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OPTIMAL ALLOCATION OF WATER IN THE OKANAGAN RIVER BASIN

Prepared by:

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ABSTRACT

The objective of this study is to demonstrate the use of linear programming as a planning tool in the allocation of water within a river basin. A linear programming model is developed which maximizes economic benefits from water use in the Okanagan River Basin of British Columbia. Many activities including agriculture, recreation, domestic use and sport fishing compete for the sometimes scarce water supplies in this Basin. The model allocates water among these activities subject to water supply, storage and resource constraints. An average water supply year, broken down into seven time periods is represented by the model. The solution represents a sustainable allocation of water over time in that no long term depletion of stored water is allowed. Because the study was intended as a demonstration project, data-gathering efforts were kept to a minimum. A previous Canada Water Act study in the region provided most of the necessary data to construct the model although some estimates of the economic value of water-use activities had to be made. The model solution is consistent with previous studies which showed shortages of water relative to potential demands on most tributaries of the system. However, better data and extensive sensitivity analysis would be required before the model could be used for water management and planning in the region. It was concluded that the approach was feasible in terms of data, manpower and computer requirements and could be integrated into future studies related to long term water planning and management.

RESUME

Le but de cette étude est de démontrer l'utilisation de la programmation linéaire comme un outil de planification pour l'allocation d'eau dans un bassin hydrographique. Un modèle de programmation linéaire, qui maximise les avantages économiques de l'utilisation d'eau du bassin de la rivière Okanagan en Colombie-Britannique, est exposé. Plusieurs activités telles que l'agriculture, les loisirs, l'utilisation domestique d'eau et la pêche sportive se font concurrence pour le peu d'eau qu'il y a, parfois, dans ce bassin. Le modèle alloue de l'eau pour ces activités selon l'approvisionnement en eau, l'emmagasinage d'eau et les contraintes d'autres ressources. Une moyenne d'alimentation annuel en eau est répartie entre sept périodes de temps. Le résultat du modèle est une allocation d'eau supportable pour une période de temps mais ne permet pas, à long terme, l'épuisement d'eau retenue. Les données recueillies pour cette étude furent minimes parce que l'intention fut d'élaborer un projet de démonstration. La plupart des données nécessaires pour constuire le modèle furent extrait d'une étude antérieure entreprise sous la Loi sur les ressources en eau du Canada pour la région Okanagan. Il fut aussi nécessaire de faire des estimations de valeur économique concernant la façon que l'eau est utilisé pour les dîtes activités. La solution du modèle est compatible avec des études antérieures qui démontrent la pénurie d'eau relative aux demandes possibles placé sur la majorité des tributaires du bassin. Cependant plus de

données et d'analyses de sensibilité sont nécessaires pour que le modèle puisse être utilisé pour la gestion et la planification des eaux de la région. En somme l'approche démontré par cette étude est réalisable étant donné les exigences de données, de main-d'oeuvre et d'informatique et qu'elle peut être incorporé dans des études futures reliées à la planification et gestion des eaux à longue terme.

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I. INTRODUCTION

The allocation of water among competing demands is a central issue in river basin planning. In a given river basin, the type, location and timing of potential water demands must be considered in the allocation of the available water supply. The type of water demands may encompass a diverse range of activities such as industry, irrigation and maintenance of minimum flows for fish habitat. Locations of these demands in a river system may vary from the upper tributary reaches to the lower valley lakes. The time of year in which these demands occur is critical in the management of water storage in the system. Thus the allocation decision can be thought of as having three dimensions: how to use the water; where to use it; and, when to use it.

Many constraints exist which limit the choices of how, when and where to use the water in a river basin. These constraints may be physical factors such as available runoff and storage or institutional factors such as committed water licences and apportionment agreements. The constraints may also take the form of regulations or policies protecting the basin from environmental degradation. The effect of these constraints is to restrict the choices available when planning present and future allocation of water in a river basin.

When selecting the "best" allocation of water from the many possible choices, some specific criteria must be used. The model developed in this report uses the criterion of maximizing social benefits when allocating water. Where possible, these benefits are quantified in economic terms using standard methods of benefit-cost analysis. Non-quantifiable factors are also entered in the model through the imposition of constraints which limit the type of activities or distribution of water in the system. A linear programming model is developed where economic benefits are expressed as a mathematical function to be maximized subject to physical and institutional constraints which are also expressed as mathematical functions.

A. Objectives

There are two basic objectives to this report:

1) Construct a water use optimization model for the Okanagan River Basin to demonstrate the technique of linear programming.
2) Discuss possible extensions of the model to improve its applicability in other river basins.

The model developed in this study can be classified as a planning model. The optimal solution sets out long range levels for activities which require water in a river basin. Seasonal patterns of storage, release and withdrawal are also given in the solution. However, the model is not intended as a tool to aid in the short term operations of a river basin system. It will not, for example, give daily or weekly guidelines for reservoir operations or lake levels. It would be up to the system managers to gear short term operations to meet the needs of the longer term water use activities selected by the planning model.

Since the primary purpose of the study is to demonstrate the applicability and flexibility of the linear programming technique, data gathering efforts were kept to a minimum. Therefore many of the relationships built into the model are based on preliminary data and rough estimates of key variables. While the model may provide some insights into management of the water resources of the Okanagan system, the results should be interpreted with caution.

B. The Problem Setting

The Okanagan River Basin in the southern interior of British Columbia was chosen to illustrate the use of the water use optimization model (figure 1). The major reason for its selection was the availability of of data from a previous Canada Water Act Study (Canada, British Columbia, 1974). This data included extensive information on water supplies, water demands and potential water use activities for a number of sub-basins of the Okanagan watershed. With a relatively small amount of supplementary data and some assumptions, it was feasible to construct a useful demonstration model using linear programming.

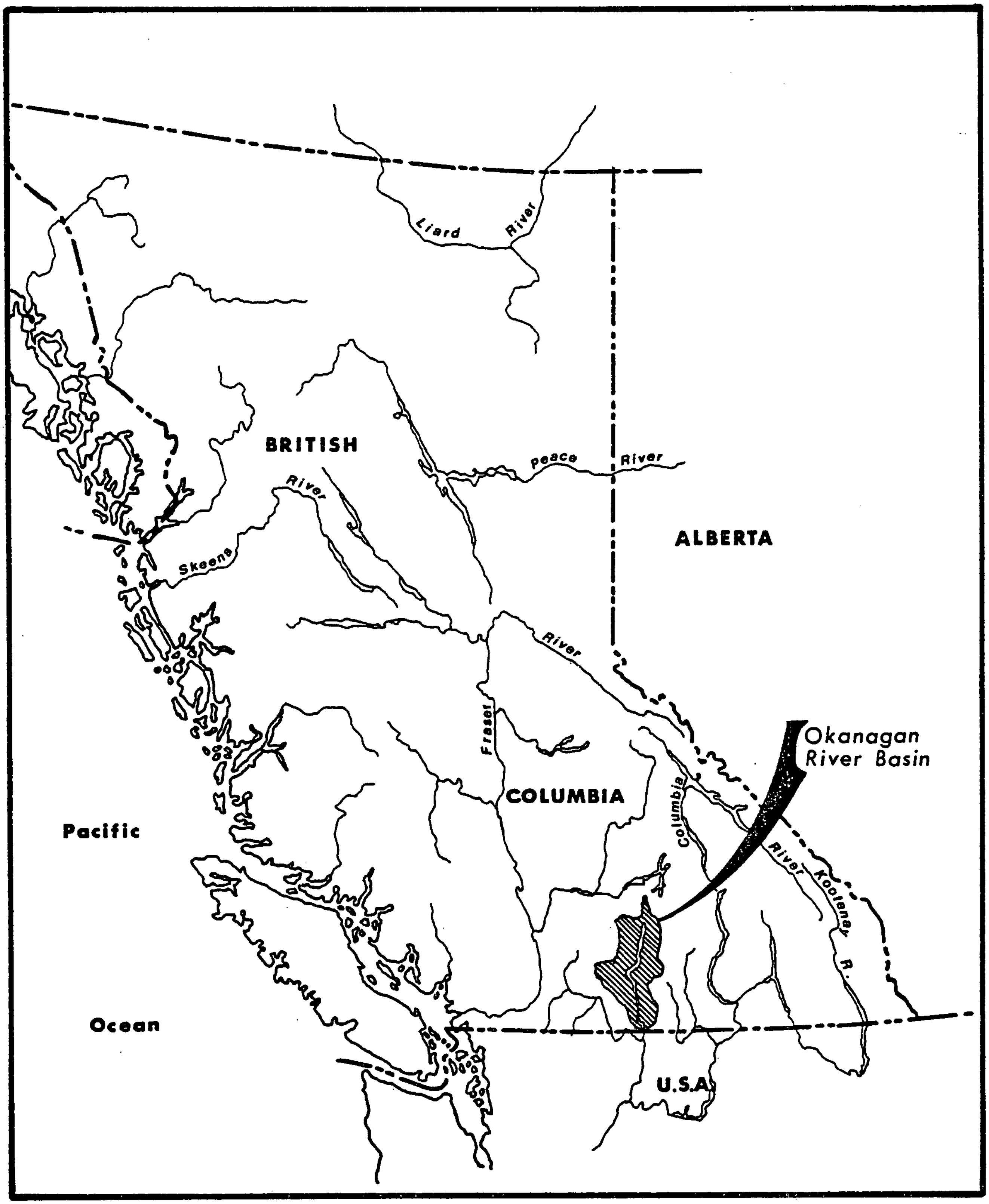

FIGURE 1 OKANAGAN RIVER BASIN — KEY MAP

Several features of the Basin make it an interesting case study for water use optimization. A wide variety of current and potential socio-economic activities require water. These include agriculture, industry, households, recreation and fisheries representing both consumptive and non-consumptive uses. These activities occur in a number of different reaches throughout the geographically diverse watershed of the Basin. Because the watershed is diverse, ranging from alpine snowfields to near-desert valley floors and benchlands, there are significant variations in both supplies and demands for water within the Basin. The possible choice of water use activities is broadened by the availability of large amounts of storage on the main valley lakes and small but important storage reservoirs on the tributaries of the system.

The Okanagan River Basin clearly illustrates the three dimensions (how, when and where) of choice when allocating water within a river basin. Several demands compete for scarce water in areas of the Basin, particularly in the lower reaches of the tributaries. Efficient management of water storage in the system is necessary to ensure that water is supplied at the time and place it is required. The application of the optimization model will demonstrate an approach to allocation of the water resources in the Basin in order to maximize economic benefits.

The next chapter outlines the basic structure of linear programming models and presents the theoretical concepts used in the measurement of economic benefits. The detailed structure of the model as applied to the Okanagan River Basin is presented in chapter 3, and the optimal solution is discussed in chapter 4. The final chapter presents the conclusions that are drawn from the project and discusses methods for improving the model and extending its application to other river basins.

II. THEORETICAL BACKGROUND

A. Introduction

The purpose of this chapter is twofold. First, the basic theory of linear programming is outlined, with emphasis on how it can be used to model water use allocation in a river basin. A brief review of other studies which have utilized similar methodology in the planning of water resources is undertaken. Second, the basic theory underlying the measurement of individual and aggregate economic benefits is presented.

B. Linear Programming Models

This section examines the basic structure and theory of linear programming models. The suitability of linear programming as a tool for allocation of water in river basins is discussed. Emphasis is placed on its ability to handle large dimensional problems expressed as linear equations.

1. Basic Structure

Linear programming is a subset of a larger class of maximization or minimization problems referred to as mathematical programming models. Mathematical programming attempts to maximize or minimize an objective function subject to a number of constraints, some of which are expressed as inequalities. It differs from classical optimization problems solved by calculus in which all constraints are in the form of equalities. In linear programming both the objective function and the constraints are expressed as linear equations. Equation (1) is an example of a linear programming model.

(1) Maximize $b1x1 + b2x2 + b3x3$

subject to:

$$c1x1 + c2x2 + c3x3 < r1$$

$$d1x1 + d2x2 + d3x3 < r2$$

$$e1x1 + e2x2 + e3x3 < r3$$

Where:

x1,x2,x3 = levels of various activities

b1,b2,b3 = coefficients representing benefits of the activity levels

c1,c2,c3

d1,d2,d3 = coefficients representing relationships between activity levels,

e1,e2,e3

r1,r2,r3 = right hand side values of linear constraints

The objective function represents a goal or target to be maximized such as economic benefits from water in a given river basin. The optimal solution to the above example is the combination of activities that results in the maximum benefits as expressed in the objective function. It would also be possible to formulate a linear programming model where the goal is to minimize the objective function. An example of such a model might be to minimize cost associated with supplying water to the various users in a river basin.

In the above example, the three constraints state that certain linear combinations of activities be less than the right hand side values, r1-r3. It is also possible to construct a linear programming model where some or all of the constraints state that combinations of activity levels be greater than (or equal to) the right hand side variables. The only restriction is that at least one of the constraints be expressed as an inequality.

The linear constraints represent the availability of resources and the linkages between the activity variables (x1,x2,x3) in the model. For example, a simple constraint might state that the surface run-off in a particular reach of the Basin is equal to 1200 acre-feet. Another constraint might state that the amount of water withdrawn from a stream is less than the total amount of water flowing into the reservoir. Linear constraints can generally be used to represent all of the important hydrologic and economic relationships in the area under study.

An additional constraint on the above model and on all linear programming models is that the activity variables must be non-negative. This does not represent a problem when applying linear programming to water use optimization since most physical activities related to the use and distribution of water are also non-negative. It is possible to conceive of variables which can take negative values such as change in reservoir levels. However, the use of such activities in the model can be avoided by defining other constraints which use only positive activities to express the same relationships.

An important consideration when solving systems of equations is the relationship between the number of equations and the number of activities. However, in linear programming there are no restrictions on the relationship between the number of constraints and the number of activities. There may be more constraints than there are activities or there may be more activities than constraints. This adds considerable flexibility when applying linear programming to water use optimization since constraints can be added or deleted as needed to reflect the characteristics of the basin under study.

2. Solution Method

The method of solving linear programming problems and the computational effort required are important factors when applying this technique to water use optimization. Depending on the basin under study and the degree of disaggregation required, the number of activities and or constraints can be in the hundreds or even thousands. Therefore, it is important to have an efficient algorithm for finding the optimal feasible solution.

Fortunately, there is a reliable and relatively fast method of solving linear programming maximization or minimization problems which is referred to as the "simplex" method. This method rests on the fact that an optimum solution to a linear programming problem will also be a "corner" solution. Figure 2 illustrates the concept of a corner solution for a problem with two activities and three

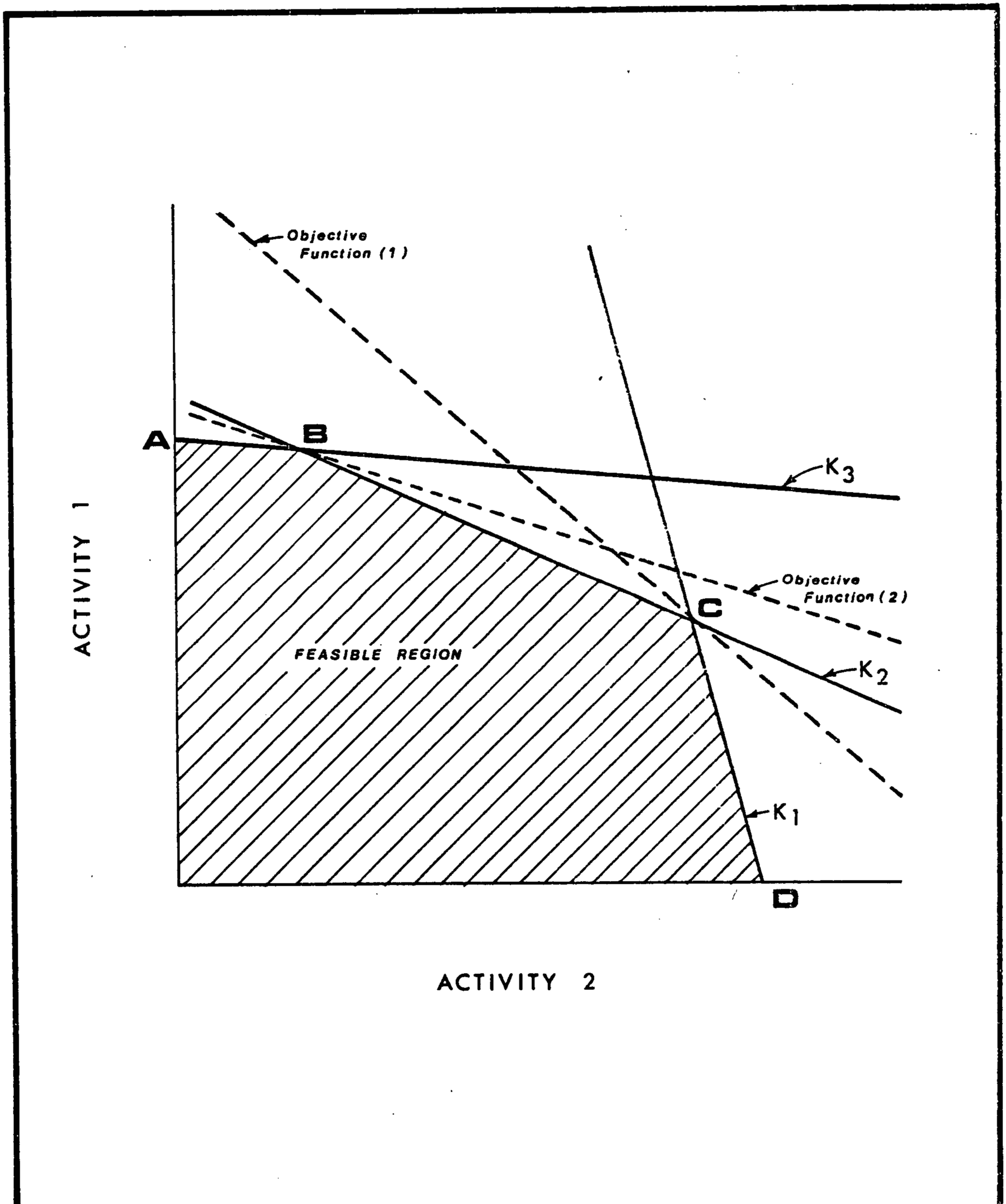

FIGURE 2 CORNER SOLUTIONS IN LINEAR PROGRAMMING

constraints. The three constraints are represented by the three solid lines labelled k1,k2 and k3. For a solution to be feasible it must lie inside all of these constraints in the area referred to as the feasible region. The four points A,B,C and D, are called corner solutions since they lie on the corners of the feasible region.

The objective function, represented by the dotted line, becomes greater as the line is moved out from the origin. The maximum feasible solution is the point within the feasible region at which the objective function is at its maximum. In figure 2 the maximum solution is at point B. If the slope of the objective function were to change, the maximum solution would also change but would still lie on a corner point, as shown by the second dotted line which intersects with point C. It is possible for the objective function to be parallel to one of the constraints in which case there could be a range of maximum solutions bordering the feasible region. However, at least one of the corner points will be included in this range. Note that for larger dimensional problems the feasible region and corner points will be defined by the intersection of planes or hyperplanes rather than lines.

The computational problem of finding the maximum feasible solution is simplified in that only corner points have to be examined. However, for a larger problem there may be a many corner points. The advantage of the simplex method is that it can find the maximum feasible solution without having to examine all of the corner points. Without going into any detail, the simplex method starts with an initial corner point, then moves along the border of the feasible region to another corner solution. The best direction to move along the border can be determined by examining the relative change in the objective function. Using this method, the maximum solution can be found by examining only a small fraction of the feasible points. This is an important consideration when solving larger models which are used in water use optimization.

There are two possible problems which can prevent an optimum solution being found. First, there may be no feasible solution that satisfies all of the constraints. If this were to occur in the case of water use optimization in a river basin, it would be safe to assume that one or more of the constraints had not been specified correctly. The problem should not occur if the situation is modeled correctly. Second, the solution may be "unbounded" which means that the objective function can be increased indefinitly without violating any of the constraints. Again, if this were to occur in the case of water use modeling, it would be because of an error in the manner in which the constraints or the objective function were specified. Thus neither of the two problems should be encountered in water use optimization if the situation is correctly specified and modeled.

3. Dual Activities

For any given linear programming problem there exists another problem known as the "dual". For instance, if we consider the problem stated earlier in equation (1) which is to maximize benefits subject to constraints on resource levels, the dual problem can be stated as follows: minimize the resource levels subject to the constraint that benefits are at a stated maximum. Equation (2) shows the dual problem to equation (1).

(2) Minimize $r1y1 + r2y2 + r3y3$

subject to:

$$c1y1 + d1y2 + e1y3 > b1$$

$$c2y1 + d2y2 + e2y3 > b2$$

$$c3y1 + d3y2 + e3y3 > b3$$

where:

y1,y2,y3 = dual activities

The dual problem is formulated by transposing the original (primal) problem and introducing the variables, y1 - y3 which are referred to as dual activities. Note that the coefficients on the primal activities, x1 - x3, occur in the dual problem but in a different order. The benefit coefficients, b1 - b3, of the primal problem become the right-hand side values, and the primal right-hand side values, r1 - r3, become the coefficients on the objective function of the dual problem.

The dual problem is automatically solved at the same time as the primal solution. This is a useful feature of linear programming because of the relationship between the dual activities and the original (primal) problem. The most important relationship for the purposes of this study is that the levels of the dual activities in the optimal solution represent "shadow prices" of the resource levels r1,r2 and r3 in the primal problem.

The shadow price of a resource represents the amount by which the objective function would increase if the level of the resource were increased by one unit. In economic terms it can be thought of as the marginal value product of the resource. It is a useful concept when analyzing the allocation of water in a river basin. For example, if we consider storage capacity as a resource, then the shadow price will tell us how much an additional unit of storage is worth in terms of increased benefits. Shadow prices on other constraining resources such as monthly run-off in different reaches of the Basin can be interpreted in the same manner.

C. Applications of Mathematical Programming in Water Management

Mathematical programming techniques have been used in a broad range of applications in water planning and management. It is convenient to classify these studies into two categories: operational models and planning models. A brief discussion of these two classes of models is given below.

Operational models are used in the short term management of water supply systems and are concerned with such problems as determining the daily or weekly release from storage reservoirs in order to meet demand requirements. These models are sometimes "real-time" implying that they are continuously solved and updated to determine what actions are required by system managers at any given time. Other operational models are short term models which are solved to give daily or weekly guidelines for management of the water supply system. In general, operational models are oriented towards supply management with fixed water demands. The objective function in these models often attempts to minimize the deviations from target water supply levels to the various users. Numerous studies which have developed operational models have been reported in the literature. Because these studies have a different emphasis than the planning model discussed in this report, no attempt was made to review this body of literature.

Planning models are concerned with a broader range of objectives over a longer term. These objectives include such factors as the optimum allocation of water among various users, the amount of storage required in the water supply system and the effects of management policies such as pricing and other conservation measures. Planning models present a framework for addressing the questions of where, when and how the water resources in a basin should be used. In contrast to operational models, the concepts of value and demand for water are explicitly considered in this framework. A planning model may form part of a hierarchical structure in which it is used to determine a longer term allocation of water which can be incorporated into the structure of a shorter-term operational model.

Previous studies which have developed planning models for water resources are numerous although less common than studies on operational models. These studies have been undertaken for a wide variety of problems over a broad range of geographical areas. A brief review of the published literature follows.

Several planning models have directly addressed the problem of water supply capacity expansion. Most of these studies attempted to determine the optimum time path for expansion of storage and delivery systems based on the criterion of maximizing economic benefits. Recent examples of such studies are Moore and Yeh (1980) for the Eel River system in California and Lin (1981) for the Umatilla River basin in Oregon. Armstrong and Willis (1979) carried out a similar study over a number of regions in California but also considered optimal allocation of water among competing users at the same time.

A number of studies have attempted to determine the optimal allocation of water among competing users. Many of these studies concentrated on a single predominant user of water in a basin and attempted to optimize the amount and timing of water supplied to this use. For example Timmons (1982) carried out a detailed analysis of irrigation profitability for various crops in Utah and Abate (1975) developed a general model for crop selection and water allocation for dryland farming. Guise and Flinn (1970) used an optimization model to analyze agricultural demand for water and to develop optimal pricing policies for areas of Australia.

Other studies have developed models to allocate water over multiple uses. For example, Nieh (1979) studied allocation of water between agricultural and urban areas as did Armstrong and Willis (1979) for selected areas of California. The variety and scope of multi-use models is noteworthy. While many studies such as Hopkins et.al. (1982) and Kindler (1982) have concentrated on the river basin as the management unit, others such as Kieth et.al. (1982) and Arizona (1971) have carried out state-wide analysis of water allocation. There is also a contrast between the structure and focus of the models. For example the Arizona (1971) study was based on an aggregate input-output model of the state economy in contrast to a study by Bartlett (1974) which developed a detailed model of the ecology of rangeland in order to optimize allocation of water.

The specification of the objective function in previous studies is of particular interest. The basic question is what are these models attempting to optimize? As mentioned, many operational models simply attempt to minimize the deviations of water supply from pre-set target levels. Other studies such as Harris and Rea (1972) and Arizona (1971) have utilized concepts such as gross state product or value added as the criteria for maximization. The disadvantage of these concepts is that they do not account for non-market factors such as recreational activity, leisure time and environmental quality. Most of the other studies quoted have optimized economic benefits from water use. In these studies, economic benefits are defined in the traditional cost-benefit framework. A few studies such as Kindler (1982) and Flatt and Howard (1976) have included optimization of some variables for which economic benefits cannot be quantified in dollar values. These models allow the managers to assign their own weights in the objective function to non-monetary variables.

Maximization of economic benefits is the criterion used in the present study to determine optimum water allocation in the Okanagan River Basin. Economic benefits are defined as in traditional cost-benefit analysis using consumer's surplus as the basis for calculating benefits. The next section describes some of the basic theory of consumer's surplus and related concepts.

D. The Measurement of Economic Benefits

When choosing between different allocations of water in a basin, it is necessary to have some method of ranking the economic benefits or utility which individuals derive from use of the water. This measure of benefits can then be incorporated into the objective function for maximization. Some theoretically sound methods exist for measuring utility changes for individuals. However, when attempts are made to sum up individual changes in utility to arrive at the aggregate benefits for a group of people, several problems are encountered. These problems have implications both for the model developed in this study and for conventional cost-benefit analysis.

1. Measuring Changes in an Individual's Utility

Given a change in prices of goods and/or income, there are three general methods which can be used to estimate the resulting change in the utility of an individual. These are the equivalent variation, the compensating variation and the consumer's surplus.[1] Although weaker on theoretical grounds, consumer's surplus is utilized in applied cost-benefit analysis because it is the easiest to observe empirically.

The consumer's surplus for a particular commodity is the area under the individual's demand curve for the commodity but above the price paid for it. For a change in the price of the good, the difference in consumer's surplus can be used as an indicator of the change in the individual's utility. However, if the price of more than one good has changed, then there is not a unique value for the change in consumer's surplus associated with the change in utility. There will be several possible values for the difference in consumer's surplus depending on the order in which the prices are changed. However, it has been shown by Willig (1976) that for many situations, the consumer's surplus will not differ appreciably from the equivalent variation or compensating variation which are exact measures of individual's utility.

In the region under study there is little metered pricing of water. Water is allocated mainly through quantity rationing by water licences or on a first come first serve basis. Therefore we are interested in the effect on an individual's utility when the amount of water allocated to him is changed. This situation is illustrated in figure 3. The amount of water rationed to the

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1. This report uses the Marshallian definition of consumer's surplus and the Hicksian definition of compensating and equivalent variation. These terms are sometimes defined in a different fashion.

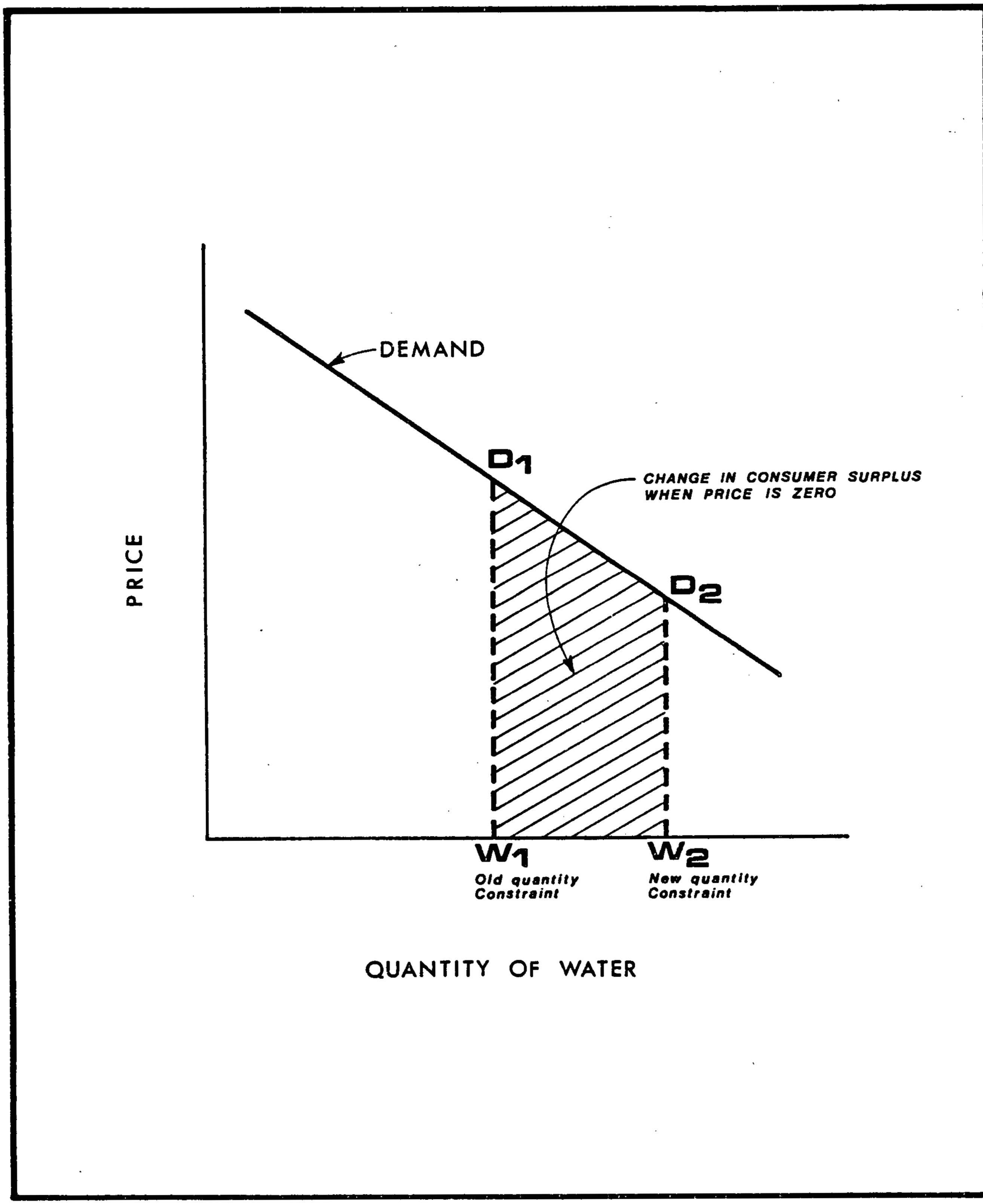

FIGURE 3 CONSUMER'S SURPLUS WITH QUANTITY CONSTRAINTS

individual is increased from W1 to W2. Assuming a zero price for water, the change in area under the demand curve represents the change in consumer surplus and can be used as an indication of the change in the individual's utility. This area is represented by D1,D2,W1,W2 in figure 3.

Equivalent variation and compensating variation are measures of the change in utility for an individual whose original allocation of goods (state A) has changed to a new allocation (state B). The equivalent variation is the amount of income that would have to be given to or taken away from the consumer in state A (keeping the original prices) which would result in him just achieving his new utility in state B. The compensating variation is the amount of income that would have to be given to or taken away from the individual in state B (keeping the new prices) in order for him to reach his original utility in state A. Both the compensating and equivalent variation have a one to one correspondence with changes in utility, and are therefore theoretically sound measures of the individual's utility change.

In order to calculate the change in consumer's surplus illustrated in figure 3, it is necessary to have an estimate of the demand curve. This can be a problem when there are no observable prices for water in the region. In applied cost-benefit analysis, the consumer's surplus is often estimated by indirect methods, without direct estimation of the demand curve.

2. Measuring Changes in Aggregate Utility

Since most changes in allocation or prices of goods will affect many individuals, it would be desirable to have a measure of change in aggregate utility (economic benefits). The usual approach in assessing the economic benefits of a project is simply to add up the changes in each individual's utility resulting from the project. The aggregate utility can then be used to compare group welfare for different allocations of water. The major problem encountered with this approach is that it does not consider the relative utilities between individuals. For instance, should a change in utility for a wealthy individual be given the same weight as a change in utility for a poor individual? Because of the difficulty in comparing the utility of individuals, applied welfare analysis has usually relied on the Pareto principle.

The Pareto principle states that state B is preferred to state A, if at least one person is better off in state B, and no one is worse off than in state A. A "Pareto improvement" is said to result when the economy moves from state A to state B. If it is not possible to make any further Pareto improvements by moving from state A to a different state, then State A is said to be "Pareto optimal". The Pareto concept is useful because we do not need to know anything about the relative utilities between individuals. All that is needed is a ordinal ranking for each individual relating his utility to the allocation of goods he receives. This ranking can be based on any of the three utility indicators discussed previously.

A number of problems with the Pareto principle are recognized. Most public projects will affect a number of people, some advantageously and some adversely. Such projects can not be directly assessed using the Pareto principle. A second problem is that the Pareto principle gives no way of comparing between Pareto optimal states. A third problem with the Pareto principle is that some Pareto optimal states cannot be shown to be superior to all non-pareto optimal states.

These problems can be overcome to some extent by assessing projects as to their potential for Pareto improvements using the principle of compensation. If states A and B are Pareto non-comparable it might still be possible to rank them if all the individuals who gain from going to state B were to compensate the individuals who were made worse off from the transition to state B. If this compensation results in everyone being at least as well off in state B as in state A, with at least one person better off, then a Pareto improvement will have taken place. It would therefore seem possible to assess a public project by its potential for a Pareto improvement if the gainers were to compensate the losers. This is in fact the object of almost all cost-benefit analysis; to determine whether a project can result in a potential Pareto improvement. Such analysis is not usually predicated on the assumption that compensation will actually take place. It is usually assumed that compensation will somewhat magically occur somewhere else in the system.

Unfortunately, even if we assume that compensation will occur somewhere else in the system, the compensation principle has a number of problems. A major theoretical problem is that two different states can be shown to be superior to each other using the compensation principle. This is often referred to as the problem of reversals. A second problem is that of intransitivity. Using the compensation principle, state C could be ranked as superior to state B and state B as superior to state A, while at the same time state A could be ranked superior to state C. The only way to avoid the problem of reversals and intransitivities is to make some highly restrictive and unrealistic assumptions about individual preferences.[2]

Even if we ignore the problems of reversals and intransitivities, the best that can be said is that an increase in aggregate compensating or equivalent variation is necessary for a potential Pareto improvement to occur, but not sufficient. In terms of benefit-cost analysis this implies that a benefit-cost ratio greater than unity is necessary but not sufficient to conclude that a project is worth undertaking. Boadway and Bruce (1984, p.271) make the following cautionary statement about measuring benefits using the compensation principle:

> The use of the unweighted sum of household compensating or equivalent variations as a necessary and sufficient indicator of potential Pareto improvement is rife with difficulties. At best such measures can be used as a preliminary attempt to rank social states.

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2. The restrictions are that all households have linear and parallel income expansion lines or Engle's curves.

3. The Approach Used in this Study

The model developed in this study is based on maximization of total consumer's surplus from water use in a river basin. The assumption is made that consumer's surplus is a good approximation to the aggregate compensating variation, and therefore the model maximizes the aggregate compensating variation from water use in the Basin.

It is recognized that this approach only yields an "optimal" allocation of water in a very limited sense. The previous discussion points out the difficulties in assuming that maximizing consumer's surplus will lead to maximization of social welfare, even if potential gainers were to compensate potential losers. Therefore it is important to recognize that the model is simply a tool which can be used as an input into the allocation decision. A variety of other factors such as distribution of the benefits, public safety and ecosystem health are also of major importance in the allocation and use of the water resource.

E. Summary

The linear programming approach has several advantages for modeling water use in a river basin. It is capable of handling large multidimensional problems encountered when modeling allocation of water. The computational methods are efficient and the simultaneous solution of dual activities gives shadow prices of the constraining resources. The economic theory behind the optimization of water use is somewhat weaker. It cannot be said that maximization of consumer's surplus will result in the maximum social welfare from water use. Therefore the model should only be used as an aid to planning within a broader decision framework.

In the next chapter we utilize the linear programming approach and the economic concepts discussed here to develop a model of water use allocation in the Okanagan River Basin. The detailed specifications of the constraints and the objective function are presented.

III. MODEL STRUCTURE

The model is constructed in modular form, with a distinct sub-model for each reach in the Basin. These sub-models are linked together to form the basin-wide model using constraints to represent the inflow-outflow relationships between the reaches. An objective function is formulated which represents the total benefits from water-use activities over the whole basin. Because the structure of the sub-models are basically similar, the detailed specification is given for only two sub-models; the first representing a tributary reach and the second representing a mainstem reach.

A. Basin Configuration

The Basin was divided into a number of reaches in the model representing both tributaries and sub-basins of the mainstem river and lakes. The breakdown is consistent with a number of previous supply and demand studies carried out in the Okanagan Basin Study allowing for a detailed analysis for most areas of the Basin where competition for scarce water has occurred in the past. The following eleven reaches are modeled:

1. Penticton Creek
2. Mission Creek
3. Kelowna Creek
4. Equesis Creek
5. Powers Creek
6. Peachland Creek
7. Trout Creek
8. Okanagan Lake
9. Skaha Lake
10. Okanagan River
11. Osoyoos Lake

The seven creeks shown are the major tributaries to Okanagan Lake based on volume of flow. These seven tributaries account for almost all of the water-use in the Basin which is not supplied from the mainstem lakes and river. However, the model does not include the highly developed Kalamalka-Vernon Creek system because of the lack of data on natural run-off and monthly water use. Several other smaller tributaries to the system were also omitted because of data limitations. The net inflow from these tributaries into the mainstem system was included as an exogenous variable in the model.

The remaining four reaches comprise the mainstem system of the Basin. Of these, Okanagan Lake is the dominant reach in terms of storage and urban development. However, both Skaha and Osoyoos

Lakes support high density recreational uses and Okanagan River supplies water to significant areas of agricultural land in the south. Figure 4 shows the location of the eleven reaches incorporated in the model.

It can be seen from figure 4 that most of the run-off occurs in the higher elevations of the Basin. Some of the seasonal run-off from the higher elevations is captured and stored in reservoirs on the major tributaries for use later on in the year. This storage, although minor in comparison to the natural storage of Okanagan Lake, is important because it is a source of water for major areas of agriculture on the lower reaches of the tributaries. In fact most agricultural land around Okanagan Lake relies on water from the tributaries where it can be obtained from gravity fed systems. This is generally a much more economical system than pumping water from the lake itself.

The tributaries also support a resident trout population and serve as spawning ground for trout and kokanee that reside in the mainstem lakes. The resident trout population is generally located in the upper reaches and reservoirs of the creeks while the spawning areas are usually found in the lower levels. Historically, the fish population has declined as a result of the water withdrawn for other uses on the tributaries. Figure 5 illustrates the location of water use and storage activities on the tributary and mainstem reaches of the model.

