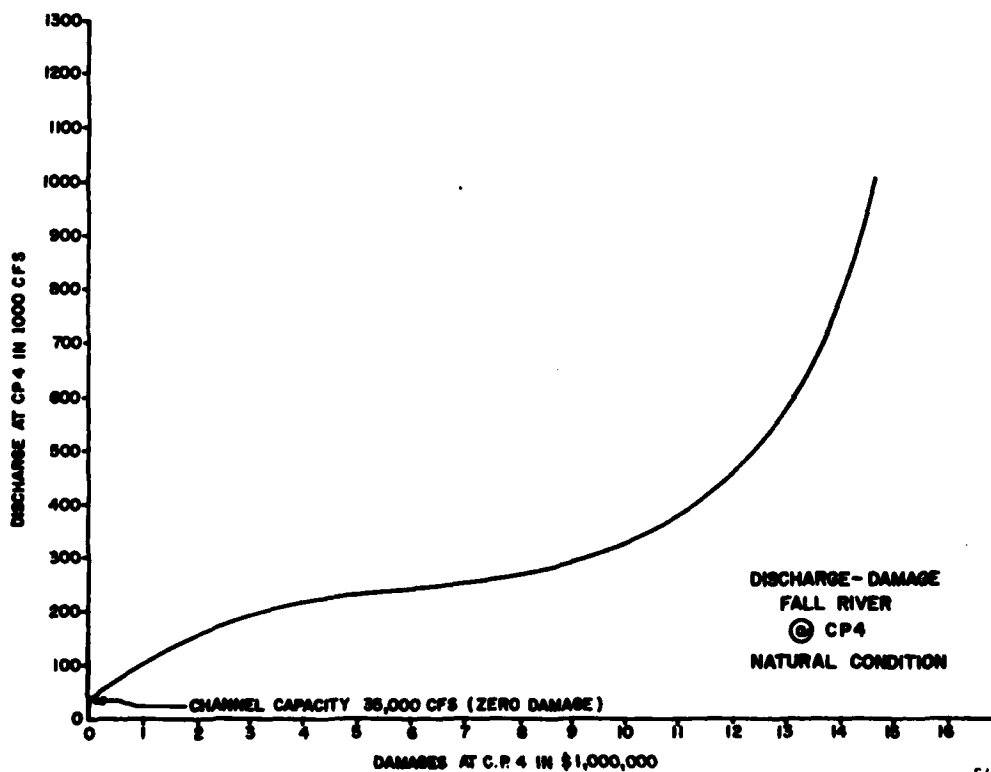


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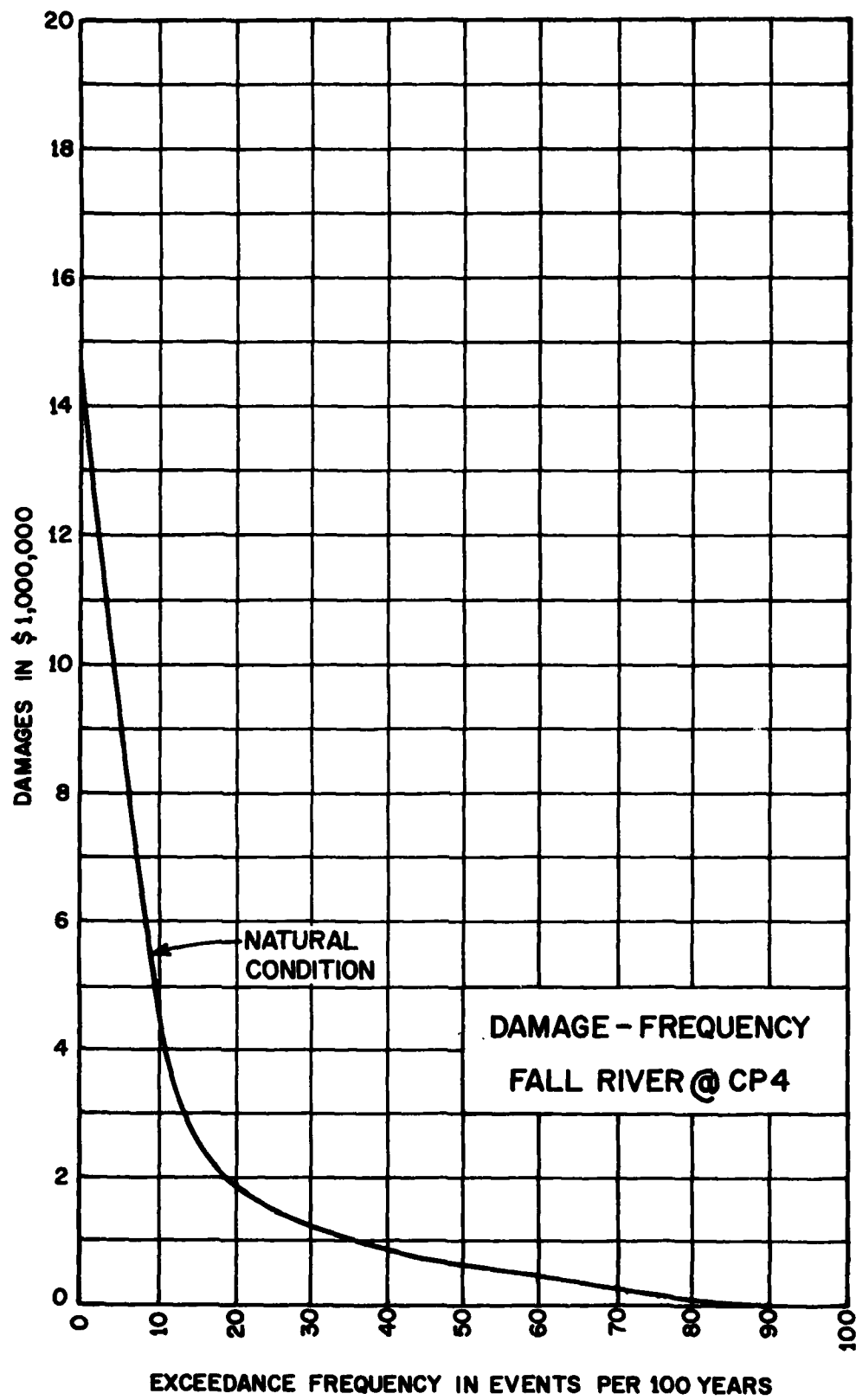


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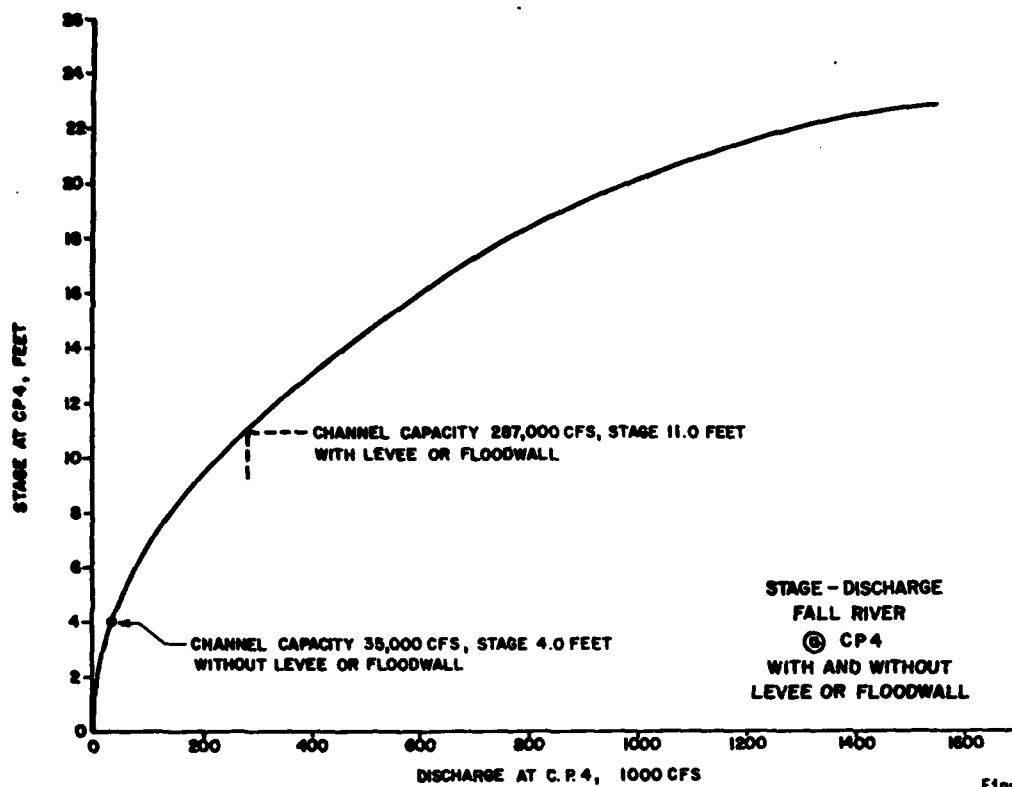


Figure 6

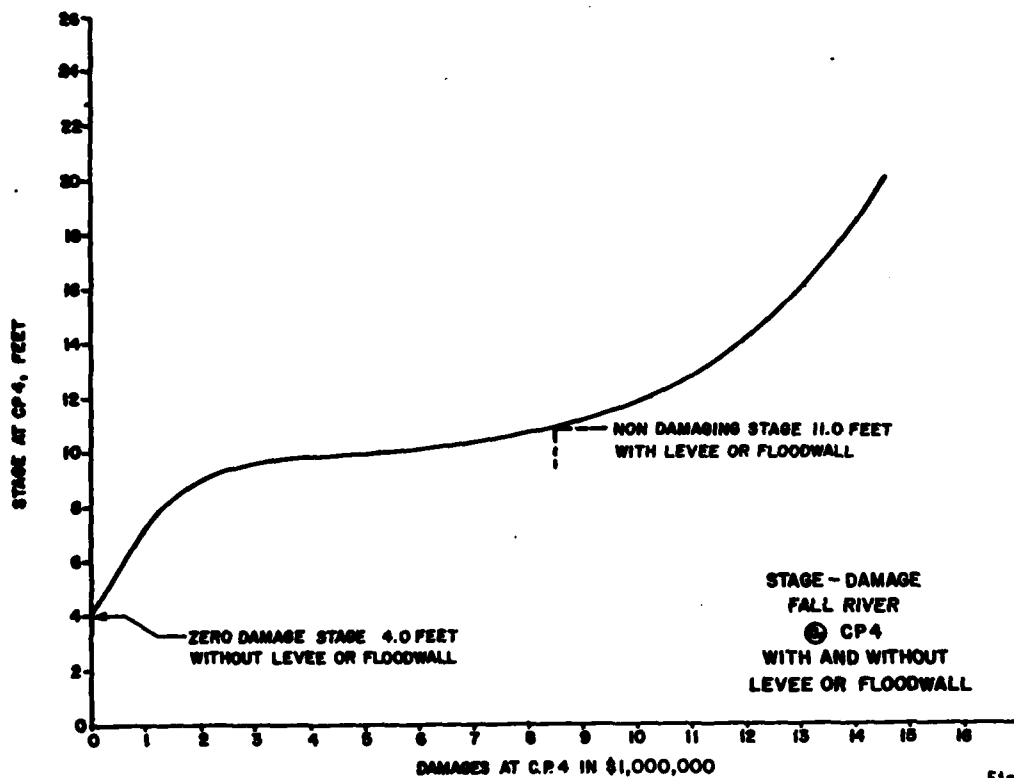


Figure 7

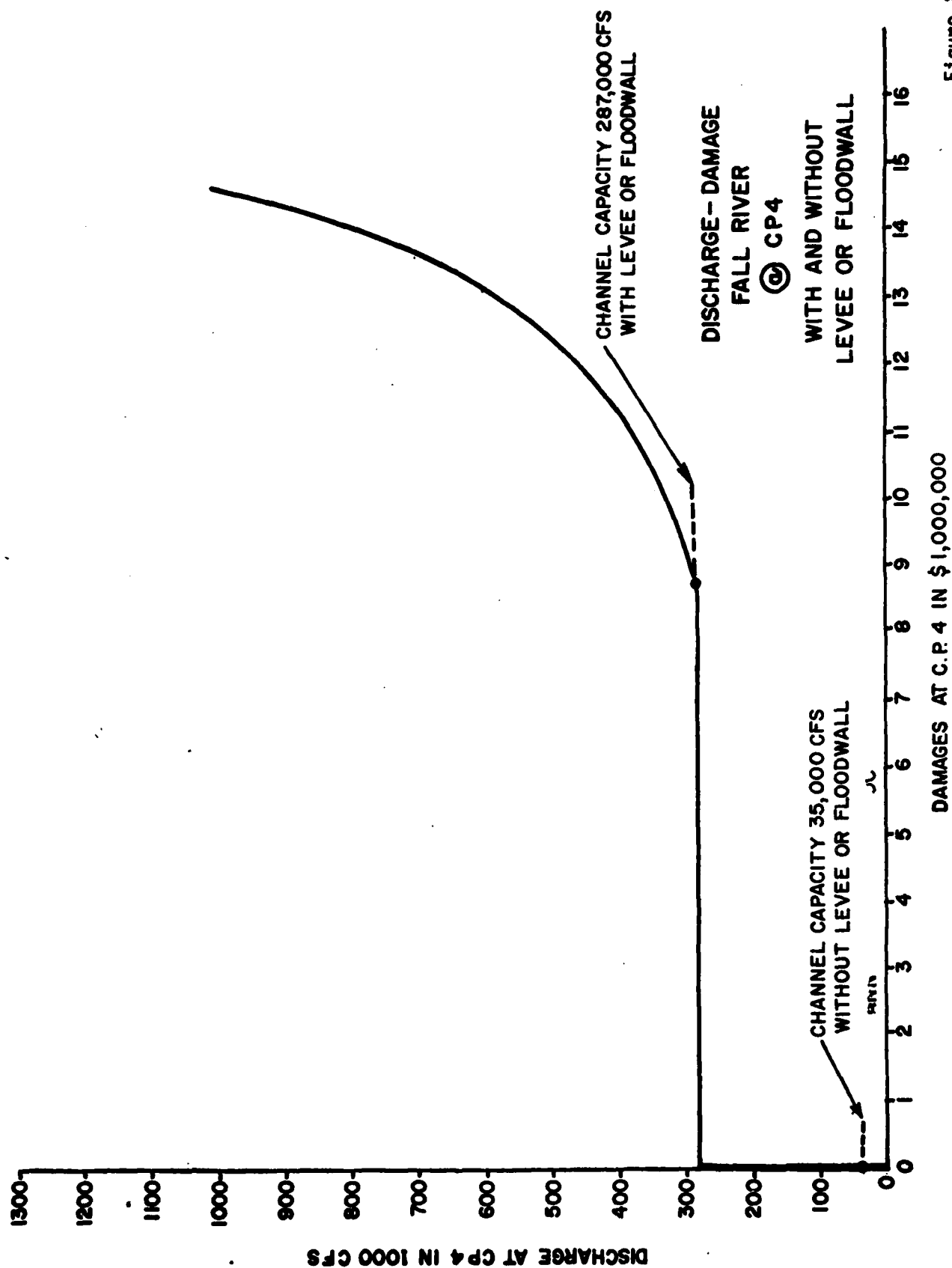


Figure 8

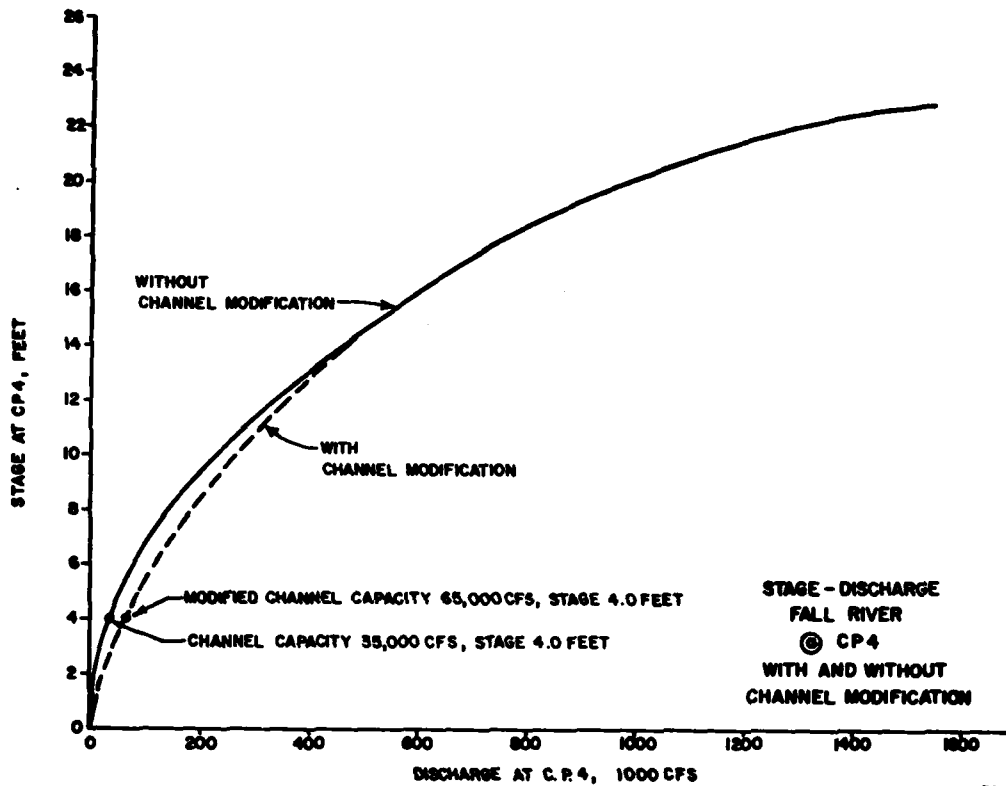


Figure 9

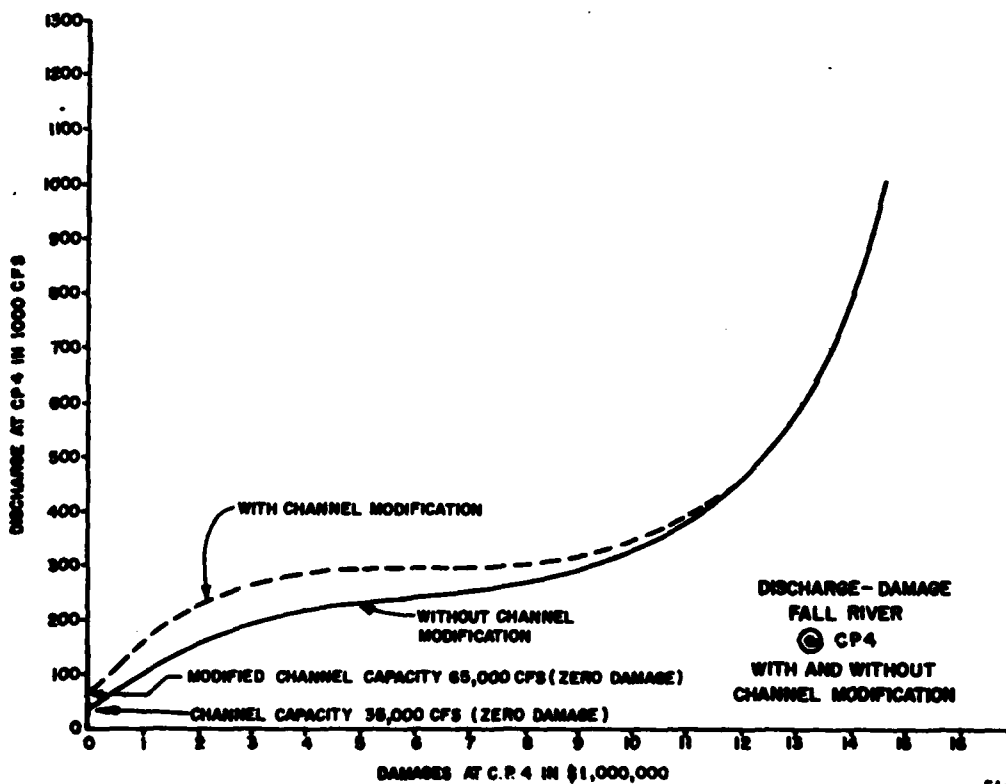


Figure 10

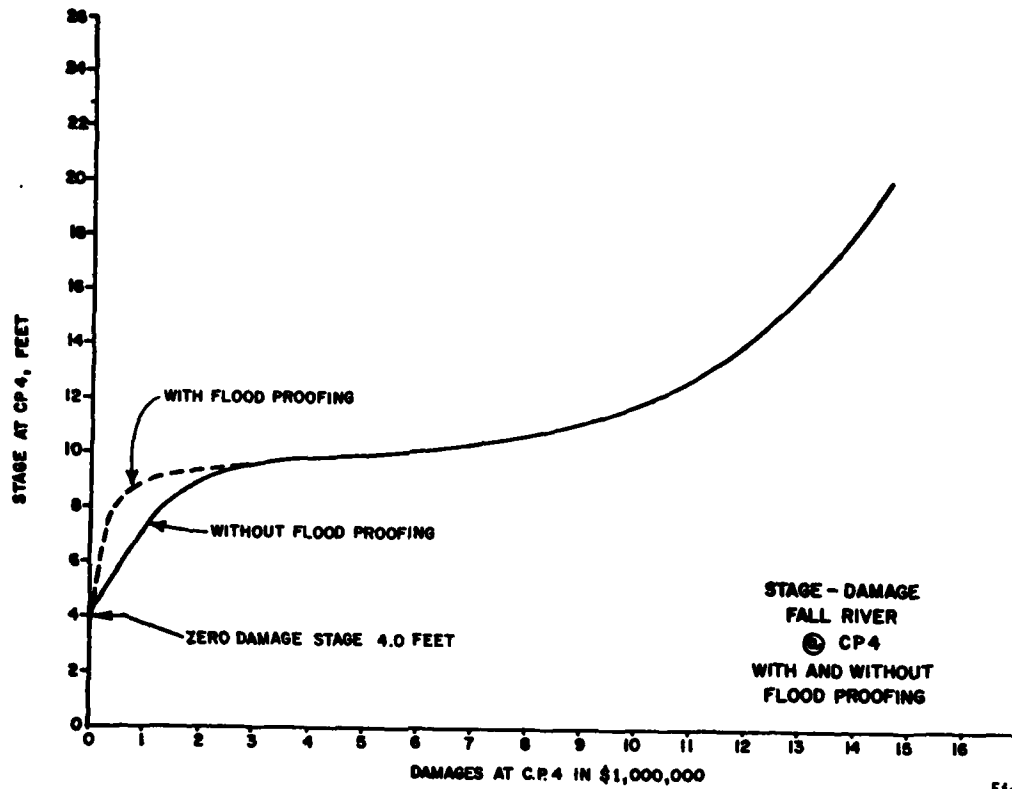


Figure 11

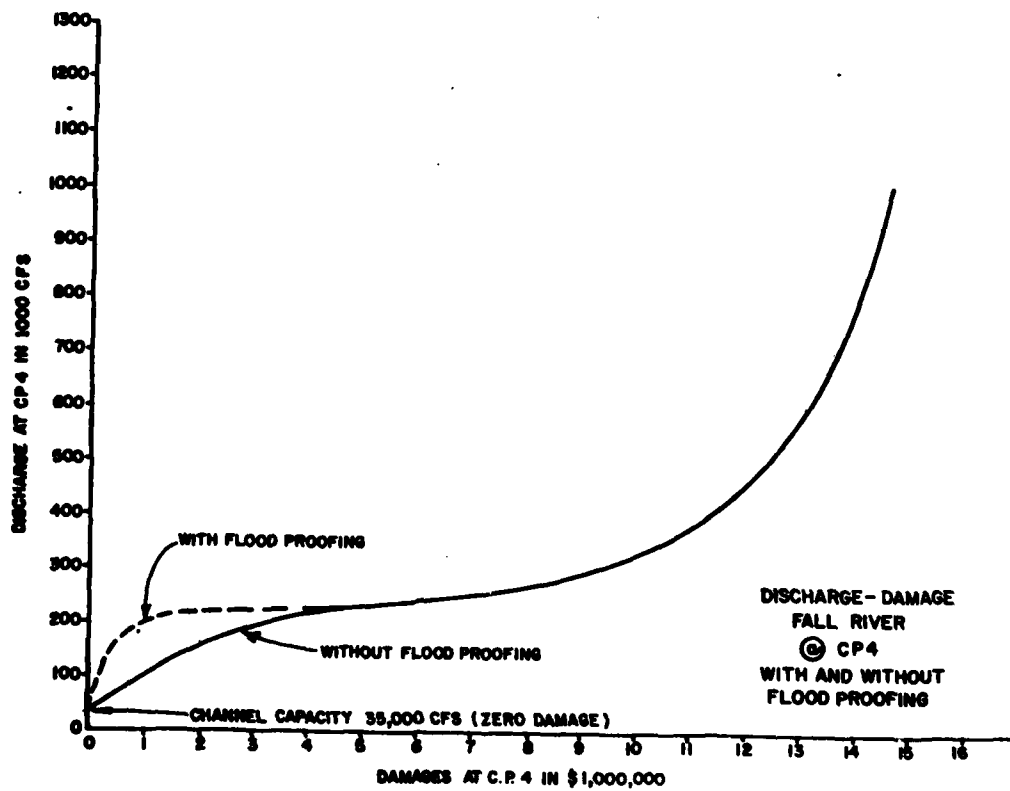


Figure 12

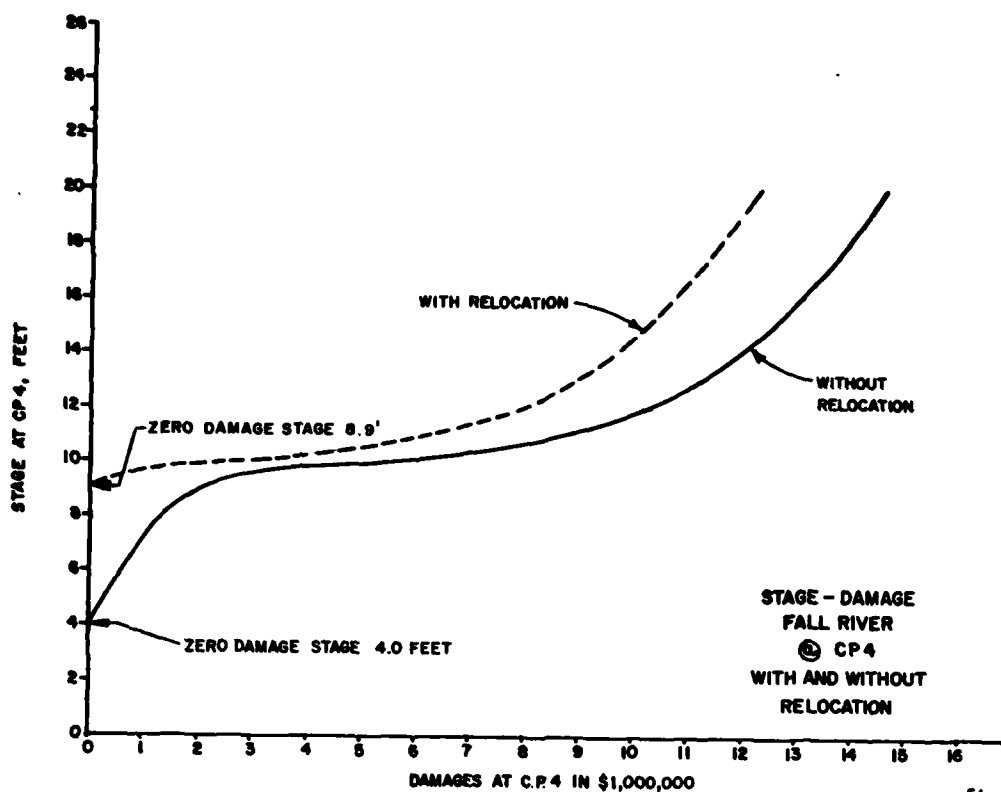


Figure 13

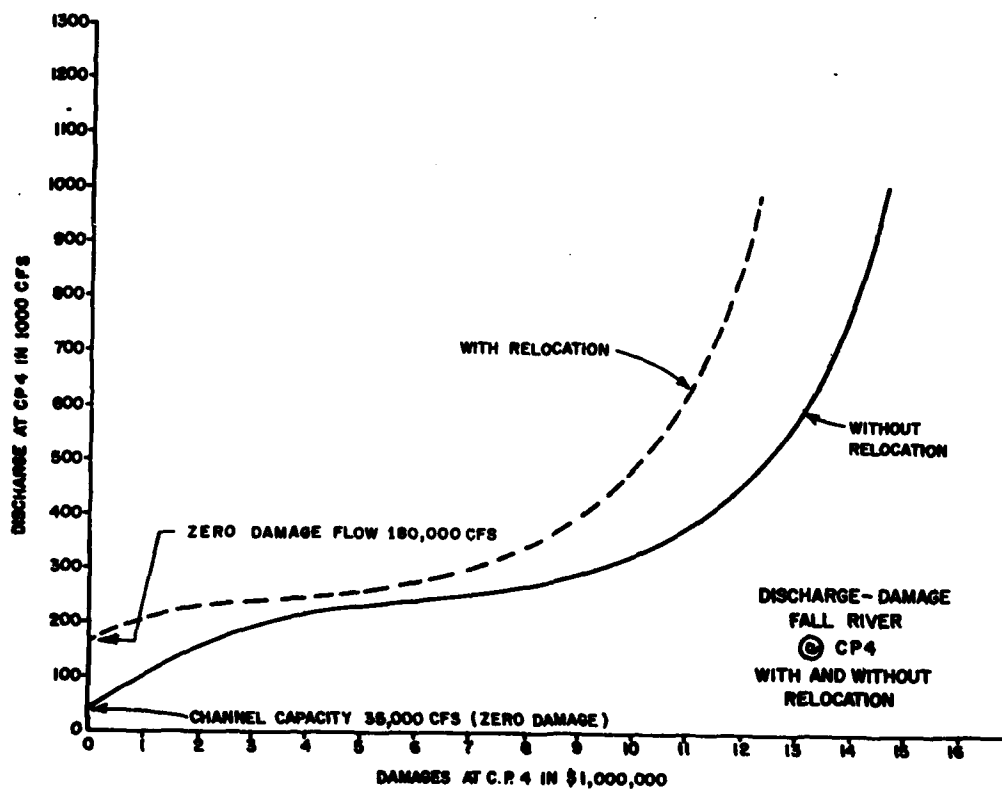


Figure 14

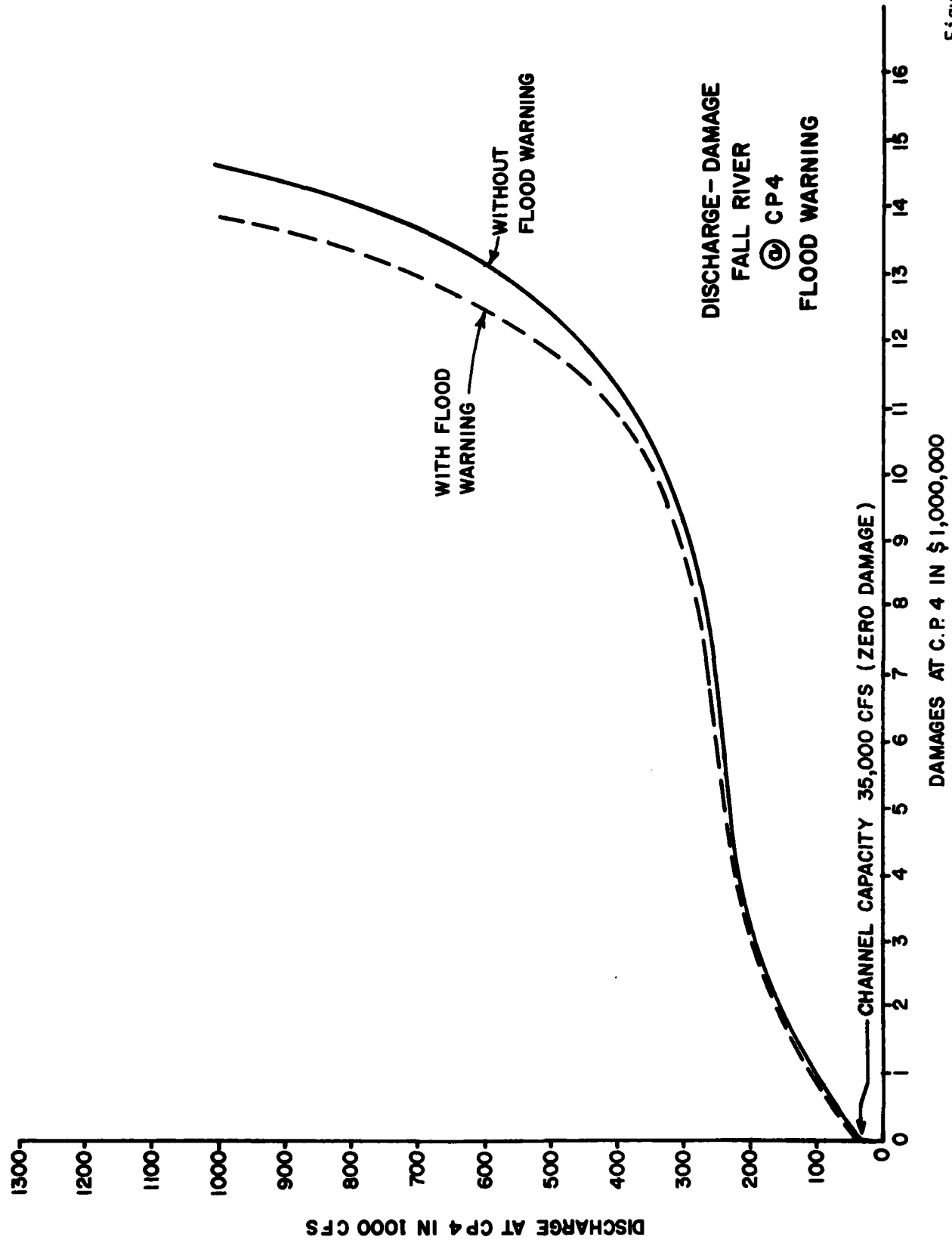


Figure 15

PART III
APPENDIX I
FALL RIVER BASIN
TRAINING DOCUMENT NO. 7
HEC-5C SELECTED OUTPUT

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FOREWORD

The purpose of this appendix is to supplement the discussion on the analysis of structural and nonstructural measures by providing selected output from computer program HEC-5C. Detailed output from the program would be too voluminous to reproduce here for the many flood control measures being discussed, so only selected portions are included. The selected portions include, (1) input data used for the simulation, (2) hydrologic data at each control point for flood number 2, (3) a summary of hydrologic data for each flood ratio, (4) expected annual flood damage data at control point 4, (5) a discharge-frequency curve plot for the input and modified conditions, and (6) summary of economic costs and performance.

