US Army Corps of Engineers
Hydrologic Engineering Center

Analysis of Structural and Nonstructural Flood Control Measures Using Computer Program HEC-5C

November 1975

TD-7

REPORT DOCUMENTATION PAGE	*Form Approved OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)* November 1975	**2. REPORT TYPE** Training Document	**3. DATES COVERED** *(From - To)*

4. TITLE AND SUBTITLE Analysis of Structural and Nonstructural Flood Control Measures Using Computer Program HEC-5C	**5a. CONTRACT NUMBER** **5b. GRANT NUMBER** **5c. PROGRAM ELEMENT NUMBER**
6. AUTHOR(S) William K. Johnson, Darryl W. Davis	**5d. PROJECT NUMBER** **5e. TASK NUMBER** **5F. WORK UNIT NUMBER**
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army Corps of Engineers Institute for Water Resources Hydrologic Engineering Center (HEC) 609 Second Street Davis, CA 95616-4687	**8. PERFORMING ORGANIZATION REPORT NUMBER** TD-7
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSOR/ MONITOR'S ACRONYM(S)** **11. SPONSOR/ MONITOR'S REPORT NUMBER(S)**

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
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14. ABSTRACT

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, stage-damage, discharge-damage, and damage frequency relationships. Diversion and flood forecasting affected these relationships the least, but all the methods affected 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 on 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.

15. SUBJECT TERMS

non-structural alternatives, flood control, flood plain management, analytical techniques, cost-benefit analysis, Fall River (CA), planning, land use, hydrologic aspects, stage-discharge relations, flood discharge, flood damage, flood control, water resources management, levees, floodwalls, reservoirs, channel improvement, levees, floodwalls, reservoirs, channel improvement, diversion, flood forecasting, floodproofing

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT U	**b. ABSTRACT** U	**c. THIS PAGE** U	UU	212	**19b. TELEPHONE NUMBER**

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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

Those Designed to Control the Hydrology	Those Designed to Reduce the Susceptibility of Property to Damage
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 streamflow 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				
Measure	Stage-discharge[1]	Stage-damage[2]	Discharge-damage	Discharge frequency[3]	Damage Frequency
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/] Stage 1	Stage 2	Stage 3	Stage 4	Formulated System
A*	--	--	--	--	A
B	20	5	-2	-8	
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 <u>net</u> 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 <u>net</u> 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	Last Added Value ($1000 per year)[1/]				Formulated System
	Stage 1	Stage 2	Stage 3	Stage 4	
K	-20	-10**	--	--	
L*	--	--	--	--	L
M	10	0	-4**	--	
N	6	6	6	8	N
O	8	8	8	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 <u>all</u> 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

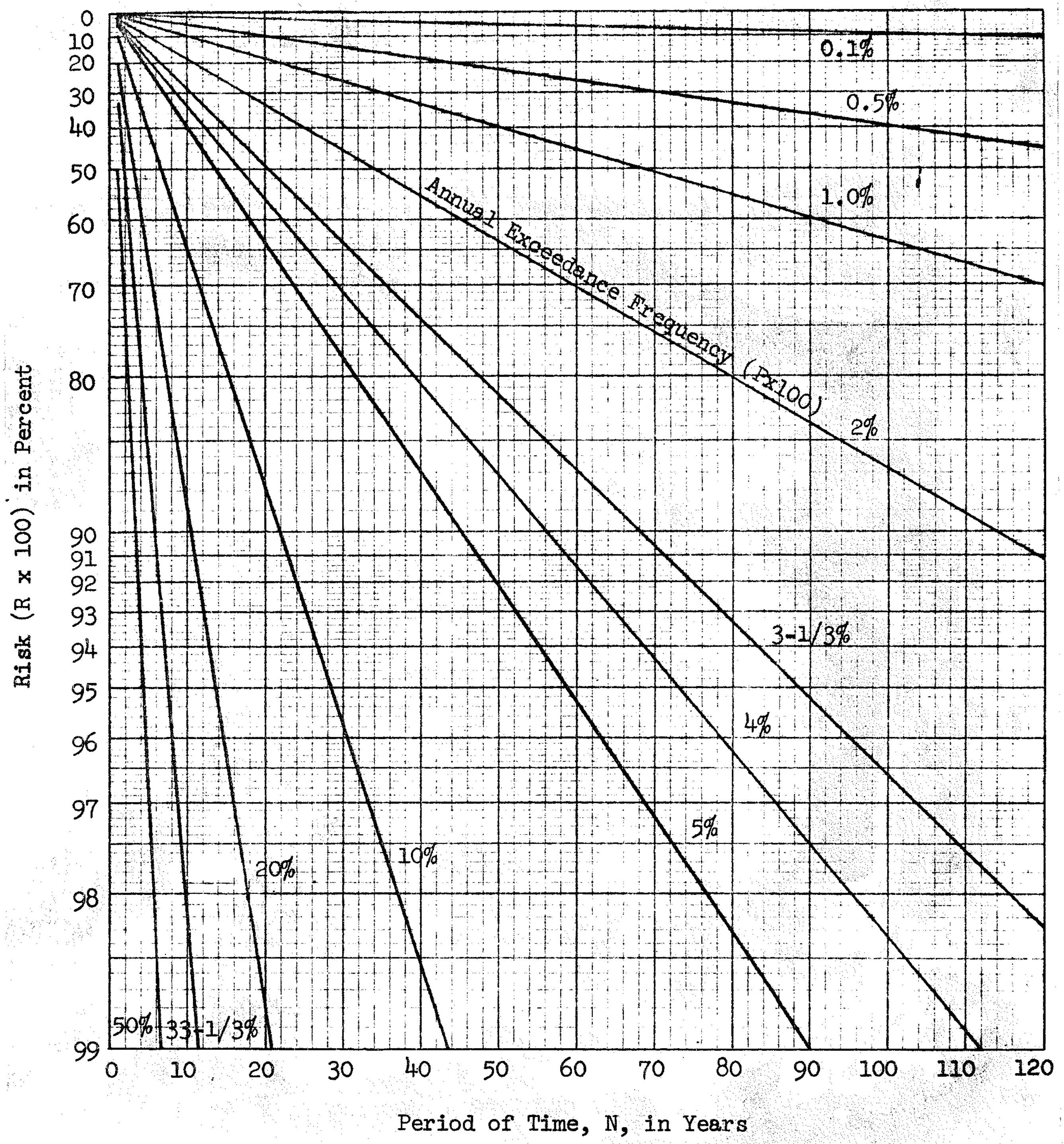
Period of Time In Years	Risk (in percent) One or More Events
30	26
50	40
70	50
100	63

*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

Criteria	Units	Measures
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

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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.

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PART II

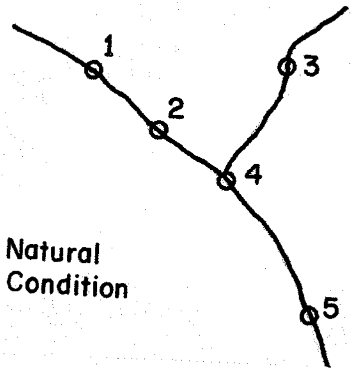
FALL RIVER: AN EXAMPLE USING HEC-5C

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.

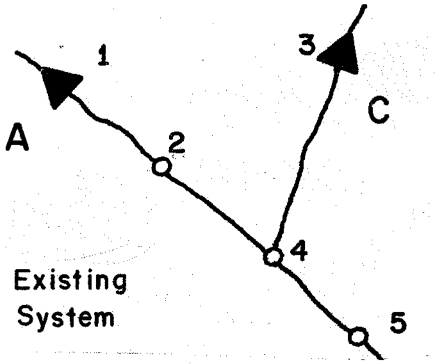
All necessary data to simulate the river system in its natural condition has been developed. These data are arranged according to the input format for HEC-5C. Input data and the simulation output are shown in the Appendix I, pages 2 through 15. Because of a requirement in the HEC-5 program that the control 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 nondamaging 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.

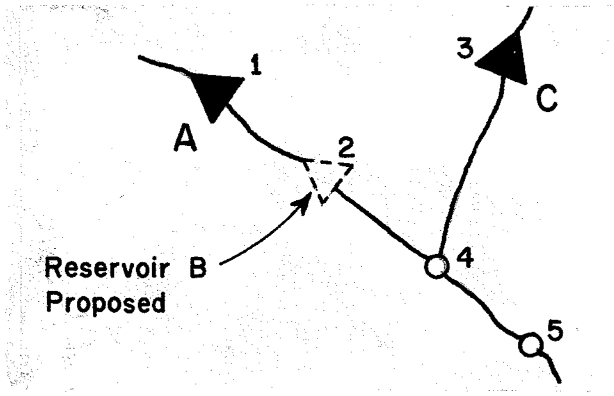


Adding two reservoirs to the natural system results in regulating the river flow below the reservoirs. Local inflow below the reservoirs, however, still remains uncontrolled. A 10% contingency allowance is made for forecasting streamflow two time periods in advance. These data are shown in fields 2 and 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 $696,820 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 (101,548 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.



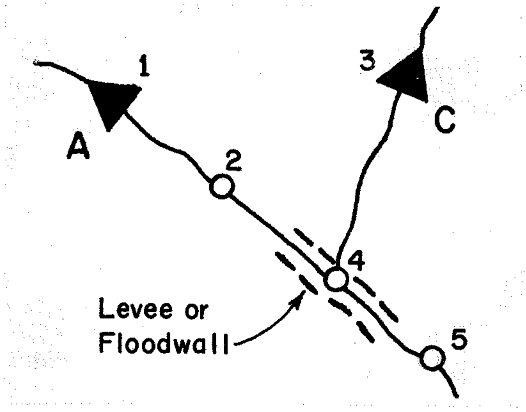
To simulate the system with Reservoir B added, it is necessary to input at control point 2 the reservoir information shown in Table 4. This is done by using the RL, RO, RS, and RQ cards. The ID card is modified to indicate that a reservoir exists at control point 2. Since any reduction in potential damages brought about by the reservoir must be computed as a reduction from damages anticipated under existing conditions, the damages remaining with the existing system - $696,820 - 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.

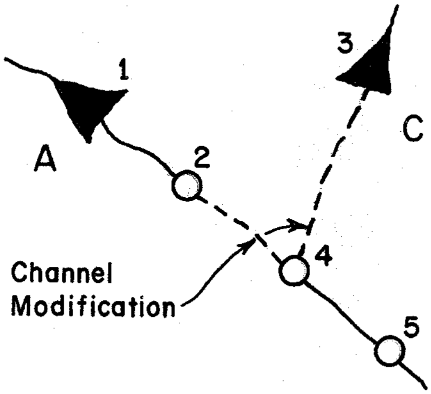


In the simulation model, increased channel capacity is taken into account by changing the maximum value specified on the CP card. The change to the stage-damage relationship may be handled in either of two ways. The first is to specify a design discharge on the C$ card corresponding to the maximum nondamaging 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 $255,820 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.

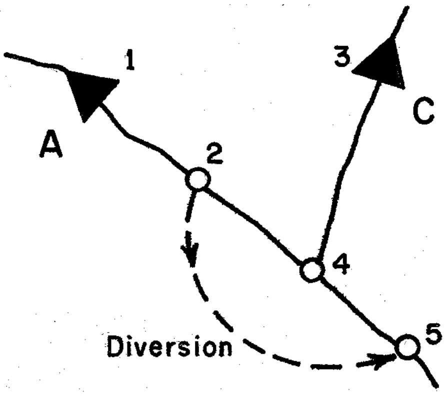


Increased channel capacity is input into the simulation model using the CP card. The change in the stage-discharge (Figure 9) relationship caused by an enlarged channel cross-section must be computed external to the model then combined with the stage-damage relationship (Figure 3) to produce modified discharge-damage data (Figure 10). These data for the modified relationship are then input using a second set of DC 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:

Control Point 2

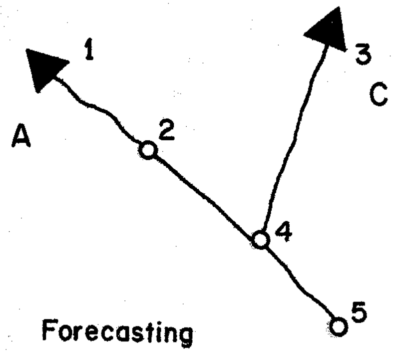
Streamflow	0	30,000	50,000	70,000	90,000	110,000	130,000	150,000	190,000
Diversion	0	0	22,000	37,500	45,000	51,000	55,000	58,500	62,500

These data were input using the QS and DQ 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 $278,870, and $417,950 in expected damages still remain (Appendix I, page 84). The maximum flow at control point 4 is 53,779 cfs during flood number 2 (Appendix I, page 79).

Flood Forecasting

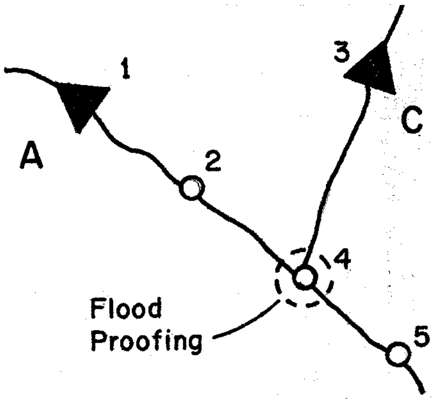
Flood forecasting is intended to provide advance information about rainfall and runoff conditions to assist in more efficient operation of a flood control system. Hopefully, this advance information will help to minimize flood damages. The usual means of forecasting is with a network of monitoring stations 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.

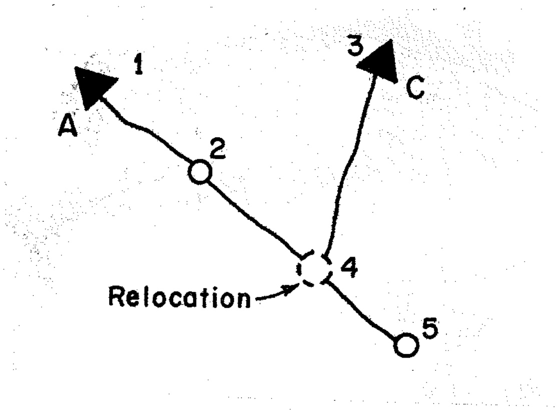


To account for flood proofing in the model it is only necessary to input the modified discharge-damage data (Figure 12). This can be done by using another set of DC cards. The first set is input to compute expected annual damages under natural conditions. Input changes are shown in Appendix I, page 100.

Output from the simulation shows an expected annual damage reduction of $233,140 with $463,680 remaining (Appendix I, page 112). The maximum flow at control point 4 with flood number 2 is 92,488 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.

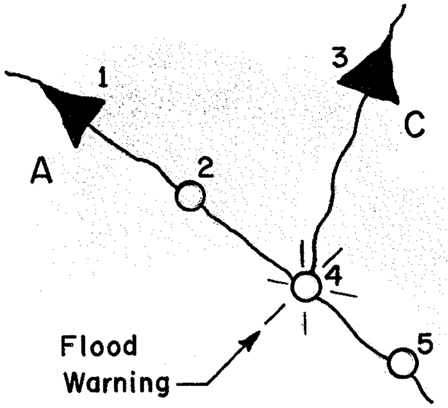


The change in stage-damage data is input into the model by modifying the discharge-damage function. This is accomplished by using a second set of DC cards to reduce damages at lower stages. Appendix I, page 100, shows the cards used. Note that the nondamaging flow is 180,000 cfs.

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 5% 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 taks.

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 - $482,270. 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

Exceedence Frequency	Stage (ft)	Discharge (cfs)	Damages
.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

		Storage (ac-ft)	
	Level	A	C
Top of Surcharge	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

Reservoir A		Reservoir C	
Storage (ac-ft)	Outlet Capacity (cfs)	Storage (ac-ft)	Outlet Capacity (cfs)
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

	Level	Storage (ac-ft)
Top of Surcharge	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

Storage (ac-ft)	Outlet Capacity (cfs)
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

Measure	Capital Cost	Percentage O&M Cost of Capital Cost	Annual Average O&M Cost	Total Average Annual Cost*
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

Measure	Annual Damage with Proposed Measure	Expected Annual Damage Reduction	Annual Cost*	Annual Net Benefit*	B/C
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

Measure	Nondamaging Flow at CP 4 (cfs)	Approximate Degree of Protection* (exceedance interval, years)	Risk of Nondamaging Frequency Flood Being Exceeded in Next 10 Years (percent chance)
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.

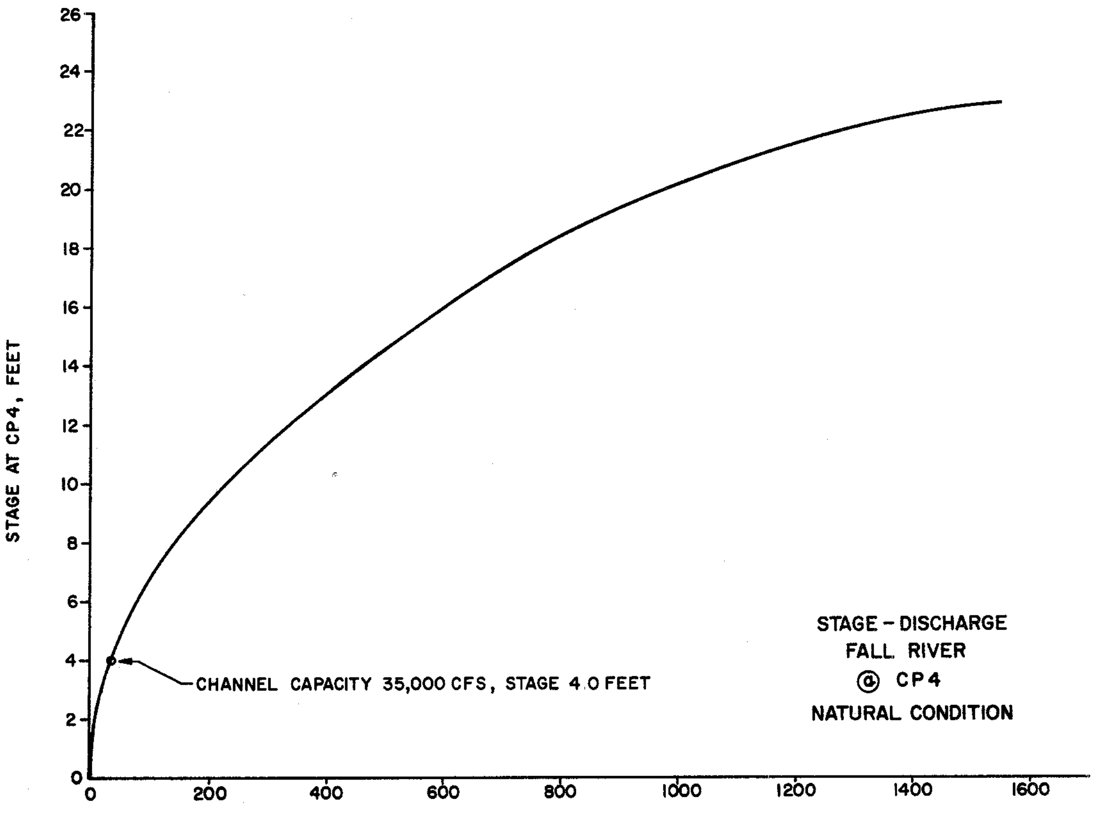


Figure 1

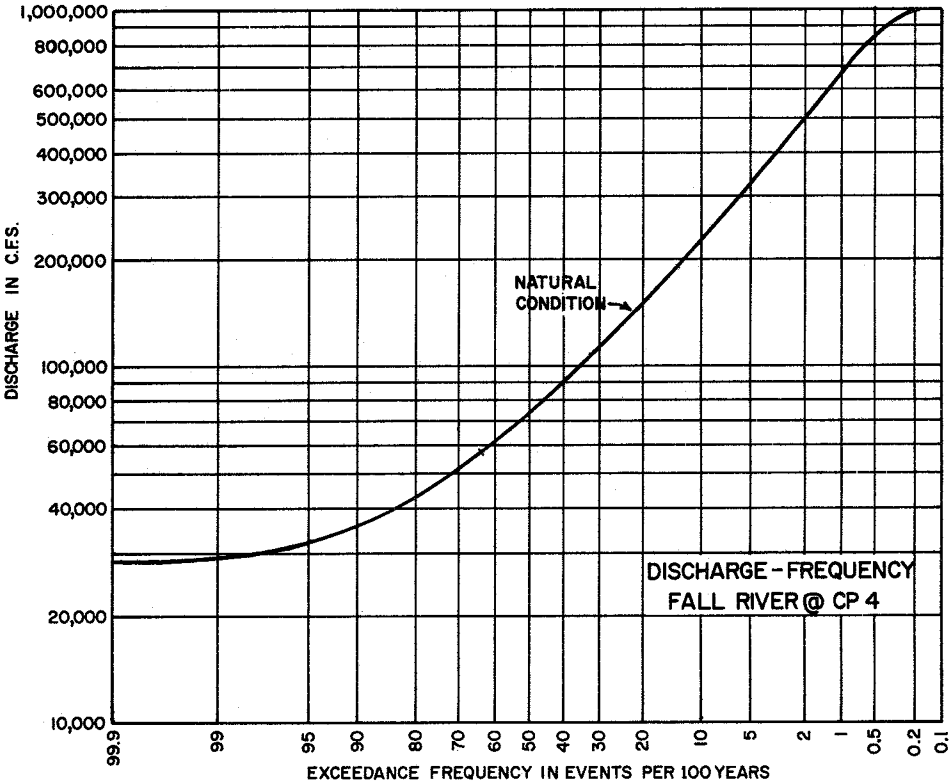


Figure 2

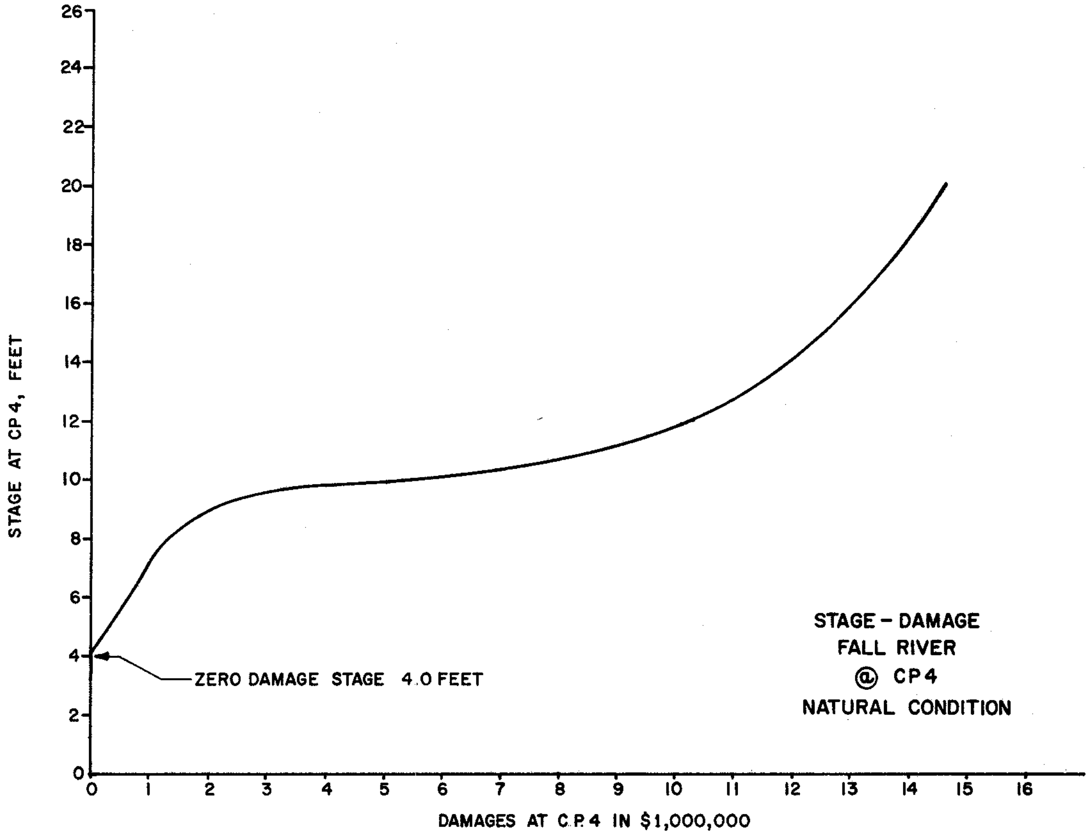


Figure 3

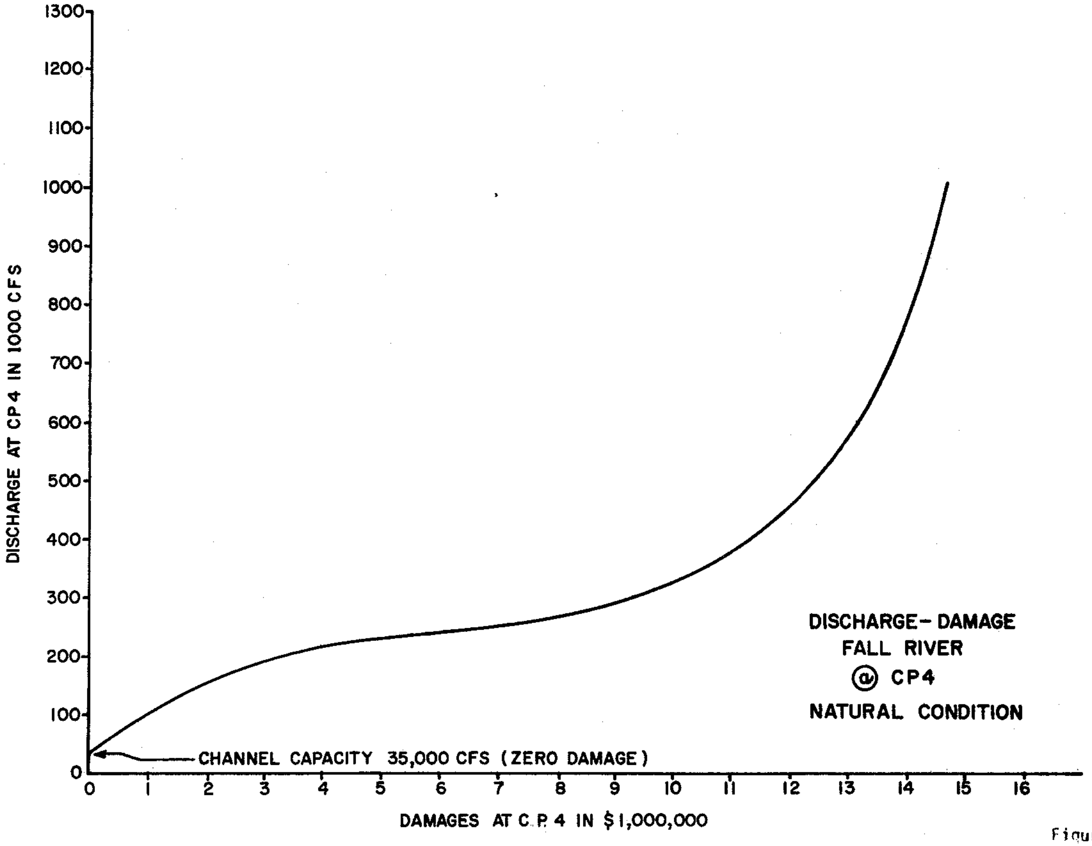


Figure 4

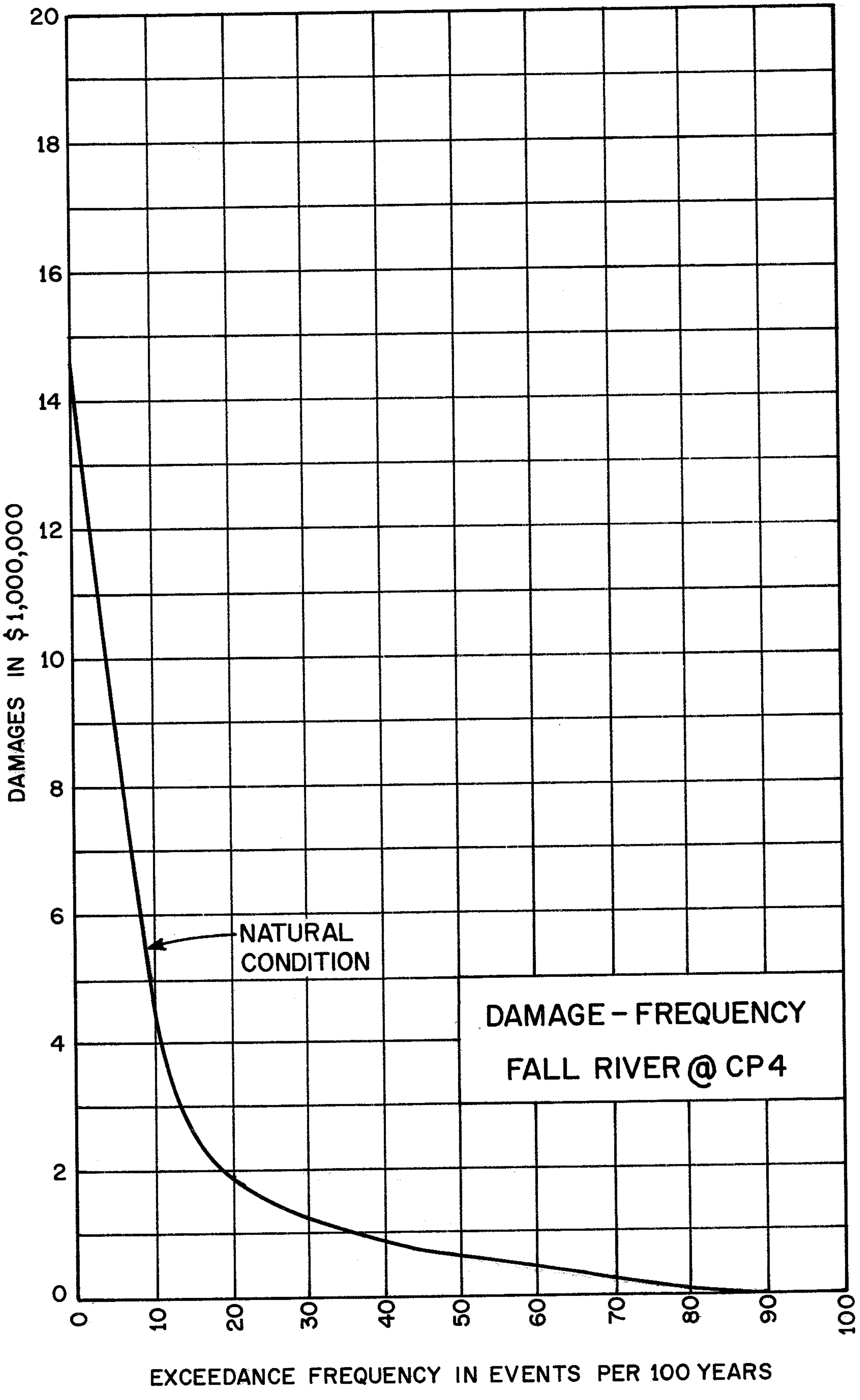

20
18
16
14
12
10
8
6
4
2
0
DAMAGES IN $1,000,000
NATURAL CONDITION
DAMAGE - FREQUENCY
FALL RIVER @ CP4
0
10
20
30
40
50
60
70
80
90
100
EXCEEDANCE FREQUENCY IN EVENTS PER 100 YEARS

Figure 5

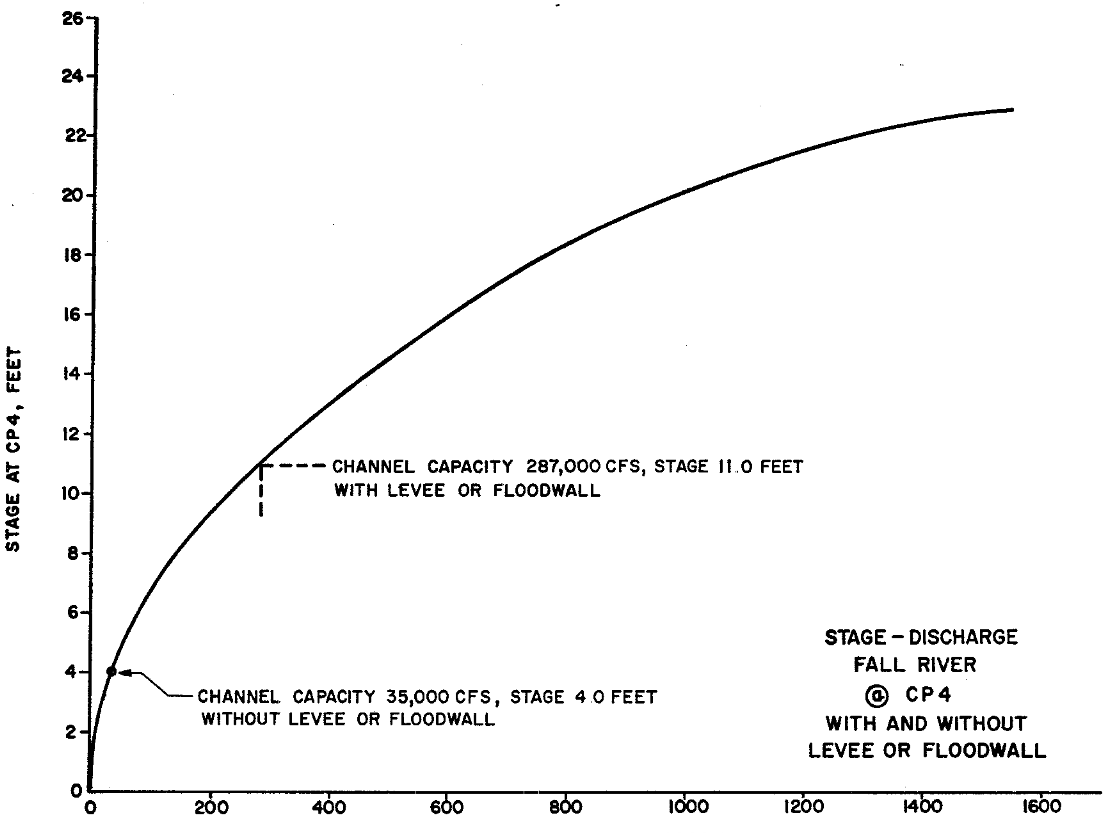


Figure 6

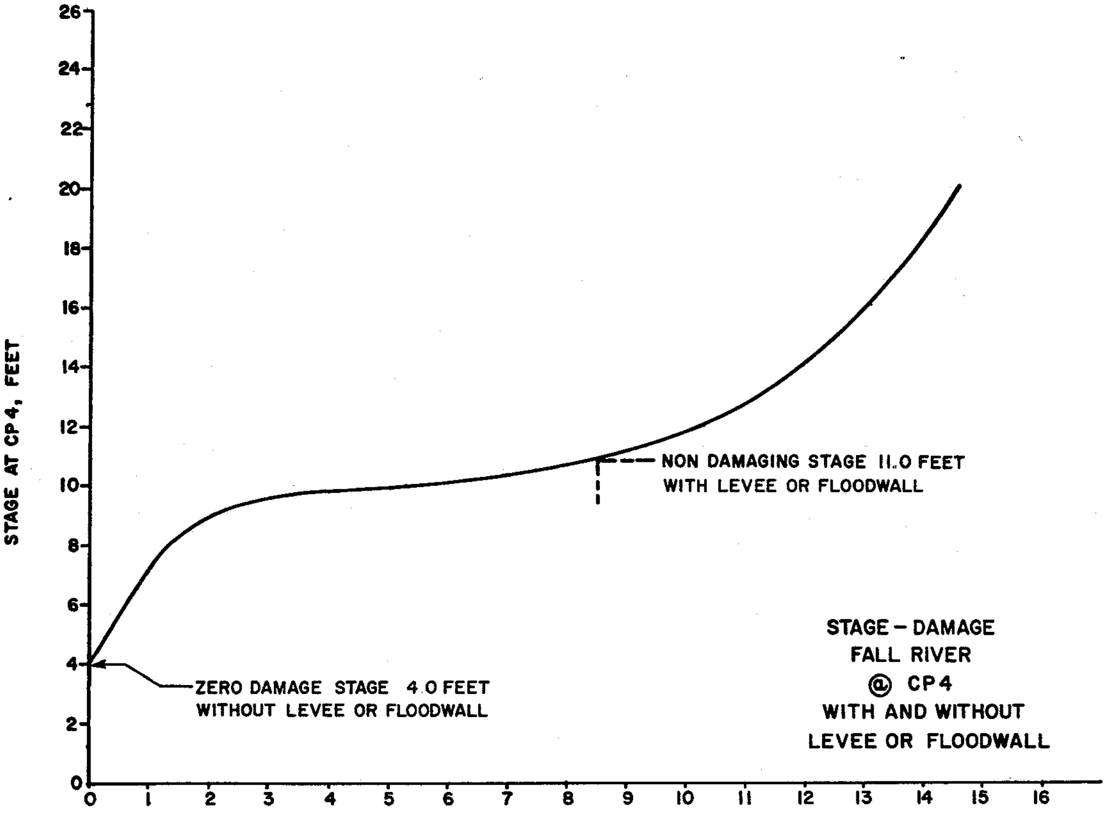


Figure 7

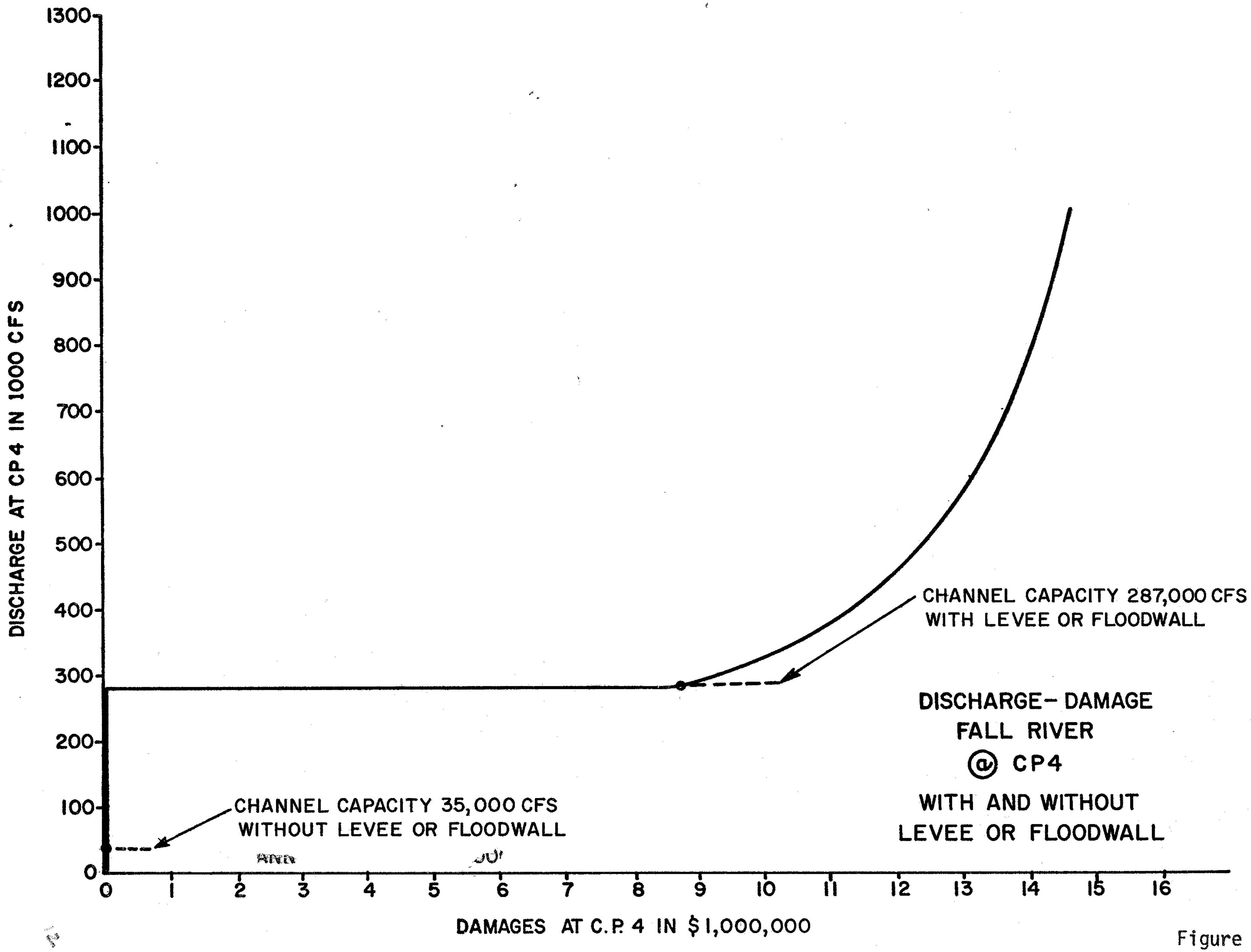

DISCHARGE AT CP 4 IN 1000 CFS
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
DAMAGES AT C.P. 4 IN $1,000,000
CHANNEL CAPACITY 287,000 CFS WITH LEVEE OR FLOODWALL
CHANNEL CAPACITY 35,000 CFS WITHOUT LEVEE OR FLOODWALL
DISCHARGE– DAMAGE
FALL RIVER
@ CP4
WITH AND WITHOUT
LEVEE OR FLOODWALL