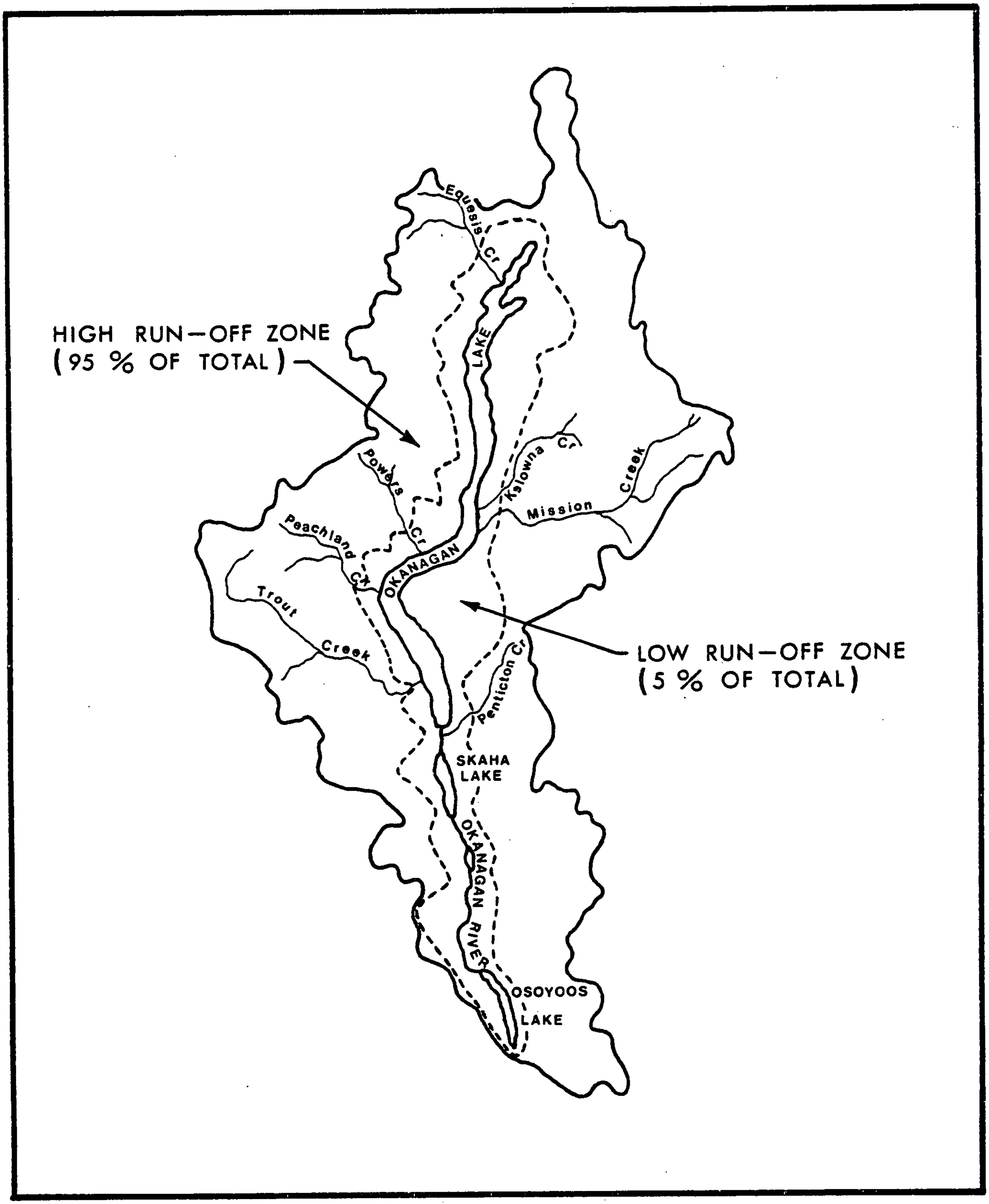

FIGURE 4 OKANAGAN RIVER BASIN — LOCATION OF REACHES IN MODEL

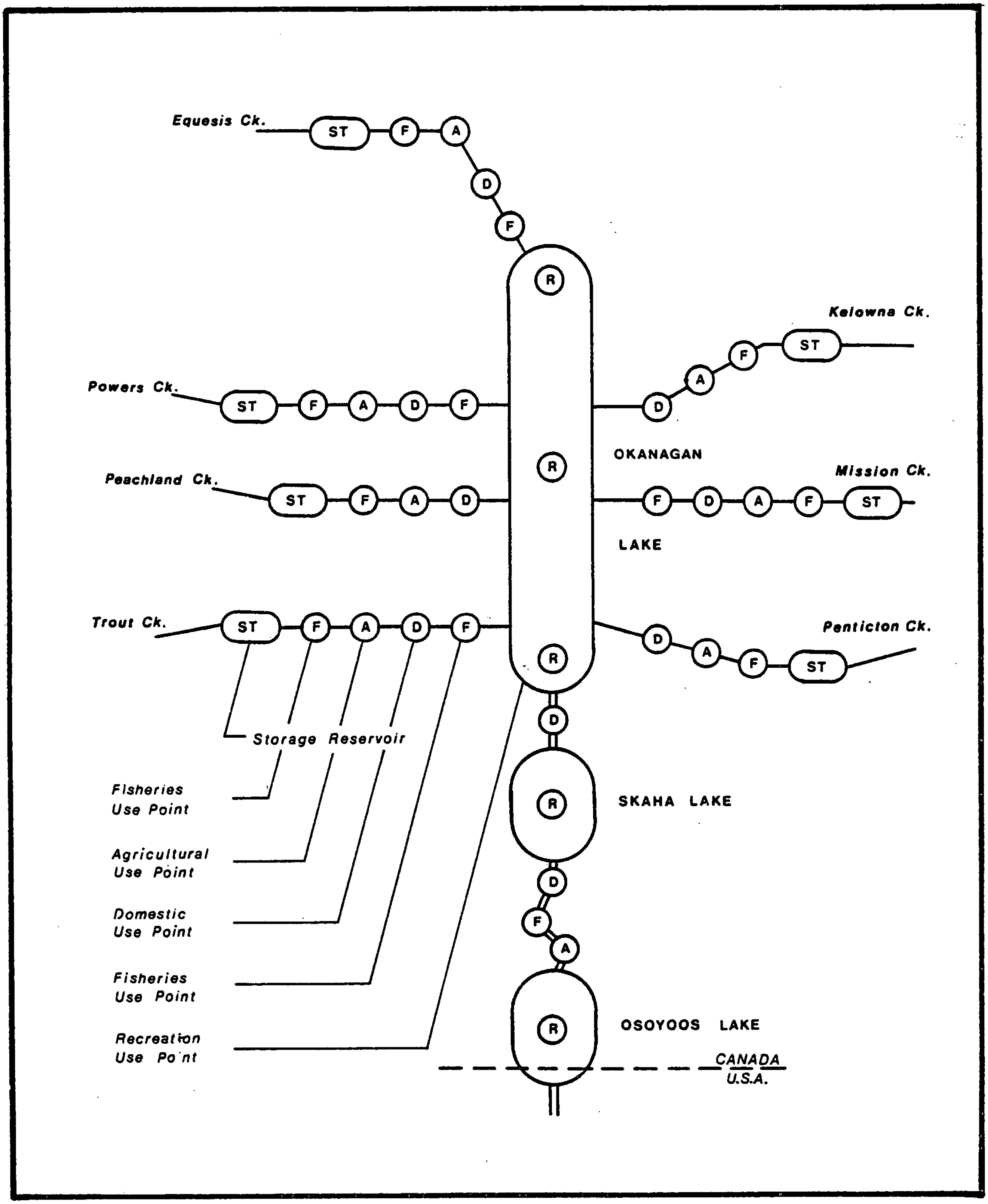

FIGURE 5 OKANAGAN RIVER BASIN — SCHEMATIC DIAGRAM OF WATER USE AND STORAGE

B. Seasonal Breakdown

The model allocates water over a single year which is divided into seven periods. The individual months from May to October form the first six periods while the remaining months are grouped together to form the seventh period. The disaggregation into sub-year periods allows analysis of the seasonal patterns of water-use, storage and run-off. Agricultural and domestic demands are at their maximum during the summer months. At the same time lake levels should be maintained to meet the requirements for water based recreation. Instream flows for fisheries are required earlier in the year and later on in the month of October. Meanwhile most of the natural run-off occurs in the freshet during May and early June. Thus the seasonal aspect of storing water and allocating it to its various uses is an important consideration in the model.

A weakness of the model is that it considers the allocation of water for only a single year. This is a problem for the mainstem system where inter-year trade-offs in water use are possible because of the large storage capacity of Okanagan Lake. In any given year, there is a choice of using the stored water or retaining it for use in the following year. This is an important decision because of the possibility of a drought occurring in the subsequent year. However, under normal snow-pack conditions, run-off in subsequent years would be adequate to replenish the water stored on the mainstem lakes. The possibility of inter-year storage is also a consideration on some tributaries where the storage capacity and water use are large compared to the normal run-off.

Without considering the demand for water in subsequent years, there will be a tendency for the model to "mine" the storage of water in the lakes and reservoirs. In other words, the optimal solution will likely use as much water from both storage and run-off as needed to maximize benefits in the current year without consideration for benefits in future years. To protect against this likelihood, a constraint is placed on the model where the end of year storage must be at least equal to the beginning year storage. The optimal solution will then represent an allocation of water that is sustainable over the long term, given average run-off conditions. Although this will prevent a solution which mines the water storage, it is not necessarily the optimal policy in all run-off conditions. In years with very low run-off it may in fact be desirable to deplete some of the storage with the hope that it will be replenished in future years. In years of high run-off it might be a good policy to store as much as the water as possible for use in future years when less run-off would likely occur. These possibilities can be included in the model using dynamic programming methods. This was beyond the scope of the present study but could be carried out as a logical extension of the current work. Chapter five discusses how dynamic programming could be used to analyze inter-year trade-offs in water use.

C. Specifying the Objective Function

The model defines three "final use" activities which have positive values in the objective function. These are (1) irrigated acreage under production, (2) harvestable population of sport fish, and (3) lake levels falling within desirable ranges for recreation. There are other final use activities which obviously have value associated with them including domestic, commercial and industrial uses of water. The model constrains the solution to supply as much water as is required by these activities before any water is allocated to the other three activities specified in the objective function. Thus an implicit assumption is made that domestic, commercial and industrial use of water takes precedence or has a higher value than other users in the model. This assumption, while probably valid, was made for the reason that consumer's surplus values or rents associated with domestic, commercial and industrial uses of water were not readily estimated. Estimating these values would again be a logical extension of the current study.

For each acre of irrigated land, a net benefit of $800, is assumed.[3] This is entered in the objective function simply as:

(3) 800A1 + 800A2 + 800A3 + 800A4 + 800A5 + 800A6
+800A7 + 800A8 + 800A9 + 800A10 + 800A11

where A1 to A11 are variables representing the number of irrigated acres in the eleven reaches of the Basin.

---

3. This figure is based on a case study of an Okanagan orchard carried out by the British Columbia Ministry of Agriculture (1983).

The figure of $800 per acre may not be representative of the average net return in all areas of the Basin, but was used as a first approximation. Because of lower tree fruit prices in recent years, the net return may in fact be much lower. This points out the need for sensitivity analysis using a range of values in the objective function before the model could to be used for planning purposes.

Populations of spawning kokanee, spawning trout and resident trout enter as activities in the objective function. A positive benefit is assigned to each fish produced in the tributaries. This value was derived from net willingness to pay figures obtained in a survey of sport fishermen in the Okanagan Basin Study[4]. Equation (4) represents the fish population activities in the objective function for a specific tributary.

(4) 10Rt1 + 10Rt2 + 10Rt3 +10Sk +10St

where:

Rt1,Rt2,Rt3 are resident trout populations

St is the spawning trout population

Sk is the spawning kokanee population

---

4. A value of $10 per fish was based on catch rates and willingness to pay for an angler day. The basic information was taken from the fisheries and wildlife technical supplement to the Okanagan Basin Study (Canada-British Columbia 1974d, p.123).

The resident trout are divided into three separate activities in the objective function because of a non-linear relationship between tributary flows and population. A series of linear functions are used to approximate this non-linear relationship, with each linear function having a corresponding value in the objective function. This process is explained in more detail in section 4 which specifies the relationship between water supply and fish populations. Note that equation (4) represents objective function values of fish for one tributary only. In the complete model the objective function values in equation (4) are entered for all seven tributaries. No attempt was made to model fish populations and values on the mainstem system because of a shortage of data.

Water based recreation enters into the objective function in the form of positive values associated with desirable lake levels for recreation. Certain minimum lake levels are required for convenient use of launches, docks and beaches on the mainstem system. If lake elevations fall below these levels, some of these facilities will be unusable resulting in extra travel time and aesthetic losses to recreationists. Critical lake levels are defined for Okanagan, Skaha and Osoyoos lakes below which recreational losses will occur. Positive values in the objective function are associated with an increase in lake levels up to the critical elevations. Equation (5) shows the lake level activities in the objective function.

(5) 0.089o2REC + 0.356o3REC + 0.356o4REC + 0.089o5REC +

0.509s2REC + 2.036s3REC + 2.036s4REC + 0.509s5REC +

1.000y2REC + 4.000y3REC + 4.000y4REC + 1.000y5REC

where:

o2REC - o5REC = Level of Okanagan Lake expressed in acre-feet of storage. (Below a critical level of 336,800 acre-feet)

s2REC - s5REC = Level of Skaha Lake expressed in acre-feet of storage. (Below a critical level of 7,065 acre-feet)

y2REC - y5REC = Level of Osoyoos Lake expressed in acre-feet of storage. (Below a critical level of 16,980 acre-feet)

The label numbers 2,3,4 and 5 refer to periods in the model corresponding to the months of June, July, August and September. No value is assigned to lake levels in other months of the year when water-based recreation is relatively insignificant. The objective function values are highest in periods 3 and 4 when recreational use of the lake is at a maximum. The objective function values associated with lake levels are derived from estimates made in the Okanagan Basin Study[5] and from recent field surveys relating recreational losses to Osoyoos Lake levels.

It should be noted that the objective function only assigns values to lake levels up to critical elevations. The model does not prevent the lake levels from going higher than the critical lake elevations: it simply stops assigning any increases in recreational value once these levels are reached.

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5. Rough estimates of the annual recreational losses on Okanagan Lake due to extreme fluctuations in lake-levels were taken from the Okanagan Basin Study (Canada-British Columbia 1974a, p.30).

D. Specifying the Constraints

There are over 800 constraints in the model so it is impractical to list them all in this report. The large number of constraints is due to the disaggregated structure of the model which includes 11 reaches and seven periods and numerous activities. However, the structure of the model can be illustrated by defining the constraints for only specific reaches and then demonstrating the linkages between reaches.

The model as a whole can be considered as a linked series of sub-models with each sub-model representing one of the eleven reaches. The seven tributary sub-models all have more or less the same structure and therefore only the constraints for a single illustrative tributary are presented. Trout Creek is used as the example tributary because it includes all of the fishery and agricultural activities specified in the objective function. The four mainstem sub-models all have the same basic structure so only the sub-model for the Okanagan Lake reach is presented. This sub-model demonstrates how both recreational and return-flow activities are incorporated as constraints.

1. Trout Creek Sub-model

The constraints for this sub model fall into four categories:

1) water supply constraints,

2) downstream demand constraints

3) constraints linking supply and demand

4) linking constraints with the downstream reach.

a. Water Supply Constraints

Water can be supplied from three sources: run-off above the storage reservoir; run-off below the reservoir; and, water released from storage. In the model it is assumed that there is only one storage reservoir on each tributary reach. For tributaries which have more than one reservoir, storage capacity is summed and modeled as if it were all contained in a single large reservoir. In general, release from storage provides most of the water requirements for the downstream reaches. Run-off below the reservoir is a less significant source of water supply for the downstream activities. Almost all of the water using activities in the model are located below the storage reservoirs so the high levels of run-off above the reservoir serve more to replenish storage than as direct supplies for water use activities.

The model first defines the run-off in each period above the reservoir as shown in equations (6) to (12). These figures represent the average run-off for the Trout Creek basin based on historical records.

(6) a1ROA = 25,104 acre-feet[6]

(7) a2ROA = 15,283

(8) a3ROA = 1,831

(9) a4ROA = 888

(10) a5ROA = 755

(11) a6ROA = 755

(12) a7ROA = 5,065

where:

ROA = run-off above the reservoir.

In all equations the variables are prefixed by a two character code signifying the sub-basin and the season.

The run-off below the reservoir is presented in a similar fashion in equations (13) to (19).

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6. Acre-feet are used in this and all subsequent equations in order to be consistent with the units used in the Okanagan Basin Study from which most of the relationships in the report are derived.

(13) a1ROB = 799

(14) a2ROB = 388

(15) a3ROB = 127

(16) a4ROB = 36

(17) a5ROB = 36

(18) a6ROB = 36

(19) a7ROB = 346

where:

ROB = run-off occurring below the storage reservoir

Because not all the run-off can be stored or utilized, the model incorporates a wastage factor. Wastage occurs on certain days of high run-off when not all the water can be utilized or when storage is not available. When the daily run-off is aggregated to give monthly figures, an attempt should be made to account for the wastage that has occurred on such days. Other losses may occur because of leakage and evaporation of the diversion and conveyance systems. In this study it is assumed that 10% of the monthly run-off is wastage.[7] Equations (20) to (33) define the relationship between the run-off and the actual water available for use over the seven periods of the model.

---

7. This is a general estimate of wastage based on figures used in Canada-British Columbia (1974c). Actual wastage will vary between tributaries, but sufficient data were not available to model this.

(20) $a1ROAW - .9a1ROA = 0$

(21) $a2ROAW - .9a2ROA = 0$

(22) $a3ROAW - .9a3ROA = 0$

(23) $a4ROAW - .9a4ROA = 0$

(24) $a5ROAW - .9a5ROA = 0$

(25) $a6ROAW - .9a6ROA = 0$

(26) $a7ROAW - .9a7ROA = 0$

(27) $a1ROBW - .9a1ROB = 0$

(28) $a2ROBW - .9a2ROB = 0$

(29) $a3ROBW - .9a3ROB = 0$

(30) $a4ROBW - .9a4ROB = 0$

(31) $a5ROBW - .9a5ROB = 0$

(32) $a6ROBW - .9a6ROB = 0$

(33) $a7ROBW - .9a7ROB = 0$

where:

ROAW = the amount of run-off occurring above the reservoir available for use.

ROBW = the amount of run-off occurring below the reservoir available for use

The next set of constraints are the storage balance equations which define the relationship between storage levels, inflows to the reservoir and outflows from the reservoir. The inflow is represented by the run-off above the reservoir after wastage has been deducted and the outflow is represented by the release from storage. Evaporation losses were not included because of a lack of data. Equations (34) to (40) define the storage balance relationship for each period.

(34) a0STO + a1ROAW - a1REL - a1STO = 0

(35) a1STO + a2ROAW - a2REL - a2STO = 0

(36) a2STO + a3ROAW - a3REL - a3STO = 0

(37) a3STO + a4ROAW - a4REL - a4STO = 0

(38) a4STO + a5ROAW - a5REL - a5STO = 0

(39) a5STO + a6ROAW - a6REL - a6STO = 0

(40) a6STO + a7ROAW - a7REL - a7STO = 0

where:

STO = the amount of water stored in the reservoir

REL = the amount of water released from storage

The variable a0STO represents the storage level at the beginning of the year before any water has been added or withdrawn. This level is defined as a fixed value in the model as shown in equation (41). An additional constraint shown in equation (42) is that the end-of-year storage, a7STO, be equal to the beginning-of-year storage.

(41) a0STO = 5000

(42) a7STO = 5000

b. Water Demand Constraints

For each acre of irrigated land, a fixed amount of water is required. Based on estimates made in the Okanagan Basin Implementation Agreement[8], a value of three acre-feet per acre is used for the Trout Creek area. Irrigation occurs only in the first five periods with the heaviest applications in the second, third and fourth periods as shown in equations (43) to (47).

(43) aOACRE - 2.22a1ACR = 0

(44) aOACRE - 1.33a2ACR = 0

(45) aOACRE - 1.33a3ACR = 0

(46) aOACRE - 1.33a4ACR = 0

(47) aOACRE - 3.33a5ACR = 0

where:

aOACRE = the number of irrigated acres

a1ACR - a5ACR = the amount of water required in each period.

As previously mentioned, the model is forced to supply all domestic and industrial water needs before any remaining water can be allocated to other uses. This is done by setting up simple constraints defining domestic/industrial use in each time period as shown in equations (48) to (54).

---

8. The water requirements are given in the main report (Canada-British Columbia 1974a, p.84). Higher requirements occur in the southern areas of the Basin and are reflected in the coefficients for the Okanagan River and Osoyoos Lake sub-models.

(48) $a1DOMR = 29$

(49) $a2DOMR = 32$

(50) $a3DOMR = 29$

(51) $a4DOMR = 29$

(52) $a5DOMR = 32$

(53) $a6DOMR = 29$

(54) $a7DOMR = 212$

where:

DOMR = a fixed amount of water supplied to domestic and industrial uses in each period.

Modeling the water use for production of sport fish is somewhat more complex than modeling consumptive uses by agriculture or domestic. The populations of spawning trout and kokanee are related to the amount of flow in certain months in the lower sections of the reach. A rough flow-population relationship for the production of spawning fish was derived in the Okanagan Basin Study[9] and has been used as the basis for all of the seven tributaries in the model. Rainbow trout require significant streamflows during the freshet when they ascend the tributaries to spawn. The resulting fry begin their downstream migration in June although about half may stay in the tributaries for at least a year before entering Okanagan Lake, thus requiring year-round flows. Equations (55) to (61) relate the population of spawning trout to levels of flow in the lower reaches.

---

9. This relationship related improvements in spawning escapement with modifications in discharge (Canada-British Columbia 1974d, p.45-52).

(55) aOSTR - .31a1FISR < 0

(56) aOSTR - .47a2FISR < 0

(57) aOSTR - .47a3FISR < 0

(58) aOSTR - .47a4FISR < 0

(59) aOSTR - .47a5FISR < 0

(60) aOSTR - .47a6FISR < 0

(61) aOSTR - 1.2a7FISR < 0

where:

aOSTR = the population of spawning trout

a1FISR - a7FISR = flows available for sport fish in the lower reaches

The constraints relating kokanee population to flows are set out in the same manner as for spawning trout. In general there are much higher populations of kokanee than trout using the lower reaches of the tributaries for spawning and less units of flow are required for each kokanee produced. Because kokanee spawn in the autumn and the fry descend to the lake in the freshet, they do not require flows in the critical summer months and thus are less competitive with consumptive uses. Equations (62) to (68) represent the relationship between flows and spawning kokanee population.

(62) aOKOK - 7.5a1FISR < 0

(63) aOKOK - 9.0a5FISR < 0

(64) aOKOK - 5.0a6FISR < 0

(65) aOKOK - 1.3a7FISR < 0

where:

aOKOK = the population of spawning kokanee

Modeling the relationship between the resident trout in the upstream reaches of the tributary is more complex than for the spawning kokanee and trout on the lower reaches. This is because a non-linear relationship exists between fish populations and stream flows.[10] This non-linear relationship can be approximated with three linear segments as shown in figure 6, each modeled with a separate set of constraints. Equations (66) to (72) represent the population-flow relationship for the segment A-B in figure 6.

(66) aORTR1 - 15.9a1FL1 = 0

(67) aORTR1 - 15.9a2FL1 = 0

(68) aORTR1 - 15.9a3FL1 = 0

(69) aORTR1 - 15.9a4FL1 = 0

(70) aORTR1 - 15.9a5FL1 = 0

(71) aORTR1 - 31.9a6FL1 = 0

(72) aORTR1 - 191 a7FL1 = 0

(73) aORTR1 < 3986

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10. This relationship was derived in the Okanagan Basin Study (Canada-British Columbia 1974d, p.32).

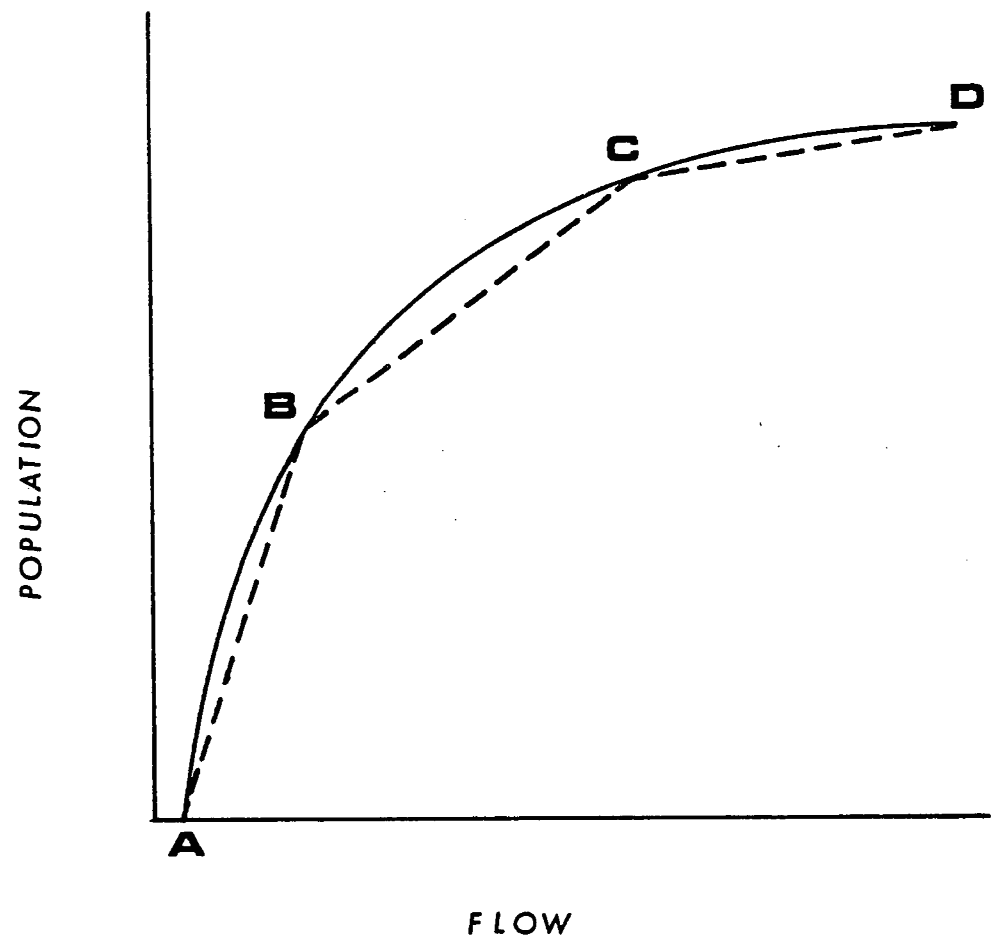

FIGURE 6 RELATIONSHIP BETWEEN TROUT POPULATION AND STREAMFLOW

where:

aORTR1 = Resident trout population on segment A-B

a1FL1 - a7FL1 = flows in the upper reaches in periods periods one to seven.

The second linear segment, B-C, is modeled by equations (74) to (81).

(74) $aORTR2 - 3.2a0FL2 = 0$

(75) $aORTR2 - 3.2a2FL2 = 0$

(76) $aORTR2 - 3.2a3FL3 = 0$

(77) $aORTR2 - 3.2a4FL2 = 0$

(78) $aORTR2 - 3.2a5FL2 = 0$

(79) $aORTR2 - 4.4a6FL2 = 0$

(80) $aORTR2 - 38.4a7FL2 = 0$

(81) $aORTR2 < 1594$

where:

aORTR2 = resident trout population on segment B-C

a7FL2 - a7FL2 = flows in the upper reaches in periods one to seven

The population-flow relationship for the final segment C-D is shown in equations (82) to (89).

(82) $aORTR3 - 1.1a1FL3 = 0$

(83) $aORTR3 - 1.1a2FL3 = 0$

(84) $aORTR3 - 1.1a3FL3 = 0$

(85) $aORTR3 - 1.1a4FL3 = 0$

(86) $aORTR3 - 1.1a5FL3 = 0$

(87) $aORTR3 - 2.2a6FL3 = 0$

(88) $aORTR3 - 13.3a7FL3 = 0$

(89) $aORTR3 < 552$

where:

RTR3 = resident trout population on segment C-D

a1FL3 - a7FL3 = flows in the upper reaches in periods one to seven

c. Constraints Linking Supply and Demand

These constraints specify that water demands in the system must be less than or equal to water supplies. These constraints apply on the upper reaches just below the storage reservoir before any water is withdrawn for consumptive uses and on the lower reaches below the withdrawal points for consumptive uses. For the upper reaches the constraints state that upstream uses (flows for resident trout) must be less than or equal to the upstream water supply (release from storage).

(90) $a1FL1 + a1FL2 + a1FL3 - a1REL < 0$

(91) $a2FL1 + a2FL2 + a2FL3 - a2REL < 0$

(92) $a3FL1 + a3FL2 + a3FL3 - a3REL < 0$

(93) $a4FL1 + a4FL2 + a4FL3 - a4REL < 0$

(94) $a5FL1 + a5FL2 + a5FL3 - a5RE1 < 0$

(95) $a6FL1 + a6FL2 + a6FL3 - a6REL < 0$

(96) $a7FL1 + a7FL2 + a7FL3 - a7REL < 0$

The linkage constraints for the lower reaches state that the total demand for agriculture, domestic and spawning kokanee and trout be less than or equal to the total water supply in each time period. The total supply is equal to release from storage plus natural run-off below the reservoir. These constraints are shown in equations (97) to (101).

(97) $a1ACR + a1DOMR + a1FISR - a1REL - a1ROBW < 0$

(98) $a2ACR + a2DOMR + a2FISR - a2REL - a2ROBW < 0$

(99) $a3ACR + a3DOMR + a3FISR - a3REL - a3ROBW < 0$

(100) $a4ACR + a4DOMR + a4FISR - a3REL - a4ROBW < 0$

(101) $a5ACR + a5DOMR + a5FISR - a5REL - a5ROBW < 0$

(102) $a6ACR + a6DOMR + a6FISR - a6REL - a6ROBW < 0$

(101) $a7ACR + a7DOMR + a7FISR - a7REL - a7ROBW < 0$

d. Linkages to Downstream Reaches

There are two sets of constraints which link the tributary sub-model to the next downstream reach. The first set of constraints defines the remaining flow in each time period which will pass into the downstream reach (Okanagan Lake in this case). The remaining flow is defined as any excess in water supply over consumptive uses. Note that flows for fisheries can be reused in the downstream reach.

(102) -a1REM + a1REL + a1ROB - a1ACR - a1DOMR = 0

(103) -a2REM + a2REL + a2ROB - a2ACR - a2DOMR = 0

(104) -a3REM + a3REL + a3ROB - a3ACR - a3DOMR = 0

(105) -a4REM + a4REL + a4ROB - a4ACR - a4DOMR = 0

(106) -a5REM + a5REL + a5ROB - a5ACR - a5DOMR = 0

(107) -a6REM + a6REL + a6ROB - a6ACR - a6DOMR = 0

(108) -a7REM + a7REL + a7ROB - a7ACR - a7DOMR = 0

where:

a1REM to a7REM = the remaining flow to the downstream reach

The second set of linking constraints defines the return flows from consumptive uses in the sub-model. It is assumed that these return flows pass directly to the downstream reach (Okanagan Lake) and are not re-usable in the tributary itself. During the Okanagan Basin Study[11] it was estimated that 90 percent of domestic water and 50 percent of irrigation water was returned to the system. Equations (109) to (115) define the return flows for each period based on these coefficients.

(109) $-a1REM + .05a0ACRE + .9a1DOMR = 0$

(110) $-a2REM + .07a0ACRE + .9a2DOMR = 0$

(111) $-a3REM + .07a0ACRE + .9a3DOMR = 0$

(112) $-a4REM + .07a0ACRE + .9a4DOMR = 0$

(113) $-a5REM + .06a0ACRE + .9a5DOMR = 0$

(114) $-a6REM + .05a0ACRE + .9a6DOMR = 0$

(115) $-a7REM + .13a0ACRE + .9a7DOMR = 0$

where:

a1RET to a7RET = return flows in periods one to seven

This completes the specification for the Trout Creek sub-model. The other sub-models for the tributaries have the same specification of constraints although the coefficients on the variables will be specific to the tributaries. Right hand side values defining limits to variables such as run-off, storage, domestic use and agricultural land will also be specific to each sub-basin.

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11. These estimates were taken from the technical supplement on water quantity (Canada-British Columbia 1974b, p.491) of the Okanagan Basin Study.

2. Okanagan Lake Sub-model

This sub-model has many of the same features of the tributary sub-models and only the differences will be highlighted in this section. The general structure of the Okanagan Lake sub-model is the same as the Trout Creek sub-model except that all run-off is considered to take place above the lake and all consumptive uses are supplied directly from lake storage rather than from downstream release. Other differences involve the inclusion of return flows and remaining flows from the tributaries as input into the available supply from Okanagan Lake. The mainstem sub-models also do not model sport fish production explicitly because data were not available to construct these relationships. However, minimum flow requirements for spawning sockeye salmon are imposed on the Okanagan River sub-model.

a. Supply Constraints

For purposes of clarity, all remaining flows and return flows from the tributaries are summed to give a single variable for each period. The constraint defining this variable for period 1 is shown in equation (116).

(116) -o1NET + a1RET + a1REM + b1RET + b1REM + c1RET +

c1REM + d1RET + d1REM + e1RET + e1REM + f1RET +

f1REM + g1RET + g1REM = 0

where:

o1NET = the sum of remaining and return flows from the seven modeled tributaries

a to g = prefixes signifying the seven tributaries

Similar equations are constructed for the remaining periods in the model.

The storage-balance equations are different from those on the tributaries since water for consumptive uses is drawn directly from the lake. Equation (117) defines the storage-balance relationship for the first period.

(117) o0STO + o1ROA + o1NET + o1RET - o1REL - o1STO -

o1EVA - o1ACR - o1DOMR = 0

where:

o1RET = the return flow from agriculture and domestic within the sub-basin

o1EVA = evaporation from Okanagan Lake

Unlike the tributaries, the return flows are available on the same reach since Okanagan Lake is large enough to catch and store the return flows. An evaporation variable is also introduced because of the large surface area of the lake. It should also be noted that the run-off variable (ROA) represents the net inflow from unmodeled tributaries.

Equation (117) also implicitly contains the link between supply and demand in the Okanagan Lake reach, so further constraints defining the relationship between available water and water use are not necessary for this reach.

b. Demand Constraints

The constraints setting out agricultural and domestic demand are similar to those for the tributary sub-models and so are not presented here. Some additional constraints are necessary in order to define the limits to recreational benefits. As specified in the objective function, recreational benefits occur when lake levels are increased up to certain elevation. Equations (118) to (125) define the relationship between lake levels for recreation and lake storage levels.

(118) $o2REC - o2STO < 0$

(119) $o3REC - o3STO < 0$

(120) $o4REC - o4STO < 0$

(121) $o5REC - o5STO < 0$

(122) $o2REC < 336800$

(123) $o3REC < 336800$

(124) $o4REC < 336800$

(125) $o5REC < 336800$

where:

o2REC - o5REC = desirable lake levels for recreation

While the Okanagan Lake sub-model does not include sport fish production, some consideration of minimum flows for the spawning sockeye salmon are included. These minimum flows are specified by setting minimums for the release from Okanagan Lake storage as shown in equations (126) to (132).

(126) $o1REL > 18000$

(127) $o2REL > 18000$

(128) $o3REL > 18000$

(129) $o4REL > 50000$

(130) $o5REL > 58000$

(131) $o6REL > 21000$

(132) $o7REL > 63000$

where:

o1REL - o7REL = release from Okanagan Lake

These minimum flows were recommended in the Report on the Okanagan Basin Implementation (Canada-British Columbia, 1984). In general, the flows should be adequate for the returning sockeye run, although increased flows would be desirable. However, there were no data to construct a population-flow relationship as was done for the tributary sub-models. Okanagan Lake also supports considerable shore-spawning kokanee for which certain lake levels are desirable in different seasons of the year. Again there was not sufficient data with which to relate populations to lake levels and this aspect of fish production was not modeled.

E. Summary of Model Structure

The model is composed of 11 sub-models each representing one reach of the Basin. Seven of these sub-models represent tributaries flowing into Okanagan Lake. The structure of each of the seven sub-models in terms of the number and kinds of constraints and activities is the same with the only differences being in the coefficients of the equations. Figure 7 illustrates the general structure for a tributary sub-basin model.

The seven tributary sub-models are linked to the mainstem by their outflow which includes return flows and remaining flows after diversions for consumptive uses. This outflow becomes inflow into the Okanagan Lake sub-model of the mainstem. Outflow from Okanagan Lake then becomes an inflow into the Skaha Lake sub-model. Okanagan River and Osoyoos Lake form the final downstream sub-models of the Basin. The general structure of the complete model is summarized in figure 8.

Given the specification of the objective function and constraints, the next step is to solve the model in order to find the maximum feasible value of the objective function subject to the constraints specified. The next chapter presents the model solution giving optimal levels of the water use activities and water management variables.

FIGURE 7 SUMMARY FLOW CHART FOR TRIBUTARY SUB-MODEL

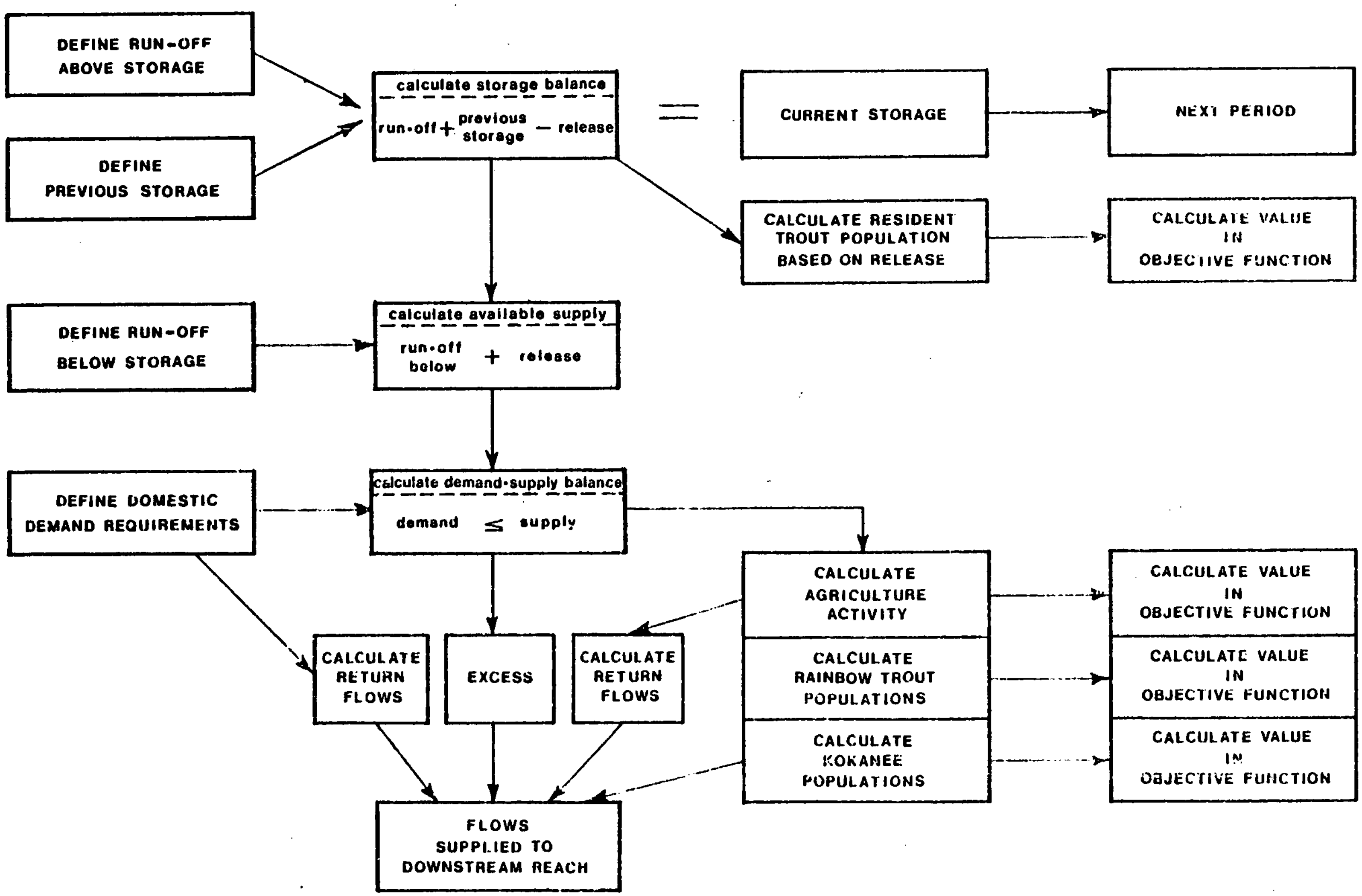
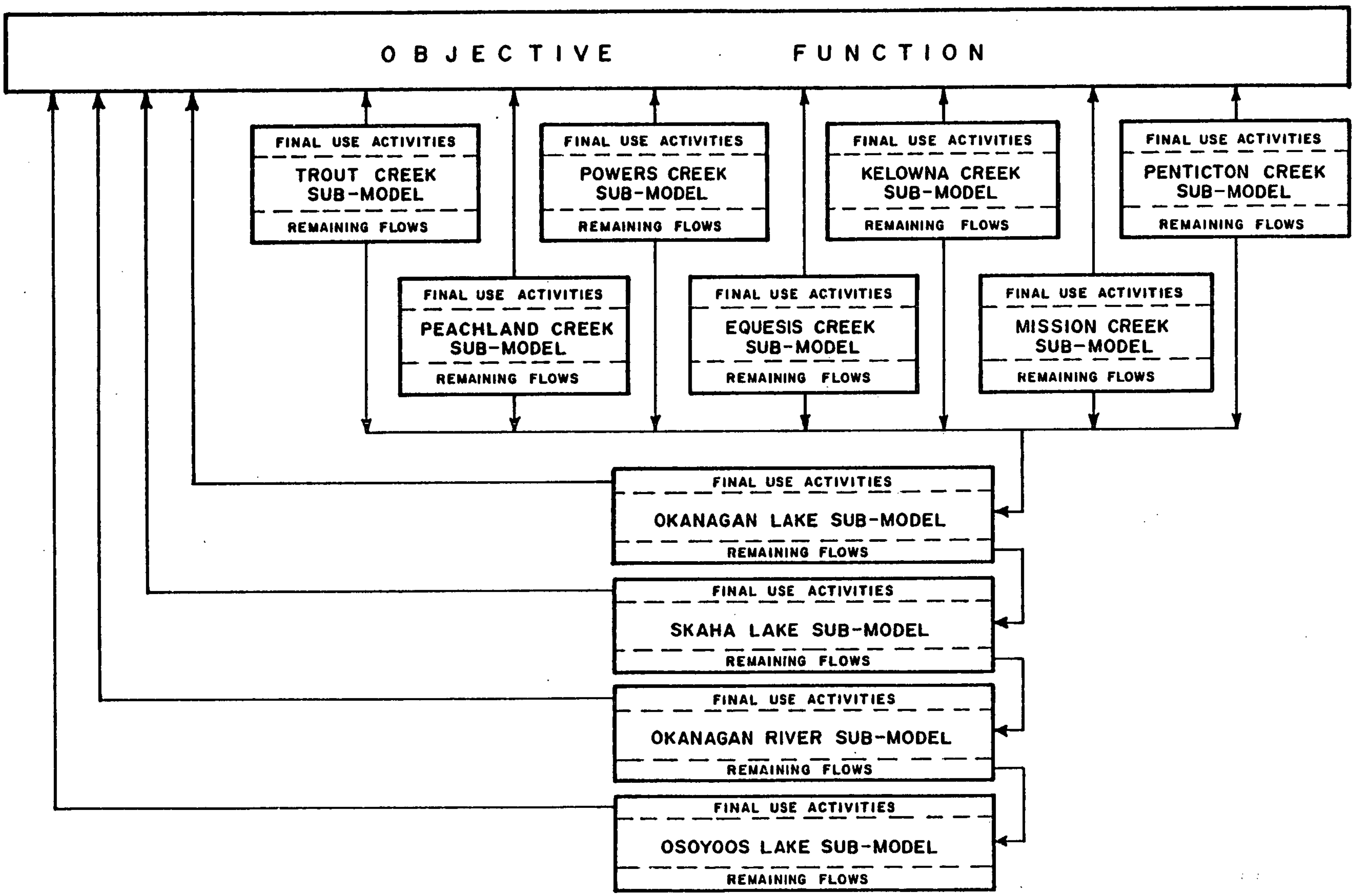


FIGURE 8 SUMMARY FLOW CHART FOR COMPLETE MODEL



IV. MODEL SOLUTION

A. Existence of an Optimal Solution

A feasible solution to the model was obtained which maximized the value of the objective function and determined the optimal allocation of water among various uses. However, it was concluded that the solution obtained did not represent a unique maximum of the objective function. This conclusion was reached when an examination of the solution showed that a surplus of water existed on the mainstem reaches of the model which could either be stored (up to a certain maximum) or released (up to a limit on maximum flows). Neither the storage limit nor the maximum flow limit were binding constraints and it followed that there were several different periods when the surplus water could be released without affecting the maximum level of the objective function. The disposal of surplus water would be critical if flood control considerations were incorporated in the model. In this were the case the disposal of the surplus would be managed so as to minimize the danger of subsequent flooding. Given this additional factor, it would be more probable that a unique optimal solution would exist.