Page 2
Natural Condition

MEC-1 VARIABLE OUTPUT MAR 1975
RES-1 VS CAPS-1 VS DEMO-100

T1 FALL RIVER BASIN *** NATURAL (UNREGULATED) CONDITION ***

T2 TRAINING DOCUMENT NO. 7
T3 FLOOD STATION 3 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

	1.0	1.5	2.0	3.0	4.0	
J1	1.00	6.00	2.00	2.00	-0.00	1.00
J2	-0.00	-0.00	2.00	0.00	0.00	-0.00
J3	6.00	1.00	1.00	3.00	3.00	-0.00
J4	2.00	1.00	1.00	-0.00	-0.00	-0.00

RL	1.00	100000.00	-0.00	90000.00	100000.00	-0.00	-0.00	-0.00	-0.00
RD	1.00	4.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RE	2.00	50000.00	100000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RF	2.00	200000.00	200000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	1.00	60000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID CP 1	1.00	2.00	.20	.30	.40	-0.00	-0.00	-0.00	-0.00
CP 2	2.00	21000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID CP 2	2.00	4.00	.20	.30	.40	-0.00	-0.00	-0.00	-0.00

RL	3.00	100000.00	-0.00	90000.00	100000.00	-0.00	-0.00	-0.00	-0.00
RD	1.00	4.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RE	2.00	50000.00	100000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RF	2.00	200000.00	200000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	12000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID CP 3	3.00	4.00	.20	.30	.40	-0.00	-0.00	-0.00	-0.00

CP	4.00	35000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID CP 4	4.00	5.00	.20	.30	.40	-0.00	-0.00	-0.00	-0.00
DA	1.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
DF	17.00	1.00	.00	.00	.00	.00	.00	.00	.00
DB	17.00	20000.00	35000.00	42000.00	50500.00	60500.00	73000.00	90000.00	110000.00
DC	15000.00	180000.00	230000.00	323000.00	490000.00	680000.00	840000.00	1000000.00	1300000.00
DE	1.00	0.00	0.00	180.00	300.00	500.00	630.00	900.00	1250.00
DC	1930.00	2660.00	5000.00	9900.00	12200.00	13350.00	14150.00	14600.00	-0.00

CP	5.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID CP 5	5.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ED	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

NRFS- 2 MCPT- 5 NEPT- -0

IN	1	6 JUNE	1000.0	2000.0	3000.0	10000.0	37000.0	42000.0	50000.0	27000.0	20000.0	13000.0
IN	2	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	3	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	4	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	5	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	6	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	7	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	8	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	9	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0
IN	10	6 JUNE	2000.0	3000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	1000.0

231000

IN	3	6	JUNE	3000.0	6000.0	27000.0	60000.0	105000.0	70000.0	60000.0	45000.0	33000.0	24000.0	SUM	517500
				18000.0	12000.0	12000.0	9000.0	6000.0	3000.0	2000.0	1000.0				
IN	4	6	JUNE	2000.0	4000.0	19000.0	13000.0	10000.0	7000.0	4000.0	1000.0	1000.0		SUM	500000
				10000.0	25000.0	13000.0	7000.0	4000.0	2000.0	1000.0	500.0				
IN	5	6	JUNE	1000.0	2000.0	4000.0	6000.0	5000.0	3000.0	2000.0	500.0	500.0		SUM	127500
				5000.0	12000.0	6000.0	4000.0	2000.0	1000.0	500.0	200.0				
BJ	-6			-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0		SUM	61700

Page 2
Natural End

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOCAL	NATURAL	INFLOW	OUTFLOW	CASE-LOC	LEVEL	END BY
1	3050.00	3050.00	3050.00	3450.00	.03	2.00	0.00
2	8400.00	8400.00	8400.00	8400.00	.03	2.00	0.00

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LOCAL	NATURAL	REGULATE	SPACE	BY US	FLOOD BY
2	12474.98	12474.98	12474.98	8325.42	0.00	0.00
4	23035.43	23035.43	23035.43	11944.57	0.00	0.00
5	25083.97	25083.97	25083.97	17910.03	0.00	0.00

COMPUTATION INTERVAL IN HOURS= 6

***** FLOOD NUMBER 2 *****
 WFLRDS 1 WFLCUM 0
 IFLOD 0 1 IFLCUM 0
 FLOD MULTIPLIED BY 1.00

LOC 1 CP 1

SERVED BY 1

STARTING TIMES 1
 HOUR=12, DAYS 8, MONTH 05 YEAR=19 0.

PER CUM LOCAL 0 SERVING 1

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
 MIN 1000.000

PER NATURAL FLOW

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
 MIN 1000.000

PER INFLOW

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
 MIN 1000.000

PER OUTFLOW

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
 MIN 1000.000

PER CASELOC.TYP

1	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
11	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03

AVG 0.030 MAX 0.030
MIN 0.030

PER LEVEL

1	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
11	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000

AVG 2,000 MAX 2,000
MIN 2,000

PER EGP STORAGE

1	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0

AVG 0.000 MAX 0.000
MIN 0.000

PER LOC 2 CP 2 SERVED BY =1

PER CUM LOCAL 0

1	3000	4167	6020	11330	30056	91043	102140	134087	90009	70302
11	40004	30147	28191	10032	11005	4100	3020	2505		

AVG 41503.202 MAX 102100.056
MIN 2500.656

PER NATURAL FLOW

1	3000	4167	6020	11330	30056	91043	102140	134087	90009	70302
11	40004	30147	28191	10032	11005	4100	3020	2505		

AVG 41503.202 MAX 102100.056
MIN 2500.656

PER REGULATED FLOW

1	3000	4167	6020	11330	30056	91043	102140	134087	90009	70302
11	40004	30147	28191	10032	11005	4100	3020	2505		

AVG 41503.202 MAX 102100.056
MIN 2500.656

PER 0 SPACE AVAIL.

1	10000	10033	12072	9602	-10056	-70003	-101140	-113087	-77009	-00302
11	-20004	-0147	-07191	2900	0005	10032	17072	10405		

AVG -20003.202 MAX 10009.300
MIN -101100.056

PER 0 BY US RES.DIV

1	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0

AVG 0.000 MAX 0.000
MIN 0.000

PER FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0

AVG 0.000 MAX 0.000
MIN 0.000

Natural Grade
Page 5

0.000
Natural Coal

MIN= 0.000
STARTING TIME
WNUM=12,DAYS 8,MONS 0,YEAR=10 0.

SERVED BY 2

LOC 3 CP 3

SERVING 2

PER CUM LOCAL 0

1	3000	6000	27000	60000	105000	78000	60000	45000	33000	24000
11	18000	12000	12000	9000	9000	3000	2000	1000		

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER NATURAL FLOW

1	3000	6000	27000	60000	105000	78000	60000	45000	33000	24000
11	18000	12000	12000	9000	9000	3000	2000	1000		

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER INFLOW

1	3000	6000	27000	60000	105000	78000	60000	45000	33000	24000
11	18000	12000	12000	9000	9000	3000	2000	1000		

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER OUTFLOW

1	3000	6000	27000	60000	105000	78000	60000	45000	33000	24000
11	18000	12000	12000	9000	9000	3000	2000	1000		

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER CASEFLOW, YYP

1	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
11	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03

AVG= .030 MAX= .030
MIN= .030

PER LEVEL

1	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
11	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000

AVG= 2.000 MAX= 2.000
MIN= 2.000

PER COP STORAGE

1	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0

AVG= 0.000 MAX= 0.000
MIN= 0.000

SERVED BY 01 02

LOC 4 CP 4

PER CUM LOCAL 0

1	9000	10600	22300	40100	87500	142277	173700	194026	175005	136907
11	106261	63527	29185	45907	51355	10061	9605	5007		

AVG= 76704.776 MAX= 194036.091
MIN= 5066.058

NATURAL FLOW

PER 1 8000 10608 32308 40141 87502 144277 173700 194036 175045 136507
11 106201 93327 50105 45997 31355 19091 9465 5047

AVG= 76704.776 MAX= 194036.091
MIN= 5066.058

REGULATED FLOW

PER 1 8000 10608 32308 40141 87502 144277 173700 194036 175045 136507
11 106201 93327 50105 45997 31355 19091 9465 5047

AVG= 76704.776 MAX= 194036.091
MIN= 5066.058

SPACE AVAILABLE

PER 1 27000 28308 2802 -17141 -32542 -109277 -130796 -130036 -140008 -101597
11 -71201 -50127 -24105 -10997 3645 15009 25535 20153

AVG= -61704.776 MAX= 29153.142
MIN= -150036.091

Q BY US RES.DIVS

PER 1 0 0 0 0 0 0 0 0 0 0
11 0 0 0 0 0 0 0 0 0 0

AVG= 0.000 MAX= 0.000
MIN= 0.000

FLOOD BY RES

PER 1 0 0 0 0 0 0 0 0 0 0
11 0 0 0 0 0 0 0 0 0 0

AVG= 0.000 MAX= 0.000
MIN= 0.000

SERVED BY -1 -2

LOC 5 CP 5

CUM LOCAL Q

PER 1 9000 10409 28937 38112 57711 94226 142355 172097 187631 172652
11 142220 121279 96295 66172 48252 32798 20104 10752

AVG= 80279.898 MAX= 187631.160
MIN= 9000.000

NATURAL FLOW

PER 1 9000 10409 28937 38112 57711 94226 142355 172097 187631 172652
11 142220 121279 96295 66172 48252 32798 20104 10752

AVG= 80279.898 MAX= 187631.160
MIN= 9000.000

REGULATED FLOW

PER 1 9000 10409 28937 38112 57711 94226 142355 172097 187631 172652
11 142220 121279 96295 66172 48252 32798 20104 10752

AVG= 80279.898 MAX= 187631.160
MIN= 9000.000

SPACE AVAILABLE

PER 1 28000 26551 13063 -1112 -20711 -57226 -105355 -130097 -150631 -135652
11 -105220 -80279 -59295 -20172 -4206 16806 26240

Page 3
Natural Flow

FALL RIVER BASIN *** NATURAL (UNREGULATED) CONDITION ***
 TRAINING DOCUMENT NO. 7
 FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES
 FLOOD SUMMARY-EACH FLOOD COPY= 1

***** FLOOD NUMBER 1 *****

										STARTING TIME	1
										SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX REG 0 *	FLO, PER	MAX MAY 0 *	FLO, PER	MAX LOC 0 *	0 BY REG *	0 BY REG *	0.0	0.0
LOC	4 CP 4	1,007	42642 *	1,007	42642 *	1,007	42642 *	0 *	0 *	0.0	0.0
LOC	5 CP 5	1,008	50211 *	1,008	50211 *	1,008	50211 *	0 *	0 *	0.0	0.0
RESERVOIRS										0.0	0.0
LOC	1 CP 1	FLO, PER	MIN STG MIN LEVEL *	FLO, PER	MAX STG MAX LEVEL *	FLO, PER	MAX REL	CHAN CAP	STORI		
LOC	3 CP 3	1,010	0	2,000 *	1,001	0	2,000 *	1,007	15000	6000	0
MIN SYSTEM STG= 0 MAX SYSTEM STG= 0										0	0

***** FLOOD NUMBER 2 *****

										STARTING TIME	1
										SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX REG 0 *	FLO, PER	MAX MAY 0 *	FLO, PER	MAX LOC 0 *	0 BY REG *	0 BY REG *	0.0	0.0
LOC	4 CP 4	2,007	142140 *	2,007	142140 *	2,007	142140 *	0 *	0 *	0.0	0.0
LOC	5 CP 5	2,008	194036 *	2,008	194036 *	2,008	194036 *	0 *	0 *	0.0	0.0
RESERVOIRS										0.0	0.0
LOC	1 CP 1	FLO, PER	MIN STG MIN LEVEL *	FLO, PER	MAX STG MAX LEVEL *	FLO, PER	MAX REL	CHAN CAP	STORI		
LOC	3 CP 3	2,010	0	2,000 *	2,001	0	2,000 *	2,007	30000	6000	0
MIN SYSTEM STG= 0 MAX SYSTEM STG= 0										0	0

***** FLOOD NUMBER 3 *****

										STARTING TIME	1
										SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX REG 0 *	FLO, PER	MAX MAY 0 *	FLO, PER	MAX LOC 0 *	0 BY REG *	0 BY REG *	0.0	0.0
LOC	4 CP 4	3,007	213211 *	3,007	213211 *	3,007	213211 *	0 *	0 *	0.0	0.0
LOC	5 CP 5	3,008	291054 *	3,008	291054 *	3,008	291054 *	0 *	0 *	0.0	0.0
RESERVOIRS										0.0	0.0
LOC	1 CP 1	FLO, PER	MIN STG MIN LEVEL *	FLO, PER	MAX STG MAX LEVEL *	FLO, PER	MAX REL	CHAN CAP	STORI		
LOC	3 CP 3	3,010	0	2,000 *	3,001	0	2,000 *	3,007	75000	6000	0

Not End
 Page 7

LOC 3 CP 3 3.010 0 2.000 3.001 0 2.000 3.005 157500 12000
MIN SYSTEM STG 0 MAX SYSTEM STG 0

***** FLOOD NUMBER 4 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX RES 0	FLO, PER	MAX NAT 0	FLO, PER	MAX LOC 0
LOC	4 CP 4	5.007	264201	5.007	264201	5.007	264201
LOC	5 CP 5	5.008	368072	5.008	368072	5.008	368072
LOC	5 CP 5	5.009	375262	5.009	375262	5.009	375262
RESERVOIRS		FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL
LOC	1 CP 1	5.010	0	2.000	4.001	0	2.000
LOC	3 CP 3	5.010	0	2.000	4.001	0	2.000
MIN SYSTEM STG		0		MAX SYSTEM STG		0	

***** FLOOD NUMBER 5 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX RES 0	FLO, PER	MAX NAT 0	FLO, PER	MAX LOC 0
LOC	4 CP 4	5.007	264201	5.007	264201	5.007	264201
LOC	5 CP 5	5.008	368072	5.008	368072	5.008	368072
LOC	5 CP 5	5.009	375262	5.009	375262	5.009	375262
RESERVOIRS		FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL
LOC	1 CP 1	5.010	0	2.000	4.001	0	2.000
LOC	3 CP 3	5.010	0	2.000	4.001	0	2.000
MIN SYSTEM STG		0		MAX SYSTEM STG		0	

***** FLOOD NUMBER 6 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO, PER	MAX RES 0	FLO, PER	MAX NAT 0	FLO, PER	MAX LOC 0
LOC	4 CP 4	5.007	264201	5.007	264201	5.007	264201
LOC	5 CP 5	5.008	368072	5.008	368072	5.008	368072
LOC	5 CP 5	5.009	375262	5.009	375262	5.009	375262
RESERVOIRS		FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL
LOC	1 CP 1	5.010	0	2.000	4.001	0	2.000
LOC	3 CP 3	5.010	0	2.000	4.001	0	2.000
MIN SYSTEM STG		0		MAX SYSTEM STG		0	

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 6

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

PREC	PEAK	SUM	TYPE 1	TYPE
.9999	28800	0.00	0.00	
.9000	35000	0.00	0.00	
.8000	42000	180.00	180.00	
.7000	50500	385.00	385.00	
.6000	60500	500.00	500.00	
.5000	73000	630.00	630.00	
.4000	90000	900.00	900.00	
.3000	114000	1250.00	1250.00	
.2500	130000	1500.00	1500.00	
.2000	150000	1930.00	1930.00	
.1500	180000	2460.00	2460.00	
.1000	230000	3000.00	3000.00	
.0500	323000	4900.00	4900.00	
.0200	496000	12280.00	12280.00	
.0100	640000	13350.00	13350.00	
.0050	840000	14150.00	14150.00	
.0020	1000000	14600.00	14600.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED 1721.30 1721.30
BASE COND- INPUT 0.00 -0.00

BASE CONDITION FLOOD DAMAGES

NO.	EXCD	PREC	PROB	INT	SUM	TYPE 1	TYPE
1	50211	.621	.623		233.27	233.27	
2	194036	.136	.279		549.61	549.61	
3	291054	.062	.050		360.93	360.93	
4	388072	.036	.025		265.67	265.67	
5	582108	.013	.014		173.38	173.38	
6	776168	.007	.010		138.03	138.03	
BASE COND DAMAGES					1721.30	1721.30	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	EXCD	PREC	PROB	INT	SUM	TYPE 1	TYPE
1	50211	.621	.623		233.27	233.27	
2	194036	.136	.279		549.61	549.61	
3	291054	.062	.050		360.93	360.93	
4	388072	.036	.025		265.67	265.67	
5	582108	.013	.014		173.38	173.38	
6	776168	.007	.010		138.03	138.03	
MODIFIED DAMAGES					1721.30	1721.30	
DAMAGE REDUCTION					.00	.00	

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	EXCD	PREC	PROB	INT	SUM	TYPE 1	TYPE
1	50211	.621	.623		233.27	233.27	
2	194036	.136	.279		549.61	549.61	
3	291054	.062	.050		360.93	360.93	
4	388072	.036	.025		265.67	265.67	

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Natural Condition

Page 13
Natural Condition

5 902100 .013 .014 172.30 172.30
 6 776100 .007 .010 136.03 136.03
 DAMAGES W/ TOTAL
 CONTROL AT PROJECTS 1721.30 1721.30

REDUCTION POSSIBLE
 W/ TOTAL CONTROL .00 .00

RESIDUAL DAMAGES 6.60 6.60

CONTROL POINT

EXCEEDENCE FREQUENCY

1000000 50.0 50.5 50 55 60 65 70 75 80 85 90 95 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400 410 420 430 440 450 460 470 480 490 500 510 520 530 540 550 560 570 580 590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810 820 830 840 850 860 870 880 890 900 910 920 930 940 950 960 970 980 990 1000

1000000

500000

200000

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EXPECTED ANNUAL DAMAGES

EXISTING COND MODIFIED

REDUCTION

BASED ON 5 FLOODS

DOLLARS

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1721.30

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Natural Cond.

SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES

CONTROL POINT	BASE CONDITION	MODIFIED CONDITIONS	UNCONTROLLED LOCAL COND	MODIFIED CONDITIONS AT PROJECTS	DAMAGE REDUCTION	RESIDUAL
	1721.30	1721.30	1721.30	.00	.00	0.00
TOTAL	1721.30	1721.30	1721.30	.00	.00	0.00

REC-SC-VARIABLE OUTPUT MAR. 1975
 RES. = 35 CPTS. = 75 PERC. @ 100

11 FALL RIVER BASIN *** EXISTING SYSTEM (RESERVOIRS A AND C) ***

12 TRAINING DOCUMENT NO. 7
 13 FLOOD RATIOS 3 1.0 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

	1.0	2.0	3.0	4.0	ANNUAL DAMAGES	1.0	2.0	3.0	4.0
14	10.00	5.00	2.00	1.00	3.00	-0.00	-0.00	-0.00	-0.00
15	-0.00	0.00	1.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00
16	0.00	0.00	1.00	0.00	0.00	-0.00	-0.00	-0.00	-0.00

	1.00	50000.00	-0.00	0.00	50000.00	150032.00	200000.00	-0.00	-0.00
17	1.00	5.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
18	0.00	0.00	50000.00	100000.00	100000.00	150032.00	200000.00	-0.00	-0.00
19	0.00	50000.00	60000.00	70000.00	80000.00	100000.00	200000.00	-0.00	-0.00

	1.00	60000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
20	1.00	2.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
21	1.00	2.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

	2.00	21000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
22	2.00	2.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
23	2.00	2.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

	1.00	100000.00	-0.00	0.00	100000.00	755000.00	1000000.00	-0.00	-0.00
24	1.00	5.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
25	7.00	100000.00	100000.00	200000.00	400000.00	755000.00	1000000.00	-0.00	-0.00
26	7.00	100000.00	120000.00	180000.00	300000.00	600000.00	1500000.00	-0.00	-0.00

	3.00	120000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
27	3.00	6.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
28	3.00	6.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

	4.00	350000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
29	4.00	5.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
30	4.00	5.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

	17.00	1.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
31	17.00	1.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
32	17.00	1.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00</
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	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
10	3.00	37000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	3.00	37000.00	-0.00	-0.00	-0.00	-0.00			

Existing System
 Page 10

RESER 2 NCPTS = 5 NCPTS = 0

	1	6	JUNE	1000.00	2000.00	3000.00	10000.00	37000.00	42000.00	50000.00	27000.00	20000.00	13000.00
39	1	6	JUNE	1000.00	2000.00	3000.00	10000.00	37000.00	42000.00	50000.00	27000.00	20000.00	13000.00
40	1	6	JUNE	5000.00	10000.00	15000.00	50000.00	100000.00	100000.00	100000.00	100000.00	100000.00	100000.00

	2	6	JUNE	2000.00	3000.00	4000.00	10000.00	20000.00	20000.00	20000.00	20000.00	20000.00	20000.00
41	2	6	JUNE	2000.00	3000.00	4000.00	10000.00	20000.00	20000.00	20000.00	20000.00	20000.00	20000.00
42	2	6	JUNE	37000.00	24000.00	24000.00	24000.00	24000.00	24000.00	24000.00	24000.00	24000.00	24000.00

IN	3	6	JUNE	3000.0	6000.0	27000.0	40000.0	105000.0	78000.0	60000.0	45000.0	33000.0	24000.0
				18000.0	12000.0	12000.0	9000.0	6000.0	3000.0	2000.0	1000.0		
												SUMS	500000

SUMS
 231000
 517500
 508000

SUMMARY OF AVERAGES FOR RESERVING

LOC	CUM LOCAL	NATURAL	INFLW	OUTFLOW	CASELOC	LEVEL	EOP STOR
1	3050.00	3050.00	3050.00	3050.00	.90	2.07	57406.67
2	8000.00	8000.00	8000.00	7456.62	1.12	2.03	122305.00

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LOCAL	NATURAL	REGULATE	SPACE	BY US	FLOOD BY
2	8625.00	12474.00	12320.67	6071.13	3703.07	476.19
3	10755.92	23035.43	21095.66	13066.34	10249.76	0.00
5	11745.97	24083.97	21119.00	15061.00	9323.04	0.00

COMPUTATION INTERVAL IN HOURS

***** FLOOD NUMBER 2 *****
 HELD 1 HELD 1
 FLOD 1 FLOD 1
 FLOWS MULTIPLIED BY 1.00

LOC 1 RESERVOIR 1 (CP 1)

***** SERVED BY 1 *****
 STARTING TIME
 MONTH, DAY, HOUR, MIN, SECOND

PER	CUM LOCAL	SERVING	1	2
1	1000	2000	3000	10000
11	5000	4000	3000	2000

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER	CUM LOCAL	NATURAL FLOW	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
11	5000	4000	3000	2000	1000	0	0	0	0	0	0	0

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER	CUM LOCAL	INFLW	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
11	5000	4000	3000	2000	1000	0	0	0	0	0	0	0

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER	CUM LOCAL	OUTFLOW	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
11	5000	4000	3000	2000	1000	0	0	0	0	0	0	0

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER CASELOC.TYP. 1 .03 .03 .03 .02 .01 4.00 4.00 4.00 4.00 4.00 4.00 4.00

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 Existing System

10

AVG	1.353	MAX	MIN
		4.020	.010

LEVEL

1	2,000	2,000	2,089	2,377	2,723	2,956	3,000
11	3,000	3,000	3,000	2,975	2,926	2,902	

1	3,000	3,000	3,000	2,975	2,951	2,926	2,902
11	3,000	3,000	3,000	3,000	3,000	3,000	3,000

PER TOP STORAGE

1	5000	5000	5096	90100	12294	14620	15032
1	5000	5000	50832	150832	150832	150832	150832

11	150032	150032	150032	145073	143304	140914
11	150032	150032	150032	146393	143304	140914

AVG	11799.368	MAX	15032.000
		MIN	5000.000

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9 74207 AND 113

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	21000	22000	23000	24000	25000	26000	27000	28000	29000	30000	31000	32000	33000	34000	35000	36000	37000	38000	39000	40000	41000	42000	43000	44000	45000	46000	47000	48000	49000	50000	51000	52000	53000	54000	55000	56000	57000	58000	59000	60000	61000	62000	63000	64000	65000	66000	67000	68000	69000	70000	71000	72000	73000	74000	75000	76000	77000	78000	79000	80000	81000	82000	83000	84000	85000	86000	87000	88000	89000	90000	91000	92000	93000	94000	95000	96000	97000	98000	99000	100000	

[illegible]

AVG	28750.000	MAX	100000.000
		MIN	1500.000

PER NATURAL FLOW

1	300	4167	6026	11336	39056	91643	142140	134837	99009	70302
1	49084	35187	26191	18032	11005	4168	3026	2595		

1	-	49884	36147	28191	18032	11005	4168	3020	2505
11	-	49884	36147	28191	18032	11005	4168	3020	2505

AVG	41503.282	MAX	102140.450
		MIN	2500.650

REGULATED FOR **USE**

	1	300	867	6028	6336	20390	57045	100011	-	70002	-	70000	-	39610
	1	40374	28362	27927	17908	11831	8472	7912		7805				

11	40374	28562	27927	17966	11031	0472	7912	7805
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AVG	31120.076	MAX	10010.028
		MIN	3000.000

PER @ SPACE AVAILABLE

1	18000	16933	14972	12602	610	36065	79011	-69002	-69000	-20610
11	-19374	-7562	-6927	3012	9109	12526	13086	13515		

Year	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
1	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100

AVR 10 1967 1000.00
MAY 10 1967 700.00

PER ... O BY US RES.DIVS

1	3375	2954	4265	2310	360	5475	8165	5885	0	610
1	1001	1491	2021	2020	360	5475	8165	5885	0	610

1	100	100	222	50	500
11	3370	4962	3927	2031	5472
			2000	2012	5012

AVG	2370.076	MAX	5985.330
		MIN	1.301

PER FLOOD BY RES

1	0	0	0	0	0	65	11	2	0	610
11	3374	4862	3927	0	0	0	0	0	0	

[illegible]

AVG	697.275	MAX	9562.320
		MIN	0.000

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LOC 3 RESERVOIR C (CP 3) SERVED BY 2 STARTING TIME 1
 MONTH 12, DAY 6, HOUR 0, YEAR 19 0.

PER	CUM LOCAL 0	SERVING	2	4
1	3000 6000 27000 60000 105000 70000 60000 45000 33000 24000			
11	10000 12000 12000 4000 6000 3000 2000 1000			

AVG 20000.000 MAX 105000.000
 MIN 1000.000

PER	NATURAL FLOW
1	3000 6000 27000 60000 105000 70000 60000 45000 33000 24000
11	10000 12000 12000 4000 6000 3000 2000 1000

AVG 20000.000 MAX 105000.000
 MIN 1000.000

PER	INFLOW
1	3000 6000 27000 60000 105000 70000 60000 45000 33000 24000
11	10000 12000 12000 4000 6000 3000 2000 1000

AVG 20000.000 MAX 105000.000
 MIN 1000.000

PER	OUTFLOW
1	3000 6000 12000 0 0 12000 12000 12000 0 0
11	0 0 0 0 0 0 0 0 0 0

AVG 3033.333 MAX 12000.000
 MIN 0.000

PER	CASE=LOC.TYP
1	.03 .03 .01 4.02 4.01 4.00 4.00 4.00 4.00 4.00
11	4.00 4.00 4.00 4.00 4.01 4.01 4.01 4.01 4.01 4.01

AVG 2.052 MAX 4.020
 MIN .010

PER	LEVEL
1	2.000 2.000 2.011 2.037 2.130 2.193 2.241 2.273 2.300 2.310
11	2.331 2.340 2.350 2.356 2.362 2.365 2.367 2.369 2.370 2.370

AVG 2.237 MAX 2.350
 MIN 2.000

PER	EOP STORAGE
1	10000 10000 107430 117191 109257 227936 257600 200003 296366 300267
11	317103 323100 329090 335557 330542 326110 321160 315706

AVG 255590.950 MAX 333557.125
 MIN 100000.000

PER	CUM LOCAL 0	SERVING	1	2
1	4000 6107 22020 17171 18029 31171 62695 92800 87000 73000			
11	61001 62100 39197 29066 19311 11052 4042 2720			

AVG 35033.070 MAX 92800.200
 MIN 2723.602

PER	NATURAL FLOW
1	4000 6107 22020 17171 18029 31171 62695 92800 87000 73000
11	61001 62100 39197 29066 19311 11052 4042 2720

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 Existing System

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AVG 76700.776 MAX 190036.091
MIN 5666.658

1 0000 10094 32308 41141 07502 144277 173790 190036 175045 136907
11 100201 03327 50105 05907 31355 10001 0465 5047

PER REGULATED FLOW

1 0000 10094 32308 41141 07502 144277 173790 190036 175045 136907
11 02007 05350 03022 33086 24411 20701 21750 29481

AVG 41202.055 MAX 92007.001
MIN 0000.000

PER 0 SPACE AVAIL.

1 27000 20306 5102 6775 13506 2900 -27002 -57400 -52910 -30500
11 -27007 -30354 -0822 1310 10500 10200 13250 10510

AVG -6282.055 MAX 27000.000
MIN -57407.001

PER 0 BY US RES.DIV8

1 4000 4528 7870 11053 3406 000 106 39 0 103
11 006 3174 0225 3020 5100 13050 10900 17757

AVG 5420.904 MAX 17750.907
MIN 7.005

PER FLOOD BY RES

1 0 0 0 0 0 0 0 0 0 103
11 006 3174 0225 3020 5100 13050 10900 17757

SERVED BY 01 02

PER CUM LOCAL 0

1 5000 0301 17509 20965 22613 23150 30500 03470 07279 07316
11 70309 75315 04530 04865 31960 20706 11950 5792

AVG 39319.000 MAX 07316.100
MIN 5666.000

PER NATURAL FLOW

1 0000 10094 32308 41141 07502 144277 173790 190036 175045 136907
11 102220 121270 00295 00172 00252 32706 20100 10752

AVG 00270.000 MAX 107031.100
MIN 0000.000

PER REGULATED FLOW

1 0000 10094 32308 41141 07502 144277 173790 190036 175045 136907
11 70620 70542 07563 00023 35907 27057 24036 22106

AVG 43990.730 MAX 07303.000
MIN 0000.000

PER 0 SPACE AVAIL.

1 20000 20551 10470 4110 5120 9054 0051 -20011 -50363 -50352
11 -01020 -30542 -50563 -11023 1003 9953 12064 10010

AVG -0099.730 MAX 20000.000
MIN -50363.000

PER 0 BY US RES.DIVE

1	4000	4000	5012	7924	9267	3096	1263	341	34	36
11	230	1226	3025	3057	4056	6381	12076	10306		

AVG 6679.892 MAX 16308.320
MIN 36,200

PER FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	0
11	230	1226	3025	3057	0	0	0	0	0	36

AVG 302.212 MAX 3097.093
MIN 0.000

CUM TIME 1

RES NO	1	3
INFLW	1000	3000
OUTFLOW	1000	3000
EOP STOR	50000	100000
CASES	.03	.03
LEVEL	2.000	2.000
EO LEVEL	2.000	2.000

CUM TIME 2

RES NO	1	3
INFLW	2000	6000
OUTFLOW	2000	6000
EOP STOR	50000	100000
CASES	.03	.03
LEVEL	2.000	2.000
EO LEVEL	2.000	2.000

CUM TIME 3

RES NO	1	3
INFLW	3000	27000
OUTFLOW	3000	12000
EOP STOR	50000	107430
CASES	.03	.01
LEVEL	2.000	2.011
EO LEVEL	2.000	2.011

CUM TIME 4

RES NO	1	3
INFLW	18000	60000
OUTFLOW	0	0
EOP STOR	50926	137191
CASES	6.02	6.02
LEVEL	2.089	2.037
EO LEVEL	2.089	2.037

CUM TIME 5

Existing System
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Existing Syst.

FALL RIVER BASIN *** EXISTING SYSTEM (RESERVOIRS A AND C) ***
TRAINING DOCUMENT NO. 7
FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES
FLOOD SUMMARY-EACH FLOOD COVE

**** FLOOD NUMBER 1 ****

		STARTING TIME 1									
		FLO,PER	MAX REG Q	FLO,PER	MAX NAT Q	FLO,PER	MAX LOC Q	Q BY REG	DES	SHORTAGE INDEX	
										REG	REG
LOC	2 CP 2	1.007	34777	1.007	42642	1.007	30000	4777	0.00	0.00	0.00
LOC	4 CP 4	1.012	33134	1.008	58211	1.008	27735	5400	0.00	0.00	0.00
LOC	5 CP 5	1.012	33586	1.009	58289	1.010	28195	7301	0.00	0.00	0.00
RESERVOIRS											
LOC	1 RESERVOIR A (CP 1)	1.010	50000	2.000	1.000	67393	2.173	1.005	6000	6000	50000
LOC	3 RESERVOIR C (CP 3)	1.003	100000	2.000	1.010	140755	2.002	1.004	12000	12000	100000
		MIN SYSTEM STGE 150000 MAX SYSTEM STGE 200100									

**** FLOOD NUMBER 2 ****

		STARTING TIME 1									
		FLO,PER	MAX REG Q	FLO,PER	MAX NAT Q	FLO,PER	MAX LOC Q	Q BY REG	DES	SHORTAGE INDEX	
										REG	REG
LOC	2 CP 2	2.007	100011	2.007	142180	2.007	100000	11	0.00	0.00	0.00
LOC	4 CP 4	2.008	92480	2.008	194034	2.008	92489	39	0.00	0.00	0.00
LOC	5 CP 5	2.009	97363	2.009	187631	2.010	87316	47	0.00	0.00	0.00
RESERVOIRS											
LOC	1 RESERVOIR A (CP 1)	2.003	50000	2.000	2.011	150032	3.000	2.015	6000	6000	50000
LOC	3 RESERVOIR C (CP 3)	2.002	100000	2.000	2.014	333357	2.336	2.003	12000	12000	100000
		MIN SYSTEM STGE 150000 MAX SYSTEM STGE 664389									

**** FLOOD NUMBER 3 ****

		STARTING TIME 1									
		FLO,PER	MAX REG Q	FLO,PER	MAX NAT Q	FLO,PER	MAX LOC Q	Q BY REG	DES	SHORTAGE INDEX	
										REG	REG
LOC	2 CP 2	3.007	157221	3.007	213211	3.007	150000	7221	0.00	0.00	0.00
LOC	4 CP 4	3.009	150695	3.008	291034	3.008	138674	12022	0.00	0.00	0.00
LOC	5 CP 5	3.010	150348	3.009	281447	3.010	130974	19374	0.00	0.00	0.00
RESERVOIRS											
LOC	1 RESERVOIR A (CP 1)	3.001	50744	2.007	3.007	150032	3.000	3.008	6000	6000	50000
LOC	3 RESERVOIR C (CP 3)	3.001	102231	2.003	3.015	470416	2.563	3.010	12000	12000	100000

MIN SYSTEM STG 152074 MAX SYSTEM STG 621850

***** FLOOD NUMBER 4 *****

STARTING TIME 1									
RESERVOIR									
LOC	2 CP 2	FLO, PER	MAX REG Q	FLO, PER	MAX NAT Q	FLO, PER	MAX LOC Q	0 BY RES	SHORTAGE INDEX
LOC	4 CP 4	6.008	252767	4.007	202281	4.007	200000	52767	0.00
LOC	5 CP 5	6.010	237006	4.008	300072	4.008	184898	52908	0.00
			220892	4.009	375262	4.010	174532	55350	0.00
RESERVOIR									
LOC	1 RESERVOIR A (CP 1)	FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	4.001	90992	2.010	4.007	150032	3.000	4.007	90650
									6000
									50000
									12000
									100000

MIN SYSTEM STG 153066 MAX SYSTEM STG 746723

***** FLOOD NUMBER 5 *****

STARTING TIME 1									
RESERVOIR									
LOC	2 CP 2	FLO, PER	MAX REG Q	FLO, PER	MAX NAT Q	FLO, PER	MAX LOC Q	0 BY RES	SHORTAGE INDEX
LOC	4 CP 4	5.008	30332	3.007	420231	3.007	300000	33382	0.00
LOC	5 CP 5	5.010	372006	5.008	502100	5.008	277348	92718	0.00
			305070	5.009	502093	5.010	261948	103121	0.00
RESERVOIR									
LOC	1 RESERVOIR A (CP 1)	FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	5.001	51088	2.015	5.007	100236	3.334	5.007	120942
									6000
									50000
									12000
									100000

MIN SYSTEM STG 155049 MAX SYSTEM STG 923044

***** FLOOD NUMBER 6 *****

STARTING TIME 1									
RESERVOIR									
LOC	2 CP 2	FLO, PER	MAX REG Q	FLO, PER	MAX NAT Q	FLO, PER	MAX LOC Q	0 BY RES	SHORTAGE INDEX
LOC	4 CP 4	6.007	516031	6.007	505562	6.007	600000	116031	0.00
LOC	5 CP 5	6.010	612533	6.008	776144	6.008	369797	242736	0.00
			504530	6.009	750525	6.010	349264	245274	0.00
RESERVOIR									
LOC	1 RESERVOIR A (CP 1)	FLO, PER	MIN STG MIN LEVEL	FLO, PER	MAX STG MAX LEVEL	FLO, PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	6.001	51083	2.020	6.007	191183	3.021	6.007	163029
									6000
									50000
									12000
									100000

MIN SYSTEM STG 157033 MAX SYSTEM STG 972050

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Existing System

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER

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Epist. Syst.