Figure 8

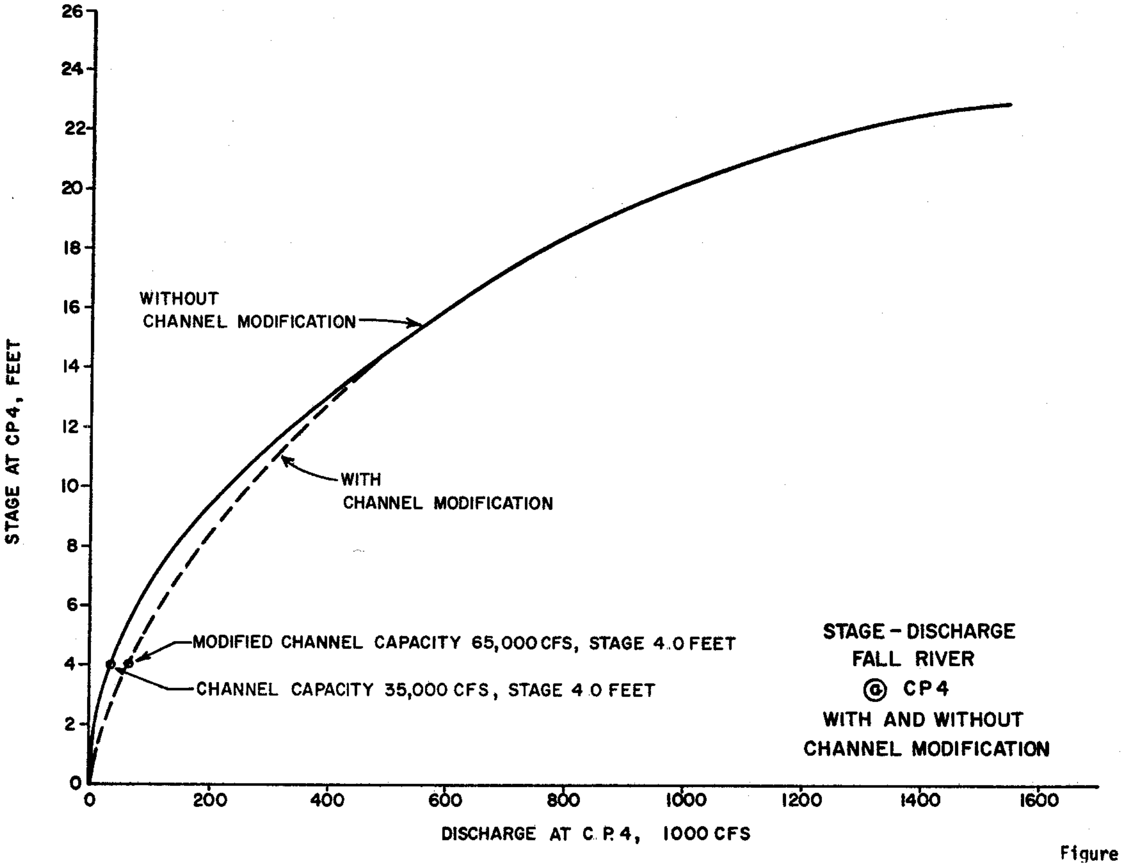


Figure 9

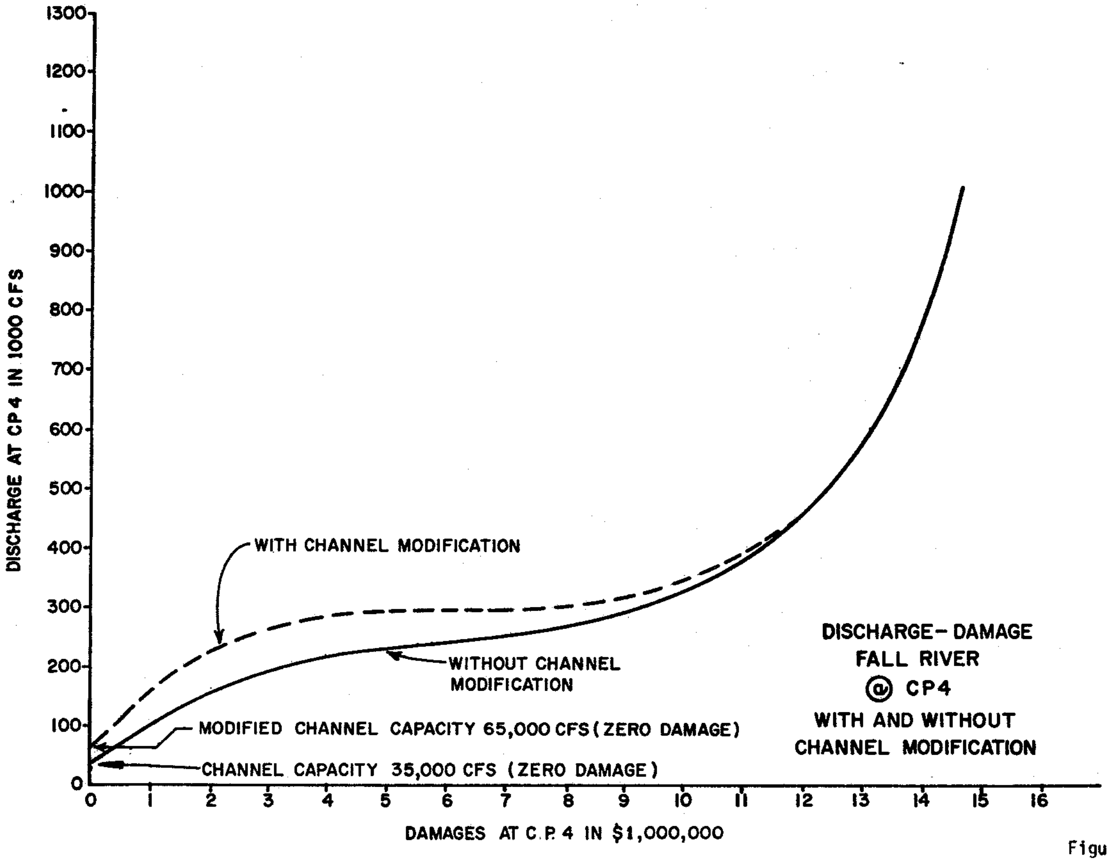


Figure 10

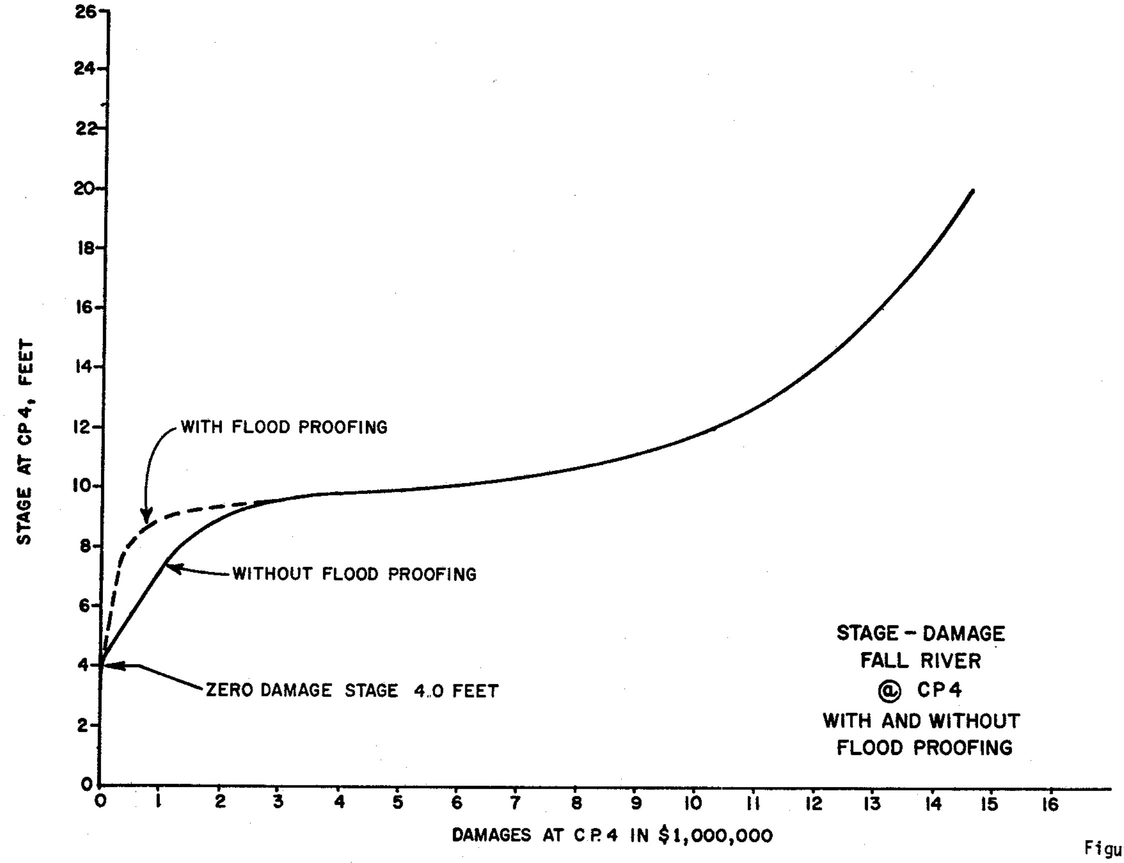


Figure 11

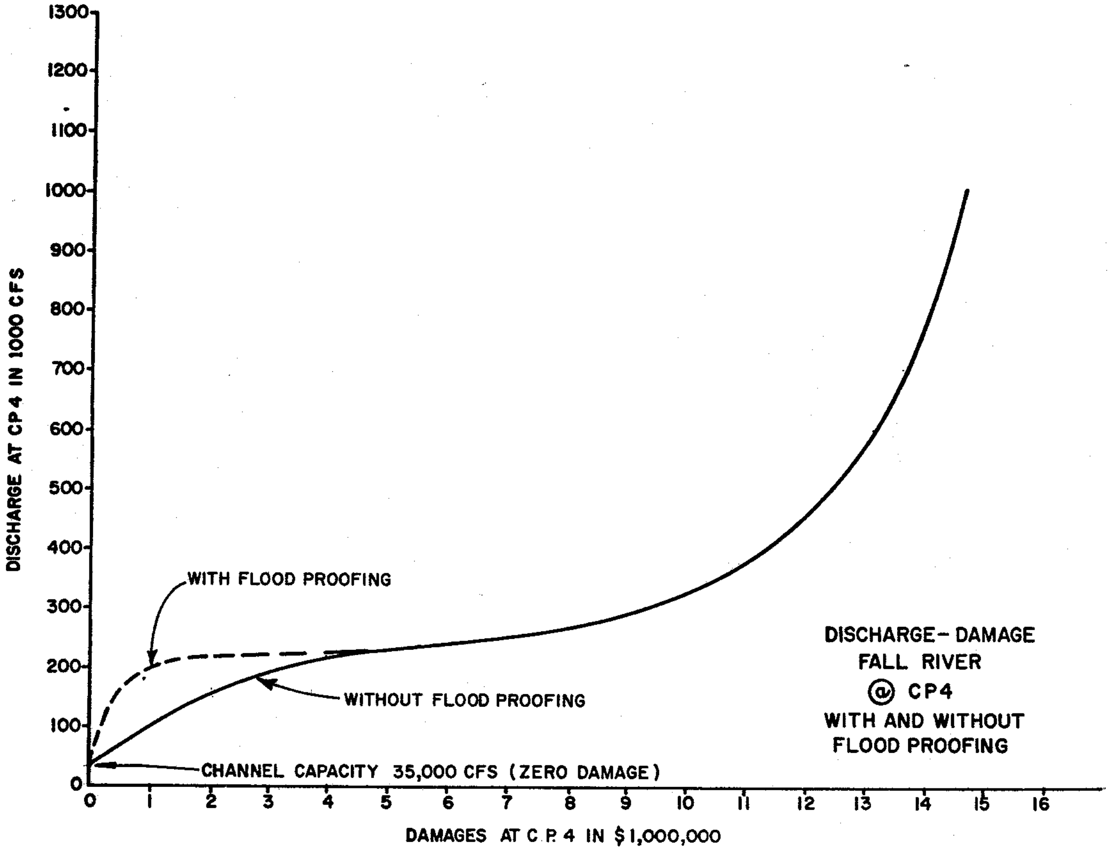


Figure 12

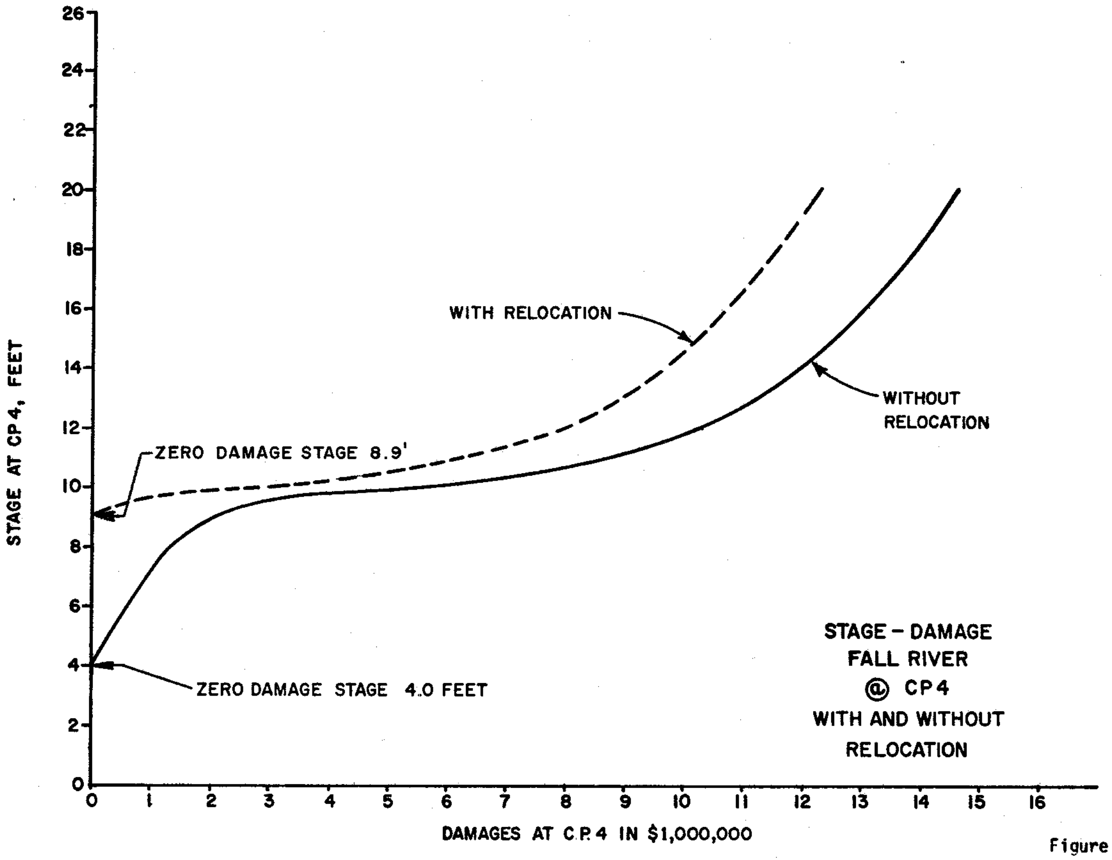


Figure 13

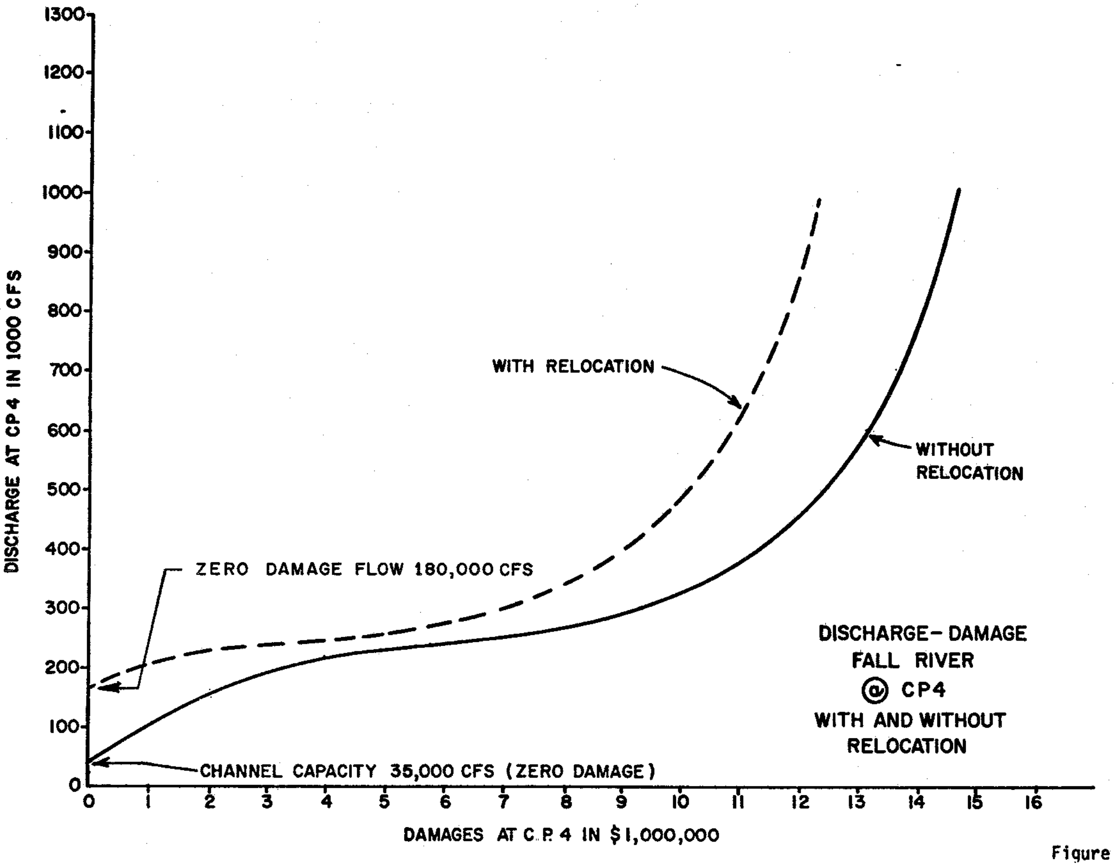


Figure 14

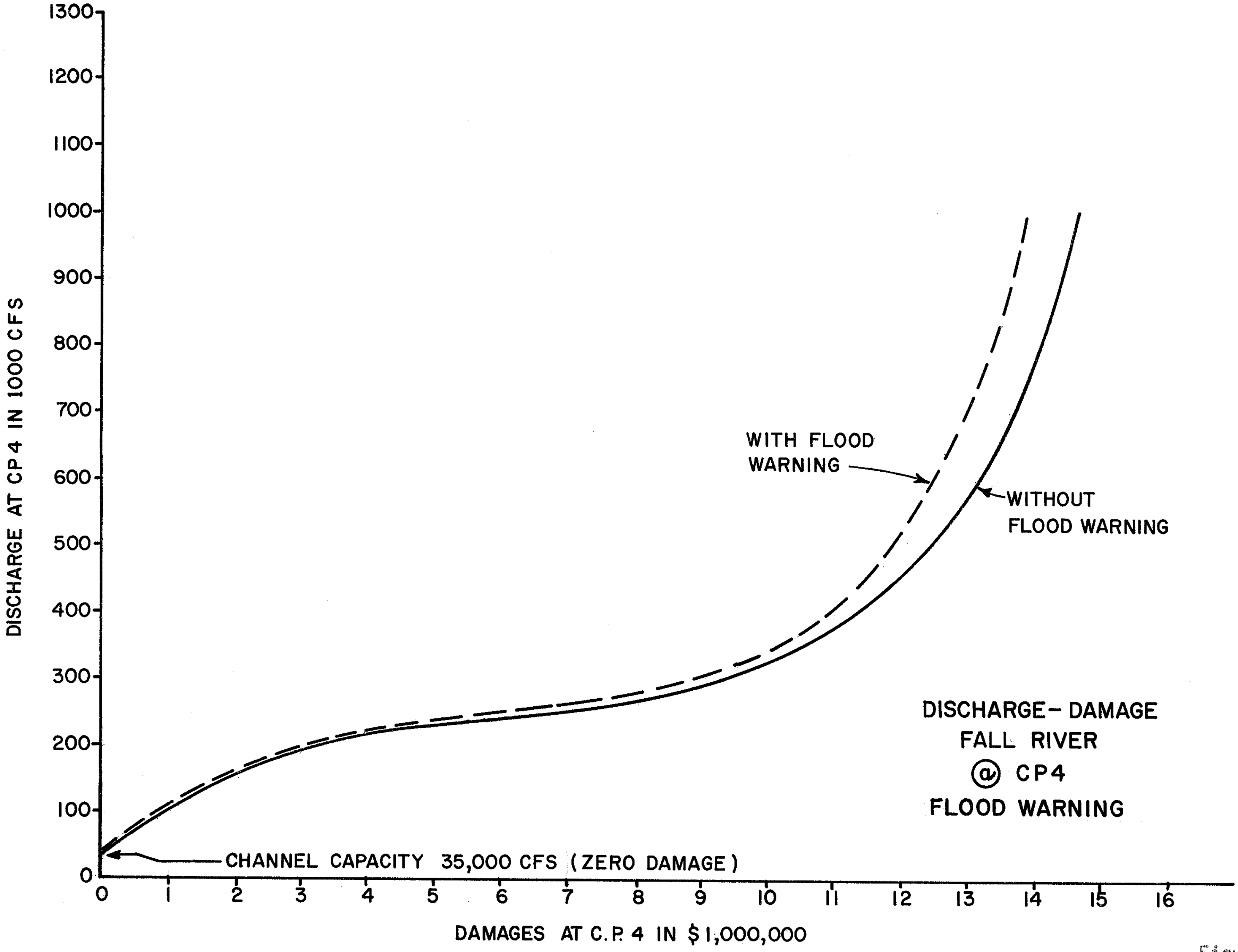

DISCHARGE AT CP4 IN 1000 CFS
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
DAMAGES AT C.P. 4 IN $1,000,000
WITH FLOOD WARNING
WITHOUT FLOOD WARNING
CHANNEL CAPACITY 35,000 CFS (ZERO DAMAGE)
DISCHARGE- DAMAGE
FALL RIVER
@ CP4
FLOOD WARNING

Figure 15

PART III

APPENDIX I

FALL RIVER BASIN

TRAINING DOCUMENT NO. 7

HEC-5C SELECTED OUTPUT

Contents

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

```
        HEC-5C-VARIABLE OUTPUT MAR.1975
        RES.= 35 CPTS.= 75 PERS.=100

     T1 FALL RIVER BASIN    ***   NATURAL (UNREGULATED) CONDITION    ***
     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       6.00       2.00       2.00       2.00      -0.00      -0.00       1.00      -0.00       1.00
     J2        -0.00      -0.00       2.00       1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
     J4         6.00        .30       1.00       1.50       2.00       3.00       4.00      -0.00      -0.00      -0.00
     J5         2.00       1.00       3.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
```

Dummy Reservoir

```
     RL         1.00  100000.00      -0.00   50000.00  100000.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RO         1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RS         2.00   50000.00  100000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RQ         2.00  200000.00  200000.00      -0.00      -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
     ID CP 1                                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT         1.00       2.00        .20        .30       6.00      -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
     ID CP 2                                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT         2.00       4.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00
```

Dummy Reservoir

```
     RL         3.00  100000.00      -0.00   50000.00  100000.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RO         1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0 00      -0.00      -0.00
     RS         2.00   50000.00  100000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RQ         2.00  200000.00  200000.00      -0.00      -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      -0.00
     ID CP 3                                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT         3.00       4.00        .20        .30       6.00      -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      -0.00
     ID CP 4                                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT         4.00       5.00        .20        .30       6.00      -0.00      -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      -0.00
     DF        17.00       1.00        .90        .80        .70        .60        .50        .40        .30        .25
     DF          .20        .15        .10        .05        .02        .01        .01        .00      -0.00      -0.00
     DQ        17.00   28800.00   35000.00   42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
     DQ    150000.00  180000.00  230000.00  323000.00  490000.00  640000.00  840000.00 1000000.00      -0.00      -0.00
     DC         1.00       0.00       0.00     180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
     DC      1930.00    2660.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00

     CP         5.00   37000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     ID CP 5                                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT         5.00       0.00       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      -0.00

          NRES=      2  NCPT=      5  NCPTR=     -0

     IN       1  6 JUNE   1000.0    2000.0    3000.0   18000.0   37000.0   42000.0   50000.0   27000.0   20000.0   13000.0
                          5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                        SUM=     231000
     IN       2  6 JUNE   2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                         37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
```

```
                                                                                                                       SUM=      517500
    IN     3  6 JUNE     3000.0      6000.0     27000.0     60000.0   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
                                                                                                                       SUM=      504000
    IN     4  6 JUNE     2000.0      4000.0     19000.0     13000.0    10000.0      7000.0      4000.0      1000.0     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      6000.0     5000.0      3000.0      2000.0       500.0      500.0     2000.0
                         5000.0     12000.0      6000.0      4000.0     2000.0      1000.0       500.0       200.0
                                                                                                                       SUM=       61700
    EJ    -0              -0.0        -0.0        -0.0        -0.0       -0.0        -0.0        -0.0        -0.0
```

Page 3
Natural Condition

Page 2
Natural Cond.

```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=        CUM LOCA    NATURAL     INFLOW      OUTFLOW     CASE=LOC    LEVEL       EOP STOR

    1         3850.00     3850.00     3850.00     3850.00        .03        2.00        0.00
    3         8400.00     8400.00     8400.00     8400.00        .03        2.00        0.00

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=        CUM LOCA    NATURAL     REGULATE    Q SPACE     Q BY US     FLOOD BY

    2        12474.98    12474.98    12474.98     8525.02       0.00        0.00
    4        23035.43    23035.43    23035.43    11964.57       0.00        0.00
    5        24083.97    24083.97    24083.97    12916.03       0.00        0.00


COMPUTATION INTERVAL IN HOURS=        6

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

                NFLRD=         1  NFLCON=        6
                IFLRD =        1  IFLCUN=        2
                   FLOWS MULTIPLIED BY      1.00

*****************************************************************************************************

**** LOC       1  CP 1                            SERVED BY       1

                                                                              STARTING TIME=        1
                                                                              HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                        SERVING        1
 PER        CUM LOCAL Q

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

                                                                              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

                                                                              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

                                                                              AVG=   12833,333   MAX=  50000,000
                                                                                                 MIN=   1000,000
```

```
PER       CASE=LOC,TYP

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

                                                                          AVG=     2.000  MAX=     2.000
                                                                                          MIN=     2.000
PER       EOP STORAGE

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

                                                                          AVG=     0.000  MAX=     0.000
                                                                                          MIN=     0.000
*********************************************************************************************************

**** LOC     2  CP 2                              SERVED BY    =1

PER       CUM LOCAL Q

  1   3000   4167   6028  11338  39056  91843 142140 134857  98809  70302
 11  49884  30147  28191  18032  11005   4168   3028   2505

                                                                          AVG=  41583.282  MAX= 142140.454
                                                                                           MIN=   2504.654
PER       NATURAL FLOW

  1   3000   4167   6028  11338  39056  91843 142140 134857  98809  70302
 11  49884  30147  28191  18032  11005   4168   3028   2505

                                                                          AVG=  41583.282  MAX= 142140.454
                                                                                           MIN=   2504.654
PER       REGULATED FLOW

  1   3000   4167   6028  11338  39056  91843 142140 134857  98809  70302
 11  49884  30147  28191  18032  11005   4168   3028   2505

                                                                          AVG=  41583.282  MAX= 142140.454
                                                                                           MIN=   2504.654
PER       Q SPACE AVAIL.

  1  18000  16833  14972   9662 =18056 =70843 =121140 =113857 =77809 =49302
 11 =28884  =9147  =7191   2968   9995  16832  17972  18495

                                                                          AVG= =20583.282  MAX=  18495.346
                                                                                           MIN==121140.454
PER       Q BY US RES,DIVS

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

                                                                          AVG=     0.000  MAX=     0.000
```

Natural Cond.
Page 5

Page 6
Natural Cond.

```
                                                                                                          MIN=      0,000
************************************************************************************************************************
**** LOC      3  CP 3                              SERVED BY      2

                                                                                         STARTING TIME=       1
                                                                                         HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                        SERVING       2
PER         CUM LOCAL Q

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

                                                                                         AVG=  28000,000  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     6000     3000     2000     1000

                                                                                         AVG=  28000,000  MAX= 105000,000
                                                                                                          MIN=   1000,000
PER         INFLOW

     1    3000      6000    27000     0000   105000    78000    60000    45000    33000    24000
    11   18000     12000    12000     9000     6000     3000     2000     1000

                                                                                         AVG=  28000,000  MAX= 105000,000
                                                                                                          MIN=   1000,000
PER         OUTFLOW

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

                                                                                         AVG=  28000,000  MAX= 105000,000
                                                                                                          MIN=   1000,000
PER         CASE=LOC,TYP

     1     ,03       ,03      ,03      ,03      ,03      ,03      ,03      ,03      ,03      ,03
    11     ,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

                                                                                         AVG=      2,000  MAX=      2,000
                                                                                                          MIN=      2,000
PER         EOP STORAGE

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

                                                                                         AVG=      0,000  MAX=      0,000
                                                                                                          MIN=      0,000
************************************************************************************************************************

**** LOC      4  CP 4                              SERVED BY     =1     =2

PER         CUM LOCAL Q

     1    8000     10694    32398    49141    87592   144277   173798   194036   175045   136597
    11  106281     93327    59185    45997    31355    19091     9465     5847
```

```
                                                                                                      AVG=  76784,776  MAX= 194036,091
                                                                                                                       MIN=   5846,858
 PER        NATURAL FLOW

   1    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
  11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                                      AVG=  76784,776  MAX= 194036,091
                                                                                                                       MIN=   5846,858
 PER        REGULATED FLOW

   1    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
  11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                                      AVG=  76784,776  MAX= 194036,091
                                                                                                                       MIN=   5846,858
 PER        Q SPACE AVAIL,

   1   27000   24306    2602  =14141  =52592 =109277 =138798 =159036 =140045 =101597
  11  =71281  =58327  =24185  =10997    3645   15909   25535   29153

                                                                                                      AVG= =41784,776  MAX=  29153,142
                                                                                                                       MIN==159036,091
 PER        Q BY US RES,DIVS

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

                                                                                                      A/G=      0,000  MAX=      0,000
                                                                                                                       MIN=      0,000
 *************************************************************************************************************************

 **** LOC      5  CP 5                        SERVED BY    =1    =2

 PER        CUM LOCAL Q

   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                                      AVG=  80279,898  MAX= 187631,160
                                                                                                                       MIN=   9000,000
 PER        NATURAL FLOW

   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                                      AVG=  80279,898  MAX= 187631,160
                                                                                                                       MIN=   9000,000
 PER        REGULATED FLOW

   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                                      AVG=  80279,898  MAX= 187631,160
                                                                                                                       MIN=   9000,000
 PER        Q SPACE AVAIL,

   1   28000   26551   14063   =1112  =20711  =57226 =105355 =135097 =150631 =135652
  11 =105220  =84279  =59295  =29172  =11252    4206   16896   26248
```

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Natural Condition

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```
                                                                                                      AVG= -43279.898  MAX=  28000.000
                                                                                                                       MIN=-150631.160
   PER        Q BY US RES,DIVS

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

                                                                                                      AVG=       0.000  MAX=       0.000
                                                                                                                        MIN=       0.000
   ***************************************************************************************************************************************

                    CUM TIME=      1

   RES NO=          1       3
   INFLOW        1000    3000
   OUTFLOW       1000    3000
   EOP STOR         0       0
   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
   EOP STOR         0       0
   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   27000
   EOP STOR         0       0
   CASE=          .03     .03
   LEVEL        2.000   2.000
   EQ LEVEL     2.000   2.000

                    CUM TIME=      4

   RES NO=          1       3
   INFLOW       18000   60000
   OUTFLOW      18000   60000
   EOP STOR         0       0
   CASE=          .03     .03
   LEVEL        2.000   2.000
   EQ LEVEL     2.000   2.000
```

```
                    FALL RIVER BASIN   ***   NATURAL (UNREGULATED) CONDITION    ***
                    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
                                  FLD.PER  MAX REG Q *     FLD.PER  MAX NAT Q *     FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                    1.007       42642 *      1.007       42642 *      1.007       42642 *         0 *   0.00     0.00
LOC     4  CP 4                    1.008       58211 *      1.008       58211 *      1.008       58211 *         0 *   0.00     0.00
LOC     5  CP 5                    1.009       56289 *      1.009       56289 *      1.009       56289 *         0 *   0.00     0.00
           RESERVOIRS             FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  CP 1                    1.018       0     2.000 *   1.001        0     2.000 *   1.007    15000      6000       0

LOC     3  CP 3                    1.018       0     2.000 *   1.001        0     2.000 *   1.005    31500     12000       0
                          MIN SYSTEM STG=      0   MAX SYSTEM STG=          0

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

                                                                                                STARTING TIME       1
                                                                                                      SHORTAGE  INDEX
                                  FLD.PER  MAX REG Q *     FLD.PER  MAX NAT Q *     FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                    2.007      142140 *      2.007      142140 *      2.007      142140 *         0 *   0.00     0.00
LOC     4  CP 4                    2.008      194036 *      2.008      194036 *      2.008      194036 *         0 *   0.00     0.00
LOC     5  CP 5                    2.009      187631 *      2.009      187631 *      2.009      187631 *         0 *   0.00     0.00
           RESERVOIRS             FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  CP 1                    2.018       0     2.000 *   2.001        0     2.000 *   2.007    50000      6000       0

LOC     3  CP 3                    2.018       0     2.000 *   2.001        0     2.000 *   2.005   105000     12000       0
                          MIN SYSTEM STG=      0   MAX SYSTEM STG=          0