The non-uniqueness of the optimal solution is not considered a problem with the model since the solution represents the maximum possible benefits that can be derived from use of the water. However, the disposal of surplus water should be included in future applications of the model to areas where flooding is of concern.

B. Computer Costs

The model was solved using the MPSX software package on a mainframe computer. An optimal solution was obtained in about nine seconds of central processing unit time using 46 page-minutes of virtual memory. Computer costs for a single solution were about $10.00 based on low-priority commercial rates. Based on these costs it would be feasible to carry out extensive sensitivity analysis and or modifications of the model in future applications.

The total computer costs of developing the model were, however, fairly significant. The basic data entry, MPSX coding and file editing required significant connect time. Each of the 11 sub-models was tested separately and modified when necessary. Many runs of the complete model were required before it could be certain that the model was specified correctly. A complete accounting of the developmental computer costs was not kept but an estimate of total cost is approximately $2,000.

C. Optimal Activity Levels

The results for the optimal solution are presented for each of the 11 reaches in the model. Patterns of storage and release were determined for each tributary and mainstem reach as was the allocation of the available water among various final use activities. Where applicable, the shadow prices of water supply are also presented. A complete computer printout of the optimal solution for all activities is also given in Appendix One.

1. Penticton Creek Sub-basin

The model indicates that there is a relative scarcity of water in this sub-basin and that there is competition for its use among a number of activities. In the average run-off year represented by the model, there is not enough water to supply all the potential irrigable land in the sub-basin and to ensure that domestic needs are met. In the optimal solution, no water at all is supplied for the spawning trout or kokanee. Table 1 shows the levels of the final use activities chosen by the model.

TABLE 1

Penticton Creek Sub-Basin
Optimal Level of Final Use Activities

Activity	Optimum	Upper Bound	Shadow Price ($)
Irrigated Acres	1,665	2,000	0.0
Resident Trout	1,249	1,776	0.0
Spawning Trout	0	120	0.0
Kokanee Trout	0	4,000	0.0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

It can be seen from Table 1 that all of the final use activities are below their maximum possible values (upper bound). This indicates that an increase in the supply of water would be of value in the sub-basin and should thus have a positive shadow price. Table 2 indicates the shadow prices for an increase in natural run-off and storage capacity in the Penticton Creek system.

TABLE 2

Penticton Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	453.0
ROA4	453.0
ROA5	453.0
ROA6	453.0
ROA7	453.0
ROB3	453.0
ROB4	453.0
ROB5	453.0
Storage Capacity	453.0

Run-off above and below the reservoir as well as storage capacity all have a positive shadow price of $453. The shadow price represents the amount by which the objective function would increase if any of these variables were to increase by one unit (one acre-foot). The shadow prices are quite high because of the potential for increasing irrigated acreage in this sub-basin and for increasing the resident trout population. Because there is a surplus of water which cannot be stored in the first two periods, the shadow price for an additional unit of run off in these periods is zero. Storage capacity has a positive shadow price because increasing it would enable some of the surplus water in the first two periods to be stored for use in the following water-short periods.

There are three competing water-use activities in the lower reaches of this sub-basin which are domestic/industrial, agricultural and spawning kokanee and trout. The model is constrained to supply a fixed amount to domestic/industrial users while allocating the remaining amount between agriculture and flows for fisheries. Figure 9 shows the allocation of water among these competing downstream uses. Agriculture and domestic activities are both significant users of water, although agricultural use is confined to the first five periods. It should again be noted that the final period includes the six months from November to April, so the domestic/industrial use for this period appears higher than for the single months representing the first six periods.

The model also determines the pattern of storage and release during the year necessary to maximize the objective function. This pattern is shown in Figure 10. Starting from an initial storage level of 5,000 acre-feet, the model increases the storage level over the next two periods until maximum capacity of about 10,000

FIGURE 9: PENTICTON CREEK SUB-BASIN

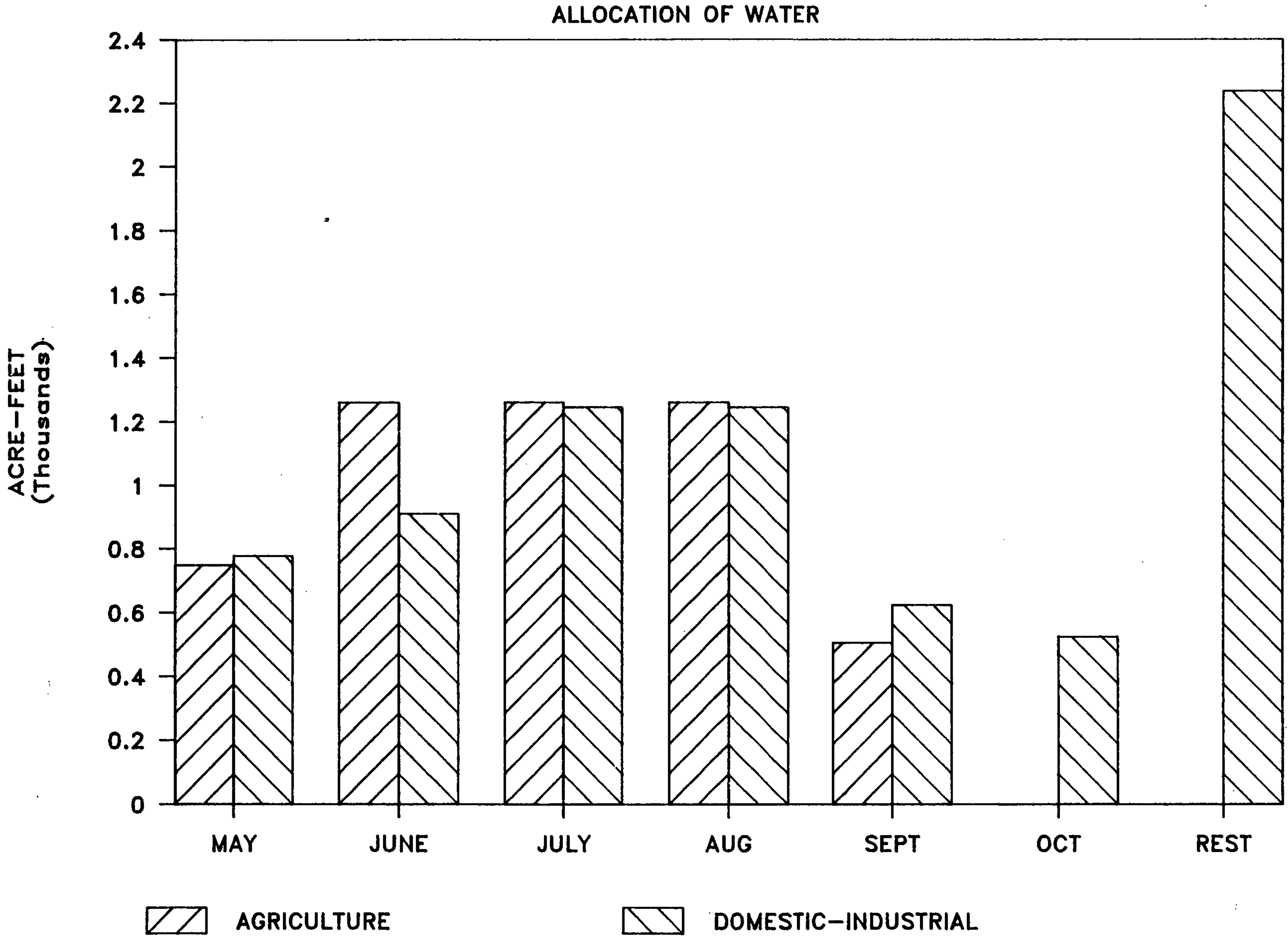
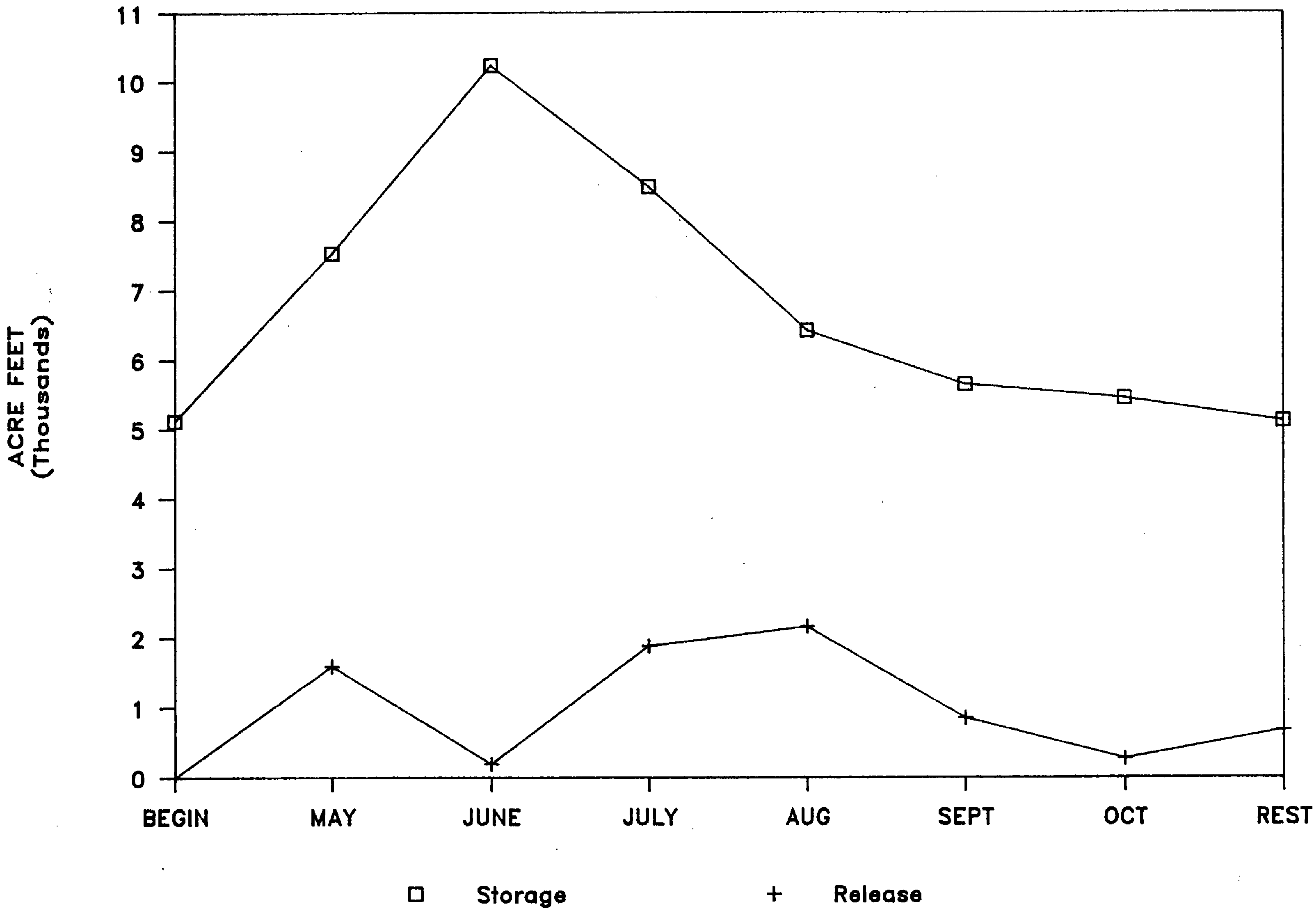


FIGURE 10: PENTICTON CREEK SUB–BASIN

STORAGE AND RELEASE



acre-feet is reached. The stored water is steadily depleted over the remaining periods in order to meet the various demands. The pattern of release reflects the higher requirements for domestic and agricultural use in the summer months. A minor amount of water is released in all periods to supply the resident trout population.

2. Trout Creek Sub-basin

There is enough water in this sub-basin to supply irrigation to all of the potential agricultural land while at the same time supplying some water for downstream fisheries. However, there is still an overall shortage in the sense that water is a limiting factor in the production of sport fish. Table 3 indicates the optimal level of final use activities for this sub-basin.

TABLE 3

Trout Creek Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Upper Bound	Shadow Price ($)
Irrigated Acres	6,150	6,150	771.0
Resident Trout	4,263	6,132	0.0
Spawning Trout	0	1,000	0.0
Kokanee Trout	1,451	2,000	0.0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

Irrigated acres are at their upper bound and there is thus a positive shadow price for an additional unit of agricultural land. However, all of the sport fish populations are below their maximum values, indicating that an increase in the supply of water would have a positive benefit. The shadow prices for additional water supply and storage are shown in Table 4.

TABLE 4

Trout Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	14.0
ROA4	14.0
ROA5	14.0
ROA6	14.0
ROA7	14.0
ROB3	14.0
ROB4	14.0
ROB5	14.0
ROB6	14.0
ROB7	5.8
Storage Capacity	15.6

The shadow prices in the Trout Creek sub-basin are much lower than for the Penticton Creek sub-basin because all available agricultural land has been used in the model. The shadow prices shown in Table 4 are based only on the extra production of sport fish that would be possible if extra water were available. Storage capacity has a positive shadow price since an increase in storage would enable extra water from the freshet to be stored for use both by resident and spawning fish.

Most of the downstream water is allocated towards irrigation as shown in Figure 11. Domestic/industrial use is relatively insignificant while flows for fisheries are also relatively small. Domestic/industrial use is fairily constant throughout the year, while flows for the fishery are highest in the months of May and October.

The optimal storage and release patterns are shown in Figure 12. The storage pattern over the seven periods is similar to that of Penticton Creek. Storage is brought to a maximum during the high run-off periods and gradually depleted to meet requirements during the summer months. In the final periods storage levels are brought back to their beginning levels. However, there are significant differences between the patterns of release for the two sub-basins because there is a higher ratio of run-off to storage in the Trout Creek sub-basin. Releases are high on the Trout Creek system in May and June because the high volume of run-off cannot be fully contained in the limited storage capacity. Releases are low in the periods when irrigation is not required.

FIGURE 11: TROUT CREEK SUB-BASIN

ALLOCATION OF WATER

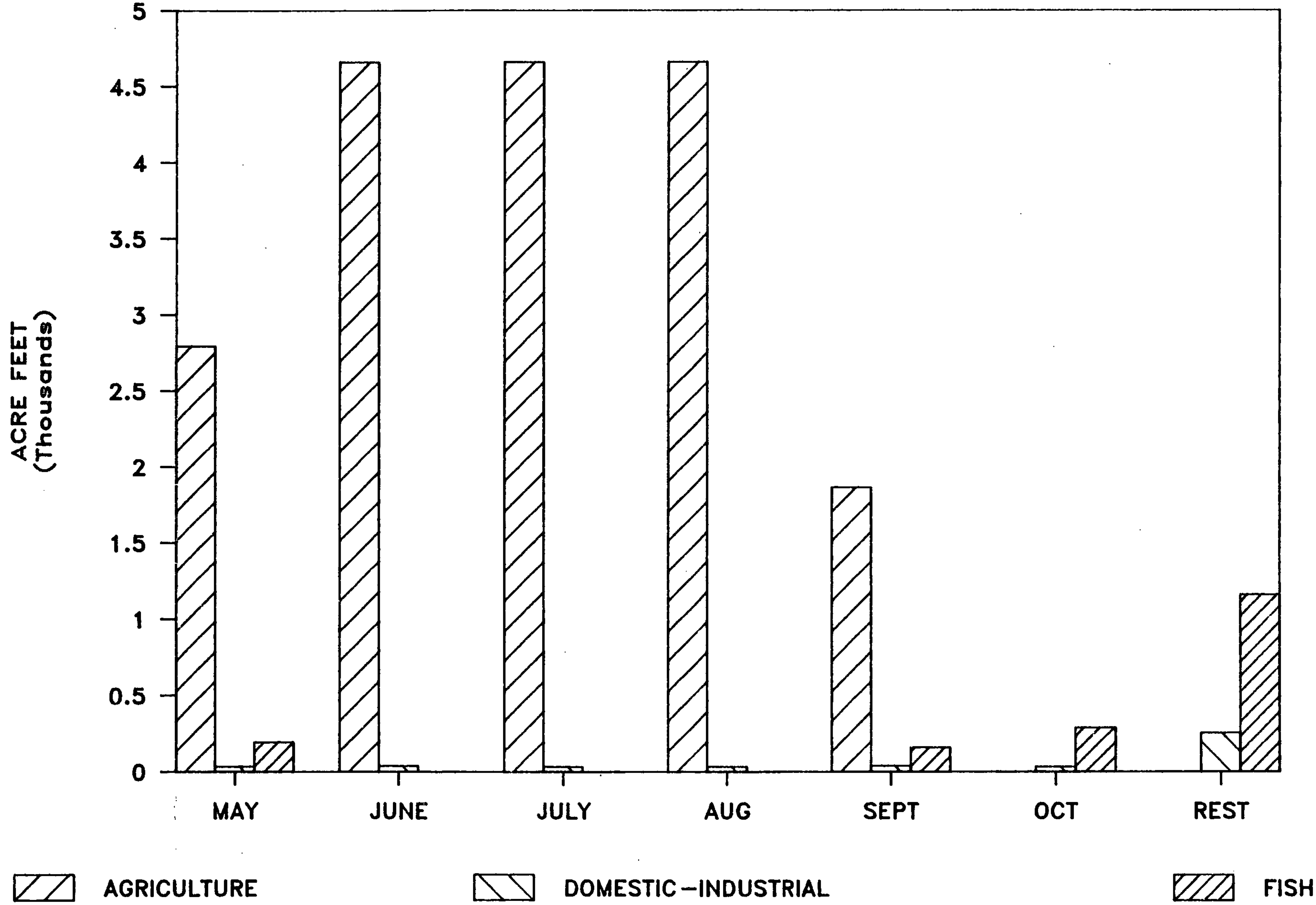
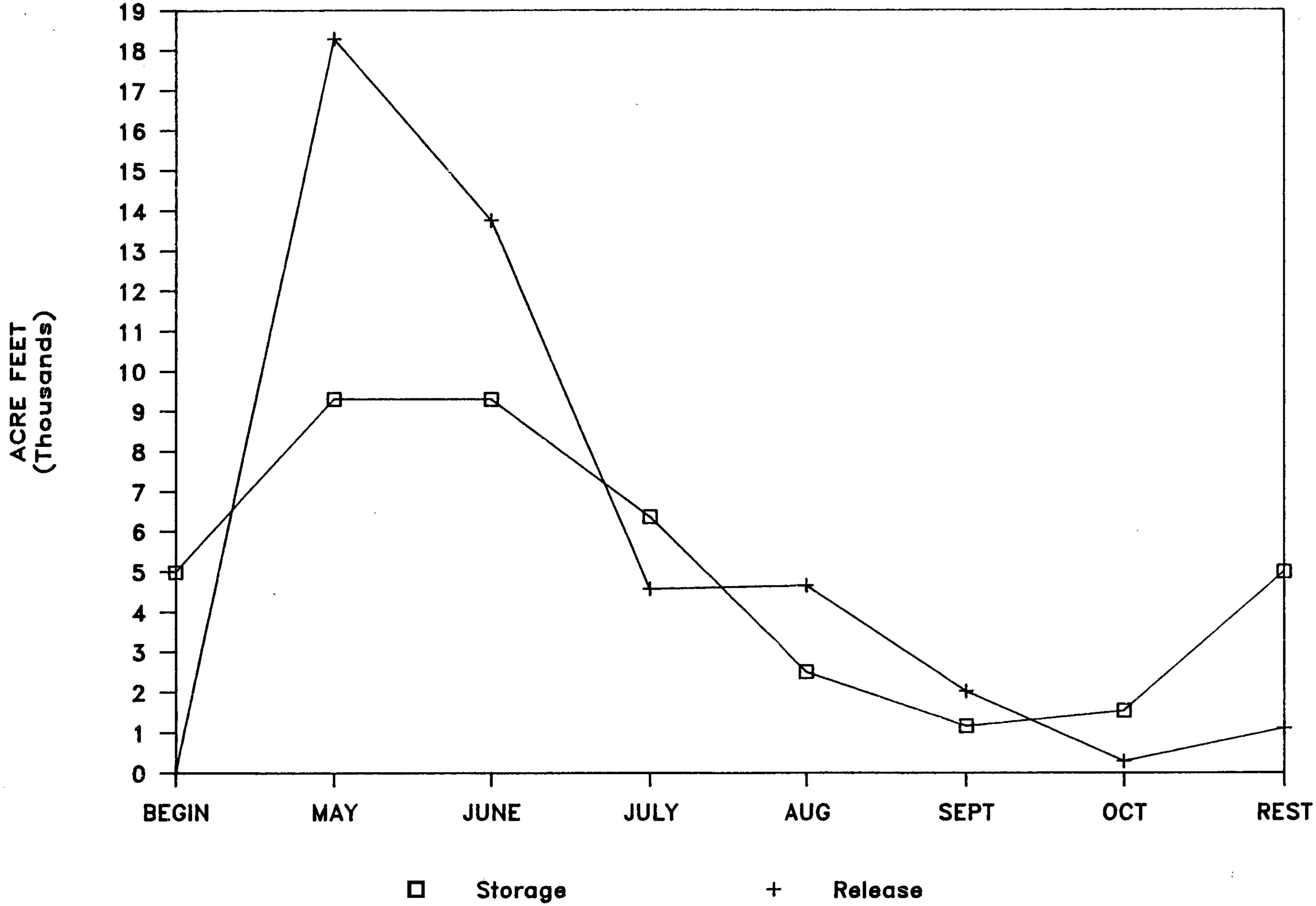


FIGURE 12: TROUT CREEK SUB-BASIN

STORAGE AND RELEASE



3. Peachland Creek Sub-basin

In this sub-basin the supply of water is high relative to the current uses. The model supplies all final use activities up to their maximum possible levels as shown in Table 5. Because of the limited agricultural and domestic/industrial use of water, the model takes advantage of the abundant water to supply flows for maximum fishery production.

TABLE 5

Peachland Creek Sub-Basin
Optimal Level of Final Use Activities

Activity	Optimum	Upper Bound	Shadow Price ($)
Irrigated Acres	459	459	800.0
Resident Trout	939	939	10.0
Spawning Trout	2,760	2,760	10.0
Kokanee Trout	21,260	21,260	10.0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

Because all potential agricultural, domestic/industrial and fishery activities can be fully supplied with water, there is no value to an additional unit of water in this sub-basin. In the optimal solution, shadow prices in all periods for both run-off and storage are zero (table 6). Two conclusions can be drawn from the zero shadow prices. First, as previously stated, there is no value to an additional unit of water in the Peachland Creek sub-basin. Second, there is no value from an additional unit of water in the reaches downstream of this sub-basin since excess water from Peachland Creek also has the potential for use in downstream reaches.

TABLE 6

Peachland Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	0.00
ROA4	0.00
ROA5	0.00
ROA6	0.00
ROA7	0.00
ROB3	0.00
ROB4	0.00
ROB5	0.00
ROB6	0.00
Storage Capacity	0.00

The allocation of water among downstream users in this sub-basin is somewhat different from the other tributaries. Because there is a relatively abundant supply of water and agricultural lands are limited, the model allocates water to the sport fishery until maximum population levels are obtained. This is in contrast to most other tributaries where sport fish production is limited by the available water supply. Figure 13 illustrates the downstream allocation of water for Peachland Creek. It can be seen that the allocation of water to fishery flows is unusually high in the month of June. This is due to the high flow requirements for both kokanee and rainbow trout spawning in this period. Aside from this month, the allocation of water among the various uses is fairly even.

The optimal patterns for storage and release are shown in Figure 14. The pattern of release over the year is somewhat atypical, as the highest release occurs in the month of May due to the earlier than usual freshet in the sub-basin and because of fishery requirements. During the remaining periods, the amount of water released is fairly constant. The storage pattern is more consistent with the other tributaries in that storage is brought to a maximum during the freshet month of June and gradually depleted during the summer and fall with refill occurring in the winter months.

FIGURE 13: PEACHLAND CREEK SUB-BASIN

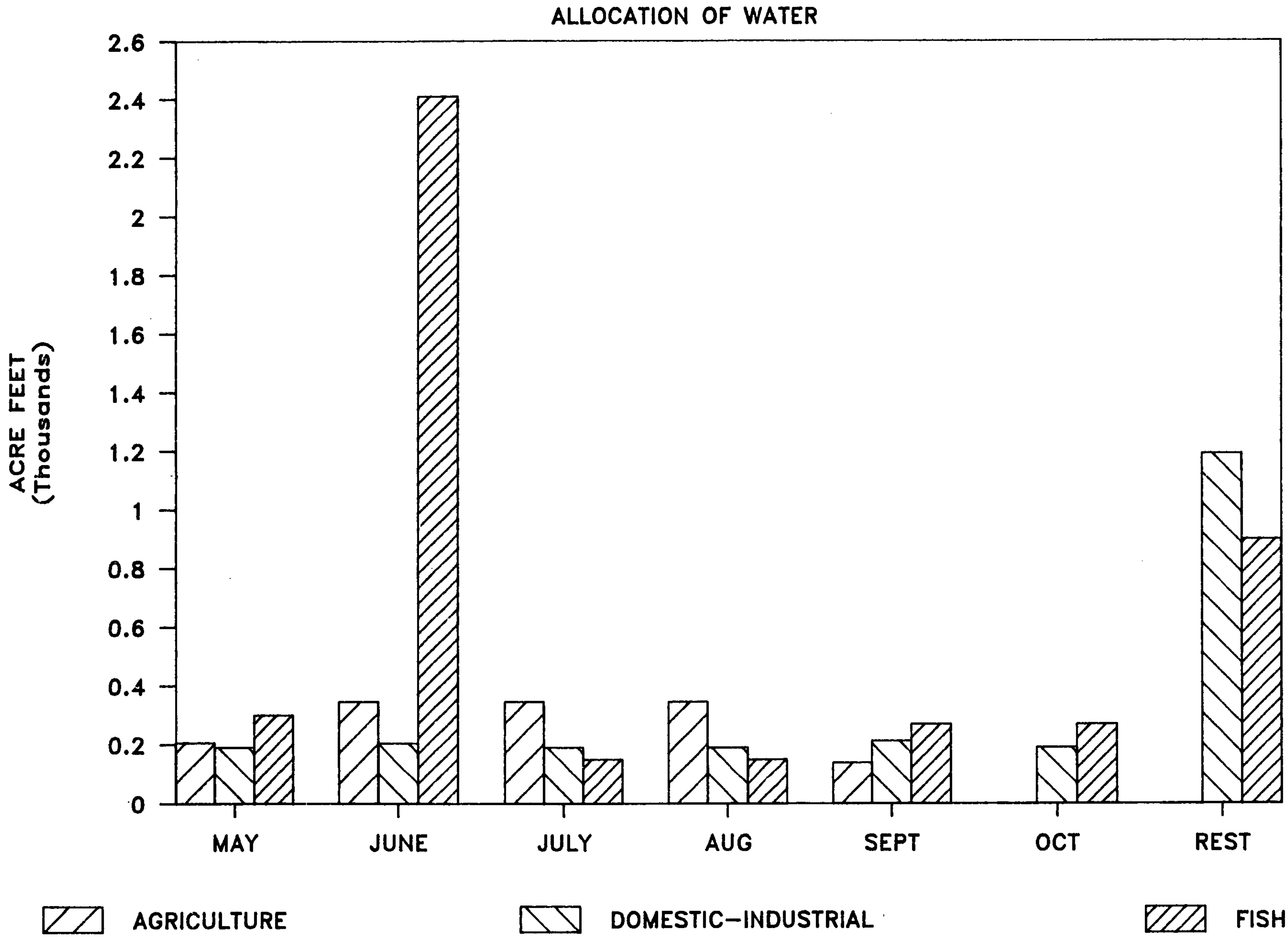
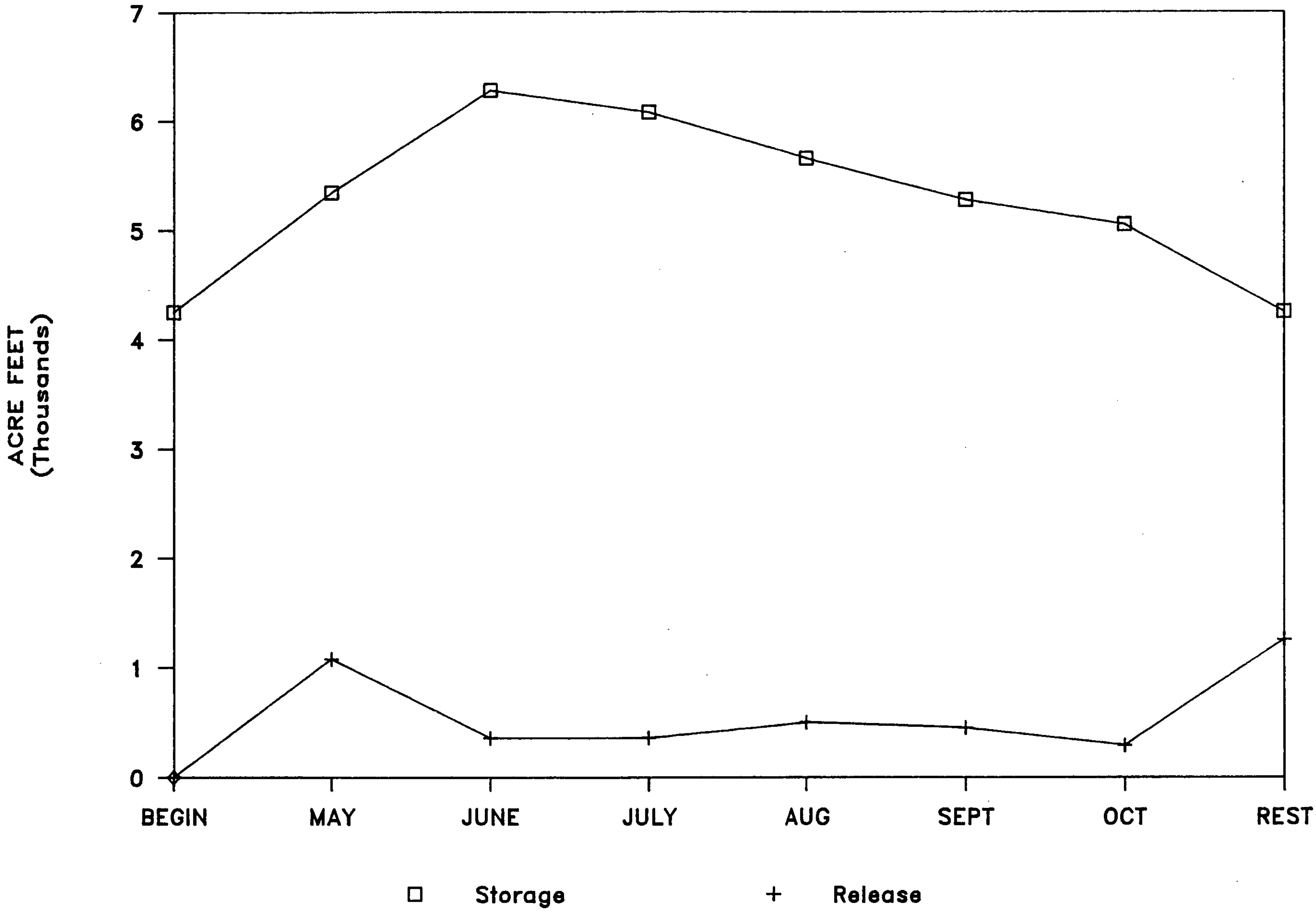


FIGURE 14: PEACHLAND CREEK SUB-BASIN

STORAGE AND RELEASE



4. Powers Creek Sub-basin

Powers Creek also has a fairly abundant supply of water relative to potential demands. Agriculture is the predominant user of water, although irrigated lands are not extensive. This sub-basin was identified in the Okanagan Basin Study as having a fairly high potential for sport fish production and the model does allocate a significant amount of water to flows for the fishery. Table 7 shows the downstream final use activities.

TABLE 7

Powers Creek Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	1,167	1,167	796.0
Resident Trout	877	897	0.0
Spawning Trout	2,560	2,560	9.6
Kokanee Trout	34,040	34,040	0.0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

Both irrigated acres and spawning trout are at their upper bound and their shadow prices are thus positive. Kokanee and resident trout are near but not quite at their maximum possible limits, indicating that additional water would have a positive value. Table 8 indicates the shadow prices on additional water supply.

TABLE 8

Powers Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	1.71
ROA4	1.71
ROA5	1.71
ROA6	1.71
ROA7	1.71
ROB3	1.71
ROB4	1.71
ROB5	1.71
ROB6	1.71
Storage Capacity	1.71

The shadow prices for additional water are positive but low in most periods. The low values occur because all agricultural land has been supplied and the only remaining remaining productive use of the water is in supplying flows for fisheries. Storage also has a positive shadow price since excess water preserved in the high run-off months could be used for sport fish production in later months.

Agriculture is again the main user of downstream water in the model, although a fairly significant and constant amount of water is allocated to flows for fish production in each period (Figure 15). Domestic and other use is low throughout the year.

The storage pattern for Powers Creek is roughly similar to that of Peachland Creek with reservoir levels being built up in May and June and depletion of stored water taking place in the remaining months. The release pattern for Powers Creek is unusual in that there is no peak in the month of May occurs in most other sub-basins. There is no peak in release because the storage capacity on this system is high compared to the spring run-off, so the peak inflows to the reservoir can be captured and stored for later use. As in most other sub-basins, the amount of water released from storage increases in the summer months in order to meet consumptive requirements (Figure 16).

FIGURE 15: POWERS CREEK SUB-BASIN

ALLOCATION OF WATER

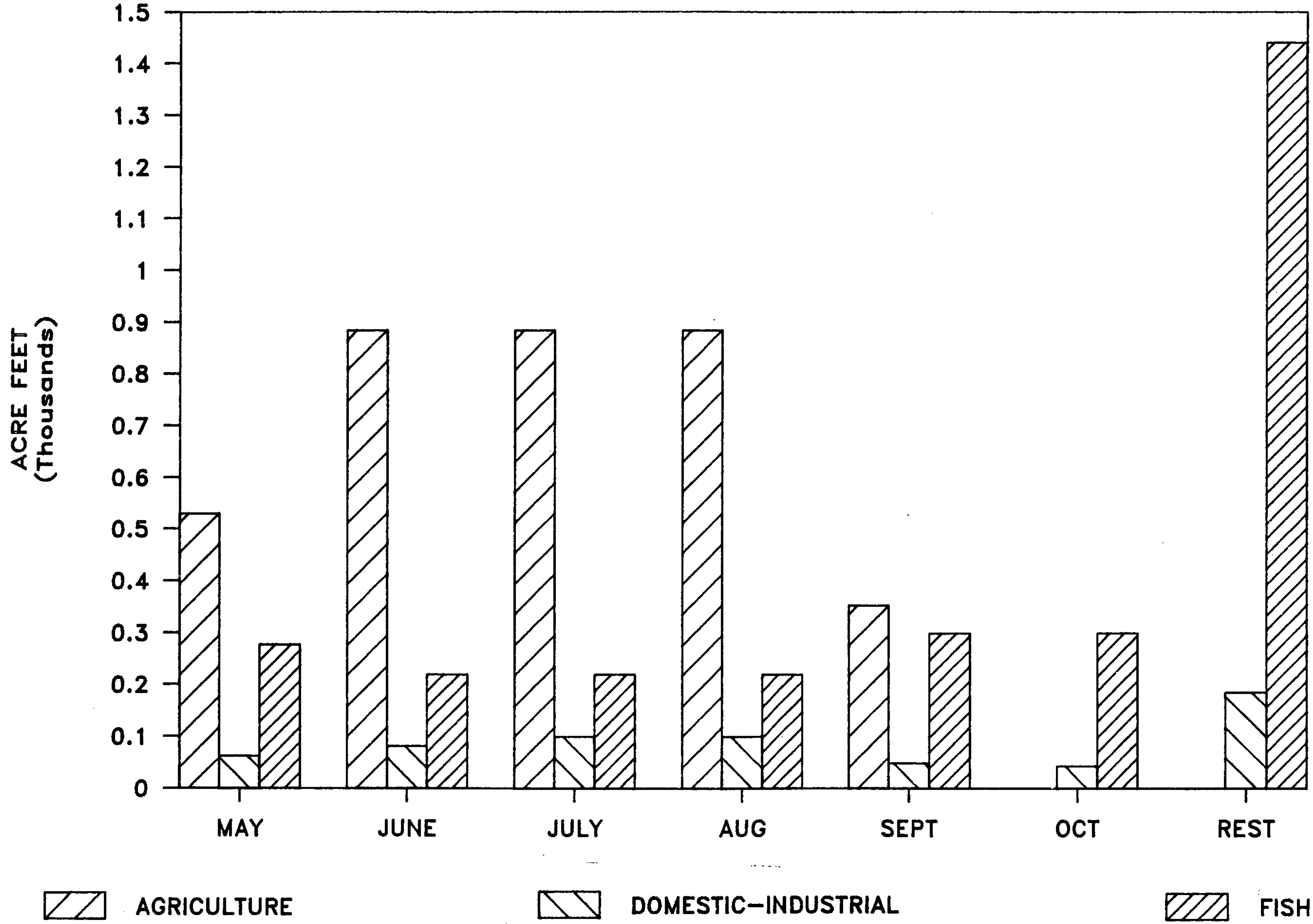
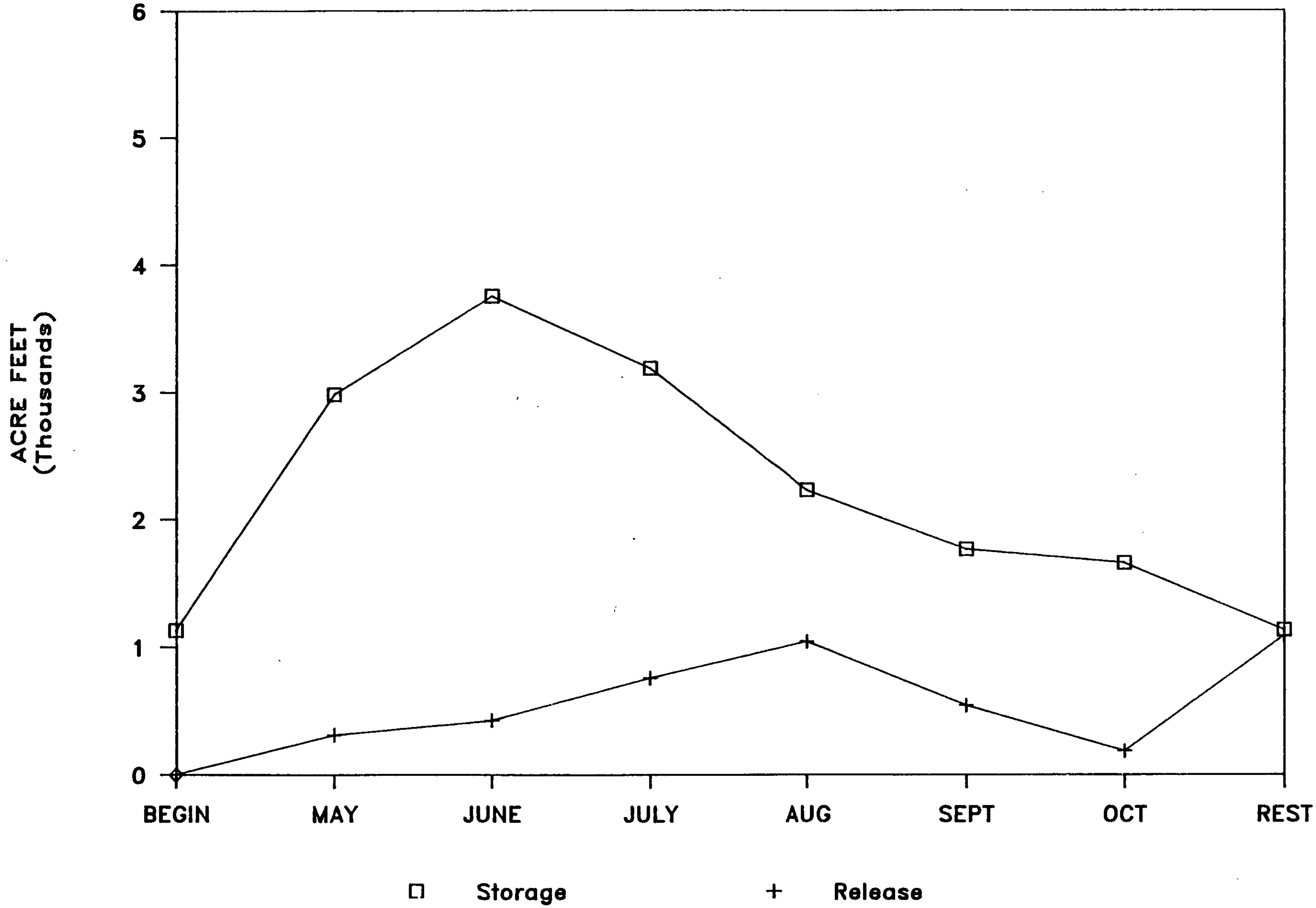


FIGURE 16: POWERS CREEK SUB-BASIN

STORAGE AND RELEASE



5. Equesis Creek Sub-basin

Equesis Creek has a fairly abundant water supply relative to consumptive uses. There is only a small amount of potentially irrigable land in this sub-basin and there is virtually no domestic or industrial use of water. As a result, the model allocates water to these uses until they are at or near their maximum as shown in table 9. Considerable flows are also allocated towards the production of kokanee and trout.

TABLE 9

Equesis Creek Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	356	356	800.0
Resident Trout	728	736	0.0
Spawning Trout	2,460	2,460	10.0
Kokanee Trout	27,600	27,600	10.0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

The downstream uses are all close to their maximum possible levels. As a result the shadow prices of additional water are quite low as shown in table 10.

TABLE 10

Equesis Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	0.67
ROA4	0.67
ROA5	0.67
ROA6	0.67
ROA7	0.67
Storage Capacity	0.75

Downstream water is allocated about equally between irrigation and flows for fisheries as shown in Figure 17. This is an unusual occurrence for the tributaries, as agriculture is usually a much more predominant user of water. Equesis Creek is an exception because most land is undeveloped or unsuitable for irrigation while the potential for sport fish production is quite high.

The storage pattern for the Equesis Creek system is similar to that of Peachland and Powers Creek, with accumulation occurring in the peak run-off months of May and June and depletion occurring throughout the remaining periods. The peak release occurs in June when storage capacity is not sufficient to contain the high run-off. For the remaining periods, release from storage is fairly constant (Figure 18).