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

TYPE 1

SUM

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED

BASE COND- INPUT

1721.30

0.00

0.00

BASE CONDITION FLOOD DAMAGES

TYPE 1

SUM

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

MODIFIED CONDITIONS FLOOD DAMAGES

TYPE 1

SUM

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

TYPE 1

SUM

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

TYPE 1

CONTROL AT PROJECTS 525.75 525.75

REDUCTION POSSIBLE

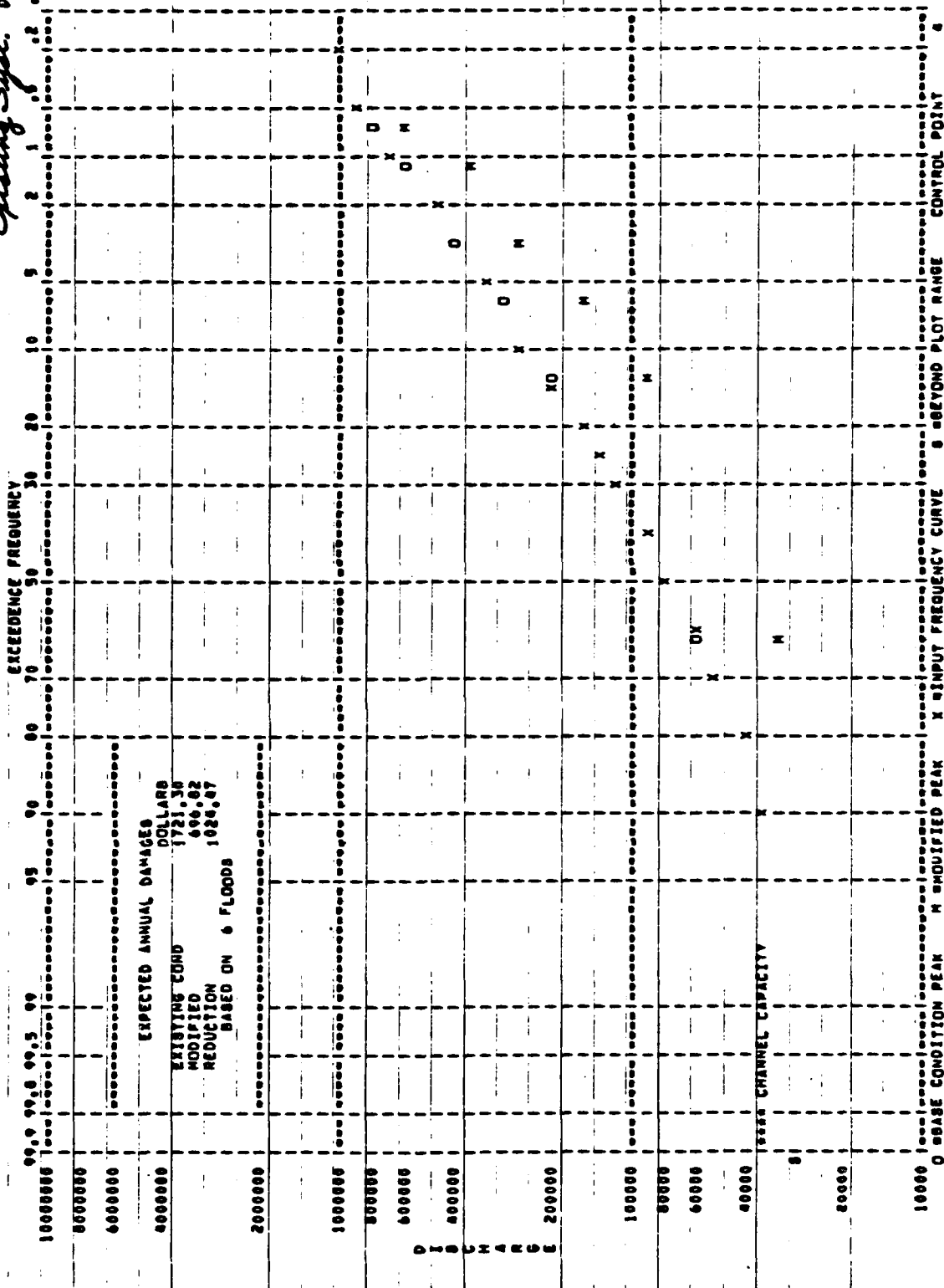
W/ TOTAL CONTROL 1195.54 1195.54

RESIDUAL DAMAGES 171.07 171.07

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Existing System

Epist. Syst. - Page 11

CONTROL POINT 4



SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES

CONTROL	BASE	DAMAGES	MODIFIED	UNCONTROL	MODIFIED	DAMAGE REDUCTION
POINT	CONDITION	CONDITIONS	LOCAL COND	CONDITIONS	AT PROJECTS	RESIDUAL
	1721.30	596.82	325.75	1826.67	1195.58	171.07
TOTAL	1721.30	596.82	325.75	1826.67	1195.58	171.07

AD-A106 700

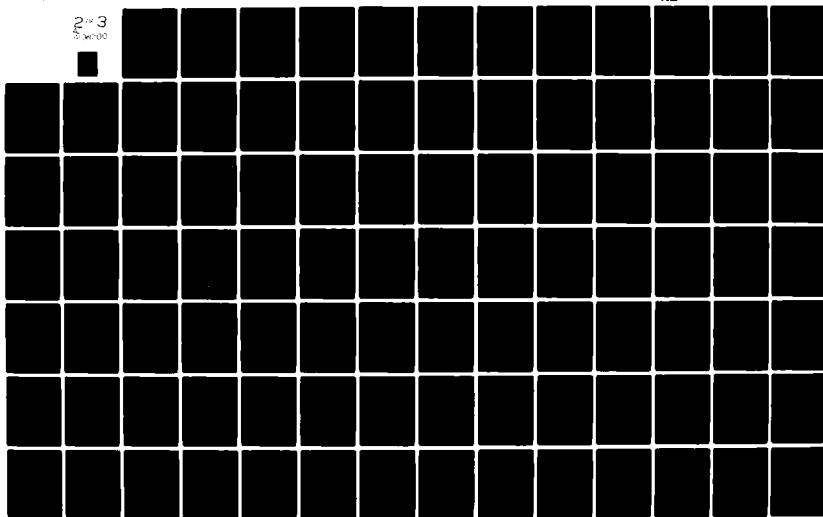
HYDROLOGIC ENGINEERING CENTER DAVIS CA
ANALYSIS OF STRUCTURAL AND NONSTRUCTURAL FLOOD CONTROL MEASURES--ETC(U)
NOV 75 W K JOHNSON, D W DAVIS
HEC-TD-7

F/G 13/2

UNCLASSIFIED

NL

2 of 3
01/01/00



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Reservoir B

MEG-SC-VARIABLE OUTPUT MAR.1975
RES. = 35 CP18. = 75 PERB. = 100

11 FALL RIVER BASIN. *** RESERVOIR B AT CP 2 ***

12 TRAINING DOCUMENT NO. 7

13 FLOOD RATIO 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

J1 10.00 6.00 4.00 3.00 2.00 1.00 0.00 0.00 0.00 1.00 0.00 0.00 1.00

J2 -0.00 1.10 2.00 1.00 0.00 -1.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

J4 6.00 .30 1.00 1.50 2.00 3.00 4.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00

ML 1.00 50000.00 -0.00 0.00 50000.00 150032.00 200000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

MO 1.00 2.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

MS 6.00 0.00 50000.00 70000.00 100000.00 150032.00 200000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

MD 6.00 5000.00 6000.00 7000.00 8000.00 100000.00 200000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

CP 1.00 6000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1D RESERVOIR A (CP 1)

MT 1.00 2.00 .20 .30 6.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

2.00 100000.00 -0.00 0.00 100000.00 654576.00 1000000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1.00 4.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

7.00 0.00 100000.00 200000.00 400000.00 600000.00 800000.00 1000000.00 -0.00 -0.00 -0.00 -0.00 -0.00

7.00 18000.00 21000.00 30000.00 40000.00 50000.00 60000.00 70000.00 80000.00 90000.00 100000.00 110000.00 120000.00

7.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

2.00 21000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1D RESERVOIR B (CP 2)

MT 2.00 4.00 .20 .30 6.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

3.00 100000.00 -0.00 0.00 100000.00 755408.00 1000000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1.00 4.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

7.00 0.00 100000.00 200000.00 400000.00 700000.00 800000.00 1000000.00 1000000.00 1000000.00 1000000.00 1000000.00 1000000.00

7.00 10000.00 12000.00 18000.00 30000.00 60000.00 150000.00 500000.00 500000.00 500000.00 500000.00 500000.00 500000.00

3.00 12000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1D RESERVOIR C (CP 3)

MT 3.00 4.00 .20 .30 6.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

4.00 35000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

4.00 3.00 .20 .30 6.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

17.00 1.00 1.00 .80 .70 .50 .40 .30 .25 .20 .15 .10 .05

17.00 28000.00 35000.00 42000.00 50500.00 60500.00 73000.00 90000.00 114000.00 138000.00 162000.00 186000.00 210000.00

150000.00 180000.00 230000.00 323000.00 490000.00 640000.00 800000.00 1000000.00 1250000.00 1500000.00 1750000.00 2000000.00 2250000.00

1.00 0.00 0.00 180.00 380.00 500.00 630.00 900.00 1250.00 1600.00 1950.00 2300.00 2650.00

1930.00 2660.00 5000.00 9000.00 12280.00 13350.00 14150.00 14800.00 15400.00 16000.00 16600.00 17200.00 17800.00

5.00 37000.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

1D CP 5

MT 5.00 0.00 0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00 -0.00

MRES 3 MCPM 5 11:10PM -0

IN	1	6 JUNE	1000.0	2000.0	1000.0	10000.0	37000.0	42000.0	50000.0	27000.0	20000.0	13000.0	
			5000.0	4000.0	5000.0	2000.0	1000.0	1000.0	1000.0	1000.0			
IN	2	6 JUNE	2000.0	3000.0	4000.0	6000.0	20000.0	57000.0	100000.0	90000.0	70000.0	50000.0	231000
			37000.0	24000.0	24000.0	15000.0	9000.0	3000.0	2000.0	1500.0			
IN	3	6 JUNE	3000.0	4000.0	27000.0	60000.0	105000.0	78000.0	60000.0	45000.0	33000.0	24000.0	517500
			18000.0	12000.0	12000.0	9000.0	6000.0	3000.0	2000.0	1000.0			
IN	4	6 JUNE	2000.0	4000.0	19000.0	13000.0	10000.0	7000.0	4000.0	1000.0	1000.0	4000.0	506000
			10000.0	25000.0	13000.0	7000.0	4000.0	2000.0	1000.0	500.0			
IN	5	6 JUNE	1000.0	2000.0	9000.0	6000.0	5000.0	3000.0	2000.0	500.0	500.0	2000.0	127500
			5000.0	12000.0	6000.0	4000.0	2000.0	1000.0	500.0	200.0			
EJ	-0		-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0			61700

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Reservoir B

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOCA	NATURAL	INFLW	OUTFLOW	CASELOC	LEVEL	EDP STOR
1	3850.00	3850.00	3850.00	3849.62	.03	2.04	53909.35
2	8625.00	12474.98	12470.37	12470.37	.02	2.01	105285.13
3	8800.00	8800.00	8800.00	8800.00	.46	2.02	109956.31

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LOCA	NATURAL	REGULATE	Q SPACE	Q BY US	FLOOD BY
4	2125.00	23035.43	22992.39	12007.61	20967.39	0.00
5	3176.27	24053.97	23833.07	13166.93	20656.00	62.62

COMPUTATION INTERVAL IN HOURS

6

***** FLOOD NUMBER 2 *****

NELROS 1 NPLCUMS 6
IFLOWS 1 IFLOWS 2
FLOWS MULTIPLIED BY 1.00

LOC 1 RESERVOIR A (CP 1)

SERVED BY 1

STARTING TIME
HOURS: DAYS 4, RUNS 5, YEARS 0.

PER CUM LOCAL Q SERVING 1 2

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
MIN 1000.000

PER NATURAL FLOW

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
MIN 1000.000

PER INFLOW

1	1000	2000	3000	18000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	

AVG 12833.333 MAX 50000.000
MIN 1000.000

PER OUTFLOW

1	1000	2000	3000	6147	6000	6000	6000	6000	6000	6000
11	6000	6000	6000	6000	6000	6000	6000	6000	6000	

AVG 5361.467 MAX 6146.961
MIN 1000.000

PER
CABELOC, TYP

[illegible]

DATE	TIME	AVG	MAX	MIN
060	016			
010				

PER LEVEL

1	2,000	2,000	2,050	2,300	2,604	2,707	2,776	2,811
11	2,800	2,700	2,701	2,762	2,712	2,663		

PER EUP STORAGE

1	5000	5000	55870	71250	69101	110920	121333	126275	131747
11	131251	130250	129771	126788	124300	121629	119150	116970	

AVGS 103210.200 MAXB 131244.511
MINS 5000.000

*** LOC 2 RESERVOIR B (CP 2)

SERVED BY 1 2

	STARTING TIME	I	HOURS	DAYS	MINS.	YEARS	S.
WH06912	0845	1	00	00	00	00	00

PER	CUM LOCAL O	SERVING	2	4
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50
51	51	51	51	51
52	52	52	52	52
53	53	53	53	53
54	54	54	54	54
55	55	55	55	55
56	56	56	56	56
57	57	57	57	57
58	58	58	58	58
59	59	59	59	59
60	60	60	60	60
61	61	61	61	61
62	62	62	62	62
63	63	63	63	63
64	64	64	64	64
65	65	65	65	65
66	66	66	66	66
67	67	67	67	67
68	68	68	68	68
69	69	69	69	69
70	70	70	70	70
71	71	71	71	71
72	72	72	72	72
73	73	73	73	73
74	74	74	74	74
75	75	75	75	75
76	76	76	76	76
77	77	77	77	77
78	78	78	78	78
79	79	79	79	79
80	80	80	80	80
81	81	81	81	81
82	82	82	82	82
83	83	83	83	83
84	84	84	84	84
85	85	85	85	85
86	86	86	86	86
87	87	87	87	8

0001 0000 !

11	37000	26000	15000
	4000	3000	2000
	1500	1500	1500

PER NATURAL FLOW

1	3000	4167	6020	11330	19056	91043	142140	134057	90009	70302
11	49006	30147	20191	18032	11005	4160	1020	2505		

PER INFLW

1	3000	4167	6020	9362	29650	62443	105991	95968	70000	50000
11	43000	30000	30000	30000	21000	9000	9000	7500		

PER OUTFLOW

\$	300	4167	.6028	*362	2100	0	2100	2100	2100
11	6935	-	21000	2100	2100	21000	2100	2100	2100

CASE NO. 08-1367

[illegible]

PER LEVEL

[illegible]

11 2.318 2.345 2.353 2.353 2.348 2.337 2.325 2.313

PER EQUIVALENT LEVEL

1 2.000 2.000 2.000 2.000 2.036 2.111 2.208 2.281 2.333 2.366
11 2.393 2.415 2.419 2.416 2.408 2.395 2.381 2.367

PER EDP STORAGE

1 10000 10000 10000 10000 102310 133522 175667 212856 240129 258843
11 276330 291407 295869 295869 292894 286948 280487 273803

LOC 3 RESERVOIR C (CP 3)

SERVED BY 3

STARTING TIME
HOURS=12, DAYS 4, MONTH 0, YEAR=19 0.

PER CUM LOCAL 0

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 24000
11 18000 12000 12000 9000 6000 3000 2000 1000

PER NATURAL FLOW

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 24000
11 18000 12000 12000 9000 6000 3000 2000 1000

PER INFLOW

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 24000
11 18000 12000 12000 9000 6000 3000 2000 1000

PER OUTFLOW

1 3000 6000 12000 12000 12000 9159 12000 12000 12000 0
11 0 0 12000 4050 12000 12000 12000 12000

PER CASE=LOC,1YP

1 .03 .03 .01 .01 .01 .01 .01 .01 .01 .01
11 .001 .000 .001 .001 .001 .001 .001 .001 .001 .001

PER LEVEL

1 2.000 2.000 2.011 2.048 2.118 2.170 2.204 2.231 2.247 2.265
11 2.276 2.288 2.286 2.292 2.287 2.281 2.273 2.265

AVG= 2.197 MAX= 2.292

AVG= 2.202 MAX= 2.553
MIN= 2.000

AVG= 2.252 MAX= 2.419
MIN= 2.000

AVG= 212041.170 MAX= 295869.421
MIN= 100000.000

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

AVG= 8567.131 MAX= 12000.000
MIN= .000

AVG= 1.121 MAX= 6.010
MIN= .010

MIN 6,000

PER EOP STORAGE

1 10000 10000 107438 131200 173356 211493 235295 251659 262072 273973
11 262099 268650 288650 291304 288359 283866 278908 273453

AVG= 229277.000

MAX= 201504.433

MIN= 10000.000

LOC 4 CP 4 SERVED BY -1 2 3

PER CUM LOCAL 0

1 2000 4000 19000 13000 10000 7000 4000 1000 1000 4000
11 10000 25000 13000 7000 4000 2000 1000 500

AVG= 7083.333

MAX= 25000.000

MIN= 500.000

PER NATURAL FLOW

1 0000 10094 32398 49141 87592 140277 173798 194036 175045 136597
11 100281 93327 59185 45947 31355 19091 9465 5847

AVG= 76786.776

MAX= 194036.091

MIN= 5847.854

PER REGULATED FLOW

1 0000 10094 20898 30395 32401 30300 20156 31193 33532 34600
11 28099 32500 19750 10300 30750 33958 33826 33871

AVG= 28492.417

MAX= 34599.060

MIN= 6000.000

PER 0 SPACE AVAIL.

1 27000 22306 5102 4005 2349 700 14844 3007 1468 400
11 6101 2500 15250 700 4250 1042 1176 1526

AVG= 6507.593

MAX= 27000.000

MIN= 400.000

PER 0 BY US RES, DIV8

1 4000 6894 10898 17305 22601 27300 16156 30193 32532 30600
11 10099 7500 6750 27300 26750 31958 32826 32971

AVG= 21409.084

MAX= 32971.000

MIN= 6000.000

PER FLOOD BY RES

1 0 0 0 0 0 0 0 0 0 0
11 0 0 0 0 0 0 0 0 0 0

AVG= 0.000

MAX= 0.000

MIN= 0.000

LOC 5 CP 5 SERVED BY -1 -2 -3

PER CUM LOCAL 0

1 3000 4333 15222 21870 17978 12996 8999 4590 2000 3583
11 9597 23000 20767 17204 4510 5258 2710 1310

AVG= 10507.575

MAX= 20767.500

MIN= 1310.203

PER NATURAL FLOW

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Reason B

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Reservoir B

1 9000 10449 22937 30112 57711 94226 142355 172097 107631 172652
11 142220 121279 96295 66172 48252 32794 20104 10752

AVG= 80279.898 MAX= 17631.140
MIN= 9000.000

PER REGULATED FLOW

1 9000 10449 22521 33251 35246 35518 33646 24410 30869 35103
11 38616 42252 36000 27863 33972 32468 34025 33917

AVG= 30502.405 MAX= 42251.723
MIN= 9000.000

PER Q SPACE AVAIL.

1 28000 26551 14479 3749 1744 1482 3354 12590 6131 1817
11 -1414 -5252 1000 9117 3028 4512 2975 3083

AVG= 6497.595 MAX= 28000.000
MIN= -5251.723

PER Q BY US RES.DIVS

1 6000 6116 7299 11381 17247 22522 24646 19910 28869 31600
11 28916 18652 9238 10589 24423 27230 31315 32599

AVG= 19914.830 MAX= 32599.587
MIN= 6000.000

PER FLOOD BY RES

1 0 0 0 0 0 0 0 0 0
11 1416 5252 0 0 0 0 0 0 0

AVG= 370.299 MAX= 5251.723
MIN= 0.000

CUM TIME= 1

RES NOS 1 2 3
INFLOW 1000 3000 3000
OUTFLOW 1000 3000 3000
EOP STOR 50000 100000 100000
CASE= .03 .03 .03
LEVEL 2,000 2,000 2,000
EO LEVEL 2,000 2,000 2,000

CUM TIME= 2

RES NOS 1 2 3
INFLOW 2000 4167 6000
OUTFLOW 2000 4167 6000
EOP STOR 50000 100000 100000
CASE= .03 .03 .03
LEVEL 2,000 2,000 2,000
EO LEVEL 2,000 2,000 2,000

CUM TIME= 3

RES NOS 1 2 3
INFLOW 3000 6028 27000

FLOOD SUMMARY-EACH FLOOD CURVE

***** FLOOD NUMBER : *****

STARTING TIME 1

NUMERICAL INDEX

	LOC	# CP #	FLOP/SEC	MAR	LDC %	FLOP/SEC	MAR	LDC %	# CP #	LOC
90C	306	5	1,012	3813 *	1,009	5028 *	1,012	7500 *	5	306
90C	306	5	1,011	3700 *	1,008	5021 *	1,012	7500 *	5	306
90C	306	4	1,011	3700 *	1,008	5021 *	1,012	7500 *	4	306

RESERVING
FLO,PER MIN SFG MIN LEVEL * FLO,PER MAX SFG MAX LEVEL * FLO,PER MAX DEL CHAN CAP STUR1

[illegible]

	LOF	2 RESERVIN O (CP 2)	1.018	10000	2,000 *	1,009	117516	2,031 *	1,006	21000	21000	100000
--	-----	---------------------	-------	-------	---------	-------	--------	---------	-------	-------	-------	--------

[illegible]

0918 H3L8A8 MIN 250000 000052 0918 H3L8A8 MIN 300000

***** FLOOD NUMBER 2 *****

STARTING TIME

INDEX

LOC	# CP	PLD.PER	MAX REG	MAX NAT	FLD.PER	MAX LOC	# BY REG	OSR
LOC 5	CP 5	2,010	3860 *	2,000	2,012	2500 *	9600 *	0.00
LOC 5	CP 5	2,012	4252 *	2,000	2,013	2676 *	15605 *	0.00

RESERVING FLD,PER MIN STG MIN LEVEL * FLD,PER MAX STG MAX LEVEL * FLD,PER MAX REL CHAN CAP STORI

[illegible][illegible][illegible]

MIN SYSTEM STGB 250000 MAX SYSTEM STGB 718919

***** FLOOD NUMBER 3 *****

STARTING TIME !

CONTENTS INDEX

[illegible]

RESERVING	FLO.PLR MIN STG MIN LEVEL * FLO.PER MAX STG MAX LEVEL * FLO.PER MAX REL CHAN CAP STOR1
-----------	--

LOC	1	RESERVOIR A (CP 1)	3.002	50000	2.000	3.000	150832	3.000	3.000	5000	50000
LOC	2	RESERVOIR B (CP 2)	3.001	100000	2.000	3.014	483597	2.692	3.006	21000	100000
LOC	3	RESERVOIR C (CP 3)	3.001	100000	2.000	3.014	426307	2.498	3.008	12000	100000

MIN SYSTEM STG= 25000 MAX SYSTEM STG= 1060736

***** FLOOD NUMBER 4 *****

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Reservoir B

STARTING TIME 1											
SHORTAGE INDEX											
FLO, PER MAX REG Q * FLO, PER MAX NAT Q * FLO, PER MAX LOC Q * U BY RES * DELS * RES											
LOC	4	CP 4	4.012	58228 *	4.008	388072 *	4.012	50000 *	4.012	4224 *	0.00
LOC	5	CP 5	4.013	69627 *	4.009	375262 *	4.013	53513 *	4.013	7694 *	0.00
RESERVOIRS											
FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STORI											
LOC	1	RESERVOIR A (CP 1)	4.001	50000	2.000	4.007	150832	3.000	4.007	82658	5000
LOC	2	RESERVOIR B (CP 2)	4.001	102975	2.005	4.014	654376	3.000	4.014	23051	100000
LOC	3	RESERVOIR C (CP 3)	4.001	102975	2.005	4.015	568840	2.709	4.004	12000	100000

MIN SYSTEM STG= 255950 MAX SYSTEM STG= 1370248

***** FLOOD NUMBER 5 *****

STARTING TIME 1											
SHORTAGE INDEX											
FLO, PER MAX REG Q * FLO, PER MAX NAT Q * FLO, PER MAX LOC Q * U BY RES * DELS * RES											
LOC	4	CP 4	5.012	270763 *	5.008	582108 *	5.012	75000 *	5.012	195763 *	0.00
LOC	5	CP 5	5.013	269295 *	5.009	562893 *	5.013	60300 *	5.013	186995 *	0.00
RESERVOIRS											
FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STORI											
LOC	1	RESERVOIR A (CP 1)	5.001	50000	2.000	5.007	167676	3.343	5.007	118246	5000
LOC	2	RESERVOIR B (CP 2)	5.001	104863	2.008	5.010	702719	3.139	5.010	196341	100000
LOC	3	RESERVOIR C (CP 3)	5.001	104863	2.007	5.012	755408	3.000	5.013	35999	100000

MIN SYSTEM STG= 258924 MAX SYSTEM STG= 1625603

***** FLOOD NUMBER 6 *****

STARTING TIME 1											
SHORTAGE INDEX											
FLO, PER MAX REG Q * FLO, PER MAX NAT Q * FLO, PER MAX LOC Q * U BY RES * DELS * RES											
LOC	4	CP 4	6.012	497775 *	6.008	776148 *	6.012	100000 *	6.012	397775 *	0.00
LOC	5	CP 5	6.012	506408 *	6.009	750525 *	6.013	107066 *	6.013	399341 *	0.00
RESERVOIRS											
FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STORI											
LOC	1	RESERVOIR A (CP 1)	6.001	50000	2.000	6.007	191183	3.821	6.007	163829	5000
LOC	2	RESERVOIR B (CP 2)	6.001	105950	2.011	6.009	611202	3.453	6.010	310627	100000

LOC	3	RESERVOIR C (CP 3)	6.001	105950	2.009 *	6.008	781273	3.106 *	6.009	130168	12000	100000
			MIN SYSTEM STOP	261900	MAX SYSTEM STOP	1703650						

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
 CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1
.9999	26800	0.00	0.00
.9000	35000	0.00	0.00
.8000	42000	180.00	180.00
.7000	50500	380.00	380.00
.6000	60500	500.00	500.00
.5000	73000	630.00	630.00
.4000	90000	900.00	900.00
.3000	114000	1250.00	1250.00
.2500	130000	1500.00	1500.00
.2000	150000	1930.00	1930.00
.1500	180000	2640.00	2640.00
.1000	230000	5000.00	5000.00
.0500	323000	9900.00	9900.00
.0200	490000	12800.00	12800.00
.0100	620000	13350.00	13350.00
.0050	680000	14150.00	14150.00
.0020	1000000	14600.00	14600.00

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED	1721.30	1721.30
BASE COND-INPUT	0.00	-0.00
EXIST SYSTEM-INPUT	696.82	696.82

BASE CONDITION FLOOD DAMAGES

NO.	FLOW	FREQ	INT	PROB	SUM	TYPE 1	TYPE
1	56211	.621	.623		213.27	213.27	
2	194036	.134	.279		549.61	549.61	
3	291052	.062	.050		360.93	360.93	
4	388072	.034	.025		265.87	265.87	
5	562108	.013	.014		173.38	173.38	
6	776144	.007	.010		138.03	138.03	

BASE COND DAMAGES	1721.30	1721.30
EXIST SYST DAMAGES	696.82	696.82

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	FREQ	INT	PROB	SUM	TYPE 1	TYPE
1	34700	.621	.623		0.00	0.00	
2	34600	.134	.279		.30	.30	
3	38262	.062	.050		4.06	4.06	
4	54226	.034	.025		15.13	15.13	
5	270763	.013	.014		68.96	68.96	
6	497775	.007	.010		126.11	126.11	

MODIFIED DAMAGES	214.55	214.55
DAMAGE REDUCTION	882.27	882.27

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	FREQ	INT	PROB	SUM	TYPE 1	TYPE
1	7500	.621	.623		0.00	0.00	
2	25000	.134	.279		0.00	0.00	

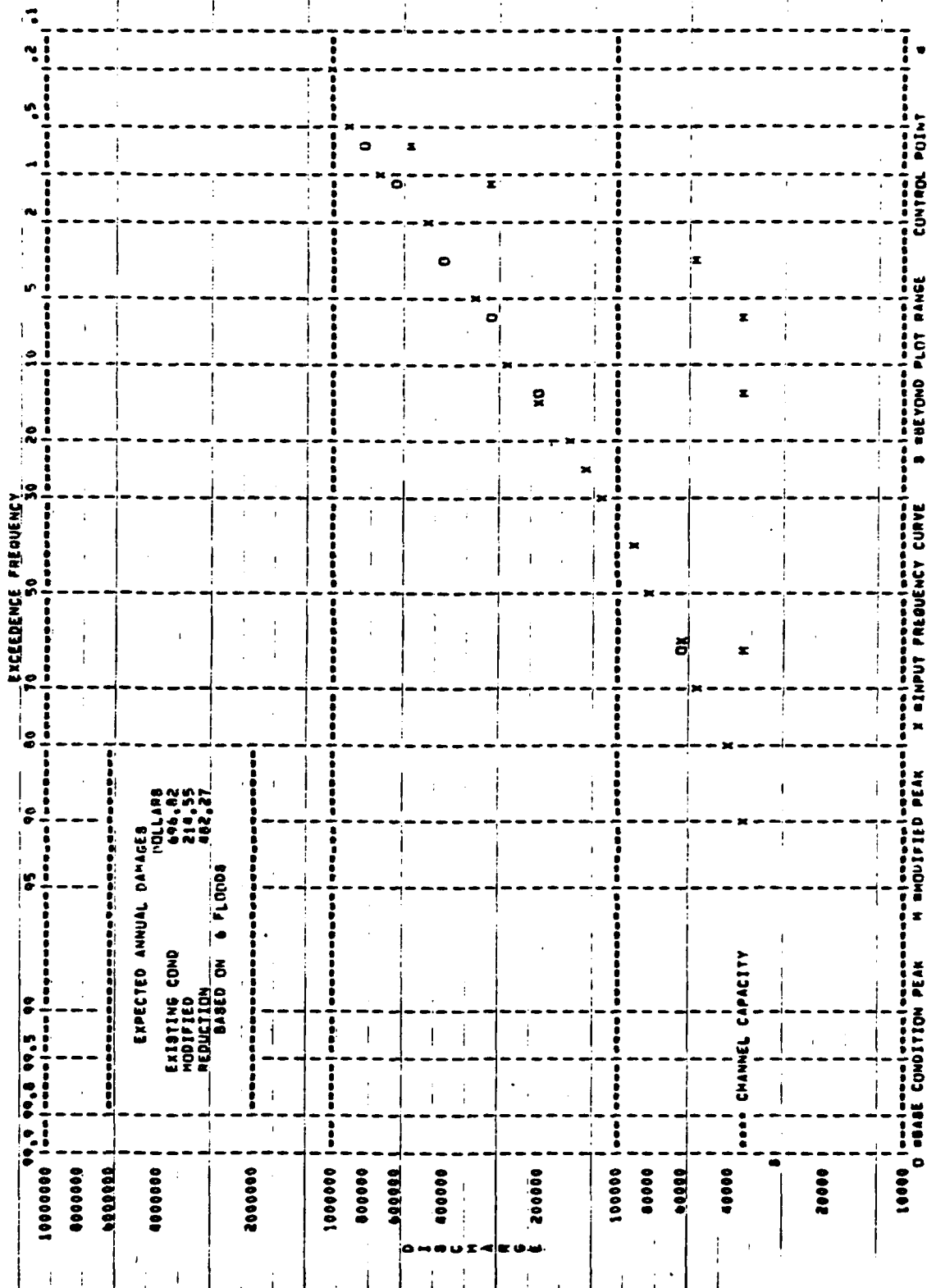
3	37500	.002	.030	2.00	4.00
4	50000	.030	.025	0.31	0.31
5	75000	.013	.010	0.27	0.27
6	100000	.007	.010	12.00	12.00
DAMAGES W/ TOTAL					
CONTROL AT PROJECTS				30.74	30.74

REDUCTION POSSIBLE	
W/ TOTAL CONTROL	666.00

RESIDUAL DAMAGES	103.01	103.01
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 Review B

CONTROL POINT 4



SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES									
CONTROL POINT	BASE CONDITION	DAMAGES EXIST	MODIFIED CONDITIONS	UNCONTROL LOCAL COND	MODIFIED CONDITIONS AT PROJECTS	TOTAL CONTROL DAMAGE REDUCTION	RESIDUAL		
1	2	3	4	5	6	7	8	9	10
		606.02	210.55	30.74	402.27	406.08	103.01		
TOTAL		996.82	210.55	30.74	402.27	594.00	103.01		