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

                                                                                                STARTING TIME       1
                                                                                                      SHORTAGE  INDEX
                                  FLD.PER  MAX REG Q *     FLD.PER  MAX NAT Q *     FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                    3.007      213211 *      3.007      213211 *      3.007      213211 *         0 *   0.00     0.00
LOC     4  CP 4                    3.008      291054 *      3.008      291054 *      3.008      291054 *         0 *   0.00     0.00
LOC     5  CP 5                    3.009      281447 *      3.009      281447 *      3.009      281447 *         0 *   0.00     0.00
           RESERVOIRS             FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  CP 1                    3.018       0     2.000 *   3.001        0     2.000 *   3.007    75000      6000       0
```

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```
LOC      3  CP 3                 3,018       0    2,000 *   3,001          0     2,000 *   3,005   157500      12000         0
                        MIN SYSTEM STG=          0    MAX SYSTEM STG=          0

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

                                                                                                 STARTING TIME       1
                                                                                                           SHORTAGE INDEX
                                 FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *     FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 4,007      284281 *      4,007      284281 *       4,007      284281 *         0 *   0,00     0,00
LOC      4  CP 4                 4,008      388072 *      4,008      388072 *       4,008      388072 *         0 *   0,00     0,00
LOC      5  CP 5                 4,009      375262 *      4,009      375262 *       4,009      375262 *         0 *   0,00     0,00
           RESERVOIRS            FLD,PER   MIN STG MIN LEVEL * FLD,PER   MAX STG MAX LEVEL * FLD,PER   MAX REL   CHAN CAP    STOR1
LOC      1  CP 1                 4,018       0    2,000 *   4,001          0     2,000 *   4,007   100000       6000         0
LOC      3  CP 3                 4,018       0    2,000 *   4,001          0     2,000 *   4,005   210000      12000         0
                        MIN SYSTEM STG=          0    MAX SYSTEM STG=          0

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

                                                                                                 STARTING TIME       1
                                                                                                           SHORTAGE INDEX
                                 FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *     FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 5,007      426421 *      5,007      426421 *       5,007      426421 *         0 *   0,00     0,00
LOC      4  CP 4                 5,008      582108 *      5,008      582108 *       5,008      582108 *         0 *   0,00     0,00
LOC      5  CP 5                 5,009      562893 *      5,009      562893 *       5,009      562893 *         0 *   0,00     0,00
           RESERVOIRS            FLD,PER   MIN STG MIN LEVEL * FLD,PER   MAX STG MAX LEVEL * FLD,PER   MAX REL   CHAN CAP    STOR1
LOC      1  CP 1                 5,018       0    2,000 *   5,001          0     2,000 *   5,007   150000       6000         0
LOC      3  CP 3                 5,018       0    2,000 *   5,001          0     2,000 *   5,005   315000      12000         0
                        MIN SYSTEM STG=          0    MAX SYSTEM STG=          0

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

                                                                                                 STARTING TIME       1
                                                                                                           SHORTAGE INDEX
                                 FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *     FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 6,007      568562 *      6,007      568562 *       6,007      568562 *         0 *   0,00     0,00
LOC      4  CP 4                 6,008      776144 *      6,008      776144 *       6,008      776144 *         0 *   0,00     0,00
LOC      5  CP 5                 6,009      750525 *      6,009      750525 *       6,009      750525 *         0 *   0,00     0,00
           RESERVOIRS            FLD,PER   MIN STG MIN LEVEL * FLD,PER   MAX STG MAX LEVEL * FLD,PER   MAX REL   CHAN CAP    STOR1
LOC      1  CP 1                 6,018       0    2,000 *   6,001          0     2,000 *   6,007   200000       6000         0
LOC      3  CP 3                 6,018       0    2,000 *   6,001          0     2,000 *   6,005   420000      12000         0
                        MIN SYSTEM STG=          0    MAX SYSTEM STG=          0
```

```
                                        EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                           CONTROL POINT NUMBER     4

                                 BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
      FREQ      PEAK          SUM    TYPE 1     TYPE
     .9990     28800         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    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
               EXCD  PROB
 NO.   FLOW    FREQ   INT         SUM    TYPE 1     TYPE
   1    58211  .621  .623      233.27    233.27
   2   194036  .134  .279      549.81    549.81
   3   291054  .062  .050      360.93    360.93
   4   388072  .034  .025      265.87    265.87
   5   582108  .013  .014      173.38    173.38
   6   776144  .007  .010      138.03    138.03

     BASE COND DAMAGES    1721.30   1721.30


                                 MUDIFIED CONDITIONS FLOOD DAMAGES
               EXCD  PROB
 NO.   FLOW    FREQ   INT         SUM    TYPE 1     TYPE
   1    58211  .621  .623      233.27    233.27
   2   194036  .134  .279      549.81    549.81
   3   291054  .062  .050      360.93    360.93
   4   388072  .034  .025      265.87    265.87
   5   582108  .013  .014      173.38    173.38
   6   776144  .007  .010      138.03    138.03

      MODIFIED DAMAGES    1721.30   1721.30
      DAMAGE REDUCTION        .00       .00


                                 UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
               EXCD  PROB
 NO.   FLOW    FREQ   INT         SUM    TYPE 1     TYPE
   1    58211  .621  .623      233.27    233.27
   2   194036  .134  .279      549.81    549.81
   3   291054  .062  .050      360.93    360.93
   4   388072  .034  .025      265.87    265.87
```

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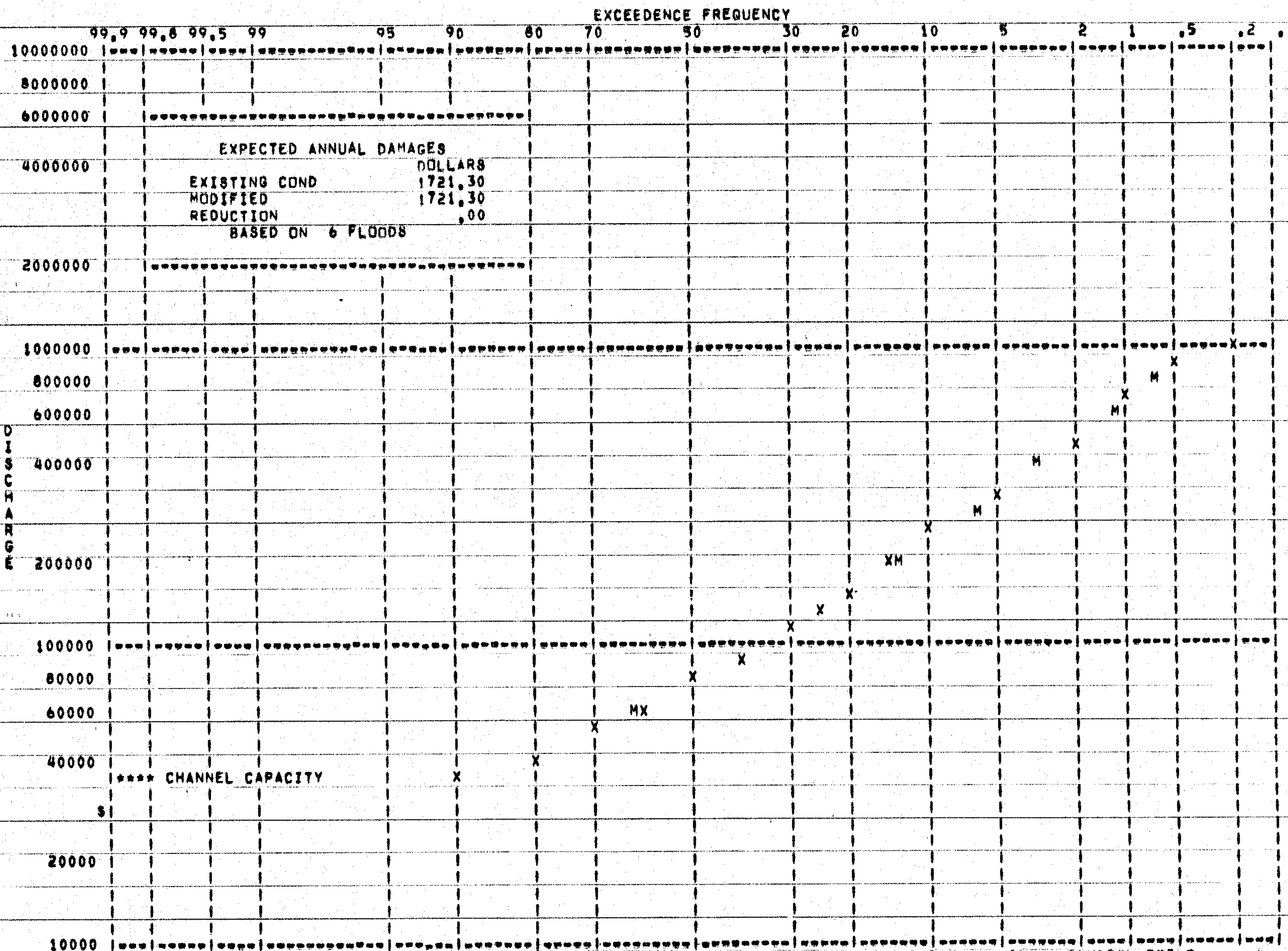
```
  5  582108 ,013  ,014     173,38     173,38
  6  776144 ,007  ,010     138,03     138,03
       DAMAGES W/ TOTAL
     CONTROL AT PROJECTS   1721,30    1721,30

      REDUCTION POSSIBLE
      W/ TOTAL CONTROL         ,00        ,00

         RESIDUAL DAMAGES     0,00       0,00
```

CONTROL POINT 4



```
      EXPECTED ANNUAL DAMAGES
                       DOLLARS
  EXISTING COND        1721.30
  MODIFIED             1721.30
  REDUCTION               .00
     BASED ON  6 FLOODS
```

O =BASE CONDITION PEAK   M =MODIFIED PEAK   X =INPUT FREQUENCY CURVE $ =BEYOND PLOT RANGE   CONTROL POINT 4

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```
                            SUMMARY OF SYSTEM!S EXPECTED ANNUAL FLOOD DAMAGES
********************************************************************************************************
*           *..................DAMAGES....................*.............DAMAGE REDUCTION...............*
*  CONTROL  * BASE (EXIST)     MODIFIED      UNCONTROL    *   MODIFIED    TOTAL CONTROL                *
*   POINT   *  CONDITION      CONDITIONS     LOCAL COND   * CONDITIONS    AT PROJECTS      RESIDUAL    *
*  -------  * -----------     -----------    -----------  * -----------    ----------     -----------  *
*        4  *      1721.30        1721.30        1721.30  *          .00            .00          0.00  *
*           *                                             *                                            *
*   TOTAL   *      1721.30        1721.30        1721.30  *          .00            .00          0.00  *
*           *                                             *                                            *
********************************************************************************************************
```

```
       HEC-5C-VARIABLE OUTPUT MAR.1975
       RES.= 35 CPTS.= 75 PERS.=100

    T1 FALL RIVER BASIN    ***   EXISTING SYSTEM (RESERVOIRS A AND C )    ***
    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       18.00       6.00       4.00       2.00       3.00      -0.00      -0.00       1.00      -0.00       1.00
    J2       -0.00       1.10       2.00       1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
    J4        6.00        .30       1.00       1.50       2.00       3.00       4.00      -C.00      -0.00      -0.00


    RL        1.00   50000.00      -0.00       0.00   50000.00  150832.00  200000.00      -0.00      -0.00      -0.00
    RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RS        6.00       0.00   50000.00   70000.00  100000.00  150832.00  200000.00      -0.00      -0.00      -0.00
    RQ        6.00    5000.00    6000.00    7000.00    8000.00  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
    ID RESERVOIR A (CP 1)                                -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RT        1.00       2.00        .20        .30       6.00      -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
    ID CP 2                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RT        2.00       4.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00


    RL        3.00  100000.00      -0.00       0.00  100000.00  755408.00 1000000.00      -0.00      -0.00      -0.00
    RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RS        7.00       0.00  100000.00  200000.00  400000.00  700000.00  800000.00 1000000.00      -0.00      -0.00
    RQ        7.00   10000.00   12000.00   18000.00   30000.00   80000.00  150000.00  500000.00      -0.00      -0.00

    CP        3.00   12000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    ID RESERVOIR C (CP 3)                                -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RT        3.00       4.00        .20        .30       6.00      -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      -0.00
    ID CP 4                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RT        4.00       5.00        .20        .30       6.00      -0.00      -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      -0.00
    DF       17.00       1.00        .90        .80        .70        .60        .50        .40        .30        .25
DISCHARGE DF   .20        .15        .10        .05        .02        .01        .01        .00      -0.00      -0.00
DAMAGE   {DQ 17.00   28800.00   35000.00   42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
FUNCTION {DQ 150000.00 180000.00 230000.00 323000.00 490000.00 640000.00  840000.00 1000000.00      -0.00      -0.00
EXISTING {DC  1.00       0.00       0.00     180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
SYSTEM   {DC 1930.00  2660.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00

    CP        5.00   37000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    ID CP 5                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
    RT        5.00       0.00       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      -0.00

        NRES=     2  NCPT=     5  NCPTR=    -0
                                                                                                  Existing System
    IN      1  6 JUNE    1000.0    2000.0    3000.0   18000.0   37000.0   42000.0   50000.0   27000.0   20000.0   13000.0   Page 16
                         5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                          SUM=     231000
    IN      2  6 JUNE    2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                        37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                          SUM=     517500
    IN      3  6 JUNE    3000.0    6000.0   27000.0   60000.0  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
                                                                                                          SUM=     504000
```

```
IN     4  6 JUNE    2000,0    [illegible]00,0   19000,0   13000,0   10000,0    7000,0    4000,0    1000,0    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    6000,0    5000,0    3000,0    2000,0     500,0     500,0    2000,0
                    5000,0   12000,0    6000,0    4000,0    2000,0    1000,0     500,0     200,0
                                                                                                              SUM=      61700
EJ    =0            =0,0      =0,0      =0,0      =0,0      =0,0      =0,0      =0,0      =0,0
```

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Existing Syst.

```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=       CUM LOCA    NATURAL     INFLOW     OUTFLOW    CASE=LOC    LEVEL       EOP STOR

   1        3850.00     3850.00    3850.00     3850.00       .90        2.07    57494.67
   3        8400.00     8400.00    8400.00     7450.62      1.12        2.03   122385.98

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=       CUM LOCA    NATURAL    REGULATE    Q SPACE     Q BY US    FLOOD BY

   2        8625.00    12474.98    12328.87    8671.13    3703.87     476.19
   4       10755.92    23035.43    21005.66   13994.34   10249.74       0.00
   5       11795.97    24083.97    21119.00   15881.00    9323.04       0.00


COMPUTATION INTERVAL IN HOURS=        6

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

                 NFLRD=        1  NFLCON=        6
                 IFLRD =       1  IFLCON=        2
                     FLOWS MULTIPLIED BY     1.00

*****************************************************************************************************************

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

                                                                                         STARTING TIME=       1
                                                                                         HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
                                     SERVING        1      4
 PER        CUM LOCAL Q

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

                                                                                         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

                                                                                         AVG=  12833.333  MAX=  50000.000
                                                                                                          MIN=   1000.000
 PER        OUTFLOW

   1    1000      2000      3000         0         0         0         0         0         0      3658
  11    5000      4000      3000      2000      6000      6000      6000      6000

                                                                                         AVG=   2647.691  MAX=   6000.000
                                                                                                          MIN=      0.000
 PER        CASE=LOC.TYP

   1     .03       .03       .03      4.02      4.01      4.00      4.00      4.00      4.00       .04
```

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```
  11     .04     .04     .04     .04     .01     .01     .01     .01
                                                                                           AVG=      1.353  MAX=      4.020
                                                                                                            MIN=       .010
 PER        LEVEL

   1   2.000   2.000   2.000   2.089   2.270   2.477   2.723   2.856   2.954   3.000
  11   3.000   3.000   3.000   3.000   2.975   2.951   2.926   2.902
                                                                                           AVG=      2.673  MAX=      3.000
                                                                                                            MIN=      2.000
 PER        EOP STORAGE

   1   50000   50000   50000   58926   77273   98100  122894  136282  146200  150832
  11  150832  150832  150832  150832  148353  145873  143394  140914
                                                                                           AVG= 117909.368  MAX= 150832.000
                                                                                                            MIN=  50000.000
*********************************************************************************************************************
**** LOC     2  CP 2                           SERVED BY     -1

 PER        CUM LOCAL Q

   1    2000    3000    4000    6000   20000   57000  100000   90000   70000   50000
  11   37000   24000   24000   15000    9000    3000    2000    1500
                                                                                           AVG=  28750.000  MAX= 100000.000
                                                                                                            MIN=   1500.000
 PER        NATURAL FLOW

   1    3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
  11   49884   30147   28191   18032   11005    4168    3028    2505
                                                                                           AVG=  41583.282  MAX= 142140.454
                                                                                                            MIN=   2504.654
 PER        REGULATED FLOW

   1    3000    4167    6028    8338   20390   57065  100011   90002   70000   50610
  11   40374   28562   27927   17988   11831    8472    7912    7485
                                                                                           AVG=  31120.076  MAX= 100010.824
                                                                                                            MIN=   3000.000
 PER        Q SPACE AVAIL.

   1   18000   16833   14972   12662     610  -36065  -79011  -69002  -49000  -29610
  11  -19374   -7562   -6927    3012    9169   12528   13088   13515
                                                                                           AVG= -10120.076  MAX=  18000.000
                                                                                                            MIN= -79010.824
 PER        Q BY US RES,DIVS

   1    1000    1167    2028    2338     390      65      11       2       0     610
  11    3374    4562    3927    2988    2831    5472    5912    5985
                                                                                           AVG=   2370.076  MAX=   5985.330
                                                                                                            MIN=       .301
 PER        FLOOD BY RES

   1       0       0       0       0       0      65      11       2       0     610
  11    3374    4562    3927       0       0       0       0       0
                                                                                           AVG=    697.275  MAX=   4562.320
                                                                                                            MIN=      0.000
*********************************************************************************************************************
```

```
**** LOC     3  RESERVOIR C (CP 3)                SERVED BY     2
                                                                                                STARTING TIME=       1
                                                                                                HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                          SERVING      2     4
 PER        CUM LOCAL Q

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

                                                                                                AVG=  28000,000  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    6000    3000    2000    1000

                                                                                                AVG=  28000,000  MAX= 105000,000
                                                                                                                 MIN=   1000,000
 PER        INFLOW

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

                                                                                                AVG=  28000,000  MAX= 105000,000
                                                                                                                 MIN=   1000,000
 PER        OUTFLOW

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

                                                                                                AVG=   3833,333  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     ,01     ,01     ,01     ,01

                                                                                                AVG=      2,452  MAX=      4,020
                                                                                                                 MIN=       ,010
 PER        LEVEL

     1   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=      2,356
                                                                                                                 MIN=      2,000
 PER        EOP STORAGE

     1  100000  100000  107438  137191  189257  227936  257688  280003  296366  308267
    11  317193  323144  329094  333557  330582  326119  321160  315706

                                                                                                AVG= 255594,556  MAX= 333557,125
                                                                                                                 MIN= 100000,000
****************************************************************************************************************
**** LOC     4  CP 4                              SERVED BY     1     2

 PER        CUM LOCAL Q

     1    4000    6167   22028   17171   18029   31171   62695   92449   87908   73485
    11   61081   62180   39197   29866   19311   11052    4842    2724

                                                                                                AVG=  35853,070  MAX=  92449,206
                                                                                                                 MIN=   2723,662
 PER        NATURAL FLOW
```

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```
    1     8000    10694    32398    4'141    87592   144277   173798   194036   175045   136597
   11   106281    93327    59185    45997    31355    19091     9465     5847
                                                                                                   AVG=  76784,776  MAX= 194036,091
                                                                                                                    MIN=   5846,858
   PER         REGULATED FLOW

    1     8000    10694    29898    28225    21494    32020    62882    92488    87916    73588
   11    62067    65354    43422    33686    24411    24701    21750    20481
                                                                                                   AVG=  41282,055  MAX=  92487,801
   PER         Q SPACE AVAIL,                                                                                       MIN=   8000,000

    1    27000    24306     5102     6775    13506     2980   -27882   -57488   -52916   -38588
   11   -27067   -30354    -8422     1314    10589    10299    13250    14519
                                                                                                   AVG=  -6282,055  MAX=  27000,000
   PER         Q BY US RES,DIVS                                                                                     MIN= -57487,801

    1     4000     4528     7870    11053     3466      848      186       39        8      103
   11      986     3174     4225     3820     5100    13650    16908    17757
                                                                                                   AVG=   5428,984  MAX=  17756,907
   PER         FLOOD BY RES                                                                                         MIN=      7,685

    1        0        0        0        0        0        0      186       39        8      103
   11      986     3174     4225        0        0        0        0        0
                                                                                                   AVG=    484,498  MAX=   4225,056
                                                                                                                    MIN=      0,000
*****************************************************************************************************************************
**** LOC      5  CP 5                               SERVED BY     -1     -2
   PER         CUM LOCAL Q

    1     5000     6361    17509    24965    22613    23150    36588    63470    87279    87316
   11    78389    75315    64539    44865    31940    20706    11959     5792
                                                                                                   AVG=  39319,888  MAX=  87316,106
   PER         NATURAL FLOW                                                                                         MIN=   5000,000

    1     9000    10449    22937    38112    57711    94226   142355   172097   187631   172652
   11   142220   121279    96295    66172    48252    32794    20104    10752
                                                                                                   AVG=  80279,898  MAX= 187631,160
   PER         REGULATED FLOW                                                                                       MIN=   9000,000

    1     9000    10449    22521    32890    31880    27146    37851    63811    87363    87352
   11    78628    76542    67563    48823    35997    27057    24936    22186
                                                                                                   AVG=  43999,739  MAX=  87363,008
   PER         Q SPACE AVAIL,                                                                                       MIN=   9000,000

    1    28000    26551    14479     4110     5120     9854     -851   -26811   -50363   -50352
   11   -41628   -39542   -30563   -11823     1003     9943    12064    14814
                                                                                                   AVG=  -6999,739  MAX=  28000,000
                                                                                                                    MIN= -50363,008
```

```
PER       Q BY US RES,DIVS

   1    4000    4088    5012    7924    9267    3996    1263     341      84      36
  11     239    1226    3025    3957    4056    6351   12976   16394

                                                                          AVG=   4679,852  MAX=  16394,328
                                                                                           MIN=     36,288
PER       FLOOD BY RES

   1       0       0       0       0       0       0     851     341      84      36
  11     239    1226    3025    3957       0       0       0       0

                                                                          AVG=    542,212  MAX=   3957,493
                                                                                           MIN=      0,000
*****************************************************************************************************************

                CUM TIME=      1

RES NO=          1        3
INFLOW        1000     3000
OUTFLOW       1000     3000
EOP 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
EOP 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
EOP 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
EOP STOR     58926   137191
CASE=         4,02     4,02
LEVEL        2,089    2,057
EQ LEVEL     2,089    2,057

                CUM TIME=      5
```

Existing System
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```
FALL RIVER BASIN   ***   EXISTING SYSTEM (RESERVOIRS A AND C )   ***
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
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC    2  CP 2              1.007      34777 *      1.007      42642 *      1.007      30000 *    4777 *   0.00     0.00
LOC    4  CP 4              1.012      33134 *      1.008      58211 *      1.008      27735 *    5400 *   0.00     0.00
LOC    5  CP 5              1.012      33586 *      1.009      56289 *      1.010      26195 *    7391 *   0.00     0.00

          RESERVOIRS        FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)  .  1.018    50000    2.000 *  1.008    67393    2.173 *  1.005     6000      6000   50000

LOC    3  RESERVOIR C (CP 3)     1.003   100000    2.000 *  1.010   140755    2.062 *  1.004    12000     12000  100000

                 MIN SYSTEM STG=    150000    MAX SYSTEM STG=    208148

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

                                                                                  STARTING TIME       1
                                                                                               SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC    2  CP 2              2.007     100011 *      2.007     142140 *      2.007     100000 *      11 *   0.00     0.00
LOC    4  CP 4              2.008      92488 *      2.008     194036 *      2.008      92449 *  .   39 *   0.00     0.00
LOC    5  CP 5              2.009      87363 *      2.009     187631 *      2.010      87316 *      47 *   0.00     0.00

          RESERVOIRS        FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)     2.003    50000    2.000 *  2.011   150832    3.000 *  2.015     6000      6000   50000

LOC    3  RESERVOIR C (CP 3)     2.002   100000    2.000 *  2.014   333557    2.356 *  2.003    12000     12000  100000

                 MIN SYSTEM STG=    150000    MAX SYSTEM STG=    484389

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

                                                                                  STARTING TIME       1
                                                                                               SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC    2  CP 2              3.007     157221 *      3.007     213211 *      3.007     150000 *    7221 *   0.00     0.00
LOC    4  CP 4              3.009     150695 *      3.008     291054 *      3.008     138674 *   12022 *   0.00     0.00
LOC    5  CP 5              3.010     150348 *      3.009     281447 *      3.010     130974 *   19374 *   0.00     0.00

          RESERVOIRS        FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)     3.001    50744    2.007 *  3.007   150832    3.000 *  3.008    40499      6000   50000

LOC    3  RESERVOIR C (CP 3)     3.001   102231    2.003 *  3.015   470418    2.565 *  3.016    12000     12000  100000
```

```
                         MIN SYSTEM STG=     152974     MAX SYSTEM STG=     621250

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

                                                                                             STARTING TIME       1
                                                                                                        SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC     2  CP 2                 4.008     252767 *      4.007     284281 *      4.007     200000 *    52767 *  0.00     0.00
LOC     4  CP 4                 4.009     237896 *      4.008     388072 *      4.008     184898 *    52998 *  0.00     0.00
LOC     5  CP 5                 4.010     229892 *      4.009     375262 *      4.010     174632 *    55259 *  0.00     0.00

           RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)     4.001    50992     2.010 *   4.007   150832     3.000 *   4.007    90650      6000   50000

LOC     3  RESERVOIR C (CP 3)     4.001   102975     2.005 *   4.015   593891     2.754 *   4.016    12000     12000  100000

                         MIN SYSTEM STG=     153966     MAX SYSTEM STG=     744723

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

                                                                                             STARTING TIME       1
                                                                                                        SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC     2  CP 2                 5.008     383382 *      5.007     426421 *      5.007     300000 *    83382 *  0.00     0.00
LOC     4  CP 4                 5.009     372066 *      5.008     582108 *      5.008     277348 *    94718 *  0.00     0.00
LOC     5  CP 5                 5.010     365070 *      5.009     562893 *      5.010     261948 *   103121 *  0.00     0.00

           RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)     5.001    51488     2.015 *   5.007   168236     3.354 *   5.007   120542      6000   50000

LOC     3  RESERVOIR C (CP 3)     5.001   104463     2.007 *   5.011   755408     3.000 *   5.012    35999     12000  100000

                         MIN SYSTEM STG=     155949     MAX SYSTEM STG=     923644

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

                                                                                             STARTING TIME       1
                                                                                                        SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES      REQ
LOC     2  CP 2                 6.007     516031 *      6.007     568562 *      6.007     400000 *   116031 *  0.00     0.00
LOC     4  CP 4                 6.009     612533 *      6.008     776144 *      6.008     369797 *   242736 *  0.00     0.00
LOC     5  CP 5                 6.010     594538 *      6.009     750525 *      6.010     349264 *   245274 *  0.00     0.00

           RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)     6.001    51983     2.020 *   6.007   191183     3.821 *   6.007   163829      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 STG=     157933     MAX SYSTEM STG=     972456
```

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```
                                   EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                      CONTROL POINT NUMBER    4

                             BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ      PEAK           SUM    TYPE 1    TYPE
    .9990     28800          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    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
              EXCD  PROB
NO.  FLOW    FREQ   INT         SUM    TYPE 1    TYPE
 1    58211  .621  .623      233.27    233.27
 2   194036  .134  .279      549.81    549.81
 3   291054  .062  .050      360.93    360.93
 4   388072  .034  .025      265.87    265.87
 5   582108  .013  .014      173.38    173.38
 6   776144  .007  .010      138.03    138.03

     BASE COND DAMAGES      1721.30   1721.30

                             MODIFIED CONDITIONS FLOOD DAMAGES
              EXCD  PROB
NO.  FLOW    FREQ   INT         SUM    TYPE 1    TYPE
 1    33134  .621  .623       33.98     33.98
 2    92488  .134  .279      177.15    177.15
 3   150695  .062  .050       88.69     88.69
 4   237896  .034  .025      127.59    127.59
 5   372066  .013  .014      137.08    137.08
 6   612533  .007  .010      132.33    132.33

      MODIFIED DAMAGES       696.82    696.82
      DAMAGE REDUCTION      1024.47   1024.47

                             UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
              EXCD  PROB
NO.  FLOW    FREQ   INT         SUM    TYPE 1    TYPE
 1    27735  .621  .623       14.43     14.43
 2    92449  .134  .279      166.49    166.49
 3   138674  .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      108.25    108.25
      DAMAGES W/ TOTAL
```

```
   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

CONTROL POINT 4

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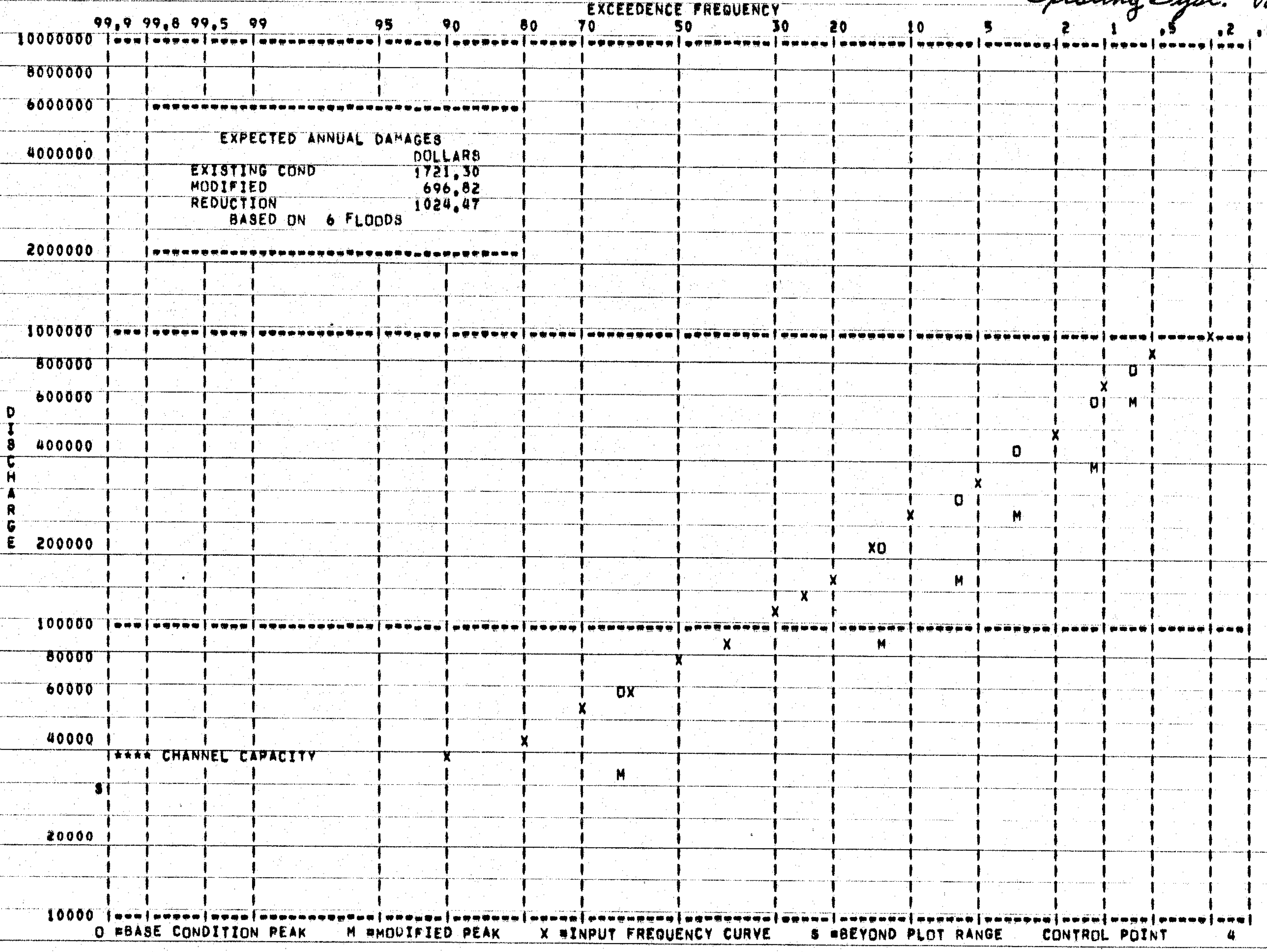

```
EXPECTED ANNUAL DAMAGES
                    DOLLARS
EXISTING COND       1721.30
MODIFIED             696.82
REDUCTION           1024.47
   BASED ON  6 FLOODS
```

```
                              SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
*************************************************************************************************
*            *.................DAMAGES...........................*.............DAMAGE REDUCTION.............*
*  CONTROL   * BASE (EXIST)   MODIFIED      UNCONTROL    *   MODIFIED     TOTAL CONTROL              *
*   POINT    *  CONDITION    CONDITIONS    LOCAL COND    *  CONDITIONS    AT PROJECTS     RESIDUAL   *
*  -------   *  ----------   ----------    ----------    *  ----------    ----------     ----------  *
*        4   *     1721.30       696.82        525.75    *     1024.47       1195.54         171.07  *
*            *                                           *                                           *
*   TOTAL    *     1721.30       696.82        525.75    *     1024.47       1195.54         171.07  *
*            *                                           *                                           *
*************************************************************************************************
```

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Reservoir B

```
      HEC-5C-VARIABLE OUTPUT MAR.1975
      RES.= 35 CPTS.= 75 PERS.=100

T1 FALL RIVER BASIN   ***   RESERVOIR B AT CP 2   ***
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       18.00        6.00        4.00        2.00        3.00       -0.00       -0.00        1.00       -0.00        1.00
J2       -0.00        1.10        2.00        1.00       -0.00        0.00       -1.00       -0.00       -0.00       -1.00
J4        6.00         .30        1.00        1.50        2.00        3.00        4.00       -0.00       -0.00       -0.00


RL        1.00    50000.00       -0.00        0.00    50000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RO        1.00        2.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        6.00        0.00    50000.00    70000.00   100000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RQ        6.00     5000.00     6000.00     7000.00     8000.00   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
ID RESERVOIR A (CP 1)                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        1.00        2.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00

RL        2.00   100000.00       -0.00        0.00   100000.00   654576.00  1000000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        7.00        0.00   100000.00   200000.00   400000.00   600000.00   800000.00  1000000.00       -0.00       -0.00
RQ        7.00    18000.00    21000.00    30000.00    40000.00   100000.00   300000.00   500000.00       -0.00       -0.00
R$        7.00        0.00        0.00        0.00        0.00    59150.00    59150.00        0.00       -0.00       -0.00

CP        2.00    21000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00         .06        1.20
ID RESERVOIR B (CP 2)                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        2.00        4.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00


RL        3.00   100000.00       -0.00        0.00   100000.00   755408.00  1000000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        7.00        0.00   100000.00   200000.00   400000.00   700000.00   800000.00  1000000.00       -0.00       -0.00
RQ        7.00    10000.00    12000.00    18000.00    30000.00    80000.00   150000.00   500000.00       -0.00       -0.00

CP        3.00    12000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID RESERVOIR C (CP 3)                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        3.00        4.00         .20         .30        6.00       -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       -0.00
ID CP 4                                                -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        4.00        5.00         .20         .30        6.00       -0.00       -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       -0.00
DB        1.00      696.82       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
DF       17.00        1.00         .90         .80         .70         .60         .50         .40         .30         .25
DF         .20         .15         .10         .05         .02         .01         .01         .00       -0.00       -0.00
DQ       17.00    28800.00    35000.00    42000.00    50500.00    60500.00    73000.00    90000.00   114000.00   130000.00
DQ   150000.00   180000.00   230000.00   323000.00   490000.00   640000.00   840000.00  1000000.00       -0.00       -0.00
DC        1.00        0.00        0.00      180.00      380.00      500.00      630.00      900.00     1250.00     1500.00
DC     1930.00     2660.00     5000.00     9900.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00

CP        5.00    37000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID CP 5                                                -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        5.00        0.00        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       -0.00
```

Reservoir B Data

Reservoir Cost

```
       NRES=      3  NCPT=      5  NCPTR=     -0

IN      1  6 JUNE     1000.0     2000.0     3000.0    18000.0    37000.0    42000.0    50000.0    27000.0    20000.0    13000.0
                      5000.0     4000.0     3000.0     2000.0     1000.0     1000.0     1000.0     1000.0
                                                                                                             SUM=      231000
IN      2  6 JUNE     2000.0     3000.0     4000.0     6000.0    20000.0    57000.0   100000.0    90000.0    70000.0    50000.0
                     37000.0    24000.0    24000.0    15000.0     9000.0     3000.0     2000.0     1500.0
                                                                                                             SUM=      517500
IN      3  6 JUNE     3000.0     6000.0    27000.0    60000.0   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
                                                                                                             SUM=      504000
IN      4  6 JUNE     2000.0     4000.0    19000.0    13000.0    10000.0     7000.0     4000.0     1000.0     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     6000.0     5000.0     3000.0     2000.0      500.0      500.0     2000.0
                      5000.0    12000.0     6000.0     4000.0     2000.0     1000.0      500.0      200.0
                                                                                                             SUM=       61700
EJ     -0               -0.0       -0.0       -0.0       -0.0       -0.0       -0.0       -0.0       -0.0
```

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SUMMARY OF AVERAGES FOR RESERVOIRS

LOC=        CUM LOCA   NATURAL    INFLOW     OUTFLOW    CASE=LOC   LEVEL      EOP 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        8400.00    8400.00    8400.00    8400.00       .46       2.02  109958.31

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   20867.39       0.00
   5        3176.27   24083.97   23833.07   13166.93   20656.80      62.82


COMPUTATION INTERVAL IN HOURS=        6

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

                  NFLRD=         1  NFLCUN=        6
                  IFLRD =        1  IFLCUN=        2
                     FLOWS MULTIPLIED BY     1.00

*****************************************************************************************************************

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

                                                                                            STARTING TIME=       1
                                                                                            HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
                              SERVING          1      2
PER        CUM LOCAL Q

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

                                                                                            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

                                                                                            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

                                                                                            AVG=   5341.497  MAX=   6146.941
                                                                                                             MIN=   1000.000
```

```
 PER        CASE=LOC.TYP

   1    .03     .03     .03     .06     .01     .01     .01     .01     .01     .01
  11    .01     .01     .01     .01     .01     .01     .01     .01

                                                                                      AVG=        .016  MAX=        .060
                                                                                                        MIN=        .010
 PER        LEVEL

   1  2.000   2.000   2.000   2.058   2.211   2.388   2.604   2.707   2.776   2.811
  11  2.806   2.796   2.781   2.762   2.737   2.712   2.688   2.663

                                                                                      AVG=       2.528  MAX=       2.811
                                                                                                        MIN=       2.000
 PER        EOP STORAGE

   1  50000   50000   50000   55878   71250   89101  110920  121333  128275  131747
  11 131251  130259  128771  126788  124308  121829  119350  116870

                                                                                      AVG= 103218.294  MAX= 131746.511
                                                                                                        MIN=  50000.000
****************************************************************************************************************

**** LOC     2  RESERVOIR B (CP 2)               SERVED BY      1      2

                                                                                      STARTING TIME=       1
                                                                                      HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                      SERVING       2      4
 PER        CUM LOCAL Q

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

                                                                                      AVG=  28750.000  MAX= 100000.000
                                                                                                        MIN=   1500.000
 PER        NATURAL FLOW

   1   3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
  11  49884   30147   28191   18032   11005    4168    3028    2505

                                                                                      AVG=  41583.282  MAX= 142140.454
                                                                                                        MIN=   2504.654
 PER        INFLOW

   1   3000    4167    6028    9362   25658   62943  105991   95998   76000   56000
  11  43000   30000   30000   21000   15000    9000    8000    7500

                                                                                      AVG=  33813.719  MAX= 105990.510
                                                                                                        MIN=   3000.000
 PER        OUTFLOW

   1   3000    4167    6028    9362   21000       0   21000   21000   21000   19068
  11   6525       0   21000   21000   21000   21000   21000   21000

                                                                                      AVG=  14341.632  MAX=  21000.000
                                                                                                        MIN=       .000
 PER        CASE=LOC.TYP

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

                                                                                      AVG=        .902  MAX=       4.010
                                                                                                        MIN=        .010
 PER        LEVEL