FIGURE 17: EQUESIS CREEK SUB-BASIN

ALLOCATION OF WATER

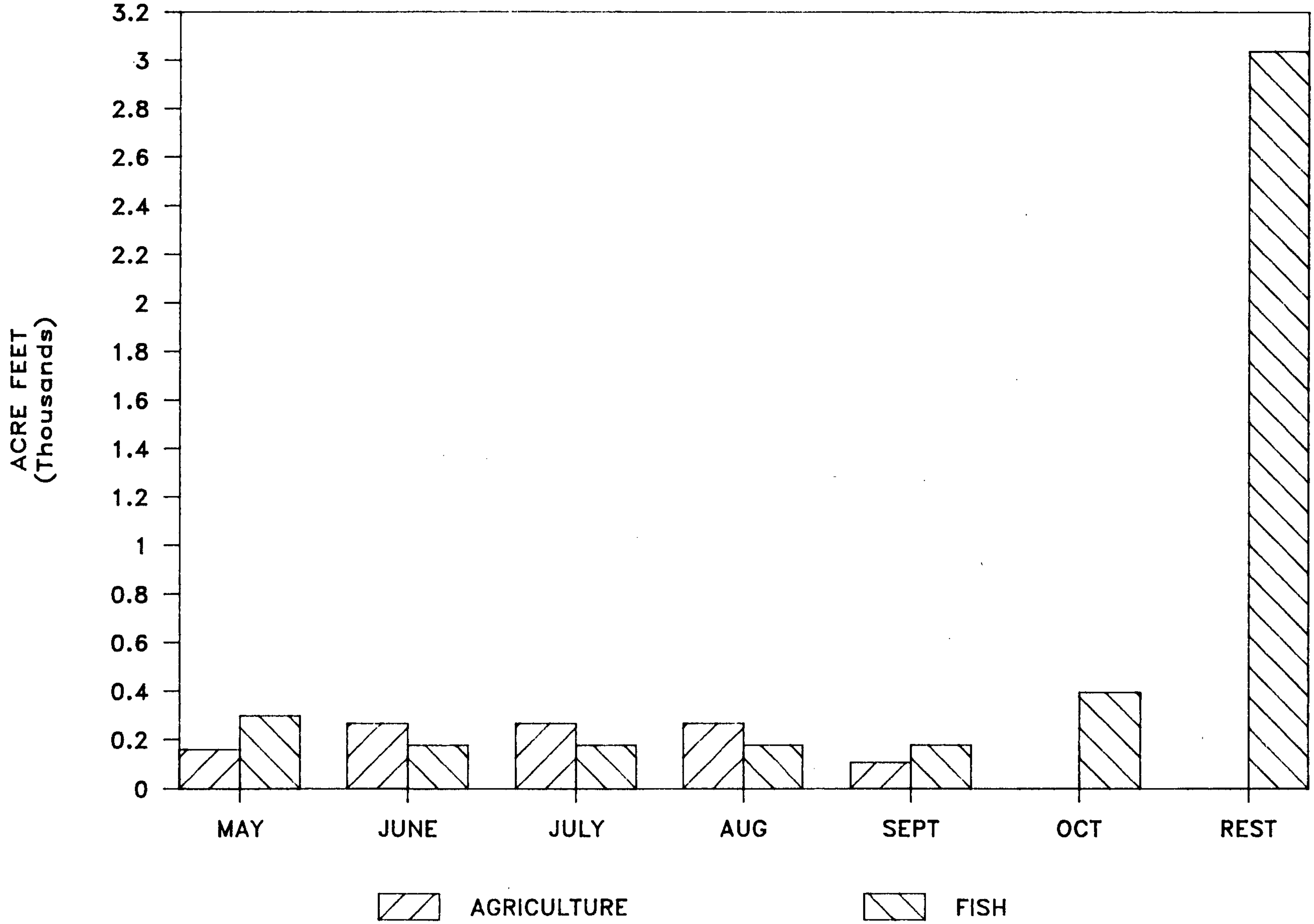
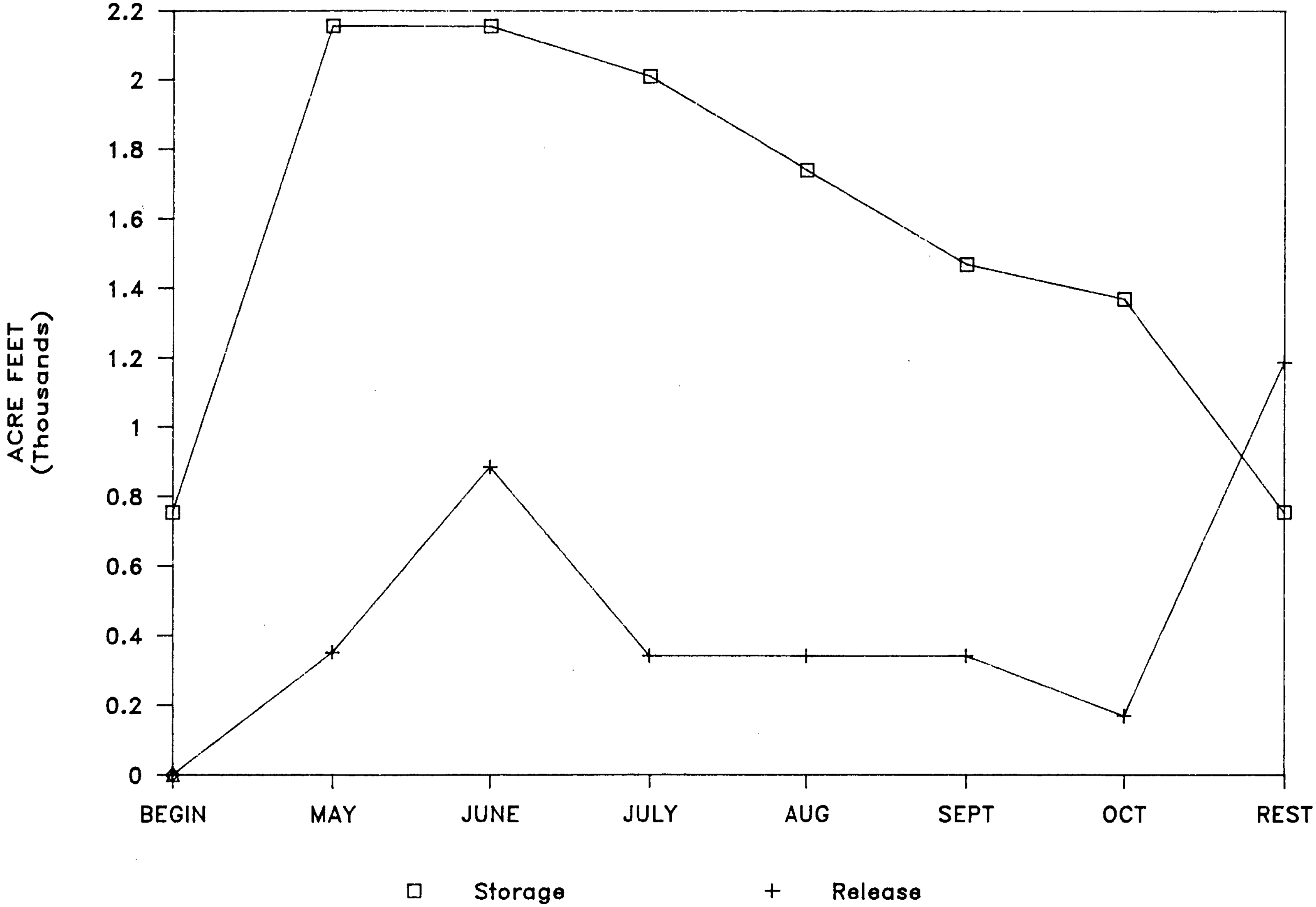


FIGURE 18: EQUESIS CREEK SUB-BASIN

STORAGE AND RELEASE



6. Kelowna Creek Sub-basin

From the model solution it is evident that there is a shortage of water in Kelowna Creek relative to potential demands. Kelowna Creek is the only tributary modeled where there is a major shortfall of water relative to potential irrigation demands. However, this shortage may not accurately reflect the actual situation as some water demands in this sub-basin are supplied by Okanagan Lake water or by diversion from other sub-basins. There is only a limited potential for sport fish production in this system and no water is supplied to this activity in the optimal solution (table 11).

TABLE 11

Kelowna Creek Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	3,009	4,202	0
Resident Trout	0	208	0
Spawning Trout	0	125	0
Kokanee Trout	0	4,000	0

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

It is felt that the model solution does not accurately represent the actual water supply and demand balance in this sub-basin since some transfer of water into this system occurs from other sources. The amount and location of these transfers were not modeled because of a lack of data. Based on information from the Okanagan Basin Study, it appears that the amount of water transferred into the sub-basin is sufficient to supply all agricultural use in the area.

Shadow prices on water supply are quite high because of the apparent shortage of water in the system. Increased storage capacity also has a high shadow price since the excess run-off occurring in the freshet could also be used to supply agricultural needs if storage were available. Table 12 shows the shadow prices for the water supply variables.

TABLE 12

Kelowna Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	457
ROA4	457
ROA5	457
ROA6	457
ROA7	457
ROB3	457
ROB4	457
ROB5	457
Storage Capacity	457

Agriculture is the predominant user of water in the optimal solution as shown in Figure 19. Domestic requirements are relatively minor although they occur throughout the year. No water was allocated to flows for sport fish production.

The seasonal pattern of storage and release on the Kelowna Creek system is shown in Figure 20. The storage pattern for Kelowna Creek is similar to other sub-basins in that water is accumulated during the freshet and depleted in the subsequent months. In most sub-basins the depletion phase of storage takes place throughout the year until the minimum required year-end level is reached in the last period. However, in the case of Kelowna Creek, the minimum storage level reached in the autumn months is below the year-end minimum required. Reliance is placed on winter precipitation to bring the storage levels back up to the required level at year-end. The Trout Creek system is the only other tributary which has a similar pattern. The release pattern for Kelowna Creek peaks in the month of June and remains high during the summer months in order to supply agricultural needs. Very little water is released during the fall and winter months.

FIGURE 19: KELOWNA CREEK SUB-BASIN

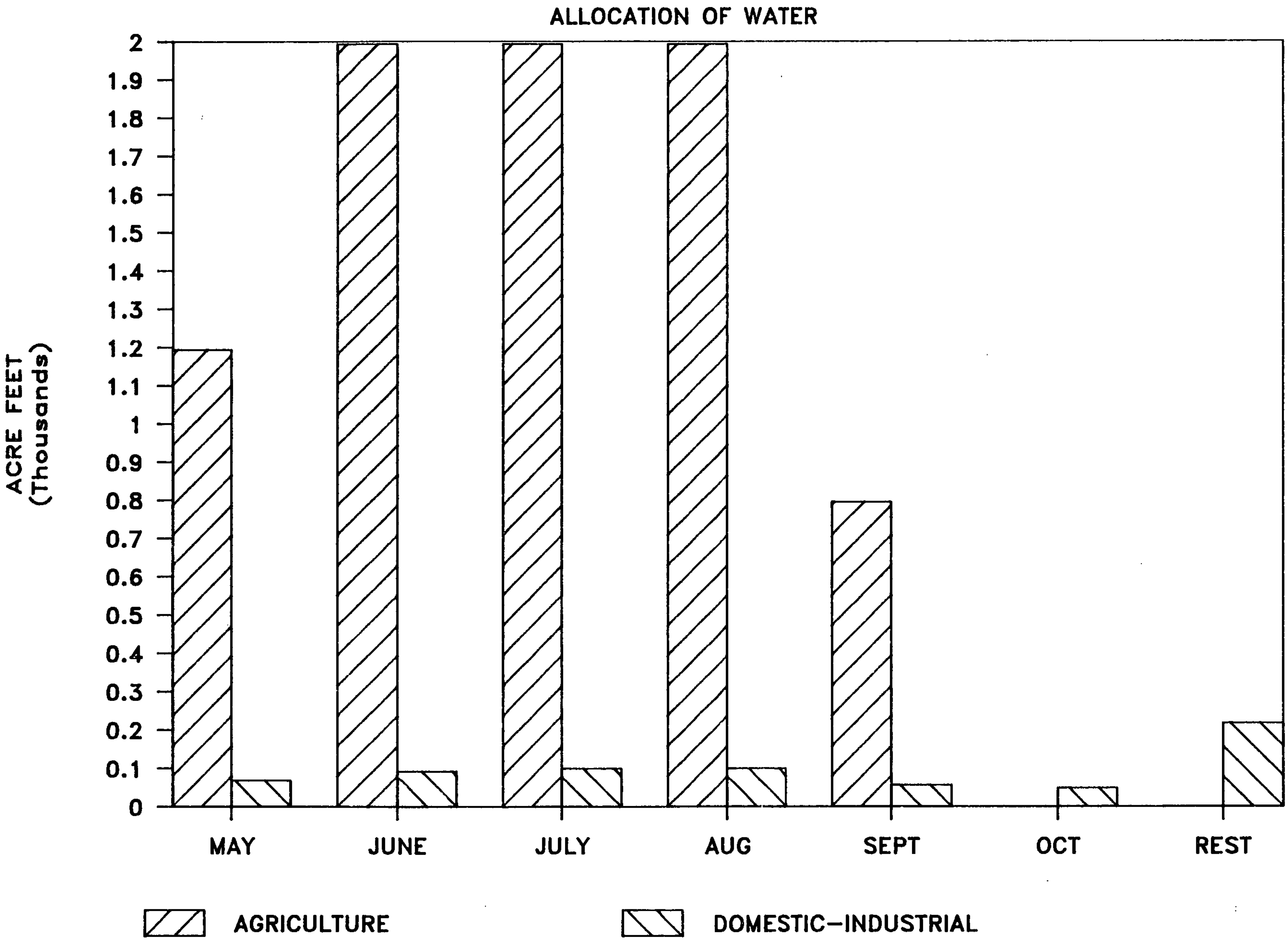
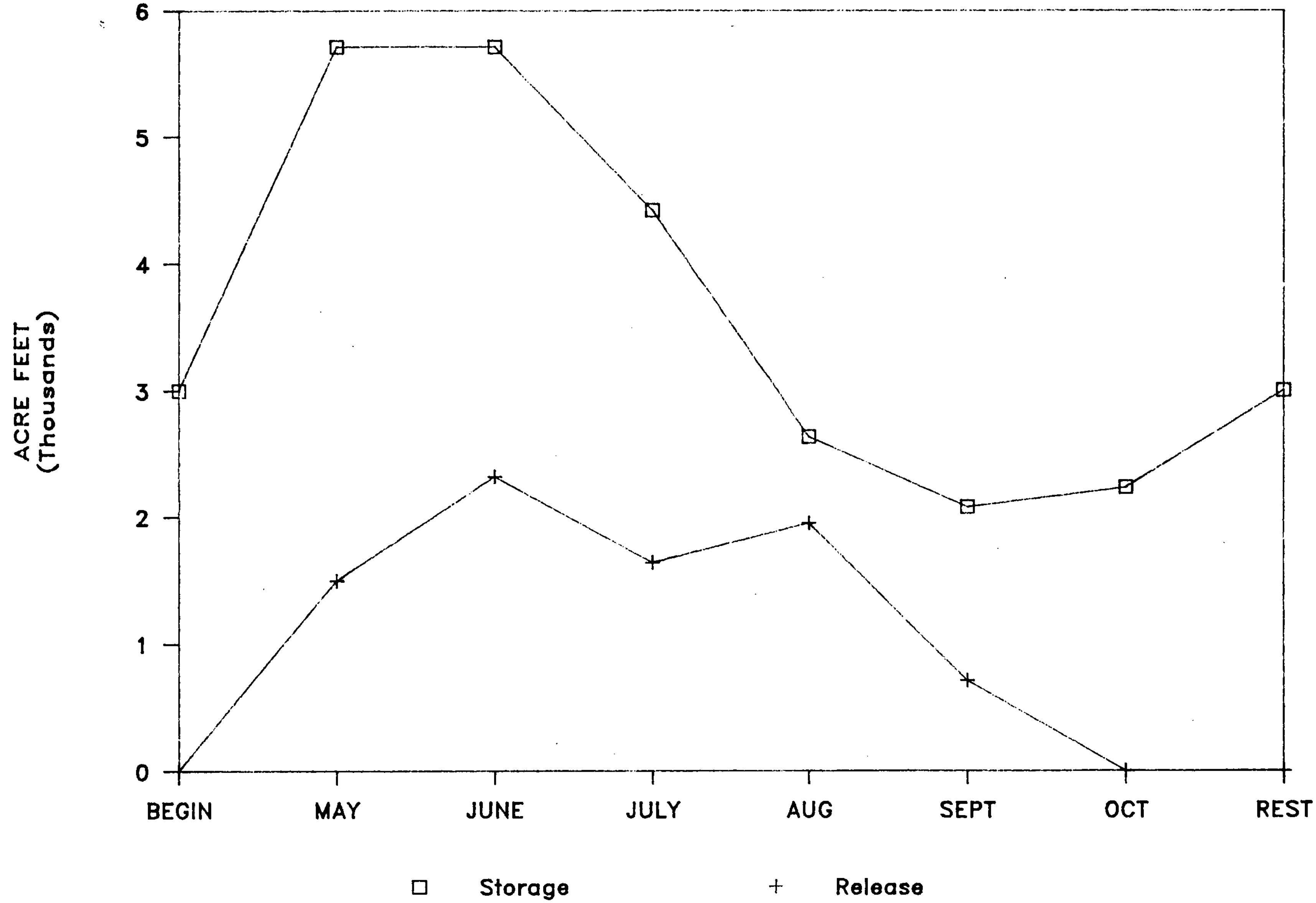


FIGURE 20: KELOWNA CREEK SUB-BASIN

STORAGE AND RELEASE



7. Mission Creek Sub-basin

Mission Creek is exceptional in that it has both a high level of agricultural activity and a very large potential for sport fish production, particularly kokanee. While there is enough water to meet all agricultural requirements, the high potential production of sport fish is not realized due to a shortage of water to maintain desirable flows. Table 13 shows the level of final use activities on the system.

TABLE 13

Mission Creek Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	8,717	8,717	398.0
Resident Trout	10,805	13,782	0.0
Spawning Trout	2,675	9,565	0.0
Kokanee Trout	1,475,000	1,475,000	7.7

Note: The shadow price is the amount by which the objective function would increase if the upper bound were increased by one unit.

The shadow prices for the water supply variables are shown in table 14. Despite the fact that the upper bound of agricultural activity has been reached, the shadow prices for an additional unit of water are quite high. This is because a large number of sport fish can be produced for a small increment in flows. In other words, an additional unit of water on Mission Creek is much more valuable for fish production than the same increase would be on another creek.

TABLE 14

Mission Creek Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
ROA3	199
ROA4	199
ROA5	199
ROA6	199
ROA7	199
ROB3	199
ROB4	199
ROB5	199
ROB6	199
ROB7	190
Storage Capacity	221

The allocation of water for downstream uses in Mission Creek is different from most of the other tributaries. A significant amount of water is allocated towards flows for sport fish production, particularly in the month of June when Kokanee requirements are highest. Agricultural water use is high compared to other tributaries, but is small relative to the amount of water allocated towards flows for the sport fishery. Domestic and other water uses are relatively low (Figure 21).

The storage and release patterns for Mission Creek are fairly typical of the tributary systems. Storage is again brought to a maximum during the month of June and then gradually depleted throughout the rest of the year. The amount released is at a maximum in May during the freshet when all the run-off cannot be captured in storage. Only small amounts of water are released in June in order to build up storage levels. The amount of water released increases in the summer months and declines in the fall and winter (Figure 22).

FIGURE 21: MISSION CREEK SUB-BASIN

ALLOCATION OF WATER

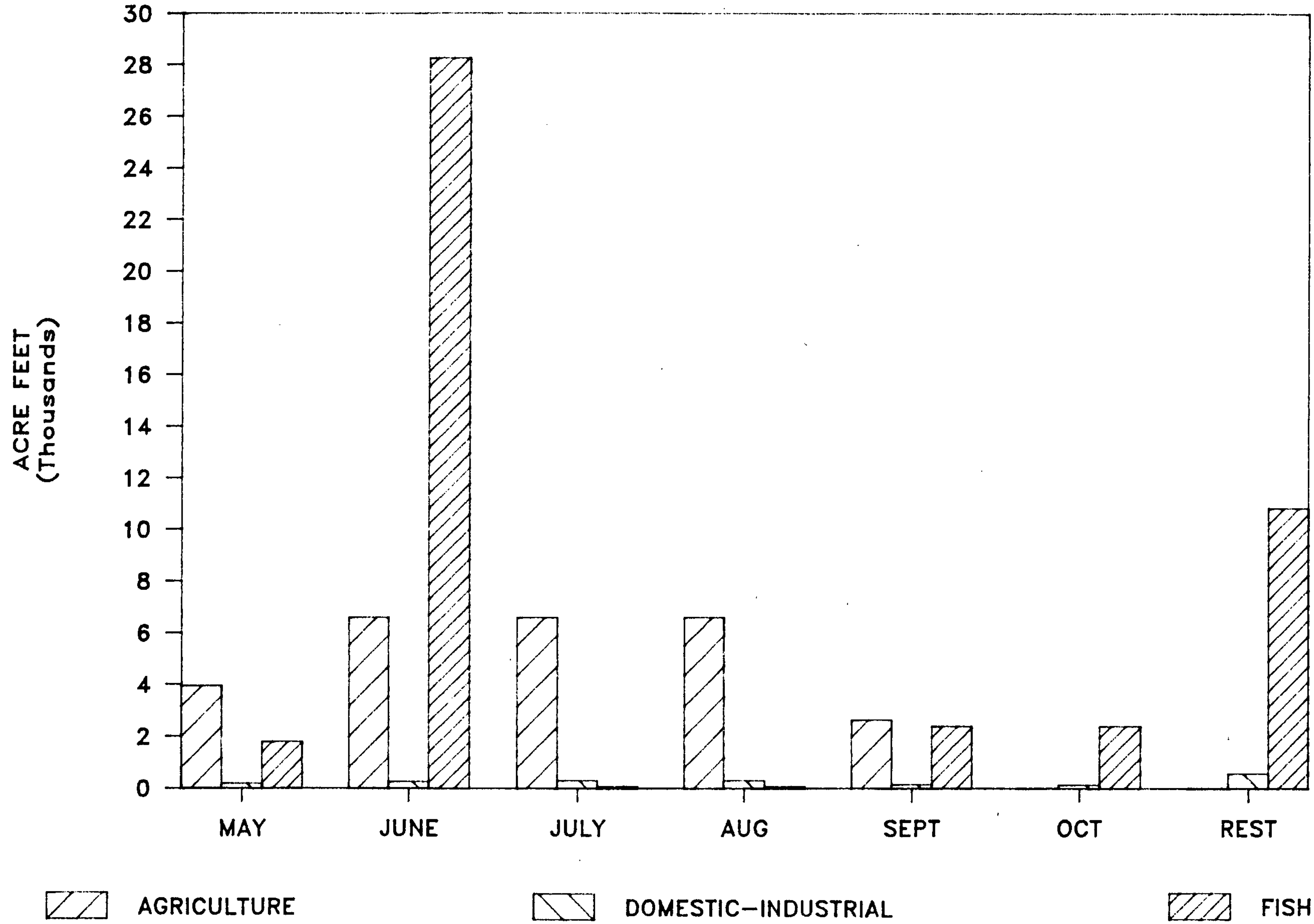
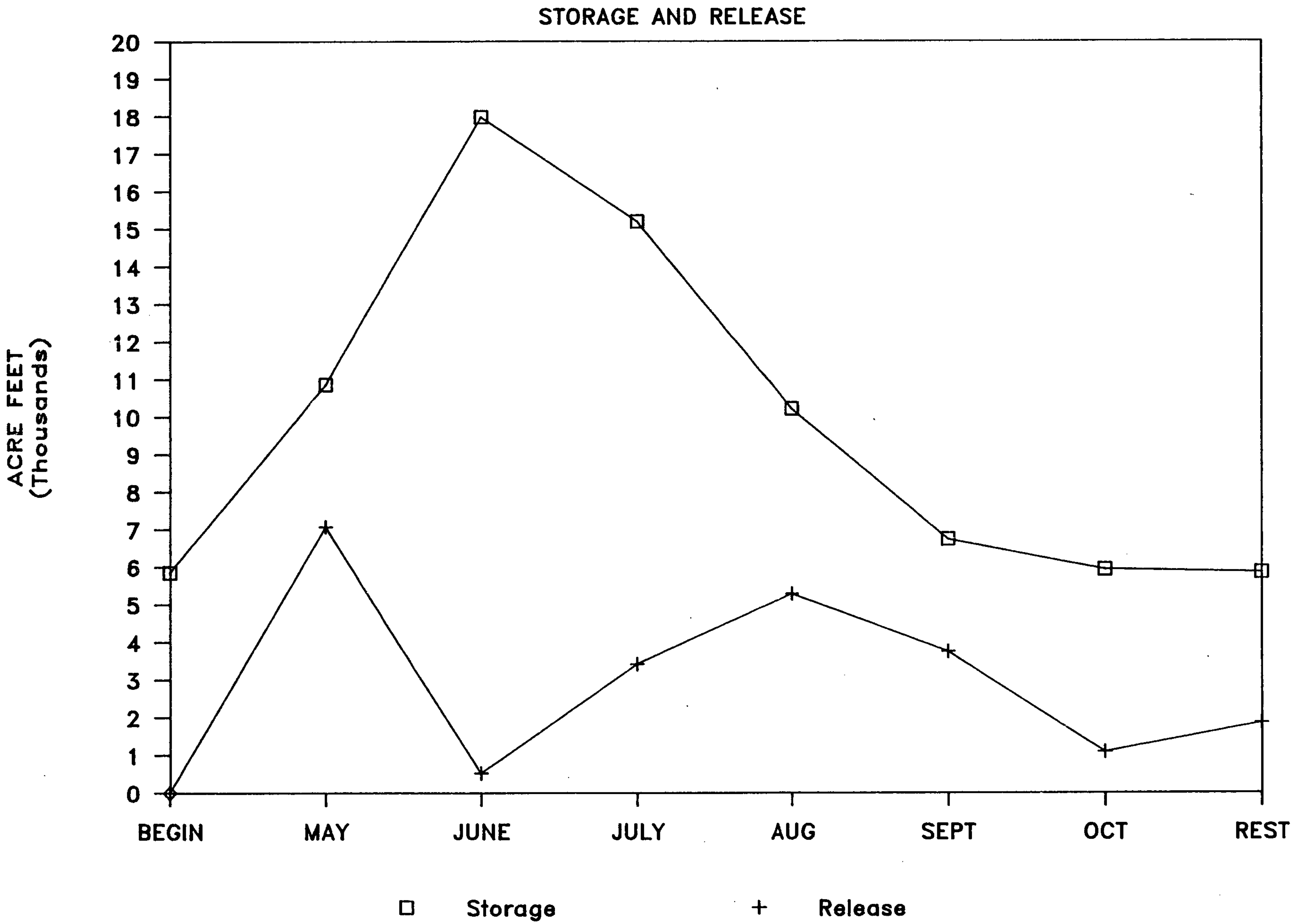


FIGURE 22: MISSION CREEK SUB-BASIN



8. Okanagan Lake Sub-basin

The water supply and demand conditions in this sub-basin are considerably different from the tributary sub-basins discussed in previous sections. For the mainstem reaches in general, there is a significant surplus of water in an average run-off year. The Okanagan Lake sub-basin receives all of the remaining flows and return flows from the developed tributaries as well as the natural run-off from several lesser developed streams. As a result, the total volume of supply is large compared to present and potential uses and all final use activities are at maximum possible levels in the optimal solution as shown in table 15.

TABLE 15

Okanagan Lake Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	1,911	1,911	800
Lake Levels For Recreation			
period 2	336.8	336.8	N.A.
period 3	336.8	336.8	N.A.
period 4	336.8	336.8	N.A.
period 5	336.8	336.8	N.A.

Note: Lake levels are shown as amount of storage in thousands of acre-feet. Shadow prices are not applicable to lake levels.

Because all final use activities can be fully supplied by water, there is no value to an additional unit of water in the Okanagan Lake sub-basin and shadow prices on all water supply variables are zero as shown in table 16. This is true for all sources of water supply including run-off, remaining flow from upstream tributaries and return flows.

TABLE 16

Okanagan Lake Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
Runoff (all periods)	0.00
Return flows (all periods)	0.00
Remaining flows (all periods)	0.00
Storage Capacity (all periods)	0.00

The amount of water allocated for domestic/industrial uses is high relative to other sub-basins primarily because part of the water supply for greater Kelowna is drawn from the lake. There are also several developments near the shoreline which use Okanagan Lake water. In contrast there is little agricultural development that draws water directly from Okanagan lake as it is generally more economical for irrigation districts to use tributary water.

Figure 23 shows the allocation of water to consumptive uses.

The pattern of storage and release for Okanagan Lake is shown in Figure 24. The storage is operated in a similar fashion to most of the reservoirs on the tributaries, with a build-up of storage in the freshet and gradual depletion during the summer months. The build-up takes place in order to reach lake levels that maximize recreational values. The amount of usable storage in the lake is immense compared to the reservoir storage on the tributaries. For example a peak storage of level of over 400,000 acre-feet is reached in June compared to a maximum storage level of 18,000 acre-feet on Mission Creek and 10,000 acre-feet on Penticton Creek. Most of the other tributaries have less than 5,000 acre-feet of usable storage.

The amount of water released is very small (less than 20,000 acre-feet per month in the summer) compared to the amount in storage. This suggests that there would be considerable flexibility in operating the system to meet drought year conditions, as extra water could be supplied from lake storage. Release from Okanagan Lake is relatively constant, increasing only slightly in the winter months. This is in contrast to the patterns of release from the tributary reservoirs which were often irregular. The even pattern of release from Okanagan Lake is desirable because of flow requirements for sockeye salmon and for intake operation. The large storage capacity makes this even release possible.

FIGURE 23: OKANAGAN LAKE SUB-BASIN

ALLOCATION OF WATER

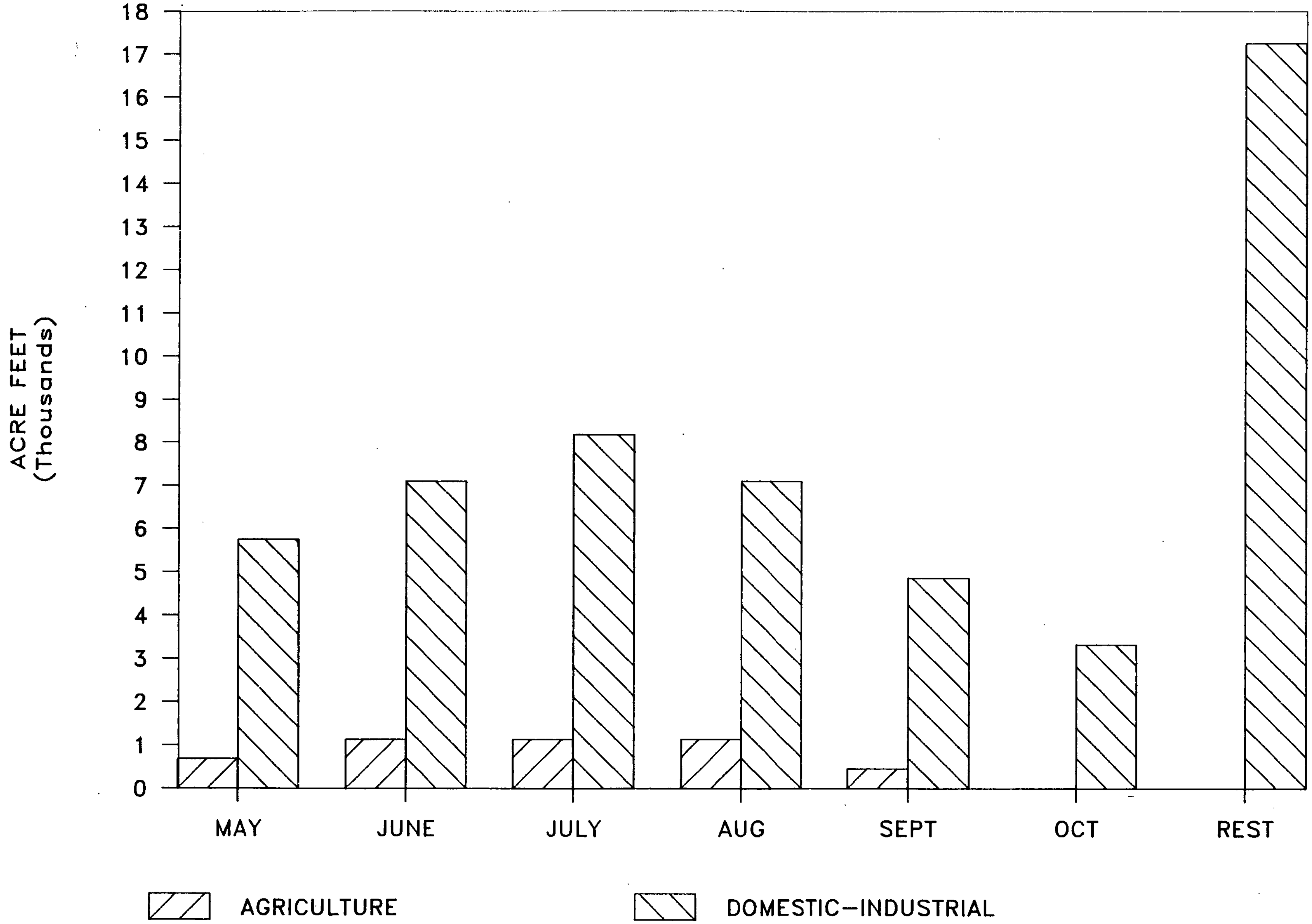
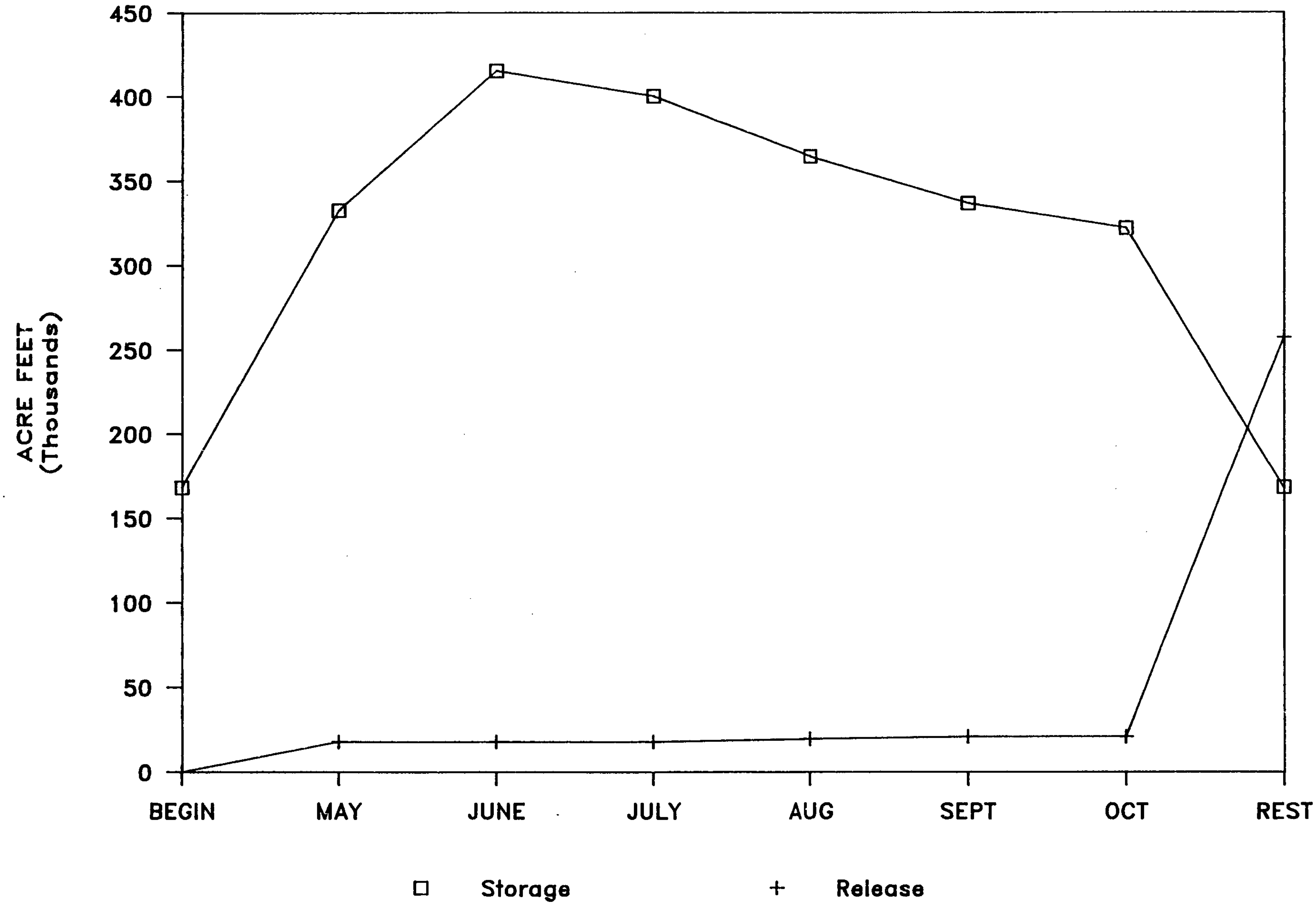


FIGURE 24: OKANAGAN LAKE SUB-BASIN

STORAGE AND RELEASE



9. Skaha Lake Sub-basin

This sub-basin also has a high ratio of water supply to water demand. For most months, consumptive demands can be fully met with about 1,000 acre-feet of water. This requirement is only a fraction of the available water released from Okanagan Lake of about 20,000 acre-feet per month. Thus final use activities are at maximum possible levels as shown in table 17.

TABLE 17

Skaha Lake Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	1,746	1,746	800
Lake Levels For Recreation			
period 2	7.07	7.07	N.A.
period 3	7.07	7.07	N.A.
period 4	7.07	7.07	N.A.
period 5	7.07	7.07	N.A.

Note: Lake levels are shown as amount of storage in thousands of acre-feet. Shadow prices are not applicable to lake levels.

Because of the excess water supplies in the Skaha Lake sub-basin, shadow prices of all water supply activities are zero as shown in table 18.

TABLE 18

Skaha Lake Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
Runoff (all periods)	0.00
Return flows (all periods)	0.00
Remaining flows (all periods)	0.00
Storage Capacity (all periods)	0.00

The allocation of water to consumptive uses is shown in Figure 25. Agriculture is the predominant user in the summer months while only a small amount of water is supplied to domestic/industrial activities. Total water use supplied directly from Okanagan Lake is not high, because the major population center of Penticton and a significant portion of the agricultural lands are supplied by the tributaries.

The pattern of storage and release is somewhat different from Okanagan Lake (Figure 26). Skaha Lake has only a fraction of the storage of Okanagan Lake, so excess water must be released immediately. This results in a slight peak in release in May with lower releases occurring in the summer months. Storage is increased in the summer in order to obtain optimal lake levels for recreational activities.