CONTROL POINT	BASE CONDITION	DAMAGED MODIFIED CONDITIONS	UNCONTROL LOCAL COND	MODIFIED CONDITIONS AT PROJECTS	DAMAGE REDUCTION, RESIDUAL
1	606.82	216.55	30.74	482.27	133.81
TOTAL	996.82	216.55	30.74	482.27	133.81

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 Summary B

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
 (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	• • • • •	59150.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	• • • • •	709.00
TOTAL SYSTEM ANNUAL COST	• • • • •	6149.65
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM		696.02
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM		214.55
AVERAGE ANNUAL DAMAGE REDUCTION		482.27
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS		-3717.35

HEC-3C-VARIABLE OUTPUT MAR.1975
RER.0 35 CPTS. 75 PERC. 8100

T1 FALL RIVER BASIN *** LEVEE OR FLOODHALL ***

T2 TRAINING DOCUMENT NO. 7
T3 FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
J1	10.00	6.00	4.00	2.00	3.00	-0.00
J2	-0.00	1.10	2.00	1.00	0.00	-0.00
J3	6.00	.30	1.00	1.50	2.00	3.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
RL	1.00	50000.00	-0.00	0.00	50000.00	200000.00
RD	1.00	4.00	-0.00	-0.00	-0.00	-0.00
RE	6.00	0.00	50000.00	70000.00	100000.00	200000.00
RF	6.00	50000.00	60000.00	70000.00	80000.00	200000.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP RESERVOIR (CP 1)	1.00	60000.00	-0.00	-0.00	-0.00	-0.00
RT	1.00	2.00	.20	.30	-0.00	-0.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP	2.00	21000.00	-0.00	-0.00	-0.00	-0.00
RD	2.00	4.00	.20	.30	-0.00	-0.00
RT	2.00	4.00	.20	.30	-0.00	-0.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
RL	3.00	100000.00	-0.00	0.00	100000.00	1000000.00
RD	1.00	4.00	-0.00	-0.00	-0.00	-0.00
RE	7.00	0.00	100000.00	200000.00	300000.00	1000000.00
RF	7.00	100000.00	120000.00	180000.00	240000.00	1000000.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP RESERVOIR (CP 3)	3.00	12000.00	-0.00	-0.00	-0.00	-0.00
RT	3.00	4.00	.20	.30	-0.00	-0.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP	5.00	267000.00	-0.00	-0.00	-0.00	-0.00
RD	4.00	5.00	.20	.30	-0.00	-0.00
RE	1.00	267000.00	-0.00	-0.00	-0.00	-0.00
RF	1.00	267000.00	-0.00	-0.00	-0.00	-0.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP	17.00	1.00	.00	.00	.00	.00
RD	.20	.15	.10	.05	.02	.01
RE	17.00	20000.00	35000.00	42000.00	50500.00	73000.00
RF	190000.00	180000.00	230000.00	323000.00	400000.00	600000.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP	1930.00	2000.00	5000.00	9700.00	12200.00	18350.00
RD	1.00	0.00	0.00	0.00	0.00	0.00
RE	0.00	0.00	0.00	0.00	0.00	0.00
RF	0.00	0.00	0.00	0.00	0.00	0.00

	1.0	1.5	2.0	3.0	4.0	ANNUAL DAMAGES
CP	5.00	37000.00	-0.00	-0.00	-0.00	-0.00
RD	5.00	6.00	0.00	-0.00	-0.00	-0.00
RE	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00

NRERO 2 MCPTS 5 MCPTS -0

	1	6 JUNE	1000.0	2000.0	3000.0	10000.0	37000.0	62000.0	50000.0	27000.0	20000.0	13000.0
RL	1.00	10000.00	-0.00	0.00	10000.00	37000.00	62000.00	50000.00	27000.00	20000.00	13000.00	

Line on Standard Page 44

Page 45
81750
Leave on floor

817500
Office on floor.

[illegible]

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOC	NATURAL	INFLOW	OUTFLOW	CASELOC	LEVEL	TOP STON
1	3050.00	3050.00	3050.00	3050.00	.02	2.01	53018.24
3	8000.00	8000.00	8000.00	8000.00	.02	2.01	100479.46

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LOC	NATURAL	REGULATE	SPACE	BY US	FLOOD BY
2	8025.00	12374.00	12374.00	8525.00	3049.56	1104.09
4	10755.92	23035.03	23027.12	203972.00	12271.20	0.00
5	11745.97	24083.97	24016.68	12063.36	12226.67	1257.74

COMPUTATION INTERVAL IN HOURS

***** FLOOD NUMBER 2 *****

INFLOW 1 INFLOW 2
 INFLOW 1 INFLOW 2
 FLOWS MULTIPLIED BY 1.00

***** LOC 1 RESERVOIR A (CP 1) *****

STARTING TIME
 HOUR:12, DAY: 8, MONTH: 6, YEAR: 1970

PER	CUM LOCAL	SERVING	1	4	SERVED BY	1
1	1000 2000 3000	18000 37000	42000 50000	27000 20000	20000 13000	
11	5000 4000 3000	2000 1000	1000 1000	1000 1000	1000 1000	

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER	NATURAL FLOW	1	4	20000	13000
1	1000 2000 3000	18000 37000	42000 50000	27000 20000	20000 13000
11	5000 4000 3000	2000 1000	1000 1000	1000 1000	1000 1000

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER	INFLOW	1	4	20000	13000
1	1000 2000 3000	18000 37000	42000 50000	27000 20000	20000 13000
11	5000 4000 3000	2000 1000	1000 1000	1000 1000	1000 1000

AVG 12033.333 MAX 50000.000
 MIN 1000.000

PER OUTFLOW

PER	OUTFLOW	1	4	20000	13000
1	1000 2000 3000	18000 37000	42000 50000	27000 20000	20000 13000
11	5000 4000 3000	2000 1000	1000 1000	1000 1000	1000 1000

AVG 5333.333 MAX 6000.000
 MIN 1000.000

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 Lane W. Lindwall

PER CASELOC.TYP

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Lance on Standwell

PER	1	03	03	01	01	01	01	01	01	01	01	01	01
11	01	01	01	01	01	01	01	01	01	01	01	01	01

AVG 013 MAX 030
MIN 010

PER LEVEL

PER	1	2000	2000	2000	2059	2011	2009	2009	2009	2009	2009	2009	2009
11	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007	2007

AVG 2000 MAX 2000
MIN 2000

PER EOP STORAGE

PER	1	5000	5000	5000	5590	7133	6917	11093	12106	12036	13181
11	13133	13033	12004	12004	12004	12004	12004	12004	12004	12004	12004

AVG 103279.018 MAX 13181.375
MIN 5000.000

PER LOC 2 CP 2 SERVED BY -1

PER CUM LOCAL G

PER	1	2000	3000	4000	6000	20000	97000	100000	90000	70000	50000
11	37000	24000	24000	15000	9000	3000	2000	1500			

AVG 20750.000 MAX 100000.000
MIN 3500.000

PER NATURAL FLOW

PER	1	3000	4167	6020	11338	39050	91843	142140	134867	90000	70302
11	49806	30167	28191	10032	11005	4100	3020	2505			

AVG 41503.202 MAX 142140.050
MIN 2500.050

PER REGULATED FLOW

PER	1	3000	4167	6020	9338	25550	62926	105000	95990	70000	50000
11	43000	30000	30000	21000	15000	9000	8000	7500			

AVG 33005.556 MAX 105007.076
MIN 3000.000

PER 0 SPACE AVAIL.

PER	1	10000	10033	14972	11662	0556	01925	04000	07098	035000	035000
11	02000	0000	0000	0000	0000	0000	12000	13000	13500		

AVG -12005.556 MAX 10000.000
MIN -00007.076

PER 0 BY US RES.DIVS

PER	1	1000	1167	2020	3338	5556	5926	5900	5990	6000	6000
11	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000

AVG 3055.556 MAX 6000.000
MIN 1000.000

PER FLOOD BY RES

PER	1	0	0	0	0	0556	5926	5900	5990	6000	6000
11	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000

AVG 2910.000 MAX 6000.000

MIN 0.000

LOC 3 RESERVOIR C (CP 3) SERVED BY 2

STARTING TIME
HOURS:12, DAYS: 8, MONTH: 6, YEAR: 19 6.

PER CUM LOCAL 0 SERVING 2 4

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 28000
11 10000 12000 12000 9000 6000 3000 2000 1000

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER NATURAL FLOW

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 28000
11 10000 12000 12000 9000 6000 3000 2000 1000

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER INFLOW

1 3000 6000 27000 60000 105000 78000 60000 45000 33000 28000
11 10000 12000 12000 9000 6000 3000 2000 1000

AVG= 20000.000 MAX= 105000.000
MIN= 1000.000

PER OUTFLOW

1 3000 6000 12000 12000 12000 12000 12000 12000 12000 12000
11 12000 12000 12000 12000 12000 12000 12000 12000 12000

AVG= 11166.667 MAX= 12000.000
MIN= 3000.000

PER CASELOC.TYP

1 .03 .03 .01 .01 .01 .01 .01 .01 .01
11 .01 .01 .01 .01 .01 .01 .01 .01 .01

AVG= .012 MAX= .030
MIN= .010

PER LEVEL

1 2.000 2.000 2.011 2.048 2.110 2.168 2.204 2.229 2.245 2.254
11 2.259 2.259 2.259 2.259 2.252 2.245 2.236 2.229 2.229

AVG= 2.182 MAX= 2.259
MIN= 2.000

PER EUP STORAGE

1 10000 10000 107430 131240 177356 210084 233066 250236 260663 266614
11 269500 269500 269500 268102 265126 260663 255705 250236

AVG= 219230.300 MAX= 269500.250
MIN= 100000.000

LOC 4 CP 4 SERVED BY 1 2

PER CUM LOCAL 0

1 4000 6167 22020 17171 18079 31171 62695 92449 97000 73805
11 61001 62180 39197 29866 19311 11052 4042 2724

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Lower or 3 Endwell

AVG= 35853.070 MAX= 92440.206
MIN= 2723.602

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Lense or Shadwell

PER NATURAL FLOW

1	8000	10494	32398	40141	67802	144277	173798	196036	175085	136597
11	100201	93327	59105	45997	31355	19091	9665	5047		

PER REGULATED FLOW

1	8000	10494	28898	30391	33383	40422	40519	110411	105900	91083
11	70000	80100	57197	47866	37311	29552	28442	10721		

PER 0 SPACE AVAIL.

1	270000	276306	257102	256609	253617	238578	206481	176389	181100	195517
11	207920	206820	220803	239134	249659	257948	264158	266276		

PER 0 BY US RES, DIV8

1	4000	4528	7070	13220	15355	17251	17024	17902	17998	
11	18000	18000	18000	18000	18000	18000	18000	18000		

PER FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0

AVG= 9,000 MAX= 9,000
MIN= 0,000

LOC 5 CP 5
CUM LOCAL 0

SERVED BY 01 02

PER NATURAL FLOW

1	5000	6361	17809	24965	22613	23150	36588	63870	87279	87316
11	76384	75315	64539	44865	31940	20706	11959	5702		

PER REGULATED FLOW

1	9000	10449	22937	30112	57711	96226	142355	172097	107631	172652
11	142220	121270	96295	66172	80242	32798	20106	10792		

PER REGULATED FLOW

1	9000	10449	22921	33291	35366	30307	53509	81181	102204	103200
11	96385	93315	82536	62865	49940	38706	29959	23792		

PER 0 SPACE AVAIL.

1	20000	20551	14779	3749	1634	-1387	-16599	-44181	-60206	-60200
11	-59385	-56315	-45539	-25065	-12040	-1706	7061	13208		

AVG= 33986.558 MAX= 103200.240
MIN= 9980.000

AVG = 10000.000 MAX = 20000.000
MIN = 00000.000

PER 0 BY US RES/DIVE

1	4000	4000	5012	5205	12753	12237	17011	17711	17925	17902
11	17000	17000	18000	18000	18000	18000	18000	18000	18000	18000

AVG = 10000.000 MAX = 20000.000
MIN = 00000.000

PER 0 BY US RES/DIVE

1	4000	4000	5012	5205	12753	12237	17011	17711	17925	17902
11	17000	17000	18000	18000	18000	18000	18000	18000	18000	18000

AVG = 10000.000 MAX = 20000.000
MIN = 00000.000

PER 0 BY US RES/DIVE

1	4000	4000	5012	5205	12753	12237	17011	17711	17925	17902
11	17000	17000	18000	18000	18000	18000	18000	18000	18000	18000

RES NOS 1 3
INFLW 1000 3000
OUTFLOW 1000 3000
EOP STOR 50000 100000
CASE# .03 .03
LEVEL 2.000 2.000
EO LEVEL 2.000 2.000

CUM TIME 2

RES NOS 1 3
INFLW 1000 3000
OUTFLOW 1000 3000
EOP STOR 50000 100000
CASE# .03 .03
LEVEL 2.000 2.000
EO LEVEL 2.000 2.000

CUM TIME 3

RES NOS 1 3
INFLW 1000 3000
OUTFLOW 1000 3000
EOP STOR 50000 100000
CASE# .03 .03
LEVEL 2.000 2.000
EO LEVEL 2.000 2.000

CUM TIME 4

RES NOS 1 3
INFLW 1000 3000
OUTFLOW 1000 3000
EOP STOR 50000 100000
CASE# .03 .03
LEVEL 2.000 2.000
EO LEVEL 2.000 2.000

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Lore on Shadwell

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Levee on Floodwall

FALL RIVER BASIN *** LEVEE OR FLOODWALL ***

TRAINING DOCUMENT NO. 7

FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

FLOOD SUMMARY-EACH FLOOD CDV#

1

***** FLOOD NUMBER 1 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	CP	FLO, PER	MAX RES 0 *	FLO, PER	MAX NAT 0 *	FLO, PER	MAX LOC 0 *
LOC 2	CP 2	1.007	35949 *	1.007	42442 *	1.007	39800 *
LOC 4	CP 4	1.008	45047 *	1.008	50211 *	1.008	27735 *
LOC 5	CP 5	1.010	44155 *	1.009	50259 *	1.010	26195 *
RESERVOIRS		FLO, PER	MIN STO MIN LEVEL *	FLO, PER	MAX STO MAX LEVEL *	FLO, PER	MAX REL CHAN CAP
LOC 1 RESERVOIR A (CP 1)		1.010	50000	2.000 *	1.000	61305	2.112 *
LOC 3 RESERVOIR C (CP 3)		1.010	100000	2.000 *	1.000	122016	2.036 *
MIN SYSTEM STOP		150000		MAX SYSTEM STOP		103321	
						STORI	
						6000	
						12000	
						100000	

***** FLOOD NUMBER 2 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	CP	FLO, PER	MAX RES 0 *	FLO, PER	MAX NAT 0 *	FLO, PER	MAX LOC 0 *
LOC 2	CP 2	2.007	105988 *	2.007	142140 *	2.007	100000 *
LOC 4	CP 4	2.008	110411 *	2.008	194036 *	2.008	92449 *
LOC 5	CP 5	2.010	105298 *	2.009	107431 *	2.010	07316 *
RESERVOIRS		FLO, PER	MIN STO MIN LEVEL *	FLO, PER	MAX STO MAX LEVEL *	FLO, PER	MAX REL CHAN CAP
LOC 1 RESERVOIR A (CP 1)		2.003	50000	2.000 *	2.010	131819	2.611 *
LOC 3 RESERVOIR C (CP 3)		2.002	100000	2.000 *	2.011	209589	2.259 *
MIN SYSTEM STOP		150000		MAX SYSTEM STOP		401400	
						STORI	
						6000	
						12000	
						100000	

***** FLOOD NUMBER 3 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	CP	FLO, PER	MAX RES 0 *	FLO, PER	MAX NAT 0 *	FLO, PER	MAX LOC 0 *
LOC 2	CP 2	3.007	155993 *	3.007	213211 *	3.007	150000 *
LOC 4	CP 4	3.008	157420 *	3.008	251034 *	3.008	130674 *
LOC 5	CP 5	3.010	157351 *	3.009	201447 *	3.010	130974 *
RESERVOIRS		FLO, PER	MIN STO MIN LEVEL *	FLO, PER	MAX STO MAX LEVEL *	FLO, PER	MAX REL CHAN CAP
LOC 1 RESERVOIR A (CP 1)		3.003	50000	2.000 *	3.008	156632	3.000 *
						STORI	
						6000	
						12000	
						100000	

******* FLOOD NUMBER 4 *******

RESERVOIRS		FLO, PER	MIN STG	MIN LEVEL	FLO, PER	MAX STG	MAX LEVEL	FLO, PER	MAX REL	CHAN CAP	STOR1
LOC	1 RESERVOIR A (CP 1)	4.003	90000	2.000	4.007	150832	3.000	4.007	72490	6000	50000
LOC	3 RESERVOIR C (CP 3)	4.002	100000	2.000	4.014	507600	2.022	4.002	12000	12000	100000
		MIN SYSTEM STCW	150000	MAX SYSTEM STOR	650001						

***** FLOOD NUMBER 9 *****

RESERVOIRS										
LOC	FLD.PLR	MIN STC	MIN LEVEL	FLD.PER	MAX STC	MAX LEVEL	FLD.PER	MAX REL	CHAN CAP	STORS
1 RESERVOIR A (CP 1)	5,002	50000	2,000	5,007	107314	3,335	5,007	116761	4000	50000
3 RESERVOIR C (CP 3)	5,001	100000	2,000	5,012	755408	3,000	5,013	35999	12000	100000
		MIN SYSTEM STCS			MAX SYSTEM STCS		922722			

***** FLOOD NUMBER 6 *****

RESERVOIRS												
LOC	1	RESERVOIR A (CP 1)	FLO.PER	MIN STG	MIN LEVEL	FLO.PER	MAX STG	MAX LEVEL	FLO.PER	MAX REL	CHAN CAP	37DB1
			6,001	50000	2,000	6,007	191163	3,021	6,007	163029	6000	50000
LOC	2	RESERVOIR C (CP 3)	FLO.PER	MIN STG	MIN LEVEL	FLO.PER	MAX STG	MAX LEVEL	FLO.PER	MAX REL	CHAN CAP	37DB1
			6,001	100000	2,000	6,009	769930	3,039	6,009	120311	12000	100000
MIN SYSTEM STGS										MAX SYSTEM STGS		
				150000			941113					

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Seven & 7/2nd all

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY=FLOW-DAMAGE DATA

PREC	PEAK	SUM	TYPE 1	TYPE 1
.0000	28000	0.00	0.00	
.0000	35000	0.00	0.00	
.0000	42000	180.00	0.00	
.0000	50000	360.00	0.00	
.0000	60000	500.00	0.00	
.0000	73000	630.00	0.00	
.0000	90000	900.00	0.00	
.0000	110000	1250.00	0.00	
.0000	130000	1500.00	0.00	
.0000	150000	1930.00	0.00	
.0000	180000	2660.00	0.00	
.0000	230000	5000.00	0.00	
.0000	320000	9900.00	0.00	
.0000	480000	12280.00	0.00	
.0100	680000	13350.00	0.00	
.0050	880000	14150.00	0.00	
.0020	1000000	14600.00	0.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED 1721.30 1721.30
BASE COND- INPUT 0.00 -0.00
EXIST SYSTEM-INPUT 696.82 696.82

BASE CONDITION FLOOD DAMAGES

NO.	FLOD	PREC	INT	SUM	TYPE 1	TYPE 1
1	58211	.621	.623	233.27	233.27	
2	190036	.134	.279	549.81	549.81	
3	291054	.062	.050	360.93	360.93	
4	388072	.038	.025	265.67	265.67	
5	582108	.013	.014	173.36	173.36	
6	776164	.007	.010	136.03	136.03	

BASE COND DAMAGES 1721.30 1721.30
EXIST SYST DAMAGES 696.82 696.82

MODIFIED CONDITIONS FLOW-DAMAGE DATA

PREC	PEAK	SUM	TYPE 1	TYPE 1
.0000	28000	0.00	0.00	
.0000	35000	0.00	0.00	
.0000	42000	0.00	0.00	
.0000	50000	0.00	0.00	
.0000	60000	0.00	0.00	
.0000	73000	0.00	0.00	
.0000	90000	0.00	0.00	
.0000	110000	0.00	0.00	
.0000	130000	0.00	0.00	
.0000	150000	0.00	0.00	
.0000	180000	0.00	0.00	
.0000	230000	6067.76	6067.76	
.0000	320000	9900.00	9900.00	
.0000	480000	12280.00	12280.00	
.0100	680000	13350.00	13350.00	
.0050	880000	14150.00	14150.00	
.0020	1000000	14600.00	14600.00	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	INT	SUM	TYPE 1	TYPE
1	85087	.621	.623		0.00	0.00	
2	119411	.134	.274		0.00	0.00	
3	157420	.062	.050		0.00	0.00	
4	240589	.036	.025		0.00	0.00	
5	346141	.013	.014		123.94	123.94	
6	601884	.007	.010		131.67	131.67	

MODIFIED DAMAGES 255.82
DAMAGE REDUCTION 441.00

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	INT	SUM	TYPE 1	TYPE
1	27735	.621	.623		0.00	0.00	
2	92446	.134	.274		0.00	0.00	
3	136674	.062	.050		0.00	0.00	
4	180808	.036	.025		0.00	0.00	
5	277348	.013	.014		22.01	22.01	
6	369767	.007	.010		107.67	107.67	

DAMAGES W/ TOTAL 129.68

CONTROL AT PROJECTS 129.68

REDUCTION POSSIBLE 566.94
W/ TOTAL CONTROL 566.94

RESIDUAL DAMAGES 125.93

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Lance on F. Indwell

CONTROL POINT

99.9 99.8 99.5 99
EXCEEDENCE FREQUENCY
100 20 30 40 50 60 70 80 90 95 99

EXPECTED ANNUAL DAMAGES
DOLLARS
EXISTING COND 696.02
MODIFIED 255.02
REDUCTION 441.00
BASED ON 6710000

CHANNEL CAPACITY

10000 8000 6000 4000 2000 1000

BASE CONDITION PEAK M MODIFIED PEAK X INPUT FREQUENCY CURVE S BEYOND PLOT RANGE CONTROL POINT

CONTROL		DAMAGES		UNCONTROLLED		MODIFIED		TOTAL CONTROL		DAMAGE REDUCTION	
POINT	CONDITION	POINT	CONDITION	LOCAL	COMO	POINT	CONDITION	POINT	CONDITION	POINT	CONDITION
1	000,00	255,02	120,00	481,00	125,03	2	000,00	255,02	120,00	481,00	125,03
TOTAL	000,00	255,02	120,00	481,00	125,03						

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Lane or Floodwell

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 Lane on Floodwall

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
 (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	\$910.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	\$9.10
TOTAL SYSTEM ANNUAL COST	300.10
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM	606.02
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM	253.02
AVERAGE ANNUAL DAMAGE REDUCTION	401.00
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS	602.01

	*** CHANNEL MODIFICATIONS ***				
	*** TRAINING DOCUMENT NO. 7				
	1.0	1.5	2.0	3.0	4.0
*** FLOOD RATIOS ***	1.0	1.5	2.0	3.0	4.0
U1	18.00	6.00	2.00	2.00	3.00
U2	-0.00	1.10	2.00	1.00	-0.00
J1	-	-	1.00	1.50	2.00
J2	6.00	.30	-	-	3.00

T1 FALL RIVER BASIN *** CHANNEL MODIFICATIONS ***									
72 TRAINING DOCUMENT NO. 7									
T3 FLOOD RATIOS .3		1.0	1.5	2.0	3.0	4.0	USED TO COMPUTE ANNUAL DAMAGES		
J1	18.00	0.00	0.00	2.00	3.00	0.00	0.00	1.00	-0.00
J2	0.00	1.10	2.00	1.00	-0.00	0.00	0.00	-0.00	-0.00
J4	-0.00	.30	1.00	1.50	2.00	3.00	4.00	-0.00	-0.00

RL	1.00	5000.00	-0.00	0.00	5000.00	15032.00	20000.00	-0.00	-0.00	-0.00
MR	1.00	4.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
PR	6.00	0.00	50000.00	70000.00	100000.00	15032.00	20000.00	-0.00	-0.00	-0.00
TR	6.00	5000.00	60000.00	70000.00	80000.00	100000.00	200000.00	-0.00	-0.00	-0.00
CP	1.00	6000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RES	1.00	2.00	.20	.30	4.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	2.00	21000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
CP	2.00	4.00	.20	.10	5.00	-0.00	-0.00	-0.00	-0.00	-0.00

CPL	3.00	10000.00	-0.00	0.00	100000.00	755886.00	1000000.00	-0.00	-0.00
ID RESERVOIR C (CP 3)	1.00	4.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
RD	7.00	0.00	100000.00	200000.00	400000.00	700000.00	800000.00	-0.00	-0.00
RZU	7.00	10000.00	12000.00	10000.00	3000.00	80006.00	150000.00	-0.00	-0.00
CPL	3.00	12000.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
ID RESERVOIR C (CP 3)	1.00	4.00	.20	(10)	-0.00	-0.00	-0.00	-0.00	-0.00
RD	7.00	0.00	100000.00	200000.00	400000.00	700000.00	800000.00	-0.00	-0.00
RZU	7.00	10000.00	12000.00	10000.00	3000.00	80006.00	150000.00	-0.00	-0.00

[illegible]

NRCS 2 NCPT 5 NCPT 00

	1	6	JUNE	1000.0	2000.0	3000.0	4000.0	5000.0	6000.0	7000.0	8000.0	9000.0	10000.0	11000.0	12000.0	13000.0	14000.0	15000.0	16000.0	17000.0	18000.0	19000.0	20000.0	21000.0	22000.0	23000.0	24000.0	25000.0	26000.0	27000.0	28000.0	29000.0	30000.0	31000.0	32000.0	33000.0	34000.0	35000.0	36000.0	37000.0	38000.0	39000.0	40000.0	41000.0	42000.0	43000.0	44000.0	45000.0	46000.0	47000.0	48000.0	49000.0	50000.0	51000.0	52000.0	53000.0	54000.0	55000.0	56000.0	57000.0	58000.0	59000.0	60000.0	61000.0	62000.0	63000.0	64000.0	65000.0	66000.0	67000.0	68000.0	69000.0	70000.0	71000.0	72000.0	73000.0	74000.0	75000.0	76000.0	77000.0	78000.0	79000.0	80000.0	81000.0	82000.0	83000.0	84000.0	85000.0	86000.0	87000.0	88000.0	89000.0	90000.0	91000.0	92000.0	93000.0	94000.0	95000.0	96000.0	97000.0	98000.0	99000.0	100000.0	101000.0	102000.0	103000.0	104000.0	105000.0	106000.0	107000.0	108000.0	109000.0	110000.0	111000.0	112000.0	113000.0	114000.0	115000.0	116000.0	117000.0	118000.0	119000.0	120000.0	121000.0	122000.0	123000.0	124000.0	125000.0	126000.0	127000.0	128000.0	129000.0	130000.0	131000.0	132000.0	133000.0	134000.0	135000.0	136000.0	137000.0	138000.0	139000.0	140000.0	141000.0	142000.0	143000.0	144000.0	145000.0	146000.0	147000.0	148000.0	149000.0	150000.0	151000.0	152000.0	153000.0	154000.0	155000.0	156000.0	157000.0	158000.0	159000.0	160000.0	161000.0	162000.0	163000.0	164000.0	165000.0	166000.0	167000.0	168000.0	169000.0	170000.0	171000.0	172000.0	173000.0	174000.0	175000.0	176000.0	177000.0	178000.0	179000.0	180000.0	181000.0	182000.0	183000.0	184000.0	185000.0	186000.0	187000.0	188000.0	189000.0	190000.0	191000.0	192000.0	193000.0	194000.0	195000.0	196000.0	197000.0	198000.0	199000.0	200000.0	201000.0	202000.0	203000.0	204000.0	205000.0	206000.0	207000.0	208000.0	209000.0	210000.0	211000.0	212000.0	213000.0	214000.0	215000.0	216000.0	217000.0	218000.0	219000.0	220000.0	221000.0	222000.0	223000.0	224000.0	225000.0	226000.0	227000.0	228000.0	229000.0	230000.0	231000.0	232000.0	233000.0	234000.0	235000.0	236000.0	237000.0	238000.0	239000.0	240000.0	241000.0	242000.0	243000.0	244000.0	245000.0	246000.0	247000.0	248000.0	249000.0	250000.0	251000.0	252000.0	253000.0	254000.0	255000.0	256000.0	257000.0	258000.0	259000.0	260000.0	261000.0	262000.0	263000.0	264000.0	265000.0	266000.0	267000.0	268000.0	269000.0	270000.0	271000.0	272000.0	273000.0	274000.0	275000.0	276000.0	277000.0	278000.0	279000.0	280000.0	281000.0	282000.0	283000.0	284000.0	285000.0	286000.0	287000.0	288000.0	289000.0	290000.0	291000.0	292000.0	293000.0	294000.0	295000.0	296000.0	297000.0	298000.0	299000.0	300000.0	301000.0	302000.0	303000.0	304000.0	305000.0	306000.0	307000.0	308000.0	309000.0	310000.0	311000.0	312000.0	313000.0	314000.0	315000.0	316000.0	317000.0	318000.0	319000.0	320000.0	321000.0
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Chenal Modifications
0000 1300.0 Page 58

231000
 Chan. Mod
 517500
 Page 59
 500000

IN	2	6	JUNE	5000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	SUM	500000.0
				2000.0	3000.0	4000.0	4000.0	2000.0	57000.0	100000.0	90000.0		
				37000.0	24000.0	24000.0	15000.0	9000.0	3000.0	2000.0	1500.0		
IN	3	6	JUNE	3000.0	4000.0	27000.0	40000.0	105000.0	70000.0	40000.0	45000.0	SUM	240000.0
				10000.0	12000.0	12000.0	9000.0	6000.0	3000.0	2000.0	1000.0		
IN	7	6	JUNE	2000.0	4000.0	19000.0	13000.0	10000.0	7000.0	4000.0	1000.0	SUM	40000.0
				10000.0	25000.0	13000.0	7000.0	4000.0	2000.0	1000.0	500.0		
IN	8	6	JUNE	1000.0	2000.0	9000.0	4000.0	5000.0	3000.0	2000.0	500.0	SUM	20000.0
				5000.0	12000.0	6000.0	2000.0	2000.0	1000.0	500.0	200.0		
EJ	-0	-0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	SUM	61700

LOC#	CUR LOCA	NATURAL	INFLW	OUTFLOW	CASE#LOC	LEVEL	END STOR
1	3050.00	3050.00	3050.00	3050.00	.02	2.00	53010.20
2	0000.00	0000.00	0000.00	0000.00	.02	2.01	100070.00

2007	2007	NATURAL	REGULAR	2007	2007	2007
2	869.30	1274.70	4925.48	3089.36	1184.09	
4	10756.16	23027.06	41081.53	12266.32	0.00	
5	19584.11	48700.82	12683.78	12250.95	1049.98	

0000 FLOOD NUMBER 2 0000

NFLAND	1	NFLONG	6
ISLAND	1	ISLONG	2

FLOWS MULTIPLIED BY 1.00

DERIVED BY

STARTING TIME 1
ROUND 12, DAYS 5, MONTH 6, YEAR 19 6:

SERVING

AVG	1253.33	MAX	5000.00
		TIME	1000.00

AVG	1233.333	MAX	5000.000
		WTM	1000.000

AVG 1203,333 MAX 3000,000

1030,500 MAXD 0000,000
 WING 0,000
 Page 60
 Signal Mail

Channel Modification
Page 60

MIN 0.000

LOC 3 RESERVOIR C (CP 3)

SERVED BY 2

STARTING TIME
M00R012, DAY 4, MON 0, YEAR 0 0.

SERVING 2 4

PER CUM LOCAL 0

1 3000 6000 27000 60000 105000 70000 60000 45000 33000 20000
11 10000 12000 12000 9000 6000 3000 2000 1000

AVG 20000.000 MAX 105000.000
MIN 1000.000

PER NATURAL FLOW

1 3000 6000 27000 60000 105000 70000 60000 45000 33000 20000
11 10000 12000 12000 9000 6000 3000 2000 1000

PER INFLOW

1 3000 6000 27000 60000 105000 70000 60000 45000 33000 20000
11 10000 12000 12000 9000 6000 3000 2000 1000

AVG 20000.000 MAX 105000.000
MIN 1000.000

PER OUTFLOW

1 3000 6000 12000 12000 12000 12000 12000 12000 12000 0
11 0 0 12000 12000 12000 12000 12000 12000 12000 0

PER CASELOC.TYP

1 .03 .03 .01 .01 .02 .01 .01 .01 .01 .01
11 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01

AVG 1.780 MAX 0.020
MIN 0.010

PER LEVEL

1 2.000 2.000 2.011 2.008 2.127 2.106 2.232 2.266 2.291 2.309
11 2.322 2.331 2.331 2.329 2.325 2.318 2.316 2.302 2.302

AVG 2.224 MAX 2.331
MIN 2.000

PER EUP STORAGE

1 10000 10000 107430 131240 103307 221905 251730 274052 290016 302317
11 311243 317193 317193 315706 312750 308267 303309 297058

AVG 266999.309 MAX 317193.250
MIN 100000.000

PER A CP 4

SERVED BY 1 2

PER CUM LOCAL 0

1 4000 6333 22200 17507 20300 37407 70015 90070 80307 60995
11 50000 60000 39200 20442 10280 10050 6070 2600

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Channel Mod.

AVG 35007.100 MAX 90009.011
MIN 2000.073

Page 63
Channel Mod.