   1  2.000   2.000   2.000   2.000   2.004   2.060   2.136   2.204   2.253   2.286
```

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```
   11   2.318   2.345   2.353   2.353   2.348   2.337   2.325   2.313
                                                                                                   AVG=      2.202  MAX=      2.353
                                                                                                                    MIN=      2.000
 PER       EQUIVALENT LEVEL

    1   2.000   2.000   2.000   2.009   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

                                                                                                   AVG=      2.252  MAX=      2.419
                                                                                                                    MIN=      2.000
 PER       EDP STORAGE

    1  100000  100000  100000  100000  102310  133522  175667  212856  240129  258443
   11  276530  291407  295869  295869  292894  286944  280497  273803

                                                                                                   AVG= 212041.170  MAX= 295869.421
                                                                                                                    MIN= 100000.000
*************************************************************************************************************************************
**** LOC      3  RESERVOIR C (CP 3)             SERVED BY      3

                                                                                                   STARTING TIME=       1
                                                                                                   HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                             SERVING        3     4
 PER       CUM LOCAL Q

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

                                                                                                   AVG=  28000.000  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    6000    3000    2000    1000

                                                                                                   AVG=  28000.000  MAX= 105000.000
                                                                                                                    MIN=   1000.000
 PER       INFLOW

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

                                                                                                   AVG=  28000.000  MAX= 105000.000
                                                                                                                    MIN=   1000.000
 PER       OUTFLOW

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

                                                                                                   AVG=   8567.131  MAX=  12000.000
                                                                                                                    MIN=       .000
 PER       CASE=LOC.TYP

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

                                                                                                   AVG=      1.121  MAX=      4.010
                                                                                                                    MIN=       .010
 PER       LEVEL

    1   2.000   2.000   2.011   2.048   2.118   2.170   2.206   2.231   2.247   2.265
   11   2.279   2.288   2.288   2.292   2.287   2.281   2.273   2.265

                                                                                                   AVG=      2.197  MAX=      2.292
```

```
                                                                                                                          MIN=      2,000
PER        EOP STORAGE

  1  100000  100000  107438  131240  177356  211493  235295  251659  262072  273973
 11  282899  288850  288850  291304  288329  283866  278908  273453

                                                                                                         AVG= 229277.048  MAX= 291304.433
                                                                                                                          MIN= 100000.000
*************************************************************************************************************************************

**** LOC.    4  CP 4                                    SERVED BY    -1      2      3

PER        CUM LOCAL Q

  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    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
 11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                                         AVG=   76784.776  MAX= 194036.091
                                                                                                                           MIN=   5846.858

PER        REGULATED FLOW

  1    8000   10694   29898   30395   32641   34300   20156   31193   33532   34600
 11   28899   32500   19750   34300   30750   33958   33826   33471

                                                                                                         AVG=   28492.417  MAX=  34599.960
                                                                                                                           MIN=   8000.000

PER        Q SPACE AVAIL.

  1   27000   24306    5102    4605    2359     700   14844    3807    1468     400
 11    6101    2500   15250     700    4250    1042    1174    1529

                                                                                                         AVG=    6507.583  MAX=  27000.000
                                                                                                                           MIN=    400.040

PER        Q BY US RES,DIVS

  1    6000    6694   10898   17395   22641   27300   16156   30193   32532   30600
 11   18899    7500    6750   27300   26750   31958   32826   32971

                                                                                                         AVG=   21409.084  MAX=  32971.064
                                                                                                                           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

                                                                                                         AVG=       0.000  MAX=      0.000
                                                                                                                           MIN=      0.000
*************************************************************************************************************************************

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

PER        CUM LOCAL Q

  1    3000    4333   15222   21870   17978   12996    8999    4500    2000    3583
 11    9597   23600   26767   17294    9549    5258    2710    1318

                                                                                                         AVG=   10587.575  MAX=  26766.589
                                                                                                                           MIN=   1318.283

PER        NATURAL FLOW
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```
   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752
                                                                                                      AVG=  80279,898  MAX= 187631,160
                                                                                                                       MIN=   9000,000
 PER        REGULATED FLOW

   1    9000   10449   22521   33251   35246   35518   33646   24410   30869   35183
  11   38414   42252   36000   27883   33972   32488   34025   33917
                                                                                                      AVG=  30502,405  MAX=  42251,723
                                                                                                                       MIN=   9000,000
 PER        Q SPACE AVAIL.

   1   28000   26551   14479    3749    1754    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.  17267   22522   24646   19910   28869   31600
  11   28816   18652    9234   10589   24423   27230   31315   32599
                                                                                                      AVG=  19914,830  MAX=  32598,587
                                                                                                                       MIN=   6000,000
 PER        FLOOD BY RES

   1       0       0       0       0       0       0       0       0       0       0
  11    1414    5252       0       0       0       0       0       0
                                                                                                      AVG=    370,299  MAX=   5251,723
                                                                                                                       MIN=      0,000
 *******************************************************************************************************************************

                 CUM TIME=       1

 RES NO=         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
 EQ LEVEL    2,000   2,000   2,000

                 CUM TIME=       2

 RES NO=         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
 EQ LEVEL    2,000   2,000   2,000

                 CUM TIME=       3

 RES NO=         1       2       3
 INFLOW       3000    6028   27000
```

```
                      FALL RIVER BASIN   ***   RESERVOIR B AT CP 2   ***
                      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
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     4  CP 4               1.011      34700 *      1.008      58211 *      1.012       7500 *    27200 *   0.00    0.00
  LOC     5  CP 5               1.012      38131 *      1.009      56289 *      1.013       8030 *    30101 *   0.00    0.00

      RESERVOIRS            . FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

  LOC     1  RESERVOIR A (CP 1)  1.004   50000     2.000 *  1.008    61274     2.112 *  1.005     6062      6000   50000

  LOC     2  RESERVOIR B (CP 2)  1.018  100000     2.000 *  1.009   117318     2.031 *  1.006    21000     21000  100000

  LOC     3  RESERVOIR C (CP 3)  1.018  100000     2.000 *  1.008   122016     2.034 *  1.004    12000     12000  100000

                         MIN SYSTEM STG=    250000    MAX SYSTEM STG=    300608

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

                                                                                   STARTING TIME      1

                                                                                             SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     4  CP 4               2.010      34600 *      2.008     194036 *      2.012      25000 *     9600 *   0.00    0.00
  LOC     5  CP 5               2.012      42252 *      2.009     187631 *      2.013      26767 *    15485 *   0.00    0.00

      RESERVOIRS              FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

  LOC     1  RESERVOIR A (CP 1)  2.003   50000     2.000 *  2.010   131746     2.811 *  2.004     6146      6000   50000

  LOC     2  RESERVOIR B (CP 2)  2.004  100000     2.000 *  2.013   295869     2.353 *  2.005    21000     21000  100000

  LOC     3  RESERVOIR C (CP 3)  2.002  100000     2.000 *  2.014   291304     2.292 *  2.003    12000     12000  100000

                         MIN SYSTEM STG=    250000    MAX SYSTEM STG=    718919

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

                                                                                   STARTING TIME      1

                                                                                             SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     4  CP 4               3.012      38262 *      3.008     291054 *      3.012      37500 *      762 *   0.00    0.00
  LOC     5  CP 5               3.013      42798 *      3.009     281447 *      3.013      40150 *     2648 *   0.00    0.00

      RESERVOIRS              FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
```

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```
 LOC    1  RESERVOIR A (CP 1)        3.002    50000     2.000 *  3.008   150832     3.000 *  3.008    38158       6000   50000
 LOC    2  RESERVOIR B (CP 2)        3.001   100000     2.000 *  3.014   483597     2.692 *  3.006    21000      21000  100000
 LOC    3  RESERVOIR C (CP 3)        3.001   100000     2.000 *  3.014   426307     2.498 *  3.004    12000      12000  100000
                        MIN SYSTEM STG=    250000    MAX SYSTEM STG=   1060736

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

                                                                                                 STARTING TIME      1
                                                                                                      SHORTAGE INDEX
                                     FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES       REQ
 LOC    4  CP 4                        4.012     54228 *      4.008     388072 *      4.012     50000 *     4228 *    0.00      0.00
 LOC    5  CP 5                        4.013     60627 *      4.009     375262 *      4.013     53533 *     7094 *    0.00      0.00
            RESERVOIRS               FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
 LOC    1  RESERVOIR A (CP 1)        4.001    50000     2.000 *  4.007   150832     3.000 *  4.007    82658       6000   50000
 LOC    2  RESERVOIR B (CP 2)        4.001   102975     2.005 *  4.014   654576     3.000 *  4.014    23051      21000  100000
 LOC    3  RESERVOIR C (CP 3)        4.001   102975     2.005 *  4.015   564840     2.709 *  4.004    12000      12000  100000
                        MIN SYSTEM STG=    255950    MAX SYSTEM STG=   1370248

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

                                                                                                 STARTING TIME      1
                                                                                                      SHORTAGE INDEX
                                     FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES       REQ
 LOC    4  CP 4                        5.012    270763 *      5.008     582108 *      5.012     75000 *   195763 *    0.00      0.00
 LOC    5  CP 5                        5.013    269295 *      5.009     562893 *      5.013     80300 *   188995 *    0.00      0.00
            RESERVOIRS               FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
 LOC    1  RESERVOIR A (CP 1)        5.001    50000     2.000 *  5.007   167676     3.343 *  5.007   118246       6000   50000
 LOC    2  RESERVOIR B (CP 2)        5.001   104463     2.008 *  5.010   702719     3.139 *  5.010   196361      21000  100000
 LOC    3  RESERVOIR C (CP 3)        5.001   104463     2.007 *  5.012   755408     3.000 *  5.013    35999      12000  100000
                        MIN SYSTEM STG=    258924    MAX SYSTEM STG=   1625803

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

                                                                                                 STARTING TIME      1
                                                                                                      SHORTAGE INDEX
                                     FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES       REQ
 LOC    4  CP 4                        6.012    497775 *      6.008     776144 *      6.012    100000 *   397775 *    0.00      0.00
 LOC    5  CP 5                        6.012    506408 *      6.009     750525 *      6.013    107066 *   399341 *    0.00      0.00
            RESERVOIRS               FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
 LOC    1  RESERVOIR A (CP 1)        6.001    50000     2.000 *  6.007   191183     3.821 *  6.007   163829       6000   50000
 LOC    2  RESERVOIR B (CP 2)        6.001   105950     2.011 *  6.009   811202     3.453 *  6.010   310627      21000  100000
```

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```
LOC     3  RESERVOIR C (CP 3)          6,001   105950      2,009 *   6,008   781273      3,106 *   6,009   136168      12000  100000
                                 MIN SYSTEM STG#    261900     MAX SYSTEM STG#   1783658
```

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```
                                     EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                       CONTROL POINT NUMBER    4

                                BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
       FREQ      PEAK          SUM    TYPE 1    TYPE
      .9990     28800         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    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
       EXIST SYSTEM-INPUT    696.82    696.82

                                BASE CONDITION FLOOD DAMAGES
                 EXCD  PROB
    NO.  FLOW    FREQ   INT        SUM    TYPE 1    TYPE
     1    58211 .621  .623      233.27    233.27
     2   194036 .134  .279      549.81    549.81
     3   291054 .062  .050      360.93    360.93
     4   388072 .034  .025      265.87    265.87
     5   582108 .013  .014      173.38    173.38
     6   776144 .007  .010      138.03    138.03

         BASE COND DAMAGES   1721.30   1721.30
         EXST SYST DAMAGES    696.82    696.82

                                MODIFIED CONDITIONS FLOOD DAMAGES
                 EXCD  PROB
    NO.  FLOW    FREQ   INT        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    54228 .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    482.27    482.27

                                UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
                 EXCD  PROB
    NO.  FLOW    FREQ   INT        SUM    TYPE 1    TYPE
     1     7500 .621  .623        0.00      0.00
     2    25000 .134  .279        0.00      0.00
```

```
 3   37500 .062  .050       2.06       2.06
 4   50000 .034  .025       8.31       8.31
 5   75000 .013  .014       8.27       8.27
 6  100000 .007  .010      12.09      12.09
      DAMAGES W/ TOTAL
   CONTROL AT PROJECTS     30.74      30.74

    REDUCTION POSSIBLE
    W/ TOTAL CONTROL      666.08     666.08

      RESIDUAL DAMAGES    183.81     183.81
```

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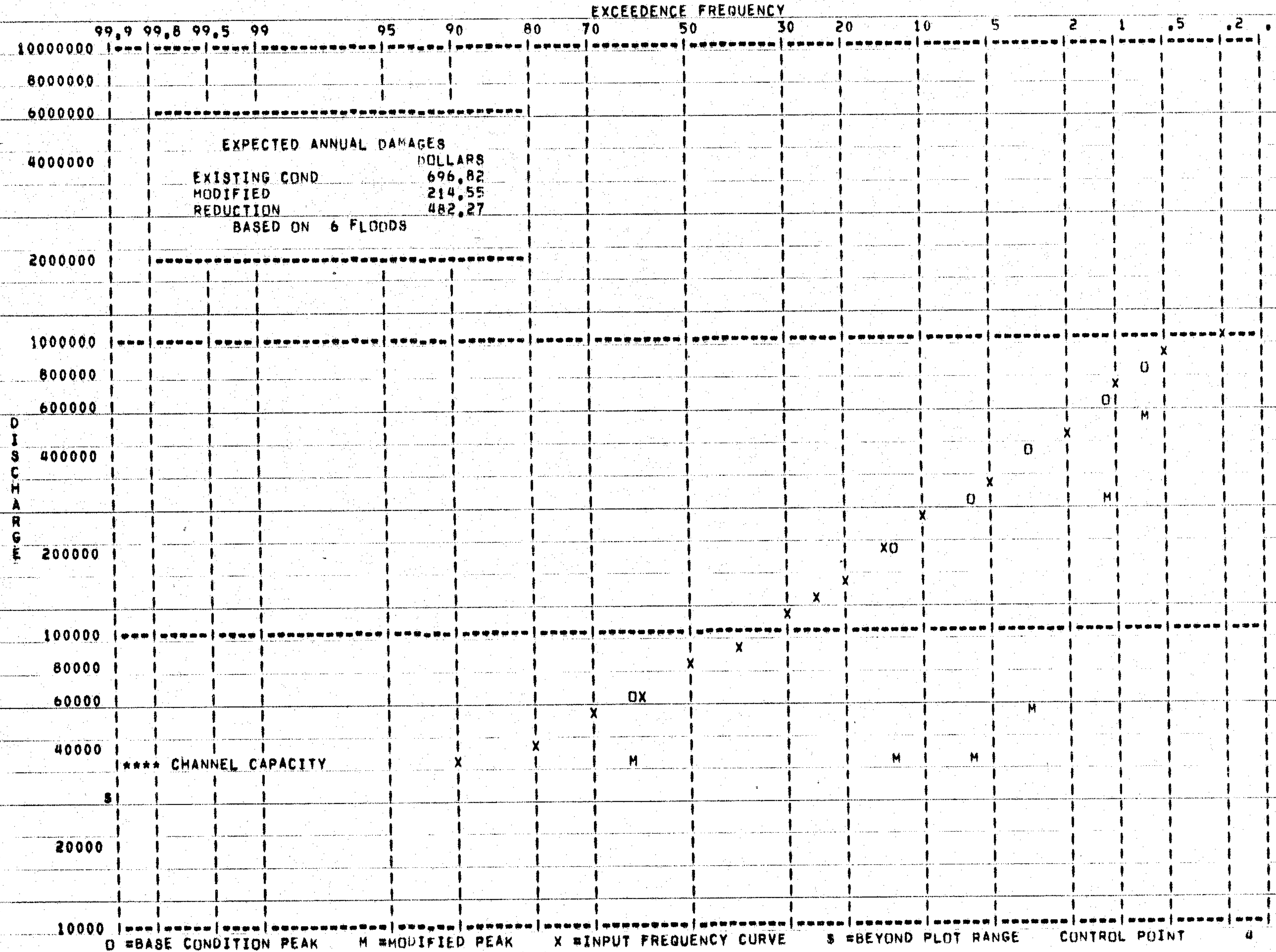
CONTROL POINT 4



```
                           SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
**************************************************************************************************
*           *.................DAMAGES.........................*.............DAMAGE REDUCTION............*
*  CONTROL  * BASE (EXIST)   MODIFIED      UNCONTROL    *   MODIFIED    TOTAL CONTROL                *
*   POINT   *  CONDITION    CONDITIONS    LOCAL COND    *  CONDITIONS   AT PROJECTS      RESIDUAL    *
*  -------  *  ----------   ----------    ----------    *  ----------   ----------      ----------   *
*        4  *      696.82       214.55         30.74    *      482.27       666.08          183.81   *
*           *                                           *                                            *
*   TOTAL   *      696.82       214.55         30.74    *      482.27       666.08          183.81   *
*           *                                           *                                            *
**************************************************************************************************
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                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 * * * *        709.80

TOTAL SYSTEM ANNUAL COST  * * * * * * *                    4199.65


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM       696.82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM       214.55

AVERAGE ANNUAL DAMAGE REDUCTION                             482.27


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS       -3717.38
```

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       HEC-5C-VARIABLE OUTPUT MAR.1975
       RES.= 35 CPTS.= 75 PERS.=100

    T1 FALL RIVER BASIN    ***   LEVEE OR FLOODWALL    ***
    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        18.00        6.00        4.00        2.00        3.00       -0.00       -0.00        1.00       -0.00        1.00
    J2        -0.00        1.10        2.00        1.00       -0.00        0.00       -1.00       -0.00       -0.00       -1.00
    J4         6.00         .30        1.00        1.50        2.00        3.00        4.00       -0.00       -0.00       -0.00


    RL         1.00    50000.00       -0.00        0.00    50000.00   150832.00   200000.00       -0.00       -0.00       -0.00
    RO         1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RS         6.00        0.00    50000.00    70000.00   100000.00   150832.00   200000.00       -0.00       -0.00       -0.00
    RQ         6.00     5000.00     6000.00     7000.00     8000.00   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
    ID RESERVOIR A (CP 1)                                   -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RT         1.00        2.00         .20         .30        6.00       -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
    ID CP 2                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RT         2.00        4.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00


    RL         3.00   100000.00       -0.00        0.00   100000.00   755408.00  1000000.00       -0.00       -0.00       -0.00
    RO         1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RS         7.00        0.00   100000.00   200000.00   400000.00   700000.00   800000.00  1000000.00       -0.00       -0.00
    RQ         7.00    10000.00    12000.00    18000.00    30000.00    80000.00   150000.00   500000.00       -0.00       -0.00

    CP         3.00    12000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    ID RESERVOIR C (CP 3)                                   -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RT         3.00        4.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00

    CP         4.00   287000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00         .06        1.00
    ID CP 4                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RT         4.00        5.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00
    QS         1.00   287000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    CS    287000.00     5510.00       -0.00       -0.00       -0.00       -0.00       -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       -0.00
    DB         1.00      696.82       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    DF        17.00        1.00         .90         .80         .70         .60         .50         .40         .30         .25
    DF          .20         .15         .10         .05         .02         .01         .01         .00       -0.00       -0.00
    DQ        17.00    28800.00    35000.00    42000.00    50500.00    60500.00    73000.00    90000.00   114000.00   130000.00
    DQ    150000.00   180000.00   230000.00   323000.00   490000.00   640000.00   840000.00  1000000.00       -0.00       -0.00
    DC         1.00        0.00        0.00      180.00      380.00      500.00      630.00      900.00     1250.00     1500.00
    DC      1930.00     2660.00     5000.00     9900.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00
    DC         1.00        0.00        0.00        0.00        0.00        0.00        0.00        0.00        0.00        0.00
    DC         0.00        0.00        0.00     9900.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00

    CP         5.00    37000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    ID CP 5                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
    RT         5.00        0.00        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       -0.00

        NRES=     2  NCPT=     5  NCPTR=    -0

    IN       1   6 JUNE      1000.0      2000.0      3000.0     18000.0     37000.0     42000.0     50000.0     27000.0     20000.0     13000.0
```

Levee or Floodwall
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Levee or Fldw.

```
                      5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                                      SUM=     231000
IN     2  6 JUNE      2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                     37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                                      SUM=     517500
IN     3  6 JUNE      3000.0    6000.0   27000.0   60000.0  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
                                                                                                                      SUM=     504000
IN     4  6 JUNE      2000.0    4000.0   19000.0   13000.0   10000.0    7000.0    4000.0    1000.0    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    6000.0    5000.0    3000.0    2000.0     500.0     500.0    2000.0
                      5000.0   12000.0    6000.0    4000.0    2000.0    1000.0     500.0     200.0
                                                                                                                      SUM=      61700
EJ    -0                -0.0      -0.0      -0.0      -0.0      -0.0      -0.0      -0.0      -0.0
```

```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=       CUM LOCA   NATURAL    INFLOW     OUTFLOW    CASE=LOC   LEVEL      EOP STOR

    1       3850,00    3850,00    3850,00    3850,00        ,02       2,04   53818,24
    3       8400,00    8400,00    8400,00    8400,00        ,02       2,01  108479,46

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=       CUM LOCA   NATURAL    REGULATE   Q SPACE    Q BY US    FLOOD BY

    2       8625,00   12474,98   12474,56    8525,44    3849,56    1104,09
    4      10755,92   23035,43   23027,12  263972,88   12271,20       0,00
    5      11795,97   24083,97   24016,64   12983,36   12220,67    1257,74


COMPUTATION INTERVAL IN HOURS=       6

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

                   NFLRD=        1  NFLCUN=       6
                   IFLRD =       1  IFLCUN=       2
                       FLOWS MULTIPLIED BY    1,00

*********************************************************************************************************************************

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

                                                                                              STARTING TIME=       1
                                                                                              HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                SERVING       1     4
PER        CUM LOCAL Q

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

                                                                                              AVG=  12833,333  MAX=  50000,000
PER        NATURAL FLOW                                                                                        MIN=   1000,000

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

                                                                                              AVG=  12833,333  MAX=  50000,000
PER        INFLOW                                                                                              MIN=   1000,000

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

                                                                                              AVG=  12833,333  MAX=  50000,000
PER        OUTFLOW                                                                                             MIN=   1000,000

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

                                                                                              AVG=   5333,333  MAX=   6000,000
                                                                                                               MIN=   1000,000
```

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Levee or Floodwall

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```
PER        CASE=LOC.TYP

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

                                                                              AVG=       .013  MAX=       .030
                                                                                               MIN=       .010
PER        LEVEL

    1    2.000    2.000    2.000    2.059    2.211    2.389    2.605    2.708    2.777    2.811
   11    2.807    2.797    2.782    2.762    2.738    2.713    2.689    2.664

                                                                              AVG=      2.528  MAX=      2.811
                                                                                               MIN=      2.000
PER        EOP STORAGE

    1    50000    50000    50000    55950    71323    89174   110993   121406   128348   131819
   11   131323   130332   128844   126861   124381   121902   119422   116943

                                                                              AVG= 103279.014  MAX= 131819.375
                                                                                               MIN=  50000.000
*************************************************************************************************************

**** LOC     2  CP 2                            SERVED BY     -1

PER        CUM LOCAL Q

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

                                                                              AVG=  28750.000  MAX= 100000.000
                                                                                               MIN=   1500.000
PER        NATURAL FLOW

    1     3000     4167     6028    11338    39056    91843   142140   134857    98809    70302
   11    49884    30147    28191    18032    11005     4168     3028     2505

                                                                              AVG=  41583.282  MAX= 142140.454
                                                                                               MIN=   2504.654
PER        REGULATED FLOW

    1     3000     4167     6028     9338    25556    62926   105988    95998    76000    56000
   11    43000    30000    30000    21000    15000     9000     8000     7500

                                                                              AVG=  33805.556  MAX= 105987.676
                                                                                               MIN=   3000.000
PER        Q SPACE AVAIL.

    1    18000    16833    14972    11662    -4556   -41926   -84988   -74998   -55000   -35000
   11   -22000    -9000    -9000        0     6000    12000    13000    13500

                                                                              AVG= -12805.556  MAX=  18000.000
                                                                                               MIN= -84987.676
PER        Q BY US RES,DIVS

    1     1000     1167     2028     3338     5556     5926     5988     5998     6000     6000
   11     6000     6000     6000     6000     6000     6000     6000     6000

                                                                              AVG=   5055.556  MAX=   6000.000
                                                                                               MIN=   1000.000
PER        FLOOD BY RES

    1        0        0        0        0     4556     5926     5988     5998     6000     6000
   11     6000     6000     6000        0        0        0        0        0

                                                                              AVG=   2914.866  MAX=   6000.000
```

```
                                                                                                          MIN=      0.000
*************************************************************************************************************
**** LOC     3  RESERVOIR C (CP 3)                       SERVED BY      2
                                                                                          STARTING TIME=       1
                                                                                          HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
                                         SERVING         2     4
PER         CUM LOCAL Q

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

                                                                                          AVG=  28000.000  MAX= 105000.000
PER         NATURAL FLOW                                                                               MIN=   1000.000

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

                                                                                          AVG=  28000.000  MAX= 105000.000
PER         INFLOW                                                                                     MIN=   1000.000

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

                                                                                          AVG=  28000.000  MAX= 105000.000
PER         OUTFLOW                                                                                    MIN=   1000.000

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

                                                                                          AVG=  11166.667  MAX=  12000.000
PER         CASE=LOC.TYP                                                                               MIN=   3000.000

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

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

    1   2.000    2.000    2.011    2.048    2.118    2.168    2.204    2.229    2.245    2.254
   11   2.259    2.259    2.259    2.256    2.252    2.245    2.238    2.229

                                                                                          AVG=      2.182  MAX=      2.259
PER         EOP STORAGE                                                                                MIN=      2.000

    1  100000   100000   107438   131240   177356   210084   233886   250250   260663   266614
   11  269589   269589   269589   268102   265126   260663   255705   250250

                                                                                          AVG= 219230.389  MAX= 269589.250
*************************************************************************************************************MIN= 100000.000
**** LOC     4  CP 4                                     SERVED BY      1     2

PER         CUM LOCAL Q

    1    4000     6167    22028    17171    18029    31171    62695    92449    87908    73485
   11   61081    62180    39197    29866    19311    11052     4842     2724
```

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```
                                                                                                      AVG=  35853,070  MAX=  92449,206
PER         NATURAL FLOW                                                                                               MIN=   2723,662

    1    8000    10694    32398    49141    87592   144277   173798   194036   175045   136597
   11  106281    93327    59185    45997    31355    19091     9465     5847

                                                                                                      AVG=  76784,776  MAX= 194036,091
PER         REGULATED FLOW                                                                                             MIN=   5846,858

    1    8000    10694    29898    30391    33383    48422    80519   110411   105900    91483
   11   79080    80180    57197    47866    37311    29052    22842    20724

                                                                                                      AVG=  51297,515  MAX= 110411,284
PER         Q SPACE AVAIL,                                                                                             MIN=   8000,000

    1  279000   276306   257102   256609   253617   238578   206481   176589   181100   195517
   11  207920   206820   229803   239134   249689   257948   264158   266276

                                                                                                      AVG= 235702,485  MAX= 279000,000
PER         Q BY US RES,DIVS                                                                                           MIN= 176588,716

    1    4000     4528     7870    13220    15355    17251    17824    17962    17992    17998
   11   18000    18000    18000    18000    18000    18000    18000    18000

                                                                                                      AVG=  15444,444  MAX=  18000,000
PER         FLOOD BY RES                                                                                               MIN=   4000,000

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

PER         CUM LOCAL Q

    1    5000     6361    17509    24965    22613    23150    36588    63470    87279    87316
   11   78389    75315    64539    44865    31940    20706    11959     5792

                                                                                                      AVG=  39319,888  MAX=  87316,106
PER         NATURAL FLOW                                                                                               MIN=   5000,000

    1    9000    10449    22937    38112    57711    94226   142355   172097   187631   172652
   11  142220   121279    96295    66172    48252    32794    20104    10752

                                                                                                      AVG=  80279,898  MAX= 187631,160
PER         REGULATED FLOW                                                                                             MIN=   9000,000

    1    9000    10449    22521    33251    35366    38387    53599    81181   105204   105298
   11   96385    93315    82539    62865    49940    38706    29959    23792

                                                                                                      AVG=  53986,554  MAX= 105298,240
PER         Q SPACE AVAIL,                                                                                             MIN=   9000,000

    1   28000    26551    14479     3749     1634    -1387   -16599   -44181   -68204   -68298
   11  -59385   -56315   -45539   -25865   -12940    -1706     7041    13208
```

```
                                                                                                      AVG= -16986,554  MAX=  28000,000
PER         Q BY US RES,DIVS                                                                                           MIN= -68298,240

   1    4000    4088    5012    8285   12753   15237   17011   17711   17925   17982
  11   17996   17999   18000   18000   18000   18000   18000   18000

                                                                                                      AVG=  14666,667  MAX=  18000,000
PER         FLOOD BY RES                                                                                               MIN=   4000,000

   1       0       0       0       0       0    1387   16599   17711   17925   17982
  11   17996   17999   18000   18000   12940    1706       0       0

                                                                                                      AVG=   8791,447  MAX=  17999,962
                                                                                                                       MIN=      0,000
************************************************************************************************************************

                  CUM TIME=       1

RES NO=         1       3
INFLOW       1000    3000
OUTFLOW      1000    3000
EOP 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
EOP 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
EOP 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      6000   12000
EOP STOR    55950  131240
CASE=         ,01     ,01
LEVEL       2,059   2,048
EQ LEVEL    2,059   2,048
```

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```
                    FALL RIVER BASIN   ***   LEVEE OR FLOODWALL   ***
                    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
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REG
  LOC     2  CP 2           1.007      35969 *      1.007      42642 *      1.007      30000 *     5969 *   0.00     0.00
  LOC     4  CP 4           1.008      45647 *      1.008      58211 *      1.008      27735 *    17913 *   0.00     0.00
  LOC     5  CP 5         . 1.010      44155 *      1.009      56289 *      1.010      26195 *    17960 *   0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

  LOC     1  RESERVOIR A (CP 1)     1.018    50000      2.000 *  1.008    61305     2.112 *  1.005     6000      6000   50000

  LOC     3  RESERVOIR C (CP 3)     1.018   100000      2.000 *  1.008   122016     2.034 *  1.004    12000     12000  100000

                    MIN SYSTEM STG=     150000     MAX SYSTEM STG=     183321

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

                                                                                     STARTING TIME       1
                                                                                             SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REG
  LOC     2  CP 2           2.007     105988 *      2.007     142140 *      2.007     100000 *     5988 *   0.00     0.00
  LOC     4  CP 4           2.008     110411 *      2.008     194036 *      2.008      92449 *    17962 *   0.00     0.00
  LOC     5  CP 5           2.010     105298 *      2.009     187631 *      2.010      87316 *    17982 *   0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

  LOC     1  RESERVOIR A (CP 1)     2.003    50000      2.000 *  2.010   131819     2.811 *  2.004     6000      6000   50000

  LOC     3  RESERVOIR C (CP 3)     2.002   100000      2.000 *  2.011   269589     2.259 *  2.003    12000     12000  100000

                    MIN SYSTEM STG=     150000     MAX SYSTEM STG=     401408

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

                                                                                     STARTING TIME       1
                                                                                             SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REG
  LOC     2  CP 2           3.007     155993 *      3.007     213211 *      3.007     150000 *     5993 *   0.00     0.00
  LOC     4  CP 4           3.008     157420 *      3.008     291054 *      3.008     138674 *    18746 *   0.00     0.00
  LOC     5  CP 5           3.010     157351 *      3.009     281447 *      3.010     130974 *    26377 *   0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

  LOC     1  RESERVOIR A (CP 1)     3.003    50000      2.000 *  3.008   150832     3.000 *  3.008    33658      6000   50000
```

```
LOC     3  RESERVOIR C (CP 3)          3,002   100000     2,000 *  3,014   387855     2,439 *  3,003    12000      12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    538687

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

                                                                                                STARTING TIME      1

                                                                                                          SHORTAGE INDEX
                                     FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        4,008     240290 *      4,007     284281 *      4,007     200000 *    40290 *   0,00     0,00
LOC     4  CP 4                        4,009     240589 *      4,008     388072 *      4,008     184898 *    55690 *   0,00     0,00
LOC     5  CP 5                        4,010     234515 *      4,009     375262 *      4,010     174632 *    59883 *   0,00     0,00

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

LOC     1  RESERVOIR A (CP 1)          4,003    50000     2,000 *  4,007   150832     3,000 *  4,007    72658       6000   50000

LOC     3  RESERVOIR C (CP 3)          4,002   100000     2,000 *  4,014   507609     2,622 *  4,002    12000      12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    658441

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

                                                                                                STARTING TIME      1

                                                                                                          SHORTAGE INDEX
                                     FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        5,008     379367 *      5,007     426421 *      5,007     300000 *    79367 *   0,00     0,00
LOC     4  CP 4                        5,009     366161 *      5,008     582108 *      5,008     277348 *    88814 *   0,00     0,00
LOC     5  CP 5                        5,010     358326 *      5,009     562893 *      5,010     261948 *    96378 *   0,00     0,00

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

LOC     1  RESERVOIR A (CP 1)          5,002    50000     2,000 *  5,007   167314     3,335 *  5,007   116761       6000   50000

LOC     3  RESERVOIR C (CP 3)          5,001   100000     2,000 *  5,012   755408     3,000 *  5,013    35999      12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    922722

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

                                                                                                STARTING TIME      1

                                                                                                          SHORTAGE INDEX
                                     FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        6,007     514878 *      6,007     568562 *      6,007     400000 *   114878 *   0,00     0,00
LOC     4  CP 4                        6,009     601884 *      6,008     776144 *      6,008     369797 *   232087 *   0,00     0,00
LOC     5  CP 5                        6,010     584489 *      6,009     750525 *      6,010     349264 *   235224 *   0,00     0,00

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

LOC     1  RESERVOIR A (CP 1)          6,001    50000     2,000 *  6,007   191183     3,821 *  6,007   163829       6000   50000

LOC     3  RESERVOIR C (CP 3)          6,001   100000     2,000 *  6,009   769930     3,059 *  6,009   128311      12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    961113
```

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                         EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                          CONTROL POINT NUMBER     4

                  BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ       PEAK           SUM    TYPE 1     TYPE
    .9990      28800          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     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
    EXIST SYSTEM-INPUT      696.82    696.82

                    BASE CONDITION FLOOD DAMAGES
              EXCD   PROB
 NO.  FLOW    FREQ    INT         SUM    TYPE 1     TYPE
  1    58211  .621   .623      233.27    233.27
  2   194036  .134   .279      549.81    549.81
  3   291054  .062   .050      360.93    360.93
  4   388072  .034   .025      265.87    265.87
  5   582108  .013   .014      173.38    173.38
  6   776144  .007   .010      138.03    138.03

      BASE COND DAMAGES     1721.30   1721.30
      EXST SYST DAMAGES      696.82    696.82

                   MODIFIED CONDITIONS FLOW-DAMAGE DATA
     FREQ       PEAK           SUM    TYPE 1     TYPE
    .9990      28800          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
    .0640     287000       6067.76   6067.76
    .0500     323000       9900.00   9900.00
    .0200     490000      12280.00  12280.00
    .0100     640000      13350.00  13350.00
    .0050     840000      14150.00  14150.00
    .0020    1000000      14600.00  14600.0
```

```
                                                    MODIFIED CONDITIONS FLOOD DAMAGES
                EXCD  PROB
 NO.  FLOW  FREQ   INT         SUM     TYPE 1    TYPE
  1   45647 .621  .623        0.00       0.00
  2  110411 .134  .279        0.00       0.00
  3  157420 .062  .050        0.00       0.00
  4  240589 .034  .025        0.00       0.00
  5  366161 .013  .014      123.94     123.94
  6  601884 .007  .010      131.87     131.87

      MODIFIED DAMAGES      255.82     255.82
      DAMAGE REDUCTION      441.00     441.00

                                                    UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
                EXCD  PROB
 NO.  FLOW  FREQ   INT         SUM     TYPE 1    TYPE
  1   27735 .621  .623        0.00       0.00
  2   92449 .134  .279        0.00       0.00
  3  138674 .062  .050        0.00       0.00
  4  184898 .034  .025        0.00       0.00
  5  277348 .013  .014       22.01      22.01
  6  369797 .007  .010      107.87     107.87
      DAMAGES W/ TOTAL
   CONTROL AT PROJECTS      129.88     129.88

    REDUCTION POSSIBLE
    W/ TOTAL CONTROL        566.94     566.94

      RESIDUAL DAMAGES      125.93     125.93
```