FIGURE 25: SKAHA LAKE SUB-BASIN

ALLOCATION OF WATER

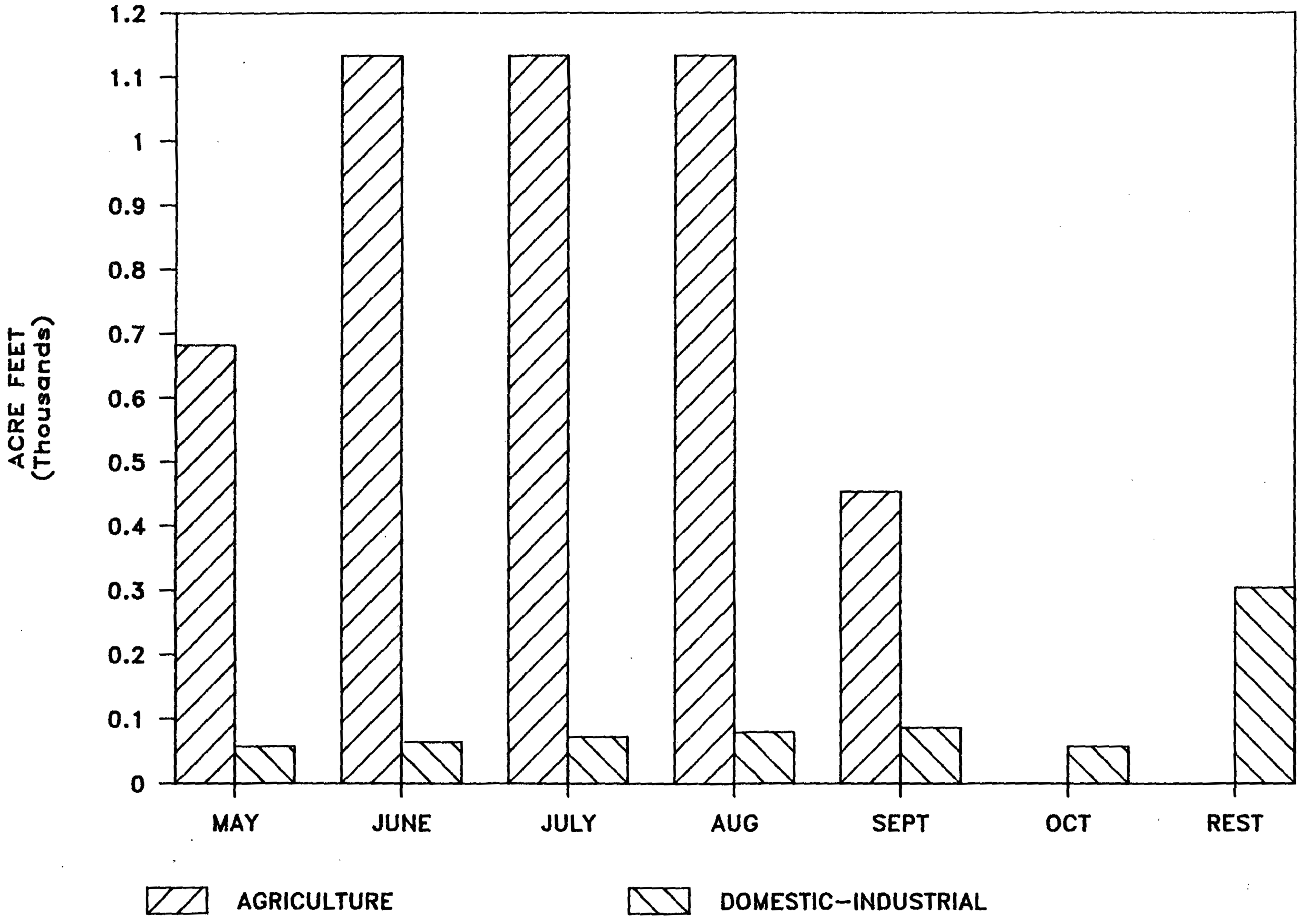
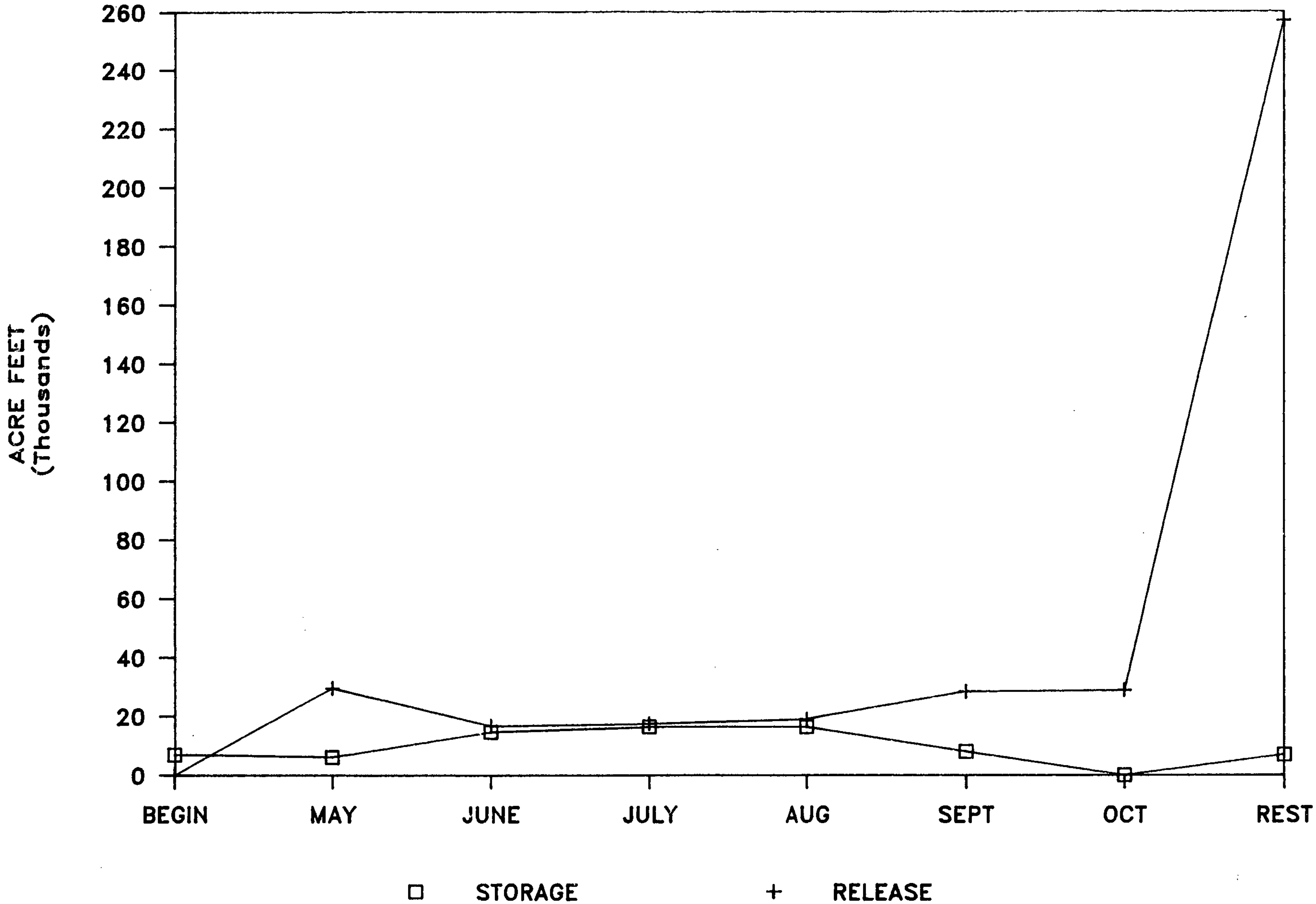


FIGURE 26: SKAHA LAKE SUB-BASIN

STORAGE AND RELEASE



10. Okanagan River Sub-basin

Despite having the heaviest agricultural demands for water of all the sub-basins, there is still a large surplus of water in the Okanagan River sub-basin. The river is mainly fed by the continual releases from Okanagan and Skaha Lakes with some additional water being supplied by tributaries along the way. Only one activity, agriculture, is included in the objective function of the the model for this sub-basin. Because of the surplus of water, agriculture is at a maximum level in the optimal solution.

Because all final use activities can be fully met with current supplies, there is no value for additional water supplies in this sub-basin. All water supply activities have a zero shadow price as shown in table 19.

TABLE 19

Okanagan River Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
Runoff (all periods)	0.00
Return flows (all periods)	0.00
Remaining flows (all periods)	0.00

The Okanagan River reach has the most water allocated towards agriculture of all the sub-basins. As a result the summer demands are very high as shown in Figure 27. Only a small amount of water is required to meet the needs of domestic/industrial users in this sub-basin.

The amount of storage in the Okanagan River sub-basin is relatively small and was not included in the model. For purposes of comparison, the release (outflow) from this reach is shown along with the inflow from upstream reaches in Figure 28. Because there is no storage, the outflow and inflow patterns are almost identical. Outflow is slightly less than inflow in the spring and summer months because of diversions for agricultural and domestic use. In the winter months, when there is no agricultural diversion, outflow is slightly greater that inflow because of some additional run-off which flows directly into the river. Both inflow and outflow peak in the freshet, decline in the summer months and then increase slightly in the winter. The pattern of inflow and outflow is quite regular throughout the year in comparison to tributary flows. This is the result of the upstream regulation made possible by Okanagan Lake storage.

FIGURE 27: OKANAGAN RIVER SUB-BASIN

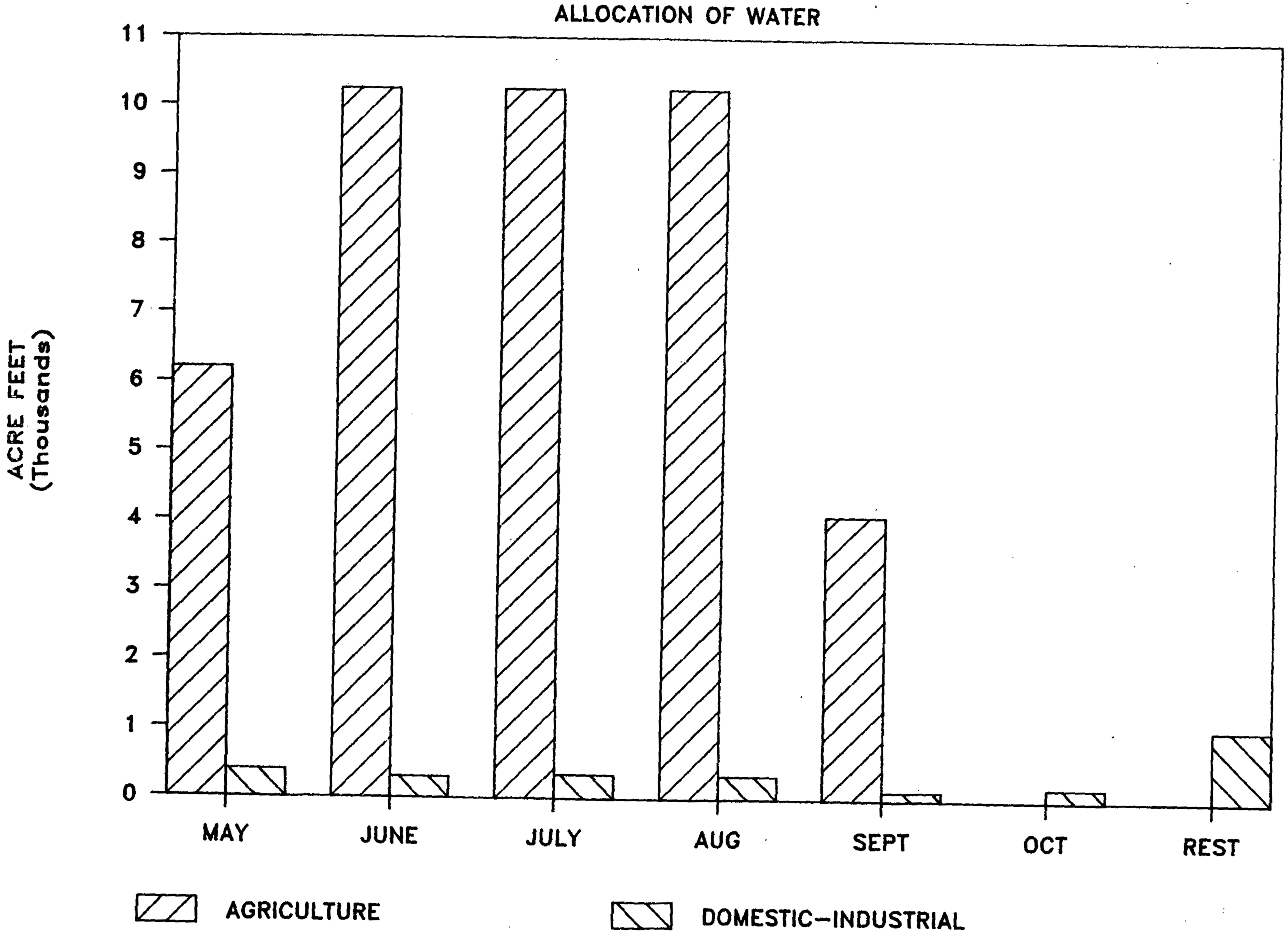
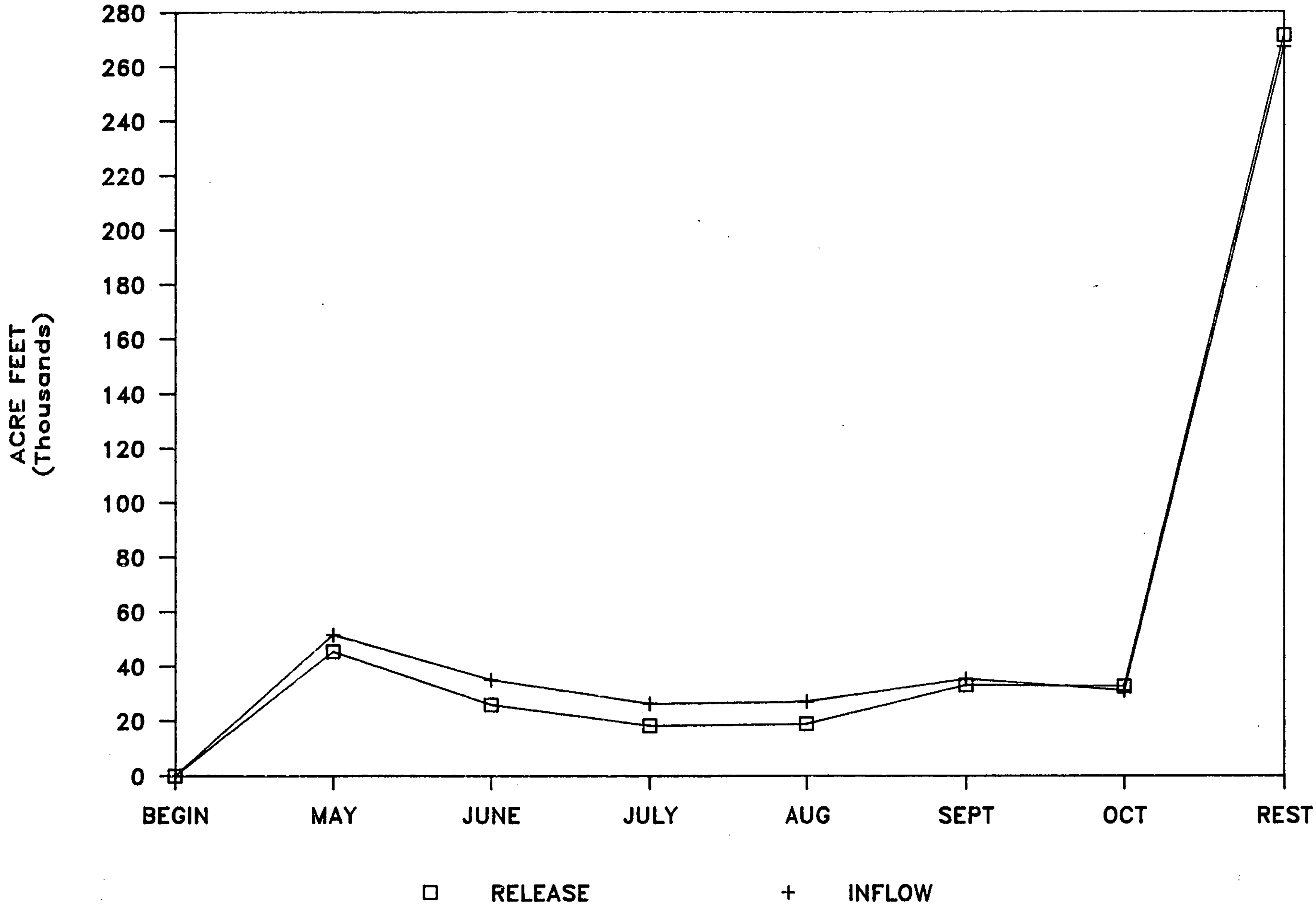


FIGURE 28: OKANAGAN RIVER SUB-BASIN

INFLOW AND RELEASE



11. Osoyoos Lake Sub-basin

Although there are fairly extensive demands for water from Osoyoos Lake, the supply of water from Okanagan River is great enough to create a substantial surplus in an average year. Agricultural and domestic/industrial demands account for about 4,000 acre-feet per month in peak periods while an additional 6,000 acre-feet of water per month is accounted for by American demands. Inflows from Okanagan River rarely fall below 20,000 acre-feet per month so there is a surplus of several thousand acre-feet even in peak periods. All final use activities are at their upper bounds in the optimal solution as shown in table 20.

TABLE 20

Osoyoos Lake Sub-basin
Optimal Level of Final Use Activities

Activity	Optimum	Maximum	Shadow Price ($)
Irrigated Acres	2,811	2,811	800
Lake Levels For Recreation			
period 2	16.98	16.98	N.A.
period 3	16.98	16.98	N.A.
period 4	16.98	16.98	N.A.
period 5	16.98	16.98	N.A.

Note: Lake levels are shown as amount of storage in thousands of acre-feet. Shadow prices are not applicable to lake levels.

As in the other mainstem reaches, shadow prices on all water supply variables are zero as shown in table 21.

TABLE 21

Osoyoos Lake Sub-basin
Shadow Prices on Water Supply

Supply Variable	Shadow Price ($)
Runoff (all periods)	0.00
Return flows (all periods)	0.00
Remaining flows (all periods)	0.00
Storage Capacity (all periods)	0.00

Figure 29 shows that agriculture is the predominant user of water in this sub-basin, accounting for almost all of the water demands in the summer months. The high agricultural demands occur because of a combination of hot dry climate, sandy soils and extensive orchard and vineyard developments. Domestic/industrial use of water in this sub-basin is relatively small.

The storage and release patterns during the year are shown in Figure 30. Because there is not a great deal of storage on the lake, high inflows require that significant amounts of water be released. At the same time, maximization of recreational values causes the model to keep the lake above a certain minimum elevation.

FIGURE 29: OSOYOOS LAKE SUB–BASIN

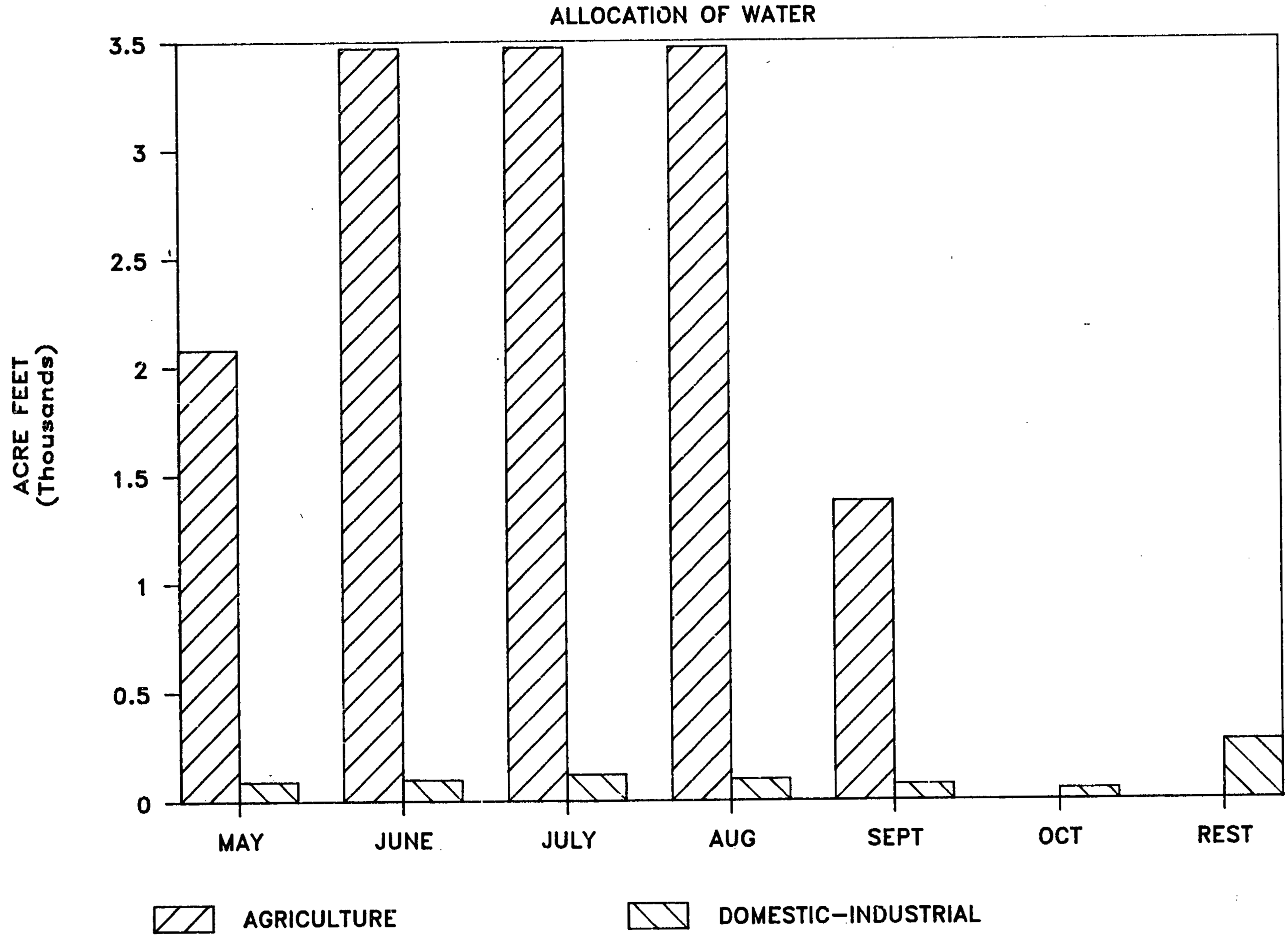
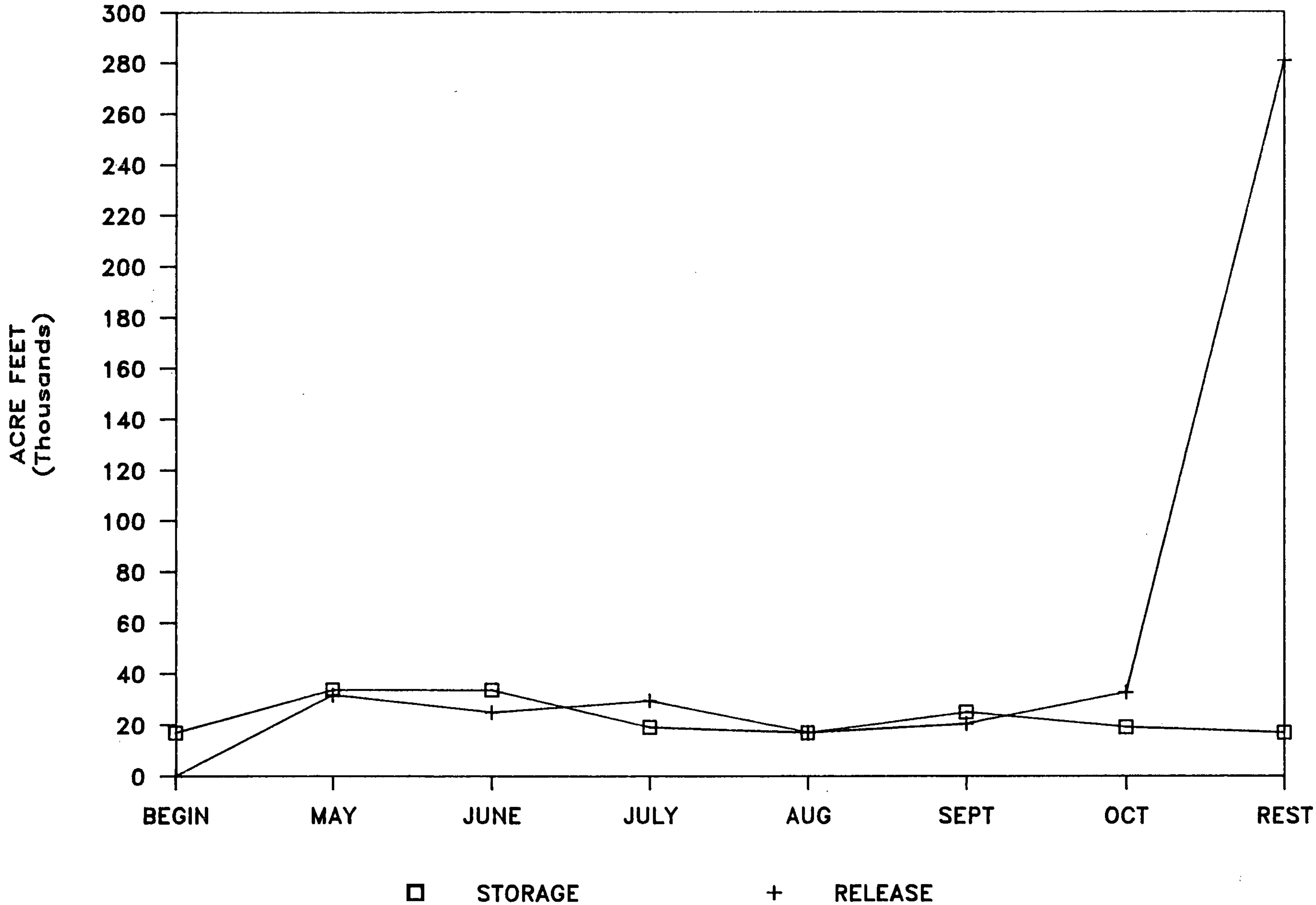


FIGURE 30: OSOYOOS LAKE SUB-BASIN

STORAGE AND RELEASE



It can also be seen from Figure 30 that it would be possible to change the storage and release patterns without affecting the value of the objective function. This relates to the problem of a non-unique maximum that was mentioned at the beginning of this chapter. For example, in the months of May and June, storage is kept at maximum levels. These levels are well above the minimum which maximizes recreational values. The storage is not required to meet needs in later months because of the continuous supply of water from Okanagan River. Therefore, lower storage levels and higher releases could take place in May and June without affecting the objective function value.

D. Summary of Model Solution

The solution to the model illustrates a general difference between the supply/demand balance for the tributary reaches and for the mainstem reaches. Most of the tributaries do not have enough water to supply domestic/industrial needs and to utilize fully all irrigable lands and potential for sport fish production. In contrast, the four mainstem reaches all have a surplus of water in the average run-off year represented by the model and all domestic/industrial, agricultural and recreational users can be supplied to maximum possible levels. The difference between the tributary and mainstem systems demonstrates the need for disaggregation of the model into a number of reaches. Without this disaggregation, the surplus existing on the mainstem reaches would have masked the shortages on the tributaries.

The allocation of water to final use activities is similar for the seven tributary reaches. In general, as much water as possible is supplied to agricultural needs before any flows are allocated towards sport fish production. However, on reaches where there is potential for resident trout production, a certain amount of water is supplied to meet their requirements. This can usually be accomplished without interfering with agricultural demands downstream. In contrast, the spawning trout and kokanee compete directly with agriculture for downstream water, and the optimal solution will not supply any water for their needs unless agricultural demands have already been fully met.

Because of the relative shortage of water on the tributaries, there is usually a positive shadow price on water supplies. Shadow prices range from a few dollars to several hundred dollars per acre foot, depending on the amount of water currently available and the potential for agricultural and sport/fish production. On most tributaries there is also a positive shadow price on reservoir storage capacity. Increasing storage capacity would have value because it would enable more of the peak run-off to be captured and stored for later use. The usual pattern of storage operation in the optimal solution is to bring storage to its maximum possible level during the freshet and to gradually deplete it during the dry summer and fall months. Release patterns are somewhat more variable, depending on the volume of run-off and the sport fish populations on the system.

On the four mainstem reaches there is a surplus of water in all time periods of the model. All final use activities are supplied to their maximum possible levels. Lake levels are maintained which maximize recreational values and minimum flow requirements for spawning salmon are easily satisfied. The shadow price of an additional unit of water is zero in the average year represented by the model. The shadow price of storage on the mainstem system is also zero since there would be no point in retaining more water in the lakes if a surplus already exists. The pattern of storage and release in the model is governed primarily by recreational lake level requirements and to some degree by the disposal of excess inflows.

It was also concluded that the model solution, while maximizing the value of the objective function, was not a unique maximum; there are other solutions which will result in the same maximum being reached. This conclusion was based on the fact that there were several alternative methods of disposing of the surplus water on the mainstem which would not affect the level of any of the final use activities. This was not considered a serious problem with the model, given that its purpose was to demonstrate the use of the linear programming techniques in maximizing the benefits of water use. If the model were also to include flood-control objectives, this would reduce the disposal options available, and it is more likely that a unique optimum would be found.

V. SUMMARY AND CONCLUSIONS

A. Summary

The purpose of this study was to demonstrate the use of linear programming to optimize allocation of water among competing uses in a river basin. A linear programming model was developed which determined optimal allocation of water on a monthly basis over 11 reaches of the the Okanagan River Basin. Several competing uses including agriculture, domestic/industrial, sport fish production and water-based recreation were included. The solution to the model determined both the optimal allocation of water among these activities and the optimal storage management of the system.

There are three notable features of the model relative to previous studies which have utilized linear programming or other optimization techniques. First, the model is developed for planning rather than operational purposes and provides a framework for addressing longer term questions of water allocation and storage requirements. Second, the model includes as many water use activities in the objective function as possible. In so doing, it was necessary to have either the net economic benefit associated with these activities or a measure of the value of water to each use. Most previous studies have not considered such a broad range of competing water use activities in their determination of the optimal allocation of water, and have often focussed on a detailed analysis of just one or two activities. The third notable feature of the model is that it uses a single river basin, disaggregated into a number of reaches, as the geographical unit for water allocation. While several previous studies have also used the river basin as a natural planning unit, many optimization models have considered only a single system of reservoirs controlled by a particular management agency. Other models have been constructed on a larger geographic scale than a single river basin in order to address such issues as regional water deficits and the need for inter-basin transfers.

The model was constructed to represent a single river basin in order to be consistent with the majority of planning studies in which Inland Waters Directorate has been involved. The ability of the model to choose among multiple water use activities is also consistent with the comprehensive nature of previous Canada Water Act studies. The dissagregation of the river basin into sub-basins or reaches allowed the model to address localized problems of water shortages which can often be disguised in aggregate supply-demand comparisons. In terms of the scope and scale of the model, it could readily be integrated into future planning studies under the Canada Water Act.

The Okanagan River Basin was selected because much of the basic water supply and water use data were available from a previous Canada Water Act Study. This data had to be supplemented to some extent from other sources, particularly when estimating the economic value of water to direct and indirect users. Since the project was intended for demonstration purposes only, efforts to obtain additional data and information were kept to a minimum. In some cases, rough estimates or assumptions were used rather than undertaking additional studies to obtain more reliable information. These limitations should be considered before any conclusions regarding allocation of water in the Okanagan River Basin are drawn from the model in its present form.

The model, as applied to the Okanagan River Basin, has only a single-year time horizon and represents an average run-off year. Constraints are imposed which state that all end-of-year storage levels be greater than or equal to beginning-of-year levels. This constraint rules out any solutions to the model that would result in longer term depletion or "mining" of the stored water in the system. The model, in its present form, could be used as a longer term allocation model if a single assured run-off scenario were incorporated, and if any inter-year trade-offs in the use of water were ruled out. These restrictions would limit its usefulness in many river basins. However, the model could be used as the basis for more complex models which would consider both stochastic run-off and inter-year trade-offs in storage. Construction of these more sophisticated models was not undertaken at this stage because of the considerable extra work and computer time that would be required. The basic concepts and data requirements for these types of models are described in the concluding section.

The model includes seven time periods within the year, 11 reaches, and numerous activities relating to the use of water and management of the system. As a result it is quite large, with a total of 830 constraints and 1039 activities. The model was constructed as a linked set of 11 sub-models, one for each reach. This feature simplifies the understanding of its structure and allows for easy incorporation of changes and testing of the model. The computer costs and time necessary to obtain an optimal solution were also reasonable.

The solution to the model gives optimal levels of a number of variables which are of interest to planners and managers of the water resource. The optimal level of final-use activities is determined for each reach as is the amount of water allocated to these activities in each reach and time period. At the same time, the model also solves for the optimal pattern of storage and release for the lakes and reservoirs in the basin. Shadow prices are calculated for supply of water and for storage capacity in all reaches and time periods.

B. Conclusions

1. Practical Application of Linear Programming

The application of linear programming to water use allocation in the Okanagan River Basin demonstrates that it is a practical and feasible tool for comprehensive river basin planning. The application to the Okanagan River Basin showed that data, manpower and computer requirements are within the scope of resources that have been available in previous Canada Water Act agreements. The modeling technique was found to be flexible enough to approximate the basic physical and socio-economic relationships encountered in river-basin planning. In general, these relationships could be easily represented by linear equations. In some cases, non-linear relationships had to be approximated by a series of linear segments, but it was not felt that this caused any significant errors in the results.

Most of the data required for the model were taken from previous studies done under a Canada Water Act agreement for the Okanagan River Basin. These data were originally intended for planning purposes such as forecasting, comparing water supply and water use and assessing the need for improved infrastructure in water supply systems. It was found that the data could also be used in the linear programming optimization model, with little alteration. Additional data and information were required for the economic relationships in the model relating to net benefits from final-use activities and valuation of water. This suggests that optimization models could be integrated into Canada Water Act Planning studies if sufficient resources were directed towards estimation of the economic value of water to competing users.

Given the availability of the basic data, the time required to construct the model was not great. Application of the model to another basin would be expected to take even less time since the same formulations could be used for many of the basic equations. The large size of the model did not prove to be prohibitive in terms of the computer costs required to solve it. Costs were low enough to conclude that extensive sensitivity analysis and expansion of the model could be undertaken at reasonable expense.

An additional question to consider when assessing the feasibility of the model is: how much confidence do we have in the solution? Since the model is a normative tool, it does not give results which can be tested empirically. The optimal solution depends upon all of the data, relationships and assumptions built into the model. Insofar as any of the internal structural relationships are incorrect, the optimal solution could also be incorrect. Thus the only way to verify the model solution is to check that each structural relationship in the model is correct. As noted, some of the structural relationships are only rough estimates and considerably more work would have to be done before we could have reasonable confidence in the solution.

An additional method of verifying the model is to compare activity levels in the optimal solution to levels that might reasonably be expected. For certain activities there are obvious bounds within which the activity levels should lie. For example, if flows in Okanagan River exceed channel capacity in the optimal solution, then it would be reasonable to conclude that the model was specified incorrectly. Other relationships that are apparant in the optimal solution can be compared to findings from previous studies and models. For example, the optimization model indicated that a surplus of water existed on the mainstem reaches of the system in an average run-off year. This finding is consistent with the conclusions from the simulation model of water supply and water use which was constructed during the Okanagan Basin Study. The optimization and simulation models were also consistent in that both indicated that there were conflicts in water use between fishery and agricultural requirements on many of the tributaries to the mainstem system. These similarities support the reliability of the model structure. However, it should be restated that many of the structural relationships of the model were approximated with rough data and assumptions. These would have to be refined before full confidence could be placed in the results of the model.

2. Methods for Improving the Model

There are a number of ways in which the model could be improved, both in its specific application to the Okanagan River Basin and in its application to river basins in general. In applying the model to the Okanagan River Basin, some obvious areas for improvement would be in the estimation of economic values associated with water use activities. More precise information on the net benefits of irrigation and sport fishing would greatly improve the usefulness of the model. The effect of lake level fluctuations on recreational values would also have to be studied more closely in order to better specify this relationship in the model. Other areas for improvement include better specification of the relationship between flows and fish populations and inclusion of the effects of lake levels on kokanne production.

There are a number of ways in which the model could be improved that would apply to all river basins. These improvements relate to the conceptual structure of the model and concern such factors as stochastic run-off, inter-year trade-offs in water use, incorporation of industrial and domestic demand functions, and sub-models for optimizing the amount of irrigation water applied. These improvements are discussed below.

a. <u>Stochastic Water Supply and Inter-Year Trade-offs</u>

In many river-basins, a model which considers the possibililty of inter-year storage of water and stochastic run-off would be more useful than the single year model developed in this study. A dynamic programming approach would be able to incorporate both of these considerations. Dynamic programming is a method of representing a sequential decision making process which considers both the current state of certain variables plus future actions. The solution of a dynamic programming model would give the optimal use of the water resource for a given level of storage or expected run-off. In arriving at the optimum, explicit consideration would be given to the trade-off between using the water in the current period or saving it for use in future periods. The linear programming model used in the present study could be used as the basic building block for such a dynamic programming model.

Numerous engineering studies have used dynamic programming for short term and real time operational models of reservoir systems. However, most of these studies have considered fixed demands for water from most sectors and have optimized over only one or two variables. An example of such a study in a Canadian setting is Silver, Okun and Russel (1972) which used dynamic programming to maximize the firm power production from the ALCAN hydroelectric system. Examples of the use of dynamic programming in planning models of water allocation can be found in Worthington, Burt and Brustkern (1985), Brown and Deacon (1972) and Burt (1964).

b. Valuation of Industrial and Domestic Water

In the application of the model to the Okanagan River Basin, no explicit values were given to domestic or industrial water use. Instead, constraints were imposed that restricted the model to supplying a fixed amount of water to these uses before allocating the remainder to other uses. Knowledge of the willingness to pay (consumer's surplus) for water use by industrial and domestic users would allow incorporation of these values directly into the objective function and the model would be free to optimize over industrial and domestic uses as well as agricultural, fishery and recreational uses. This would be an important improvement in the model if it were to be applied to river basins where there are significant industrial and domestic demands.

Incorporation of willingness to pay values for industrial and domestic water into the model would be fairly straightforward if these values were known. As outlined in chapter three, the willingness to pay is the area under the demand curve for water. This area can be translated into a marginal value function which would be directly included in the objective function. The marginal value function is non-linear but could be approximated by linear segmentation in a linear programming model or alternatively a non-linear programming model could be used. The important point is that once the demand functions for water are known, the problem of incorporating them in the model is relatively easy.

Recent work by Renzetti (1986a,1986b) focussed on econometric estimation of industrial water demand in British Columbia for a number of different industries. These studies relied for a large part on data from a national survey of industrial water use, and the scope of such estimations could be expanded to include other areas of Canada. The estimated demand functions could be used to generate willingness to pay figures which could be incorporated into the optimization model for river basins where the type and size of industrial establishments are known.

There has not been a great deal of work done on the estimation of domestic water demands in Canada. The most recent study was carried out by Sigurdson (1982) for Saskatchewan and Manitoba. Other Canadian studies include Sewell and Roueche (1974) which examined municipal water demands in Victoria, B.C. and Grima (1972) which looked at residential demand for regions in Ontario. These studies do not provide a sufficient basis for any generalized estimates of domestic water demands which are sensitive to climate and socio-economic variables that vary across regions of Canada. In order to estimate domestic water demand functions which could be used in optimization models, it would be necessary to use a much broader data base or to estimate demand functions specific to river basins under study.

c. Improved Modeling of Agricultural Water Use

In its present form the model uses a fixed application rate of water per acre based on observed irrigation practices in the Basin. The model does not have the capacity to optimize the application rate which is a significant limitation given the importance of irrigation in the region. It would be possible to develop a sub-model to determine the optimum per acre application rate using information that relates yields to the amount of water applied over a unit area. Recent work by Wigington and Short (1985) simulated the relationship between per-acre yields and irrigation rates in Okanagan orchards. This work could be used as the basis for an irrigation sub-model which could then be integrated into the optimization model for the Okanagan Basin. Further work by Wigington (1985) expanded the analysis to include other crop types for various soil and weather conditions. Using this information it would be possible to determine optimal irrigation rates for a number of different crops over a variety of geographical areas.

d. Water Quality Considerations

In its present form the model does not incorporate any values or requirements related to water quality. However, water quality will be affected by the activities in the model through such pathways as industrial and domestic discharge and leaching and erosion from agricultural lands. Furthermore, withdrawal of water from surface supplies may result in an increased concentration of effluents or nutrients in the unused water. Therefore, water use should not be considered in isolation from water quality. The issue of optimal water quality is complex and incorporates such factors as ecosystem health, human health, aesthetic values, recreational uses and international obligations. For the purposes of water use modeling, a simpler approach would be to incorporate established water quality objectives into the model in the form of limits on activities which pollute the water system and constraints on activities which withdraw water needed for effluent dilution.

e. Further Testing of the Model

Further testing of the model could provide a more realistic evaluation of the applicability of linear programming to river basin planning. Application to a another river basin with a different set of economic activities would provide further testing of its capabilities to model a wide range of demands for water. An additional test of the model would be to utilize it for planning purposes, rather than as a demonstration of the methodology. This application would require a much more rigourous estimation of the structural relationships and demands for water than was undertaken in the demonstration model for the Okanagan River Basin. Extensive sensitivity analysis would have to be undertaken in order to determine the key variables in the model and to assess the reliability of the model solution. Such a project would require considerably more resources than were used in applying the model to the Okanagan Basin.

Initial work has begun in applying the model to the portion of the South Saskatchewan River Basin located in Saskatchewan. This should provide the opportunity to test the model in a situation where there are a variety of water users competing for relatively scarce supplies. A Canada Water Act study planned for this Basin will generate a significant amount of information on water supply and demand which could be used in the optimization model. This information would allow for a realistic application and assessment of the model. The model solution could also provide information on the allocation of water in the Basin which should be useful in the formulation of recommendations under the Canada Water Act study.

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APPENDIX

Complete Model Solution

This appendix shows the complete model solution reproduced from the MPSX printout. The first part of the printout summarizes the simplex search for the solution which maximizes the objective function. Phase one first searches for a starting basis or feasible solution. Once a starting solution has been found, phase two begins and further feasible solutions are examined, until the maximum value of the objective function is obtained. The printout then specifies the right hand side value of each constraint and the level of each variable (activity) in the optimal solution. Some conventions are used in the names of the variables and rows as outlined below.