PER NATURAL FLOW
1 0000 11309 36231 55039 90830 140000 170008 166787 130090
11 101053 09009 50006 03904 20672 17450 0113 5637

AVG 76759.467 MAX 190200.790
MIN 5637.126

PER REGULATED FLOW
1 0000 11309 31231 30972 31730 42000 71302 91201 04305 70012
11 35017 01115 45957 43192 35672 27867 22635 20000

AVG 43791.310 MAX 91201.152
MIN 0000.000

PER 0 SPACE AVAIL.
1 57000 53611 33769 34028 33262 22000 4302 26001 10305 05012
11 5003 3005 19003 21000 29520 37133 42305 44300

AVG 21200.602 MAX 57000.000
MIN 02001.152

PER 0 BY US REG. DIV.
1 4000 5056 0031 13463 11370 4053 1327 332 77 17
11 151 1078 6740 14750 17143 17600 17057 17001

AVG 7940.127 MAX 17990.059
MIN 17.301

PER FLOOD BY REG
1 0 0 0 0 0 0 1307 330 77 17
11 0 0 0 0 0 0 0 0 0

AVG 97.411 MAX 1327.234
MIN 0.000

LOC 5 CP S SERVED BY -1 02
PER CUM LOCAL 0

1 5000 0309 17654 25160 23250 25056 42416 60057 00957 00210
11 75176 72906 62710 44332 30731 19657 11000 5520

AVG 30319.354 MAX 86357.190
MIN 0000.000

PER NATURAL FLOW
1 0000 10565 24059 41937 64792 104313 147025 175069 104373 108870
11 139909 110577 92003 65021 40411 31093 10674 10244

AVG 00269.554 MAX 104372.522
MIN 0000.000

PER REGULATED FLOW
1 0000 10505 23225 34354 35663 36279 47477 70841 07000 04350
11 75237 73237 60009 51005 40601 36399 20750 23422

AVG 46387.001 MAX 87000.366
MIN 0000.000

PER 0 SPACE AVAIL.
1 20000 20435 13775 2446 1337 721 10477 03061 05000 007550
11 030237 030237 027000 010005 07401 601 0250 13550

AVG 7087.091 MAX 20000.000
MIN -50000.368

PER 0 BY US RES.DIVS

1	0000	4176	5572	9194	12404	10423	5051	1703	531	143
1	01	200	1800	7273	13906	18742	17656	17013		

AVG 7167.737 MAX 17012.500
MIN 60.003

PER FLOOD BY RES

1	0	0	0	0	0	0	3051	1703	531	143
1	01	200	1800	7273	1641	0	0	0		

AVG 1370.675 MAX 7600.554
MIN 0.000

CUM TIME= 1

RES NOS 1 3
INFLOW 1000 3000
OUTFLOW 1000 3000
EQP STOR 50000 100000
CASES .03 .03
LEVEL 2.000 2.000
EQ LEVEL 2.000 2.000

CUM TIME= 2

RES NOS 1 3
INFLOW 2000 5000
OUTFLOW 2000 6000
EQP STOR 50000 100000
CASES .03 .03
LEVEL 2.000 2.000
EQ LEVEL 2.000 2.000

CUM TIME= 3

RES NOS 1 3
INFLOW 3000 27000
OUTFLOW 3000 12000
EQP STOR 50000 107436
CASES .03 .01
LEVEL 2.000 2.011
EQ LEVEL 2.000 2.011

CUM TIME= 4

RES NOS 1 3
INFLOW 10000 60000
OUTFLOW 6000 12000
EQP STOR 55950 131240
CASES .01 .01
LEVEL 2.059 2.048
EQ LEVEL 2.059 2.048

Page 64
Channel Mod.

FLOOD_RATIOS	.3	1.0	1.5	2.0	3.0	4.0	USED TO COMPUTE ANNUAL DAMAGES
1	1.00	1.00	1.00	1.00	1.00	1.00	
2	1.00	1.00	1.00	1.00	1.00	1.00	
3	1.00	1.00	1.00	1.00	1.00	1.00	
4	1.00	1.00	1.00	1.00	1.00	1.00	
5	1.00	1.00	1.00	1.00	1.00	1.00	
6	1.00	1.00	1.00	1.00	1.00	1.00	
7	1.00	1.00	1.00	1.00	1.00	1.00	
8	1.00	1.00	1.00	1.00	1.00	1.00	
9	1.00	1.00	1.00	1.00	1.00	1.00	
10	1.00	1.00	1.00	1.00	1.00	1.00	
11	1.00	1.00	1.00	1.00	1.00	1.00	
12	1.00	1.00	1.00	1.00	1.00	1.00	
13	1.00	1.00	1.00	1.00	1.00	1.00	
14	1.00	1.00	1.00	1.00	1.00	1.00	
15	1.00	1.00	1.00	1.00	1.00	1.00	
16	1.00	1.00	1.00	1.00	1.00	1.00	
17	1.00	1.00	1.00	1.00	1.00	1.00	
18	1.00	1.00	1.00	1.00	1.00	1.00	
19	1.00	1.00	1.00	1.00	1.00	1.00	
20	1.00	1.00	1.00	1.00	1.00	1.00	
21	1.00	1.00	1.00	1.00	1.00	1.00	
22	1.00	1.00	1.00	1.00	1.00	1.00	
23	1.00	1.00	1.00	1.00	1.00	1.00	
24	1.00	1.00	1.00	1.00	1.00	1.00	
25	1.00	1.00	1.00	1.00	1.00	1.00	
26	1.00	1.00	1.00	1.00	1.00	1.00	
27	1.00	1.00	1.00	1.00	1.00	1.00	
28	1.00	1.00	1.00	1.00	1.00	1.00	
29	1.00	1.00	1.00	1.00	1.00	1.00	
30	1.00	1.00	1.00	1.00	1.00	1.00	
31	1.00	1.00	1.00	1.00	1.00	1.00	
32	1.00	1.00	1.00	1.00	1.00	1.00	
33	1.00	1.00	1.00	1.00	1.00	1.00	
34	1.00	1.00	1.00	1.00	1.00	1.00	
35	1.00	1.00	1.00	1.00	1.00	1.00	
36	1.00	1.00	1.00	1.00	1.00	1.00	
37	1.00	1.00	1.00	1.00	1.00	1.00	
38	1.00	1.00	1.00	1.00	1.00	1.00	
39	1.00	1.00	1.00	1.00	1.00	1.00	
40	1.00	1.00	1.00	1.00	1.00	1.00	
41	1.00	1.00	1.00	1.00	1.00	1.00	
42	1.00	1.00	1.00	1.00	1.00	1.00	
43	1.00	1.00	1.00	1.00	1.00	1.00	
44	1.00	1.00	1.00	1.00	1.00	1.00	
45	1.00	1.00	1.00	1.00	1.00	1.00	
46	1.00	1.00	1.00	1.00	1.00	1.00	
47	1.00	1.00	1.00	1.00	1.00	1.00	
48	1.00	1.00	1.00	1.00	1.00	1.00	
49	1.00	1.00	1.00	1.00	1.00	1.00	
50	1.00	1.00	1.00	1.00	1.00	1.00	
5							

FLOOD SUMMARY-EACH FLOOD COPYD

**** FLOOD NUMBER 1 ****

STARTING TIME !

	LOC	2	CP 2	FLO. PER	MAX	REQ 0 *	FLO. PER	MAX	WAY 0 *	FLO. PER	MAX	LOC 0 *	0 5V	REQ	DES	SHORTAGE INDEX
	LOC	2	CP 2	1.007	3599 *		1.007	4242 *		1.007	3000 *	3000 *	9969 *	0.00	0.00	
	LOC	4	CP 4	1.008	4510 *		1.008	5705 *		1.008	2726 *	2726 *	17007 *	0.00	0.00	
	LOC	5	CP 5	1.009	4308 *		1.009	5532 *		1.009	2596 *	2596 *	17041 *	0.00	0.00	

[illegible][illegible]

MIN SYSTEM STG=	15000	MAX SYSTEM STG=	103321
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***** FLOOD NUMBER *****

STARTING TIME

LOC	2	CP 2	F.LD.PER	MAX	REQ	Q	F.LD.PER	MAX	MAT	Q	F.LD.PER	MAX	LOC	Q	Q	BY	RES	DEF	REQ	SHORTAGE INDEX
LOC			2,007		100127		2,007		102140		2,007		100000				127	0.00	0.00	
LOC			2,008		91201		2,008		190285		2,008		90870				332	0.00	0.00	
LOC			2,009		87088		2,009		184373		2,009		86557				531	0.00	0.00	

RESERVOIRS FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STOR1

	LOC	I RESERVOIR A (CP I)	2,003	5000	2,012	150832	3,000 *	2,004	6000	50000
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[illegible]

MIN SYSTEM 876 15000 MAY SYSTEM 876 66AARD

***** FLOOD NUMBER 3 *****

STARTING TIME

		FLO.PER	MAX REQ Q *	FLO.PER	MAX MAY Q *	FLO.PER	MAX LOC Q *	B BY RES *	DES	SHORTAGE INDEX
LOC	2 CP 2	3,007	153287	3,007	213211	3,007	150000	5297	0.00	0.00
LOC	8 CP 4	3,009	144615	3,008	285227	3,006	163304	8311	0.00	0.00
LOC	9 CP 5	3,010	144668	3,009	276359	3,009	168334	14819	0.00	0.00

RESERVOIR	FLO, PER	MIN	STG	MIN	LEVEL	FLO, PER	MAX	STG	MAX	LEVEL	FLO, PER	MAX	STG	MAX	LEVEL	STAGE
1	100	10	100	10	100	100	10	100	10	100	100	10	100	10	100	100

LOC	RESERVE	AMOUNT	DATE	BY	REMARKS
1	RESERVE	50000	3-0-73		
2	RESERVE	20000	3-0-73		
3	RESERVE	15000	3-0-73		
4	RESERVE	10000	3-0-73		
5	RESERVE	5000	3-0-73		
6	RESERVE	2000	3-0-73		
7	RESERVE	1000	3-0-73		
8	RESERVE	500	3-0-73		
9	RESERVE	200	3-0-73		
10	RESERVE	100	3-0-73		
11	RESERVE	50	3-0-73		
12	RESERVE	25	3-0-73		
13	RESERVE	12	3-0-73		
14	RESERVE	6	3-0-73		
15	RESERVE	3	3-0-73		
16	RESERVE	1	3-0-73		
17	RESERVE	0	3-0-73		
18	RESERVE	0	3-0-73		
19	RESERVE	0	3-0-73		
20	RESERVE	0	3-0-73		
21	RESERVE	0	3-0-73		
22	RESERVE	0	3-0-73		
23	RESERVE	0	3-0-73		
24	RESERVE	0	3-0-73		
25	RESERVE	0	3-0-73		
26	RESERVE	0	3-0-73		
27	RESERVE	0	3-0-73		
28	RESERVE	0	3-0-73		
29	RESERVE	0	3-0-73		
30	RESERVE	0	3-0-73		
31	RESERVE	0	3-0-73		
32	RESERVE	0	3-0-73		
33	RESERVE	0	3-0-73		
34	RESERVE	0	3-0-73		
35	RESERVE	0	3-0-73		
36	RESERVE	0	3-0-73		
37	RESERVE	0	3-0-73		
38	RESERVE	0	3-0-73		
39	RESERVE	0	3-0-73		
40	RESERVE	0	3-0-73		
41	RESERVE	0	3-0-73		
42	RESERVE	0	3-0-73		
43	RESERVE	0	3-0-73		
44	RESERVE	0	3-0-73		
45	RESERVE	0	3-0-73		
46	RESERVE	0	3-0-73		
47	RESERVE	0	3-0-73		
48	RESERVE	0	3-0-73		
49	RESERVE	0	3-0-73		
50	RESERVE	0	3-0-73		
51	RESERVE	0	3-0-73		
52	RESERVE	0	3-0-73		
53	RESERVE	0	3-0-73		
54	RESERVE	0	3-0-73		
55	RESERVE	0	3-0-73		
56	RESERVE	0	3-0-73		
57	RESERVE	0	3-0-73		
58	RESERVE	0	3-0-73		
59	RESERVE	0	3-0-73		
60	RESERVE	0	3-0-73		
61	RESERVE	0	3-0-73		
62	RESERVE	0	3-0-73		
63	RESERVE	0	3-0-73		
64	RESERVE	0	3-0-73		
65	RESERVE	0	3-0-73		
66	RESERVE	0	3-0-73		
67	RESERVE	0	3-0-73		
68	RESERVE	0	3-0-73		
69	RESERVE	0	3-0-73		
70	RESERVE	0	3-0-73		
71	RESERVE	0	3-0-73		
72	RESERVE	0	3-0-73		
73	RESERVE	0	3-0-73		
74	RESERVE	0	3-0-73		
75	RESERVE	0	3-0-73		
76	RESERVE	0	3-0-73		
77	RESERVE	0	3-0-73		

[illegible]

***** FLOOD NUMBER *****

STARTING TIME

[illegible]

***** FLOOD NUMBER *****

STARTING TIME !

	PLO.PER	MAX REG Q *	FLO.PER	MAX MAY Q *	FLO.PER	MAX LOC Q *	O BY RES *	DES REC	SHORTAGE INDEX
LOC 2 CP 2	5,008	33382 *	5,007	26621 *	5,007	30000 *	23382 *	0.00	0.00
LOC 4 CP 6	5,009	382013 *	5,008	570854 *	5,008	272609 *	29404 *	0.00	0.00
LOC 5 CP 5	5,010	355932 *	5,009	553118 *	5,009	255672 *	96261 *	0.00	0.00
RESERVOIRS									
	FLO.PER	MIN STG MIN LEVEL *	FLO.PER	MAX STG MAX LEVEL *	FLO.PER	MAX REL CHAN CAP	STONI		
LOC 1 RESERVOIR A (CP 1)	5,001	51486	2,019 *	5,007	162236	3,358 *	5,007	120542	6000
LOC 3 RESERVOIR C (CP 3)	5,001	104463	2,007 *	5,011	755408	3,000 *	5,012	35999	12000
MIN SYSTEM STGS									
		155949		MAX SYSTEM STGS		923644			

***** FLOOD NUMBER 6 *****

STARTING TIME 1

		F.LD.PER	MAX RES Q *	F.LD.PER	MAX NAT Q *	F.LD.PER	MAX LDC Q *	B BY RES *	DEB	REG	SHORTAGE INDEX
LOC	2 CP 2	6,007	510031 *	6,007	508562 *	6,007	400000 *	116031 *	0,00	0,00	
LOC	2 CP 4	6,004	590042 *	6,008	781139 *	6,008	363878 *	235353 *	0,00	0,00	
LOC	5 CP 5	6,010	584434 *	6,009	737490 *	6,009	366220 *	238266 *	0,00	0,00	
	RESERVOIRS			F.LD.PER	MIN STG MIN LEVEL *	F.LD.PER	MAX STC MAX LEVEL *	F.LD.PER	MAX REL	CMAN CAP	STORI
LOC	1 RESERVOIR A (CP 1)	6,001	51983	2,020 *	6,007	191183	3,821 *	6,007	163839	6000	50000
LOC	3 RESERVOIR C (CP 3)	6,001	105950	2,009 *	6,008	781273	3,106 *	6,009	136168	12000	100000
	MIN SYSTEM STOR		157033	MAX SYSTEM STOR		972896					

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EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

NO.	FREQ	PEAK	SUM	TYPE 1	TYPE
1	.0000	28800	0.00	0.00	
2	.0000	35000	0.00	0.00	
3	.0000	42000	180.00	180.00	
4	.0000	50500	360.00	360.00	
5	.0000	60500	500.00	500.00	
6	.0000	73000	630.00	630.00	
7	.0000	90000	900.00	900.00	
8	.0000	114000	1250.00	1250.00	
9	.0000	130000	1500.00	1500.00	
10	.0000	150000	1930.00	1930.00	
11	.0000	180000	2660.00	2660.00	
12	.0000	230000	5000.00	5000.00	
13	.0000	323000	9900.00	9900.00	
14	.0200	490000	12280.00	12280.00	
15	.0100	640000	13350.00	13350.00	
16	.0050	840000	14150.00	14150.00	
17	.0020	1000000	14600.00	14600.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED 1721.30 1721.30
BASE COND- INPUT 0.00 -0.00
EXIST SYSTEM-INPUT 696.82 696.82

BASE CONDITION FLOOD DAMAGES

NO.	FREQ	EXCD	PROB	INT	SUM	TYPE 1	TYPE
1	.0000	57085	.632	.615	226.00	226.00	
2	.0000	190245	.138	.284	540.14	540.14	
3	.0000	285427	.065	.051	357.83	357.83	
4	.0000	380570	.036	.026	273.38	273.38	
5	.0000	570858	.013	.014	178.59	178.59	
6	.0000	761139	.007	.010	145.27	145.27	

BASE COND DAMAGES 1721.30 1721.30
EXIST SYST DAMAGES 696.82 696.82

MODIFIED CONDITIONS FLOW-DAMAGE DATA

NO.	FREQ	PEAK	SUM	TYPE 1	TYPE
1	.0000	28800	0.00	0.00	
2	.0000	35000	0.00	0.00	
3	.0000	42000	0.00	0.00	
4	.0000	50500	0.00	0.00	
5	.0000	60500	72.00	72.00	
6	.0000	73000	200.00	200.00	
7	.0000	90000	300.00	300.00	
8	.0000	114000	500.00	500.00	
9	.0000	130000	600.00	600.00	
10	.0000	150000	1800.00	1800.00	
11	.0000	180000	1100.00	1100.00	
12	.0000	230000	2150.00	2150.00	
13	.0000	323000	9400.00	9400.00	
14	.0200	490000	12280.00	12280.00	
15	.0100	640000	13350.00	13350.00	
16	.0050	840000	14150.00	14150.00	
17	.0020	1000000	14600.00	14600.00	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE 1	TYPE
		FREQ	INT			

1	45168	.632	.615	0.00	0.00	
2	11201	.138	.288	48.98	48.98	
3	19815	.065	.051	48.37	48.37	
4	22836	.036	.026	61.81	61.81	
5	36213	.013	.014	127.51	127.51	
6	59908	.007	.010	138.91	138.91	

MODIFIED DAMAGES				425.18	425.18	
DAMAGE REDUCTION				271.64	271.64	

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE 1	TYPE
		FREQ	INT			

1	27261	.632	.615	0.00	0.00	
2	90870	.138	.288	33.07	33.07	
3	136304	.065	.051	41.21	41.21	
4	181739	.036	.026	36.88	36.88	
5	272909	.013	.014	57.54	57.54	
6	363876	.007	.010	111.24	111.24	

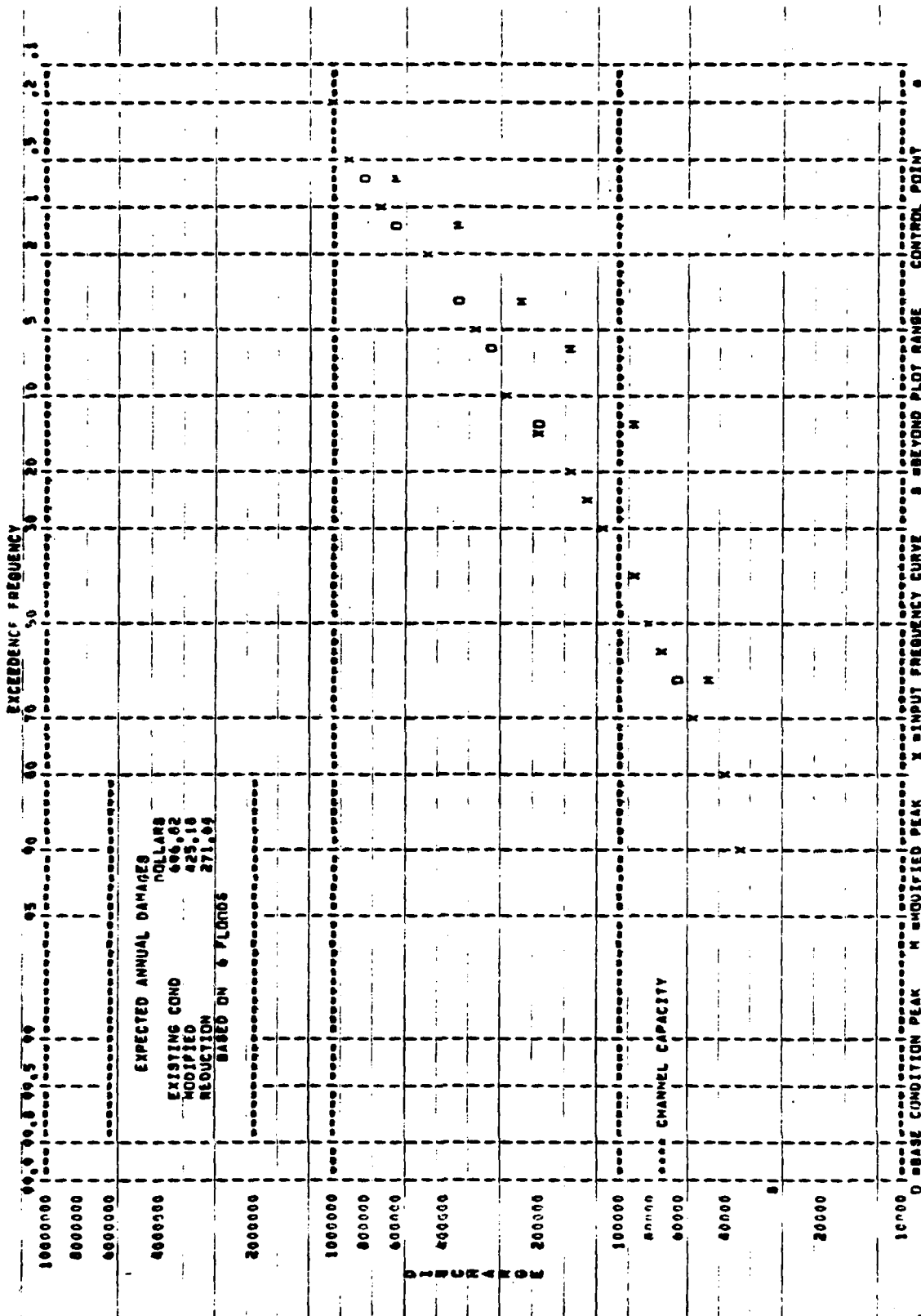
CONTROL AT PROJECTS				279.95	279.95	
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REDUCTION POSSIBLE						
W/ TOTAL CONTROL				816.87	416.87	

RESIDUAL DAMAGES				145.23	145.23	
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CONTROL POINT



SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES									
CONTROL POINT	BASE CONDITION	DAMAGES		UNCONTROL		MODIFIED CONDITIONS		TOTAL DAMAGE REDUCTION	
		MODIFIED	LOCAL COND	MODIFIED	LOCAL COND	MODIFIED	AT PROJECTS	RESIDUAL	
	006.02	025.10	279.95	0	271.00	0	0	0	105.23
TOTAL	006.02	025.10	279.95	0	271.00	0	0	0	105.23

SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES										
CONTROL POINT	BASE CONDITION	DAMAGES		UNCONTROL		MODIFIED CONDITIONS		TOTAL CONTROL		RESIDUAL
		MODIFIED	LOCAL COND	MODIFIED	LOCAL COND	MODIFIED	AT PROJECTS	MODIFIED	AT PROJECTS	
	006.02	025.10	279.95	0	271.00	0	0	0	0	105.23
TOTAL	006.02	025.10	279.95	0	271.00	0	0	0	0	105.23

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SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
(EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	• • • • •	3420.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	• • • • •	36.00
TOTAL SYSTEM ANNUAL COST	• • • • •	278.10
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM		606.82
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM		425.10
AVERAGE ANNUAL DAMAGE REDUCTION		271.60
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS		1.46

[illegible]

MIN -47911.005

PER FLOW BY RES

1	0	0	0	3546	-27244	-47911	-44005	-37400	-22000
11	-47740	2513	3505	0	0	0	0	0	0

AVG 40874.332 MAX 3505.000
MIN -47911.005

PER RESERVOIR C (CP 3)

SERVED BY 2

AVG 40874.332 MAX 3505.000
MIN -47911.005

PER CUM LOCAL 0

SERVING 2 2

1	3000	6000	27000	40000	105000	78000	40000	45000	33000	24000
11	18000	12000	12000	4000	6000	3000	2000	1000	1000	1000

AVG 20000.000 MAX 105000.000
MIN 1000.000

PER NATURAL FLOW

1	3000	6000	27000	40000	105000	78000	40000	45000	33000	24000
11	18000	12000	12000	4000	6000	3000	2000	1000	1000	1000

AVG 20000.000 MAX 105000.000
MIN 1000.000

PER INFLOW

1	3000	6000	27000	40000	105000	78000	40000	45000	33000	24000
11	18000	12000	12000	4000	6000	3000	2000	1000	1000	1000

AVG 20000.000 MAX 105000.000
MIN 1000.000

PER OUTFLOW

1	3000	6000	12000	11300	0	0	0	0	0	0
11	0	0	0	0	12000	12000	12000	12000	12000	12000

AVG 40874.332 MAX 12000.000
MIN 0.000

PER CASELOC.TYP

1	.03	.03	.01	4.02	4.02	4.01	4.00	4.00	4.00	4.00
11	4.00	4.00	4.00	4.00	.01	.01	.01	.01	.01	.01

AVG 2.353 MAX 4.020
MIN .010

PER LEVEL

1	2.000	2.000	2.011	2.048	2.126	2.187	2.232	2.266	2.291	2.309
11	2.323	2.332	2.341	2.348	2.353	2.356	2.359	2.362	2.365	2.368

AVG 2.230 MAX 2.368
MIN 2.000

PER EOP STORAGE

1	100000	100000	107430	113340	103413	222893	252045	274340	290724	302625
11	317550	317551	323451	327910	324937	320076	315517	310063	302625	302625

AVG 250892.066 MAX 327910.130
MIN 100000.000

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SERVED BY 1 2

LOC 4 CP 0

PER CUM LOCAL 0

1	4000	6167	22028	17171	18029	31171	62695	92449	67908	73085
11	61001	62180	39197	29866	19311	11052	4842	2724		

AVG 35053.070 MAX 92449.200
MIN 2723.662

PER NATURAL FLOW

1	8000	10694	32398	49141	87592	144277	173708	194036	175025	136397
11	106281	93327	59185	45907	31395	18091	9465	5847		

AVG 76708.776 MAX 194036.091
MIN 5046.858

PER REGULATED FLOW

1	8000	10694	29898	30288	30746	31713	36644	48669	48372	37563
11	39137	53779	40069	32890	24239	24066	21743	20470		

AVG 31428.338 MAX 53779.693
MIN 8000.000

PER 0 SPACE AVAILABLE

1	27000	23306	5102	4712	4214	3207	-1644	-13669	-9372	-2563
11	-4137	-10774	-5064	2110	10761	10354	13257	14521		

AVG 3571.662 MAX 27000.000
MIN -10770.693

PER 0 BY US RES.DIV

1	8000	4528	7670	13117	12747	621	-26051	-43780	-43337	-35921
11	-21944	-8401	873	3026	4926	13614	10901	17756		

AVG -6428.733 MAX 17755.560
MIN -43780.328

PER FLOOD BY RES

1	-21944	-8401	873	0	0	0	-26051	-43780	-43337	-35921
11										

AVG -9931.230 MAX 872.549
MIN -43780.324

LOC 5 CP 3 SERVED BY -1 -2

PER CUM LOCAL 0

1	3600	6361	17509	20945	22613	23150	36588	63470	87279	87316
11	78309	75315	60539	44865	31900	20766	11959	5792		

AVG 39319.888 MAX 87316.106
MIN 5000.000

PER NATURAL FLOW

1	9000	10449	28937	38112	57711	94226	142353	172097	107631	172052
11	142220	121279	66295	66172	44252	32764	20104	10752		

AVG 80279.888 MAX 187631.160
MIN 9000.000

PER DIVERSION 0

1	0	0	0	0	0	0	0	0	0	0
11	-209	-844	-1967	-3448	-5266	-6987	-8523	-9730	27	27

AVG -2093,285 MAX 26,700
MIN -0730,100

PER REGULATED FLOW

1 0000 1000 32521 33234 300,2 3300 34935 30933 05500
11 2000 5000 37610 47931 300,3 33700 35376 31000

AVG 36199,571 MAX 57410,707
MIN 9000,000

PER 0 SPACE AVAIL.

1 2000 20551 10070 3766 2110 3200 2565 -1203 -0530 -05500
11 7030 -17370 -20410 -10931 -2093 3201 3622 0102

AVG 000,020 MAX 20000,000
MIN -20410,707

PER 0 BY US RES.DIV

1 0000 0000 5012 0200 12249 10050 -2155 -25017 -00000 -01007
11 -30350 -20942 -7120 3066 00,2 13003 21410 26100

AVG -3120,317 MAX 26100,100
MIN -01000,020

PER FLOOD BY RES

1 0 0 0 0 0 0 0 -25017 -00000 -01007
11 -30350 -20942 -7120 3066 2093 0 0 0

AVG -9103,710 MAX 3009,073
MIN -01000,020

CUM TIMES 1

RES NOS 1 3
DIV 0 -1000 -1000
INFLW 1000 3000
OUTFLOW 1000 3000
EOP STOR 50000 100000
CASES .03 .03
LEVEL 2,000 2,000
EO LEVEL 2,000 2,000

CUM TIMES 2

RES NOS 1 3
DIV 0 -1000 -1000
INFLW 2000 6000
OUTFLOW 2000 6000
EOP STOR 50000 100000
CASES .03 .03
LEVEL 2,000 2,000
EO LEVEL 2,000 2,000

CUM TIMES 3

RES NOS 1 3
DIV 0 -1000 -1000
INFLW 3000 27000

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FALL RIVER BASIN *** DIVERSION ***
 TRAINING DOCUMENT NO. 7
 FLOOD RATIOS .3 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES
 FLOOD SUMMARY-EACH FLOOD COPY= 1

***** FLOOD NUMBER 1 *****

		STARTING TIME		1			
						SHORTAGE INDEX	
						DES	
						REG	

LOC 3 RESERVOIR C (CP 3) 3,001 102231 2,003 3,015 000101 2,503 3,010 12000 12000 100000

MIN SYSTEM STOR 15076 MAX SYSTEM STOR 02023

***** FLOOD NUMBER 6 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO,PER	MAX RES B *	FLO,PER	MAX LOC B * BY RES *	DES	REG
LOC	4 CP 4	2,000	10391 *	2,007	20000 *	10000 *	0,00
LOC	5 CP 5	2,000	10400 *	2,008	10000 *	10000 *	0,00
LOC	5 CP 5	2,010	10476 *	2,009	17000 *	10000 *	0,00

RESERVOIR FLO,PER MIN STG MIN LEVEL * FLO,PER MAX STG MAX LEVEL * FLO,PER MAX REL CHAN CAP STOR1

LOC 1 RESERVOIR A (CP 1) 2,001 50992 2,010 4,007 10032 3,000 4,007 00000 4000 50000

LOC 3 RESERVOIR C (CP 3) 2,001 10275 2,005 4,015 593091 2,750 4,010 12000 12000 100000

MIN SYSTEM STOR 15306 MAX SYSTEM STOR 700723

***** FLOOD NUMBER 5 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO,PER	MAX RES B *	FLO,PER	MAX LOC B * BY RES *	DES	REG
LOC	4 CP 4	2,000	10391 *	2,007	20000 *	10000 *	0,00
LOC	5 CP 5	2,010	10476 *	2,009	17000 *	10000 *	0,00

RESERVOIR FLO,PER MIN STG MIN LEVEL * FLO,PER MAX STG MAX LEVEL * FLO,PER MAX REL CHAN CAP STOR1

LOC 1 RESERVOIR A (CP 1) 2,001 51000 2,015 4,007 10032 3,350 4,007 12000 4000 50000

LOC 3 RESERVOIR C (CP 3) 2,001 10003 2,007 4,011 75000 3,000 4,012 35000 12000 100000

MIN SYSTEM STOR 15500 MAX SYSTEM STOR 903000

***** FLOOD NUMBER 6 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLO,PER	MAX RES B *	FLO,PER	MAX LOC B * BY RES *	DES	REG
LOC	4 CP 4	2,000	10391 *	2,007	20000 *	10000 *	0,00
LOC	5 CP 5	2,010	10476 *	2,009	17000 *	10000 *	0,00

RESERVOIR FLO,PER MIN STG MIN LEVEL * FLO,PER MAX STG MAX LEVEL * FLO,PER MAX REL CHAN CAP STOR1

LOC 1 RESERVOIR A (CP 1) 2,001 51003 2,020 4,007 10103 3,021 4,007 16320 4000 50000

LOC 3 RESERVOIR C (CP 3) 2,001 10500 2,009 4,000 701073 3,100 4,000 136100 12000 100000

MIN SYSTEM STOR 15703 MAX SYSTEM STOR 972000

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EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

PREC	PEAK	SUM	TYPE 1	TYPE
.9990	28800	0.00	0.00	
.9000	35000	0.00	0.00	
.8000	42000	180.00	180.00	
.7000	50000	360.00	360.00	
.6000	60000	500.00	500.00	
.5000	73000	630.00	630.00	
.4000	90000	900.00	900.00	
.3000	114000	1250.00	1250.00	
.2500	130000	1500.00	1500.00	
.2000	150000	1930.00	1930.00	
.1500	180000	2660.00	2660.00	
.1000	230000	5000.00	5000.00	
.0500	323000	9900.00	9900.00	
.0200	490000	12280.00	12280.00	
.0100	600000	13350.00	13350.00	
.0050	800000	14150.00	14150.00	
.0020	1000000	14600.00	14600.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED 1721.30 1721.30
BASE COND- INPUT 0.00 0.00
EXIST SYSTEM-INPUT 456.82 456.82

BASE CONDITION FLOOD DAMAGES

NO.	FLOW	FREQ	INT	EXCD	PROB	SUM	TYPE 1	TYPE
1	58211	.621	.623			233.27	233.27	
2	104036	.134	.270			540.81	540.81	
3	291034	.062	.050			140.43	360.93	
4	388072	.034	.025			265.87	265.87	
5	562108	.013	.014			173.36	173.36	
6	776184	.007	.010			134.03	134.03	

BASE COND DAMAGES 1721.30 1721.30
EXIST SYST DAMAGES 696.82 696.82

MODIFIED CONDITIONS FLOW-DAMAGE DATA

PREC	PEAK	SUM	TYPE 1	TYPE
.9990	28800	0.00	0.00	
.9000	35000	0.00	0.00	
.8000	42000	180.00	180.00	
.7000	50000	360.00	360.00	
.6000	60000	500.00	500.00	
.5000	73000	630.00	630.00	
.4000	90000	900.00	900.00	
.3000	114000	1250.00	1250.00	
.2500	130000	1500.00	1500.00	
.2000	150000	1930.00	1930.00	
.1500	180000	2660.00	2660.00	
.1000	230000	5000.00	5000.00	
.0500	323000	9900.00	9900.00	
.0200	490000	12280.00	12280.00	
.0100	600000	13350.00	13350.00	
.0050	800000	14150.00	14150.00	
.0020	1000000	14600.00	14600.00	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE
		FREQ	INT		
1	33167	.021	.023	10.00	
2	53779	.134	.279	80.50	
3	92710	.062	.050	42.50	
4	170000	.036	.025	60.00	
5	201000	.013	.014	95.45	
6	510000	.007	.010	127.53	
MODIFIED DAMAGES				417.95	
DAMAGE REDUCTION				270.07	

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE
		FREQ	INT		
1	27735	.021	.023	10.00	
2	92000	.134	.279	166.00	
3	130070	.062	.050	76.32	
4	180000	.036	.025	72.10	
5	277300	.013	.014	87.50	
6	500000	.007	.010	108.25	
DAMAGES W/ TOTAL				525.75	
CONTROL AT PROJECTS				171.07	
REDUCTION POSSIBLE				354.68	
W/ TOTAL CONTROL				171.07	
RESIDUAL DAMAGES				-107.00	

[illegible]

SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES

CONTROL	BASE CONDITION	EXISTING CONDITIONS	UNCONTROLLED LOCAL COND	ASSUMED CONDITIONS AT PROJECTS	DAMAGE REDUCTION	RESIDUAL
POINT						
4	606.02	417.95	525.75	278.87	171.07	-107.80
TOTAL	606.02	417.95	525.75	278.87	171.07	-107.80

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
(EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	10920.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	34.16
TOTAL SYSTEM ANNUAL COST	708.84
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM	695.82
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM	217.99
AVERAGE ANNUAL DAMAGE REDUCTION	276.97
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS	276.97

IN	3	6	JUNE	3000.0	6000.0	27000.0	80000.0	105000.0	70000.0	60000.0	45000.0	33000.0	24000.0	
				10000.0	12000.0	12000.0	7000.0	6000.0	3000.0	2000.0	1000.0			SUM=
														504000
IN	4	6	JUNE	2000.0	4000.0	19000.0	13000.0	10000.0	7000.0	4000.0	4000.0	1000.0	4000.0	
				10000.0	25000.0	13000.0	7000.0	4000.0	2000.0	1000.0	500.0			SUM=
														127500
IN	5	6	JUNE	1000.0	2000.0	9000.0	4000.0	5000.0	3000.0	2000.0	500.0	500.0	2000.0	
				5000.0	12000.0	8000.0	4000.0	2000.0	1000.0	500.0	200.0			SUM=
														61700
EF	-0			-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0			

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 Flood Forecasting

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOC	NATURAL	INFLW	OUTFLOW	CASELOC	LEVEL	EDP STOR
1	3050.00	3050.00	3050.00	3050.00	0.00	2.00	20719.10
2	2000.00	2000.00	2000.00	2000.00	1.12	2.00	121001.23

SUMMARY OF AVERAGES FOR MIN RESERVOIRS

LOC	CUM LOC	NATURAL	REGULATE	SPACE	SPACE	SPACE	FLOOD BY
2	8625.00	12070.00	1202.07	8707.11	3577.07	320.00	
3	10755.92	23035.03	21310.31	13000.00	10563.30	0.00	
5	11795.07	24003.07	21027.36	15572.00	9631.30	0.00	

COMPUTATION INTERVAL IN HOURS

***** FLOOD NUMBER 2 *****

WFLD# 1 WFLD# 2
FLOOD MULTIPLIED BY 1.00

RESERVOIR A TOP 17

SERVED BY 1

STARTING TIME
MOURN 12.00 AM 4.00 PM 0.00

PER CUM LOCAL 0 SERVING 1 2

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

PER NATURAL FLOW

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

PER INFLW

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

PER OUTFLOW

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

PER CASELOC.TYP

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG 2007.001 MAX 9000.000
MIN 0.000

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Still Forecasting

LOC 3 RESERVOIR C (CP 3)

SERVED BY 2

STARTING TIME
MOUNTE, DAY 8, MON 0, YEAR 0 0.