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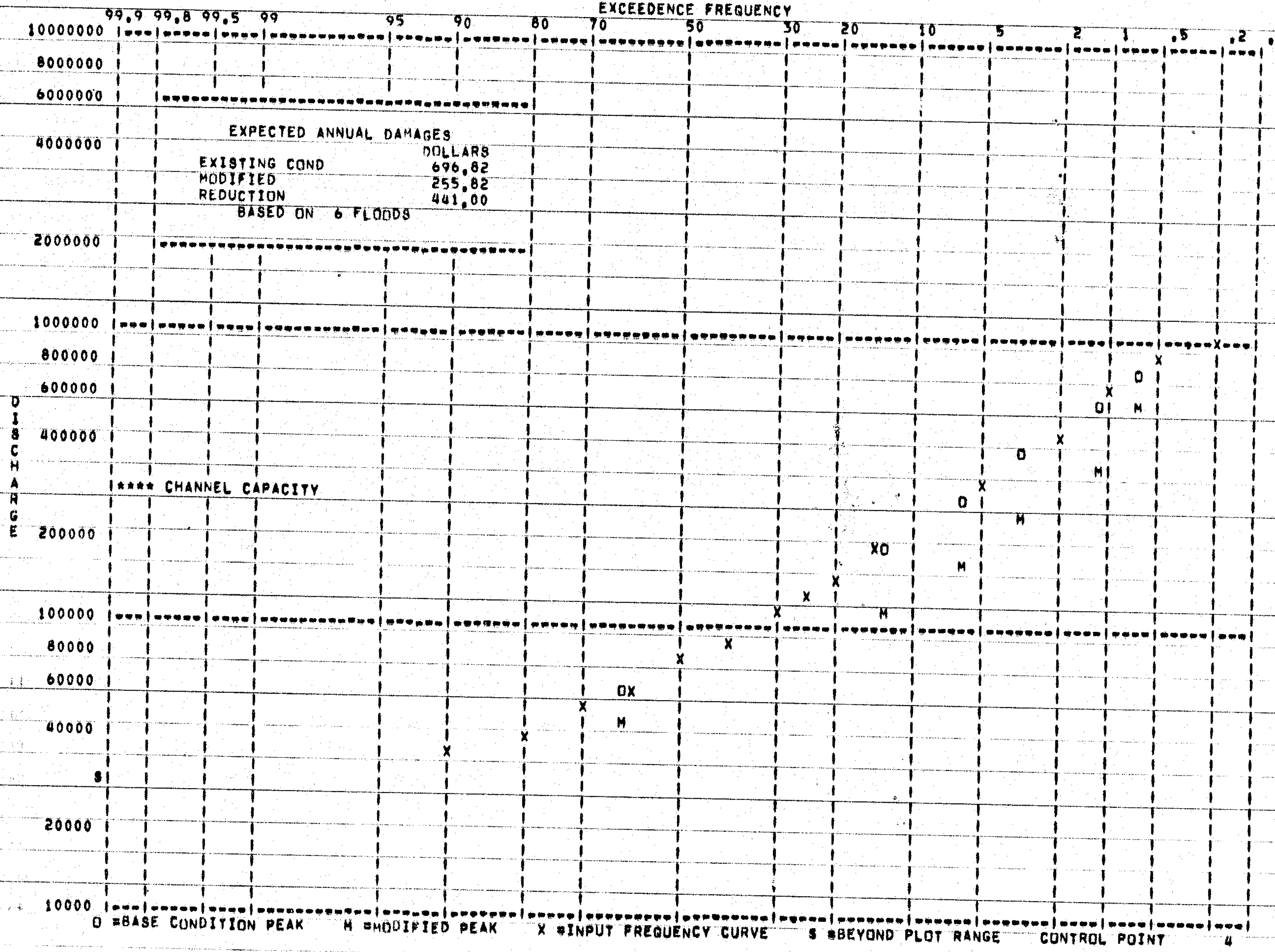
CONTROL POINT 4



```
EXPECTED ANNUAL DAMAGES
                          DOLLARS
EXISTING COND              696,82
MODIFIED                   255,82
REDUCTION                  441,00
   BASED ON  6 FLOODS
```

```
                              SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
*******************************************************************************************
*          *..................DAMAGES...................*.........DAMAGE REDUCTION.........*
*  CONTROL * BASE (EXIST)   MODIFIED      UNCONTROL    *   MODIFIED    TOTAL CONTROL        *
*   POINT  *  CONDITION    CONDITIONS    LOCAL COND    *  CONDITIONS   AT PROJECTS  RESIDUAL*
*  ------- *  ----------   ----------    ----------    *  ----------   ----------  ---------*
*       4  *      696,82       255,82        129,88    *      441,00       566,94     125,93 *
*          *                                           *                                    *
*   TOTAL  *      696,82       255,82        129,88    *      441,00       566,94     125,93 *
*          *                                           *                                    *
*******************************************************************************************
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                    SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
                        (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST * * * * * * *          5510.00

TOTAL SYSTEM ANNUAL OPERATING
   MAINTENANCE, AND REPAIR COST * * * *            55.10

TOTAL SYSTEM ANNUAL COST  * * * * * * *                          380.19


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM          696.82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM          255.82

AVERAGE ANNUAL DAMAGE REDUCTION                                  441.00


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS               60.81
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     HEC-5C-VARIABLE OUTPUT MAR.1975
      RES.= 35 CPTS.= 75 PERS.=100

T1 FALL RIVER BASIN    ***   CHANNEL MODIFICATIONS   ***
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       18.00        6.00        4.00        2.00        3.00       -0.00       -0.00        1.00       -0.00        1.00
J2       -0.00        1.10        2.00        1.00       -0.00        0.00       -1.00       -0.00       -0.00       -1.00
J4        6.00         .30        1.00        1.50        2.00        3.00        4.00       -0.00       -0.00       -0.00


RL        1.00    50000.00       -0.00        0.00    50000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        6.00        0.00    50000.00    70000.00   100000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RQ        6.00     5000.00     6000.00     7000.00     8000.00   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
ID RESERVOIR A (CP 1)                                    -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        1.00        2.00         .20         .30        6.00       -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
ID CP 2                                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        2.00        4.00         .20         .10        5.00       -0.00       -0.00       -0.00       -0.00       -0.00


RL        3.00   100000.00       -0.00        0.00   100000.00   755408.00  1000000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        7.00        0.00   100000.00   200000.00   400000.00   700000.00   800000.00  1000000.00       -0.00       -0.00
RQ        7.00    10000.00    12000.00    18000.00    30000.00    80000.00   150000.00   500000.00       -0.00       -0.00

CP        3.00    12000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID RESERVOIR C (CP 3)                                    -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        3.00        4.00         .20         .10        5.00       -0.00       -0.00       -0.00       -0.00       -0.00

CP        4.00    65000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00         .06        2.00
ID CP 4                                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        4.00        5.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00
QS        1.00    65000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
CS    65000.00     3420.00       -0.00       -0.00       -0.00       -0.00       -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       -0.00
DB        1.00      696.82       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
DF       17.00        1.00         .90         .80         .70         .60         .50         .40         .30         .25
DF         .20         .15         .10         .05         .02         .01         .01         .00       -0.00       -0.00
DQ       17.00    28800.00    35000.00    42000.00    50500.00    60500.00    73000.00    90000.00   114000.00   130000.00
DQ   150000.00   180000.00   230000.00   323000.00   490000.00   640000.00   840000.00  1000000.00       -0.00       -0.00
DC        1.00        0.00        0.00      180.00      380.00      500.00      630.00      900.00     1250.00     1500.00
DC     1930.00     2660.00     5000.00     9900.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00
DC        1.00        0.00        0.00        0.00        0.00        0.00      200.00      300.00      500.00      600.00
DC     1800.00     1100.00     2150.00     9600.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00

CP        5.00    37000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID CP 5                                                  -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        5.00        0.00        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       -0.00

    NRES=     2  NCPT=     5  NCPTR=     -0

IN      1  6 JUNE    1000.0      2000.0     30000.0     18000.0     37000.0     42000.0     50000.0     27000.0     20000.0     13000.0
```

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```
                   5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                              SUM=    231000
   IN    2  6 JUNE  2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                   37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                              SUM=    517500
   IN    3  6 JUNE  3000.0    6000.0   27000.0   60000.0  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
                                                                                                              SUM=    504000
   IN    4  6 JUNE  2000.0    4000.0   19000.0   13000.0   10000.0    7000.0    4000.0    1000.0    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    6000.0    5000.0    3000.0    2000.0     500.0     500.0    2000.0
                    5000.0   12000.0    6000.0    4000.0    2000.0    1000.0     500.0     200.0
                                                                                                              SUM=     61700
   EJ   =0            =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0
```

```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=        CUM LOCA   NATURAL    INFLOW     OUTFLOW    CASE=LOC   LEVEL      EOP STOR

    1         3850.00   3850.00   3850.00    3850.00        .02       2.04   53818.24
    3         8400.00   8400.00   8400.00    8400.00        .02       2.01  108479.46

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=        CUM LOCA   NATURAL   REGULATE    Q SPACE    Q BY US   FLOOD BY

    2         8625.00  12474.98   12474.56    8525.44    3849.56    1104.09
    4        10754.16  23027.84   23018.47   41981.53   12264.32       0.00
    5        11795.81  24080.87   24016.26   12983.74   12220.45    1144.98


COMPUTATION INTERVAL IN HOURS=      6

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

                   NFLRD=        1  NFLCON=       6
                   IFLRD =       1  IFLCON=       2
                     FLOWS MULTIPLIED BY     1.00

*******************************************************************************************************

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

                                                                                  STARTING TIME=      1
                              SERVING       1     4                               HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
PER       CUM LOCAL Q

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

                                                                                  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

                                                                                  AVG=   12833.333   MAX=  50000.000
                                                                                                     MIN=   1000.000
PER       OUTFLOW

    1    1000    2000    3000    6000       0       0       0       0       0       0
   11    2658    4000    6000    6000    6000    6000    6000    6000

                                                                                  AVG=    3036.580   MAX=   6000.000
                                                                                                     MIN=      0.000
```

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```
PER        CASE=LOC,TYP

   1     ,03     ,03     ,03     ,01    4,02    4,01    4,00    4,00    4,00    4,00
  11     ,04     ,04     ,01     ,01     ,01     ,01     ,01     ,01

                                                                                                AVG=      1,348  MAX=      4,020
                                                                                                                 MIN=       ,010
PER        LEVEL

   1   2,000   2,000   2,000   2,059   2,241   2,448   2,693   2,826   2,925   2,988
  11   3,000   3,000   2,985   2,966   2,941   2,916   2,892   2,867

                                                                                                AVG=      2,653  MAX=      3,000
                                                                                                                 MIN=      2,000
PER        EOP STORAGE

   1   50000   50000   50000   55950   74298   95125  119918  133307  143224  149671
  11  150832  150832  149344  147361  144881  142402  139923  137443

                                                                                                AVG= 115806,264  MAX= 150832,000
                                                                                                                 MIN=  50000,000
************************************************************************************************************************************
**** LOC     2  CP 2                                    SERVED BY     -1

PER        CUM LOCAL Q

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

                                                                                                AVG=  28750,000  MAX= 100000,000
                                                                                                                 MIN=   1500,000
PER        NATURAL FLOW

   1    3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
  11   49884   30147   28191   18032   11005    4168    3028    2505

                                                                                                AVG=  41583,282  MAX= 142140,454
                                                                                                                 MIN=   2504,654
PER        REGULATED FLOW

   1    3000    4167    6028    9338   24556   57759  100127   90021   70004   50001
  11   37443   26513   28085   20681   14947    8991    7999    7500

                                                                                                AVG=  31508,805  MAX= 100126,565
                                                                                                                 MIN=   3000,000
PER        Q SPACE AVAIL,

   1   18000   16833   14972   11662   -3556  -36759  -79127  -69021  -49004  -29001
  11  -16443   -5513   -7085     319    6053   12009   13001   13500

                                                                                                AVG= -10508,805  MAX=  18000,000
                                                                                                                 MIN= -79126,565
PER        Q BY US RES,DIVS

   1    1000    1167    2028    3338    4556     759     127      21       4       1
  11     443    2513    4085    5681    5947    5991    5999    6000

                                                                                                AVG=   2758,805  MAX=   5999,754
                                                                                                                 MIN=       ,586
PER        FLOOD BY RES

   1       0       0       0       0    3556     759     127      21       4       1
  11     443    2513    4085       0       0       0       0       0

                                                                                                AVG=    639,385  MAX=   4085,469
```

```
                                                                                                        MIN=      0.000
*******************************************************************************************************************
**** LOC     3  RESERVOIR C (CP 3)                    SERVED BY      2

                                                                                         STARTING TIME=        1
                                                                                         HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                         SERVING        2     4
PER         CUM LOCAL Q

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

                                                                                         AVG=  28000.000  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     6000     3000     2000     1000

                                                                                         AVG=  28000.000  MAX= 105000.000
                                                                                                          MIN=   1000.000
PER         INFLOW

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

                                                                                         AVG=  28000.000  MAX= 105000.000
                                                                                                          MIN=   1000.000
PER         OUTFLOW

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

                                                                                         AVG=   5833.333  MAX=  12000.000
                                                                                                          MIN=      0.000
PER         CASE=LOC.TYP

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

                                                                                         AVG=      1.788  MAX=      4.020
                                                                                                          MIN=       .010
PER         LEVEL

     1    2.000    2.000    2.011    2.048    2.127    2.186    2.232    2.266    2.291    2.309
    11    2.322    2.331    2.331    2.329    2.325    2.318    2.310    2.302

                                                                                         AVG=      2.224  MAX=      2.331
                                                                                                          MIN=      2.000
PER         EOP STORAGE

     1   100000   100000   107438   131240   183307   221985   251738   274052   290416   302317
    11   311243   317193   317193   315706   312730   308267   303309   297854

                                                                                         AVG= 246999.389  MAX= 317193.250
                                                                                                          MIN= 100000.000
*******************************************************************************************************************
**** LOC     4  CP 4                                  SERVED BY      1     2

PER         CUM LOCAL Q

     1     4000     6333    22200    17507    20368    37407    70015    90870    84307    69995
    11    58866    60040    39208    28442    18288    10058     4678     2669
```

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```
                                                                                                              AVG=  35847.190  MAX=  90869.611
PER        NATURAL FLOW                                                                                                        MIN=   2668.973

   1   8000   11389   36231   55639   99838  148808  179002  190285  166727  130090
  11 101853   89099   58886   43944   29672   17459    9113    5637

                                                                                                              AVG=  76759.467  MAX= 190284.798
PER        REGULATED FLOW                                                                                                      MIN=   5637.126

   1   8000   11389   31231   30972   31738   42060   71342   91201   84385   70012
  11  59017   61115   45957   43192   35472   27867   22635   20660

                                                                                                              AVG=  43791.318  MAX=  91201.152
PER        Q SPACE AVAIL.                                                                                                      MIN=   8000.000

   1  57000   53611   33769   34028   33262   22940   -6342  -26201  -19385   -5012
  11   5983    3885   19043   21808   29528   37133   42365   44340

                                                                                                              AVG=  21208.682  MAX=  57000.000
PER        Q BY US RES,DIVS                                                                                                    MIN= -26201.152

   1   4000    5056    9031   13465   11370    4653    1327     332      77      17
  11    151    1075    6749   14750   17183   17809   17957   17991

                                                                                                              AVG=   7944.127  MAX=  17990.659
PER        FLOOD BY RES                                                                                                        MIN=     17.301

   1      0       0       0       0       0       0    1327     332      77      17
  11      0       0       0       0       0       0       0       0

                                                                                                              AVG=     97.411  MAX=   1327.234
                                                                                                                               MIN=      0.000
*****************************************************************************************************************************************
**** LOC     5  CP 5                               SERVED BY    -1    -2

PER        CUM LOCAL Q

   1   5000    6389   17654   25160   23259   25856   42416   69057   86557   84214
  11  75176   72946   62719   44332   30731   19657   11094    5529

                                                                                                              AVG=  39319.354  MAX=  86557.198
PER        NATURAL FLOW                                                                                                        MIN=   5000.000

   1   9000   10565   24059   41937   64722  104313  147925  175869  184373  165478
  11 135949  116577   92643   65021   46411   31093   18674   10244

                                                                                                              AVG=  80269.554  MAX= 184372.522
PER        REGULATED FLOW                                                                                                      MIN=   9000.000

   1   9000   10565   23225   34354   35663   36279   47477   70841   87088   84356
  11  75237   73237   64609   51605   44641   36399   28750   23442

                                                                                                              AVG=  46487.091  MAX=  87088.364
PER        Q SPACE AVAIL.                                                                                                      MIN=   9000.000

   1  28000   26435   13775    2646    1337     721  -10477  -33841  -50088  -47356
  11 -38237  -36237  -27609  -14605   -7641     601    8250   13558
```

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```
                                                                                                   AVG=  -9487,091  MAX=  28000,000
 PER        Q BY US RES,DIVS                                                                                        MIN= -50088,364

   1    4000    4176    5572    9194   12404   10423    5061    1783     531     143
  11      61     290    1890    7273   13909   16742   17656   17913
                                                                                                   AVG=   7167,737  MAX=  17912,509
 PER        FLOOD BY RES                                                                                            MIN=     60,603

   1       0       0       0       0       0       0    5061    1783     531     143
  11      61     290    1890    7273    7641       0       0       0
                                                                                                   AVG=   1370,675  MAX=   7640,554
                                                                                                                    MIN=      0,000
 **********************************************************************************************************************************

              CUM TIME=       1

 RES NO=          1        3
 INFLOW        1000     3000
 OUTFLOW       1000     3000
 EOP 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
 EOP 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
 EOP 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       6000    12000
 EOP STOR     55950   131240
 CASE=          ,01      ,01
 LEVEL        2,059    2,048
 EQ LEVEL     2,059    2,048
```

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```
                 FALL RIVER BASIN   ***   CHANNEL MODIFICATIONS   ***
                 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
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
LOC     2  CP 2                  1.007      35969 *      1.007      42642 *      1.007      30000 *     5969 *   0.00    0.00
LOC     4  CP 4                  1.008      45168 *      1.008      57085 *      1.008      27261 *    17907 *   0.00    0.00
LOC     5  CP 5                  1.009      43808 *      1.009      55312 *      1.009      25967 *    17841 *   0.00    0.00

          RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)    1.018    50000     2.000 *   1.008    61305     2.112 *   1.005     6000      6000   50000

LOC     3  RESERVOIR C (CP 3)    1.018   100000     2.000 *   1.008   122016     2.034 *   1.004    12000     12000  100000

                          MIN SYSTEM STG=    150000    MAX SYSTEM STG=    183321

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

                                                                                STARTING TIME      1

                                                                                           SHORTAGE INDEX
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
LOC     2  CP 2                  2.007     100127 *      2.007     142140 *      2.007     100000 *      127 *   0.00    0.00
LOC     4  CP 4                  2.008      91201 *      2.008     190285 *      2.008      90870 *      332 *   0.00    0.00
LOC     5  CP 5                  2.009      87088 *      2.009     184373 *      2.009      86557 *      531 *   0.00    0.00

          RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)    2.003    50000     2.000 *   2.012   150832     3.000 *   2.004     6000      6000   50000

.LOC    3  RESERVOIR C (CP 3)    2.002   100000     2.000 *   2.012   317193     2.331 *   2.003    12000     12000  100000

                          MIN SYSTEM STG=    150000    MAX SYSTEM STG=    468025

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

                                                                                STARTING TIME      1

                                                                                           SHORTAGE INDEX
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
LOC     2  CP 2                  3.007     155287 *      3.007     213211 *      3.007     150000 *     5287 *   0.00    0.00
LOC     4  CP 4                  3.009     144615 *      3.008     285427 *      3.008     136304 *     8311 *   0.00    0.00
LOC     5  CP 5                  3.010     144668 *      3.009     276559 *      3.009     129836 *    14832 *   0.00    0.00

          RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)    3.003    50000     2.000 *   3.007   150832     3.000 *   3.008    40499      6000   50000
```

```
LOC     3  RESERVOIR C (CP 3)          3,002  100000     2,000 *   3,014  447360     2,530 *  3,003    12000      12000  100000

                          MIN SYSTEM STG=    150000    MAX SYSTEM STG=    598192

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

                                                                                                    STARTING TIME      1

                                                                                                             SHORTAGE INDEX
                                       FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        4,008    244438 *       4,007    284281 *       4,007    200000 *    44438 *    0,00     0,00
LOC     4  CP 4                        4,009    222830 *       4,008    380570 *       4,008    181739 *    41091 *    0,00     0,00
LOC     5  CP 5                        4,010    218118 *       4,009    368745 *       4,009    173114 *    45004 *    0,00     0,00
          RESERVOIRS                   FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)          4,003    50000    2,000 *   4,007  150832     3,000 *  4,007    78658      6000   50000

LOC     3  RESERVOIR C (CP 3)          4,002  100000     2,000 *   4,014  573064     2,722 *  4,002    12000      12000  100000

                          MIN SYSTEM STG=    150000    MAX SYSTEM STG=    723896

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

                                                                                                    STARTING TIME      1

                                                                                                             SHORTAGE INDEX
                                       FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        5,008    383382 *       5,007    426421 *       5,007    300000 *    83382 *    0,00     0,00
LOC     4  CP 4                        5,009    362013 *       5,008    570854 *       5,008    272609 *    89404 *    0,00     0,00
LOC     5  CP 5                        5,010    355932 *       5,009    553118 *       5,009    259672 *    96261 *    0,00     0,00
          RESERVOIRS                   FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)          5,001    51408    2,015 *   5,007  168236     3,354 *  5,007   120542      6000   50000

LOC     3  RESERVOIR C (CP 3)          5,001  104463     2,007 *   5,011  755408     3,000 *  5,012    35999      12000  100000

                          MIN SYSTEM STG=    155949    MAX SYSTEM STG=    923644

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

                                                                                                    STARTING TIME      1

                                                                                                             SHORTAGE INDEX
                                       FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                        6,007    516031 *       6,007    568562 *       6,007    400000 *   116031 *    0,00     0,00
LOC     4  CP 4                        6,009    599044 *       6,008    761139 *       6,008    363478 *   235565 *    0,00     0,00
LOC     5  CP 5                        6,010    584434 *       6,009    737490 *       6,009    346229 *   238206 *    0,00     0,00
          RESERVOIRS                   FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)          6,001    51983    2,020 *   6,007  191183     3,821 *  6,007   163829      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 STG=    157933    MAX SYSTEM STG=    972456
```

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```
                           EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                             CONTROL POINT NUMBER    4

                                BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ       PEAK         SUM     TYPE 1     TYPE
     .9990      28800        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     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
     EXIST SYSTEM-INPUT     696.82    696.82

                                BASE CONDITION FLOOD DAMAGES
              EXCD  PROB
 NO.  FLOW    FREQ   INT        SUM     TYPE 1      TYPE
  1   57085  .632   .615     226.09    226.09
  2  190285  .138   .284     540.14    540.14
  3  285427  .065   .051     357.83    357.83
  4  380570  .036   .026     273.38    273.38
  5  570854  .013   .014     178.59    178.59
  6  761139  .007   .010     145.27    145.27

     BASE COND DAMAGES    1721.30   1721.30
     EXST SYST DAMAGES     696.82    696.82

                                MODIFIED CONDITIONS FLOW-DAMAGE DATA
     FREQ       PEAK         SUM     TYPE 1     TYPE
     .9990      28800        0.00      0.00
     .9000      35000        0.00      0.00
     .8000      42000        0.00      0.00
     .7000      50500        0.00      0.00
     .5608      65000       72.00     72.00
     .5000      73000      200.00    200.00
     .4000      90000      300.00    300.00
     .3000     114000      500.00    500.00
     .2500     130000      600.00    600.00
     .2000     150000     1800.00   1800.00
     .1500     180000     1100.00   1100.00
     .1000     230000     2150.00   2150.00
     .0500     323000     9600.00   9600.00
     .0200     490000    12280.00  12280.00
     .0100     640000    13350.00  13350.00
     .0050     840000    14150.00  14150.00
     .0020    1000000    14600.00  14600.00
```

```
                                                    MODIFIED CONDITIONS FLOOD DAMAGES
             EXCD  PROB
NO.  FLOW    FREQ   INT        SUM      TYPE 1     TYPE
 1    45168 .632   .615        0.00      0.00
 2    91201 .138   .284       48.98     48.98
 3   144615 .065   .051       48.37     48.37
 4   222830 .036   .026       61.41     61.41
 5   362013 .013   .014      127.51    127.51
 6   599044 .007   .010      138.91    138.91

     MODIFIED DAMAGES         425.18    425.18
     DAMAGE REDUCTION         271.64    271.64


                                                    UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
             EXCD  PROB
NO.  FLOW    FREQ   INT        SUM      TYPE 1     TYPE
 1    27261 .632   .615        0.00      0.00
 2    90870 .138   .284       33.07     33.07
 3   136304 .065   .051       41.21     41.21
 4   181739 .036   .026       36.88     36.88
 5   272609 .013   .014       57.54     57.54
 6   363478 .007   .010      111.24    111.24
     DAMAGES W/ TOTAL
   CONTROL AT PROJECTS        279.95    279.95

    REDUCTION POSSIBLE
    W/ TOTAL CONTROL          416.87    416.87

     RESIDUAL DAMAGES         145.23    145.23
```

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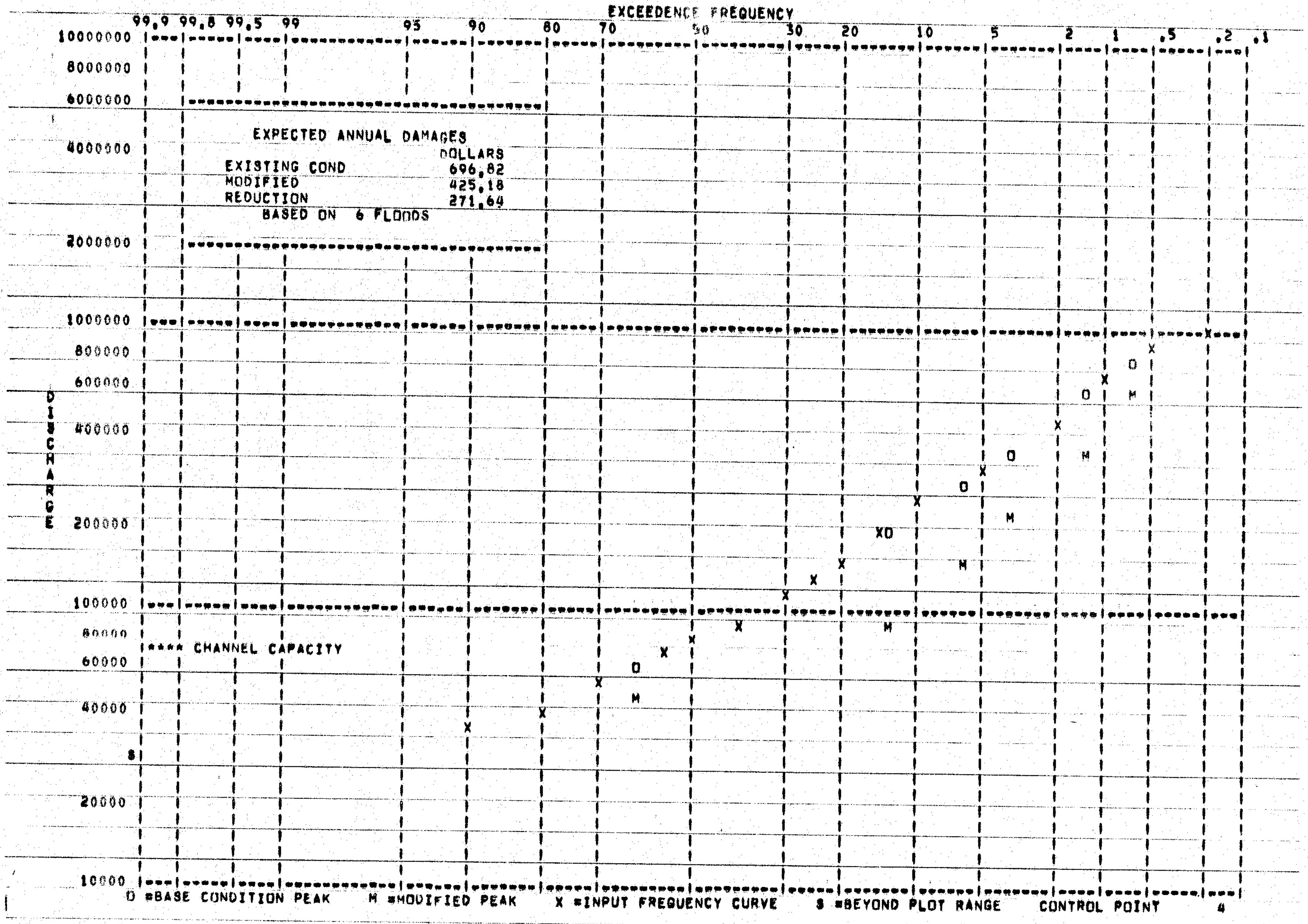
CONTROL POINT 4



EXPECTED ANNUAL DAMAGES

	DOLLARS
EXISTING COND	696.82
MODIFIED	425.18
REDUCTION	271.64

BASED ON 6 FLOODS

O =BASE CONDITION PEAK M =MODIFIED PEAK X =INPUT FREQUENCY CURVE $ =BEYOND PLOT RANGE CONTROL POINT 4

```
                          SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
*****************************************************************************
*          *.................DAMAGES.................*.......DAMAGE REDUCTION.......*
*  CONTROL  * BASE (EXIST)   MODIFIED    UNCONTROL   *  MODIFIED   TOTAL CONTROL             *
*   POINT   *  CONDITION    CONDITIONS   LOCAL COND  * CONDITIONS   AT PROJECTS    RESIDUAL  *
*  -------  *  ----------   ----------   ----------  * ----------   ----------   ---------- *
*      4    *      696.82       425.18       279.95  *     271.64       416.87       145.23 *
*           *                                        *                                       *
*   TOTAL   *      696.82       425.18       279.95  *     271.64       416.87       145.23 *
*           *                                        *                                       *
*****************************************************************************
```

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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 * * * *            68.40

TOTAL SYSTEM ANNUAL COST  * * * * * * *                          270.18


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM          696.82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM          425.18

AVERAGE ANNUAL DAMAGE REDUCTION                                  271.64


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS                1.46
```

```
    HEC-5C-VARIABLE OUTPUT MAR.1975
    RES.= 35 CPTS.= 75 PERS.=100

T1 FALL RIVER BASIN   ***   DIVERSION   ***
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       18.00        6.00        4.00        2.00        3.00       -0.00       -0.00        1.00       -0.00        1.00
J2       -0.00        1.10        2.00        1.00       -0.00        0.00       -1.00       -0.00       -0.00       -1.00
J4        6.00         .30        1.00        1.50        2.00        3.00        4.00       -0.00       -0.00       -0.00

RL        1.00    50000.00       -0.00        0.00    50000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        6.00        0.00    50000.00    70000.00   100000.00   150832.00   200000.00       -0.00       -0.00       -0.00
RQ        6.00     5000.00     6000.00     7000.00     8000.00   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
ID RESERVOIR A (CP 1)                                   -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        1.00        2.00         .20         .30        6.00       -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
ID CP 2                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        2.00        4.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00
DR        2.00        5.00        4.20         .15       24.00         .90       -1.00       -0.00       -0.00       -0.00
DQ        9.00        0.00    30000.00    50000.00    70000.00    90000.00   110000.00   130000.00   150000.00   190000.00
DQ        9.00        0.00        0.00    22000.00    37500.00    45000.00    51000.00    55000.00    58500.00    62500.00

RL        3.00   100000.00       -0.00        0.00   100000.00   755408.00  1000000.00       -0.00       -0.00       -0.00
RO        1.00        4.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RS        7.00        0.00   100000.00   200000.00   400000.00   700000.00   800000.00  1000000.00       -0.00       -0.00
RQ        7.00    10000.00    12000.00    18000.00    30000.00    80000.00   150000.00   500000.00       -0.00       -0.00

CP        3.00    12000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID RESERVOIR C (CP 3)                                   -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        3.00        4.00         .20         .30        6.00       -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         .06         .80
ID CP 4                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        4.00        5.00         .20         .30        6.00       -0.00       -0.00       -0.00       -0.00       -0.00
QS        1.00    35000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
CS    35000.00    10520.00       -0.00       -0.00       -0.00       -0.00       -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       -0.00
DB        1.00      696.82       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
DF       17.00        1.00         .90         .80         .70         .60         .50         .40         .30         .25
DF         .20         .15         .10         .05         .02         .01         .01         .00       -0.00       -0.00
DQ       17.00    28800.00    35000.00    42000.00    50500.00    60500.00    73000.00    90000.00   114000.00   130000.00
DQ   150000.00   180000.00   230000.00   323000.00   490000.00   640000.00   840000.00  1000000.00       -0.00       -0.00
DC        1.00        0.00        0.00      180.00      380.00      500.00      630.00      900.00     1250.00     1500.00
DC     1930.00     2660.00     5000.00     9900.00    12280.00    13350.00    14150.00    14600.00       -0.00       -0.00

CP        5.00    37000.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
ID CP 5                                                 -0.00       -0.00       -0.00       -0.00       -0.00       -0.00
RT        5.00        0.00        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       -0.00

     NRES=      2  NCPT=    5  NCPTR=    -0
```

DIVERSION DATA

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```
IN     1  6 JUNE     1000.0    2000.0    3000.0   18000.0   37000.0   42000.0   50000.0   27000.0   20000.0   13000.0
                     5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                          SUM=      231000
IN     2  6 JUNE     2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                    37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                          SUM=      517500
IN     3  6 JUNE     3000.0    6000.0   27000.0   60000.0  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
                                                                                                          SUM=      504000
IN     4  6 JUNE     2000.0    4000.0   19000.0   13000.0   10000.0    7000.0    4000.0    1000.0    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    6000.0    5000.0    3000.0    2000.0     500.0     500.0    2000.0
                     5000.0   12000.0    6000.0    4000.0    2000.0    1000.0     500.0     200.0
                                                                                                          SUM=       61700
EJ    =0               =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0
```

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```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC#       CUM LOCA   NATURAL    INFLOW    OUTFLOW    CASE#LOC   LEVEL      EOP STOR

    1       3850.00    3850.00    3850.00    3850.00        .02       2.04    53818.24
    3       8400.00    8400.00    8400.00    8034.61       1.12       2.03   119539.16

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC#       CUM LOCA   NATURAL   REGULATE    Q SPACE    Q BY US   FLOOD BY

    2       8625.00   12474.98   11926.81    9073.19    3301.81     556.33
    4      10755.92   23035.43   21468.91   13531.09   10712.99       0.00
    5      11795.97   24083.97   21977.37   15022.63   10181.40       0.00


COMPUTATION INTERVAL IN HOURS=      6

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

                    NFLRD=        1  NFLCUN=       6
                    IFLRD =       1  IFLCUN=       2
                       FLOWS MULTIPLIED BY      1.00

************************************************************************************************************************

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

                                                                                   STARTING TIME=        1
                                                                                   HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                   SERVING         1      4
PER          CUM LOCAL Q

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

                                                                                   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

                                                                                   AVG=  12833.333  MAX=  50000.000
                                                                                                    MIN=   1000.000
PER          OUTFLOW

     1     1000      2000      3000      6000         0         0         0         0         0         0
    11     2658      4000      3000      2000      6000      6000      6000      6000