1. Variable Names

All variables are referred to as "activities" in the optimal solution. These activities are given names, similar to the variable names used in chapter three. Each activity name is given a prefix to indicate the sub-basin to which it belongs. Immediately after the prefix there is a single digit from 1 to 7 which indicates the time period for the variable. The prefixes and the corresponding sub-basins are:

A - Trout Creek Sub-basin

B - Mission Creek Sub-basin

C - Peachland Creek Sub-basin

D - Powers Creek Sub-basin

E - Equesis Creek Sub-basin

F - Kelowna Creek Sub-basin

G - Penticton Creek Sub-basin

2. Row Names

All constraints are given a name which appears under the heading called "row" in the solution. All row names are appended with the letter "C" in order to distinguish them from names of activities. As with the activity names, row names are prefixed with a letter and number indicating the sub-basin and time period. The next three or four letters constitute a short code indicating the nature of the constraint. The basic codes used and the corresponding constraints are:

ACR - maximum acreage available for irrigation

ACRD - irrigation demands

RTR - return flows

STR - relationship between spawning trout and flows

KOK - relationship between kokanee and flows

DWN - downstream relationship between supply and demand

SPD - downstream supply

SPU - upstream supply

BAL - storage balance

REM - remaining flow to next reach

RET - return flows within the sub-basin

WAS - wastage factor

REC - relationship between recreation and lake levels

```
LARGE TABLES
          0001          PROGRAM
          0002          INITIALZ
          0096          TITLE('MAINMOD')
          0097          MOVE(XDATA, 'BASIN')
          0098          MOVE(XPBNAME,'STORAGE')
          0099          MOVE(XBOUND,'BND1')
          0100          MOVE(XOBJ,'OBJFUN')
          0101          MOVE(XRHS,'RHSA')
          0102          CONVERT
          0103          SETUP('MAX')
          0104          OPTIMIZE
          0413           SAVE('NAME','BASE')
          0414          SOLUTION
          0415          EXIT
          0416          PEND
Compilation phase succeeded.
   VSS CS: UNLOAD
Enter command:
Semantics for dsdef.
   VSS CS: DSDEF SYSIN=BASINMOD
Semantics for execute.
   VSS CS: DSDEF MATRIX1=-MPSX.M1
   VSS CS: DSDEF MATRIX2=-MPSX.M2
   VSS CS: DSDEF MATRIX3=-MPSX.M3
   VSS CS: DSDEF MATRIX4=-MPSX.M4
   VSS CS: DSDEF ETA1=-MPSX.E1
   VSS CS: DSDEF ETA2=-MPSX.E2
   VSS CS: DSDEF ETA3=-MPSX.E3
   VSS CS: DSDEF ETA4=-MPSX.E4
   VSS CS: DSDEF MPSCRAT=-MPSX.MS
   VSS CS: DSDEF SCRATCH1=-MPSX.S1
   VSS CS: DSDEF SCRATCH2=-MPSX.S2
   VSS CS: DSDEF SYSPRINT=UNIT=SPRINT
   VSS CS: DSDEF SYSPUNCH=-BASIS
   VSS CS: DSDEF SYSABS=-MONITOR
   VSS CS: DSDEF PROBFILE=-PROBFILE
   VSS CS: SET JOBLIB=MPS:MPSXLINK
   VSS CS: SET SIZE=214K
   VSS CS: LOAD MEMBER=DJLEXEC PAR=TASK
   VSS CS: START
```

```
CONVERT BASIN    TO STORAGE

TIME =    0.00

1- ROWS SECTION.


   0 MINOR ERROR(S) -   0 MAJOR ERROR(S).

2- COLUMNS SECTION.


   0 MINOR ERROR(S) -   0 MAJOR ERROR(S).

3- RHS'S SECTION.

  RHSA

   0 MINOR ERROR(S) -   0 MAJOR ERROR(S).

5- BOUNDS SECTION.

 THE COLUMN R0STO    IS NOT USED.
 THE COLUMN R1STO    IS NOT USED.
 THE COLUMN R2STO    IS NOT USED.
 THE COLUMN R3STO    IS NOT USED.
 THE COLUMN R4STO    IS NOT USED.
 THE COLUMN R5STO    IS NOT USED.
 THE COLUMN R6STO    IS NOT USED.
 THE COLUMN R7STO    IS NOT USED.
 ELEMENT BND1     ,Y7STO    - UPPER AND LOWER LIMITS EQUAL - ASSUMED FIXED.

   1 MINOR ERROR(S) -   0 MAJOR ERROR(S).

 THE FOLLOWING ROWS HAVE NO STRUCTURAL ELEMENTS

 F2K0K1C   F3K0K1C   F4K0K1C   G2K0K1C   G3K0K1C   G4K0K1C   E2K0K1C   E3K0K1C   E4K0K1C   D2K0K1C   D3K0K1C   D4K0K1C   C2K0K1C
 C3K0K1C   C4K0K1C   B2K0K1C   B3K0K1C   B4K0K1C   A2K0K1C   A3K0K1C   A4K0K1C

 PROBLEM STATISTICS

   830 LP ROWS,    1869 VARIABLES,    3427 LP ELEMENTS, DENSITY =   0.22

 THESE STATISTICS CONTAIN ONE SLACK VARIABLE FOR EACH ROW

     1 MINOR ERRORS,     0 MAJOR ERRORS.
```

```
SETUP  STORAGE

TIME =   0.02

    MAX
    SCALE
    BOUND     = BND1


 MATRIX1  ASSIGNED TO MATRIX1
 MATRIX2  ASSIGNED TO MATRIX2
 MATRIX3  ASSIGNED TO MATRIX3
 MATRIX4  ASSIGNED TO MATRIX4

 ETA1     ASSIGNED TO ETA1
 ETA2     ASSIGNED TO ETA2
 ETA3     ASSIGNED TO ETA3
 ETA4     ASSIGNED TO ETA4

 SCRATCH1 ASSIGNED TO SCRATCH1
 SCRATCH2 ASSIGNED TO SCRATCH2
 MPSCRAT  ASSIGNED TO MPSCRAT

 MAXIMUM PRICING NOT REQUIRED - MAXIMUM POSSIBLE   5

 NO CYCLING

     POOLS        NUMBER   SIZE    CORE
 H.REG-BITS MAP                    3576
 BOUND  VECTOR                     6664
 WORK   REGIONS     7     6664    46648
 MATRIX BUFFERS     5     4248    21240
 ETA    BUFFERS     9     6440    57960

                       TOTAL  NORMAL  .FREE.   FIXED BOUNDED
 ROWS    (LOG.VAR.)     830     399       1     430       0
 COLUMNS (STR.VAR.)    1039     667       0     244     128

     3427 ELEMENTS - DENSITY =   0.22 -    18 MATRIX RECORDS (WITHOUT RHS'S)


WRITE

TIME =   0.03

    OPTIMIZE SYSTEM MACRO CALLED


CRASH          TIME   0.03 MINS.

    CHERCHE


        INFEASIBILITIES   349  AT START
```

```
     233  AFTER CHERCHE     193 SELECTED STRUCTURALS
      52  AFTER PASS B
    COMPLETED

NEGDJ

TIME =    0.06  MINS.

PRIMAL       OBJ = OBJFUN      RHS = RHSA

TIME =    0.06  MINS.       PRICING    5
 SCALE =     .
 INVERT DEMANDED AFTER 573 MAJOR/ 573 MINOR ITERATIONS - FREQUENCY

 INVERT CALLED      TIME   0.06   CURRENT INVERSE ---- ETA-VECTORS ...568   ELEMENTS ..3481   RECORDS .....7   ITERATION ....573
  BASIS ---- NO.OF ROWS ...830   LOGICALS ......357   STRUCTURALS ...473   ELEMENTS ..1533
  INVERSE -- NUCLEUS ........0   TRANSFORMED .....0   ETA-VECTORS ...473   ELEMENTS ..1176   RECORDS .....3   TIME TAKEN    0.001

NEGDJ

TIME =    0.06  MINS.

PRIMAL       OBJ = OBJFUN      RHS = RHSA

TIME =    0.06  MINS.       PRICING    5
 SCALE =     .
```

	ITER NUMBER	NUMBER INFEAS	VECTOR OUT	VECTOR IN	REDUCED COST	SUM INFEAS
M	574	51	340	1236	37.7863-	73240.7
	575		248	1130	44.1816-	71785.7
	576		1427	1461	74.0979-	71283.3
	577		247	1129	29.9267-	71183.6
	578		536	1460	30.4231-	71117.8
M	579	46	728	1569	22.1607-	41225.1
	580		631	1791	27.4688-	38642.5
	581		539	1463	25.6850-	37433.2
	582		636	1796	25.8451-	37227.9
	583		822	1684	21.6403-	37084.0
M	584	41	733	1574	16.7512-	27404.1
	585		732	1573	11.4636-	25989.4
	586		624	1792	15.5387-	25216.3
	587		538	1462	17.3934-	25091.9
	588		1093	1127	1.80874-	25081.2
M	589	37	250	1206	1.00000-	22411.6
	590		541	1761	1.00000-	21798.9
	591		542	1762	1.00000-	21186.2
	592		1836	1764	.65396-	21034.0
	593		1852	1763	.97773-	20991.1
M	594	34	145	1030	.61247-	14167.0
	595		253	1209	.65396-	13468.7
	596		544	1832	1.76195-	13456.4
	597		1283	1207	.65396-	12600.0

	ITER NUMBER	NUMBER INFEAS	VECTOR OUT	VECTOR IN	REDUCED COST	SUM INFEAS
M	598	31	251	1273	1.76195-	11240.0
	599		543	1818	1.05404-	10671.2
	600		532	1499	.60971-	10471.1
	601		568	1836	.60971-	10111.1
	602		1154	1170	.60971-	10016.7
M	603	28	338	1283	.60971-	6821.18
	604		629	1828	.60971-	4910.14
	605		632	1817	.58036-	4375.59
	606		1275	1208	1.00000-	2034.21
	607		1152	1168	.60971-	1931.59
M	608	25	241	1166	.60971-	860.338
	609		677	1577	.10095-	441.169
	610		252	1204	.08567	112.940
	611		386	1355	.09166-	98.1071
	612		390	1363	.09579-	87.7734
M	613	20	580	1799	.06527-	61.6894
	614		387	1357	.03626-	51.9108
	615		388	1359	.03626-	42.1323
	616		483	1466	.06549-	38.0716
	617		192	1133	.03850-	35.4152
M	618	15	389	1361	.03626-	25.6366
	619		484	1468	.03543-	22.7315
	620		584	1853	.03371-	21.2392
	621		585	1822	.03371-	20.0625
M	622	11	193	1135	.02852-	17.4382
	623		293	1298	.02303-	15.9417
	624		778	1696	.03263-	14.6690
	625		583	1852	.02347-	13.5082
	626		774	1688	.03118-	12.4169
M	627	6	294	1299	.02155-	11.0169
	628		292	1297	.01706-	9.62017
	629		775	1690	.01884-	8.88535
	630		776	1692	.01884-	8.22589
	631		784	1694	.01884-	7.61536
M	632	2	295	1300	.01459-	2.45464
	633		291	1296	.01706-	.04893
	634		777	1707	.01127-	.

FEASIBLE SOLUTION

NEGDJ

TIME = 0.08 MINS.

PHASE2

PRIMAL OBJ = OBJFUN RHS = RHSA

TIME = 0.08 MINS. PRICING 5
SCALE = 1.00000-

	ITER NUMBER	NUMBER NONOPT	VECTOR OUT	VECTOR IN	REDUCED COST	FUNCTION VALUE
M	635	51	101	969	32.4991-	.14E+08
	636		1127	1093	1.00000-	.14E+08
	637		446	1427	46.6915-	.14E+08
	638		178	1123	1.00000-	.14E+08
	639		577	1797	1.00000-	.14E+08
M	640	51	983	1050	34.4102-	.19E+08
	641		156	1152	33.7792-	.19E+08
	642		1460	1430	28.0149-	.19E+08
	643		578	1794	663.615-	.19E+08
	644		182	1124	5.09929-	.19E+08
M	645	50	154	1154	84.5599-	.21E+08
	646		1461	1485	29.5288-	.21E+08
	647		966	927	24.1773-	.21E+08
	648		573	1795	663.615-	.21E+08
	649		275	1234	1.00000-	.21E+08
M	650	48	1426	1487	73.8221-	.22E+08
	651		579	1790	1031.27-	.22E+08
	652		281	1235	5.09929-	.22E+08
M	653	46	1016	1016	1.00000-	.24E+08
	654		1797	1824	6.71109-	.25E+08
	655		185	1131	1.00000-	.25E+08
	656		288	1242	1.00000-	.25E+08
	657		379	1353	1.00000-	.25E+08
M	658	44	383	1346	2814.94-	.25E+08
	659		189	1128	1972.17-	.25E+08
	660		1131	178	30.1975-	.25E+08
M	661	42	1353	1350	3230.38-	.25E+08
M	662	41	480	1464	1.00000-	.25E+08
	663		469	1456	1.00000-	.25E+08
	664		663	1567	1.00000-	.25E+08
	665		373	1345	1.00000-	.25E+08
	666		569	1789	1.00000-	.25E+08
M	667	41	566	1793	219.193-	.25E+08
	668		476	1461	882.548-	.25E+08
	669		470	1457	1113.07-	.25E+08
	670		374	1347	176.620-	.25E+08
	671		667	1568	136.596-	.25E+08
M	672	41	481	469	1041.99-	.25E+08
	673		1789	573	65.8864-	.25E+08
	674		665	1572	219.742-	.25E+08
	675		375	1348	176.620-	.25E+08
	676		471	1458	164.923-	.25E+08
M	677	40	482	1489	32.7166-	.25E+08
	678		396	1349	176.620-	.25E+08
	679		666	1570	424.789-	.25E+08
	680		472	1459	164.923-	.25E+08
	681		773	1686	1.00000-	.25E+08
M	682	40	668	1571	424.789-	.26E+08
	683		1464	1491	6.79498-	.26E+08
	684		469	1460	164.923-	.26E+08
	685		372	1388	6.40380-	.26E+08
	686		767	1685	29.3277-	.26E+08

	ITER NUMBER	NUMBER NONOPT	VECTOR OUT	VECTOR IN	REDUCED COST	FUNCTION VALUE
M	687	39	669	1600	12.3596-	.26E+08
	688		1456	476	71.0835-	.26E+08
	689		376	379	41.8159-	.26E+08
	690		771	1679	112.432-	.26E+08
	691		648	1543	1.00000-	.26E+08
M	692	38	674	1575	1.00000-	.35E+08
	693		1608	1602	30.6892-	.36E+08
	694		397	383	66.8521-	.36E+08
	695		787	1683	128.907-	.36E+08
	696		642	1550	1.52469-	.36E+08
M	697	37	409	1376	3.83090-	.36E+08
	698		675	667	2725.21-	.36E+08
	699		643	1544	3.91341-	.36E+08
M	700	37	662	668	2397.89-	.38E+08
	701		1345	1386	3.20189-	.38E+08
M	702	36	676	669	690.211-	.38E+08
	703		761	1678	1.00000-	.38E+08
	704		738	1648	1.00000-	.38E+08
M	705	39	1723	1653	70.0373-	.39E+08
	706		670	662	62.2775-	.39E+08
	707		644	1545	3.91341-	.39E+08
	708		656	1559	.22133-	.39E+08
M	709	36	1575	663	386.618-	.41E+08
	710		783	1721	49.3608-	.41E+08
	711		762	1680	11.6597-	.41E+08
	712		645	1546	3.91341-	.41E+08
	713		745	1654	1.00000-	.41E+08
M	714	34	785	1719	24.6804-	.42E+08
	715		646	1547	3.91341-	.42E+08
	716		801	1661	1.55336-	.42E+08
	717		551	1765	.89896-	.42E+08
	718		454	1432	.89896-	.42E+08
M	719	35	1648	1723	123.402-	.45E+08
	720		763	1681	11.6595-	.45E+08
	721		647	1548	3.91341-	.45E+08
M	722	33	760	1682	11.6592-	.45E+08
	723		657	1549	6.58154-	.45E+08
	724		739	1713	1.75374-	.45E+08
	725		545	1772	.89896-	.45E+08
	726		448	1439	.89896-	.45E+08

INVERT DEMANDED AFTER 35 MAJOR/ 153 MINOR ITERATIONS - FREQUENCY

INVERT CALLED TIME 0.11 CURRENT INVERSE ---- ETA-VECTORS ...625 ELEMENTS ..4828 RECORDS .....9 ITERATION 726
BASIS ---- NO.OF ROWS ...830 LOGICALS ......241 STRUCTURALS ...589 ELEMENTS ..1801
INVERSE -- NUCLEUS ....32 TRANSFORMED .....7 ETA-VECTORS ...608 ELEMENTS ..1615 RECORDS .....4 TIME TAKEN 0.002

NEGDJ

TIME = 0.11 MINS.

PRIMAL OBJ = OBJFUN RHS = RHSA

TIME = 0.11 MINS. PRICING 5
SCALE = 1.00000-

	ITER NUMBER	NUMBER NONOPT	VECTOR OUT	VECTOR IN	REDUCED COST	FUNCTION VALUE
M	727	37	1543	1592	4.75369-	.45E+08
	728		764	767	4.64680-	.45E+08
	729		740	1655	4.71706-	.45E+08
	730		546	1766	2.29485-	.45E+08
M	731	36	766	771	6.73109-	.45E+08
	732		741	1656	4.72660-	.45E+08
	733		449	1433	2.29485-	.45E+08
	734		547	1767	2.29485-	.45E+08
	735		260	1210	.89708-	.45E+08
M	736	35	772	1677	.82300-	.45E+08
	737		742	1657	3.72995-	.45E+08
	738		450	1434	2.29485-	.45E+08
	739		548	1768	2.29485-	.45E+08
	740		254	1217	.89708-	.45E+08
M	741	32	743	1658	3.72995-	.45E+08
	742		255	1211	2.30190-	.45E+08
	743		549	1769	2.29485-	.45E+08
	744		451	1435	2.29485-	.45E+08
	745		357	1321	.76812-	.45E+08
M	746	32	744	1659	3.72995-	.45E+08
	747		256	1212	2.30190-	.45E+08
	748		550	1770	2.29485-	.45E+08
	749		452	1436	2.29485-	.45E+08
	750		413	1328	.76812-	.45E+08
M	751	32	1677	1660	6.22853-	.45E+08
	752		662	1560	.56353-	.45E+08
	753		560	1771	3.82038-	.45E+08
	754		257	1213	2.30190-	.45E+08
	755		453	1437	2.29485-	.45E+08
M	756	30	1654	1725	2.35510-	.45E+08
	757		1765	1814	2.33770-	.45E+08
	758		1432	1438	3.82038-	.45E+08
	759		258	1214	2.30190-	.45E+08
	760		351	1380	.54248-	.45E+08
M	761	31	1719	801	.82299-	.45E+08
	762		259	1215	2.30190-	.45E+08
	763		352	1322	1.95002-	.45E+08
M	764	28	771	766	7.04520-	.45E+08
	765		269	1216	3.83180-	.45E+08
	766		353	1323	1.95002-	.45E+08
	767		655	1551	.44263-	.45E+08
	768		752	1662	.43506-	.45E+08
M	769	27	1210	1259	2.34329-	.45E+08
	770		767	764	15.8751-	.45E+08
	771		354	1324	1.95002-	.45E+08
	772		746	1669	.43506-	.45E+08
	773		163	1099	.26907-	.45E+08

	ITER NUMBER	NUMBER NONOPT	VECTOR OUT	VECTOR IN	REDUCED COST	FUNCTION VALUE
M	774	27	1682	760	11.3535-	.45E+08
	775		355	1325	1.95002-	.45E+08
	776		747	1663	1.11726-	.45E+08
	777		1122	1106	.26907-	.45E+08
	778		649	1558	.26653-	.45E+08
M	779	26	1678	763	10.6678-	.45E+08
	780		356	1326	1.95002-	.45E+08
	781		748	1664	1.11726-	.45E+08
	782		650	1552	.68235-	.45E+08
	783		267	1218	.26516-	.45E+08
M	784	25	411	1327	3.25234-	.45E+08
	785		749	1665	1.11726-	.45E+08
	786		651	1553	.68234-	.45E+08
	787		261	1225	.26516-	.45E+08
	788		558	1773	.26067-	.45E+08
M	789	27	1321	397	3.14580-	.45E+08
	790		750	1666	1.11726-	.45E+08
	791		652	1554	.68234-	.45E+08
M	792	24	751	1667	1.11726-	.45E+08
	793		653	1555	.68234-	.45E+08
	794		262	1219	.66311-	.45E+08
	795		461	1440	.26067-	.45E+08
	796		552	1780	.26067-	.45E+08
M	797	24	801	1668	1.87901-	.45E+08
	798		654	1556	.68234-	.45E+08
	799		553	1774	.66517-	.45E+08
	800		263	1220	.66311-	.45E+08
	801		455	1447	.26067-	.45E+08
M	802	23	98	1081	.25428-	.45E+08
	803		1560	1557	1.14844-	.45E+08
	804		456	1441	.66517-	.45E+08
	805		554	1775	.66516-	.45E+08
	806		264	1221	.66311-	.45E+08
M	807	24	99	1082	.25428-	.45E+08
	808		1559	656	.85291-	.45E+08
	809		457	1442	.66517-	.45E+08
	810		555	1776	.66516-	.45E+08
	811		265	1222	.66311-	.45E+08
M	812	26	1047	101	.25428-	.45E+08
	813		458	1443	.66517-	.45E+08
	814		556	1777	.66516-	.45E+08
	815		266	1223	.66311-	.45E+08
M	816	23	1081	97	.50857-	.45E+08
	817		1233	1224	1.12074-	.45E+08
	818		459	1444	.66517-	.45E+08
	819		557	1778	.66516-	.45E+08
M	820	21	1082	98	.25428-	.45E+08
	821		561	1779	1.12074-	.45E+08
	822		460	1445	.66517-	.45E+08
	823		364	1329	.22133-	.45E+08

	ITER NUMBER	NUMBER NONOPT	VECTOR OUT	VECTOR IN	REDUCED COST	FUNCTION VALUE
	824		759	1670	.19831-	.45E+08
M	825	19	468	1446	1.12075-	.45E+08
	826		1788	589	.75723-	.45E+08
	827		358	1336	.22132-	.45E+08
M	828	19	1440	496	.21502-	.45E+08
	829		1773	593	.21502-	.45E+08
	830		359	1330	.56134-	.45E+08
M	831	16	954	954	.14023-	.45E+08
	832		955	955	.14023-	.45E+08
	833		360	1331	.56134-	.45E+08
	834		462	1448	.13407-	.45E+08
	835		565	1781	.13407-	.45E+08
M	836	14	361	1332	.56134-	.45E+08
	837		463	1449	.33818-	.45E+08
	838		274	1226	.13407-	.45E+08
	839		559	1788	.13407-	.45E+08
	840		371	1337	.11237-	.45E+08
M	841	13	1781	1782	.33817-	.45E+08
	842		445	1450	.33818-	.45E+08
	843		362	1333	.56134-	.45E+08
	844		365	1344	.11236-	.45E+08
	845		170	1107	.07677-	.45E+08
M	846	10	1083	1083	.06357-	.45E+08
	847		953	953	.03506-	.45E+08
	848		363	1334	.56134-	.45E+08
	849		366	1338	.28615-	.45E+08
	850		177	1115	.05590-	.45E+08
M	851	7	890	890	.02926-	.46E+08
	852		891	891	.02926-	.46E+08
	853		93	956	.03506-	.46E+08
	854		410	1335	.96486-	.46E+08
	855		367	1339	.28615-	.46E+08
M	856	12	1329	396	.60297-	.46E+08
	857		956	861	.03506-	.46E+08
	858		368	1340	.28615-	.46E+08
M	859	3	889	889	.00977-	.46E+08
	860		892	892	.00977-	.46E+08
	861		369	1341	.28615-	.46E+08
M	862	1	370	1342	.28615-	.46E+08
M	863	1	1386	1343	.47894-	.46E+08

OPTIMAL SOLUTION

SAVE. TIME 0.15 .

NAME = BASE

SOLUTION (OPTIMAL)

TIME = 0.15 MINS. ITERATION NUMBER = 863

...NAME...	...ACTIVITY...	DEFINED AS
FUNCTIONAL	45897183.5727	OBJFUN
RESTRAINTS		RHSA
BOUNDS....		BND1

SECTION 1 - ROWS

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	1	OBJFUN	BS	45897183.5727	45897183.5727-	NONE	NONE	1.00000
A	2	OOACRDC	EQ	.	.	.	.	.
A	3	SOACRDC	EQ	.	.	.	.	.
A	4	ROACRDC	EQ	.	.	.	.	.
A	5	YOACRDC	EQ	.	.	.	.	.
A	6	O1ACR1C	EQ	.	.	.	.	.
A	7	O2ACR1C	EQ	.	.	.	.	.
A	8	O3ACR1C	EQ	.	.	.	.	.
A	9	O4ACR1C	EQ	.	.	.	.	.
A	10	O5ACR1C	EQ	.	.	.	.	.
A	11	S1ACR1C	EQ	.	.	.	.	.
A	12	S2ACR1C	EQ	.	.	.	.	.
A	13	S3ACR1C	EQ	.	.	.	.	.
A	14	S4ACR1C	EQ	.	.	.	.	.
A	15	S5ACR1C	EQ	.	.	.	.	.
A	16	R1ACR1C	EQ	.	.	.	.	.
A	17	R2ACR1C	EQ	.	.	.	.	.
A	18	R3ACR1C	EQ	.	.	.	.	.
A	19	R4ACR1C	EQ	.	.	.	.	.
A	20	R5ACR1C	EQ	.	.	.	.	.
A	21	Y1ACR1C	EQ	.	.	.	.	.
A	22	Y2ACR1C	EQ	.	.	.	.	.
A	23	Y3ACR1C	EQ	.	.	.	.	.
A	24	Y4ACR1C	EQ	.	.	.	.	.
A	25	Y5ACR1C	EQ	.	.	.	.	.
A	26	O1BALC	EQ	.	.	.	.	.
A	27	O2BALC	EQ	.	.	.	.	.
A	28	O3BALC	EQ	.	.	.	.	.
A	29	O4BALC	EQ	.	.	.	.	.
A	30	O5BALC	EQ	.	.	.	.	.
A	31	O6BALC	EQ	.	.	.	.	.
A	32	O7BALC	EQ	.	.	.	.	.
A	33	S1BALC	EQ	.	.	.	.	.
A	34	S2BALC	EQ	.	.	.	.	.
A	35	S3BALC	EQ	.	.	.	.	.
A	36	S4BALC	EQ	.	.	.	.	.
A	37	S5BALC	EQ	.	.	.	.	.
A	38	S6BALC	EQ	.	.	.	.	.
A	39	S7BALC	EQ	.	.	.	.	.
A	40	Y1BALC	EQ	.	.	.	.	.
A	41	Y2BALC	EQ	.	.	.	.	.
A	42	Y3BALC	EQ	.	.	.	.	.
A	43	Y4BALC	EQ	.	.	.	.	.
A	44	Y5BALC	EQ	.	.	.	.	.
A	45	Y6BALC	EQ	.	.	.	.	.
A	46	Y7BALC	EQ	.	.	.	.	.
A	47	O1NETC	EQ	.	.	.	.	.
A	48	O2NETC	EQ	.	.	.	.	.
A	49	O3NETC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	50	04NETC	EQ	.	.	.	.	.
A	51	05NETC	EQ	.	.	.	.	.
A	52	06NETC	EQ	.	.	.	.	.
A	53	07NETC	EQ	.	.	.	.	.
A	54	01RETC	EQ	.	.	.	.	.
A	55	02RETC	EQ	.	.	.	.	.
A	56	03RETC	EQ	.	.	.	.	.
A	57	04RETC	EQ	.	.	.	.	.
A	58	05RETC	EQ	.	.	.	.	.
A	59	06RETC	EQ	.	.	.	.	.
A	60	07RETC	EQ	.	.	.	.	.
A	61	S1RETC	EQ	.	.	.	.	.
A	62	S2RETC	EQ	.	.	.	.	.
A	63	S3RETC	EQ	.	.	.	.	.
A	64	S4RETC	EQ	.	.	.	.	.
A	65	S5RETC	EQ	.	.	.	.	.
A	66	S6RETC	EQ	.	.	.	.	.
A	67	S7RETC	EQ	.	.	.	.	.
A	68	R1RETC	EQ	.	.	.	.	.
A	69	R2RETC	EQ	.	.	.	.	.
A	70	R3RETC	EQ	.	.	.	.	.
A	71	R4RETC	EQ	.	.	.	.	.
A	72	R5RETC	EQ	.	.	.	.	.
A	73	R6RETC	EQ	.	.	.	.	.
A	74	R7RETC	EQ	.	.	.	.	.
A	75	Y1RETC	EQ	.	.	.	.	.
A	76	Y2RETC	EQ	.	.	.	.	.
A	77	Y3RETC	EQ	.	.	.	.	.
A	78	Y4RETC	EQ	.	.	.	.	.
A	79	Y5RETC	EQ	.	.	.	.	.
A	80	Y6RETC	EQ	.	.	.	.	.
A	81	Y7RETC	EQ	.	.	.	.	.
	82	01RECC	BS	340137.88639-	340137.88639	NONE	.	.
	83	02RECC	BS	103051.28329-	103051.28329	NONE	.	.
	84	03RECC	BS	105802.73654-	105802.73654	NONE	.	.
	85	04RECC	BS	90056.86377-	90056.86377	NONE	.	.
	86	05RECC	BS	82557.07950-	82557.07950	NONE	.	.
	87	06RECC	BS	425572.78720-	425572.78720	NONE	.	.
	88	07RECC	BS	529329.03557-	529329.03557	NONE	.	.
A	89	S1RECC	UL	.	.	NONE	.	.
	90	S2RECC	BS	545.16025-	545.16025	NONE	.	.
	91	S3RECC	BS	1758.56401-	1758.56401	NONE	.	.
	92	S4RECC	BS	959.83049-	959.83049	NONE	.	.
A	93	S5RECC	UL	.	.	NONE	.	.
	94	S6RECC	BS	6857.48200-	6857.48200	NONE	.	.
	95	S7RECC	BS	13469.43200-	13469.43200	NONE	.	.
	96	Y1RECC	BS	33960.00000-	33960.00000	NONE	.	.
	97	Y2RECC	BS	6710.39143-	6710.39143	NONE	.	.
	98	Y3RECC	BS	4069.56837-	4069.56837	NONE	.	.
A	99	Y4RECC	UL	.	.	NONE	.	.
	100	Y5RECC	BS	288.26633-	288.26633	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	101	Y6RECC	BS	15339.62773-	15339.62773	NONE	.	.
	102	Y7RECC	BS	16980.00000-	16980.00000	NONE	.	.
A	103	S1REMC	EQ	.	.	.	.	.
A	104	S2REMC	EQ	.	.	.	.	.
A	105	S3REMC	EQ	.	.	.	.	.
A	106	S4REMC	EQ	.	.	.	.	.
A	107	S5REMC	EQ	.	.	.	.	.
A	108	S6REMC	EQ	.	.	.	.	.
A	109	S7REMC	EQ	.	.	.	.	.
A	110	R1REMC	EQ	.	.	.	.	.
A	111	R2REMC	EQ	.	.	.	.	.
A	112	R3REMC	EQ	.	.	.	.	.
A	113	R4REMC	EQ	.	.	.	.	.
A	114	R5REMC	EQ	.	.	.	.	.
A	115	R6REMC	EQ	.	.	.	.	.
A	116	R7REMC	EQ	.	.	.	.	.
A	117	Y1REMC	EQ	.	.	.	.	.
A	118	Y2REMC	EQ	.	.	.	.	.
A	119	Y3REMC	EQ	.	.	.	.	.
A	120	Y4REMC	EQ	.	.	.	.	.
A	121	Y5REMC	EQ	.	.	.	.	.
A	122	Y6REMC	EQ	.	.	.	.	.
A	123	Y7REMC	EQ	.	.	.	.	.
A	124	R1BALC	EQ	.	.	.	.	.
A	125	R2BALC	EQ	.	.	.	.	.
A	126	R3BALC	EQ	.	.	.	.	.
A	127	R4BALC	EQ	.	.	.	.	.
A	128	R5BALC	EQ	.	.	.	.	.
A	129	R6BALC	EQ	.	.	.	.	.
A	130	R7BALC	EQ	.	.	.	.	.
A	131	S1WASC	EQ	.	.	.	.	.
A	132	S2WASC	EQ	.	.	.	.	.
A	133	S3WASC	EQ	.	.	.	.	.
A	134	S4WASC	EQ	.	.	.	.	.
A	135	S5WASC	EQ	.	.	.	.	.
A	136	S6WASC	EQ	.	.	.	.	.
A	137	S7WASC	EQ	.	.	.	.	.
A	138	R1WASC	EQ	.	.	.	.	.
A	139	R2WASC	EQ	.	.	.	.	.
A	140	R3WASC	EQ	.	.	.	.	.
A	141	R4WASC	EQ	.	.	.	.	.
A	142	R5WASC	EQ	.	.	.	.	.
A	143	R6WASC	EQ	.	.	.	.	.
A	144	R7WASC	EQ	.	.	.	.	.
A	145	Y1WASC	EQ	.	.	.	.	.
A	146	Y2WASC	EQ	.	.	.	.	.
A	147	Y3WASC	EQ	.	.	.	.	.
A	148	Y4WASC	EQ	.	.	.	.	.
A	149	Y5WASC	EQ	.	.	.	.	.
A	150	Y6WASC	EQ	.	.	.	.	.
A	151	Y7WASC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	152	F1ACR1C	UL	.	.	NONE	.	.
A	153	F2ACR1C	UL	.	.	NONE	.	.
	154	F3ACR1C	UL	.	.	NONE	.	333.40684-
	155	F4ACR1C	UL	.	.	NONE	.	333.40684-
	156	F5ACR1C	UL	.	.	NONE	.	133.18633-
	157	F1RTR1C	BS	.	.	NONE	.	.
	158	F2RTR1C	BS	.	.	NONE	.	.
	159	F3RTR1C	BS	.	.	NONE	.	.
	160	F4RTR1C	BS	.	.	NONE	.	.
	161	F5RTR1C	BS	.	.	NONE	.	.
	162	F6RTR1C	BS	.	.	NONE	.	.
	163	F7RTR1C	UL	.	.	NONE	.	10.00000-
	164	F1RTR2C	BS	.	.	NONE	.	.
	165	F2RTR2C	BS	.	.	NONE	.	.
	166	F3RTR2C	BS	.	.	NONE	.	.
	167	F4RTR2C	BS	.	.	NONE	.	.
	168	F5RTR2C	BS	.	.	NONE	.	.
	169	F6RTR2C	BS	.	.	NONE	.	.
	170	F7RTR2C	UL	.	.	NONE	.	10.00000-
	171	F1RTR3C	BS	.	.	NONE	.	.
	172	F2RTR3C	BS	.	.	NONE	.	.
	173	F3RTR3C	BS	213.63220-	213.63220	NONE	.	.
	174	F4RTR3C	BS	254.11825-	254.11825	NONE	.	.
	175	F5RTR3C	BS	92.54428-	92.54428	NONE	.	.
	176	F6RTR3C	BS	.	.	NONE	.	.
	177	F7RTR3C	UL	.	.	NONE	.	10.00000-
	178	F1STR1C	BS	.	.	NONE	.	.
	179	F2STR1C	BS	.	.	NONE	.	.
	180	F3STR1C	BS	.	.	NONE	.	.
	181	F4STR1C	BS	.	.	NONE	.	.
	182	F5STR1C	UL	.	.	NONE	.	10.00000-
	183	F6STR1C	BS	759.64342-	759.64342	NONE	.	.
	184	F7STR1C	BS	1174.46241-	1174.46241	NONE	.	.
	185	F1KOK1C	UL	.	.	NONE	.	.00001-
	186	F2KOK1C	BS	.	.	NONE	.	.
	187	F3KOK1C	BS	.	.	NONE	.	.
	188	F4KOK1C	BS	.	.	NONE	.	.
	189	F5KOK1C	UL	.	.	NONE	.	27.02062-
	190	F6KOK1C	BS	1229.10675-	1229.10675	NONE	.	.
	191	F7KOK1C	BS	3752.87989-	3752.87989	NONE	.	.
A	192	F1DWNC	EQ	.	.	.	.	.
A	193	F2DWNC	EQ	.	.	.	.	.
	194	F3DWNC	EQ	.	.	.	.	503.44432-
	195	F4DWNC	EQ	.	.	.	.	503.44432-
	196	F5DWNC	EQ	.	.	.	.	503.44432-
	197	F6DWNC	EQ	.	.	.	.	.00010
	198	F7DWNC	EQ	.	.	.	.	.00010
	199	F1SPDC	BS	3468.90500-	3468.90500	NONE	.	.
	200	F2SPDC	BS	1759.81490-	1759.81490	NONE	.	.
	201	F3SPDC	UL	.	.	NONE	.	503.44432-
	202	F4SPDC	UL	.	.	NONE	.	503.44432-

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	203	F5SPDC	UL	.	.	NONE	.	503.44432-
A	204	F6SPDC	UL	.	.	NONE	.	.
A	205	F7SPDC	UL	.	.	NONE	.	.
A	206	F1BALC	EQ	.	.	.	.	.
A	207	F2BALC	EQ	.	.	.	.	.
	208	F3BALC	EQ	.	.	.	.	503.44432
	209	F4BALC	EQ	.	.	.	.	503.44432
	210	F5BALC	EQ	.	.	.	.	503.44432
	211	F6BALC	EQ	.	.	.	.	503.44432
	212	F7BALC	EQ	.	.	.	.	503.44432
	213	F1SPUC	BS	1500.12151-	1500.12151	NONE	.	.
	214	F2SPUC	BS	2324.03240-	2324.03240	NONE	.	.
A	215	F3SPUC	UL	.	.	NONE	.	.
A	216	F4SPUC	UL	.	.	NONE	.	.
A	217	F5SPUC	UL	.	.	NONE	.	.
A	218	F6SPUC	UL	.	.	NONE	.	.
	219	F7SPUC	UL	.	.	NONE	.	4.80000-
A	220	F1REMC	EQ	.	.	.	.	.
A	221	F2REMC	EQ	.	.	.	.	.
A	222	F3REMC	EQ	.	.	.	.	.
A	223	F4REMC	EQ	.	.	.	.	.
A	224	F5REMC	EQ	.	.	.	.	.
A	225	F6REMC	EQ	.	.	.	.	.
A	226	F7REMC	EQ	.	.	.	.	.
A	227	FOACRDC	EQ	.	.	.	.	.
A	228	F1RETC	EQ	.	.	.	.	.
A	229	F2RETC	EQ	.	.	.	.	.
A	230	F3RETC	EQ	.	.	.	.	.
A	231	F4RETC	EQ	.	.	.	.	.
A	232	F5RETC	EQ	.	.	.	.	.
A	233	F6RETC	EQ	.	.	.	.	.
A	234	F7RETC	EQ	.	.	.	.	.
A	235	F1WASA	EQ	.	.	.	.	.
A	236	F2WASA	EQ	.	.	.	.	.
	237	F3WASA	EQ	.	.	.	.	453.14520
	238	F4WASA	EQ	.	.	.	.	453.14520
	239	F5WASA	EQ	.	.	.	.	453.14520
	240	F6WASA	EQ	.	.	.	.	453.14520
	241	F7WASA	EQ	.	.	.	.	453.14520
A	242	F1WASB	EQ	.	.	.	.	.
A	243	F2WASB	EQ	.	.	.	.	.
	244	F3WASB	EQ	.	.	.	.	453.14520
	245	F4WASB	EQ	.	.	.	.	453.14520
	246	F5WASB	EQ	.	.	.	.	453.14520
A	247	F6WASB	EQ	.	.	.	.	.
A	248	F7WASB	EQ	.	.	.	.	.
	249	G1ACR1C	BS	26557.50347-	26557.50347	NONE	.	.
A	250	G2ACR1C	UL	.	.	NONE	.	.
	251	G3ACR1C	UL	.	.	NONE	.	333.33336-
	252	G4ACR1C	UL	.	.	NONE	.	333.33336-
	253	G5ACR1C	UL	.	.	NONE	.	133.33335-

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	254	G1RTR1C	UL	.	.	NONE	.	.
A	255	G2RTR1C	UL	.	.	NONE	.	.
A	256	G3RTR1C	UL	.	.	NONE	.	.
A	257	G4RTR1C	UL	.	.	NONE	.	.
A	258	G5RTR1C	UL	.	.	NONE	.	.
A	259	G6RTR1C	UL	.	.	NONE	.	.
	260	G7RTR1C	UL	.	.	NONE	.	1.96651-
A	261	G1RTR2C	UL	.	.	NONE	.	.
A	262	G2RTR2C	UL	.	.	NONE	.	.
A	263	G3RTR2C	UL	.	.	NONE	.	.
A	264	G4RTR2C	UL	.	.	NONE	.	.
A	265	G5RTR2C	UL	.	.	NONE	.	.
A	266	G6RTR2C	UL	.	.	NONE	.	.
	267	G7RTR2C	UL	.	.	NONE	.	9.99994-
	268	G1RTR3C	BS	912.16589-	912.16589	NONE	.	.
A	269	G2RTR3C	UL	.	.	NONE	.	.
	270	G3RTR3C	BS	1107.50888-	1107.50888	NONE	.	.
	271	G4RTR3C	BS	1282.44137-	1282.44137	NONE	.	.
	272	G5RTR3C	BS	427.71492-	427.71492	NONE	.	.
	273	G6RTR3C	BS	222.68228-	222.68228	NONE	.	.
	274	G7RTR3C	UL	.	.	NONE	.	9.99985-
	275	G1STR1C	UL	.	.	NONE	.	.00024-
	276	G2STR1C	BS	33388.25115-	33388.25115	NONE	.	.
	277	G3STR1C	BS	.	.	NONE	.	.
	278	G4STR1C	BS	.	.	NONE	.	.
	279	G5STR1C	BS	.	.	NONE	.	.
	280	G6STR1C	BS	.	.	NONE	.	.
	281	G7STR1C	UL	.	.	NONE	.	9.99976-
	282	G1KOK1C	BS	.	.	NONE	.	.
	283	G2KOK1C	BS	.	.	NONE	.	.
	284	G3KOK1C	BS	.	.	NONE	.	.
	285	G4KOK1C	BS	.	.	NONE	.	.
	286	G5KOK1C	BS	.	.	NONE	.	.
	287	G6KOK1C	BS	.	.	NONE	.	.
	288	G7KOK1C	UL	.	.	NONE	.	10.00000-
A	289	G1DWNC	EQ	.	.	.	.	.
	290	G2DWNC	EQ	.	.	.	.	.00010
	291	G3DWNC	EQ	.	.	.	.	440.00004-
	292	G4DWNC	EQ	.	.	.	.	440.00004-
	293	G5DWNC	EQ	.	.	.	.	440.00004-
	294	G6DWNC	EQ	.	.	.	.	440.00004-
	295	G7DWNC	EQ	.	.	.	.	435.30007-
A	296	G1SPDC	UL	.	.	NONE	.	.
A	297	G2SPDC	UL	.	.	NONE	.	.
	298	G3SPDC	UL	.	.	NONE	.	440.00004-
	299	G4SPDC	UL	.	.	NONE	.	440.00004-
	300	G5SPDC	UL	.	.	NONE	.	440.00004-
	301	G6SPDC	UL	.	.	NONE	.	440.00004-
	302	G7SPDC	UL	.	.	NONE	.	435.30007-
A	303	G1BALC	EQ	.	.	.	.	.
A	304	G2BALC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	305	G3BALC	EQ	.	.	.	.	440.00004
	306	G4BALC	EQ	.	.	.	.	440.00004
	307	G5BALC	EQ	.	.	.	.	440.00004
	308	G6BALC	EQ	.	.	.	.	440.00004
	309	G7BALC	EQ	.	.	.	.	440.00004
A	310	G1SPUC	UL	.	.	NONE	.	.
A	311	G2SPUC	UL	.	.	NONE	.	.
A	312	G3SPUC	UL	.	.	NONE	.	.
A	313	G4SPUC	UL	.	.	NONE	.	.
A	314	G5SPUC	UL	.	.	NONE	.	.
A	315	G6SPUC	UL	.	.	NONE	.	.
	316	G7SPUC	UL	.	.	NONE	.	4.69997-
A	317	G1REMC	EQ	.	.	.	.	.
A	318	G2REMC	EQ	.	.	.	.	.
A	319	G3REMC	EQ	.	.	.	.	.
A	320	G4REMC	EQ	.	.	.	.	.
A	321	G5REMC	EQ	.	.	.	.	.
A	322	G6REMC	EQ	.	.	.	.	.
A	323	G7REMC	EQ	.	.	.	.	.
A	324	GOACRDC	EQ	.	.	.	.	.
A	325	G1RETC	EQ	.	.	.	.	.
A	326	G2RETC	EQ	.	.	.	.	.
A	327	G3RETC	EQ	.	.	.	.	.
A	328	G4RETC	EQ	.	.	.	.	.
A	329	G5RETC	EQ	.	.	.	.	.
A	330	G6RETC	EQ	.	.	.	.	.
A	331	G7RETC	EQ	.	.	.	.	.
A	332	G1WASA	EQ	.	.	.	.	.
A	333	G2WASA	EQ	.	.	.	.	.
	334	G3WASA	EQ	.	.	.	.	396.03964
	335	G4WASA	EQ	.	.	.	.	396.03964
	336	G5WASA	EQ	.	.	.	.	396.03964
	337	G6WASA	EQ	.	.	.	.	396.03964
	338	G7WASA	EQ	.	.	.	.	396.03964
A	339	G1WASB	EQ	.	.	.	.	.
A	340	G2WASB	EQ	.	.	.	.	.
	341	G3WASB	EQ	.	.	.	.	396.03964
	342	G4WASB	EQ	.	.	.	.	396.03964
	343	G5WASB	EQ	.	.	.	.	396.03964
	344	G6WASB	EQ	.	.	.	.	396.03964
	345	G7WASB	EQ	.	.	.	.	391.80924
A	346	E1ACR1C	UL	.	.	NONE	.	.
A	347	E2ACR1C	UL	.	.	NONE	.	.
A	348	E3ACR1C	UL	.	.	NONE	.	.
A	349	E4ACR1C	UL	.	.	NONE	.	.
A	350	E5ACR1C	UL	.	.	NONE	.	.
A	351	E1RTR1C	UL	.	.	NONE	.	.
A	352	E2RTR1C	UL	.	.	NONE	.	.
	353	E3RTR1C	UL	.	.	NONE	.	.11098-
	354	E4RTR1C	UL	.	.	NONE	.	.11098-
	355	E5RTR1C	UL	.	.	NONE	.	.11098-