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	10000	12000	10000	70000
			3000	20000

PER	NATURAL FLOW	AVG	20000.000	MAX	100000.000
1	3000	6000	27000	60000	100000.000
11	10000	12000	10000	70000	100000.000

PER	INFLOW	AVG	20000.000	MAX	100000.000
1	3000	6000	27000	60000	100000.000
11	10000	12000	10000	70000	100000.000

PER	OUTFLOW	AVG	20000.000	MAX	100000.000
1	3000	6000	27000	60000	100000.000
11	10000	12000	10000	70000	100000.000

PER	CASE LOG, TVP	AVG	2033.333	MAX	12000.000
1	1.03	2.00	2.00	2.00	12000.000
11	2.00	2.00	2.00	2.00	12000.000

PER	LEVEL	AVG	2.300	MAX	2.300
1	2.000	2.000	2.000	2.000	2.300
11	2.300	2.300	2.300	2.300	2.300

PER	EQP STORAGE	AVG	2.300	MAX	2.300
1	10000	10000	10000	10000	2.300
11	30000	30000	30000	30000	2.300

PER	CUM LOCAL 0	SERVED BY	1	2
1	3000	6000	27000	60000
11	10000	12000	10000	70000

PER	NATURAL FLOW	AVG	30000.000	MAX	100000.000
1	3000	6000	27000	60000	100000.000
11	10000	12000	10000	70000	100000.000

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3rd Forecasting

AVG 30000.000 MAX 100000.000
MIN 0.000

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Blood Forecasting

AVG 76784.776 MAX 194036.001
MIN 5000.000

1 0000 10694 32300 49101 07592 10000 17370 194036 175045 136507
11 106201 03327 50105 45007 31355 10000 9465 5007

PER REGULATED FLOW

1 7000 8667 22404 17241 10040 31173 62696 92409 87900 73753
11 63455 00079 44425 33934 24466 20713 21752 20481

AVG 60170.930 MAX 92409.260
MIN 7000.000

PER 0 SPACE AVAIL.

1 20000 26333 12550 17759 10960 3027 -27696 -57489 -52900 -30753
11 -20455 -33470 -9425 1066 10534 10287 13240 14810

AVG -5170.938 MAX 20000.000
MIN -57489.260

PER 0 BY US REG.DIV

1 3000 2900 217 49 12 1361 16910 17757 0 260
11 2375 6299 5228 4060 5155 13661 16910 17757

PER FLOOD BY REG

1 0 0 0 0 0 0 0 0 0 0 260
11 2375 6299 5228 4060 5155 13661 16910 17757

AVG 767.280 MAX 6290.932
MIN 0.000

SERVED BY 01 02

PER CUM LOCAL 0

1 3000 0361 17509 24965 22613 23130 36508 63070 87279 87310
11 78300 75315 64530 44665 31940 20706 11959 5792

PER NATURAL FLOW

1 9000 10449 22937 38112 57711 94226 142355 172097 187031 172652
11 182220 121279 96295 66172 40252 32798 20108 10752

AVG 30319.088 MAX 87316.106
MIN 0.000.000

PER REGULATED FLOW

1 3000 9270 19731 25825 22771 23180 36590 63071 87279 87310
11 78971 78045 70064 49950 36359 27154 24960 22192

AVG 62032.985 MAX 87316.072
MIN 0.000.000

PER 0 SPACE AVAIL.

1 20000 27722 17269 11375 14229 13016 400 -26471 -50379 -50361
11 -51971 -61085 -33068 -12950 661 9844 12000 14808

AVG -5032.985 MAX 29000.000
MIN -50360.072

PER 0 BY US RES.DIVE

1 3000 2017 2222 660 190 34 0 0 25
11 502 2730 5526 5000 4410 6050 13001 16000

AVG= 3513.097 MAX= 16399.973
MIN= .271

PER FLOOD BY RES

1 302 2730 5526 5000 4410 6050 13001 16000

AVG= 1776.026 MAX= 5525.046
MIN= 0.000

CUM TIME= 1

RES HDG 3
INFLW 1000 3000
OUTFLOW 0 3000
EOP STOR 50490 100000
CASES 2.03
LEVEL 2.005 2.000
EO LEVEL 2.005 2.000

CUM TIME= 2

RES HDG 3
INFLW 2000 6000
OUTFLOW 0 0
EOP STOR 91400 102975
CASES 2.02 2.02
LEVEL 2.015 2.005
EO LEVEL 2.015 2.005

CUM TIME= 3

RES HDG 3
INFLW 3000 27000
OUTFLOW 0 0
EOP STOR 52975 116360
CASES 2.03 2.03
LEVEL 2.030 2.025
EO LEVEL 2.030 2.025

CUM TIME= 4

RES HDG 3
INFLW 10000 60000
OUTFLOW 0 0
EOP STOR 61901 140110
CASES 2.02 2.02
LEVEL 2.110 2.070
EO LEVEL 2.110 2.070

CUM TIME= 5

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Final Forecasting

Page 93
Flow Forecasting

FALL RIVER BASIN *** FLOOD FORECASTING ***
TRAINING DOCUMENT NO. 7
FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES
FLOOD SUMMARY EACH FLOOD COPY 1

***** FLOOD NUMBER 1 *****

STARTING TIME 1									
RESERVOIRS									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	1.007	32928 *	1.007	42642 *	1.007	30000 *	2928 *	DES REG
LOC	5 CP 5	1.012	31770 *	1.008	58211 *	1.008	27735 *	4048 *	0.00
LOC		1.013	32228 *	1.009	58289 *	1.010	26195 *	5034 *	0.00
RESERVOIR A (CP 1)									
LOC		FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL CHAN CAP	STOR1	
LOC		1.018	50000	2.000 *	1.010	70647	2.205 *	1.005	6000
LOC		1.003	100000	2.000 *	1.010	102592	2.705 *	1.008	12000
MIN SYSTEM STGS 213239									

***** FLOOD NUMBER 2 *****

STARTING TIME 1									
RESERVOIRS									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	2.007	100000 *	2.007	102150 *	2.007	100000 *	0 *	DES REG
LOC	5 CP 5	2.008	92449 *	2.008	100036 *	2.008	92449 *	0 *	0.00
LOC		2.010	87361 *	2.009	107631 *	2.010	87316 *	45 *	0.00
RESERVOIR A (CP 1)									
LOC		FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL CHAN CAP	STOR1	
LOC		2.001	90496	2.705 *	2.010	150832	3.700 *	2.010	9650
LOC		2.001	100000	2.000 *	2.014	342482	2.370 *	2.015	12000
MIN SYSTEM STGS 493314									

***** FLOOD NUMBER 3 *****

STARTING TIME 1									
RESERVOIRS									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	3.007	155099 *	3.007	213211 *	3.007	150000 *	5999 *	DES REG
LOC	5 CP 5	3.008	145354 *	3.008	201054 *	3.008	136674 *	6482 *	0.00
LOC		3.010	146608 *	3.009	201487 *	3.010	130974 *	13633 *	0.00
RESERVOIR A (CP 1)									
LOC		FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL CHAN CAP	STOR1	
LOC		3.003	48512	1.970 *	3.008	150832	3.000 *	3.008	6000
LOC		3.001	102231	2.003 *	3.015	470410	2.565 *	3.016	12000

MIN SYSTEM STOR 150743 MAX SYSTEM STOR 621250

***** FLOOD NUMBER 8 *****

		STARTING TIME 1									
		SHORTAGE INDEX									
		REG									
		BY RES *									
		MAX LOC 0 *									
		FLO, PER									
		MAX NAT 0 *									
		MAX STG									
		MAX REL									
		CHAN CAP									
		STOR									
		12000									
		100000									
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		6000									
		72658									
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EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

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Flood Forecasting

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1	TYPE
.0000	28800	0.00	0.00	
.0000	35000	0.00	0.00	
.0000	42000	180.00	380.00	
.0000	50500	380.00	500.00	
.0000	60500	500.00	630.00	
.0000	73000	630.00	900.00	
.0000	90000	900.00	1250.00	
.0000	114000	1250.00	1500.00	
.0000	130000	1500.00	1930.00	
.0000	150000	1930.00	2660.00	
.0000	180000	2660.00	3900.00	
.0000	220000	3900.00	5000.00	
.0000	270000	5000.00	6300.00	
.0000	330000	6300.00	7900.00	
.0000	400000	7900.00	9900.00	
.0000	500000	9900.00	12500.00	
.0000	640000	12500.00	15000.00	
.0000	840000	15000.00	19300.00	
.0000	1100000	19300.00	26600.00	
.0000	1400000	26600.00	39000.00	
.0000	1800000	39000.00	50000.00	
.0000	2300000	50000.00	63000.00	
.0000	3000000	63000.00	79000.00	
.0000	4000000	79000.00	99000.00	
.0000	5000000	99000.00	125000.00	
.0000	6400000	125000.00	150000.00	
.0000	8400000	150000.00	193000.00	
.0000	11000000	193000.00	266000.00	
.0000	14000000	266000.00	390000.00	
.0000	18000000	390000.00	500000.00	
.0000	23000000	500000.00	630000.00	
.0000	30000000	630000.00	790000.00	
.0000	40000000	790000.00	990000.00	
.0000	50000000	990000.00	1250000.00	
.0000	64000000	1250000.00	1500000.00	
.0000	84000000	1500000.00	1930000.00	
.0000	110000000	1930000.00	2660000.00	
.0000	140000000	2660000.00	3900000.00	
.0000	180000000	3900000.00	5000000.00	
.0000	230000000	5000000.00	6300000.00	
.0000	300000000	6300000.00	7900000.00	
.0000	400000000	7900000.00	9900000.00	
.0000	500000000	9900000.00	12500000.00	
.0000	640000000	12500000.00	15000000.00	
.0000	840000000	15000000.00	19300000.00	
.0000	1100000000	19300000.00	26600000.00	
.0000	1400000000	26600000.00	39000000.00	
.0000	1800000000	39000000.00	50000000.00	
.0000	2300000000	50000000.00	63000000.00	
.0000	3000000000	63000000.00	79000000.00	
.0000	4000000000	79000000.00	99000000.00	
.0000	5000000000	99000000.00	125000000.00	
.0000	6400000000	125000000.00	150000000.00	
.0000	8400000000	150000000.00	193000000.00	
.0000	11000000000	193000000.00	266000000.00	
.0000	14000000000	266000000.00	390000000.00	
.0000	18000000000	390000000.00	500000000.00	
.0000	23000000000	500000000.00	630000000.00	
.0000	30000000000	630000000.00	790000000.00	
.0000	40000000000	790000000.00	990000000.00	
.0000	50000000000	990000000.00	1250000000.00	
.0000	64000000000	1250000000.00	1500000000.00	
.0000	84000000000	1500000000.00	1930000000.00	
.0000	110000000000	1930000000.00	2660000000.00	
.0000	140000000000	2660000000.00	3900000000.00	
.0000	180000000000	3900000000.00	5000000000.00	
.0000	230000000000	5000000000.00	6300000000.00	
.0000	300000000000	6300000000.00	7900000000.00	
.0000	400000000000	7900000000.00	9900000000.00	
.0000	500000000000	9900000000.00	12500000000.00	
.0000	640000000000	12500000000.00	15000000000.00	
.0000	840000000000	15000000000.00	19300000000.00	
.0000	1100000000000	19300000000.00	26600000000.00	
.0000	1400000000000	26600000000.00	39000000000.00	
.0000	1800000000000	39000000000.00	50000000000.00	
.0000	2300000000000	50000000000.00	63000000000.00	
.0000	3000000000000	63000000000.00	79000000000.00	
.0000	4000000000000	79000000000.00	99000000000.00	
.0000	5000000000000	99000000000.00	125000000000.00	
.0000	6400000000000	125000000000.00	150000000000.00	
.0000	8400000000000	150000000000.00	193000000000.00	
.0000	11000000000000	193000000000.00	266000000000.00	
.0000	14000000000000	266000000000.00	390000000000.00	
.0000	18000000000000	390000000000.00	500000000000.00	
.0000	23000000000000	500000000000.00	630000000000.00	
.0000	30000000000000	630000000000.00	790000000000.00	
.0000	40000000000000	790000000000.00	990000000000.00	
.0000	50000000000000	990000000000.00	1250000000000.00	
.0000	64000000000000	1250000000000.00	1500000000000.00	
.0000	84000000000000	1500000000000.00	1930000000000.00	
.0000	110000000000000	1930000000000.00	2660000000000.00	
.0000	140000000000000	2660000000000.00	3900000000000.00	
.0000	180000000000000	3900000000000.00	5000000000000.00	
.0000	230000000000000	5000000000000.00	6300000000000.00	
.0000	300000000000000	6300000000000.00	7900000000000.00	
.0000	400000000000000	7900000000000.00	9900000000000.00	
.0000	500000000000000	9900000000000.00	12500000000000.00	
.0000	640000000000000	12500000000000.00	15000000000000.00	
.0000	840000000000000	15000000000000.00	19300000000000.00	
.0000	1100000000000000	19300000000000.00	26600000000000.00	
.0000	1400000000000000	26600000000000.00	39000000000000.00	
.0000	1800000000000000	39000000000000.00	50000000000000.00	
.0000	2300000000000000	50000000000000.00	63000000000000.00	
.0000	3000000000000000	63000000000000.00	79000000000000.00	
.0000	4000000000000000	79000000000000.00	99000000000000.00	
.0000	5000000000000000	99000000000000.00	125000000000000.00	
.0000	6400000000000000	125000000000000.00	150000000000000.00	
.0000	8400000000000000	150000000000000.00	193000000000000.00	
.0000	11000000000000000	193000000000000.00	266000000000000.00	
.0000	14000000000000000	266000000000000.00	390000000000000.00	
.0000	18000000000000000	390000000000000.00	500000000000000.00	
.0000	23000000000000000	500000000000000.00	630000000000000.00	
.0000	30000000000000000	630000000000000.00	790000000000000.00	
.0000	40000000000000000	790000000000000.00	990000000000000.00	
.0000	50000000000000000	990000000000000.00	1250000000000000.00	
.0000	64000000000000000	1250000000000000.00	1500000000000000.00	
.0000	84000000000000000	1500000000000000.00	1930000000000000.00	
.0000	110000000000000000	1930000000000000.00	2660000000000000.00	
.0000	140000000000000000	2660000000000000.00	3900000000000000.00	
.0000	180000000000000000	3900000000000000.00	5000000000000000.00	
.0000	230000000000000000	5000000000000000.00	6300000000000000.00	
.0000	300000000000000000	6300000000000000.00	7900000000000000.00	
.0000	400000000000000000	7900000000000000.00	9900000000000000.00	
.0000	500000000000000000	9900000000000000.00	12500000000000000.00	
.0000	640000000000000000	12500000000000000.00	15000000000000000.00	
.0000	840000000000000000	15000000000000000.00	19300000000000000.00	
.0000	1100000000000000000	19300000000000000.00	26600000000000000.00	
.0000	1400000000000000000	26600000000000000.00	39000000000000000.00	
.0000	1800000000000000000	39000000000000000.00	50000000000000000.00	
.0000	2300000000000000000	50000000000000000.00	63000000000000000.00	
.0000	3000000000000000000	63000000000000000.00	79000000000000000.00	
.0000	4000000000000000000	79000000000000000.00	99000000000000000.00	
.0000	5000000000000000000	99000000000000000.00	125000000000000000.00	
.0000	6400000000000000000	125000000000000000.00	150000000000000000.00	
.0000	8400000000000000000	150000000000000000.00	193000000000000000.00	
.0000	11000000000000000000	193000000000000000.00	266000000000000000.00	
.0000	14000000000000000000	266000000000000000.00	390000000000000000.00	
.0000	18000000000000000000	390000000000000000.00	500000000000000000.00	
.0000	23000000000000000000	500000000000000000.00	630000000000000000.00	
.0000	30000000000000000000	630000000000000000.00	790000000000000000.00	
.0000	40000000000000000000	790000000000000000.00	990000000000000000.00	
.0000	50000000000000000000	990000000000000000.00	1250000000000000000.00	
.0000	64000000000000000000	1250000000000000000.00	1500000000000000000.00	
.0000	84000000000000000000	1500000000000000000.00	1930000000000000000.00	
.0000	110000000000000000000	1930000000000000000.00	2660000000000000000.00	
.0000	140000000000000000000	2660000000000000000.00	3900000000000000000.00	
.0000	180000000000000000000	3900000000000000000.00	5000000000000000000.00	
.0000	230000000000000000000	5000000000000000000.00	6300000000000000000.00	
.0000	300000000000000000000	6300000000000000000.00	7900000000000000000.00	
.0000	400000000000000000000	7900000000000000000.00	9900000000000000000.00	
.0000	500000000000000000000	9900000000000000000.00	12500000000000000000.00	
.0000	640000000000000000000	12500000000000000000.00	15000000000000000000.00	
.0000	840000000000000000000	15000000000000000000.00	19300000000000000000.00	
.0000	1100000000000000000000	19300000000000000000.00	26600000000000000000.00	
.0000	1400000000000000000000	26600000000000000000.00	39000000000000000000.00	
.0000	1800000000000000000000	39000000000000000000.00	50000000000000000000.00	
.0000	2300000000000000000000	50000000000000000000.00	63000000000000000000.00	
.0000	3000000000000000000000	63000000000000000000.00	79000000000000000000.00	
.0000	4000000000000000000000	79000000000000000000.00	99000000000000000000.00	

NO.	PLUM	EXCD	PROB	SUM	TYPE 1	TYPE
1	31779	.021	.023	27.07	27.07	
2	92449	.134	.279	174.34	174.34	
3	145356	.062	.050	84.07	84.07	
4	232988	.034	.025	110.78	110.78	
5	377367	.013	.014	136.83	136.83	
6	601840	.007	.010	131.99	131.99	
MODIFIED DAMAGES				673.97	673.97	
DAMAGE REDUCTION				22.05	22.05	

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	PLUM	EXCD	PROB	SUM	TYPE 1	TYPE
1	27735	.021	.023	16.43	16.43	
2	92449	.134	.279	166.49	166.49	
3	136674	.062	.050	76.32	76.32	
4	184898	.034	.025	72.39	72.39	
5	277348	.013	.014	87.88	87.88	
6	369797	.007	.010	106.25	106.25	
DAMAGES W/ TOTAL				525.75	525.75	
CONTROL AT PROJECTS				525.75	525.75	

REDUCTION POSSIBLE
W/ TOTAL CONTROL

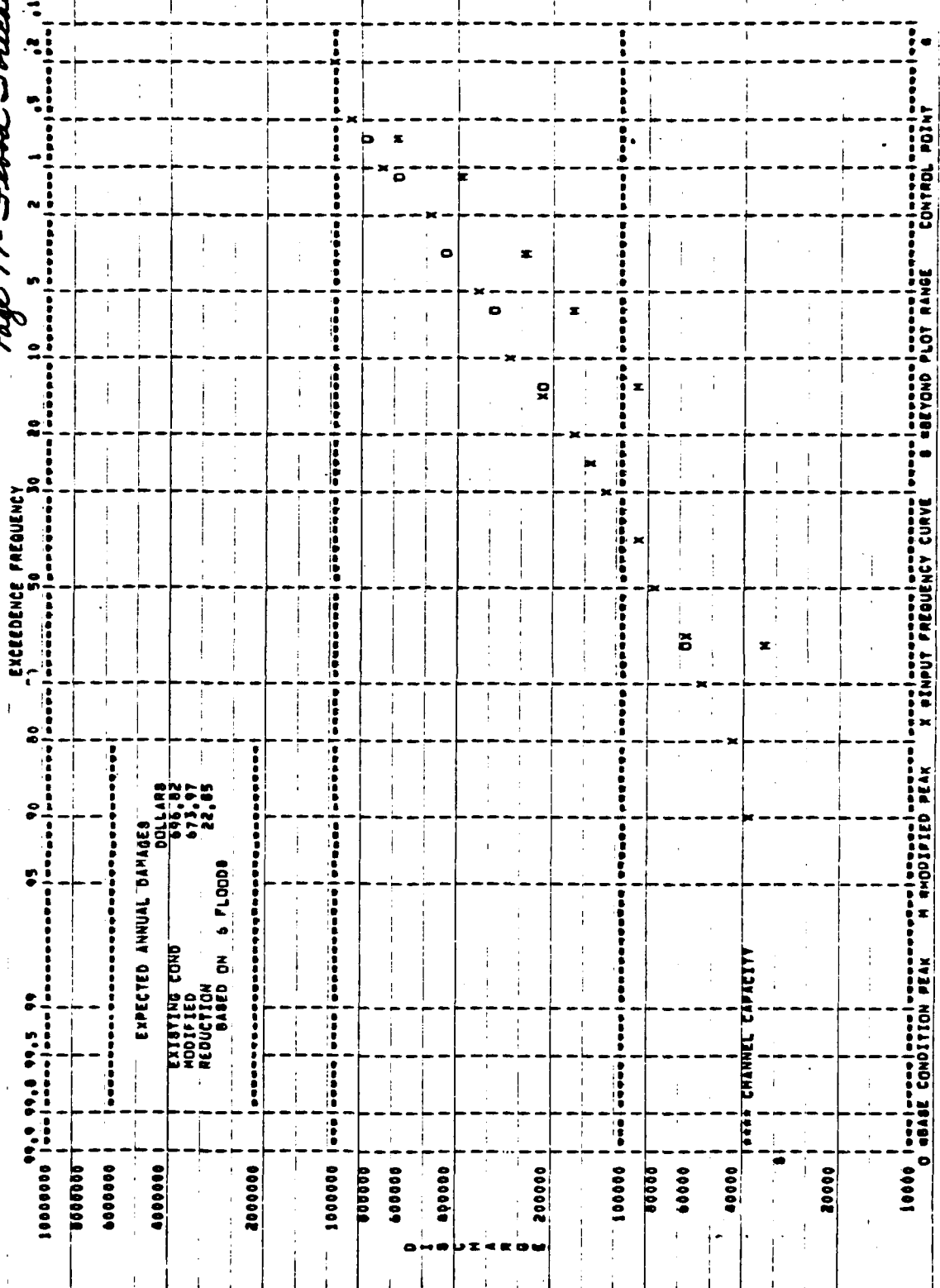
171.07

RESIDUAL DAMAGES

148.22

CONTROL POINT

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SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES

CONTROL POINT	BASE (EXIST) CONDITION	DAMAGES	MODIFIED CONDITIONS	UNCONTROL LOCAL COND	MODIFIED CONDITIONS	TOTAL CONTROL AT PROJECTS	RESIDUAL
	606.82	673.97	525.75	22.85	171.07	148.22	
TOTAL	606.82	673.97	525.75	22.85	171.07	148.22	

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Final Forecasting

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
(EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	120.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	1.92
TOTAL SYSTEM ANNUAL COST	9.00
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM	696.82
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM	673.97
AVERAGE ANNUAL DAMAGE REDUCTION	22.85
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS	13.05

IN	2	6	JUNE	5000.0	4000.0	3000.0	2000.0	1000.0	1000.0	1000.0	1000.0	SUMS	231000
				2000.0	3000.0	4000.0	6000.0	20000.0	57000.0	100000.0	90000.0	50000.0	
				37000.0	24000.0	24000.0	15000.0	9000.0	3000.0	2000.0	1500.0		
IN	3	6	JUNE	3000.0	6000.0	27000.0	60000.0	105000.0	70000.0	60000.0	45000.0	SUMS	517500
				16000.0	12000.0	12000.0	9000.0	6000.0	3000.0	2000.0	1000.0	24000.0	
IN	4	6	JUNE	2000.0	4000.0	14000.0	13000.0	10000.0	7000.0	4000.0	1000.0	SUMS	504000
				19000.0	25000.0	15000.0	7000.0	4000.0	2000.0	1000.0	500.0	4000.0	
IN	5	6	JUNE	1000.0	2000.0	9000.0	6000.0	5000.0	3000.0	2000.0	500.0	SUMS	127500
				5000.0	12000.0	6000.0	2000.0	2000.0	1000.0	500.0	200.0	2000.0	
EJ	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	SUMS	61700

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 Flood Proofing

0

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOC	NATURAL	INFLOW	OUTFLOW	CASE LOC	LEVEL	TOP STOR
1	3850.00	3850.00	3850.00	3850.00	.90	2.07	57898.67
3	8425.00	8425.00	8425.00	7450.02	1.12	2.03	122385.98

SUMMARY OF AVERAGES FOR NON-RESERVOIRS

LOC	CUM LOC	NATURAL	REGULATE	SPACE	BY US	FLOOD BY
2	8425.00	12474.00	12328.07	6671.13	3703.07	476.19
4	10755.02	23035.43	21005.64	13992.34	10269.74	0.00
5	11745.67	24083.67	21119.00	15881.00	9323.08	0.00

COMPUTATION INTERVAL IN HOURS

***** FLOOD NUMBER 2 *****

WPLONG 1 MPLONG 6
 FLOOD 2 1 FPLONG 2
 FLOODS MULTIPLIED BY 1.00

LOC 1 RESERVOIR A (CP 1)

SERVED BY 1

STARTING TIMES
 MONTHS, DAYS, HOURS, YEARS 9.

SERVING 1 4

PER	CUM LOCAL	0
1	1000	2000
11	5000	4000

1	1000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000

AVG 12833.333 MAX 50000.000
 MIN 1000.000

NATURAL FLOW

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG 12833.333 MAX 50000.000
 MIN 1000.000

INFLOW

1	1000	2000	3000	10000	37000	42000	50000	27000	20000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG 12833.333 MAX 50000.000
 MIN 1000.000

OUTFLOW

1	1000	2000	3000	0	0	0	0	0	0	3650
11	5000	4000	3000	2000	0	0	0	0	0	0

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 J. D. Harding
 MAX 5000.000
 MIN 0.000
 AVG 2667.691

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Flood Profiling

PER CASELOC, TYP

1	.03	.03	.03	4.02	4.01	4.00	4.00	4.00	4.00	.00
11	.04	.04	.04	.04	.01	.01	.01	.01	.01	

AVG 1.353 MAX 4.027 MIN 0.010

PER LEVEL

1	2.000	2.000	2.000	2.009	2.270	2.077	2.723	2.056	2.056	3.000
11	3.000	3.000	3.000	3.000	2.975	2.951	2.926	2.962		

AVG 2.673 MAX 3.000 MIN 2.000

PER CUP STORAGE

1	5000	5000	5000	5026	77273	98160	122004	136282	146200	150832
11	150832	150832	150832	150832	147353	105873	143394	140514		

AVG 117900.300 MAX 150832.000 MIN 5000.000

=====

SERVED BY -1

PER CUM LOCAL 0

1	2000	3000	4000	6000	20000	57000	100000	90000	70000	50000
11	37000	24000	24000	15000	9000	3000	2000	1500		

AVG 20750.000 MAX 100000.000 MIN 1500.000

PER NATURAL FLOW

1	3000	4167	6020	11330	37056	91043	142140	134857	90009	70302
11	40804	30147	28191	18032	11005	4160	3028	2505		

AVG 41903.202 MAX 142140.450 MIN 2504.050

PER REGULATED FLOW

1	3000	4167	6020	8330	20390	57065	100011	90002	70000	50610
11	40378	28562	27927	17988	11011	8472	7412	7085		

AVG 31120.076 MAX 100010.024 MIN 3000.000

PER 0 SPACE AVAIL.

1	18000	16833	14972	12662	610	-30065	-79011	-69002	-40000	-29610
11	-19378	-7562	-6927	3012	9149	12528	13008	13515		

AVG -10120.076 MAX 10000.000 MIN -79010.024

PER 0 BY US RES, DIV

1	1000	1167	2020	2330	300	45	11	2	0	610
11	3374	4562	3927	2988	2831	5472	5912	3985		

AVG 2370.076 MAX 5905.330 MIN 0.301

PER FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	610
11	3374	4562	3927	0	0	0	0	0		

AVG 697.275 MAX 4502.320 MIN 0.000

AVG 35853.070 MAX 92449.200
MIN 2723.662

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Shed Roofing

PER NATURAL FLOW
1 8000 10000 32304 49101 87502 140277 173708 104036 175045 136507
11 10000 93327 50105 49907 31395 19001 9465 5067

AVG 70704.776 MAX 100036.091
MIN 5046.056

PER REGULATED FLOW
1 8000 10000 20000 20225 21404 32020 42082 92000 87016 73500
11 62007 65354 43022 33686 24811 28761 21750 20401

AVG 21282.055 MAX 92487.001
MIN 8000.000

PER 0 SPACE AVAIL.
1 27000 28300 5102 6775 13500 2900 -27002 -37400 -52916 -30508
11 -27007 -30358 -0.22 1314 10500 10200 13250 14519

AVG -6282.095 MAX 27000.000
MIN -57407.001

PER 0 BY US RES.DIVS
1 4000 4520 7870 11053 3460 840 100 30 0 103
11 906 3174 4225 3020 5100 13050 16900 17757

AVG 5428.004 MAX 17756.907
MIN 7.005

PER FLOOD BY 1/3
1 0 0 0 0 0 0 0 0 0 0 103
11 906 3174 4225 3020 5100 13050 16900 17757

AVG 484.000 MAX 4225.056
MIN 0.000

..... SERVED BY -1 -2

PER CUM LOCAL 0
1 5000 6361 17800 20005 22413 23150 34500 63070 07270 07310
11 70300 79315 60530 40665 31940 20700 11950 5792

AVG 39319.000 MAX 07310.106
MIN 5000.000

PER LOCAL FLOW
1 9000 10000 22037 30112 57711 94226 142355 172097 107631 172632
11 102220 121270 06205 06172 42422 32700 20100 10752

AVG 00270.000 MAX 107631.100
MIN 0000.000

PER REGULATED FLOW
1 9000 10000 22521 32000 31000 27146 37051 63011 07363 07352
11 70024 70502 67563 80023 35007 27057 28930 22106

AVG 83999.739 MAX 07363.000
MIN 0000.000

PER 0 SPACE AVAIL.
1 20000 20551 14479 4110 5120 9054 -051 -26011 -50363 -50352
11 -01024 -30542 -30563 -11023 1053 9943 12060 14014

AVG 83999.739 MAX 07363.000
MIN 0000.000

AVG -6999.739 MAX 20000.000
MINS -50303.000

PER 9 BY US RES.DIVS
1 4000 4000 5012 7024 9267 3996 1263 301 84 36
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 6699.082 MAX 16302.320
MINS 36.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

PER FLOOD BY RES
1 0 0 0 0 0 0 0 0 0 0
11 239 1226 3025 3037 4056 6351 12976 16302

AVG 582.212 MAX 3037.493
MINS 0.000

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Flood Proofing

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FALL RIVER BASIN FLOOD PROOFING

TRAINING DOCUMENT NO. 7

FLOOD RATIOS 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

FLOOD SUMMARY-EACH FLOOD COPY

1

***** FLOOD NUMBER 1 *****

		STARTING TIME		1		SHORTAGE INDEX	
LOC	2 CP 2	FLD,PER	MAX REG Q *	FLD,PER	MAX NAT Q *	FLD,PER	MAX LOC Q *
LOC	4 CP 4	1.007	34777 *	1.007	42642 *	1.007	39000 *
LOC	5 CP 5	1.012	33136 *	1.008	50211 *	1.008	27735 *
		1.012	33586 *	1.009	56289 *	1.010	26195 *
RESERVOIRS		FLD,PER	MIN STG MIN LEVEL *	FLD,PER	MAX STG MAX LEVEL *	FLD,PER	MAX REL CHAN CAP
LOC	1 RESERVOIR A (CP 1)	1.010	50000	2.000 *	1.008	67393	2.173 *
LOC	3 RESERVOIR C (CP 3)	1.003	100000	2.000 *	1.010	140755	2.062 *
MIN SYSTEM STG		150000		MAX SYSTEM STG		208148	

LOC 3 RESERVOIR C (CP 3) 3.001 10000 2.003 3.015 470010 2.905 3.016 12000 12000 100000
 MIN SYSTEM STGO 1.0076 MAX SYSTEM STGO 621250