                                                                                   AVG=   2647.691  MAX=   6000.000
                                                                                                    MIN=      0.000
```

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```
PER         CASE=LOC.TYP

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

                                                                                      AVG=      1.352  MAX=       4.020
                                                                                                       MIN=        .010
PER         LEVEL

    1   2.000   2.000   2.000   2.059   2.241   2.448   2.693   2.826   2.925   2.988
   11   3.000   3.000   3.000   3.000   2.975   2.951   2.926   2.902

                                                                                      AVG=      2.663  MAX=       3.000
PER         EOP STORAGE                                                                                MIN=       2.000

    1   50000   50000   50000   55950   74298   95125  119918  133307  143224  149671
   11  150832  150832  150832  150832  148353  145873  143394  140914

                                                                                      AVG= 116853.111  MAX= 150832.000
                                                                                                       MIN=  50000.000
****************************************************************************************************
**** LOC      2  CP 2                            SERVED BY    -1

PER         CUM LOCAL Q

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

                                                                                      AVG=  28750.000  MAX= 100000.000
PER         NATURAL FLOW                                                                               MIN=   1500.000

    1    3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
   11   49884   30147   28191   18032   11005    4168    3028    2505

                                                                                      AVG=  41583.282  MAX= 142140.454
PER         DIVERSION Q                                                                                MIN=   2504.654

    1       0       0       0       0       0   28014   48038   45006   37501   22000
   11    8187       0       0       0       0       0       0       0

                                                                                      AVG=  10485.949  MAX=  48037.969
PER         REGULATED FLOW                                                                             MIN=      0.000

    1    3000    4167    6028    9338   24556   29746   52089   45015   32502   28000
   11   29256   26513   27585   17931   11822    8470    7912    7485

                                                                                      AVG=  20634.127  MAX=  52088.595
PER         Q SPACE AVAIL.                                                                             MIN=   3000.000

    1   18000   16833   14972   11662   -3556   -8746  -31089  -24015  -11502   -7000
   11   -8256   -5513   -6585    3069    9178   12530   13088   13515

                                                                                      AVG=    365.873  MAX=  18000.000
PER         Q BY US RES,DIVS                                                                           MIN= -31088.595

    1    1000    1167    2028    3338    4556  -27254  -47911  -44985  -37498  -22000
   11   -7744    2513    3585    2931    2822    5470    5912    5985

                                                                                      AVG=  -8115.873  MAX=    5985.286
```

```
PER        FLOOD BY RES                                                                                          MIN= -47911.405

   1        0       0       0       0     3596  -27254  -47911  -44985  -37498  -22000
  11    -7744    2513    3585       0        0       0       0       0

                                                                                    AVG=  -9874.342  MAX=   3585.469
                                                                                                     MIN= -47911.405
****************************************************************************************************

**** LOC     3  RESERVOIR C (CP 3)                   SERVED BY     2

                                                                                    STARTING TIME=       1
                                                                                    HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
                                         SERVING      2    4
PER        CUM LOCAL Q

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

                                                                                    AVG=  28000.000  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    6000    3000    2000    1000

                                                                                    AVG=  28000.000  MAX= 105000.000
                                                                                                     MIN=   1000.000
PER        INFLOW

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

                                                                                    AVG=  28000.000  MAX= 105000.000
                                                                                                     MIN=   1000.000
PER        OUTFLOW

   1     3000    6000   12000   11380       0       0       0       0       0       0
  11        0       0       0       0   12000   12000   12000   12000

                                                                                    AVG=   4465.548  MAX=  12000.000
                                                                                                     MIN=      0.000
PER        CASE=LOC.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

                                                                                    AVG=      2.453  MAX=      4.020
                                                                                                     MIN=       .010
PER        LEVEL

   1    2.000   2.000   2.011   2.048   2.128   2.187   2.232   2.266   2.291   2.309
  11    2.323   2.332   2.341   2.348   2.343   2.336   2.329   2.321

                                                                                    AVG=      2.230  MAX=      2.348
                                                                                                     MIN=      2.000
PER        EOP STORAGE

   1   100000  100000  107438  131548  183615  222293  252045  274360  290724  302625
  11   311550  317501  323451  327914  324939  320476  315517  310063

                                                                                    AVG= 250892.066  MAX= 327914.138
                                                                                                     MIN= 100000.000
****************************************************************************************************
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```
**** LOC      4  CP 4                                   SERVED BY      1      2
PER         CUM LOCAL Q

    1    4000    6167   22028   17171   18029   31171   62695   92449   87908   73485
   11   61081   62180   39197   29866   19311   11052    4842    2724

                                                                                          AVG=  35853,070   MAX=  92449,206
PER         NATURAL FLOW                                                                                    MIN=   2723,662

    1    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
   11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                          AVG=  76784,776   MAX= 194036,091
PER         REGULATED FLOW                                                                                  MIN=   5846,858

    1    8000   10694   29898   30288   30786   31793   36644   48669   44372   37563
   11   39137   53779   40069   32890   24239   24666   21743   20479

                                                                                          AVG=  31428,338   MAX=  53778,693
PER         Q SPACE AVAIL.                                                                                  MIN=   8000,000

    1   27000   24306    5102    4712    4214    3207   -1644  -13669   -9372   -2563
   11   -4137  -18779   -5069    2110   10761   10334   13257   14521

                                                                                          AVG=   3571.662   MAX=  27000,000
PER         Q BY US RES,DIVS                                                                                MIN= -18778,693

    1    4000    4528    7870   13117   12767     621  -26051  -43780  -43537  -35921
   11  -21944   -8401     873    3024    4928   13614   16901   17756

                                                                                          AVG=  -4424,733   MAX=  17755,560
PER         FLOOD BY RES                                                                                    MIN= -43780,324

    1       0       0       0       0       0       0  -26051  -43780  -43537  -35921
   11  -21944   -8401     873       0       0       0       0       0

                                                                                          AVG=  -9931.236   MAX=    872,549
                                                                                                            MIN= -43780,324
*******************************************************************************************************************
**** LOC      5  CP 5                                   SERVED BY     -1     -2
PER         CUM LOCAL Q

    1    5000    6361   17509   24965   22613   23150   36588   63470   87279   87316
   11   78389   75315   64539   44865   31940   20706   11959    5792

                                                                                          AVG=  39319,888   MAX=  87316,106
PER         NATURAL FLOW                                                                                    MIN=   5000,000

    1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
   11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                          AVG=  80279,898   MAX= 187631,160
PER         DIVERSION Q                                                                                     MIN=   9000,000

    1       0       0       0       0       0      -0       0      -6      27      27
   11    -209    -849   -1967   -3494   -5246   -6987   -8523   -9730
```

```
                                                                                                AVG= -2053.285  MAX=     26.704
                                                                                                                MIN=  -9730.180
PER         REGULATED FLOW

   1    9000   10449   22521   33234   34862   33800   34435   38453   46639   45509
  11   44030   54374   57419   47931   39953   33709   33378   31898
                                                                                                AVG= 36199.571  MAX=  57418.767
                                                                                                                MIN=   9000.000
PER         Q SPACE AVAIL.

   1   28000   26551   14479    3766    2138    3200    2565   -1453   -9639   -8509
  11   -7030  -17374  -20419  -10931   -2953    3291    3622    5102
                                                                                                AVG=   800.429  MAX=  28000.000
                                                                                                                MIN= -20418.767
PER         Q BY US RES,DIVS

   1    4000    4088    5012    8268   12249   10650   -2153  -25017  -40640  -41807
  11  -34359  -20942   -7120    3066    8012   13003   21419   26106
                                                                                                AVG= -3120.317  MAX=  26106.189
                                                                                                                MIN= -41806.829
PER         FLOOD BY RES

   1       0       0       0       0       0       0       0  -25017  -40640  -41807
  11  -34359  -20942   -7120    3066    2953       0       0       0
                                                                                                AVG= -9103.718  MAX=   3065.673
                                                                                                                MIN= -41806.829
*****************************************************************************************************************

                CUM TIME=      1

RES NO=          1       3
DIV Q        -1000   -1000
INFLOW        1000    3000
OUTFLOW       1000    3000
EOP STOR     50000  100000
CASE=          .03     .03
LEVEL        2.000   2.000
EQ LEVEL     2.000   2.000

                CUM TIME=      2

RES NO=          1       3
DIV Q        -1000   -1000
INFLOW        2000    6000
OUTFLOW       2000    6000
EOP STOR     50000  100000
CASE=          .03     .03
LEVEL        2.000   2.000
EQ LEVEL     2.000   2.000

                CUM TIME=      3

RES NO=          1       3
DIV Q        -1000   -1000
INFLOW        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
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 1.008      29701 *      1.007      42642 *      1.007      30000 *     -299 *   0.00     0.00
LOC     4  CP 4                 1.011      33167 *      1.008      58211 *      1.008      27735 *     5433 *   0.00     0.00
LOC     5  CP 5                 1.012      35946 *      1.009      56289 *      1.010      26195 *     9751 *   0.00     0.00

            RESERVOIRS         FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)   1.018    50000     2.000 *  1.008    61305     2.112 *  1.005     6000       6000   50000

LOC     3  RESERVOIR C (CP 3)   1.003   100000     2.000 *  1.009   138256     2.058 *  1.004    12000      12000  100000
                         MIN SYSTEM STG=     150000     MAX SYSTEM STG=     199561

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

                                                                                 STARTING TIME       1
                                                                                               SHORTAGE INDEX
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 2.007      52089 *      2.007     142140 *      2.007     100000 *   -47911 *   0.00     0.00
LOC     4  CP 4                 2.012      53779 *      2.008     194036 *      2.008      92449 *   -38671 *   0.00     0.00
LOC     5  CP 5                 2.013      57419 *      2.009     187631 *      2.010      87316 *   -29897 *   0.00     0.00

            RESERVOIRS         FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)   2.003    50000     2.000 *  2.012   150832     3.000 *  2.004     6000       6000   50000

LOC     3  RESERVOIR C (CP 3)   2.002   100000     2.000 *  2.014   327914     2.348 *  2.003    12000      12000  100000
                         MIN SYSTEM STG=     150000     MAX SYSTEM STG=     478746

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

                                                                                 STARTING TIME       1
                                                                                               SHORTAGE INDEX
                               FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 3.007      97999 *      3.007     213211 *      3.007     150000 *   -52001 *   0.00     0.00
LOC     4  CP 4                 3.009      92719 *      3.008     291054 *      3.008     138674 *   -45955 *   0.00     0.00
LOC     5  CP 5                 3.010      93466 *      3.009     281447 *      3.010     130974 *   -37509 *   0.00     0.00

            RESERVOIRS         FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)   3.001    50744     2.007 *  3.007   150832     3.000 *  3.008    40499       6000   50000
```

```
LOC     3  RESERVOIR C (CP 3)         3.001   102231     2.003 *   3.015   469191     2.563 *  3.016    12000      12000  100000

                        MIN SYSTEM STG=    152974    MAX SYSTEM STG=    620023

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

                                                                                        STARTING TIME       1

                                                                                                         SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 4.008     183991 *      4.007     284281 *      4.007     200000 *   -16009 *   0.00     0.00
LOC     4  CP 4                 4.009     170999 *      4.008     388072 *      4.008     184898 *   -13899 *   0.00     0.00
LOC     5  CP 5                 4.010     164746 *      4.009     375262 *      4.010     174632 *    -9886 *   0.00     0.00
          RESERVOIRS          FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)         4.001    50992     2.010 *   4.007   150832     3.000 *  4.007    90658       6000   50000

LOC     3  RESERVOIR C (CP 3)         4.001   102975     2.005 *   4.015   593891     2.754 *  4.016    12000      12000  100000

                        MIN SYSTEM STG=    153966    MAX SYSTEM STG=    744723

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

                                                                                        STARTING TIME       1

                                                                                                         SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 5.008     301544 *      5.007     426421 *      5.007     300000 *     1544 *   0.00     0.00
LOC     4  CP 4                 5.009     291940 *      5.008     582108 *      5.008     277348 *    14593 *   0.00     0.00
LOC     5  CP 5                 5.010     286931 *      5.009     562893 *      5.010     261948 *    24983 *   0.00     0.00
          RESERVOIRS          FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)         5.001    51488     2.015 *   5.007   168236     3.354 *  5.007   120542       6000   50000

LOC     3  RESERVOIR C (CP 3)         5.001   104463     2.007 *   5.011   755408     3.000 *  5.012    35999      12000  100000

                        MIN SYSTEM STG=    155949    MAX SYSTEM STG=    923644

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

                                                                                        STARTING TIME       1

                                                                                                         SHORTAGE INDEX
                              FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC     2  CP 2                 6.007     420928 *      6.007     568562 *      6.007     400000 *    20928 *   0.00     0.00
LOC     4  CP 4                 6.009     519662 *      6.008     776144 *      6.008     369797 *   149865 *   0.00     0.00
LOC     5  CP 5                 6.010     504091 *      6.009     750525 *      6.010     349264 *   154826 *   0.00     0.00
          RESERVOIRS          FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC     1  RESERVOIR A (CP 1)         6.001    51983     2.020 *   6.007   191183     3.821 *  6.007   163829       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 STG=    157933    MAX SYSTEM STG=    972456
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                                   EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                     CONTROL POINT NUMBER     4

                             BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
      FREQ       PEAK           SUM     TYPE 1     TYPE
     .9990      28800          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     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
     EXIST SYSTEM-INPUT      696.82     696.82

                             BASE CONDITION FLOOD DAMAGES
              EXCD  PROB
  NO.   FLOW  FREQ   INT        SUM     TYPE 1     TYPE
   1   58211  .621  .623     233.27     233.27
   2  194036  .134  .279     549.81     549.81
   3  291054  .062  .050     360.93     360.93
   4  388072  .034  .025     265.87     265.87
   5  582108  .013  .014     173.38     173.38
   6  776144  .007  .010     138.03     138.03

      BASE COND DAMAGES     1721.30    1721.30
      EXST SYST DAMAGES      696.82     696.82

                             MODIFIED CONDITIONS FLOW-DAMAGE DATA
      FREQ       PEAK           SUM     TYPE 1     TYPE
     .9990      28800          0.00       0.00
     .9000      35000           .00        .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     840000      14150.00   14150.00
     .0020    1000000      14600.00   14600.00
```

```
                                            MODIFIED CONDITIONS FLOOD DAMAGES
               EXCD  PROB
 NO,  FLOW     FREQ   INT         SUM     TYPE 1    TYPE
  1    33167  ,621   ,623       10,64     10,64
  2    53779  ,134   ,279       80,58     80,58
  3    92719  ,062   ,050       42,90     42,90
  4   170999  ,034   ,025       60,84     60,84
  5   291940  ,013   ,014       95,45     95,45
  6   519662  ,007   ,010      127,53    127,53

      MODIFIED DAMAGES         417,95    417,95
      DAMAGE REDUCTION         278,87    278,87

                                            UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
               EXCD  PROB
 NO,  FLOW     FREQ   INT         SUM     TYPE 1    TYPE
  1    27735  ,621   ,623       14,43     14,43
  2    92449  ,134   ,279      166,49    166,49
  3   138674  ,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      108,25    108,25
      DAMAGES W/ TOTAL
    CONTROL AT PROJECTS        525,75    525,75

     REDUCTION POSSIBLE
     W/ TOTAL CONTROL          171,07    171,07

      RESIDUAL DAMAGES        -107,80   -107,80
```

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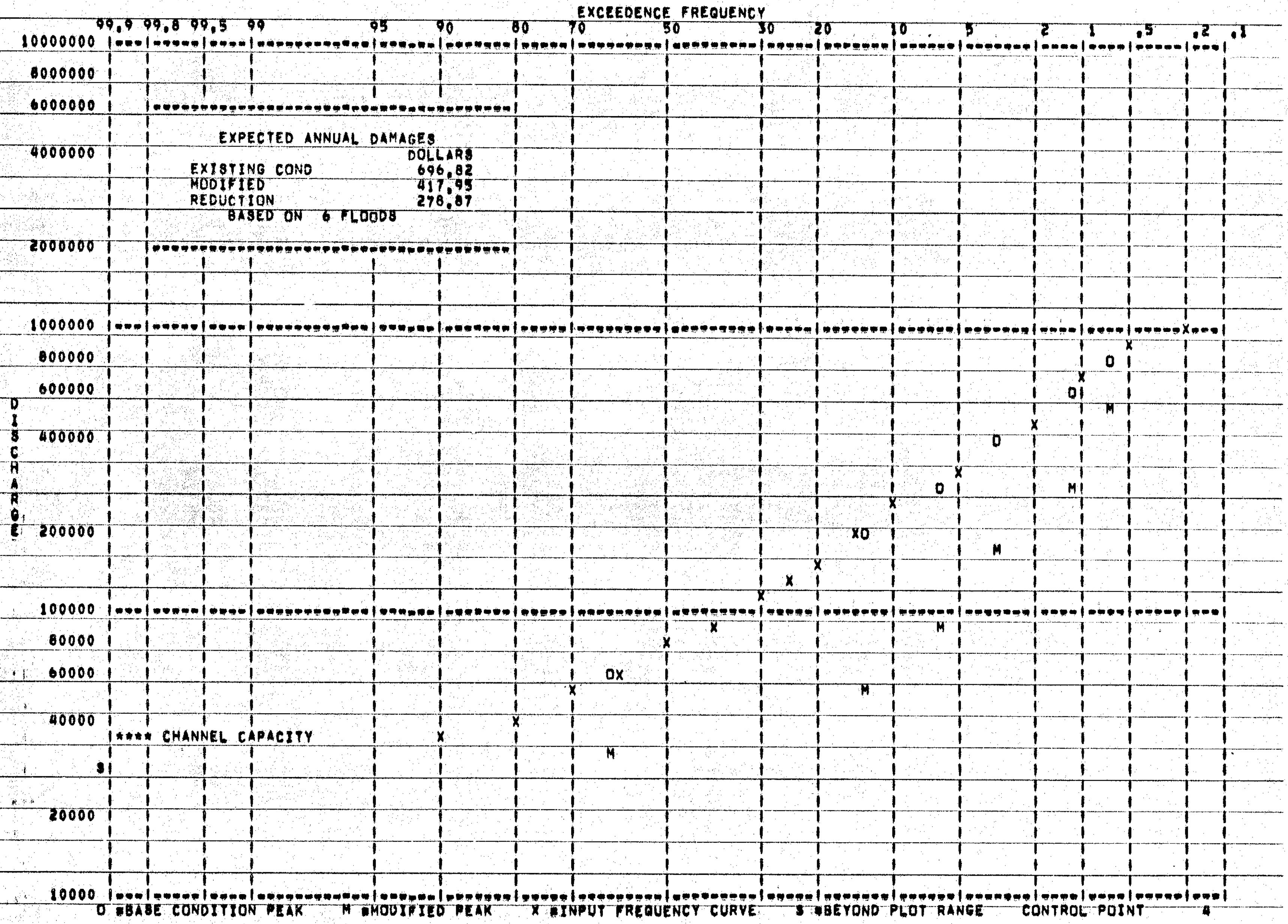
CONTROL POINT 4



EXPECTED ANNUAL DAMAGES

	DOLLARS
EXISTING COND	696.82
MODIFIED	417.95
REDUCTION	278.87

BASED ON 6 FLOODS

```
                         SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
*****************************************************************************************
*          *....................DAMAGES.......................*..............DAMAGE REDUCTION..............*
*  CONTROL * BASE (EXIST)   MODIFIED      UNCONTROL   *  MODIFIED    TOTAL CONTROL              *
*   POINT  *  CONDITION    CONDITIONS    LOCAL COND   * CONDITIONS   AT PROJECTS    RESIDUAL   *
*  ------- *  ----------   ----------    ----------   * ----------   ----------    ----------  *
*       4  *      696.82       417.95        525.75   *     278.87        171.07       -107.80  *
*          *                                          *                                         *
*   TOTAL  *      696.82       417.95        525.75   *     278.87        171.07       -107.80  *
*          *                                          *                                         *
*****************************************************************************************
```

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

              TOTAL SYSTEM CAPITAL COST * * * * * * * *         10520.00

              TOTAL SYSTEM ANNUAL OPERATING
                 MAINTENANCE, AND REPAIR COST * * * * *            84.16

              TOTAL SYSTEM ANNUAL COST  * * * * * * * *                      704.84


              AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM            696.82

              AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM            417.95

              AVERAGE ANNUAL DAMAGE REDUCTION                                278.87


              AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS           -425.97
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       HEC-5C-VARIABLE OUTPUT MAR.1975
       RES.= 35 CPTS.= 75 PERS.=100

     T1 FALL RIVER BASIN     ***   FLOOD FORECASTING    ***
     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       18.00       6.00       4.00       2.00       3.00      -0.00      -0.00       1.00      -0.00       1.00
     J2       -0.00       1.15       6.00       1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
     J4        6.00        .30       1.00       1.50       2.00       3.00       4.00      -0.00      -0.00      -0.00


     RL        1.00   50000.00      -0.00       0.00   50000.00  150832.00  200000.00      -0.00      -0.00      -0.00
     RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RS        6.00       0.00   50000.00   70000.00  100000.00  150832.00  200000.00      -0.00      -0.00      -0.00
     RQ        6.00    5000.00    6000.00    7000.00    8000.00  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
     ID RESERVOIR A (CP 1)                             -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT        1.00       2.00        .20        .30       6.00      -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
     ID CP 2                                           -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT        2.00       4.00        .20        .33       6.00      -0.00      -0.00      -0.00      -0.00      -0.00


     RL        3.00  100000.00      -0.00       0.00  100000.00  755408.00 1000000.00      -0.00      -0.00      -0.00
     RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RS        7.00       0.00  100000.00  200000.00  400000.00  700000.00  800000.00 1000000.00      -0.00      -0.00
     RQ        7.00   10000.00   12000.00   18000.00   30000.00   80000.00  150000.00  500000.00      -0.00      -0.00

     CP        3.00   12000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     ID RESERVOIR C (CP 3)                             -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT        3.00       4.00        .20        .30       6.00      -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        .06       1.60
     ID CP 4                                           -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT        4.00       5.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00
     QS        1.00   35000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     CS    35000.00     120.00      -0.00      -0.00      -0.00      -0.00      -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      -0.00
     DB        1.00     696.82      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     DF       17.00       1.00        .90        .80        .70        .60        .50        .40        .30        .25
     DF         .20        .15        .10        .05        .02        .01        .01        .00      -0.00      -0.00
     DQ       17.00   28800.00   35000.00   42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
     DQ   150000.00  180000.00  230000.00  323000.00  490000.00  640000.00  840000.00 1000000.00      -0.00      -0.00
     DC        1.00       0.00       0.00     180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
     DC     1930.00    2660.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00

     CP        5.00   37000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     ID CP 5                                           -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     RT        5.00       0.00       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      -0.00

          NRES=     2  NCPT=     5  NCPTR=    -0

     IN      1  6 JUNE     1000.0    2000.0    3000.0   18000.0   37000.0   42000.0   50000.0   27000.0   20000.0   13000.0
                           5000.0    4000.0    3000.0    2000.0    1000.0    1000.0    1000.0    1000.0
                                                                                                        SUM=     231000
     IN      2  6 JUNE     2000.0    3000.0    4000.0    6000.0   20000.0   57000.0  100000.0   90000.0   70000.0   50000.0
                          37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                        SUM=     517500
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IN     3  6 JUNE    3000,0     6000,0    27000,0    60000,0   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
                                                                                                                     SUM=      504000
IN     4  6 JUNE    2000,0     4000,0    19000,0    13000,0    10000,0     7000,0     4000,0     1000,0     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     6000,0     5000,0     3000,0     2000,0      500,0      500,0     2000,0
                    5000,0    12000,0     6000,0     4000,0     2000,0     1000,0      500,0      200,0
                                                                                                                     SUM=       61700
EJ    -0              -0,0       -0,0       -0,0       -0,0       -0,0       -0,0       -0,0       -0,0
```

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SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=       CUM LOCA   NATURAL    INFLOW    OUTFLOW    CASE=LOC   LEVEL      EOP STOR

   1        3850.00    3850.00    3850.00   3850.00        .90       2.09   58715.16
   3        8400.00    8400.00    8400.00   7911.42       1.12       2.03  121001.52

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=       CUM LOCA   NATURAL    REGULATE   Q SPACE    Q BY US    FLOOD BY

   2        8625.00   12474.98   12202.87    8797.13    3577.87    328.84
   4       10755.92   23035.43   21319.31   13680.69   10563.39      0.00
   5       11795.97   24083.97   21427.36   15572.64    9631.39      0.00


COMPUTATION INTERVAL IN HOURS=        6

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

                  NFLRD=        1  NFLCUN=       6
                  IFLRD =       1  IFLCUN=       2
                    FLOWS MULTIPLIED BY    1.00

**************************************************************************************************************************

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

                                                                                             STARTING TIME=       1
                                                                                             HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                    SERVING        1     4
PER         CUM LOCAL Q

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

                                                                                             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

                                                                                             AVG=   12833.333  MAX=  50000.000
                                                                                                               MIN=   1000.000
PER         OUTFLOW

  1       0        0        0        0        0        0        0        0        0     9658
 11    5000     4000     3000     2000     6000     6000     6000     6000

                                                                                             AVG=    2647.691  MAX=   9658.432
                                                                                                               MIN=      0.000
PER         CASE=LOC.TYP .

  1    4.05     4.04     4.03     4.02     4.11     4.00     4.00     4.00     4.00      .04
```

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

                                                                              AVG=      2.022  MAX=      4.050
PER        LEVEL                                                                               MIN=       .010

      1   2.005  2.015  2.030  2.118  2.300  2.507  2.752  2.885  2.984  3.000
     11   3.000  3.000  3.000  3.000  2.975  2.951  2.926  2.902

                                                                              AVG=      2.686  MAX=      3.000
PER        EOP STORAGE                                                                         MIN=      2.005

      1   50496  51488  52975  61901  80248 101075 125869 139257 149175 150832
     11  150832 150832 150832 150832 148353 145873 143394 140914

                                                                              AVG= 119176.604  MAX= 150832.000
                                                                                               MIN=  50495.875
**************************************************************************************************************
**** LOC    2  CP 2                          SERVED BY    -1
PER        CUM LOCAL Q

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

                                                                              AVG=  28750.000  MAX= 100000.000
PER.       NATURAL FLOW                                                                        MIN=   1500.000

      1    3000   4167   6028  11338  39056  91843 142140 134857  98809  70302
     11   49684  30147  28191  18032  11005   4168   3028   2505

                                                                              AVG=  41583.282  MAX= 142140.454
PER        REGULATED FLOW                                                                      MIN=   2504.654

      1    2000   3000   4000   6000  20000  57000 100000  90000  70000  51610
     11   44541  29257  28043  18007  11835   8472   7912   7485

                                                                              AVG=  31064.520  MAX= 100000.000
PER        Q SPACE AVAIL.                                                                      MIN=   2000.000

      1   19000  18000  17000  15000   1000 -36000 -79000 -69000 -49000 -30610
     11  -23541  -8257  -7043   2993   9165  12528  13088  13515

                                                                              AVG= -10064.520  MAX=  19000.000
PER        Q BY US RES,DIVS                                                                    MIN= -79000.000

      1       0      0      0      0      0      0      0      0      0   1610
     11    7541   5257   4043   3007   2835   5472   5912   5985

                                                                              AVG=   2314.520  MAX=   7540.578
PER        FLOOD BY RES                                                                        MIN=      0.000

      1       0      0      0      0      0      0      0      0      0   1610
     11    7541   5257   4043      0      0      0      0      0

                                                                              AVG=   1024.993  MAX=   7540.578
                                                                                               MIN=      0.000
**************************************************************************************************************
```

```
**** LOC     3  RESERVOIR C (CP 3)                      SERVED BY      2

                                                                                         STARTING TIME=        1
                                                                                         HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
PER        CUM LOCAL Q               SERVING       2     4

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

                                                                                         AVG=  28000.000  MAX= 105000.000
PER        NATURAL FLOW                                                                                   MIN=   1000.000

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

                                                                                         AVG=  28000.000  MAX= 105000.000
PER        INFLOW                                                                                         MIN=   1000.000

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

                                                                                         AVG=  28000.000  MAX= 105000.000
PER        OUTFLOW                                                                                        MIN=   1000.000

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

                                                                                         AVG=   2833.333  MAX=  12000.000
PER        CASE=LOC,TYP                                                                                   MIN=      0.000

    1    .03    4.04     4.03    4.02    4.01    4.00    4.00    4.00    4.00    4.00
   11   4.00    4.00     4.00    4.00     .01     .01     .01     .01

                                                                                         AVG=      2.898  MAX=      4.040
PER        LEVEL                                                                                          MIN=       .010

    1  2.000   2.005    2.025   2.070   2.150   2.209   2.254   2.288   2.313   2.331
   11  2.345   2.354    2.363   2.370   2.365   2.359   2.351   2.343

                                                                                         AVG=      2.250  MAX=      2.370
PER        EOP STORAGE                                                                                    MIN=      2.000

    1 100000  102975   116364  146116  198183  236861  266614  288928  305292  317193
   11 326119  332069   338020  342483  339508  335045  330086  324631

                                                                                         AVG= 263693.847  MAX= 342482.875
                                                                                                          MIN= 100000.000
****************************************************************************************************************
**** LOC     4  CP 4                                    SERVED BY      1     2

PER        CUM LOCAL Q

    1   4000    6167    22028   17171   18029   31171   62695   92449   87908   73485
   11  61081   62180    39197   29866   19311   11052    4842    2724

                                                                                         AVG=  35853.070  MAX=  92449.206
PER        NATURAL FLOW                                                                                   MIN=   2723.662
```

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```
    1    8000   10694   32398   49141   87592  144877  173798  194036  175045  136597
   11  106281   93327   59185   45997   31355   19991    9465    5847
                                                                                    AVG=  76784,776  MAX= 194036,091
                                                                                                     MIN=   5846,858
 PER        REGULATED FLOW

    1    7000    8667   22444   17241   18040   31173   62696   92449   87908   73753
   11   63455   68479   44425   33934   24466   24713   21752   20481

                                                                                    AVG=  40170,938  MAX=  92449,260
                                                                                                     MIN=   7000,000
 PER        Q SPACE AVAIL.

    1   28000   26333   12556   17759   16960    3827  -27696  -57449  -52908  -38753
   11  -28455  -33479   -9425    1066   10534   10287   13248   14519

                                                                                    AVG=  -5170,938  MAX=  28000,000
                                                                                                     MIN= -57449,260
 PER        Q BY US RES,DIVS

    1    3000    2500     417      69      12       2       0       0       0     268
   11    2375    6299    5228    4068    5155   13361   16910   17757

                                                                                    AVG=   4317,868  MAX=  17757,346
                                                                                                     MIN=       ,009
 PER        FLOOD BY RES

    1       0       0       0       0       0       0       0       0       0     268
   11    2375    6299    5228       0       0       0       0       0

                                                                                    AVG=    787,244  MAX=   6298,952
                                                                                                     MIN=      0,000
*********************************************************************************************************************
**** LOC     5  CP 5                           SERVED BY     #1     #2

 PER        CUM LOCAL Q

    1    5000    6361   17509   24965   22613   23150   36588   63470   87279   87316
   11   78389   75315   64539   44865   31940   20706   11959    5792

                                                                                    AVG=  39319,888  MAX=  87316,106
                                                                                                     MIN=   5000,000
 PER        NATURAL FLOW

    1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
   11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                    AVG=  80279,898  MAX= 187631,160
                                                                                                     MIN=   9000,000
 PER        REGULATED FLOW

    1    8000    9278   19731   25625   22771   23184   36596   63471   87279   87361
   11   78971   78045   70064   49950   36359   27156   24960   22192

                                                                                    AVG=  42832,985  MAX=  87360,872
                                                                                                     MIN=   8000,000
 PER        Q SPACE AVAIL.

    1   29000   27722   17269   11375   14229   13816     404  -26471  -50279  -50361
   11  -41971  -41045  -33064  -12950     641    9844   12040   14808

                                                                                    AVG=  -5832,985  MAX=  29000,000
                                                                                                     MIN= -50360,872
```

```
PER        Q BY US RES,DIVS

   1    3000    2917    2222     660     158      34       7       1       0      45
  11     582    2730    5526    5084    4418    6450   13001   16400

                                                                    AVG=   3513,097  MAX=  16399,973
                                                                                     MIN=       ,271
PER        FLOOD BY RES

   1       0       0       0       0       0       0       0       1       0      45
  11     582    2730    5526    5084       0       0       0       0

                                                                    AVG=    776,024  MAX=   5525,646
                                                                                     MIN=      0,000
*****************************************************************************************************

                CUM TIME=      1

RES NO=          1       3
INFLOW        1000    3000
OUTFLOW          0    3000
EOP STOR     50496  100000
CASE=         4,05     ,03
LEVEL        2,005   2,000
EQ LEVEL     2,005   2,000

                CUM TIME=      2

RES NO=          1       3
INFLOW        2000    6000
OUTFLOW          0       0
EOP STOR     51488  102975
CASE=         4,04    4,04
LEVEL        2,015   2,005
EQ LEVEL     2,015   2,005

                CUM TIME=      3

RES NO=          1       3
INFLOW        3000   27000
OUTFLOW          0       0
EOP STOR     52975  116364
CASE=         4,03    4,03
LEVEL        2,030   2,025
EQ LEVEL     2,030   2,025

                CUM TIME=      4

RES NO=          1       3
INFLOW       18000   60000
OUTFLOW          0       0
EOP STOR     61901  146116
CASE=         4,02    4,02
LEVEL        2,118   2,070
EQ LEVEL     2,118   2,070

                CUM TIME=      5
```

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```
                FALL RIVER BASIN   ***   FLOOD FORECASTING   ***
                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
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                1.007      32928 *     1.007      42642 *     1.007      30000 *     2928 *  0.00    0.00
LOC    4  CP 4                1.012      31779 *     1.008      58211 *     1.008      27735 *     4044 *  0.00    0.00
LOC    5  CP 5                1.013      32228 *     1.009      56289 *     1.010      26195 *     6034 *  0.00    0.00

       RESERVOIRS            FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)  1.018   50000     2.000 *  1.010    70647     2.205 *  1.005     6000      6000    50000

LOC    3  RESERVOIR C (CP 3)  1.003  100000     2.000 *  1.010   142592     2.065 *  1.004    12000     12000   100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    213239

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

                                                                                       STARTING TIME      1
                                                                                                   SHORTAGE INDEX
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                2.007     100000 *     2.007     142140 *     2.007     100000 *        0 *  0.00    0.00
LOC    4  CP 4                2.008      92449 *     2.008     194036 *     2.008      92449 *        0 *  0.00    0.00
LOC    5  CP 5                2.010      87361 *     2.009     187631 *     2.010      87316 *       45 *  0.00    0.00

       RESERVOIRS            FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)  2.001   50496     2.005 *  2.010   150832     3.000 *  2.010     9658      6000    50000

LOC    3  RESERVOIR C (CP 3)  2.001  100000     2.000 *  2.014   342482     2.370 *  2.015    12000     12000   100000

                        MIN SYSTEM STG=    150495    MAX SYSTEM STG=    493314

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

                                                                                       STARTING TIME      1
                                                                                                   SHORTAGE INDEX
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                3.007     155999 *     3.007     213211 *     3.007     150000 *     5999 *  0.00    0.00
LOC    4  CP 4                3.008     145356 *     3.008     291054 *     3.008     138674 *     6682 *  0.00    0.00
LOC    5  CP 5                3.010     144608 *     3.009     281447 *     3.010     130974 *    13633 *  0.00    0.00

       RESERVOIRS            FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)  3.003   48512     1.970 *  3.008   150832     3.000 *  3.008    30658      6000    50000

LOC    3  RESERVOIR C (CP 3)  3.001  102231     2.003 *  3.015 . 470418     2.565 *  3.016    12000     12000   100000
```

```
                        MIN SYSTEM STG=    150743    MAX SYSTEM STG=    621250

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

                                                                                           STARTING TIME       1
                                                                                                        SHORTAGE  INDEX
                               FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 4,008     240290 *      4,007     284281 *      4,007     200000 *    40290 *    0,00     0,00
LOC      4  CP 4                 4,009     228588 *      4,008     388072 *      4,008     184898 *    43689 *    0,00     0,00
LOC      5  CP 5                 4,010     222512 *      4,009     375262 *      4,010     174632 *    47880 *    0,00     0,00
            RESERVOIRS         FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1
LOC      1  RESERVOIR A (CP 1)   4,001    48016      1,960 *  4,007   150832      3,000 *  4,007    72658      6000   50000
LOC      3  RESERVOIR C (CP 3)   4,001   102975      2,005 *  4,015   593891      2,754 *  4,016    12000     12000  100000
                        MIN SYSTEM STG=    150991    MAX SYSTEM STG=    744723

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

                                                                                           STARTING TIME       1
                                                                                                        SHORTAGE  INDEX
                               FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 5,008     379020 *      5,007     426421 *      5,007     300000 *    79020 *    0,00     0,00
LOC      4  CP 4                 5,009     377567 *      5,008     582108 *      5,008     277348 *   100220 *    0,00     0,00
LOC      5  CP 5                 5,010     369489 *      5,009     562893 *      5,010     261948 *   107540 *    0,00     0,00
            RESERVOIRS         FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1
LOC      1  RESERVOIR A (CP 1)   5,002    48512      1,970 *  5,007   167314      3,335 *  5,007   116761      6000   50000
LOC      3  RESERVOIR C (CP 3)   5,001   104463      2,007 *  5,012   755408      3,000 *  5,013    35999     12000  100000
                        MIN SYSTEM STG=    152974    MAX SYSTEM STG=    922722

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

                                                                                           STARTING TIME       1
                                                                                                        SHORTAGE  INDEX
                               FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC      2  CP 2                 6,007     514646 *      6,007     568562 *      6,007     400000 *   114646 *    0,00     0,00
LOC      4  CP 4                 6,009     601840 *      6,008     776144 *      6,008     369797 *   232043 *    0,00     0,00
LOC      5  CP 5                 6,010     584478 *      6,009     750525 *      6,010     349264 *   235213 *    0,00     0,00
            RESERVOIRS         FLD,PER  MIN STG MIN LEVEL * FLD,PER  MAX STG MAX LEVEL * FLD,PER  MAX REL  CHAN CAP   STOR1
LOC      1  RESERVOIR A (CP 1)   6,001    49008      1,980 *  6,007   191183      3,821 *  6,007   163829      6000   50000
LOC      3  RESERVOIR C (CP 3)   6,001   105950      2,009 *  6,009   769930      3,059 *  6,009   128311     12000  100000
                        MIN SYSTEM STG=    154958    MAX SYSTEM STG=    961113
```

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```
                                   EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                     CONTROL POINT NUMBER     4

                           BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ      PEAK         SUM    TYPE 1    TYPE
     .9990     28800        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    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
     EXIST SYSTEM-INPUT      696.82    696.82

                           BASE CONDITION FLOOD DAMAGES
             EXCD  PROB
  NO.  FLOW  FREQ   INT        SUM    TYPE 1    TYPE
   1   58211 .621  .623     233.27    233.27
   2  194036 .134  .279     549.81    549.81
   3  291054 .062  .050     360.93    360.93
   4  388072 .034  .025     265.87    265.87
   5  582108 .013  .014     173.38    173.38
   6  776144 .007  .010     138.03    138.03

     BASE COND DAMAGES     1721.30   1721.30
     EXST SYST DAMAGES      696.82    696.82

                           MODIFIED CONDITIONS FLOW-DAMAGE DATA
     FREQ      PEAK         SUM    TYPE 1    TYPE
     .9990     28800        0.00      0.00
     .9000     35000         .00       .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    840000    14150.00  14150.00
     .0020   1000000    14600.00  14600.00

                           MODIFIED CONDITIONS FLOOD DAMAGES
```

```
               EXCD  PROB
NO.   FLOW     FREQ   INT        SUM     TYPE 1    TYPE
  1   31779    .621  .623      27.97     27.97
  2   92449    .134  .279     174.34    174.34
  3  145356    .062  .050      84.07     84.07
  4  228588    .034  .025     118.78    118.78
  5  377567    .013  .014     136.83    136.83
  6  601840    .007  .010     131.99    131.99

      MODIFIED DAMAGES        673.97    673.97
      DAMAGE REDUCTION         22.85     22.85


                                   UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
               EXCD  PROB
NO.   FLOW     FREQ   INT        SUM     TYPE 1    TYPE
  1   27735    .621  .623      14.43     14.43
  2   92449    .134  .279     166.49    166.49
  3  138674    .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     108.25    108.25
      DAMAGES W/ TOTAL
   CONTROL AT PROJECTS        525.75    525.75

    REDUCTION POSSIBLE
    W/ TOTAL CONTROL          171.07    171.07

      RESIDUAL DAMAGES        148.22    148.22
```

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CONTROL POINT 4

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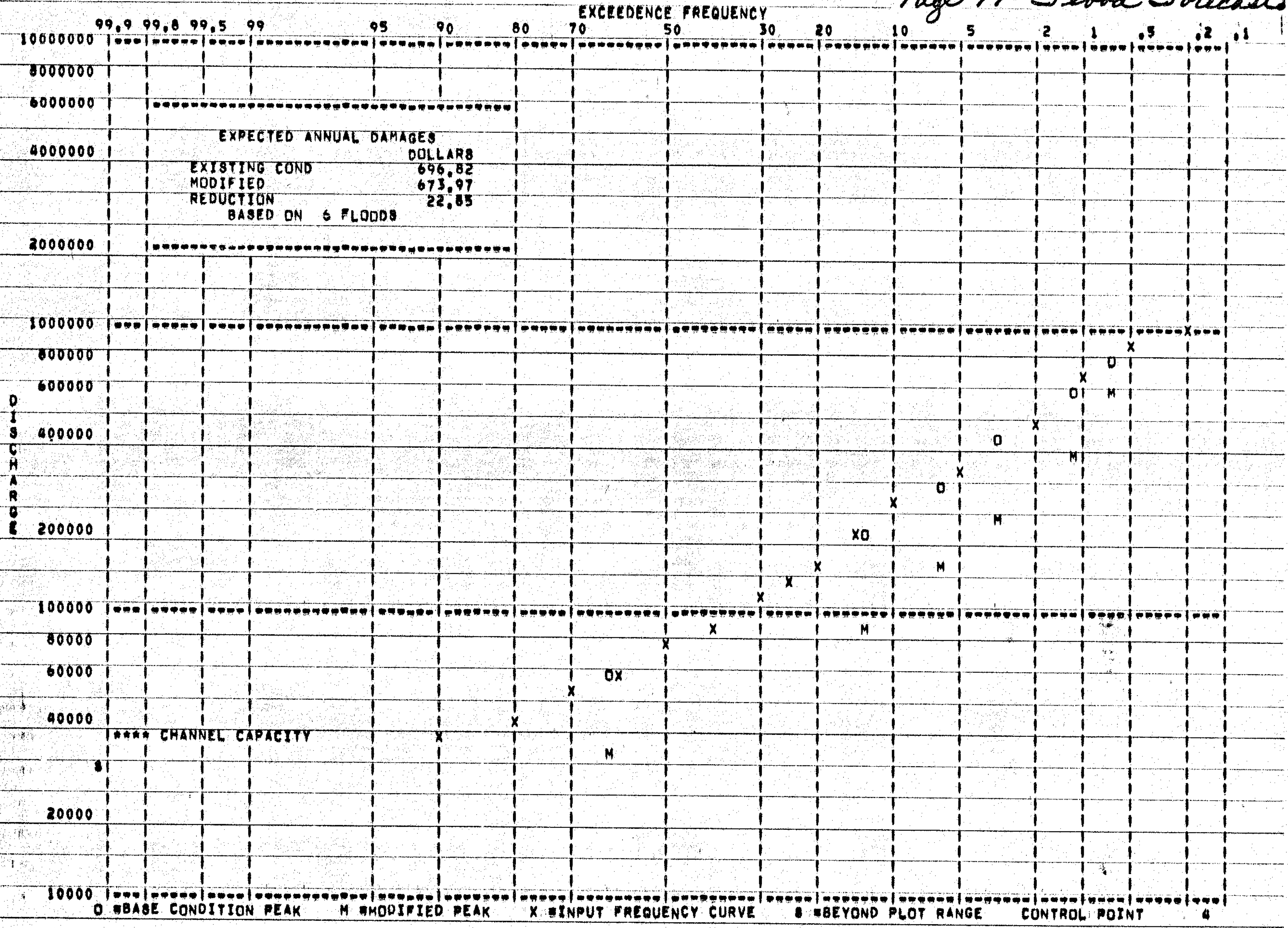

```
          EXPECTED ANNUAL DAMAGES
                            DOLLARS
   EXISTING COND             696.82
   MODIFIED                  673.97
   REDUCTION                  22.85
       BASED ON   6 FLOODS
```

```
                                 SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
***********************************************************************************************************
*          *.................DAMAGES.................................*..............DAMAGE REDUCTION..............*
*  CONTROL  * BASE (EXIST)   MODIFIED       UNCONTROL   *  MODIFIED      TOTAL CONTROL                 *
*   POINT   *  CONDITION    CONDITIONS     LOCAL COND   *  CONDITIONS    AT PROJECTS      RESIDUAL     *
*  -------  *  ----------   ----------     ----------   *  ----------    ----------      ----------   *
*       4   *     696.82       673.97         525.75    *      22.85        171.07          148.22     *
*           *                                           *                                              *
*    TOTAL  *     696.82       673.97         525.75    *      22.85        171.07          148.22     *
*           *                                           *                                              *
***********************************************************************************************************
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                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              13.85
```

```
         HEC-5C-VARIABLE OUTPUT MAR.1975
         RES.= 35 CPTS.= 75 PERS.=100

      T1 FALL RIVER BASIN    ***   FLOOD PROOFING    ***
      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       18.00       6.00       4.00       2.00       3.00      -0.00      -0.00       1.00      -0.00       1.00
      J2       -0.00       1.10       2.00       1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
      J4        6.00        .30       1.00       1.50       2.00       3.00       4.00      -0.00      -0.00      -0.00


      RL        1.00   50000.00      -0.00       0.00   50000.00  150832.00  200000.00      -0.00      -0.00      -0.00
      RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RS        6.00       0.00   50000.00   70000.00  100000.00  150832.00  200000.00      -0.00      -0.00      -0.00
      RQ        6.00    5000.00    6000.00    7000.00    8000.00  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
      ID RESERVOIR A (CP 1)                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RT        1.00       2.00        .20        .30       6.00      -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
      ID CP 2                                             -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RT .      2.00       4.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00


      RL        3.00  100000.00      -0.00       0.00  100000.00  755408.00 1000000.00      -0.00      -0.00      -0.00
      RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -'.00      -0.00      -0.00
      RS        7.00       0.00  100000.00  200000.00  400000.00  700000.00  800000.00 1000000.00      -0.00      -0.00
      RQ        7.00   10000.00   12000.00   18000.00   30000.00   80000.00  150000.00  500000.00      -0.00      -0.00

      CP        3.00   12000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      ID RESERVOIR C (CP 3)                               -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RT        3.00       4.00        .20        .30       6.00      -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        .06        .70
      ID CP 4                                             -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RT        4.00       5.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00
      QS        1.00   35000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      CS    35000.00    3480.00      -0.00      -0.00      -0.00      -0.00      -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      -0.00
      DB        1.00     696.82      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      DF       17.00       1.00        .90        .80        .70        .60        .50        .40        .30        .25
      DF         .20        .15        .10        .05        .02        .01        .01        .00      -0.00      -0.00
      DQ       17.00   28800.00   35000.00   42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
      DQ   150000.00  180000.00  230000.00  323000.00  490000.00  640000.00  840000.00 1000000.00      -0.00      -0.00
EXISTING DC     1.00       0.00       0.00     180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
      DC     1930.00    2660.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00
MODIFIED DC     1.00       0.00       0.00      90.00     120.00     140.00     150.00     200.00     250.00     300.00
      DC      400.00     700.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00

      CP        5.00   37000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      ID CP 5                                             -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
      RT        5.00       0.00       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      -0.00

          NRES=     2  NCPT=     5  NCPTR=    -0

      IN     1  6 JUNE     1000.0     2000.0     3000.0    18000.0    37000.0    42000.0    50000.0    27000.0    20000.0    13000.0
```