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	356	E6RTR1C	UL	.	.	NONE	.	.05616-
	357	E7RTR1C	UL	.	.	NONE	.	.38503-
A	358	E1RTR2C	UL	.	.	NONE	.	.
A	359	E2RTR2C	UL	.	.	NONE	.	.
	360	E3RTR2C	UL	.	.	NONE	.	.57897-
	361	E4RTR2C	UL	.	.	NONE	.	.57897-
	362	E5RTR2C	UL	.	.	NONE	.	.57897-
	363	E6RTR2C	UL	.	.	NONE	.	.28402-
	364	E7RTR2C	UL	.	.	NONE	.	2.01882-
A	365	E1RTR3C	UL	.	.	NONE	.	.
A	366	E2RTR3C	UL	.	.	NONE	.	.
	367	E3RTR3C	UL	.	.	NONE	.	1.43628-
	368	E4RTR3C	UL	.	.	NONE	.	1.43628-
	369	E5RTR3C	UL	.	.	NONE	.	1.43628-
	370	E6RTR3C	UL	.	.	NONE	.	.71140-
	371	E7RTR3C	UL	.	.	NONE	.	4.97977-
	372	E1STR1C	UL	.	.	NONE	.	.00001-
	373	E2STR1C	UL	.	.	NONE	.	.00001-
	374	E3STR1C	UL	.	.	NONE	.	.00001-
	375	E4STR1C	UL	.	.	NONE	.	.00001-
	376	E5STR1C	UL	.	.	NONE	.	.00001-
	377	E6STR1C	BS	2992.70542-	2992.70542	NONE	.	.
	378	E7STR1C	BS	4407.36064-	4407.36064	NONE	.	.
	379	E1KOK1C	BS	138000.00000-	138000.00000	NONE	.	.
	380	E2KOK1C	BS	.	.	NONE	.	.
	381	E3KOK1C	BS	.	.	NONE	.	.
	382	E4KOK1C	BS	.	.	NONE	.	.
	383	E5KOK1C	BS	91270.07299-	91270.07299	NONE	.	.
	384	E6KOK1C	BS	137175.18581-	137175.18581	NONE	.	.
	385	E7KOK1C	BS	252260.13941-	252260.13941	NONE	.	.
A	386	E1DWNC	EQ	.	.	.	.	.
A	387	E2DWNC	EQ	.	.	.	.	.
A	388	E3DWNC	EQ	.	.	.	.	.
A	389	E4DWNC	EQ	.	.	.	.	.
A	390	E5DWNC	EQ	.	.	.	.	.
	391	E6DWNC	EQ	.	.	.	.	.00010
	392	E7DWNC	EQ	.	.	.	.	.00010
	393	E1SPDC	BS	5925.66067-	5925.66067	NONE	.	.
	394	E2SPDC	BS	3601.14603-	3601.14603	NONE	.	.
	395	E3SPDC	BS	542.45373-	542.45373	NONE	.	.
	396	E4SPDC	BS	140.11350-	140.11350	NONE	.	.
	397	E5SPDC	BS	283.02979-	283.02979	NONE	.	.
A	398	E6SPDC	UL	.	.	NONE	.	.
A	399	E7SPDC	UL	.	.	NONE	.	.
A	400	E1BALC	EQ	.	.	.	.	.
A	401	E2BALC	EQ	.	.	.	.	.
	402	E3BALC	EQ	.	.	.	.	.74687
	403	E4BALC	EQ	.	.	.	.	.74687
	404	E5BALC	EQ	.	.	.	.	.74687
	405	E6BALC	EQ	.	.	.	.	.74687
	406	E7BALC	EQ	.	.	.	.	.74687

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	407	E1SPUC	BS	10.52758-	10.52758	NONE	.	.
	408	E2SPUC	BS	543.84081-	543.84081	NONE	.	.
	409	E3SPUC	UL	.	.	NONE	.	.74687-
	410	E4SPUC	UL	.	.	NONE	.	.74687-
	411	E5SPUC	UL	.	.	NONE	.	.74687-
	412	E6SPUC	UL	.	.	NONE	.	.74697-
	413	E7SPUC	UL	.	.	NONE	.	.74697-
A	414	E1REMC	EQ	.	.	.	.	.
A	415	E2REMC	EQ	.	.	.	.	.
A	416	E3REMC	EQ	.	.	.	.	.
A	417	E4REMC	EQ	.	.	.	.	.
A	418	E5REMC	EQ	.	.	.	.	.
A	419	E6REMC	EQ	.	.	.	.	.
A	420	E7REMC	EQ	.	.	.	.	.
A	421	EOACRDC	EQ	.	.	.	.	.
A	422	E1RETC	EQ	.	.	.	.	.
A	423	E2RETC	EQ	.	.	.	.	.
A	424	E3RETC	EQ	.	.	.	.	.
A	425	E4RETC	EQ	.	.	.	.	.
A	426	E5RETC	EQ	.	.	.	.	.
A	427	E6RETC	EQ	.	.	.	.	.
A	428	E7RETC	EQ	.	.	.	.	.
A	429	E1WASA	EQ	.	.	.	.	.
A	430	E2WASA	EQ	.	.	.	.	.
	431	E3WASA	EQ	.	.	.	.	.67225
	432	E4WASA	EQ	.	.	.	.	.67225
	433	E5WASA	EQ	.	.	.	.	.67225
	434	E6WASA	EQ	.	.	.	.	.67225
	435	E7WASA	EQ	.	.	.	.	.67225
A	436	E1WASB	EQ	.	.	.	.	.
A	437	E2WASB	EQ	.	.	.	.	.
A	438	E3WASB	EQ	.	.	.	.	.
A	439	E4WASB	EQ	.	.	.	.	.
A	440	E5WASB	EQ	.	.	.	.	.
A	441	E6WASB	EQ	.	.	.	.	.
A	442	E7WASB	EQ	.	.	.	.	.
A	443	D1ACR1C	UL	.	.	NONE	.	.
A	444	D2ACR1C	UL	.	.	NONE	.	.
	445	D3ACR1C	UL	.	.	NONE	.	1.43939-
	446	D4ACR1C	UL	.	.	NONE	.	1.43939-
	447	D5ACR1C	UL	.	.	NONE	.	.57576-
A	448	D1RTR1C	UL	.	.	NONE	.	.
A	449	D2RTR1C	UL	.	.	NONE	.	.
A	450	D3RTR1C	UL	.	.	NONE	.	.
A	451	D4RTR1C	UL	.	.	NONE	.	.
A	452	D5RTR1C	UL	.	.	NONE	.	.
A	453	D6RTR1C	UL	.	.	NONE	.	.
	454	D7RTR1C	UL	.	.	NONE	.	.79167-
A	455	D1RTR2C	UL	.	.	NONE	.	.
A	456	D2RTR2C	UL	.	.	NONE	.	.
A	457	D3RTR2C	UL	.	.	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	458	D4RTR2C	UL	.	.	NONE	.	.
A	459	D5RTR2C	UL	.	.	NONE	.	.
A	460	D6RTR2C	UL	.	.	NONE	.	.
	461	D7RTR2C	UL	.	.	NONE	.	4.13043-
A	462	D1RTR3C	UL	.	.	NONE	.	.
A	463	D2RTR3C	UL	.	.	NONE	.	.
	464	D3RTR3C	BS	288.68780-	288.68780	NONE	.	.
	465	D4RTR3C	BS	474.73641-	474.73641	NONE	.	.
	466	D5RTR3C	BS	149.69280-	149.69280	NONE	.	.
	467	D6RTR3C	BS	34.16329-	34.16329	NONE	.	.
	468	D7RTR3C	UL	.	.	NONE	.	10.00000-
	469	D1STR1C	UL	.	.	NONE	.	.00001-
	470	D2STR1C	UL	.	.	NONE	.	.00001-
	471	D3STR1C	UL	.	.	NONE	.	.15201-
	472	D4STR1C	UL	.	.	NONE	.	.15201-
	473	D5STR1C	BS	983.58974-	983.58974	NONE	.	.
	474	D6STR1C	BS	983.58974-	983.58974	NONE	.	.
	475	D7STR1C	BS	239.30864-	239.30864	NONE	.	.
	476	D1KOK1C	BS	5417.83133-	5417.83133	NONE	.	.
	477	D2KOK1C	BS	.	.	NONE	.	.
	478	D3KOK1C	BS	.	.	NONE	.	.
	479	D4KOK1C	BS	.	.	NONE	.	.
	480	D5KOK1C	UL	.	.	NONE	.	.01624-
	481	D6KOK1C	UL	.	.	NONE	.	.01624-
	482	D7KOK1C	UL	.	.	NONE	.	.00000-
A	483	D1DWNC	EQ	.	.	.	.	.
A	484	D2DWNC	EQ	.	.	.	.	.
	485	D3DWNC	EQ	.	.	.	.	1.90000-
	486	D4DWNC	EQ	.	.	.	.	1.90000-
	487	D5DWNC	EQ	.	.	.	.	1.90000-
	488	D6DWNC	EQ	.	.	.	.	1.90000-
A	489	D7DWNC	EQ	.	.	.	.	.
	490	D1SPDC	BS	3344.83821-	3344.83821	NONE	.	.
	491	D2SPDC	BS	1183.62869-	1183.62869	NONE	.	.
	492	D3SPDC	UL	.	.	NONE	.	1.90000-
	493	D4SPDC	UL	.	.	NONE	.	1.90000-
	494	D5SPDC	UL	.	.	NONE	.	1.90000-
	495	D6SPDC	UL	.	.	NONE	.	1.90000-
	496	D7SPDC	BS	770.25501-	770.25501	NONE	.	.
A	497	D1BALC	EQ	.	.	.	.	.
A	498	D2BALC	EQ	.	.	.	.	.
	499	D3BALC	EQ	.	.	.	.	1.90000
	500	D4BALC	EQ	.	.	.	.	1.90000
	501	D5BALC	EQ	.	.	.	.	1.90000
	502	D6BALC	EQ	.	.	.	.	1.90000
	503	D7BALC	EQ	.	.	.	.	1.90000
A	504	D1SPUC	UL	.	.	NONE	.	.
	505	D2SPUC	BS	116.51445-	116.51445	NONE	.	.
A	506	D3SPUC	UL	.	.	NONE	.	.
A	507	D4SPUC	UL	.	.	NONE	.	.
A	508	D5SPUC	UL	.	.	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	509	D6SPUC	UL	.	.	NONE	.	.
	510	D7SPUC	UL	.	.	NONE	.	1.90000-
A	511	D1REMC	EQ	.	.	.	.	.
A	512	D2REMC	EQ	.	.	.	.	.
A	513	D3REMC	EQ	.	.	.	.	.
A	514	D4REMC	EQ	.	.	.	.	.
A	515	D5REMC	EQ	.	.	.	.	.
A	516	D6REMC	EQ	.	.	.	.	.
A	517	D7REMC	EQ	.	.	.	.	.
A	518	DOACRDC	EQ	.	.	.	.	.
A	519	D1RETC	EQ	.	.	.	.	.
A	520	D2RETC	EQ	.	.	.	.	.
A	521	D3RETC	EQ	.	.	.	.	.
A	522	D4RETC	EQ	.	.	.	.	.
A	523	D5RETC	EQ	.	.	.	.	.
A	524	D6RETC	EQ	.	.	.	.	.
A	525	D7RETC	EQ	.	.	.	.	.
A	526	D1WASA	EQ	.	.	.	.	.
A	527	D2WASA	EQ	.	.	.	.	.
	528	D3WASA	EQ	.	.	.	.	1.71017
	529	D4WASA	EQ	.	.	.	.	1.71017
	530	D5WASA	EQ	.	.	.	.	1.71017
	531	D6WASA	EQ	.	.	.	.	1.71017
	532	D7WASA	EQ	.	.	.	.	1.71017
A	533	D1WASB	EQ	.	.	.	.	.
A	534	D2WASB	EQ	.	.	.	.	.
	535	D3WASB	EQ	.	.	.	.	1.71017
	536	D4WASB	EQ	.	.	.	.	1.71017
	537	D5WASB	EQ	.	.	.	.	1.71017
	538	D6WASB	EQ	.	.	.	.	1.71017
A	539	D7WASB	EQ	.	.	.	.	.
A	540	C1ACR1C	UL	.	.	NONE	.	.
A	541	C2ACR1C	UL	.	.	NONE	.	.
A	542	C3ACR1C	UL	.	.	NONE	.	.
A	543	C4ACR1C	UL	.	.	NONE	.	.
A	544	C5ACR1C	UL	.	.	NONE	.	.
A	545	C1RTR1C	UL	.	.	NONE	.	.
A	546	C2RTR1C	UL	.	.	NONE	.	.
A	547	C3RTR1C	UL	.	.	NONE	.	.
A	548	C4RTR1C	UL	.	.	NONE	.	.
A	549	C5RTR1C	UL	.	.	NONE	.	.
A	550	C6RTR1C	UL	.	.	NONE	.	.
A	551	C7RTR1C	UL	.	.	NONE	.	.
A	552	C1RTR2C	UL	.	.	NONE	.	.
A	553	C2RTR2C	UL	.	.	NONE	.	.
A	554	C3RTR2C	UL	.	.	NONE	.	.
A	555	C4RTR2C	UL	.	.	NONE	.	.
A	556	C5RTR2C	UL	.	.	NONE	.	.
A	557	C6RTR2C	UL	.	.	NONE	.	.
A	558	C7RTR2C	UL	.	.	NONE	.	.
A	559	C1RTR3C	UL	.	.	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	560	C2RTR3C	UL	.	.	NONE	.	.
A	561	C3RTR3C	UL	.	.	NONE	.	.
	562	C4RTR3C	BS	90.84726-	90.84726	NONE	.	.
	563	C5RTR3C	BS	58.22718-	58.22718	NONE	.	.
	564	C6RTR3C	BS	140.29583-	140.29583	NONE	.	.
A	565	C7RTR3C	UL	.	.	NONE	.	.
	566	C1STR1C	UL	.	.	NONE	.	.00001-
	567	C2STR1C	BS	41603.80877-	41603.80877	NONE	.	.
	568	C3STR1C	UL	.	.	NONE	.	.00001-
	569	C4STR1C	UL	.	.	NONE	.	.00001-
	570	C5STR1C	BS	2212.60000-	2212.60000	NONE	.	.
	571	C6STR1C	BS	2212.60000-	2212.60000	NONE	.	.
	572	C7STR1C	BS	32.58333-	32.58333	NONE	.	.
	573	C1KOK1C	BS	21580.00000-	21580.00000	NONE	.	.
	574	C2KOK1C	BS	.	.	NONE	.	.
	575	C3KOK1C	BS	.	.	NONE	.	.
	576	C4KOK1C	BS	.	.	NONE	.	.
	577	C5KOK1C	UL	.	.	NONE	.	.00000-
	578	C6KOK1C	UL	.	.	NONE	.	.00000-
	579	C7KOK1C	UL	.	.	NONE	.	.00000-
A	580	C1DWNC	EQ	.	.	.	.	.
	581	C2DWNC	EQ	.	.	.	.	.00010
A	582	C3DWNC	EQ	.	.	.	.	.
A	583	C4DWNC	EQ	.	.	.	.	.
A	584	C5DWNC	EQ	.	.	.	.	.
A	585	C6DWNC	EQ	.	.	.	.	.
A	586	C7DWNC	EQ	.	.	.	.	.
	587	C1SPDC	BS	5154.14626-	5154.14626	NONE	.	.
A	588	C2SPDC	UL	.	.	NONE	.	.
	589	C3SPDC	BS	169.86594-	169.86594	NONE	.	.
A	590	C4SPDC	UL	.	.	NONE	.	.
A	591	C5SPDC	UL	.	.	NONE	.	.
A	592	C6SPDC	UL	.	.	NONE	.	.
	593	C7SPDC	BS	549.47799-	549.47799	NONE	.	.
A	594	C1BALC	EQ	.	.	.	.	.
A	595	C2BALC	EQ	.	.	.	.	.
A	596	C3BALC	EQ	.	.	.	.	.
A	597	C4BALC	EQ	.	.	.	.	.
A	598	C5BALC	EQ	.	.	.	.	.
A	599	C6BALC	EQ	.	.	.	.	.
A	600	C7BALC	EQ	.	.	.	.	.
	601	C1SPUC	BS	718.86177-	718.86177	NONE	.	.
A	602	C2SPUC	UL	.	.	NONE	.	.
A	603	C3SPUC	UL	.	.	NONE	.	.
A	604	C4SPUC	UL	.	.	NONE	.	.
A	605	C5SPUC	UL	.	.	NONE	.	.
A	606	C6SPUC	UL	.	.	NONE	.	.
A	607	C7SPUC	UL	.	.	NONE	.	.
A	608	C1REMC	EQ	.	.	.	.	.
A	609	C2REMC	EQ	.	.	.	.	.
A	610	C3REMC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	611	C4REMC	EQ	.	.	.	.	.
A	612	C5REMC	EQ	.	.	.	.	.
A	613	C6REMC	EQ	.	.	.	.	.
A	614	C7REMC	EQ	.	.	.	.	.
A	615	COACRDC	EQ	.	.	.	.	.
A	616	C1RETC	EQ	.	.	.	.	.
A	617	C2RETC	EQ	.	.	.	.	.
A	618	C3RETC	EQ	.	.	.	.	.
A	619	C4RETC	EQ	.	.	.	.	.
A	620	C5RETC	EQ	.	.	.	.	.
A	621	C6RETC	EQ	.	.	.	.	.
A	622	C7RETC	EQ	.	.	.	.	.
A	623	C1WASA	EQ	.	.	.	.	.
A	624	C2WASA	EQ	.	.	.	.	.
A	625	C3WASA	EQ	.	.	.	.	.
A	626	C4WASA	EQ	.	.	.	.	.
A	627	C5WASA	EQ	.	.	.	.	.
A	628	C6WASA	EQ	.	.	.	.	.
A	629	C7WASA	EQ	.	.	.	.	.
A	630	C1WASB	EQ	.	.	.	.	.
A	631	C2WASB	EQ	.	.	.	.	.
A	632	C3WASB	EQ	.	.	.	.	.
A	633	C4WASB	EQ	.	.	.	.	.
A	634	C5WASB	EQ	.	.	.	.	.
A	635	C6WASB	EQ	.	.	.	.	.
A	636	C7WASB	EQ	.	.	.	.	.
A	637	B1ACR1C	UL	.	.	NONE	.	.
A	638	B2ACR1C	UL	.	.	NONE	.	.
	639	B3ACR1C	UL	.	.	NONE	.	167.42417-
	640	B4ACR1C	UL	.	.	NONE	.	167.42417-
	641	B5ACR1C	UL	.	.	NONE	.	66.96967-
A	642	B1RTR1C	UL	.	.	NONE	.	.
A	643	B2RTR1C	UL	.	.	NONE	.	.
A	644	B3RTR1C	UL	.	.	NONE	.	.
A	645	B4RTR1C	UL	.	.	NONE	.	.
A	646	B5RTR1C	UL	.	.	NONE	.	.
A	647	B6RTR1C	UL	.	.	NONE	.	.
	648	B7RTR1C	UL	.	.	NONE	.	1.91752-
A	649	B1RTR2C	UL	.	.	NONE	.	.
A	650	B2RTR2C	UL	.	.	NONE	.	.
A	651	B3RTR2C	UL	.	.	NONE	.	.
A	652	B4RTR2C	UL	.	.	NONE	.	.
A	653	B5RTR2C	UL	.	.	NONE	.	.
A	654	B6RTR2C	UL	.	.	NONE	.	.
	655	B7RTR2C	UL	.	.	NONE	.	9.99997-
	656	B1RTR3C	BS	.	.	NONE	.	.
A	657	B2RTR3C	UL	.	.	NONE	.	.
	658	B3RTR3C	BS	3768.82199-	3768.82199	NONE	.	.
	659	B4RTR3C	BS	6192.13432-	6192.13432	NONE	.	.
	660	B5RTR3C	BS	4185.06680-	4185.06680	NONE	.	.
	661	B6RTR3C	BS	2141.76336-	2141.76336	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	662	B7RTR3C	UL	.	.	NONE	.	25.13506-
	663	B1STR1C	BS	50388.67077-	50388.67077	NONE	.	.
	664	B2STR1C	BS	1246688.00319-	1246688.00319	NONE	.	.
	665	B3STR1C	UL	.	.	NONE	.	5.00000-
	666	B4STR1C	UL	.	.	NONE	.	5.00000-
	667	B5STR1C	BS	103505.42813-	103505.42813	NONE	.	.
	668	B6STR1C	BS	103505.42813-	103505.42813	NONE	.	.
	669	B7STR1C	BS	77256.63167-	77256.63167	NONE	.	.
	670	B1KOK1C	UL	.	.	NONE	.	.00000-
	671	B2KOK1C	BS	.	.	NONE	.	.
	672	B3KOK1C	BS	.	.	NONE	.	.
	673	B4KOK1C	BS	.	.	NONE	.	.
	674	B5KOK1C	UL	.	.	NONE	.	.35993-
	675	B6KOK1C	UL	.	.	NONE	.	.35993-
	676	B7KOK1C	UL	.	.	NONE	.	1.55662-
A	677	B1DWNC	EQ	.	.	.	.	.
	678	B2DWNC	EQ	.	.	.	.	.00010
	679	B3DWNC	EQ	.	.	.	.	220.99990-
	680	B4DWNC	EQ	.	.	.	.	220.99990-
	681	B5DWNC	EQ	.	.	.	.	220.99990-
	682	B6DWNC	EQ	.	.	.	.	220.99990-
	683	B7DWNC	EQ	.	.	.	.	211.69993-
	684	B1SPDC	BS	54460.48496-	54460.48496	NONE	.	.
A	685	B2SPDC	UL	.	.	NONE	.	.
	686	B3SPDC	UL	.	.	NONE	.	220.99990-
	687	B4SPDC	UL	.	.	NONE	.	220.99990-
	688	B5SPDC	UL	.	.	NONE	.	220.99990-
	689	B6SPDC	UL	.	.	NONE	.	220.99990-
	690	B7SPDC	UL	.	.	NONE	.	211.69993-
A	691	B1BALC	EQ	.	.	.	.	.
A	692	B2BALC	EQ	.	.	.	.	.
	693	B3BALC	EQ	.	.	.	.	220.99990
	694	B4BALC	EQ	.	.	.	.	220.99990
	695	B5BALC	EQ	.	.	.	.	220.99990
	696	B6BALC	EQ	.	.	.	.	220.99990
	697	B7BALC	EQ	.	.	.	.	220.99990
	698	B1SPUC	BS	6546.53629-	6546.53629	NONE	.	.
A	699	B2SPUC	UL	.	.	NONE	.	.
A	700	B3SPUC	UL	.	.	NONE	.	.
A	701	B4SPUC	UL	.	.	NONE	.	.
A	702	B5SPUC	UL	.	.	NONE	.	.
A	703	B6SPUC	UL	.	.	NONE	.	.
	704	B7SPUC	UL	.	.	NONE	.	9.29997-
A	705	B1REMC	EQ	.	.	.	.	.
A	706	B2REMC	EQ	.	.	.	.	.
A	707	B3REMC	EQ	.	.	.	.	.
A	708	B4REMC	EQ	.	.	.	.	.
A	709	B5REMC	EQ	.	.	.	.	.
A	710	B6REMC	EQ	.	.	.	.	.
A	711	B7REMC	EQ	.	.	.	.	.
A	712	BOACRDC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	713	B1RETC	EQ	.	.	.	.	.
A	714	B2RETC	EQ	.	.	.	.	.
A	715	B3RETC	EQ	.	.	.	.	.
A	716	B4RETC	EQ	.	.	.	.	.
A	717	B5RETC	EQ	.	.	.	.	.
A	718	B6RETC	EQ	.	.	.	.	.
A	719	B7RETC	EQ	.	.	.	.	.
A	720	B1WASA	EQ	.	.	.	.	.
A	721	B2WASA	EQ	.	.	.	.	.
	722	B3WASA	EQ	.	.	.	.	198.91980
	723	B4WASA	EQ	.	.	.	.	198.91980
	724	B5WASA	EQ	.	.	.	.	198.91980
	725	B6WASA	EQ	.	.	.	.	198.91980
	726	B7WASA	EQ	.	.	.	.	198.91980
A	727	B1WASB	EQ	.	.	.	.	.
A	728	B2WASB	EQ	.	.	.	.	.
	729	B3WASB	EQ	.	.	.	.	198.91980
	730	B4WASB	EQ	.	.	.	.	198.91980
	731	B5WASB	EQ	.	.	.	.	198.91980
	732	B6WASB	EQ	.	.	.	.	198.91980
	733	B7WASB	EQ	.	.	.	.	190.54899
A	734	A1ACR1C	UL	.	.	NONE	.	.
A	735	A2ACR1C	UL	.	.	NONE	.	.
	736	A3ACR1C	UL	.	.	NONE	.	11.78173-
	737	A4ACR1C	UL	.	.	NONE	.	11.78173-
	738	A5ACR1C	UL	.	.	NONE	.	4.71269-
A	739	A1RTR1C	UL	.	.	NONE	.	.
A	740	A2RTR1C	UL	.	.	NONE	.	.
A	741	A3RTR1C	UL	.	.	NONE	.	.
A	742	A4RTR1C	UL	.	.	NONE	.	.
A	743	A5RTR1C	UL	.	.	NONE	.	.
A	744	A6RTR1C	UL	.	.	NONE	.	.
	745	A7RTR1C	UL	.	.	NONE	.	1.83099-
A	746	A1RTR2C	UL	.	.	NONE	.	.
A	747	A2RTR2C	UL	.	.	NONE	.	.
A	748	A3RTR2C	UL	.	.	NONE	.	.
A	749	A4RTR2C	UL	.	.	NONE	.	.
A	750	A5RTR2C	UL	.	.	NONE	.	.
A	751	A6RTR2C	UL	.	.	NONE	.	.
	752	A7RTR2C	UL	.	.	NONE	.	10.00000-
	753	A1RTR3C	BS	.	.	NONE	.	.
	754	A2RTR3C	BS	.	.	NONE	.	.
	755	A3RTR3C	BS	.	.	NONE	.	.
	756	A4RTR3C	BS	.	.	NONE	.	.
	757	A5RTR3C	BS	.	.	NONE	.	.
	758	A6RTR3C	BS	.	.	NONE	.	.
	759	A7RTR3C	UL	.	.	NONE	.	10.00000-
	760	A1STR1C	BS	59.98763-	59.98763	NONE	.	.
	761	A2STR1C	UL	.	.	NONE	.	.00021-
	762	A3STR1C	UL	.	.	NONE	.	33.08934-
	763	A4STR1C	BS	.	.	NONE	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
	764	A5STR1C	BS	75.79082-	75.79082	NONE	.	.
	765	A6STR1C	BS	136.42348-	136.42348	NONE	.	.
	766	A7STR1C	BS	90.56197-	90.56197	NONE	.	.
	767	A1KOK1C	UL	.	.	NONE	.	.00001-
	768	A2KOK1C	BS	.	.	NONE	.	.
	769	A3KOK1C	BS	.	.	NONE	.	.
	770	A4KOK1C	BS	.	.	NONE	.	.
	771	A5KOK1C	UL	.	.	NONE	.	1.72800-
	772	A6KOK1C	UL	.	.	NONE	.	3.11040-
	773	A7KOK1C	UL	.	.	NONE	.	5.16159-
A	774	A1DWNC	EQ	.	.	.	.	.
A	775	A2DWNC	EQ	.	.	.	.	.
	776	A3DWNC	EQ	.	.	.	.	15.55189-
	777	A4DWNC	EQ	.	.	.	.	15.55189-
	778	A5DWNC	EQ	.	.	.	.	15.55189-
	779	A6DWNC	EQ	.	.	.	.	15.55189-
	780	A7DWNC	EQ	.	.	.	.	6.45189-
	781	A1SPDC	BS	15966.06668-	15966.06668	NONE	.	.
	782	A2SPDC	BS	9407.21962-	9407.21962	NONE	.	.
	783	A3SPDC	UL	.	.	NONE	.	15.55189-
	784	A4SPDC	UL	.	.	NONE	.	15.55189-
	785	A5SPDC	UL	.	.	NONE	.	15.55189-
	786	A6SPDC	UL	.	.	NONE	.	15.55189-
	787	A7SPDC	UL	.	.	NONE	.	6.45189-
A	788	A1BALC	EQ	.	.	.	.	.
A	789	A2BALC	EQ	.	.	.	.	.
	790	A3BALC	EQ	.	.	.	.	15.55189
	791	A4BALC	EQ	.	.	.	.	15.55189
	792	A5BALC	EQ	.	.	.	.	15.55189
	793	A6BALC	EQ	.	.	.	.	15.55189
	794	A7BALC	EQ	.	.	.	.	15.55189
	795	A1SPUC	BS	17952.33083-	17952.33083	NONE	.	.
	796	A2SPUC	BS	13419.54685-	13419.54685	NONE	.	.
	797	A3SPUC	BS	4243.25072-	4243.25072	NONE	.	.
	798	A4SPUC	BS	4325.15891-	4325.15891	NONE	.	.
	799	A5SPUC	BS	1694.96143-	1694.96143	NONE	.	.
	800	A6SPUC	BS	124.55592-	124.55592	NONE	.	.
	801	A7SPUC	UL	.	.	NONE	.	9.10000-
A	802	A1REMC	EQ	.	.	.	.	.
A	803	A2REMC	EQ	.	.	.	.	.
A	804	A3REMC	EQ	.	.	.	.	.
A	805	A4REMC	EQ	.	.	.	.	.
A	806	A5REMC	EQ	.	.	.	.	.
A	807	A6REMC	EQ	.	.	.	.	.
A	808	A7REMC	EQ	.	.	.	.	.
A	809	AOACRDC	EQ	.	.	.	.	.
A	810	A1RETC	EQ	.	.	.	.	.
A	811	A2RETC	EQ	.	.	.	.	.
A	812	A3RETC	EQ	.	.	.	.	.
A	813	A4RETC	EQ	.	.	.	.	.
A	814	A5RETC	EQ	.	.	.	.	.

	NUMBER	...ROW..	AT	...ACTIVITY...	SLACK ACTIVITY	..LOWER LIMIT.	..UPPER LIMIT.	.DUAL ACTIVITY
A	815	A6RETC	EQ	.	.	.	.	.
A	816	A7RETC	EQ	.	.	.	.	.
A	817	A1WASA	EQ	.	.	.	.	.
A	818	A2WASA	EQ	.	.	.	.	.
	819	A3WASA	EQ	.	.	.	.	13.99810
	820	A4WASA	EQ	.	.	.	.	13.99810
	821	A5WASA	EQ	.	.	.	.	13.99810
	822	A6WASA	EQ	.	.	.	.	13.99810
	823	A7WASA	EQ	.	.	.	.	13.99810
A	824	A1WASB	EQ	.	.	.	.	.
A	825	A2WASB	EQ	.	.	.	.	.
	826	A3WASB	EQ	.	.	.	.	13.99810
	827	A4WASB	EQ	.	.	.	.	13.99810
	828	A5WASB	EQ	.	.	.	.	13.99810
	829	A6WASB	EQ	.	.	.	.	13.99810
	830	A7WASB	EQ	.	.	.	.	5.80728

SECTION 2 - COLUMNS

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	831	01NETA	BS	110672.72832	.	.	NONE	.
	832	02NETA	BS	68335.93965	.	.	NONE	.
	833	03NETA	BS	8780.28988	.	.	NONE	.
	834	04NETA	BS	7303.91551	.	.	NONE	.
	835	05NETA	BS	8887.06931	.	.	NONE	.
	836	06NETA	BS	7958.14284	.	.	NONE	.
	837	07NETA	BS	35208.95712	.	.	NONE	.
	838	00ACRD	BS	2895.16500	.	.	NONE	.
	839	00ACR1A	UL	1911.00000	800.00000	.	1911.00000	800.00000
	840	01ACR1R	BS	687.41007	.	.	NONE	.
	841	02ACR1R	BS	1144.31138	.	.	NONE	.
	842	03ACR1R	BS	1144.31138	.	.	NONE	.
	843	04ACR1R	BS	1144.31138	.	.	NONE	.
	844	05ACR1R	BS	458.27338	.	.	NONE	.
A	845	00STO	EQ	168400.00000	.	168400.00000	168400.00000	.
	846	01STO	BS	340137.88639	.	.	589400.00000	.
	847	02STO	BS	439851.28328	.	.	589400.00000	.
	848	03STO	BS	442602.73654	.	.	589400.00000	.
	849	04STO	BS	426856.86377	.	.	589400.00000	.
	850	05STO	BS	419357.07950	.	.	589400.00000	.
	851	06STO	BS	425572.78720	.	.	589400.00000	.
	852	07STO	BS	529329.03557	.	168400.00000	589400.00000	.
A	853	01ROA	EQ	91910.00000	.	91910.00000	91910.00000	.
A	854	02ROA	EQ	71720.00000	.	71720.00000	71720.00000	.
A	855	03ROA	EQ	42500.00000	.	42500.00000	42500.00000	.
A	856	04ROA	EQ	23500.00000	.	23500.00000	23500.00000	.
A	857	05ROA	EQ	18010.00000	.	18010.00000	18010.00000	.
A	858	06ROA	EQ	19930.00000	.	19930.00000	19930.00000	.
A	859	07ROA	EQ	115650.00000	.	115650.00000	115650.00000	.
A	860	01REL	LL	.	.	.	NONE	.
	861	02REL	BS	192.65448	.	.	NONE	.
A	862	03REL	LL	.	.	.	NONE	.
A	863	04REL	LL	.	.	.	NONE	.
A	864	05REL	LL	.	.	.	NONE	.
A	865	06REL	LL	.	.	.	NONE	.
A	866	07REL	LL	.	.	.	NONE	.
A	867	01EVA	EQ	29900.00000	.	29900.00000	29900.00000	.
A	868	02EVA	EQ	38700.00000	.	38700.00000	38700.00000	.
A	869	03EVA	EQ	47000.00000	.	47000.00000	47000.00000	.
A	870	04EVA	EQ	45100.00000	.	45100.00000	45100.00000	.
A	871	05EVA	EQ	33800.00000	.	33800.00000	33800.00000	.
A	872	06EVA	EQ	21600.00000	.	21600.00000	21600.00000	.
A	873	07EVA	EQ	46100.00000	.	46100.00000	46100.00000	.
A	874	01DOM	EQ	5759.00000	.	5759.00000	5759.00000	.
A	875	02DOM	EQ	7109.00000	.	7109.00000	7109.00000	.
A	876	03DOM	EQ	8188.00000	.	8188.00000	8188.00000	.
A	877	04DOM	EQ	7108.00000	.	7108.00000	7108.00000	.
A	878	05DOM	EQ	4860.00000	.	4860.00000	4860.00000	.
A	879	06DOM	EQ	3330.00000	.	3330.00000	3330.00000	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
A	880	07DOM	EQ	17265.00000	.	17265.00000	17265.00000	.
	881	01RETA	BS	5501.56815	.	.	NONE	.
	882	02RETA	BS	6803.42310	.	.	NONE	.
	883	03RETA	BS	7803.47475	.	.	NONE	.
	884	04RETA	BS	6802.52310	.	.	NONE	.
	885	05RETA	BS	4721.41980	.	.	NONE	.
	886	06RETA	BS	3257.56485	.	.	NONE	.
	887	07RETA	BS	16262.29125	.	.	NONE	.
A	888	01REC	LL	.	.	.	336800.00000	.
	889	02REC	UL	336800.00000	.15500	.	336800.00000	.15500
	890	03REC	UL	336800.00000	.62600	.	336800.00000	.62600
	891	04REC	UL	336800.00000	.62600	.	336800.00000	.62600
	892	05REC	UL	336800.00000	.15500	.	336800.00000	.15500
A	893	06REC	LL	.	.	.	336800.00000	.
A	894	07REC	LL	.	.	.	336800.00000	.
	895	SOACRD	BS	2269.80000	.	.	NONE	.
	896	SOACR1A	UL	1746.00000	800.00000	.	1746.00000	800.00000
	897	S1ACR1R	BS	682.03125	.	.	NONE	.
	898	S2ACR1R	BS	1133.76623	.	.	NONE	.
	899	S3ACR1R	BS	1133.76623	.	.	NONE	.
	900	S4ACR1R	BS	1133.76623	.	.	NONE	.
	901	S5ACR1R	BS	453.50649	.	.	NONE	.
A	902	SOSTO	EQ	7065.00000	.	7065.00000	7065.00000	.
	903	S1STO	BS	.	.	.	16485.00000	.
	904	S2STO	BS	7610.16025	.	.	16485.00000	.
	905	S3STO	BS	8823.56401	.	.	16485.00000	.
	906	S4STO	BS	8024.83049	.	.	16485.00000	.
	907	S5STO	BS	7065.00000	.	.	16485.00000	.
	908	S6STO	BS	6857.48200	.	.	16485.00000	.
	909	S7STO	BS	13469.43200	.	7065.00000	16485.00000	.
	910	S1ROAW	BS	12996.00000	.	.	NONE	.
	911	S2ROAW	BS	10440.00000	.	.	NONE	.
	912	S3ROAW	BS	4464.00000	.	.	NONE	.
	913	S4ROAW	BS	2619.00000	.	.	NONE	.
	914	S5ROAW	BS	1080.00000	.	.	NONE	.
	915	S6ROAW	BS	774.00000	.	.	NONE	.
	916	S7ROAW	BS	8775.00000	.	.	NONE	.
A	917	S1ROA	EQ	14440.00000	.	14440.00000	14440.00000	.
A	918	S2ROA	EQ	11600.00000	.	11600.00000	11600.00000	.
A	919	S3ROA	EQ	4960.00000	.	4960.00000	4960.00000	.
A	920	S4ROA	EQ	2910.00000	.	2910.00000	2910.00000	.
A	921	S5ROA	EQ	1200.00000	.	1200.00000	1200.00000	.
A	922	S6ROA	EQ	860.00000	.	860.00000	860.00000	.
A	923	S7ROA	EQ	9750.00000	.	9750.00000	9750.00000	.
	924	S1REL	BS	17882.84675	.	.	NONE	.
A	925	S2REL	LL	.	.	.	NONE	.
A	926	S3REL	LL	.	.	.	NONE	.
	927	S4REL	BS	153.73929	.	.	NONE	.
A	928	S5REL	LL	.	.	.	NONE	.
A	929	S6REL	LL	.	.	.	NONE	.
A	930	S7REL	LL	.	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
A	931	S1EVA	EQ	1740.00000	.	1740.00000	1740.00000	.
A	932	S2EVA	EQ	2200.00000	.	2200.00000	2200.00000	.
A	933	S3EVA	EQ	2450.00000	.	2450.00000	2450.00000	.
A	934	S4EVA	EQ	2440.00000	.	2440.00000	2440.00000	.
A	935	S5EVA	EQ	1850.00000	.	1850.00000	1850.00000	.
A	936	S6EVA	EQ	1180.00000	.	1180.00000	1180.00000	.
A	937	S7EVA	EQ	2700.00000	.	2700.00000	2700.00000	.
A	938	S1DOM	EQ	58.00000	.	58.00000	58.00000	.
A	939	S2DOM	EQ	65.00000	.	65.00000	65.00000	.
A	940	S3DOM	EQ	73.00000	.	73.00000	73.00000	.
A	941	S4DOM	EQ	80.00000	.	80.00000	80.00000	.
A	942	S5DOM	EQ	87.00000	.	87.00000	87.00000	.
A	943	S6DOM	EQ	58.00000	.	58.00000	58.00000	.
A	944	S7DOM	EQ	305.00000	.	305.00000	305.00000	.
	945	S1RETA	BS	301.87800	.	.	NONE	.
	946	S2RETA	BS	376.27200	.	.	NONE	.
	947	S3RETA	BS	406.17000	.	.	NONE	.
	948	S4RETA	BS	389.77200	.	.	NONE	.
	949	S5RETA	BS	350.67600	.	.	NONE	.
	950	S6RETA	BS	256.48200	.	.	NONE	.
	951	S7RETA	BS	841.95000	.	.	NONE	.
A	952	S1REC	LL	.	.	.	7065.00000	.
	953	S2REC	UL	7065.00000	.75000	.	7065.00000	.75000
	954	S3REC	UL	7065.00000	3.00000	.	7065.00000	3.00000
	955	S4REC	UL	7065.00000	3.00000	.	7065.00000	3.00000
	956	S5REC	UL	7065.00000	.75000	.	7065.00000	.75000
A	957	S6REC	LL	.	.	.	7065.00000	.
A	958	S7REC	LL	.	.	.	7065.00000	.
	959	S1REM	BS	19326.84675	.	.	NONE	.
	960	S2REM	BS	1160.00000	.	.	NONE	.
	961	S3REM	BS	496.00000	.	.	NONE	.
	962	S4REM	BS	444.73929	.	.	NONE	.
	963	S5REM	BS	120.00000	.	.	NONE	.
	964	S6REM	BS	86.00000	.	.	NONE	.
	965	S7REM	BS	975.00000	.	.	NONE	.
	966	ROACR1A	UL	8512.00000	800.00000	.	8512.00000	800.00000
	967	R1ACR1R	BS	6213.13869	.	.	NONE	.
	968	R2ACR1R	BS	10255.42169	.	.	NONE	.
	969	R3ACR1R	BS	10255.42169	.	.	NONE	.
	970	R4ACR1R	BS	10255.42169	.	.	NONE	.
	971	R5ACR1R	BS	4092.30769	.	.	NONE	.
	972	ROACRD	BS	20684.16000	.	.	NONE	.
A	973	R1ROA	EQ	20590.00000	.	20590.00000	20590.00000	.
A	974	R2ROA	EQ	17170.00000	.	17170.00000	17170.00000	.
A	975	R3ROA	EQ	8440.00000	.	8440.00000	8440.00000	.
A	976	R4ROA	EQ	7720.00000	.	7720.00000	7720.00000	.
A	977	R5ROA	EQ	6880.00000	.	6880.00000	6880.00000	.
A	978	R6ROA	EQ	2200.00000	.	2200.00000	2200.00000	.
A	979	R7ROA	EQ	9240.00000	.	9240.00000	9240.00000	.
	980	R1REL	BS	33880.46566	.	.	NONE	.
	981	R2REL	BS	9222.86071	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	982	R3REL	BS	904.60231	.	.	NONE	.
A	983	R4REL	LL	.	.	.	NONE	.
	984	R5REL	BS	4688.99151	.	.	NONE	.
	985	R6REL	BS	3908.37440	.	.	NONE	.
	986	R7REL	BS	14358.94000	.	.	NONE	.
A	987	R1DOM	EQ	395.00000	.	395.00000	395.00000	.
A	988	R2DOM	EQ	305.00000	.	305.00000	305.00000	.
A	989	R3DOM	EQ	346.00000	.	346.00000	346.00000	.
A	990	R4DOM	EQ	331.00000	.	331.00000	331.00000	.
A	991	R5DOM	EQ	128.00000	.	128.00000	128.00000	.
A	992	R6DOM	EQ	192.00000	.	192.00000	192.00000	.
A	993	R7DOM	EQ	1031.00000	.	1031.00000	1031.00000	.
	994	R1RETA	BS	2630.75760	.	.	NONE	.
	995	R2RETA	BS	3170.28240	.	.	NONE	.
	996	R3RETA	BS	3414.02400	.	.	NONE	.
	997	R4RETA	BS	3193.68240	.	.	NONE	.
	998	R5RETA	BS	2597.29920	.	.	NONE	.
	999	R6RETA	BS	2034.37440	.	.	NONE	.
	1000	R7RETA	BS	6098.94000	.	.	NONE	.
	1001	R1ROAW	BS	18531.00000	.	.	NONE	.
	1002	R2ROAW	BS	15453.00000	.	.	NONE	.
	1003	R3ROAW	BS	7596.00000	.	.	NONE	.
	1004	R4ROAW	BS	6948.00000	.	.	NONE	.
	1005	R5ROAW	BS	6192.00000	.	.	NONE	.
	1006	R6ROAW	BS	1980.00000	.	.	NONE	.
	1007	R7ROAW	BS	8316.00000	.	.	NONE	.
	1008	R1REM	BS	35939.46566	.	.	NONE	.
	1009	R2REM	BS	10939.86071	.	.	NONE	.
	1010	R3REM	BS	1748.60231	.	.	NONE	.
	1011	R4REM	BS	772.00000	.	.	NONE	.
	1012	R5REM	BS	5376.99151	.	.	NONE	.
	1013	R6REM	BS	4128.37440	.	.	NONE	.
	1014	R7REM	BS	15282.94000	.	.	NONE	.
	1015	YOACRD	BS	3654.30000	.	.	NONE	.
	1016	YOACR1A	UL	2811.00000	800.00000	.	2811.00000	800.00000
	1017	Y1ACR1R	BS	2082.22222	.	.	NONE	.
	1018	Y2ACR1R	BS	3470.37037	.	.	NONE	.
	1019	Y3ACR1R	BS	3470.37037	.	.	NONE	.
	1020	Y4ACR1R	BS	3470.37037	.	.	NONE	.
	1021	Y5ACR1R	BS	1377.94118	.	.	NONE	.
A	1022	YOSTO	EQ	16980.00000	.	16980.00000	16980.00000	.
A	1023	Y1STO	UL	33960.00000	.	.	33960.00000	.
	1024	Y2STO	BS	23690.39143	.	.	33960.00000	.
	1025	Y3STO	BS	21049.56837	.	.	33960.00000	.
	1026	Y4STO	BS	16980.00000	.	.	33960.00000	.
	1027	Y5STO	BS	17268.26633	.	.	33960.00000	.
	1028	Y6STO	BS	15339.62773	.	.	33960.00000	.
A	1029	Y7STO	EQ	16980.00000	.	16980.00000	16980.00000	.
	1030	Y1ROAW	BS	11142.00000	.	.	NONE	.
	1031	Y2ROAW	BS	9153.00000	.	.	NONE	.
	1032	Y3ROAW	BS	7875.00000	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1033	Y4ROAW	BS	7137.00000	.	.	NONE	.
	1034	Y5ROAW	BS	4338.00000	.	.	NONE	.
	1035	Y6ROAW	BS	1179.00000	.	.	NONE	.
	1036	Y7ROAW	BS	14976.00000	.	.	NONE	.
A	1037	Y1ROA	EQ	12380.00000	.	12380.00000	12380.00000	.
A	1038	Y2ROA	EQ	10170.00000	.	10170.00000	10170.00000	.
A	1039	Y3ROA	EQ	8750.00000	.	8750.00000	8750.00000	.
A	1040	Y4ROA	EQ	7930.00000	.	7930.00000	7930.00000	.
A	1041	Y5ROA	EQ	4820.00000	.	4820.00000	4820.00000	.
A	1042	Y6ROA	EQ	1310.00000	.	1310.00000	1310.00000	.
A	1043	Y7ROA	EQ	16640.00000	.	16640.00000	16640.00000	.
	1044	Y1REL	BS	20082.21644	.	.	NONE	.
	1045	Y2REL	BS	18483.90092	.	.	NONE	.
A	1046	Y3REL	LL	.	.	.	NONE	.
A	1047	Y4REL	LL	.	.	.	NONE	.
A	1048	Y5REL	LL	.	.	.	NONE	.
A	1049	Y6REL	LL	.	.	.	NONE	.
	1050	Y7REL	BS	19945.24273	.	.	NONE	.
A	1051	Y1EVA	EQ	2330.00000	.	2330.00000	2330.00000	.
A	1052	Y2EVA	EQ	2910.00000	.	2910.00000	2910.00000	.
A	1053	Y3EVA	EQ	3330.00000	.	3330.00000	3330.00000	.
A	1054	Y4EVA	EQ	3010.00000	.	3010.00000	3010.00000	.
A	1055	Y5EVA	EQ	2480.00000	.	2480.00000	2480.00000	.
A	1056	Y6EVA	EQ	1560.00000	.	1560.00000	1560.00000	.
A	1057	Y7EVA	EQ	3560.00000	.	3560.00000	3560.00000	.
A	1058	Y1DOM	EQ	90.00000	.	90.00000	90.00000	.
A	1059	Y2DOM	EQ	98.00000	.	98.00000	98.00000	.
A	1060	Y3DOM	EQ	122.00000	.	122.00000	122.00000	.
A	1061	Y4DOM	EQ	98.00000	.	98.00000	98.00000	.
A	1062	Y5DOM	EQ	73.00000	.	73.00000	73.00000	.
A	1063	Y6DOM	EQ	49.00000	.	49.00000	49.00000	.
A	1064	Y7DOM	EQ	269.00000	.	269.00000	269.00000	.
A	1065	Y1USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1066	Y2USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1067	Y3USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1068	Y4USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1069	Y5USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1070	Y6USD	EQ	6000.00000	.	6000.00000	6000.00000	.
A	1071	Y7USD	EQ	6000.00000	.	6000.00000	6000.00000	.
	1072	Y1RETA	BS	482.97300	.	.	NONE	.
	1073	Y2RETA	BS	599.80200	.	.	NONE	.
	1074	Y3RETA	BS	657.94500	.	.	NONE	.
	1075	Y4RETA	BS	599.80200	.	.	NONE	.
	1076	Y5RETA	BS	504.21600	.	.	NONE	.
	1077	Y6RETA	BS	372.98700	.	.	NONE	.
	1078	Y7RETA	BS	1155.67500	.	.	NONE	.
A	1079	Y1REC	LL	.	.	.	16980.00000	.
	1080	Y2REC	UL	16980.00000	1.36000	.	16980.00000	1.36000
	1081	Y3REC	UL	16980.00000	5.44000	.	16980.00000	5.44000
	1082	Y4REC	UL	16980.00000	5.44000	.	16980.00000	5.44000
	1083	Y5REC	UL	16980.00000	1.36000	.	16980.00000	1.36000