***** FLOOD NUMBER 3 *****

STARTING TIME 1

LOC	2 CP 2	FLD,PER	MAX REG D	FLD,PER	MAX NAT B	FLD,PER	MAX LOC B	FLD,PER	MAX BY RES	SHORTAGE INDEX
LOC	4 CP 4	5.008	303302	5.007	426421	5.007	300000	5.007	83302	0.00
LOC	5 CP 5	5.009	372066	5.008	582108	5.008	277348	5.008	98710	0.00
LOC	6 CP 6	5.010	365070	5.009	582093	5.010	261948	5.010	103121	0.00
LOC	7 CP 7	5.011	104403	5.011	755000	5.011	30990	5.011	30990	0.00
LOC	8 CP 8	5.012	155009	5.012	923044	5.012	30990	5.012	30990	0.00
LOC	9 CP 9	5.013	155009	5.013	923044	5.013	30990	5.013	30990	0.00
LOC	10 CP 10	5.014	155009	5.014	923044	5.014	30990	5.014	30990	0.00
LOC	11 CP 11	5.015	155009	5.015	923044	5.015	30990	5.015	30990	0.00
LOC	12 CP 12	5.016	155009	5.016	923044	5.016	30990	5.016	30990	0.00
LOC	13 CP 13	5.017	155009	5.017	923044	5.017	30990	5.017	30990	0.00
LOC	14 CP 14	5.018	155009	5.018	923044	5.018	30990	5.018	30990	0.00
LOC	15 CP 15	5.019	155009	5.019	923044	5.019	30990	5.019	30990	0.00
LOC	16 CP 16	5.020	155009	5.020	923044	5.020	30990	5.020	30990	0.00
LOC	17 CP 17	5.021	155009	5.021	923044	5.021	30990	5.021	30990	0.00
LOC	18 CP 18	5.022	155009	5.022	923044	5.022	30990	5.022	30990	0.00
LOC	19 CP 19	5.023	155009	5.023	923044	5.023	30990	5.023	30990	0.00
LOC	20 CP 20	5.024	155009	5.024	923044	5.024	30990	5.024	30990	0.00
LOC	21 CP 21	5.025	155009	5.025	923044	5.025	30990	5.025	30990	0.00
LOC	22 CP 22	5.026	155009	5.026	923044	5.026	30990	5.026	30990	0.00
LOC	23 CP 23	5.027	155009	5.027	923044	5.027	30990	5.027	30990	0.00
LOC	24 CP 24	5.028	155009	5.028	923044	5.028	30990	5.028	30990	0.00
LOC	25 CP 25	5.029	155009	5.029	923044	5.029	30990	5.029	30990	0.00
LOC	26 CP 26	5.030	155009	5.030	923044	5.030	30990	5.030	30990	0.00
LOC	27 CP 27	5.031	155009	5.031	923044	5.031	30990	5.031	30990	0.00
LOC	28 CP 28	5.032	155009	5.032	923044	5.032	30990	5.032	30990	0.00
LOC	29 CP 29	5.033	155009	5.033	923044	5.033	30990	5.033	30990	0.00
LOC	30 CP 30	5.034	155009	5.034	923044	5.034	30990	5.034	30990	0.00
LOC	31 CP 31	5.035	155009	5.035	923044	5.035	30990	5.035	30990	0.00
LOC	32 CP 32	5.036	155009	5.036	923044	5.036	30990	5.036	30990	0.00
LOC	33 CP 33	5.037	155009	5.037	923044	5.037	30990	5.037	30990	0.00
LOC	34 CP 34	5.038	155009	5.038	923044	5.038	30990	5.038	30990	0.00
LOC	35 CP 35	5.039	155009	5.039	923044	5.039	30990	5.039	30990	0.00
LOC	36 CP 36	5.040	155009	5.040	923044	5.040	30990	5.040	30990	0.00
LOC	37 CP 37	5.041	155009	5.041	923044	5.041	30990	5.041	30990	0.00
LOC	38 CP 38	5.042	155009	5.042	923044	5.042	30990	5.042	30990	0.00
LOC	39 CP 39	5.043	155009	5.043	923044	5.043	30990	5.043	30990	0.00
LOC	40 CP 40	5.044	155009	5.044	923044	5.044	30990	5.044	30990	0.00
LOC	41 CP 41	5.045	155009	5.045	923044	5.045	30990	5.045	30990	0.00
LOC	42 CP 42	5.046	155009	5.046	923044	5.046	30990	5.046	30990	0.00
LOC	43 CP 43	5.047	155009	5.047	923044	5.047	30990	5.047	30990	0.00
LOC	44 CP 44	5.048	155009	5.048	923044	5.048	30990	5.048	30990	0.00
LOC	45 CP 45	5.049	155009	5.049	923044	5.049	30990	5.049	30990	0.00
LOC	46 CP 46	5.050	155009	5.050	923044	5.050	30990	5.050	30990	0.00
LOC	47 CP 47	5.051	155009	5.051	923044	5.051	30990	5.051	30990	0.00
LOC	48 CP 48	5.052	155009	5.052	923044	5.052	30990	5.052	30990	0.00
LOC	49 CP 49	5.053	155009	5.053	923044	5.053	30990	5.053	30990	0.00
LOC	50 CP 50	5.054	155009	5.054	923044	5.054	30990	5.054	30990	0.00
LOC	51 CP 51	5.055	155009	5.055	923044	5.055	30990	5.055	30990	0.00
LOC	52 CP 52	5.056	155009	5.056	923044	5.056	30990	5.056	30990	0.00
LOC	53 CP 53	5.057	155009	5.057	923044	5.057	30990	5.057	30990	0.00
LOC	54 CP 54	5.058	155009	5.058	923044	5.058	30990	5.058	30990	0.00
LOC	55 CP 55	5.059	155009	5.059	923044	5.059	30990	5.059	30990	0.00
LOC	56 CP 56	5.060	155009	5.060	923044	5.060	30990	5.060	30990	0.00
LOC	57 CP 57	5.061	155009	5.061	923044	5.061	30990	5.061	30990	0.00
LOC	58 CP 58	5.062	155009	5.062	923044	5.062	30990	5.062	30990	0.00
LOC	59 CP 59	5.063	155009	5.063	923044	5.063	30990	5.063	30990	0.00
LOC	60 CP 60	5.064	155009	5.064	923044	5.064	30990	5.064	30990	0.00
LOC	61 CP 61	5.065	155009	5.065	923044	5.065	30990	5.065	30990	0.00
LOC	62 CP 62	5.066	155009	5.066	923044	5.066	30990	5.066	30990	0.00
LOC	63 CP 63	5.067	155009	5.067	923044	5.067	30990	5.067	30990	0.00
LOC	64 CP 64	5.068	155009	5.068	923044	5.068	30990	5.068	30990	0.00
LOC	65 CP 65	5.069	155009	5.069	923044	5.069	30990	5.069	30990	0.00
LOC	66 CP 66	5.070	155009	5.070	923044	5.070	30990	5.070	30990	0.00
LOC	67 CP 67	5.071	155009	5.071	923044	5.071	30990	5.071	30990	0.00
LOC	68 CP 68	5.072	155009	5.072	923044	5.072	30990	5.072	30990	0.00
LOC	69 CP 69	5.073	155009	5.073	923044	5.073	30990	5.073	30990	0.00
LOC	70 CP 70	5.074	155009	5.074	923044	5.074	30990	5.074	30990	0.00
LOC	71 CP 71	5.075	155009	5.075	923044	5.075	30990	5.075	30990	0.00
LOC	72 CP 72	5.076	155009	5.076	923044	5.076	30990	5.076	30990	0.00
LOC	73 CP 73	5.077	155009	5.077	923044	5.077	30990	5.077	30990	0.00
LOC	74 CP 74	5.078	155009	5.078	923044	5.078	30990	5.078	30990	0.00
LOC	75 CP 75	5.079	155009	5.079	923044	5.079	30990	5.079	30990	0.00
LOC	76 CP 76	5.080	155009	5.080	923044	5.080	30990	5.080	30990	0.00
LOC	77 CP 77	5.081	155009	5.081	923044	5.081	30990	5.081	30990	0.00
LOC	78 CP 78	5.082	155009	5.082	923044	5.082	30990	5.082	30990	0.00
LOC	79 CP 79	5.083	155009	5.083	923044	5.083	30990	5.083	30990	0.00
LOC	80 CP 80	5.084	155009	5.084	923044	5.084	30990	5.084	30990	0.00
LOC	81 CP 81	5.085	155009	5.085	923044	5.085	30990	5.085	30990	0.00
LOC	82 CP 82	5.086	155009	5.086	923044	5.086	30990	5.086	30990	0.00
LOC	83 CP 83	5.087	155009	5.087	923044	5.087	30990	5.087	30990	0.00
LOC	84 CP 84	5.088	155009	5.088	923044	5.088	30990	5.088	30990	0.00
LOC	85 CP 85	5.089	155009	5.089	923044	5.089	30990	5.089	30990	0.00
LOC	86 CP 86	5.090	155009	5.090	923044	5.090	30990	5.090	30990	0.00
LOC	87 CP 87	5.091	155009	5.091	923044	5.091	30990	5.091	30990	0.00
LOC	88 CP 88	5.092	155009	5.092	923044	5.092	30990	5.092	30990	0.00
LOC	89 CP 89	5.093	155009	5.093	923044	5.093	30990	5.093	30990	0.00
LOC	90 CP 90	5.094	155009	5.094	923044	5.094	30990	5.094	30990	0.00
LOC	91 CP 91	5.095	155009	5.095	923044	5.095	30990	5.095	30990	0.00
LOC	92 CP 92	5.096	155009	5.096	923044	5.096	30990	5.096	30990	0.00
LOC	93 CP 93	5.097	155009	5.097	923044	5.097	30990	5.097	30990	0.00
LOC	94 CP 94	5.098	155009	5.098	923044	5.098	30990	5.098	30990	0.00
LOC	95 CP 95	5.099	155009	5.099	923044	5.099	30990	5.099	30990	0.00
LOC	96 CP 96	5.100	155009	5.100	923044	5.100	30990	5.100	30990	0.00
LOC	97 CP 97	5.101	155009	5.101	923044	5.101	30990	5.101	30990	0.00
LOC	98 CP 98	5.102	155009	5.102	923044	5.102	30990	5.102	30990	0.00
LOC	99 CP 99	5.103	155009	5.103	923044	5.103	30990	5.103	30990	0.00
LOC	100 CP 100	5.104	155009	5.104	923044	5.104	30990	5.104	30990	0.00
LOC	101 CP 101	5.105	155009	5.105	923044	5.105	30990	5.105	30990	0.00
LOC	102 CP 102	5.106	155009	5.106	923044	5.106	30990	5.106	30990	0.00
LOC	103 CP 103	5.107	155009	5.107	923044	5.107	30990	5.107	30990	0.00
LOC	104 CP 104	5.108	155009	5.108	923044	5.108	30990	5.108	30990	0.00
LOC	105 CP 105	5.109	155009	5.109	923044	5.109	30990	5.109	30990	0.00
LOC	106 CP 106	5.110	155009	5.110	923044	5.110	30990	5.110	30990	0.00
LOC	107 CP 107	5.111	155009	5.111	923044	5.111	30990	5.111	30990	0.00
LOC	108 CP 108	5.112	155009	5.112	923044	5.112	30990	5.112	30990	0.00
LOC	109 CP 109	5.113	155009	5.113						

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

PEAK	FREQ	PROB	SUM	TYPE 1	TYPE 1
.9990	28800	.00	0.00	0.00	
.9000	35000	.00	0.00	0.00	
.8000	42000	.00	180.00	180.00	
.7000	50500	.00	380.00	380.00	
.6000	60500	.00	500.00	500.00	
.5000	73000	.00	630.00	630.00	
.4000	90000	.00	900.00	900.00	
.3000	114000	.00	1250.00	1250.00	
.2500	130000	.00	1500.00	1500.00	
.2000	150000	.00	1930.00	1930.00	
.1500	180000	.00	2600.00	2600.00	
.1000	230000	.00	5000.00	5000.00	
.0500	323000	.00	9900.00	9900.00	
.0200	490000	.00	12280.00	12280.00	
.0100	640000	.00	13350.00	13350.00	
.0050	820000	.00	14150.00	14150.00	
.0020	1000000	.00	14600.00	14600.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED	1721.30	1721.30
BASE COND- INPUT	0.00	0.00
EXIST SYSTEM-INPUT	666.82	666.82

BASE CONDITION FLOOD DAMAGES

NO.	FLOW	FREQ	PROB	SUM	TYPE 1	TYPE 1
1	38211	.021	.623	233.27	233.27	
2	194036	.134	.279	549.81	549.81	
3	241056	.062	.050	360.93	360.93	
4	388072	.034	.025	265.87	265.87	
5	502108	.013	.014	173.38	173.38	
6	774184	.007	.010	138.03	138.03	
BASE COND DAMAGES				1721.30	1721.30	
EXIST SYST DAMAGES				666.82	666.82	

MODIFIED CONDITIONS FLOW-DAMAGE DATA

PEAK	FREQ	PROB	SUM	TYPE 1	TYPE 1
.9990	28800	.00	0.00	0.00	
.9000	35000	.00	0.00	0.00	
.8000	42000	.00	90.00	90.00	
.7000	50500	.00	120.00	120.00	
.6000	60500	.00	140.00	140.00	
.5000	73000	.00	150.00	150.00	
.4000	90000	.00	200.00	200.00	
.3000	114000	.00	250.00	250.00	
.2500	130000	.00	300.00	300.00	
.2000	150000	.00	400.00	400.00	
.1500	180000	.00	700.00	700.00	
.1000	230000	.00	5000.00	5000.00	
.0500	323000	.00	9900.00	9900.00	
.0200	490000	.00	12280.00	12280.00	
.0100	640000	.00	13350.00	13350.00	
.0050	820000	.00	14150.00	14150.00	
.0020	1000000	.00	14600.00	14600.00	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE
		PROB	INT		
1	33134	.021	.023	14.30	
2	92808	.134	.079	43.91	
3	150895	.062	.050	19.71	
4	237096	.034	.025	116.36	
5	372064	.013	.014	137.08	
6	612333	.007	.010	132.33	

MODIFIED DAMAGES 463.68
DAMAGE REDUCTION 233.14

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	SUM	TYPE
		PROB	INT		
1	27735	.021	.023	6.81	
2	92809	.134	.079	42.36	
3	138674	.062	.050	15.59	
4	184898	.034	.025	34.03	
5	277368	.013	.014	87.18	
6	369797	.007	.010	108.25	

DAMAGES W/ TOTAL CONTROL AT PROJECTS 295.03

REDUCTION POSSIBLE W/ TOTAL CONTROL 401.79

RESIDUAL DAMAGES 168.65

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Flood Proofing

[illegible]

SUMMARY OF SYSTEMS EXPECTED ANNUAL FLOOD DAMAGES									
CONTROL	BASE (EXIST)	MODIFIED	UNCONTROL	LOCAL CONO	MODIFIED	AT PROJECTS	TOTAL CONTROL	DAMAGE REDUCTION	RESIDUAL
POINT	CONDITION	CONDITIONS	CONDITIONS	CONDITIONS	CONDITIONS	CONDITIONS	CONDITIONS	CONDITIONS	CONDITIONS
	690.02	463.60	295.03	295.03	233.14	401.79	401.79	168.05	
TOTAL	690.02	463.60	295.03	295.03	233.14	401.79	401.79	168.05	

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 Flood Pumping

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
 (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST 3000.00

TOTAL SYSTEM ANNUAL OPERATING
 MAINTENANCE, AND REPAIR COST 24.36

TOTAL SYSTEM ANNUAL COST 229.68

AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM 606.02

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM 263.68

AVERAGE ANNUAL DAMAGE REDUCTION 233.10

AVERAGE ANNUAL SYSTEM NEW DAMAGE REDUCTION BENEFITS 3.86

REC-SC-VARIABLE OUTPUT MAR.1975
RES. 35 CPTS. 75 PERS. 1106

11 FALL RIVEN 2.11 *** RELUCATI ***

12 TRAINING DRUGS 1.0 1.5 2.0 3.0 4.0 5.0 USED TO COMPUTE ANNUAL DAMAGES

13 FLOOD RATIOS	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	64.0	65.0	66.0	67.0	68.0	69.0	70.0	71.0	72.0	73.0	74.0	75.0	76.0	77.0	78.0	79.0	80.0	81.0	82.0	83.0	84.0	85.0	86.0	87.0	88.0	89.0	90.0	91.0	92.0	93.0	94.0	95.0	96.0	97.0	98.0	99.0	100.0	101.0	102.0	103.0	104.0	105.0	106.0	107.0	108.0	109.0	110.0	111.0	112.0	113.0	114.0	115.0	116.0	117.0	118.0	119.0	120.0	121.0	122.0	123.0	124.0	125.0	126.0	127.0	128.0	129.0	130.0	131.0	132.0	133.0	134.0	135.0	136.0	137.0	138.0	139.0	140.0	141.0	142.0	143.0	144.0	145.0	146.0	147.0	148.0	149.0	150.0	151.0	152.0	153.0	154.0	155.0	156.0	157.0	158.0	159.0	160.0	161.0	162.0	163.0	164.0	165.0	166.0	167.0	168.0	169.0	170.0	171.0	172.0	173.0	174.0	175.0	176.0	177.0	178.0	179.0	180.0	181.0	182.0	183.0	184.0	185.0	186.0	187.0	188.0	189.0	190.0	191.0	192.0	193.0	194.0	195.0	196.0	197.0	198.0	199.0	200.0	201.0	202.0	203.0	204.0	205.0	206.0	207.0	208.0	209.0	210.0	211.0	212.0	213.0	214.0	215.0	216.0	217.0	218.0	219.0	220.0	221.0	222.0	223.0	224.0	225.0	226.0	227.0	228.0	229.0	230.0	231.0	232.0	233.0	234.0	235.0	236.0	237.0	238.0	239.0	240.0	241.0	242.0	243.0	244.0	245.0	246.0	247.0	248.0	249.0	250.0	251.0	252.0	253.0	254.0	255.0	256.0	257.0	258.0	259.0	260.0	261.0	262.0	263.0	264.0	265.0	266.0	267.0	268.0	269.0	270.0	271.0	272.0	273.0	274.0	275.0	276.0	277.0	278.0	279.0	280.0	281.0	282.0	283.0	284.0	285.0	286.0	287.0	288.0	289.0	290.0	291.0	292.0	293.0	294.0	295.0	296.0	297.0	298.0	299.0	300.0	301.0	302.0	303.0	304.0	305.0	306.0	307.0	308.0	309.0	310.0	311.0	312.0	313.0	314.0	315.0	316.0	317.0	318.0	319.0	320.0	321.0	322.0	323.0	324.0	325.0	326.0	327.0	328.0	329.0	330.0	331.0	332.0	333.0	334.0	335.0	336.0	337.0	338.0	339.0	340.0	341.0	342.0	343.0	344.0	345.0	346.0	347.0	348.0	349.0	350.0	351.0	352.0	353.0	354.0	355.0	356.0	357.0	358.0	359.0	360.0	361.0	362.0	363.0	364.0	365.0	366.0	367.0	368.0	369.0	370.0	371.0	372.0	373.0	374.0	375.0	376.0	377.0	378.0	379.0	380.0	381.0	382.0	383.0	384.0	385.0	386.0	387.0	388.0	389.0	390.0	391.0	392.0	393.0	394.0	395.0	396.0	397.0	398.0	399.0	400.0	401.0	402.0	403.0	404.0	405.0	406.0	407.0	408.0	409.0	410.0	411.0	412.0	413.0	414.0	415.0	416.0	417.0	418.0	419.0	420.0	421.0	422.0	423.0	424.0	425.0	426.0	427.0	428.0	429.0	430.0	431.0	432.0	433.0	434.0	435.0	436.0	437.0	438.0	439.0	440.0	441.0	442.0	443.0	444.0	445.0	446.0	447.0	448.0	449.0	450.0	451.0	452.0	453.0	454.0	455.0	456.0	457.0	458.0	459.0	460.0	461.0	462.0	463.0	464.0	465.0	466.0	467.0	468.0	469.0	470.0	471.0	472.0	473.0	474.0	475.0	476.0	477.0	478.0	479.0	480.0	481.0	482.0	483.0	484.0	485.0	486.0	487.0	488.0	489.0	490.0	491.0	492.0	493.0	494.0	495.0	496.0	497.0	498.0	499.0	500.0	501.0	502.0	503.0	504.0	505.0	506.0	507.0	508.0	509.0	510.0	511.0	512.0	513.0	514.0	515.0	516.0	517.0	518.0	519.0	520.0	521.0	522.0	523.0	524.0	525.0	526.0	527.0	528.0	529.0	530.0	531.0	532.0	533.0	534.0	535.0	536.0	537.0	538.0	539.0	540.0	541.0	542.0	543.0	544.0	545.0	546.0	547.0	548.0	549.0	550.0	551.0	552.0	553.0	554.0	555.0	556.0	557.0	558.0	559.0	560.0	561.0	562.0	563.0	564.0	565.0	566.0	567.0	568.0	569.0	570.0	571.0	572.0	573.0	574.0	575.0	576.0	577.0	578.0	579.0	580.0	581.0	582.0	583.0	584.0	585.0	586.0	587.0	588.0	589.0	590.0	591.0	592.0	593.0	594.0	595.0	596.0	597.0	598.0	599.0	600.0	601.0	602.0	603.0	604.0	605.0	606.0	607.0	608.0	609.0	610.0	611.0	612.0	613.0	614.0	615.0	616.0	617.0	618.0	619.0	620.0	621.0	622.0	623.0	624.0	625.0	626.0	627.0	628.0	629.0	630.0	631.0	632.0	633.0	634.0	635.0	636.0	637.0	638.0	639.0	640.0	641.0	642.0	643.0	644.0	645.0	646.0	647.0	648.0	649.0	650.0	651.0	652.0	653.0	654.0	655.0	656.0	657.0	658.0	659.0	660.0	661.0	662.0	663.0	664.0	665.0	666.0	667.0	668.0	669.0	670.0	671.0	672.0	673.0	674.0	675.0	676.0	677.0	678.0	679.0	680.0	681.0	682.0	683.0	684.0	685.0	686.0	687.0	688.0	689.0	690.0	691.0	692.0	693.0	694.0	695.0	696.0	697.0	698.0	699.0	700.0	701.0	702.0	703.0	704.0	705.0	706.0	707.0	708.0	709.0	710.0	711.0	712.0	713.0	714.0	715.0	716.0	717.0	718.0	719.0	720.0	721.0	722.0	723.0	724.0	725.0	726.0	727.0	728.0	729.0	730.0	731.0	732.0	733.0	734.0	735.0	736.0	737.0	738.0	739.0	740.0	741.0	742.0	743.0	744.0	745.0	746.0	747.0	748.0	749.0	750.0	751.0	752.0	753.0	754.0	755.0	756.0	757.0	758.0	759.0	760.0	761.0	762.0	763.0	764.0	765.0	766.0	767.0	768.0	769.0	770.0	771.0	772.0	773.0	774.0	775.0	776.0	777.0	778.0	779.0	780.0	781.0	782.0	783.0	784.0	785.0	786.0	787.0	788.0	789.0	790.0	791.0	792.0	793.0	794.0	795.0	796.0	797.0	798.0	799.0	800.0	801.0	802.0	803.0	804.0	805.0	806.0	807.0	808.0	809.0	810.0	811.0	812.0	813.0	814.0	815.0	816.0	817.0	818.0	819.0	820.0	821.0	822.0	823.0	824.0	825.0	826.0	827.0	828.0	829.0	830.0	831.0	832.0	833.0	834.0	835.0	836.0	837.0	838.0	839.0	840.0	841.0	842.0	843.0	844.0	845.0	846.0	847.0	848.0	849.0	850.0	851.0	852.0	853.0	854.0	855.0	856.0	857.0	858.0	859.0	860.0	861.0	862.0	863.0	864.0	865.0	866.0	867.0	868.0	869.0	870.0	871.0	872.0	873.0	874.0	875.0	876.0	877.0	878.0	879.0	880.0	881.0	882.0	883.0	884.0	885.0	886.0	887.0	888.0	889.0	890.0	891.0	892.0	893.0	894.0	895.0	896.0	897.0	898.0	899.0	900.0	901.0	902.0	903.0	904.0	905.0	906.0	907.0	908.0	909.0	910.0	911.0	912.0	913.0	914.0	915.0	916.0	917.0	918.0	919.0	920.0	921.0	922.0	923.0	924.0	925.0	926.0	927.0	928.0	929.0	930.0	931.0	932.0	933.0	934.0	935.0	936.0	937.0	938.0	939.0	940.0	941.0	942.0	943.0	944.0	945.0	946.0	947.0	948.0	949.0	950.0	951.0	952.0	953.0	954.0	955.0	956.0	957.0	958.0	959.0	960.0	961.0	962.0	963.0	964.0	965.0	966.0	967.0	968.0	969.0	970.0	971.0	972.0	973.0	974.0	975.0	976.0	977.0	978.0	979.0	980.0	981.0	982.0	983.0	984.0	985.0	986.0	987.0	988.0	989.0	990.0	991.0	992.0	993.0	994.0	995.0	996.0	997.0	998.0	999.0	1000.0	1001.0	1002.0	1003.0	1004.0	1005.0	1006.0	1007.0	1008.0	1009.0	1010.0	1011.0	1012.0	1013.0	1014.0	1015.0	1016.0	1017.0	1018.0	1019.0	1020.0	1021.0	1022.0	1023.0	1024.0	1025.0	1026.0	1027.0	1028.0	1029.0	1030.0	1031.0	1032.0	1033.0	1034.0	1035.0	1036.0	1037.0	1038.0	1039.0	1040.0	1041.0	1042.0	1043.0	1044.0	1045.0	1046.0	1047.0	1048.0	1049.0	1050.0	1051.0	1052.0	1053.0	1054.0	1055.0	1056.0	1057.0	1058.0	1059.0	1060.0	1061.0	1062.0	1063.0	1064.0	1065.0	1066.0	1067.0	1068.0	1069.0	1070.0	1071.0	1072.0	1073.0	1074.0	1075.0	1076.0	1077.0	1078.0	1079.0	1080.0	1081.0	1082.0	1083.0	1084.0	1085.0	1086.0	1087.0	1088.0	1089.0	1090.0	1091.0	1092.0	1093.0	1094.0	1095.0	1096.0	1097.0	1098.0	1099.0	1100.0	1101.0	1102.0	1103.0	1104.0	1105.0	1106.0	1107.0	1108.0	1109.0	1110.0	1111.0	1112.0	1113.0	1114.0	1115.0	1116.0	1117.0	1118.0	1119.0	1120.0	1121.0	1122.0	1123.0	1124.0	1125.0	1126.0	1127.0	1128.0	1129.0	1130.0	1131.0	1132.0	1133.0	1134.0	1135.0	1136.0	1137.0	1138.0	1139.0	1140.0	1141.0	1142.0	1143.0	1144.0	1145.0	1146.0	1147.0	1148.0	1149.0	1150.0	1151.0	1152.0	1153.0	1154.0	1155.0	1156.0	1157.0	1158.0	1159.0	1160.0	1161.0	1162.0	1163.0	1164.0	1165.0	1166.0	1167.0	1168.0	1169.0	1170.0	1171.0	1172.0	1173.0	1174.0	1175.0	1176.0	1177.0	1178.0	1179.0	1180.0	1181.0	1182.0	1183.0	1184.0	1185.0	1186.0	1187.0	1188.0	1189.0	1190.0	1191.0	1192.0	1193.0	1194.0	1195.0	1196.0	1197.0	1198.0	1199.0	1200.0	1201.0	1202.0	1203.0	1204.0
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SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LUCA	NATURAL	FLOW	CASELINE	LEVEL	EMP STOP
1	3850.00	3850.00	1000.00	0.00	2.07	57494.67
3	8400.00	8400.00	4000.00	1.12	2.03	122385.98

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LUCA	NATURAL	REGULATE	Q SP4IF	Q BY US	FLOOD BY
2	8625.00	12870.98	12425.87	8671.11	3703.87	876.19
4	10754.92	23035.41	21005.88	13894.11	10249.78	0.00
5	11795.97	24083.97	21119.00	15881.00	9323.08	0.00

COMPUTATION INTERVAL IN MONTHS

***** FLOOD NUMBER 2 *****
 NLRDZ 1 FPLC-0.02 6
 TPLRD 1 FPLC-0.02 2
 FLOCS MULTIPLIED BY 1.00

**** LOC 1 RESERVOIR A (CP 1) SERVED BY 1

STARTING TIME 1
 40URS12, DAYE 8, MONR 0, YEAR219 0.

PER	CUM LOCAL Q	SERVING	1	4
1	1000 2000 3000 4000	10000 370.0 42000 50000	27000 20000 13000	
11	5000 8000 10000 12000	10.0 1000 1000 1000		

PER	NATURAL FLOW	AVG	12833.333	MAX	50000.000	MIN	1000.000
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PER	INFLOW	AVG	12833.333	MAX	50000.000	MIN	1000.000
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PER	OUTFLOW	AVG	12833.333	MAX	50000.000	MIN	1000.000
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Page 116
 Reservoir

PER	AVG	2687.691	MAX	6000.000	MIN	0.000
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Page 119 Reluctant									
PER	CASH	LOC	2	CP	2	SP	AV	AVG	MAX
1	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
11	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
PER LEVEL									
1	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
11	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
PER EUP STORAGE									
1	5000	5000	5000	5000	5000	5000	5000	5000	5000
11	150832	150832	150832	150832	150832	150832	150832	150832	150832
PER NATURAL FLOW									
1	3000	4167	4167	4167	4167	4167	4167	4167	4167
11	49800	50167	50167	50167	50167	50167	50167	50167	50167
PER REGULATED FLOW									
1	3000	4167	4167	4167	4167	4167	4167	4167	4167
11	40378	24562	27927	17000	17000	17000	17000	17000	17000
PER Q SPACE AVAIL.									
1	10000	10033	10072	12662	12662	12662	12662	12662	12662
11	19374	17562	16927	5012	5012	5012	5012	5012	5012
PER Q BY US RES.DIVS									
1	1000	1167	2028	2338	2338	2338	2338	2338	2338
11	3374	4562	3927	2900	2900	2900	2900	2900	2900
PER Q BY US RES.DIVS									
1	1000	1167	2028	2338	2338	2338	2338	2338	2338
11	3374	4562	3927	2900	2900	2900	2900	2900	2900

MIN 0.000

LOC 3 RESERVOIR C (CP 3)

SERVED BY 2

STARTING TIME
HOURS: 12, DAYS: 8, MONTH: 0, YEAR: 19 0,

SERVING 2 4

CUM LOCAL 0

PER	3000	6000	27000	60000	105000	78000	60000	45000	33000	28000
11	18000	12000	12000	9000	6000	3000	2000	1000		

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

NATURAL FLOW

PER	3000	6000	27000	60000	105000	78000	60000	45000	33000	28000
11	18000	12000	12000	9000	6000	3000	2000	1000		

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

INFLOW

PER	3000	6000	27000	60000	105000	78000	60000	45000	33000	28000
11	18000	12000	12000	9000	6000	3000	2000	1000		

AVG= 28000.000 MAX= 105000.000
MIN= 1000.000

OUTFLOW

PER	3000	6000	12000	0	0	0	0	0	0	0
11	0	0	0	0	12000	12000	12000	12000		

AVG= 3033.333 MAX= 12000.000
MIN= 0.000

CASECLOC.TYP

PER	0.03	0.03	0.01	4.02	4.01	4.00	4.00	4.00	4.00	4.00
11	4.00	4.00	4.00	4.00	0.01	0.01	0.01	0.01		

AVG= 2.452 MAX= 4.020
MIN= 0.010

LEVEL

PER	2.000	2.000	2.011	2.057	2.136	2.195	2.241	2.275	2.300	2.318
11	2.331	2.340	2.350	2.356	2.352	2.345	2.337	2.329		

AVG= 2.237 MAX= 2.338
MIN= 2.000

EDP STORAGE

PER	100000	100000	107438	137191	189257	227936	257488	280003	296366	308267
11	317193	323164	329094	333557	330562	326119	321160	315706		

AVG= 255594.556 MAX= 333557.125
MIN= 100000.000

SERVED BY 1 2

CUM LOCAL 0

PER	4000	6167	22028	17171	18029	31171	62693	92449	87908	73885
11	61081	62180	39197	29866	19311	11052	4842	2724		

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Relocation

200° 17' 12" 201° 17' 12" 202° 17' 12"

PER	NATURAL FLOW				
1	8000	10688	32394	49141	87552
11	106281	43327	49144	45907	31355
				14091	14091
				137379	137379
				5847	5847
				190436	190436
				175045	175045
				136597	136597

AVG 76788.770 MAY 194034.091
MINE 5840.454

[illegible]

AVGS	41247.055	MAVS	92007.001
		MINS	4000.000

[illegible]

AVG#	-622,055	MAX#	2700,000
		MIN#	-5707,801

[illegible]

AVGS	502A, 7A, 4	114E	17756.907
		114E	7.605

DATE	DESCRIPTION	AMOUNT	BALANCE
1	1	0	0
11	986	3170	4255
		0	0
		0	0
		0	0
		186	30
		0	0
		0	103

AVGS	640.474	RAYE	225.050
		TIME	0.000

LOC 5 5 SERVED NY -1 -2

AVG	39310.498	MAX	67310.106
		MIN	5000.000

PER	NATURAL FLO-			
1	900	1089	2297	3412
11	10220	12170	96208	64172
			94226	13784
			142355	20104
			172097	10752
			187031	172692

AVC# 00270,000 WAX 107631.100
WAX 0000.000

[illegible]

AVENUE 399, 739 552-2242 2424-0730

PER	O SPACE AVAIL.				851	26811	50363	50352
1	24000	26551	14479	4110	5120			
11	41428	30522	30543	11825	10.3	9051	12048	14818

AVG= -6999.739 MAX= 28000.000
MIN= -50363.008

PER 0 BY US RES, DIVS

1	4000	4088	5012	7924	9267	3996	1263	341	64	36
11	239	1226	3025	3957	4856	6351	12776	16348		

AVG= 8679.852 MAX= 16308.328
MIN= 36.288

PER FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	0
11	239	1226	3025	3957	0	0	0	0	0	0

AVG= 592.212 MAX= 3957.493
MIN= 0.000

CUM TIME= 1

RES NO=	1	3
INFLOW	1000	3000
OUTFLOW	1000	3000
EDP STOR	50000	100000
CASE=	.03	.03
LEVEL	2.000	2.000
EQ LEVEL	2.000	2.000

CUM TIME= 2

RES NO=	1	3
INFLOW	2000	6000
OUTFLOW	2000	6000
EDP STOR	50000	100000
CASE=	.03	.03
LEVEL	2.000	2.000
EQ LEVEL	2.000	2.000

CUM TIME= 3

RES NO=	1	3
INFLOW	3000	27000
OUTFLOW	3000	12000
EDP STOR	50000	107438
CASE=	.03	.01
LEVEL	2.000	2.011
EQ LEVEL	2.000	2.011

CUM TIME= 4

RES NO=	1	3
INFLOW	18000	60000
OUTFLOW	0	0
EDP STOR	58926	137191
CASE=	4.02	4.02
LEVEL	2.089	2.057
EQ LEVEL	2.089	2.057

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Relocation

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 Restoration

FALL RIVER BASIN *** REPLICATION ***

TRAINING DOCUMENT NO. 7

FLOOD RATINGS 0.3 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES

FLOOD SUMMARY-EACH FLOOD CURVE 1

***** FLOOD NUMBER 1 *****

STARTING TIME 1

SHORTAGE INDEX

DES RES

LOC 2 CP 2

LOC 4 CP 4

LOC 5 CP 5

RESERVOIR

LOC 1 RESERVOIR A (CP 1)