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```
                   5000,0    4000,0    3000,0    2000,0    1000,0    1000,0    1000,0    1000,0
                                                                                                              SUM=     231000
IN    2  6 JUNE    2000,0    3000,0    4000,0    6000,0   20000,0   57000,0  100000,0   90000,0   70000,0   50000,0
                  37000,0   24000,0   24000,0   15000,0    9000,0    3000,0    2000,0    1500,0
                                                                                                              SUM=     517500
IN    3  6 JUNE    3000,0    6000,0   27000,0   60000,0  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
                                                                                                              SUM=     504000
IN    4  6 JUNE    2000,0    4000,0   19000,0   13000,0   10000,0    7000,0    4000,0    1000,0    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    6000,0    5000,0    3000,0    2000,0     500,0     500,0    2000,0
                   5000,0   12000,0    6000,0    4000,0    2000,0    1000,0     500,0     200,0
                                                                                                              SUM=      61700
EJ   =0              =0,0      =0,0      =0,0      =0,0      =0,0      =0,0      =0,0      =0,0
```

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```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC#        CUM LOCA    NATURAL     INFLOW      OUTFLOW     CASE=LOC    LEVEL       EOP STOR

    1        3850,00     3850,00     3850,00     3850,00       ,90        2,07    57494,67
    3        8400,00     8400,00     8400,00     7450,62      1,12        2,03   122385,98

SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC#        CUM LOCA    NATURAL     REGULATE    Q SPACE     Q BY US     FLOOD BY

    2        8625,00    12474,98    12328,87     8671,13     3703,87      476,19
    4       10755,92    23035,43    21005,66    13994,34    10249,74        0,00
    5       11795,97    24083,97    21119,00    15881,00     9323,04        0,00


COMPUTATION INTERVAL IN HOURS=       6

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

                    NFLRD=         1  NFLCON=        6
                    IFLRD =        1  IFLCON=        2
                       FLOWS MULTIPLIED BY     1,00

*************************************************************************************************

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

                                                                                  STARTING TIME=       1
                                                                                  HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                              SERVING          1     4
PER        CUM LOCAL Q

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

                                                                                  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

                                                                                  AVG=  12833,333  MAX=  50000,000
                                                                                                   MIN=   1000,000
PER        OUTFLOW

    1    1000    2000    3000       0       0       0       0       0       0    3658
   11    5000    4000    3000    2000    6000    6000    6000    6000

                                                                                  AVG=   2647,691  MAX=   6000,000
                                                                                                   MIN=      0,000
```

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```
PER        CASE=LOC,TYP

  1     .03     .03     .03    4,02    4,01    4,00    4,00    4,00    4,00     .04
 11     .04     .04     .04     .04     .01     .01     .01     .01

                                                                              AVG=      1,353  MAX=      4,020
PER        LEVEL                                                                                MIN=       .010

  1   2,000   2,000   2,000   2,089   2,270   2,477   2,723   2,856   2,954   3,000
 11   3,000   3,000   3,000   3,000   2,975   2,951   2,926   2,902

                                                                              AVG=      2,673  MAX=      3,000
PER        EOP STORAGE                                                                          MIN=      2,000

  1   50000   50000   50000   58926   77273   98100  122894  136282  146200  150832
 11  150832  150832  150832  150832  148353  145873  143394  140914

                                                                              AVG= 117909,368  MAX= 150832,000
                                                                                               MIN=  50000,000
***************************************************************************************************************
**** LOC      2  CP  2                     SERVED BY    -1
PER        CUM LOCAL Q

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

                                                                              AVG=  28750,000  MAX= 100000,000
PER        NATURAL FLOW                                                                         MIN=   1500,000

  1    3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
 11   49884   30147   28191   18032   11005    4168    3028    2505

                                                                              AVG=  41583,282  MAX= 142140,454
PER        REGULATED FLOW                                                                       MIN=   2504,654

  1    3000    4167    6028    8338   20390   57065  100011   90002   70000   50610
 11   40374   28562   27927   17988   11831    8472    7912    7485

                                                                              AVG=  31120,076  MAX= 100010,824
PER        Q SPACE AVAIL.                                                                       MIN=   3000,000

  1   18000   16833   14972   12662     610  -36065  -79011  -69002  -49000  -29610
 11  -19374   -7562   -6927    3012    9169   12528   13088   13515

                                                                              AVG= -10120,076  MAX=  18000,000
PER        Q BY US RES,DIVS                                                                     MIN= -79010,824

  1    1000    1167    2028    2338     390      65      11       2       0     610
 11    3374    4562    3927    2988    2831    5472    5912    5985

                                                                              AVG=   2370,076  MAX=   5985,330
PER        FLOOD BY RES                                                                         MIN=       .301

  1       0       0       0       0       0      65      11       2       0     610
 11    3374    4562    3927       0       0       0       0       0

                                                                              AVG=    697,275  MAX=   4562,320
```

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                                                                                                   MIN=      0.000
**************************************************************************************************************
**** LOC      3  RESERVOIR C (CP 3)                      SERVED BY      2

                                                                                      STARTING TIME=        1
                                                                                      HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                          SERVING        2     4
PER          CUM LOCAL Q

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

                                                                                      AVG=  28000.000   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     6000     3000     2000     1000

                                                                                      AVG=  28000.000   MAX= 105000.000
                                                                                                        MIN=   1000.000
PER          INFLOW

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

                                                                                      AVG=  28000.000   MAX= 105000.000
                                                                                                        MIN=   1000.000
PER          OUTFLOW

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

                                                                                      AVG=   3833.333   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      .01      .01      .01      .01

                                                                                      AVG=      2.452   MAX=      4.020
                                                                                                        MIN=       .010
PER          LEVEL

   1   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=      2.356
                                                                                                        MIN=      2.000
PER          EOP STORAGE

   1  100000   100000   107438   137191   189257   227936   257688   280003   296366   308267
  11  317193   323144   329094   333557   330582   326119   321160   315706

                                                                                      AVG= 255594.556   MAX= 333557.125
                                                                                                        MIN= 100000.000
**************************************************************************************************************
**** LOC      4  CP 4                                    SERVED BY      1      2

PER          CUM LOCAL Q

   1    4000     6167    22028    17171    18029    31171    62695    92449    87908    73485
  11   61081    62180    39197    29866    19311    11052     4842     2724
```

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```
                                                                                               AVG=  35853,070  MAX=  92449,206
 PER        NATURAL FLOW                                                                                        MIN=   2723,662

   1    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
  11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                               AVG=  76784,776  MAX= 194036,091
 PER        REGULATED FLOW                                                                                      MIN=   5846,858

   1    8000   10694   29898   28225   21404   32020   62882   92488   87916   73588
  11   62067   65354   43422   33686   24411   24701   21750   20481

                                                                                               AVG=  41282,055  MAX=  92487,801
 PER        Q SPACE AVAIL.                                                                                      MIN=   8000,000

   1   27000   24306    5102    6775   13506    2980  -27882  -57488  -52916  -38588
  11  -27067  -30354   -8422    1314   10589   10299   13250   14519

                                                                                               AVG=  -6282,055  MAX=  27000,000
 PER        Q BY US RES,DIVS                                                                                    MIN= -57487,801

   1    4000    4528    7870   11053    3466     848     186      39       8     103
  11     986    3174    4225    3820    5100   13650   16908   17757

                                                                                               AVG=   5428,984  MAX=  17756,907
 PER        FLOOD BY RES                                                                                        MIN=      7,685

   1       0       0       0       0       0       0     186      39       8     103
  11     986    3174    4225       0       0       0       0       0

                                                                                               AVG=    484,498  MAX=   4225,056
                                                                                                                MIN=      0,000
******************************************************************************************************************************
**** LOC     5  CP 5                         SERVED BY    -1    -2

 PER        CUM LOCAL Q

   1    5000    6361   17509   24965   22613   23150   36588   63470   87279   87316
  11   78389   75315   64539   44865   31940   20706   11959    5792

                                                                                               AVG=  39319,888  MAX=  87316,106
 PER        NATURAL FLOW                                                                                        MIN=   5000,000

   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                               AVG=  80279,898  MAX= 187631,160
 PER        REGULATED FLOW                                                                                      MIN=   9000,000

   1    9000   10449   22521   32890   31880   27146   37851   63811   87363   87352
  11   78628   76542   67563   48823   35997   27057   24936   22186

                                                                                               AVG=  43999,739  MAX=  87363,008
 PER        Q SPACE AVAIL.                                                                                      MIN=   9000,000

   1   28000   26551   14479    4110    5120    9854    -851  -26811  -50363  -50352
  11  -41628  -39542  -30563  -11823    1023    9943   12064   14814
```

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                                                                                                                      AVG=  -6999.739  MAX=  28000.000
                                                                                                                                       MIN= -50363.008
PER        Q BY US RES,DIVS

    1     4000     4088     5012     7924     9267     3996     1263      341       84       36
   11      239     1226     3025     3957     4056     6351    12976    16394
                                                                                                                      AVG=   4679.852  MAX=  16394.328
                                                                                                                                       MIN=     36.288
PER        FLOOD BY RES

    1        0        0        0        0        0        0      851      341       84       36
   11      239     1226     3025     3957        0        0        0        0
                                                                                                                      AVG=    542.212  MAX=   3957.493
                                                                                                                                       MIN=      0.000
****************************************************************************************************************************

                 CUM TIME=       1

RES NO=          1        3
INFLOW        1000     3000
OUTFLOW       1000     3000
EOP 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
EOP 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
EOP 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
EOP STOR     58926   137191
CASE=         4.02     4.02
LEVEL        2.089    2.057
EQ LEVEL     2.089    2.057
```

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```
                    FALL RIVER BASIN   ***   FLOOD PROOFING   ***
                    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
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC    2  CP 2              1.007      34777 *      1.007      42642 *      1.007      30000 *      4777 *  0.00     0.00
LOC    4  CP 4              1.012      33134 *      1.008      58211 *      1.008      27735 *      5400 *  0.00     0.00
LOC    5  CP 5              1.012      33586 *      1.009      56289 *      1.010      26195 *      7391 *  0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
LOC    1  RESERVOIR A (CP 1)  1.018    50000    2.000 *  1.008    67393     2.173 *  1.005     6000      6000   50000
LOC    3  RESERVOIR C (CP 3)  1.003   100000    2.000 *  1.010   140755     2.062 *  1.004    12000     12000  100000
                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    208148

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

                                                                                       STARTING TIME       1
                                                                                                 SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC    2  CP 2              2.007     100011 *      2.007     142140 *      2.007     100000 *        11 *  0.00     0.00
LOC    4  CP 4              2.008      92488 *      2.008     194036 *      2.008      92449 *        39 *  0.00     0.00
LOC    5  CP 5              2.009      87363 *      2.009     187631 *      2.010      87316 *        47 *  0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
LOC    1  RESERVOIR A (CP 1)  2.003    50000    2.000 *  2.011   150832     3.000 *  2.015     6000      6000   50000
LOC    3  RESERVOIR C (CP 3)  2.002   100000    2.000 *  2.014   333557     2.356 *  2.003    12000     12000  100000
                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    484389

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

                                                                                       STARTING TIME       1
                                                                                                 SHORTAGE INDEX
                          FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *   DES      REQ
LOC    2  CP 2              3.007     157221 *      3.007     213211 *      3.007     150000 *      7221 *  0.00     0.00
LOC    4  CP 4              3.009     150695 *      3.008     291054 *      3.008     138674 *     12022 *  0.00     0.00
LOC    5  CP 5              3.010     150348 *      3.009     281447 *      3.010     130974 *     19374 *  0.00     0.00
         RESERVOIRS       FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1
LOC    1  RESERVOIR A (CP 1)  3.001    50744    2.007 *  3.007   150832     3.000 *  3.008    40499      6000   50000
```

```
LOC    3  RESERVOIR C (CP 3)        3.001  102231    2.003 *  3.015  470418    2.565 *  3.016   12000      12000 100000

                         MIN SYSTEM STG=   152974   MAX SYSTEM STG=   621250

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

                                                                                                  STARTING TIME     1

                                                                                                          SHORTAGE INDEX
                                    FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                        4.008    282767 *      4.007    284281 *      4.007    200000 *    52767 *   0.00    0.00
LOC    4  CP 4                        4.009    237896 *      4.008    388072 *      4.008    184898 *    52998 *   0.00    0.00
LOC    5  CP 5                        4.010    229892 *      4.009    375262 *      4.010    174632 *    55259 *   0.00    0.00
          RESERVOIRS                FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)        4.001   50992    2.010 *  4.007  150832    3.000 *  4.007   90658       6000   50000

LOC    3  RESERVOIR C (CP 3)        4.001  102975    2.005 *  4.015  593891    2.754 *  4.016   12000      12000 100000

                         MIN SYSTEM STG=   153966   MAX SYSTEM STG=   744723

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

                                                                                                  STARTING TIME     1

                                                                                                          SHORTAGE INDEX
                                    FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                        5.008    383382 *      5.007    426421 *      5.007    300000 *    83382 *   0.00    0.00
LOC    4  CP 4                        5.009    372066 *      5.008    582108 *      5.008    277348 *    94718 *   0.00    0.00
LOC    5  CP 5                        5.010    365070 *      5.009    562893 *      5.010    261948 *   103121 *   0.00    0.00
          RESERVOIRS                FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)        5.001   51488    2.015 *  5.007  168236    3.354 *  5.007  120542       6000   50000

LOC    3  RESERVOIR C (CP 3)        5.001  104463    2.007 *  5.011  755408    3.000 *  5.012   35999      12000 100000

                         MIN SYSTEM STG=   155949   MAX SYSTEM STG=   923644

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

                                                                                                  STARTING TIME     1

                                                                                                          SHORTAGE INDEX
                                    FLD.PER  MAX REG Q *    FLD.PER  MAX NAT Q *    FLD.PER  MAX LOC Q * Q BY RES *  DES     REQ
LOC    2  CP 2                        6.007    516031 *      6.007    568562 *      6.007    400000 *   116031 *   0.00    0.00
LOC    4  CP 4                        6.009    612533 *      6.008    776144 *      6.008    369797 *   242736 *   0.00    0.00
LOC    5  CP 5                        6.010    594538 *      6.009    750525 *      6.010    349264 *   245274 *   0.00    0.00
          RESERVOIRS                FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

LOC    1  RESERVOIR A (CP 1)        6.001   51983    2.020 *  6.007  191183    3.821 *  6.007  163829       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 STG=   157933   MAX SYSTEM STG=   972456
```

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                         EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                            CONTROL POINT NUMBER     4

                         BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
      FREQ        PEAK          SUM      TYPE 1     TYPE
     .9990       28800         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      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
     EXIST SYSTEM-INPUT    696.82      696.82

                         BASE CONDITION FLOOD DAMAGES
               EXCD  PROB
  NO.  FLOW    FREQ   INT          SUM     TYPE 1     TYPE
   1   58211  .621  .623        233.27     233.27
   2  194036  .134  .279        549.81     549.81
   3  291054  .062  .050        360.93     360.93
   4  388072  .034  .025        265.87     265.87
   5  582108  .013  .014        173.38     173.38
   6  776144  .007  .010        138.03     138.03

      BASE COND DAMAGES       1721.30    1721.30
      EXST SYST DAMAGES        696.82     696.82

                         MODIFIED CONDITIONS FLOW-DAMAGE DATA
      FREQ        PEAK          SUM      TYPE 1     TYPE
     .9990       28800         0.00        0.00
     .9000       35000          .00         .00
     .8000       42000        90.00       90.00
     .7000       50500       120.00      120.00
     .6000       60500       140.00      140.00
     .5000       73000       150.00      150.00
     .4000       90000       200.00      200.00
     .3000      114000       250.00      250.00
     .2500      130000       300.00      300.00
     .2000      150000       400.00      400.00
     .1500      180000       700.00      700.00
     .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      840000     14150.00    14150.00
     .0020     1000000     14600.00    14600.00
```

```
                                                MODIFIED CONDITIONS FLOOD DAMAGES
               EXCD  PROB
 NO.  FLOW     FREQ   INT         SUM      TYPE 1    TYPE
  1    33134  .621   .623        14.30      14.30
  2    92488  .134   .279        43.91      43.91
  3   150695  .062   .050        19.71      19.71
  4   237896  .034   .025       116.36     116.36
  5   372066  .013   .014       137.08     137.08
  6   612533  .007   .010       132.33     132.33

      MODIFIED DAMAGES          463.68     463.68
      DAMAGE REDUCTION          233.14     233.14

                                                UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
               EXCD  PROB
 NO.  FLOW     FREQ   INT         SUM      TYPE 1    TYPE
  1    27735  .621   .623         6.81       6.81
  2    92449  .134   .279        42.36      42.36
  3   138674  .062   .050        15.59      15.59
  4   184898  .034   .025        34.83      34.83
  5   277348  .013   .014        87.18      87.18
  6   369797  .007   .010       108.25     108.25
      DAMAGES W/ TOTAL
   CONTROL AT PROJECTS          295.03     295.03

     REDUCTION POSSIBLE
     W/ TOTAL CONTROL           401.79     401.79

      RESIDUAL DAMAGES          168.65     168.65
```

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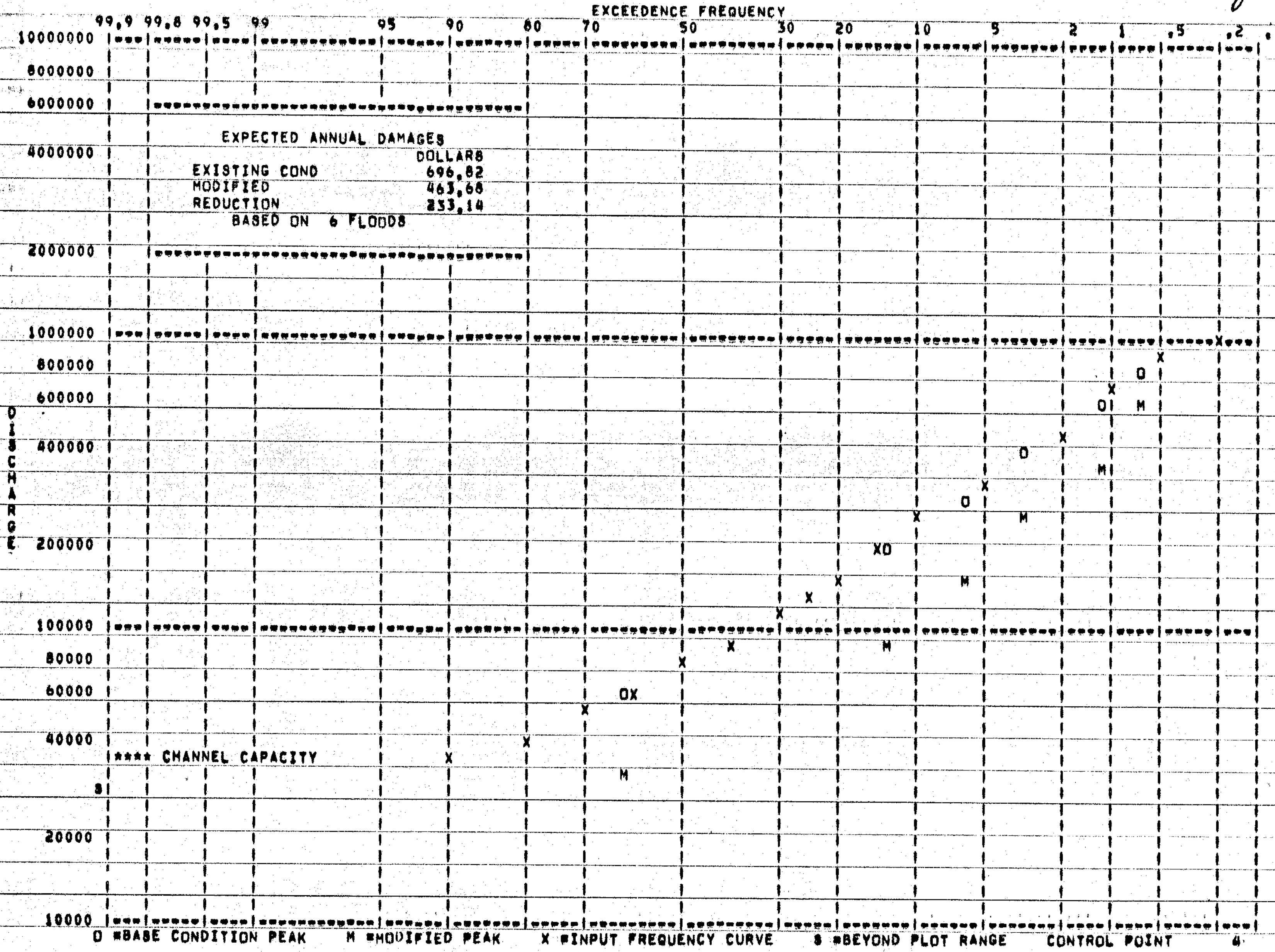
CONTROL POINT 4



EXPECTED ANNUAL DAMAGES

	DOLLARS
EXISTING COND	696.82
MODIFIED	463.68
REDUCTION	233.14

BASED ON 6 FLOODS

```
                        SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
**********************************************************************************************
*          *.................DAMAGES..................*............DAMAGE REDUCTION............*
*  CONTROL * BASE (EXIST)   MODIFIED     UNCONTROL    *  MODIFIED    TOTAL CONTROL              *
*   POINT  *  CONDITION    CONDITIONS    LOCAL COND   * CONDITIONS   AT PROJECTS     RESIDUAL   *
*  ------- *  ----------   ----------    ----------   * ----------   ----------     ---------- *
*       4  *      696.82       463.68        295.03   *     233.14       401.79         168.65 *
*          *                                          *                                         *
*   TOTAL  *      696.82       463.68        295.03   *     233.14       401.79         168.65 *
*          *                                          *                                         *
**********************************************************************************************
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                    SYSTEM ECONOMIC COST AND PERFORMANCE SUMMARY
                      (EXCLUSIVE OF EXISTING SYSTEM COSTS)

TOTAL SYSTEM CAPITAL COST * * * * * * *         3480,00

TOTAL SYSTEM ANNUAL OPERATING
   MAINTENANCE, AND REPAIR COST * * * *           24,36

TOTAL SYSTEM ANNUAL COST  * * * * * * *                      229,68


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM         696,82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM         463,68

AVERAGE ANNUAL DAMAGE REDUCTION                              233,14


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS            3,46
```

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HEC-5C-VARIABLE OUTPUT MAR,1975
RES,= 35 CPTS,= 75 PERS,=100

T1 FALL RIVER BASIN     ***    RELOCATION     ***
T2 TRAINING DOCUMENT NO. 7
T3 FLOOD RATIOS .5  1.0  1.5  2.0  3.0  4.0  USED TO COMPUTE ANNUAL DAMAGES
J1        18.00      6.00      4.00      2.00       3.00      -0.00      -0.00       1.00      -0.00       1.00
J2        -0.00      1.10      2.00      1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
J4         6.00       .30      1.00      1.50       2.00       3.00       4.00      -0.00      -0.00      -0.00


RL         1.00  50000.00     -0.00      0.00   50000.00  150832.00  200000.00      -0.00      -0.00      -0.00
RO         1.00      4.00     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RS         6.00      0.00  50000.00  70000.00  100000.00  150832.00  200000.00      -0.00      -0.00      -0.00
RQ         6.00   5000.00   6000.00   7000.00    8000.00  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
ID RESERVOIR A (CP 1)                            -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RT         1.00      2.00       .20       .30       6.00      -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
ID CP 2                                          -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RT         2.00      4.00       .20       .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00


RL         3.00 100000.00     -0.00      0.00  100000.00  755408.00 1000000.00      -0.00      -0.00      -0.00
RO         1.00      4.00     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RS         7.00      0.00 100000.00 200000.00  400000.00  700000.00  800000.00 1000000.00      -0.00      -0.00
RQ         7.00  10000.00  12000.00  18000.00   30000.00   80000.00  150000.00  500000.00      -0.00      -0.00

CP         3.00  12000.00     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
ID RESERVOIR C (CP 3)                            -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RT         3.00      4.00       .20       .30       6.00      -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        .06        .50
ID CP 4                                          -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RT         4.00      5.00       .20       .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00
QS         1.00 180000.00     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
CS    180000.00   4450.00     -0.00     -0.00      -0.00      -0.00      -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      -0.00
DB         1.00    696.22     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
DF        17.00      1.00       .90       .80        .70        .60        .50        .40        .30        .25
DF          .20       .15       .10       .05        .02        .01        .01        .00      -0.00      -0.00
DQ        17.00  28800.00  35000.00  42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
DQ    150000.00 180000.00 230000.00 323000.00  490000.00  640000.00  840000.00 1000000.00      -0.00      -0.00
DC         1.00      0.00      0.00    180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
DC      1930.00   2660.00   5000.00   9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00
DC         1.00      0.00      0.00      0.00       0.00       0.00       0.00       0.00       0.00       0.00
DC         0.00      0.00   2600.00   7500.00    9880.00   10950.00   11750.00   12200.00      -0.00      -0.00

CP         5.00  37000.00     -0.00     -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
ID CP 5                                          -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
RT         5.00      0.00      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      -0.00

    NRES=     2  NCPT=     5  NCPTR=     -0

IN     1  6 JUNE    1000.0    2000.0    3000.0   18000.0   37000.0   42000.0   50000.0   27000.0   20000.0   13000.0
```

Existing

Modified

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```
                    5000.0    4000.0    3000.0    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     SUM=    231000
                   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   78000.0   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    4000.0     SUM=    504000
                   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     SUM=    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                          SUM=     61700
```

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```
SUMMARY OF AVERAGES FOR RESERVOIRS

 LOC=        CUM LOCA   NATURAL    INFLOW     OUTFLOW    CASE=LOC   LEVEL      EOP STOR

   1          3850.00   3850.00    3850.00    3850.00       .90       2.07   57494.67
   3          8400.00   8400.00    8400.00    7450.62      1.12       2.03  122385.98


SUMMARY OF AVERAGES FOR NON RESERVOIRS

 LOC=        CUM LOCA   NATURAL    REGULATE   Q SPACE    Q BY US    FLOOD BY

   2          8625.00  12474.98   12328.87    8671.13    3703.87    476.19
   4         10755.92  23035.43   21005.66   13994.34   10249.74      0.00
   5         11795.97  24083.97   21119.00   15881.00    9323.04      0.00



COMPUTATION INTERVAL IN HOURS=        6

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

                    NFLRD=         1  NFLCON=        6
                    IFLRD =        1  IFLCON=        2
                        FLOWS MULTIPLIED BY     1.00

**********************************************************************************************************************************

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

                                                                                                                   STARTING TIME=        1
                                                                                                                   HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
                                SERVING         1      4
PER         CUM LOCAL Q

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

                                                                                                                   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

                                                                                                                   AVG=  12833.333   MAX=   50000.000
                                                                                                                                     MIN=    1000.000
PER         OUTFLOW

   1    1000    2000    3000       0       0       0       0       0       0    3658
  11    5000    4000    3000    2000    6000    6000    6000    6000

                                                                                                                   AVG=   2647.691   MAX=    6000.000
                                                                                                                                     MIN=       0.000
```

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```
PER       CASE=LUC.TYP

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

                                                                               AVG=       1.353  MAX=       4.020
PER       LEVEL                                                                                 MIN=        .010

    1  2.000   2.000   2.000   2.089   2.270   2.477   2.723   2.856   2.954   3.000
   11  3.000   3.000   3.000   3.000   2.975   2.951   2.926   2.902

                                                                               AVG=       2.673  MAX=       3.000
PER       EOP STORAGE                                                                           MIN=       2.000

    1  50000   50000   50000   58926   77273   98100  122894  136282  146200  150832
   11 150832  150832  150832  150832  148353  145873  143394  140914

                                                                               AVG= 117909.368  MAX= 150832.000
                                                                                                MIN=  50000.000
*********************************************************************************************************************
**** LOC     2  CP 2                         SERVED BY    =1
PER       CUM LOCAL Q

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

                                                                               AVG=  28750.000  MAX= 100000.000
PER       NATURAL FLOW                                                                          MIN=   1500.000

    1   3000    4167    6028   11338   39056   91843  142140  134857   98809   70302
   11  49884   30147   28191   18032   11005    4168    3028    2505

                                                                               AVG=  41583.282  MAX= 142140.454
PER       REGULATED FLOW                                                                        MIN=   2504.654

    1   3000    4167    6028    8338   20390   57065  100011   90002   70000   50610
   11  40374   28562   27927   17988   11831    8472    7912    7485

                                                                               AVG=  31120.076  MAX= 100010.824
PER       Q SPACE AVAIL.                                                                        MIN=   3000.000

    1  18000   16833   14972   12662     610  =36065  =79011  =69002  =49000  =29610
   11 =19374   =7562   =6927    3012    9169   12528   13088   13515

                                                                               AVG= =10120.076  MAX=  18000.000
PER       Q BY US RES,DIVS                                                                      MIN= =79010.824

    1   1000    1167    2028    2338     390      65      11       2       0     610
   11   3374    4562    3927    2988    2831    5472    5912    5985

                                                                               AVG=   2370.076  MAX=   5985.330
PER       FLOOD BY RES                                                                          MIN=       .301

    1      0       0       0       0       0      65      11       2       0     610
   11   3374    4562    3927       0       0       0       0       0

                                                                               AVG=    697.275  MAX=   4562.320
```

```
                                                                                                      MIN=      0.000
*****************************************************************************************************************
**** LOC      3  RESERVOIR C (CP 3)                     SERVED BY      2

                                                                                       STARTING TIME=       1
                                                                                       HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
                                           SERVING        2     4
PER        CUM LOCAL Q

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

                                                                                       AVG=  28000.000  MAX= 105000.000
PER        NATURAL FLOW                                                                             MIN=   1000.000

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

                                                                                       AVG=  28000.000  MAX= 105000.000
PER        INFLOW                                                                                   MIN=   1000.000

    1    3000     6000    27000    50000   105000    78000    60000    45000    33000    24000
   11   18000    12000    12000     9000     6000     3000     2000     1000

                                                                                       AVG=  28000.000  MAX= 105000.000
PER        OUTFLOW                                                                                  MIN=   1000.000

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

                                                                                       AVG=   3833.333  MAX=  12000.000
PER        CASE=LOC.TYP                                                                             MIN=      0.000

    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      .01      .01      .01      .01

                                                                                       AVG=      2.452  MAX=      4.020
PER        LEVEL                                                                                    MIN=       .010

    1   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=      2.356
PER        EOP STORAGE                                                                              MIN=      2.000

    1  100000   100000   107438   137191   189257   227936   257688   280003   296366   308267
   11  317193   323144   329094   333557   330582   326119   321160   315706

                                                                                       AVG= 255594.556  MAX= 333557.125
                                                                                                    MIN= 100000.000
*****************************************************************************************************************
**** LOC      4  CP 4                                   SERVED BY      1     2
PER        CUM LOCAL Q

    1    4000     6167    22028    17171    18029    31171    62695    92449    87908    73485
   11   61081    62180    39197    29866    19311    11052     4842     2724
```

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```
                                                                                                   AVG=  35853.070  MAX=  92449.206
                                                                                                                    MIN=   2723.662
 PER        NATURAL FLOW

   1    8000   10694   32398   49141   87592  144277  173798  194036  175045  136597
  11  106281   93327   59185   45997   31355   19091    9465    5847

                                                                                                   AVG=  76784.776  MAX= 194036.091
                                                                                                                    MIN=   5846.858
 PER        REGULATED FLOW

   1    8000   10694   29898   28225   21494   32020   62882   92488   87916   73588
  11   62067   65354   43422   33686   24411   24701   21750   20481

                                                                                                   AVG=  41282.055  MAX=  92487.801
                                                                                                                    MIN=   8000.000
 PER        Q SPACE AVAIL.

   1   27000   24306    5102    6775   13506    2980  -27882  -57488  -52916  -38588
  11  -27067  -30354   -8422    1314   10589   10299   13250   14519

                                                                                                   AVG=  -6282.055  MAX=  27000.000
                                                                                                                    MIN= -57487.801
 PER        Q BY US RES,DIVS

   1    4000    4528    7870   11053    3466     848     186      39       8     103
  11     986    3174    4225    3820    5100   13650   16908   17757

                                                                                                   AVG=   5428.984  MAX=  17756.907
                                                                                                                    MIN=      7.685
 PER        FLOOD BY RES

   1       0       0       0       0       0       0     186      39       8     103
  11     986    3174    4225       0       0       0       0       0

                                                                                                   AVG=    484.498  MAX=   4225.056
                                                                                                                    MIN=      0.000
 ****************************************************************************************************************************

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

 PER        CUM LOCAL Q

   1    5000    6361   17509   24965   22613   23150   36588   63470   87279   87316
  11   78389   75315   64539   44865   31940   20706   11959    5792

                                                                                                   AVG=  39319.888  MAX=  87316.106
                                                                                                                    MIN=   5000.000
 PER        NATURAL FLOW

   1    9000   10449   22937   38112   57711   94226  142355  172097  187631  172652
  11  142220  121279   96295   66172   48252   32794   20104   10752

                                                                                                   AVG=  80279.898  MAX= 187631.160
                                                                                                                    MIN=   9000.000
 PER        REGULATED FLOW

   1    9000   10449   22521   32890   31880   27146   37851   63811   87363   87352
  11   78628   76542   67563   48823   35997   27057   24936   22186

                                                                                                   AVG=  43999.739  MAX=  87363.008
                                                                                                                    MIN=   9000.000
 PER        Q SPACE AVAIL.