LOC 3 RESERVOIR C (CP 3)

MIN SYSTEM STG

MAX SYSTEM STG

MAX STG

MAX NAT Q

FLO, PER

MAX REC Q

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

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MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

***** FLOOD NUMBER 2 *****

STARTING TIME 1

SHORTAGE INDEX

DES RES

LOC 2 CP 2

LOC 4 CP 4

LOC 5 CP 5

RESERVOIR

LOC 1 RESERVOIR A (CP 1)

LOC 3 RESERVOIR C (CP 3)

MIN SYSTEM STG

MAX SYSTEM STG

MAX STG

MAX NAT Q

FLO, PER

MAX REC Q

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

***** FLOOD NUMBER 3 *****

STARTING TIME 1

SHORTAGE INDEX

DES RES

LOC 2 CP 2

LOC 4 CP 4

LOC 5 CP 5

RESERVOIR

LOC 1 RESERVOIR A (CP 1)

LOC 3 RESERVOIR C (CP 3)

MIN SYSTEM STG

MAX SYSTEM STG

MAX STG

MAX NAT Q

FLO, PER

MAX NAT Q

FLO, PER

LUC 3 RESERVOIR C (CP 3) 3.001 102231 2.003 * 3.015 470018 2.565 * 3.016 12000 12000 100000

MIN SYSTEM STGS 152974 MAX SYSTEM STGS 621250

***** FLOOD NUMBER 4 *****

STARTING TIME 1

LOC	2 CP 2	4 CP 4	5 CP 5	FLO, PER	MAX REG Q *	FLO, PER	MAX NAT Q *	FLO, PER	MAX LOC Q *	Q BY DES *	SHORTAGE INDEX
LUC	2 CP 2	4 CP 4	5 CP 5	4.001	252707 *	4.007	240281 *	4.007	200000 *	4.007	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	4.001	237896 *	4.008	388072 *	4.008	188998 *	4.008	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	4.010	229892 *	4.009	375262 *	4.010	178632 *	4.010	0.00

RESERVOIR FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STU, P1

LUC 1 RESERVOIR A (CP 1) 4.001 50992 2.010 * 4.007 150832 3.000 * 4.007 90654 6000 50000

LUC 3 RESERVOIR C (CP 3) 4.001 102975 2.005 * 4.015 593691 2.750 * 4.016 12000 12000 100000

MIN SYSTEM STGS 153966 MAX SYSTEM STGS 740723

***** FLOOD NUMBER 5 *****

STARTING TIME 1

LOC	2 CP 2	4 CP 4	5 CP 5	FLO, PER	MAX REG Q *	FLO, PER	MAX NAT Q *	FLO, PER	MAX LOC Q *	Q BY DES *	SHORTAGE INDEX
LUC	2 CP 2	4 CP 4	5 CP 5	5.001	363302 *	5.007	426421 *	5.007	300000 *	5.007	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	5.001	372066 *	5.008	502108 *	5.008	277308 *	5.008	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	5.010	365070 *	5.009	502893 *	5.010	261908 *	5.010	0.00

RESERVOIR FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STU, P1

LUC 1 RESERVOIR A (CP 1) 5.001 51408 2.015 * 5.007 140236 3.350 * 5.007 120542 6000 50000

LUC 3 RESERVOIR C (CP 3) 5.001 104463 2.007 * 5.011 755600 3.000 * 5.012 35094 12000 100000

MIN SYSTEM STGS 155949 MAX SYSTEM STGS 923608

***** FLOOD NUMBER 6 *****

STARTING TIME 1

LOC	2 CP 2	4 CP 4	5 CP 5	FLO, PER	MAX REG Q *	FLO, PER	MAX NAT Q *	FLO, PER	MAX LOC Q *	Q BY DES *	SHORTAGE INDEX
LUC	2 CP 2	4 CP 4	5 CP 5	6.007	516031 *	6.007	508562 *	6.007	400000 *	6.007	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	6.009	612513 *	6.008	776148 *	6.008	389797 *	6.008	0.00
LUC	2 CP 2	4 CP 4	5 CP 5	6.010	598538 *	6.009	750525 *	6.010	302264 *	6.010	0.00

RESERVOIR FLO, PER MIN STG MIN LEVEL * FLO, PER MAX STG MAX LEVEL * FLO, PER MAX REL CHAN CAP STU, P1

LUC 1 RESERVOIR A (CP 1) 6.001 51963 2.020 * 6.007 191183 3.821 * 6.007 163429 6000 50000

LUC 3 RESERVOIR C (CP 3) 6.001 105950 2.009 * 6.008 781273 3.106 * 6.009 136168 12000 100000

MIN SYSTEM STGS 157933 MAX SYSTEM STGS 972056

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Recreation

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Reclamation

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL POINT NUMBER 4

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1	TYPE
.9990	28000	0.00	0.00	
.9000	35000	0.00	0.00	
.8000	42000	180.00	180.00	
.7000	50500	380.00	380.00	
.6000	60500	500.00	500.00	
.5000	73000	630.00	630.00	
.4000	90000	900.00	900.00	
.3000	114000	1250.00	1250.00	
.2500	130000	1500.00	1500.00	
.2000	150000	1930.00	1930.00	
.1500	180000	2660.00	2660.00	
.1000	230000	5000.00	5000.00	
.0500	323000	9900.00	9900.00	
.0200	490000	12280.00	12280.00	
.0100	640000	13350.00	13350.00	
.0050	800000	14150.00	14150.00	
.0020	1000000	14600.00	14600.00	

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED	1721.30	1721.30
BASE COND- INPUT	0.00	-0.00
EXIST SYSTEM-INPUT	696.82	696.82

BASE CONDITION FLOOD DAMAGES

NO.	FREQ	PEAK	INT	SUM	TYPE 1	TYPE
1	.9211	.621	.623	233.27	233.27	
2	.194036	.134	.379	549.81	549.81	
3	.291058	.082	.350	360.93	360.93	
4	.388072	.034	.025	265.87	265.87	
5	.582108	.013	.014	173.38	173.38	
6	.776146	.007	.010	136.03	136.03	

BASE COND DAMAGES	1721.30	1721.30
EXIST SYST DAMAGES	696.82	696.82

MODIFIED CONDITIONS FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1	TYPE
.9990	28000	0.00	0.00	
.9000	35000	0.00	0.00	
.8000	42000	0.00	0.00	
.7000	50500	0.00	0.00	
.6000	60500	0.00	0.00	
.5000	73000	0.00	0.00	
.4000	90000	0.00	0.00	
.3000	114000	0.00	0.00	
.2500	130000	0.00	0.00	
.2000	150000	0.00	0.00	
.1500	180000	0.00	0.00	
.1000	230000	2600.00	2600.00	
.0500	323000	7500.00	7500.00	
.0200	490000	9880.00	9880.00	
.0100	640000	10950.00	10950.00	
.0050	800000	11750.00	11750.00	
.0020	1000000	12200.00	12200.00	

MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLO.	EXCD	FREQ	PROB	TNT	SUM	TYPE 1	TYPE 2
1	331.1	.021	.023			0.00	0.00	
2	928.0	.134	.279			0.00	0.00	
3	1506.7	.062	.050			.22		
4	2378.6	.034	.025			66.84		
5	3720.4	.013	.014			104.05		
6	6153.3	.007	.010			108.95		
MODIFIED DAMAGES						280.07	280.07	
DAMAGE REDUCTION						316.75	416.75	

UNCONTROLLED IDEAL FLOW FLOOD DAMAGES

UNCONTROLLED							
						TYPE 1	TYPE 2
NO.	FLO.	EXCD	PROB	TNT	SUM		
1	277.5	.621	.623		0.00	0.00	
2	928.0	.134	.279		0.00	0.00	
3	1346.7	.062	.050		0.00	0.00	
4	1489.8	.034	.025		11.52	11.52	
5	2773.4	.013	.014		54.75	54.75	
6	3697.7	.007	.010		84.84	84.84	
DAMAGES w/ TOTAL					151.10	151.10	
CONTROL AT PROJECTS					545.68	545.68	
REDUCTION POSSIBLE							
w/ TOTAL CONTROL					128.92	128.92	
RESIDUAL DAMAGES							128.92

AD-A106 700

HYDROLOGIC ENGINEERING CENTER DAVIS CA
ANALYSIS OF STRUCTURAL AND NONSTRUCTURAL FLOOD CONTROL MEASURES--ETC(U)
NOV 75 W K JOHNSON, D W DAVIS
HEC-TD-7

F/G 13/2

UNCLASSIFIED

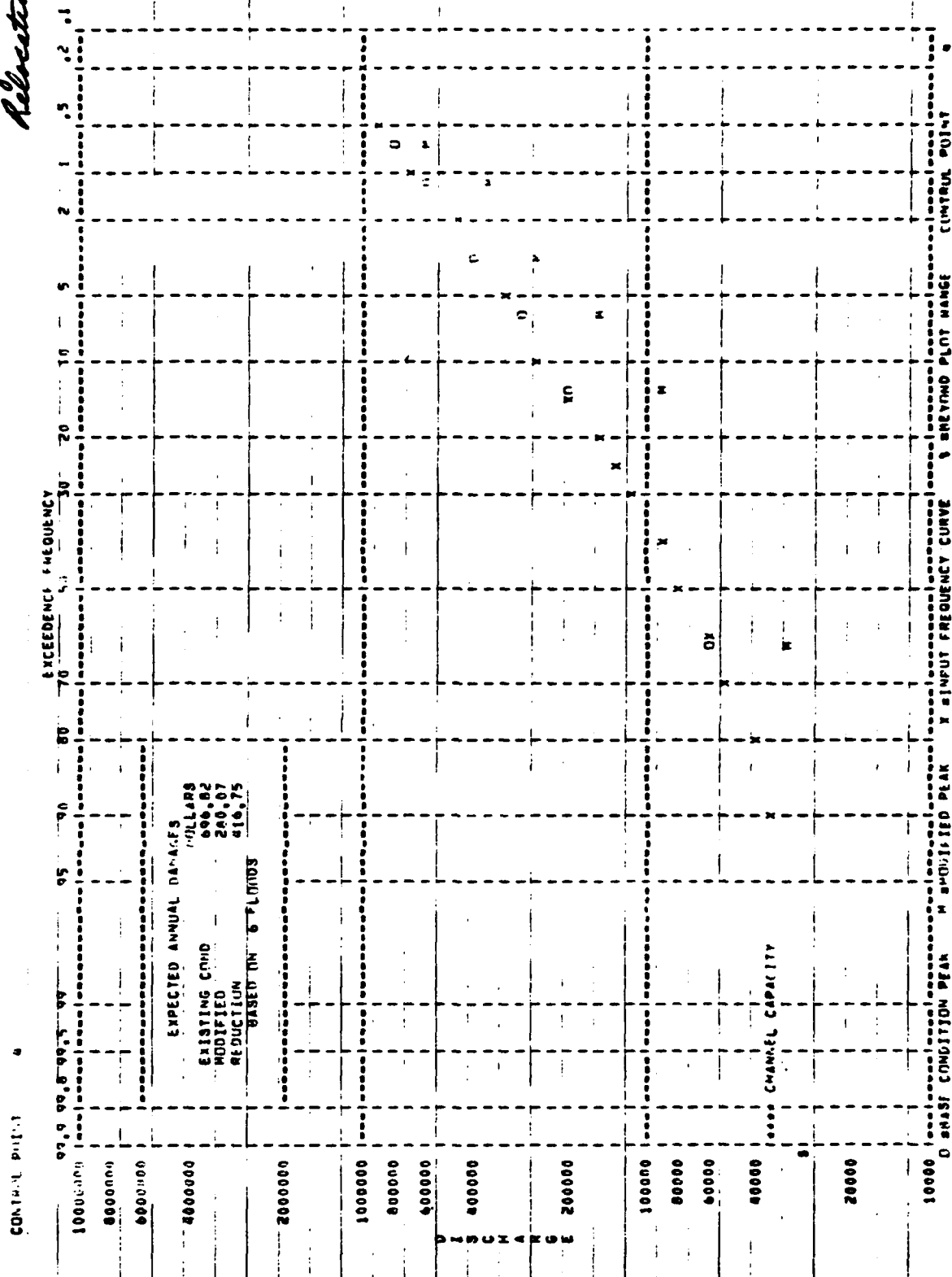
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Relocation



SUMMARY OF SYSTEMS EXPECTED ANNUAL FLOOD DAMAGES

CONTROL	RISK (EXIST)	UNIDENTIFIED	UNCONTROL	MONITORED	CONDITIONS	AT PROJECTS	DAMAGE REDUCTION
POINT	CONDITION	CONDITIONS	LOCAL COMD	CONDITIONS	CONDITIONS	AT PROJECTS	INITIAL
	696.82	200.07	151.14	410.75	545.60	124.02	
TOTAL	696.82	200.07	151.14	410.75	545.60	124.02	

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
(EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	• • • • •	2050.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	• • • • •	22.25
TOTAL SYSTEM ANNUAL COST	• • • • •	205.00
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM		496.82
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM		280.67
AVERAGE ANNUAL DAMAGE REDUCTION		416.75
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS		131.95

MEC-SC-VARIABLE (OUTPUT MAR.1975
REG. 35 CPT8.0 75 PER8.0100

T1 FILL WIVER BASIN ... FLOOD WARNING ...									
T2 TRAINING DOCUMENT NO. 7									
T3 FLOOD RATIOS .3 1.0 1.5 2.0 3.0 4.0 USED TO COMPUTE ANNUAL DAMAGES									
J1	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
J2	0.00	1.10	2.00	1.00	0.00	0.00	0.00	0.00	0.00
J6	0.00	0.30	1.50	2.00	3.00	4.00	0.00	0.00	0.00

ML	1.00	5000.00	0.00	0.00	5000.00	15000.00	20000.00	0.00	0.00
RU	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RB	0.00	0.00	5000.00	7000.00	10000.00	15000.00	20000.00	0.00	0.00
RG	0.00	5000.00	6000.00	7000.00	8000.00	10000.00	20000.00	0.00	0.00
CP	1.00	5000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID RESERVOIR A (CP 1)	1.00	2.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
CP	2.00	21000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID CP 2	2.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
RY	2.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00

ML	3.00	10000.00	0.00	0.00	10000.00	75000.00	100000.00	0.00	0.00
RU	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RB	7.00	0.00	10000.00	20000.00	40000.00	70000.00	100000.00	0.00	0.00
RG	7.00	10000.00	10000.00	10000.00	30000.00	60000.00	150000.00	0.00	0.00
CP	3.00	12000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID RESERVOIR C (CP 3)	3.00	4.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
CP	4.00	35000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID CP 4	4.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
RY	4.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00

ML	1.00	15000.00	0.00	0.00	15000.00	10000.00	10000.00	0.00	0.00
RU	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RB	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RG	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID RESERVOIR D (CP 4)	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CP	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID CP 5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RY	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ED	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ML	1.00	5000.00	0.00	0.00	5000.00	15000.00	20000.00	0.00	0.00
RU	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RB	0.00	0.00	5000.00	7000.00	10000.00	15000.00	20000.00	0.00	0.00
RG	0.00	5000.00	6000.00	7000.00	8000.00	10000.00	20000.00	0.00	0.00
CP	1.00	5000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID RESERVOIR A (CP 1)	1.00	2.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
CP	2.00	21000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ID CP 2	2.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00
RY	2.00	0.00	0.20	0.30	0.00	0.00	0.00	0.00	0.00

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SUMS 231000

IN	3	6	JUNE	37000.0	24000.0	24000.0	15000.0	9000.0	3000.0	2000.0	1500.0	SUM	517500
				3000.0	6000.0	27000.0	60000.0	105000.0	70000.0	60000.0	45000.0		
				10000.0	12000.0	12000.0	4000.0	8000.0	3000.0	2000.0	1000.0		
IN	4	6	JUNE	2000.0	4000.0	19000.0	13000.0	10000.0	7000.0	4000.0	1000.0	SUM	504000
				10000.0	25000.0	13000.0	7000.0	2000.0	2000.0	1000.0	500.0		
IN	5	6	JUNE	1000.0	2000.0	9000.0	4000.0	5000.0	3000.0	2000.0	500.0	SUM	127500
				5000.0	12000.0	6000.0	4000.0	2000.0	1000.0	500.0	200.0		
ET	-0			-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	SUM	61700

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 End Working

SUMMARY OF AVERAGES FOR RESERVOIRS

LOC	CUM LOC	NATURAL	INFLOW	OUTFLOW	CASE=LOC	LEVEL	TOP STOR
1	3050.00	3050.00	3050.00	3050.00	1.00	2.07	57000.07
2	8000.00	8000.00	8000.00	7600.00	1.12	2.03	122300.00

SUMMARY OF AVERAGES FOR NON RESERVOIRS

LOC	CUM LOC	NATURAL	PERMITS	SPACE	Q BY US	FLOOD BY
2	8025.00	12070.00	12070.00	8071.13	3703.07	476.19
4	10755.00	23035.00	21005.00	13000.00	10200.70	0.00
5	11705.00	20003.00	21117.00	15001.00	9323.00	0.00

COMPUTATION INTERVAL IN HOURS

***** FLOOD NUMBER 2 *****

NPLD= 1 NPLDUM= 6
IFLO= 1 IFICUM= 2
FLODS MULTIPLIED BY 1.00

RES LOC 1 RESERVOIR A (CP 1)

BEYOND BY 1

STARTING TIME:
MOUN=12.DAYS 4.MONS 0.YEARS 0.

SERVING 1 4

PER	CUM LOCAL 0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000	1000

AVG= 12033.333 MAX= 50000.000
MIN= 1000.000

PER NATURAL FLOW

PER	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG= 12033.333 MAX= 50000.000
MIN= 1000.000

PER INFLOW

PER	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG= 12033.333 MAX= 50000.000
MIN= 1000.000

PER OUTFLOW

PER	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

AVG= 2007.691 MAX= 60000.000
MIN= 0.000

PER CASE=LOC.TYP

PER	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
1	1000	2000	3000	4000	5000	6000	7000	8000	9000	13000
11	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000

11 .04 .04 .04 .04 .01 .01 .01 .01

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Blind Running

PER LEVEL
1 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000 2.000
11 3.000 3.000 3.000 3.000 3.000 3.000 3.000 3.000 3.000 3.000

PER EOP STORAGE
1 3000 3000 3000 3000 3000 3000 3000 3000 3000 3000
11 150032 150032 150032 150032 150032 150032 150032 150032 150032 150032

1 3000 3000 3000 3000 3000 3000 3000 3000 3000 3000
11 150032 150032 150032 150032 150032 150032 150032 150032 150032 150032

PER LDC 2 CP 2 SERVED BY 01
1 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000
11 37000 24000 20000 15000 10000 5000 0000 0000 0000 0000

PER CUM LOCAL 0
1 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000
11 37000 24000 20000 15000 10000 5000 0000 0000 0000 0000

PER NATURAL FLOW
1 3000 4167 6028 11330 37040 91003 142140 130057 90000 70302
11 49888 30167 20191 10032 11005 0100 3020 2505

PER REGULATED FLOW
1 3000 4167 6028 11330 37040 91003 142140 130057 90000 70302
11 40378 26502 27927 17900 11631 0172 7912 7005

PER 0 SPACE AVAIL.
1 10000 10033 14972 12062 610 36005 79011 00002 40000 20610
11 01378 07562 00027 3012 010 12520 13000 13515

PER 0 BY US RES.DIV6
1 1000 1167 2020 2330 300 65 11 2 0 610
11 3370 4562 3927 2900 0031 0072 5012 5005

PER FLOW BY RES
1 1000 1167 2020 2330 300 65 11 2 0 610
11 3370 4562 3927 2900 0031 0072 5012 5005

PER FLOW BY RES
1 1000 1167 2020 2330 300 65 11 2 0 610
11 3370 4562 3927 2900 0031 0072 5012 5005

PER FLOW BY RES
1 1000 1167 2020 2330 300 65 11 2 0 610
11 3370 4562 3927 2900 0031 0072 5012 5005

PER FLOW BY RES
1 1000 1167 2020 2330 300 65 11 2 0 610
11 3370 4562 3927 2900 0031 0072 5012 5005

LOC 3 RESERVOIR C (CP 1) SERVED BY 2

STARTING TIME
HOURS 12, DAYS 6, MONTHS 0, YEARS 19 0.

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
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PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
-----	-----------	-----	------------	-----	----------

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
-----	-----------	-----	------------	-----	----------

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
-----	-----------	-----	------------	-----	----------

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
-----	-----------	-----	------------	-----	----------

PER	CUM LOCAL 0	SERVING	2	4
1	3000	6000	27000	60000
11	18000	12000	105000	78000
			45000	33000
			45000	24000

AVG	20000.000	MAX	105000.000	MIN	1000.000
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Blood Warning

AVG 35053.070 MAX 92009.200 MIN 2723.002

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Shed Zehring

1 8000 10490 32304 09101 07502 104277 171794 194036 175005 130597
11 106201 03327 50105 05007 31345 19001 0465 5007

AVG= 76704.770

MAX= 194036.001
MIN= 5000.050

PER 0 SPACE AVAILABLE

1 8000 10490 20800 20225 21404 32020 62002 02400 07016 73500
11 02007 05354 43422 33000 24411 20701 21750 20001

AVG= 41202.055

MAX= 92007.001
MIN= 0000.000

PER 0 SPACE AVAILABLE

1 27000 24306 9102 0775 13506 2900 -27002 -57400 -32916 -30500
11 -27007 -30354 -0822 1314 10500 10200 13250 14810

AVG= -6202.055

MAX= 27000.000
MIN= -57407.001

PER 0 BY US RES.DIV0

1 8000 4520 7870 11053 3404 000 104 39 0 103
11 000 3174 4225 3020 5100 13050 10900 17757

AVG= 5420.984

MAX= 17750.907
MIN= 7.045

PER FLOOD BY RES

1 0 0 0 0 0 0 104 39 0 103
11 000 3174 4225 0 0 0 0 0 0

AVG= 404.400

MAX= 4205.750
MIN= 1.000

.....

LOC 5 CP 5 SERVED BY -01 -02

PER CUM LOCAL 0

1 5000 6361 17509 24965 22613 23150 34300 63470 07270 07310
11 70300 75315 04530 00065 31940 30706 11950 5792

AVG= 39319.000

MAX= 07310.100
MIN= 5000.000

PER NATURAL FLOW

1 9000 10490 22937 30112 57711 04220 102355 172097 107031 172652
11 102220 121270 06295 06172 45242 32700 20100 10752

AVG= 00270.000

MAX= 107031.100
MIN= 9000.000

PER REGULATED FLOW

1 9000 10490 22937 30112 31040 27104 37051 03011 07303 07352
11 70620 70502 07503 00025 35907 27057 20050 22100

AVG= 03000.730

MAX= 07303.000
MIN= 0000.000

PER 0 SPACE AVAILABLE

1 20000 26551 14479 4110 9120 9050 -051 -20011 -00363 -50352
11 -01025 -39502 -30503 -11023 1003 9943 12004 14014

AVG= -0000.730

MAX= 20000.000
MIN= -50363.000

PER 0 BY US RES.DIVS

1	4000	4000	5012	7924	9247	3906	1263	341	84	36
11	239	1226	3025	3957	4056	6351	12076	16394		

AVG 8079.812 MAX 10390.320
MIN 36.280

FLOOD BY RES

1	0	0	0	0	0	0	0	0	0	0
11	239	1226	3025	3957	0	0	0	0	0	36

AVG 582.212 MAX 3057.493
MIN 0.300

CUM TIME= 1

RES NO=	1	3
INFLOW	1000	3000
OUTFLOW	1000	3000
EQ STOR	50000	100000
CASE	.03	.03
LEVEL	2.000	2.000
EQ LEVEL	2.000	2.000

CUM TIME= 2

RES NO=	1	3
INFLOW	2000	6000
OUTFLOW	2000	6000
EQ STOR	50000	100000
CASE	.03	.03
LEVEL	2.000	2.000
EQ LEVEL	2.000	2.000

CUM TIME= 3

RES NO=	1	3
INFLOW	3000	27000
OUTFLOW	3000	12000
EQ STOR	50000	107438
CASE	.03	.01
LEVEL	2.000	2.011
EQ LEVEL	2.000	2.011

CUM TIME= 4

RES NO=	1	3
INFLOW	10000	60000
OUTFLOW	0	0
EQ STOR	58920	137191
CASE	4.02	2.02
LEVEL	2.000	2.057
EQ LEVEL	2.000	2.057

CUM TIME= 5

FLOOD SUMMARY-EACH FLOOD CASE

***** FLOOD NUMBER 1 *****

STARTING TIME 1									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	1.007	38777 *	1.007	42482 *	1.007	30000 *	4777 *	0.00
LOC	5 CP 5	1.012	33134 *	1.008	58211 *	1.008	27735 *	5400 *	0.00
		1.012	33586 *	1.009	56289 *	1.010	26195 *	7391 *	0.00
RESERVOIRS									
LOC	1 RESERVOIR A (CP 1)	FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	1.018	50000	2.000 *	1.008	67393	2.173 *	6000	50000
		1.003	100000	2.000 *	1.010	180753	2.082 *	12000	100000
MIN SYSTEM STGS									
			150000	MAX SYSTEM STGS		208168			

***** FLOOD NUMBER 2 *****

STARTING TIME 1									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	2.007	100011 *	2.007	142180 *	2.007	100000 *	11 *	0.00
LOC	5 CP 5	2.009	92804 *	2.008	198036 *	2.008	92849 *	30 *	0.00
		2.009	87355 *	2.009	187631 *	2.010	87316 *	87 *	0.00
RESERVOIRS									
LOC	1 RESERVOIR A (CP 1)	FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	2.003	50000	2.000 *	2.011	150832	3.000 *	6000	50000
		2.002	100000	2.000 *	2.018	333557	2.356 *	12000	100000
MIN SYSTEM STGS									
			150000	MAX SYSTEM STGS		480389			

***** FLOOD NUMBER 3 *****

STARTING TIME 1									
LOC	2 CP 2	FLO,PER	MAX REG Q *	FLO,PER	MAX NAT Q *	FLO,PER	MAX LOC Q *	Q BY RES *	SHORTAGE INDEX
LOC	4 CP 4	3.007	157221 *	3.007	213211 *	3.007	130000 *	7221 *	0.00
LOC	5 CP 5	3.009	150695 *	3.008	201054 *	3.008	136674 *	12022 *	0.00
		3.010	150368 *	3.009	201487 *	3.010	130978 *	10374 *	0.00
RESERVOIRS									
LOC	1 RESERVOIR A (CP 1)	FLO,PER	MIN STG MIN LEVEL *	FLO,PER	MAX STG MAX LEVEL *	FLO,PER	MAX REL	CHAN CAP	STOR1
LOC	3 RESERVOIR C (CP 3)	3.001	50744	2.007 *	3.007	150832	3.000 *	40499	50000
		3.001	102231	2.003 *	3.015	470418	2.505 *	12000	100000

EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
CONTROL PRINT NUMBER 4

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Flood Warning

BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1
.0000	24600	0.00	0.00
.0000	35000	0.00	0.00
.0000	42000	160.00	160.00
.0000	50500	360.00	360.00
.0000	60500	500.00	500.00
.0000	73000	630.00	630.00
.0000	80000	900.00	900.00
.0000	114000	1250.00	1250.00
.0000	130000	1500.00	1500.00
.0000	150000	1930.00	1930.00
.0000	180000	2560.00	2560.00
.0000	230000	5000.00	5000.00
.0000	320000	8000.00	8000.00
.0000	490000	12280.00	12280.00
.0000	600000	13350.00	13350.00
.0000	640000	14150.00	14150.00
.0000	1000000	14600.00	14600.00

EXPECTED ANNUAL DAMAGES

BASE COND-COMPUTED	1721.30
BASE COND- INPUT	0.00
EXIST SYSTEM-INPUT	696.62

BASE CONDITION FLOOD DAMAGES

NO.	FREQ	PEAK	SUM	TYPE 1
1	50211	.021	233.27	233.27
2	144036	.134	549.01	549.01
3	291054	.062	360.93	360.93
4	388072	.038	265.87	265.87
5	502108	.013	173.34	173.34
6	776168	.007	134.03	134.03
BASE COND DAMAGES	1721.30			
EXIST SYST DAMAGES	696.62			

MODIFIED CONDITIONS FLOW-DAMAGE DATA

FREQ	PEAK	SUM	TYPE 1
.0000	28000	0.00	0.00
.0000	35000	0.00	0.00
.0000	42000	171.00	171.00
.0000	50500	361.00	361.00
.0000	60500	475.00	475.00
.0000	73000	594.00	594.00
.0000	80000	855.00	855.00
.0000	114000	1197.00	1197.00
.0000	130000	1425.00	1425.00
.0000	150000	1833.00	1833.00
.0000	180000	2527.00	2527.00
.0000	230000	5000.00	5000.00
.0000	320000	8000.00	8000.00
.0000	490000	12280.00	12280.00
.0000	600000	13350.00	13350.00
.0000	640000	14150.00	14150.00
.0000	1000000	14600.00	14600.00

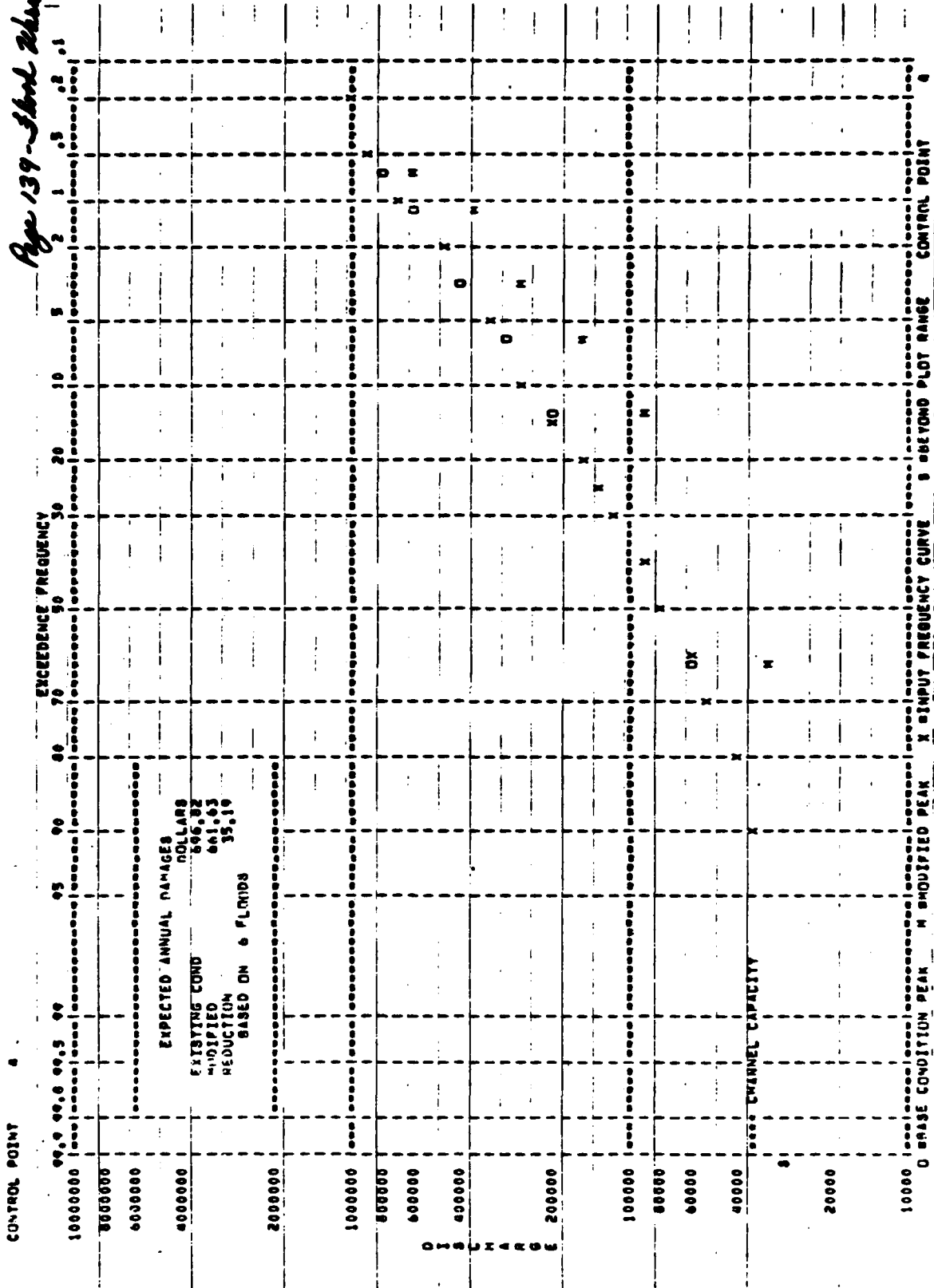
MODIFIED CONDITIONS FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	INT	SUM	TYPE 1	TYPE
1	33134	.621	.623		32.26	32.26	
2	42488	.134	.279		166.24	166.24	
3	156695	.062	.050		84.24	84.24	
4	237896	.034	.025		121.21	121.21	
5	372046	.013	.018		130.06	130.06	
6	612533	.007	.010		125.58	125.58	
MODIFIED DAMAGES					661.63	661.63	
DAMAGE REDUCTION					35.10	35.10	

UNCONTROLLED LOCAL FLOW FLOOD DAMAGES

NO.	FLOW	EXCD	PROB	INT	SUM	TYPE 1	TYPE
1	27735	.621	.623		13.71	13.71	
2	92449	.134	.279		156.13	156.13	
3	138678	.062	.050		72.89	72.89	
4	184898	.034	.025		68.77	68.77	
5	277386	.013	.018		83.48	83.48	
6	369797	.007	.010		102.59	102.59	
DAMAGES W/ TOTAL					499.16	499.16	
CONTROL AT PROJECTS					499.16	499.16	
REDUCTION POSSIBLE					197.66	197.66	
W/ TOTAL CONTROL					197.66	197.66	
RESIDUAL DAMAGES					197.66	197.66	

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SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES

CONTROL	BASE (EXIST)	DAMAGES	UNCONTROL	MODIFIED	MODIFIED	TOTAL CONTROL	RESIDUAL
POINT	CONDITION	CONDITIONS	LOCAL COND	CONDITIONS	AT PROJECTS		
	600.82	661.63	400.10	35.19	197.66	102.87	
TOTAL	600.82	661.63	400.10	35.19	197.66	102.87	

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 Fred E. Kruming

SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
 (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST	100.00
TOTAL SYSTEM ANNUAL OPERATING MAINTENANCE, AND REPAIR COST	5.00
TOTAL SYSTEM ANNUAL COST	105.00
AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM	696.02
AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM	661.63
AVERAGE ANNUAL DAMAGE REDUCTION	35.19
AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS	24.20