   1   28000   26551   14479    4110    5120    9854    -851  -26811  -50363  -50352
  11  -41628  -39542  -30563  -11823    1003    9943   12064   14814
```

```
                                                                                                                AVG=  -6999,739  MAX=  28000,000
 PER        Q BY US RES,DIVS                                                                                               MIN= -50363,008

   1    4000    4088    5012    7924    9267    3996    1263     341      84      36
  11     239    1226    3025    3957    4056    6351   12976   16394
                                                                                                                AVG=   4679,852  MAX=  16394,328
 PER        FLOOD BY RES                                                                                                   MIN=     36,288

   1       0       0       0       0       0       0     851     341      84      36
  11     239    1226    3025    3957       0       0       0       0
                                                                                                                AVG=    542,212  MAX=   3957,493
 ***************************************************************************************************************************************   MIN=      0,000

                 CUM TIME=       1

 RES NO=         1       3
 INFLOW       1000    3000
 OUTFLOW      1000    3000
 EOP 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
 EOP 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
 EOP 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
 EOP STOR    58926  137191
 CASE=        4,02    4,02
 LEVEL       2,089   2,057
 EQ LEVEL    2,089   2,057
```

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```
                    FALL RIVER BASIN   ***   RELOCATION   ***
                    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
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
 LOC    2  CP 2                1.007     34777 *     1.007     42642 *     1.007     30000 *     4777 *   0.00    0.00
 LOC    4  CP 4                1.012     33134 *     1.008     58211 *     1.008     27735 *     5400 *   0.00    0.00
 LOC    5  CP 5                1.012     33586 *     1.009     56289 *     1.010     26195 *     7391 *   0.00    0.00

        RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

 LOC    1  RESERVOIR A (CP 1)  1.018    50000    2.000 *   1.008    67393    2.173 *   1.005     6000      6000   50000

 LOC    3  RESERVOIR C (CP 3)  1.003   100000    2.000 *   1.010   140755    2.062 *   1.004    12000     12000  100000

                       MIN SYSTEM STG=    150000    MAX SYSTEM STG=    208148

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

                                                                                 STARTING TIME       1
                                                                                           SHORTAGE INDEX
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
 LOC    2  CP 2                2.007    100011 *     2.007    142140 *     2.007    100000 *       11 *   0.00    0.00
 LOC    4  CP 4                2.008     92488 *     2.008    194036 *     2.008     92449 *       39 *   0.00    0.00
 LOC    5  CP 5                2.009     87363 *     2.009    187631 *     2.010     87316 *       47 *   0.00    0.00

        RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

 LOC    1  RESERVOIR A (CP 1)  2.003    50000    2.000 *   2.011   150832    3.000 *   2.015     6000      6000   50000

 LOC    3  RESERVOIR C (CP 3)  2.002   100000    2.000 *   2.014   333557    2.356 *   2.003    12000     12000  100000

                       MIN SYSTEM STG=    150000    MAX SYSTEM STG=    484389

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

                                                                                 STARTING TIME       1
                                                                                           SHORTAGE INDEX
                             FLD.PER  MAX REG Q *   FLD.PER  MAX NAT Q *   FLD.PER  MAX LOC Q * Q BY RES *   DES     REQ
 LOC    2  CP 2                3.007    157221 *     3.007    213211 *     3.007    150000 *     7221 *   0.00    0.00
 LOC    4  CP 4                3.009    150695 *     3.008    291054 *     3.008    138674 *    12022 *   0.00    0.00
 LOC    5  CP 5                3.010    150348 *     3.009    281447 *     3.010    130974 *    19374 *   0.00    0.00

        RESERVOIRS           FLD.PER  MIN STG MIN LEVEL * FLD.PER  MAX STG MAX LEVEL * FLD.PER  MAX REL  CHAN CAP   STOR1

 LOC    1  RESERVOIR A (CP 1)  3.001    50744    2.007 *   3.007   150832    3.000 *   3.008    40499      6000   50000
```

```
LOC     3  RESERVOIR C (CP 3)        3.001   102231     2.003 *   3.015   470418     2.565 *   3.016    12000      12000  100000

                           MIN SYSTEM STG=     152974     MAX SYSTEM STG=     621250

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

                                                                                                   STARTING TIME        1

                                                                                                             SHORTAGE INDEX
                               FLD.PER   MAX REG Q *      FLD.PER   MAX NAT Q *      FLD.PER   MAX LOC Q * Q BY RES *    DES        REQ
LOC     2  CP 2                  4.008      252767 *        4.007      284281 *        4.007     200000 *     52767 *    0.00       0.00
LOC     4  CP 4                  4.009      237896 *        4.008      388072 *        4.008     184898 *     52998 *    0.00       0.00
LOC     5  CP 5                  4.010      229892 *        4.009      375262 *        4.010     174632 *     55259 *    0.00       0.00
          RESERVOIRS           FLD.PER   MIN STG MIN LEVEL * FLD.PER   MAX STG MAX LEVEL * FLD.PER   MAX REL   CHAN CAP    STOR1

LOC     1  RESERVOIR A (CP 1)    4.001     50992     2.010 *   4.007   150832     3.000 *   4.007    90658       6000   50000

LOC     3  RESERVOIR C (CP 3)    4.001    102975     2.005 *   4.015   593891     2.754 *   4.016    12000      12000  100000

                           MIN SYSTEM STG=     153966     MAX SYSTEM STG=     744723

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

                                                                                                   STARTING TIME        1

                                                                                                             SHORTAGE INDEX
                               FLD.PER   MAX REG Q *      FLD.PER   MAX NAT Q *      FLD.PER   MAX LOC Q * Q BY RES *    DES        REQ
LOC     2  CP 2                  5.008      383382 *        5.007      426421 *        5.007     300000 *     83382 *    0.00       0.00
LOC     4  CP 4                  5.009      372066 *        5.008      582108 *        5.008     277348 *     94718 *    0.00       0.00
LOC     5  CP 5                  5.010      365070 *        5.009      562893 *        5.010     261948 *    103121 *    0.00       0.00
          RESERVOIRS           FLD.PER   MIN STG MIN LEVEL * FLD.PER   MAX STG MAX LEVEL * FLD.PER   MAX REL   CHAN CAP    STOR1

LOC     1  RESERVOIR A (CP 1)    5.001     51488     2.015 *   5.007   168236     3.354 *   5.007   120542       6000   50000

LOC     3  RESERVOIR C (CP 3)    5.001    104463     2.007 *   5.011   755408     3.000 *   5.012    35999      12000  100000

                           MIN SYSTEM STG=     155949     MAX SYSTEM STG=     923644

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

                                                                                                   STARTING TIME        1

                                                                                                             SHORTAGE INDEX
                               FLD.PER   MAX REG Q *      FLD.PER   MAX NAT Q *      FLD.PER   MAX LOC Q * Q BY RES *    DES        REQ
LOC     2  CP 2                  6.007      516031 *        6.007      568562 *        6.007     400000 *    116031 *    0.00       0.00
LOC     4  CP 4                  6.009      612533 *        6.008      776144 *        6.008     369797 *    242736 *    0.00       0.00
LOC     5  CP 5                  6.010      594538 *        6.009      750525 *        6.010     349264 *    245274 *    0.00       0.00
          RESERVOIRS           FLD.PER   MIN STG MIN LEVEL * FLD.PER   MAX STG MAX LEVEL * FLD.PER   MAX REL   CHAN CAP    STOR1

LOC     1  RESERVOIR A (CP 1)    6.001     51983     2.020 *   6.007   191183     3.821 *   6.007   163829       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 STG=     157933     MAX SYSTEM STG=     972456
```

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```
                               EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                   CONTROL POINT NUMBER     4

                                          BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ       PEAK          SUM     TYPE 1     TYPE
    .9990      28800         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     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
    EXIST SYSTEM-INPUT     696.82     696.82


                                          BASE CONDITION FLOOD DAMAGES
              EXCD  PROB
 NO.  FLOW    FREQ   INT          SUM     TYPE 1     TYPE
  1   58211 .621  .623         233.27     233.27
  2  194036 .134  .279         549.81     549.81
  3  291054 .062  .050         360.93     360.93
  4  388072 .034  .025         265.87     265.87
  5  582108 .013  .014         173.38     173.38
  6  776144 .007  .010         138.03     138.03

     BASE COND DAMAGES    1721.30    1721.30
     EXST SYST DAMAGES     696.82     696.82


                                          MODIFIED CONDITIONS FLOW-DAMAGE DATA
     FREQ       PEAK          SUM     TYPE 1     TYPE
    .9990      28800         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          .00        .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     840000     11750.00   11750.00
    .0020    1000000     12200.00   12200.00
```

```
                                          MODIFIED CONDITIONS FLOOD DAMAGES
                EXCD   PROB
  NO.   FLOW    FREQ    INT       SUM     TYPE 1    TYPE
   1    33134  .621   .623       0.00      0.00
   2    92488  .134   .279       0.00      0.00
   3   150695  .062   .050        .22       .22
   4   237896  .034   .025      66.84     66.84
   5   372066  .013   .014     104.05    104.05
   6   612533  .007   .010     108.95    108.95

         MODIFIED DAMAGES      280.07    280.07
         DAMAGE REDUCTION      416.75    416.75


                                          UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
                EXCD   PROB
  NO.   FLOW    FREQ    INT       SUM     TYPE 1    TYPE
   1    27735  .621   .623       0.00      0.00
   2    92449  .134   .279       0.00      0.00
   3   138674  .062   .050       0.00      0.00
   4   184898  .034   .025      11.52     11.52
   5   277348  .013   .014      54.75     54.75
   6   369797  .007   .010      84.87     84.87
         DAMAGES W/ TOTAL
      CONTROL AT PROJECTS      151.14    151.14

       REDUCTION POSSIBLE
       W/ TOTAL CONTROL        545.68    545.68

         RESIDUAL DAMAGES      128.92    128.92
```

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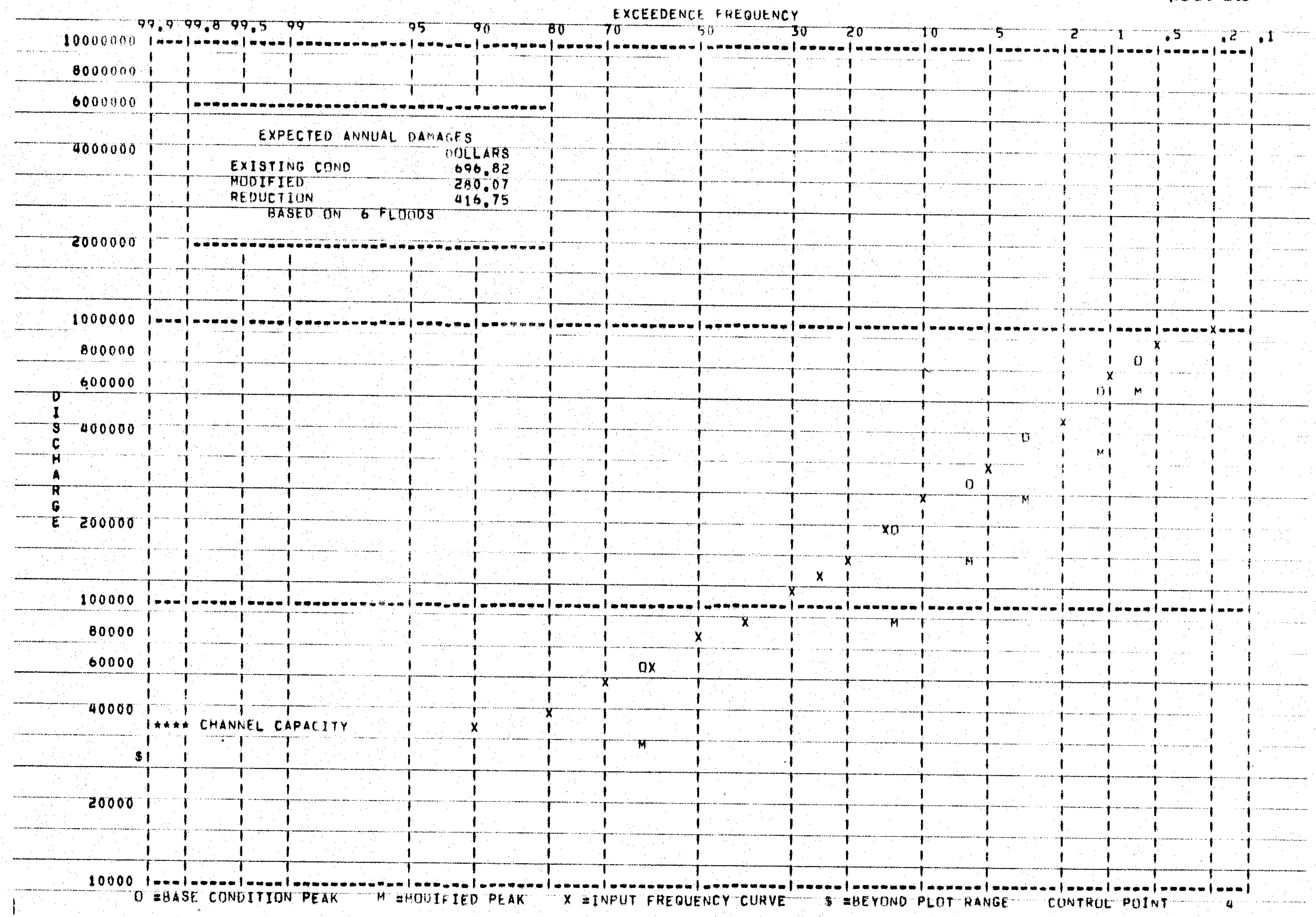
CONTROL POINT 4



```
EXPECTED ANNUAL DAMAGES
                                DOLLARS
EXISTING COND                    696.82
MODIFIED                         280.07
REDUCTION                        416.75
      BASED ON   6 FLOODS
```

```
                               SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
********************************************************************************************************
*             *...................DAMAGES.....................*...............DAMAGE REDUCTION...............*
*  CONTROL    * BASE (EXIST)    MODIFIED       UNCONTROL     *   MODIFIED     TOTAL CONTROL                *
*   POINT     *  CONDITION     CONDITIONS      LOCAL COND    *  CONDITIONS    AT PROJECTS      RESIDUAL    *
*  -------    *  ----------    ----------      ----------    *  ----------    ----------      ----------   *
*        4    *      696.82        280.07          151.14    *      416.75        545.68          128.92   *
*             *                                              *                                             *
*   TOTAL     *      696.82        280.07          151.14    *      416.75        545.68          128.92   *
*             *                                              *                                             *
********************************************************************************************************
```

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

TOTAL SYSTEM CAPITAL COST * * * * * * * *       4450.00

TOTAL SYSTEM ANNUAL OPERATING
   MAINTENANCE, AND REPAIR COST * * * *           22.25

TOTAL SYSTEM ANNUAL COST  * * * * * * *                      284.80


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM         696.82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM         280.07

AVERAGE ANNUAL DAMAGE REDUCTION                              416.75


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS          131.95
```

```
             HEC-5C-VARIABLE OUTPUT MAR,1975
             RES.= 35 CPTS.= 75 PERS.=100

         T1 FALL RIVER 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       18.00       6.00       4.00       2.00       3.00      -0.00      -0.00       1.00      -0.00       1.00
         J2       -0.00       1.10       2.00       1.00      -0.00       0.00      -1.00      -0.00      -0.00      -1.00
         J4        6.00        .30       1.00       1.50       2.00       3.00       4.00      -0.00      -0.00      -0.00

         RL        1.00   50000.00      -0.00       0.00   50000.00  150832.00  200000.00      -0.00      -0.00      -0.00
         RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RS        6.00       0.00   50000.00   70000.00  100000.00  150832.00  200000.00      -0.00      -0.00      -0.00
         RQ        6.00    5000.00    6000.00    7000.00    8000.00  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
         ID RESERVOIR A (CP 1)                                -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RT        1.00       2.00        .20        .30       6.00      -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
         ID CP 2                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RT        2.00       4.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00

         RL        3.00  100000.00      -0.00       0.00  100000.00  755408.00 1000000.00      -0.00      -0.00      -0.00
         RO        1.00       4.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RS        7.00       0.00  100000.00  200000.00  400000.00  700000.00  800000.00 1000000.00      -0.00      -0.00
         RQ        7.00   10000.00   12000.00   18000.00   30000.00   80000.00  150000.00  500000.00      -0.00      -0.00

         CP        3.00   12000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         ID RESERVOIR C (CP 3)                                -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RT        3.00       4.00        .20        .30       6.00      -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        .06       5.00
         ID CP 4                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RT        4.00       5.00        .20        .30       6.00      -0.00      -0.00      -0.00      -0.00      -0.00
         QS        1.00   35000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         CS    35000.00     100.00      -0.00      -0.00      -0.00      -0.00      -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      -0.00
         DB        1.00     696.82      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         DF       17.00       1.00        .90        .80        .70        .60        .50        .40        .30        .25
         DF         .20        .15        .10        .05        .02        .01        .01        .00      -0.00      -0.00
         DQ       17.00   28800.00   35000.00   42000.00   50500.00   60500.00   73000.00   90000.00  114000.00  130000.00
         DQ   150000.00  180000.00  230000.00  323000.00  490000.00  640000.00  840000.00 1000000.00      -0.00      -0.00
EXISTING DC        1.00       0.00       0.00     180.00     380.00     500.00     630.00     900.00    1250.00    1500.00
         DC     1930.00    2660.00    5000.00    9900.00   12280.00   13350.00   14150.00   14600.00      -0.00      -0.00
MODIFIED DC        1.00       0.00       0.00     171.00     361.00     475.00     598.00     855.00    1187.00    1425.00
         DC     1833.00    2527.00    4750.00    9405.00   11609.00   12682.00   13442.00   13870.00      -0.00      -0.00

         CP        5.00   37000.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         ID CP 5                                              -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         RT        5.00       0.00       0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
         ED       -C.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00

              NRES=     2  NCPT=     5  NCPTR=    -0

         IN       1  6 JUNE     1000.0     2000.0     3000.0    18000.0    37000.0    42000.0    50000.0    27000.0    20000.0    13000.0
                                5000.0     4000.0     3000.0     2000.0     1000.0     1000.0     1000.0     1000.0
                                                                                                               SUM=     231000
         IN       2  6 JUNE     2000.0     3000.0     4000.0     6000.0    20000.0    57000.0   100000.0    90000.0    70000.0    50000.0
```

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```
                37000.0   24000.0   24000.0   15000.0    9000.0    3000.0    2000.0    1500.0
                                                                                                       SUM=      517500
IN    3  6 JUNE  3000.0    6000.0   27000.0   60000.0  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
                                                                                                       SUM=      504000
IN    4  6 JUNE  2000.0    4000.0   19000.0   13000.0   10000.0    7000.0    4000.0    1000.0    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    6000.0    5000.0    3000.0    2000.0     500.0     500.0    2000.0
                 5000.0   12000.0    6000.0    4000.0    2000.0    1000.0     500.0     200.0
                                                                                                       SUM=       61700
EJ   =0            =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0      =0.0
```

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```
SUMMARY OF AVERAGES FOR RESERVOIRS

  LOC=        CUM LOCA   NATURAL    INFLOW     OUTFLOW    CASE=LOC   LEVEL      EOP STOR

    1         3850.00    3850.00    3850.00    3850.00       .90      2.07   57494.67
    3         8400.00    8400.00    8400.00    7450.62      1.12      2.03  122385.98

SUMMARY OF AVERAGES FOR NON RESERVOIRS

  LOC=        CUM LOCA   NATURAL    REGULATE   Q SPACE    Q BY US    FLOOD BY

    2         8625.00   12474.98   12328.87    8671.13    3703.87     476.19
    4        10755.92   23035.43   21005.66   13994.34   10249.74       0.00
    5        11795.97   24083.97   21119.00   15881.00    9323.04       0.00


COMPUTATION INTERVAL IN HOURS=        6

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

               NFLRD=         1  NFLCON=        6
               IFLRD =        1  IFLCON=        2
                  FLOWS MULTIPLIED BY     1.00

****************************************************************************************************

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

                                                                               STARTING TIME=        1
                                        SERVING        1     4                 HOUR=12,DAY= 4,MON= 0,YEAR=19 0,
 PER       CUM LOCAL Q

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

                                                                               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

                                                                               AVG=   12833.333  MAX=  50000.000
                                                                                                 MIN=   1000.000
 PER        OUTFLOW

    1   1000    2000    3000       0       0       0       0       0       0    3658
   11   5000    4000    3000    2000    6000    6000    6000    6000

                                                                               AVG=    2647.691  MAX=   6000.000
                                                                                                 MIN=      0.000
 PER        CASE=LOC.TYP

    1    .03     .03     .03    4.02    4.01    4.00    4.00    4.00    4.00     .04
```

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```
 11    .04    .04    .04    .04    .01    .01    .01    .01
                                                                                  AVG=     1,353  MAX=      4,020
                                                                                                  MIN=       ,010
 PER       LEVEL

   1  2,000  2,000  2,000  2,089  2,270  2,477  2,723  2,856  2,954  3,000
  11  3,000  3,000  3,000  3,000  2,975  2,951  2,926  2,902
                                                                                  AVG=     2,673  MAX=      3,000
                                                                                                  MIN=      2,000
 PER       EOP STORAGE

   1  50000  50000  50000  58926  77273  98100 122894 136282 146200 150832
  11 150832 150832 150832 150832 148353 145873 143394 140914
                                                                                  AVG= 117909,368  MAX= 150832,000
                                                                                                   MIN=  50000,000
**************************************************************************************************************
**** LOC     2  CP 2                             SERVED BY    -1

 PER       CUM LOCAL Q

   1   2000   3000   4000   5000  20000  57000 100000  90000  70000  50000
  11  37000  24000  24000  15000   9000   3000   2000   1500
                                                                                  AVG=  28750,000  MAX= 100000,000
                                                                                                   MIN=   1500,000
 PER.      NATURAL FLOW

   1   3000   4167   6028  11338  39056  91843 142140 134857  98809  70302
  11  49884  30147  28191  18032  11005   4168   3028   2505
                                                                                  AVG=  41583,282  MAX= 142140,454
                                                                                                   MIN=   2504,654
 PER       REGULATED FLOW

   1   3000   4167   6028   8338  20390  57065 100011  90002  70000  50610
  11  40374  28562  27927  17988  11831   8472   7912   7485
                                                                                  AVG=  31120,076  MAX= 100010,824
                                                                                                   MIN=   3000,000
 PER       Q SPACE AVAIL.

   1  18000  16833  14972  12662    610 -36065 -79011 -69002 -49000 -29610
  11 -19374  -7562  -6927   3012   9169  12528  13088  13515
                                                                                  AVG= -10120,076  MAX=  18000,000
                                                                                                   MIN= -79010,824
 PER       Q BY US RES,DIVS

   1   1000   1167   2028   2338    390     65     11      2      0    610
  11   3374   4562   3927   2988   2831   5472   5912   5985
                                                                                  AVG=   2370,076  MAX=   5985,330
                                                                                                   MIN=       ,301
 PER       FLOOD BY RES

   1      0      0      0      0      0     65     11      2      0    610
  11   3374   4562   3927      0      0      0      0      0
                                                                                  AVG=    697,275  MAX=   4562,320
                                                                                                   MIN=      0,000
**************************************************************************************************************
```

```
**** LOC      3  RESERVOIR C (CP 3)              .    SERVED BY      2

                                                                                          STARTING TIME=        1
                                          SERVING        2     4                          HOUR=12,DAY= 4,MON= 0,YEAR=19 0.
 PER         CUM LOCAL Q

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

                                                                                          AVG=  28000.000  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    6000    3000    2000    1000

                                                                                          AVG=  28000.000  MAX= 105000.000
                                                                                                           MIN=   1000.000
 PER         INFLOW

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

                                                                                          AVG=  28000.000  MAX= 105000.000
                                                                                                           MIN=   1000.000
 PER         OUTFLOW

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

                                                                                          AVG=   3833.333  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     .01     .01     .01     .01

                                                                                          AVG=      2.452  MAX=      4.020
                                                                                                           MIN=       .010
 PER         LEVEL

    1   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=      2.356
                                                                                                           MIN=      2.000
 PER         EOP STORAGE

    1  100000  100000  107438  137191  189257  227936  257688  280003  296366  308267
   11  317193  323144  329094  333557  330582  326119  321160  315706

                                                                                          AVG= 255594.556  MAX= 333557.125
                                                                                                           MIN= 100000.000
************************************************************************************************************
**** LOC      4  CP 4                             SERVED BY      1      2
 PER         CUM LOCAL Q

    1    4000    6167   22028   17171   18029   31171   62695   92449   87908   73485
   11   61081   62180   39197   29866   19311   11052    4842    2724

                                                                                          AVG=  35853.070  MAX=  92449.206
                                                                                                           MIN=   2723.662
 PER         NATURAL FLOW
```

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```
   1     8000    10694    32398    49141    87592   144277   173798   194036   175045   136597
  11   106281    93327    59185    45997    31355    19091     9465     5847
                                                                                                 AVG=  76784,776  MAX= 194036,091
                                                                                                                  MIN=   5846,858
 PER         REGULATED FLOW

   1     8000    10694    29898    28225    21494    32020    62882    92488    87916    73588
  11    62067    65354    43422    33686    24411    24701    21750    20481
                                                                                                 AVG=  41282,055  MAX=  92487,801
 PER         Q SPACE AVAIL,                                                                                       MIN=   8000,000

   1    27000    24306     5102     6775    13506     2980   -27882   -57488   -52916   -36588
  11   -27067   -30354    -8422     1314    10589    10299    13250    14519
                                                                                                 AVG=  -6282,055  MAX=  27000,000
 PER         Q BY US RES,DIVS                                                                                     MIN= -57487,801

   1     4000     4528     7870    11053     3466      848      186       39        8      103
  11      986     3174     4225     3820     5100    13650    16908    17757
                                                                                                 AVG=   5428,984  MAX=  17756,907
 PER         FLOOD BY RES                                                                                         MIN=      7,685

   1        0        0        0        0        0        0      186       39        8      103
  11      986     3174     4225        0        0        0        0        0
                                                                                                 AVG=    484,498  MAX=   4225,056
                                                                                                                  MIN=      0,000
*************************************************************************************************************************************
**** LOC     5  CP 5                               SERVED BY     -1    -2
 PER         CUM LOCAL Q

   1     5000     6361    17509    24965    22613    23150    36588    63470    87279    87316
  11    78389    75315    64539    44865    31940    20706    11959     5792
                                                                                                 AVG=  39319,888  MAX=  87316,106
 PER         NATURAL FLOW                                                                                         MIN=   5000,000

   1     9000    10449    22937    38112    57711    94226   142355   172097   187631   172652
  11   142220   121279    96295    66172    48252    32794    20104    10752
                                                                                                 AVG=  80279,898  MAX= 187631,160
 PER         REGULATED FLOW                                                                                       MIN=   9000,000

   1     9000    10449    22521    32890    31880    27146    37851    63811    87363    87352
  11    78628    76542    67563    48823    35997    27057    24936    22186
                                                                                                 AVG=  43999,739  MAX=  87363,008
 PER         G SPACE AVAIL,                                                                                       MIN=   9000,000

   1    28000    26551    14479     4110     5120     9854     -851   -26811   -50363   -50352
  11   -41628   -39542   -30563   -11823     1003     9943    12064    14814
                                                                                                 AVG=  -6999,739  MAX=  28000,000
                                                                                                                  MIN= -50363,008
```

```
PER        Q BY US RES,DIVS

   1   4000   4088   5012   7924   9267   3996   1263    341     84     36
  11    239   1226   3025   3957   4056   6351  12976  16394

                                                                          AVG=   4679,852  MAX=  16394,328
                                                                                           MIN=     36,288
PER        FLOOD BY RES

   1      0      0      0      0      0      0    851    341     84     36
  11    239   1226   3025   3957      0      0      0      0

                                                                          AVG=    542,212  MAX=   3957,493
                                                                                           MIN=      0,000
*************************************************************************************************************************

                 CUM TIME=      1

RES NO=        1        3
INFLOW      1000     3000
OUTFLOW     1000     3000
EOP 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
EOP 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
EOP 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
EOP STOR   58926   137191
CASE=       4,02     4,02
LEVEL      2,089    2,057
EQ LEVEL   2,089    2,057

                 CUM TIME=      5
```

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```
                    FALL RIVER BASIN  *** FLOOD WARNING ***
                    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
                            FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     2  CP 2             1,007      34777 *      1,007      42642 *      1,007      30000 *      4777 *   0,00    0,00
  LOC     4  CP 4             1,012      33134 *      1,008      58211 *      1,008      27735 *      5400 *   0,00    0,00
  LOC     5  CP 5             1,012      33586 *      1,009      56289 *      1,010      26195 *      7391 *   0,00    0,00

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

  LOC     1  RESERVOIR A (CP 1)   1,018    50000     2,000 *   1,008    67393     2,173 *   1,005     6000      6000   50000

  LOC     3  RESERVOIR C (CP 3)   1,003   100000     2,000 *   1,010   140755     2,062 *   1,004    12000     12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    208148

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

                                                                                STARTING TIME      1
                                                                                              SHORTAGE INDEX
                            FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     2  CP 2             2,007     100011 *      2,007     142140 *      2,007     100000 *        11 *   0,00    0,00
  LOC     4  CP 4             2,008      92888 *      2,008     194036 *      2,008      92449 *        39 *   0,00    0,00
  LOC     5  CP 5             2,009      87363 *      2,009     187631 *      2,010      87316 *        47 *   0,00    0,00

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

  LOC     1  RESERVOIR A (CP 1)   2,003    50000     2,000 *   2,011   150832     3,000 *   2,015     6000      6000   50000

  LOC     3  RESERVOIR C (CP 3)   2,002   100000     2,000 *   2,014   333557     2,356 *   2,003    12000     12000  100000

                        MIN SYSTEM STG=    150000    MAX SYSTEM STG=    484389

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

                                                                                STARTING TIME      1
                                                                                              SHORTAGE INDEX
                            FLD,PER  MAX REG Q *    FLD,PER  MAX NAT Q *    FLD,PER  MAX LOC Q * Q BY RES *   DES     REQ
  LOC     2  CP 2             3,007     157221 *      3,007     213211 *      3,007     150000 *      7221 *   0,00    0,00
  LOC     4  CP 4             3,009     150695 *      3,008     291054 *      3,008     138674 *     12022 *   0,00    0,00
  LOC     5  CP 5             3,010     150348 *      3,009     281447 *      3,010     130974 *     19374 *   0,00    0,00

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

  LOC     1  RESERVOIR A (CP 1)   3,001    50744     2,007 *   3,007   150832     3,000 *   3,008    40499      6000   50000

  LOC     3  RESERVOIR C (CP 3)   3,001   102231     2,003 *   3,015   470418     2,565 *   3,016    12000     12000  100000
```

```
                        MIN SYSTEM STG=     152974     MAX SYSTEM STG=     621250

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

                                                                                        STARTING TIME       1
                                                                                                 SHORTAGE INDEX
                                FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *    FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
  LOC     2  CP 2                4,008     252767 *       4,007     284281 *       4,007     200000 *    52767 *    0,00     0,00
  LOC     4  CP 4                4,009     237896 *       4,008     388072 *       4,008     184898 *    52998 *    0,00     0,00
  LOC     5  CP 5                4,010     229892 *       4,009     375262 *       4,010     174632 *    55259 *    0,00     0,00

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

  LOC     1  RESERVOIR A (CP 1)  4,001    50992     2,010 *   4,007   150832     3,000 *   4,007    90658      6000    50000

  LOC     3  RESERVOIR C (CP 3)  4,001   102975     2,005 *   4,015   593891     2,754 *   4,016    12000     12000   100000

                        MIN SYSTEM STG=     153966     MAX SYSTEM STG=     744723

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

                                                                                        STARTING TIME       1
                                                                                                 SHORTAGE INDEX
                                FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *    FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
  LOC     2  CP 2                5,008     383382 *       5,007     426421 *       5,007     300000 *    83382 *    0,00     0,00
  LOC     4  CP 4                5,009     372066 *       5,008     582108 *       5,008     277348 *    94718 *    0,00     0,00
  LOC     5  CP 5                5,010     365070 *       5,009     562893 *       5,010     261948 *   103121 *    0,00     0,00

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

  LOC     1  RESERVOIR A (CP 1)  5,001    51488     2,015 *   5,007   168236     3,354 *   5,007   120542      6000    50000

  LOC     3  RESERVOIR C (CP 3)  5,001   104463     2,007 *   5,011   755408     3,000 *   5,012    35999     12000   100000

                        MIN SYSTEM STG=     155949     MAX SYSTEM STG=     923644

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

                                                                                        STARTING TIME       1
                                                                                                 SHORTAGE INDEX
                                FLD,PER   MAX REG Q *    FLD,PER   MAX NAT Q *    FLD,PER   MAX LOC Q * Q BY RES *   DES      REQ
  LOC     2  CP 2                6,007     516031 *       6,007     568562 *       6,007     400000 *   116031 *    0,00     0,00
  LOC     4  CP 4                6,009     612533 *       6,008     776144 *       6,008     369797 *   242736 *    0,00     0,00
  LOC     5  CP 5                6,010     594538 *       6,009     750525 *       6,010     349264 *   245274 *    0,00     0,00

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

  LOC     1  RESERVOIR A (CP 1)  6,001    51983     2,020 *   6,007   191183     3,821 *   6,007   163829      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 STG=     157933     MAX SYSTEM STG=     972456
```

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```
                                    . EXPECTED ANNUAL FLOOD DAMAGE SUMMARY
                                         CONTROL POINT NUMBER    4

                              BASE CONDITION FREQUENCY-FLOW-DAMAGE DATA
     FREQ      PEAK          SUM    TYPE 1    TYPE
    .9990     28800         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    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
    EXIST SYSTEM-INPUT    696.82    696.82

                              BASE CONDITION FLOOD DAMAGES
             EXCD  PROB
 NO.  FLOW   FREQ   INT        SUM    TYPE 1    TYPE
  1   58211  .621  .623     233.27    233.27
  2  194036  .134  .279     549.81    549.81
  3  291054  .062  .050     360.93    360.93
  4  388072  .034  .025     265.87    265.87
  5  582108  .013  .014     173.38    173.38
  6  776144  .007  .010     138.03    138.03

     BASE COND DAMAGES   1721.30   1721.30
     EXST SYST DAMAGES    696.82    696.82


                              MODIFIED CONDITIONS FLOW-DAMAGE DATA
     FREQ      PEAK          SUM    TYPE 1    TYPE
    .9990     28800         0.00      0.00
    .9000     35000          .00       .00
    .8000     42000       171.00    171.00
    .7000     50500       361.00    361.00
    .6000     60500       475.00    475.00
    .5000     73000       598.00    598.00
    .4000     90000       855.00    855.00
    .3000    114000      1187.00   1187.00
    .2500    130000      1425.00   1425.00
    .2000    150000      1833.00   1833.00
    .1500    180000      2527.00   2527.00
    .1000    230000      4750.00   4750.00
    .0500    323000      9405.00   9405.00
    .0200    490000     11609.00  11609.00
    .0100    640000     12682.00  12682.00
    .0050    840000     13442.00  13442.00
    .0020   1000000     13870.00  13870.00

                              MODIFIED CONDITIONS FLOOD DAMAGES
```

```
              EXCD   PROB
NO.  FLOW    FREQ    INT          SUM      TYPE 1     TYPE
  1   33134 .621    .623        32.28      32.28
  2   92488 .134    .279       168.24     168.24
  3  150695 .062    .050        84.24      84.24
  4  237896 .034    .025       121.21     121.21
  5  372066 .013    .014       130.06     130.06
  6  612533 .007    .010       125.58     125.58

      MODIFIED DAMAGES         661.63     661.63
      DAMAGE REDUCTION          35.19      35.19

                                    UNCONTROLLED LOCAL FLOW FLOOD DAMAGES
              EXCD   PROB
NO.  FLOW    FREQ    INT          SUM      TYPE 1     TYPE
  1   27735 .621    .623        13.71      13.71
  2   92449 .134    .279       158.13     158.13
  3  138674 .062    .050        72.49      72.49
  4  184898 .034    .025        68.77      68.77
  5  277348 .013    .014        83.48      83.48
  6  369797 .007    .010       102.59     102.59
      DAMAGES W/ TOTAL
   CONTROL AT PROJECTS         499.16     499.16

     REDUCTION POSSIBLE
     W/ TOTAL CONTROL          197.66     197.66

      RESIDUAL DAMAGES         162.47     162.47
```

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CONTROL POINT 4

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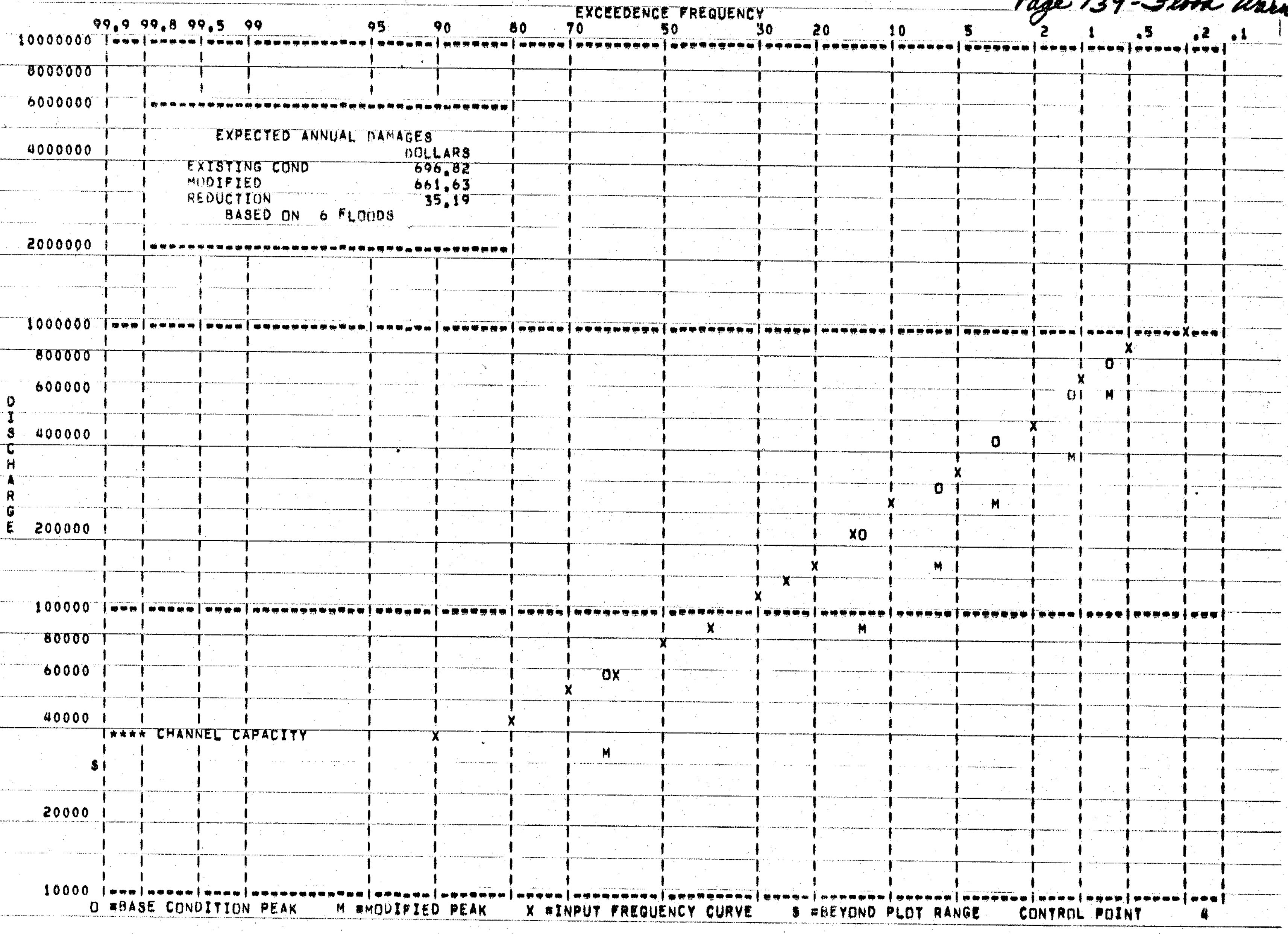

EXPECTED ANNUAL DAMAGES

	DOLLARS
EXISTING COND	696.82
MODIFIED	661.63
REDUCTION	35.19

BASED ON 6 FLOODS

```
                              SUMMARY OF SYSTEM'S EXPECTED ANNUAL FLOOD DAMAGES
*************************************************************************************************
*          *..................DAMAGES..................*..............DAMAGE REDUCTION............*
*  CONTROL * BASE (EXIST)   MODIFIED      UNCONTROL    *  MODIFIED     TOTAL CONTROL               *
*   POINT  *  CONDITION    CONDITIONS    LOCAL COND    * CONDITIONS    AT PROJECTS      RESIDUAL   *
*  ------- *  ----------   ----------    ----------    * ----------    ----------      ----------  *
*       4  *      696.82       661.63        499.16    *      35.19        197.66          162.47  *
*          *                                           *                                           *
*   TOTAL  *      696.82       661.63        499.16    *      35.19        197.66          162.47  *
*          *                                           *                                           *
*************************************************************************************************
```

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```
                 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  * * * * * * *                          10.90


AVERAGE ANNUAL DAMAGES - EXISTING SYSTEM           696.82

AVERAGE ANNUAL DAMAGES - PROPOSED SYSTEM           661.63

AVERAGE ANNUAL DAMAGE REDUCTION                                  35.19


AVERAGE ANNUAL SYSTEM NET DAMAGE REDUCTION BENEFITS              24.29
```