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
A	1084	Y6REC	LL	.	.	.	16980.00000	.
A	1085	Y7REC	LL	.	.	.	16980.00000	.
	1086	Y1REM	BS	21320.21644	.	.	NONE	.
	1087	Y2REM	BS	19500.90092	.	.	NONE	.
	1088	Y3REM	BS	875.00000	.	.	NONE	.
	1089	Y4REM	BS	793.00000	.	.	NONE	.
	1090	Y5REM	BS	482.00000	.	.	NONE	.
	1091	Y6REM	BS	131.00000	.	.	NONE	.
	1092	Y7REM	BS	21609.24273	.	.	NONE	.
	1093	FOACR1A	BS	3009.98813	800.00000	.	4202.00000	.
	1094	F1ACR1R	BS	1194.43973	.	.	NONE	.
	1095	F2ACR1R	BS	1993.36962	.	.	NONE	.
	1096	F3ACR1R	BS	1993.36962	.	.	NONE	.
	1097	F4ACR1R	BS	1993.36962	.	.	NONE	.
	1098	F5ACR1R	BS	796.29316	.	.	NONE	.
	1099	FORTR1A	BS	.	10.00000	.	135.00000	.
A	1100	F1RTR1R	LL	.	.	.	NONE	.
A	1101	F2RTR1R	LL	.	.	.	NONE	.
A	1102	F3RTR1R	LL	.	.	.	NONE	.
A	1103	F4RTR1R	LL	.	.	.	NONE	.
A	1104	F5RTR1R	LL	.	.	.	NONE	.
A	1105	F6RTR1R	LL	.	.	.	NONE	.
	1106	F7RTR1R	BS	.	.	.	NONE	.
	1107	FORTR2A	BS	.	10.00000	.	52.00000	.
A	1108	F1RTR2R	LL	.	.	.	NONE	.
A	1109	F2RTR2R	LL	.	.	.	NONE	.
A	1110	F3RTR2R	LL	.	.	.	NONE	.
A	1111	F4RTR2R	LL	.	.	.	NONE	.
A	1112	F5RTR2R	LL	.	.	.	NONE	.
A	1113	F6RTR2R	LL	.	.	.	NONE	.
	1114	F7RTR2R	LL	.	.	.	NONE	3.90000-
	1115	FORTR3A	BS	.	10.00000	.	21.00000	.
A	1116	F1RTR3R	LL	.	.	.	NONE	.
A	1117	F2RTR3R	LL	.	.	.	NONE	.
	1118	F3RTR3R	BS	1643.32462	.	.	NONE	.
	1119	F4RTR3R	BS	1954.75576	.	.	NONE	.
	1120	F5RTR3R	BS	711.87912	.	.	NONE	.
	1121	F6RTR3R	BS	.	.	.	NONE	.
	1122	F7RTR3R	LL	.	.	.	NONE	4.40000-
	1123	FOSTR1A	BS	.	10.00000	.	125.00000	.
	1124	F1FIS1R	BS	.	.00010-	.	NONE	.
	1125	F2FIS1R	LL	.	.00010-	.	NONE	.00010-
	1126	F3FIS1R	LL	.	.00010-	.	NONE	503.44442-
	1127	F4FIS1R	LL	.	.00010-	.	NONE	503.44442-
	1128	F5FIS1R	BS	.	.00010-	.	NONE	.
	1129	F6FIS1R	BS	92.41404	.00010-	.	NONE	.
	1130	F7FIS1R	BS	1349.95680	.00010-	.	NONE	.
	1131	FOKOK1A	LL	.	10.00000	.	4000.00000	17.02063-
A	1132	F1DOM1R	EQ	69.00000	.	69.00000	69.00000	.
	1133	F1DWN1R	BS	1263.43973	.	.	NONE	.
A	1134	F2DOM1R	EQ	92.00000	.	92.00000	92.00000	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1135	F2DWN1R	BS	2085.36962	.	.	NONE	.
	1136	F3DOM1R	EQ	100.00000	.	100.00000	100.00000	503.44432-
	1137	F3DWN1R	BS	2093.36962	.	.	NONE	.
	1138	F4DOM1R	EQ	100.00000	.	100.00000	100.00000	503.44432-
	1139	F4DWN1R	BS	2093.36962	.	.	NONE	.
	1140	F5DOM1R	EQ	56.00000	.	56.00000	56.00000	503.44432-
	1141	F5DWN1R	BS	852.29316	.	.	NONE	.
A	1142	F6DOM1R	EQ	48.00000	.	48.00000	48.00000	.
	1143	F6DWN1R	BS	140.41404	.	.	NONE	.
A	1144	F7DOM1R	EQ	218.00000	.	218.00000	218.00000	.
	1145	F7DWN1R	BS	1567.95680	.	.	NONE	.
	1146	F1REL	BS	1500.12151	.	.	NONE	.
	1147	F1ROBW	BS	3232.22322	.	.	NONE	.
	1148	F2REL	BS	2324.03240	.	.	NONE	.
	1149	F2ROBW	BS	1521.15212	.	.	NONE	
	1150	F3REL	BS	1643.32462	.	.	NONE	.
	1151	F3ROBW	BS	450.04500	.	.	NONE	.
	1152	F4REL	BS	1954.75576	.	.	NONE	.
	1153	F4ROBW	BS	138.61386	.	.	NONE	.
	1154	F5REL	BS	711.87912	.	.	NONE	.
	1155	F5ROBW	BS	140.41404	.	.	NONE	.
	1156	F6REL	LL	.	.	.	NONE	503.44442-
	1157	F6ROBW	BS	140.41404	.	.	NONE	.
	1158	F7REL	LL	.	.	.	NONE	498.64442-
	1159	F7ROBW	BS	1567.95680	.	.	NONE	.
A	1160	FOSTO	EQ	3000.00000	.	3000.00000	3000.00000	.
	1161	F1ROAW	BS	4215.12151	.	.	NONE	.
A	1162	F1STO	UL	5715.00000	.	.	5715.00000	.
	1163	F2ROAW	BS	2324.03240	.	.	NONE	.
	1164	F2STO	UL	5715.00000	.	.	5715.00000	503.44432
	1165	F3ROAW	BS	351.93519	.	.	NONE	.
	1166	F3STO	BS	4423.61057	.	.	5715.00000	.
	1167	F4ROAW	BS	168.31683	.	.	NONE	.
	1168	F4STO	BS	2637.17164	.	.	5715.00000	.
	1169	F5ROAW	BS	154.81548	.	.	NONE	.
	1170	F5STO	BS	2080.10801	.	.	5715.00000	.
	1171	F6ROAW	BS	154.81548	.	.	NONE	.
	1172	F6STO	BS	2234.92349	.	.	5715.00000	.
	1173	F7ROAW	BS	765.07651	.	.	NONE	.
	1174	F7STO	EQ	3000.00000	.	3000.00000	3000.00000	503.44432-
	1175	FOACRD	BS	3973.18433	.	.	NONE	.
	1176	F1RETA	BS	499.15028	.	.	NONE	.
	1177	F2RETA	BS	629.84581	.	.	NONE	.
	1178	F3RETA	BS	675.97765	.	.	NONE	.
	1179	F4RETA	BS	636.24581	.	.	NONE	.
	1180	F5RETA	BS	527.18212	.	.	NONE	.
	1181	F6RETA	BS	400.78659	.	.	NONE	.
	1182	F7RETA	BS	1189.49608	.	.	NONE	.
	1183	F1REMA	BS	4295.98178	.	.	NONE	.
	1184	F2REMA	BS	2186.86278	.	.	NONE	.
	1185	F3REMA	BS	89.05500	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1186	F4REMA	BS	34.08614	.	.	NONE	.
	1187	F5REMA	BS	32.78596	.	.	NONE	.
	1188	F6REMA	BS	125.20000	.	.	NONE	.
	1189	F7REMA	BS	1609.00000	.	.	NONE	.
A	1190	F1ROA	EQ	4683.00000	.	4683.00000	4683.00000	.
A	1191	F2ROA	EQ	2582.00000	.	2582.00000	2582.00000	.
	1192	F3ROA	EQ	391.00000	.	391.00000	391.00000	453.14520
	1193	F4ROA	EQ	187.00000	.	187.00000	187.00000	453.14520
	1194	F5ROA	EQ	172.00000	.	172.00000	172.00000	453.14520
	1195	F6ROA	EQ	172.00000	.	172.00000	172.00000	453.14520
	1196	F7ROA	EQ	850.00000	.	850.00000	850.00000	453.14520
A	1197	F1ROB	EQ	3591.00000	.	3591.00000	3591.00000	.
A	1198	F2ROB	EQ	1690.00000	.	1690.00000	1690.00000	.
	1199	F3ROB	EQ	500.00000	.	500.00000	500.00000	453.14520
	1200	F4ROB	EQ	154.00000	.	154.00000	154.00000	453.14520
	1201	F5ROB	EQ	156.00000	.	156.00000	156.00000	453.14520
A	1202	F6ROB	EQ	156.00000	.	156.00000	156.00000	.
A	1203	F7ROB	EQ	1742.00000	.	1742.00000	1742.00000	.
	1204	G0ACR1A	BS	1665.11436	800.00000	.	2000.00000	.
	1205	G1ACR1R	BS	12828.46265	.	.	NONE	.
	1206	G2ACR1R	BS	1261.45027	.	.	NONE	.
	1207	G3ACR1R	BS	1261.45027	.	.	NONE	.
	1208	G4ACR1R	BS	1261.45027	.	.	NONE	.
	1209	G5ACR1R	BS	504.58011	.	.	NONE	.
	1210	G0RTR1A	UL	1156.00000	10.00000	.	1156.00000	8.03347
	1211	G1RTR1R	BS	137.94749	.	.	NONE	.
	1212	G2RTR1R	BS	137.94749	.	.	NONE	.
	1213	G3RTR1R	BS	137.94749	.	.	NONE	.
	1214	G4RTR1R	BS	137.94749	.	.	NONE	.
	1215	G5RTR1R	BS	137.94749	.	.	NONE	.
	1216	G6RTR1R	BS	68.80952	.	.	NONE	.
	1217	G7RTR1R	BS	483.68201	.	.	NONE	.
	1218	G0RTR2A	BS	93.51235	10.00000	.	445.00000	.
	1219	G1RTR2R	BS	58.08221	.	.	NONE	.
	1220	G2RTR2R	BS	58.08221	.	.	NONE	.
	1221	G3RTR2R	BS	58.08221	.	.	NONE	.
	1222	G4RTR2R	BS	58.08221	.	.	NONE	.
	1223	G5RTR2R	BS	58.08221	.	.	NONE	.
	1224	G6RTR2R	BS	29.04110	.	.	NONE	.
	1225	G7RTR2R	BS	198.96246	.	.	NONE	.
	1226	G0RTR3A	BS	.	10.00000	.	175.00000	.
	1227	G1RTR3R	BS	1403.33214	.	.	NONE	.
	1228	G2RTR3R	BS	.	.	.	NONE	.
	1229	G3RTR3R	BS	1703.85981	.	.	NONE	.
	1230	G4RTR3R	BS	1972.98672	.	.	NONE	.
	1231	G5RTR3R	BS	658.02295	.	.	NONE	.
	1232	G6RTR3R	BS	172.62192	.	.	NONE	.
	1233	G7RTR3R	LL	.	.	.	NONE	2.80000-
	1234	G0STR1A	BS	.	10.00000	.	125.00000	.
	1235	G1FIS1R	BS	.	.00010-	.	NONE	.
	1236	G2FIS1R	BS	6396.21670	.00010-	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1237	G3FIS1R	LL	.	.00010-	.	NONE	440.00014-
	1238	G4FIS1R	LL	.	.00010-	.	NONE	440.00014-
	1239	G5FIS1R	LL	.	.00010-	.	NONE	440.00014-
	1240	G6FIS1R	LL	.	.00010-	.	NONE	440.00014-
	1241	G7FIS1R	LL	.	.00010-	.	NONE	398.80038-
	1242	GOKOK1A	BS	.	10.00000	.	4000.00000	.
A	1243	G1DOM1R	EQ	779.00000	.	779.00000	779.00000	.
	1244	G1DWN1R	BS	13607.46265	.	.	NONE	.
A	1245	G2DOM1R	EQ	911.00000	.	911.00000	911.00000	.
	1246	G2DWN1R	BS	8568.66697	.	.	NONE	.
	1247	G3DOM1R	EQ	1246.00000	.	1246.00000	1246.00000	440.00004-
	1248	G3DWN1R	BS	2507.45027	.	.	NONE	.
	1249	G4DOM1R	EQ	1246.00000	.	1246.00000	1246.00000	440.00004-
	1250	G4DWN1R	BS	2507.45027	.	.	NONE	.
	1251	G5DOM1R	EQ	624.00000	.	624.00000	624.00000	440.00004-
	1252	G5DWN1R	BS	1128.58011	.	.	NONE	.
	1253	G6DOM1R	EQ	545.00000	.	545.00000	545.00000	440.00004-
	1254	G6DWN1R	BS	545.00000	.	.	NONE	.
	1255	G7DOM1R	EQ	2238.00000	.	2238.00000	2238.00000	435.30007-
	1256	G7DWN1R	BS	2238.00000	.	.	NONE	.
	1257	G1REL	BS	1599.36184	.	.	NONE	.
	1258	G1ROBW	BS	12008.10081	.	.	NONE	.
	1259	G2REL	BS	196.02970	.	.	NONE	.
	1260	G2ROBW	BS	8372.63726	.	.	NONE	.
	1261	G3REL	BS	1899.88951	.	.	NONE	.
	1262	G3ROBW	BS	607.56076	.	.	NONE	.
	1263	G4REL	BS	2169.01643	.	.	NONE	.
	1264	G4ROBW	BS	338.43384	.	.	NONE	.
	1265	G5REL	BS	854.05266	.	.	NONE	.
	1266	G5ROBW	BS	274.52745	.	.	NONE	.
	1267	G6REL	BS	270.47255	.	.	NONE	.
	1268	G6ROBW	BS	274.52745	.	.	NONE	.
	1269	G7REL	BS	682.64446	.	.	NONE	.
	1270	G7ROBW	BS	1555.35554	.	.	NONE	.
A	1271	GOSTO	EQ	5120.00000	.	5120.00000	5120.00000	.
	1272	G1ROAW	BS	4017.10171	.	.	NONE	.
	1273	G1STO	BS	7537.73987	.	.	10240.00000	.
	1274	G2ROAW	BS	2898.28983	.	.	NONE	.
	1275	G2STO	UL	10240.00000	.	.	10240.00000	440.00004
	1276	G3ROAW	BS	152.11521	.	.	NONE	.
	1277	G3STO	BS	8492.22570	.	.	10240.00000	.
	1278	G4ROAW	BS	102.61026	.	.	NONE	.
	1279	G4STO	BS	6425.81953	.	.	10240.00000	.
	1280	G5ROAW	BS	75.60756	.	.	NONE	.
	1281	G5STO	BS	5647.37444	.	.	10240.00000	.
	1282	G6ROAW	BS	75.60756	.	.	NONE	.
	1283	G6STO	BS	5452.50945	.	.	10240.00000	.
	1284	G7ROAW	BS	350.13501	.	.	NONE	.
	1285	G7STO	LL	5120.00000	.	5120.00000	NONE	440.00004-
	1286	GOACRD	BS	2522.64825	.	.	NONE	.
	1287	G1RETA	BS	978.59131	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1288	G2RETA	BS	1081.97076	.	.	NONE	.
	1289	G3RETA	BS	1375.19724	.	.	NONE	.
	1290	G4RETA	BS	1349.97076	.	.	NONE	.
	1291	G5RETA	BS	864.31779	.	.	NONE	.
	1292	G6RETA	BS	717.53834	.	.	NONE	.
	1293	G7RETA	BS	2644.86206	.	.	NONE	.
	1294	G1REMA	BS	1779.19919	.	.	NONE	.
	1295	G2REMA	BS	7647.57943	.	.	NONE	.
	1296	G3REMA	BS	84.33924	.	.	NONE	.
	1297	G4REMA	BS	48.96616	.	.	NONE	.
	1298	G5REMA	BS	38.87255	.	.	NONE	.
	1299	G6REMA	BS	38.87255	.	.	NONE	.
	1300	G7REMA	BS	211.54446	.	.	NONE	.
A	1301	G1ROA	EQ	4463.00000	.	4463.00000	4463.00000	.
A	1302	G2ROA	EQ	3220.00000	.	3220.00000	3220.00000	.
	1303	G3ROA	EQ	169.00000	.	169.00000	169.00000	396.03964
	1304	G4ROA	EQ	114.00000	.	114.00000	114.00000	396.03964
	1305	G5ROA	EQ	84.00000	.	84.00000	84.00000	396.03964
	1306	G6ROA	EQ	84.00000	.	84.00000	84.00000	396.03964
	1307	G7ROA	EQ	389.00000	.	389.00000	389.00000	396.03964
A	1308	G1ROB	EQ	13341.00000	.	13341.00000	13341.00000	.
A	1309	G2ROB	EQ	9302.00000	.	9302.00000	9302.00000	.
	1310	G3ROB	EQ	675.00000	.	675.00000	675.00000	396.03964
	1311	G4ROB	EQ	376.00000	.	376.00000	376.00000	396.03964
	1312	G5ROB	EQ	305.00000	.	305.00000	305.00000	396.03964
	1313	G6ROB	EQ	305.00000	.	305.00000	305.00000	396.03964
	1314	G7ROB	EQ	1728.00000	.	1728.00000	1728.00000	391.80924
	1315	E0ACR1A	UL	356.00000	800.00000	.	356.00000	800.00000
	1316	E1ACR1R	BS	161.81818	.	.	NONE	.
	1317	E2ACR1R	BS	269.69697	.	.	NONE	.
	1318	E3ACR1R	BS	269.69697	.	.	NONE	.
	1319	E4ACR1R	BS	269.69697	.	.	NONE	.
	1320	E5ACR1R	BS	107.87879	.	.	NONE	.
	1321	E0RTR1A	UL	478.00000	10.00000	.	478.00000	9.22588
	1322	E1RTR1R	BS	71.02526	.	.	NONE	.
	1323	E2RTR1R	BS	71.02526	.	.	NONE	.
	1324	E3RTR1R	BS	71.02526	.	.	NONE	.
	1325	E4RTR1R	BS	71.02526	.	.	NONE	.
	1326	E5RTR1R	BS	71.02526	.	.	NONE	.
	1327	E6RTR1R	BS	35.93985	.	.	NONE	.
	1328	E7RTR1R	BS	246.39175	.	.	NONE	.
	1329	E0RTR2A	UL	184.00000	10.00000	.	184.00000	5.96026
	1330	E1RTR2R	BS	142.63566	.	.	NONE	.
	1331	E2RTR2R	BS	142.63566	.	.	NONE	.
	1332	E3RTR2R	BS	142.63566	.	.	NONE	.
	1333	E4RTR2R	BS	142.63566	.	.	NONE	.
	1334	E5RTR2R	BS	142.63566	.	.	NONE	.
	1335	E6RTR2R	BS	69.96198	.	.	NONE	.
	1336	E7RTR2R	BS	497.29730	.	.	NONE	.
	1337	E0RTR3A	BS	66.65716	10.00000	.	74.00000	.
	1338	E1RTR3R	BS	128.18684	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1339	E2RTR3R	BS	128.18684	.	.	NONE	.
	1340	E3RTR3R	BS	128.18684	.	.	NONE	.
	1341	E4RTR3R	BS	128.18684	.	.	NONE	.
	1342	E5RTR3R	BS	128.18684	.	.	NONE	.
	1343	E6RTR3R	BS	63.48301	.	.	NONE	.
	1344	E7RTR3R	BS	444.38104	.	.	NONE	.
	1345	E0STR1A	UL	2460.00000	10.00000	.	2460.00000	9.99996
	1346	E1FIS1R	BS	300.00000	.00010-	.	NONE	.
	1347	E2FIS1R	BS	179.56204	.00010-	.	NONE	.
	1348	E3FIS1R	BS	179.56204	.00010-	.	NONE	.
	1349	E4FIS1R	BS	179.56204	.00010-	.	NONE	.
	1350	E5FIS1R	BS	179.56204	.00010-	.	NONE	.
	1351	E6FIS1R	BS	398.00770	.00010-	.	NONE	.
	1352	E7FIS1R	BS	3038.65515	.00010-	.	NONE	.
	1353	E0K0K1A	UL	27600.00000	10.00000	.	27600.00000	10.00000
A	1354	E1DOM1R	EQ	.	.	.	.	.
	1355	E1DWN1R	BS	461.81818	.	.	NONE	.
A	1356	E2DOM1R	EQ	.	.	.	.	.
	1357	E2DWN1R	BS	449.25901	.	.	NONE	.
A	1358	E3DOM1R	EQ	.	.	.	.	.
	1359	E3DWN1R	BS	449.25901	.	.	NONE	.
A	1360	E4DOM1R	EQ	.	.	.	.	.
	1361	E4DWN1R	BS	449.25901	.	.	NONE	.
A	1362	E5DOM1R	EQ	.	.	.	.	.
	1363	E5DWN1R	BS	287.44083	.	.	NONE	.
A	1364	E6DOM1R	EQ	.	.	.	.	.
	1365	E6DWN1R	BS	398.00770	.	.	NONE	.
A	1366	E7DOM1R	EQ	.	.	.	.	.
	1367	E7DWN1R	BS	3038.65515	.	.	NONE	.
	1368	E1REL	BS	352.37534	.	.	NONE	.
	1369	E1ROBW	BS	6035.10351	.	.	NONE	.
	1370	E2REL	BS	885.68857	.	.	NONE	.
	1371	E2ROBW	BS	3164.71647	.	.	NONE	.
	1372	E3REL	BS	341.84776	.	.	NONE	.
	1373	E3ROBW	BS	649.86499	.	.	NONE	.
	1374	E4REL	BS	341.84776	.	.	NONE	.
	1375	E4ROBW	BS	247.52475	.	.	NONE	.
	1376	E5REL	BS	341.84776	.	.	NONE	.
	1377	E5ROBW	BS	228.62286	.	.	NONE	.
	1378	E6REL	BS	169.38483	.	.	NONE	.
	1379	E6ROBW	BS	228.62286	.	.	NONE	.
	1380	E7REL	BS	1188.07009	.	.	NONE	.
	1381	E7ROBW	BS	1850.58506	.	.	NONE	.
A	1382	E0STO	EQ	755.00000	.	755.00000	755.00000	.
	1383	E1ROAW	BS	1753.37534	.	.	NONE	.
A	1384	E1STO	UL	2156.00000	.	.	2156.00000	.
	1385	E2ROAW	BS	885.68857	.	.	NONE	.
	1386	E2STO	UL	2156.00000	.	.	2156.00000	.74687
	1387	E3ROAW	BS	197.11971	.	.	NONE	.
	1388	E3STO	BS	2011.27195	.	.	2156.00000	.
	1389	E4ROAW	BS	72.00720	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1390	E4STO	BS	1741.43140	.	.	2156.00000	.
	1391	E5ROAW	BS	69.30693	.	.	NONE	.
	1392	E5STO	BS	1468.89057	.	.	2156.00000	.
	1393	E6ROAW	BS	69.30693	.	.	NONE	.
	1394	E6STO	BS	1368.81267	.	.	2156.00000	.
	1395	E7ROAW	BS	574.25743	.	.	NONE	.
	1396	E7STO	LL	755.00000	.	755.00000	NONE	.74687-
	1397	EOACRD	BS	539.34000	.	.	NONE	.
	1398	E1RETA	BS	59.32740	.	.	NONE	.
	1399	E2RETA	BS	75.50760	.	.	NONE	.
	1400	E3RETA	BS	80.90100	.	.	NONE	.
	1401	E4RETA	BS	75.50760	.	.	NONE	.
	1402	E5RETA	BS	64.72080	.	.	NONE	.
	1403	E6RETA	BS	48.54060	.	.	NONE	.
	1404	E7RETA	BS	134.83500	.	.	NONE	.
	1405	E1REMA	BS	7090.35716	.	.	NONE	.
	1406	E2REMA	BS	4230.39160	.	.	NONE	.
	1407	E3REMA	BS	816.05079	.	.	NONE	.
	1408	E4REMA	BS	355.15079	.	.	NONE	.
	1409	E5REMA	BS	495.66897	.	.	NONE	.
	1410	E6REMA	BS	431.08483	.	.	NONE	.
	1411	E7REMA	BS	3307.87009	.	.	NONE	.
A	1412	E1ROA	EQ	1948.00000	.	1948.00000	1948.00000	.
A	1413	E2ROA	EQ	984.00000	.	984.00000	984.00000	.
	1414	E3ROA	EQ	219.00000	.	219.00000	219.00000	.67225
	1415	E4ROA	EQ	80.00000	.	80.00000	80.00000	.67225
	1416	E5ROA	EQ	77.00000	.	77.00000	77.00000	.67225
	1417	E6ROA	EQ	77.00000	.	77.00000	77.00000	.67225
	1418	E7ROA	EQ	638.00000	.	638.00000	638.00000	.67225
A	1419	E1ROB	EQ	6705.00000	.	6705.00000	6705.00000	.
A	1420	E2ROB	EQ	3516.00000	.	3516.00000	3516.00000	.
A	1421	E3ROB	EQ	722.00000	.	722.00000	722.00000	.
A	1422	E4ROB	EQ	275.00000	.	275.00000	275.00000	.
A	1423	E5ROB	EQ	254.00000	.	254.00000	254.00000	.
A	1424	E6ROB	EQ	254.00000	.	254.00000	254.00000	.
A	1425	E7ROB	EQ	2056.00000	.	2056.00000	2056.00000	.
	1426	DOACR1A	UL	1167.00000	800.00000	.	1167.00000	796.54545
	1427	D1ACR1R	BS	530.45455	.	.	NONE	.
	1428	D2ACR1R	BS	884.09091	.	.	NONE	.
	1429	D3ACR1R	BS	884.09091	.	.	NONE	.
	1430	D4ACR1R	BS	884.09091	.	.	NONE	.
	1431	D5ACR1R	BS	353.63636	.	.	NONE	.
	1432	DORTR1A	UL	578.00000	10.00000	.	578.00000	9.20833
	1433	D1RTR1R	BS	69.13876	.	.	NONE	.
	1434	D2RTR1R	BS	69.13876	.	.	NONE	.
	1435	D3RTR1R	BS	69.13876	.	.	NONE	.
	1436	D4RTR1R	BS	69.13876	.	.	NONE	.
	1437	D5RTR1R	BS	69.13876	.	.	NONE	.
	1438	D6RTR1R	BS	34.61078	.	.	NONE	.
	1439	D7RTR1R	BS	240.83333	.	.	NONE	.
	1440	DORTR2A	UL	222.00000	10.00000	.	222.00000	5.86957

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1441	D1RTR2R	BS	137.03704	.	.	NONE	.
	1442	D2RTR2R	BS	137.03704	.	.	NONE	.
	1443	D3RTR2R	BS	137.03704	.	.	NONE	.
	1444	D4RTR2R	BS	137.03704	.	.	NONE	.
	1445	D5RTR2R	BS	137.03704	.	.	NONE	.
	1446	D6RTR2R	BS	68.94410	.	.	NONE	.
	1447	D7RTR2R	BS	482.60870	.	.	NONE	.
	1448	D0RTR3A	BS	69.70294	10.00000	.	89.00000	.
	1449	D1RTR3R	BS	107.23530	.	.	NONE	.
	1450	D2RTR3R	BS	107.23530	.	.	NONE	.
	1451	D3RTR3R	BS	551.37038	.	.	NONE	.
	1452	D4RTR3R	BS	837.59900	.	.	NONE	.
	1453	D5RTR3R	BS	337.53191	.	.	NONE	.
	1454	D6RTR3R	BS	80.51646	.	.	NONE	.
	1455	D7RTR3R	BS	366.85760	.	.	NONE	.
	1456	D0STR1A	UL	2760.00000	10.00000	.	2760.00000	9.69597
	1457	D1FIS1R	BS	277.10843	.00010-	.	NONE	.
	1458	D2FIS1R	BS	220.80000	.00010-	.	NONE	.
	1459	D3FIS1R	BS	220.80000	.00010-	.	NONE	.
	1460	D4FIS1R	BS	220.80000	.00010-	.	NONE	.
	1461	D5FIS1R	BS	299.48718	.00010-	.	NONE	.
	1462	D6FIS1R	BS	299.48718	.00010-	.	NONE	.
	1463	D7FIS1R	BS	1441.97531	.00010-	.	NONE	.
	1464	D0KOK1A	UL	35040.00000	10.00000	.	35040.00000	9.96752
A	1465	D1DOM1R	EQ	62.00000	.	62.00000	62.00000	.
	1466	D1DWN1R	BS	869.56298	.	.	NONE	.
A	1467	D2DOM1R	EQ	82.00000	.	82.00000	82.00000	.
	1468	D2DWN1R	BS	1186.89091	.	.	NONE	.
	1469	D3DOM1R	EQ	100.00000	.	100.00000	100.00000	1.90000-
	1470	D3DWN1R	BS	1204.89091	.	.	NONE	.
	1471	D4DOM1R	EQ	100.00000	.	100.00000	100.00000	1.90000-
	1472	D4DWN1R	BS	1204.89091	.	.	NONE	.
	1473	D5DOM1R	EQ	49.00000	.	49.00000	49.00000	1.90000-
	1474	D5DWN1R	BS	702.12354	.	.	NONE	.
	1475	D6DOM1R	EQ	43.00000	.	43.00000	43.00000	1.90000-
	1476	D6DWN1R	BS	342.48718	.	.	NONE	.
A	1477	D7DOM1R	EQ	185.00000	.	185.00000	185.00000	.
	1478	D7DWN1R	BS	1626.97531	.	.	NONE	.
	1479	D1REL	BS	313.41109	.	.	NONE	.
	1480	D1ROBW	BS	3900.99010	.	.	NONE	.
	1481	D2REL	BS	429.92554	.	.	NONE	.
	1482	D2ROBW	BS	1940.59406	.	.	NONE	.
	1483	D3REL	BS	757.54617	.	.	NONE	.
	1484	D3ROBW	BS	447.34473	.	.	NONE	.
	1485	D4REL	BS	1043.77480	.	.	NONE	.
	1486	D4ROBW	BS	161.11611	.	.	NONE	.
	1487	D5REL	BS	543.70770	.	.	NONE	.
	1488	D5ROBW	BS	158.41584	.	.	NONE	.
	1489	D6REL	BS	184.07134	.	.	NONE	.
	1490	D6ROBW	BS	158.41584	.	.	NONE	.
	1491	D7REL	BS	1090.29963	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1492	D7ROBW	BS	1306.93069	.	.	NONE	.
A	1493	DOSTO	EQ	1131.00000	.	1131.00000	1131.00000	.
	1494	D1ROAW	BS	2165.61656	.	.	NONE	.
	1495	D1STO	BS	2983.20547	.	.	3754.00000	.
	1496	D2ROAW	BS	1200.72007	.	.	NONE	.
	1497	D2STO	UL	3754.00000	.	.	3754.00000	1.90000
	1498	D3ROAW	BS	193.51935	.	.	NONE	.
	1499	D3STO	BS	3189.97318	.	.	3754.00000	.
	1500	D4ROAW	BS	85.50855	.	.	NONE	.
	1501	D4STO	BS	2231.70693	.	.	3754.00000	.
	1502	D5ROAW	BS	77.40774	.	.	NONE	.
	1503	D5STO	BS	1765.40697	.	.	3754.00000	.
	1504	D6ROAW	BS	77.40774	.	.	NONE	.
	1505	D6STO	BS	1658.74337	.	.	3754.00000	.
	1506	D7ROAW	BS	562.55626	.	.	NONE	.
	1507	D7STO	LL	1131.00000	.	1131.00000	NONE	1.90000-
	1508	DOACRD	BS	1768.00500	.	.	NONE	.
	1509	D1RETA	BS	250.28055	.	.	NONE	.
	1510	D2RETA	BS	313.12070	.	.	NONE	.
	1511	D3RETA	BS	345.20075	.	.	NONE	.
	1512	D4RETA	BS	327.52070	.	.	NONE	.
	1513	D5RETA	BS	256.26060	.	.	NONE	.
	1514	D6RETA	BS	197.82045	.	.	NONE	.
	1515	D7RETA	BS	608.50125	.	.	NONE	.
	1516	D1REMA	BS	4295.55655	.	.	NONE	.
	1517	D2REMA	BS	1753.23463	.	.	NONE	.
	1518	D3REMA	BS	291.95527	.	.	NONE	.
	1519	D4REMA	BS	248.18389	.	.	NONE	.
	1520	D5REMA	BS	325.67134	.	.	NONE	.
	1521	D6REMA	BS	325.67134	.	.	NONE	.
	1522	D7REMA	BS	2419.79963	.	.	NONE	.
A	1523	D1ROA	EQ	2406.00000	.	2406.00000	2406.00000	.
A	1524	D2ROA	EQ	1334.00000	.	1334.00000	1334.00000	.
	1525	D3ROA	EQ	215.00000	.	215.00000	215.00000	1.71017
	1526	D4ROA	EQ	95.00000	.	95.00000	95.00000	1.71017
	1527	D5ROA	EQ	86.00000	.	86.00000	86.00000	1.71017
	1528	D6ROA	EQ	86.00000	.	86.00000	86.00000	1.71017
	1529	D7ROA	EQ	625.00000	.	625.00000	625.00000	1.71017
A	1530	D1ROB	EQ	4334.00000	.	4334.00000	4334.00000	.
A	1531	D2ROB	EQ	2156.00000	.	2156.00000	2156.00000	.
	1532	D3ROB	EQ	497.00000	.	497.00000	497.00000	1.71017
	1533	D4ROB	EQ	179.00000	.	179.00000	179.00000	1.71017
	1534	D5ROB	EQ	176.00000	.	176.00000	176.00000	1.71017
	1535	D6ROB	EQ	176.00000	.	176.00000	176.00000	1.71017
A	1536	D7ROB	EQ	1452.00000	.	1452.00000	1452.00000	.
	1537	BOACR1A	EQ	8717.00000	800.00000	8717.00000	8717.00000	398.18208
	1538	B1ACR1R	BS	3962.27273	.	.	NONE	.
	1539	B2ACR1R	BS	6603.78788	.	.	NONE	.
	1540	B3ACR1R	BS	6603.78788	.	.	NONE	.
	1541	B4ACR1R	BS	6603.78788	.	.	NONE	.
	1542	B5ACR1R	BS	2641.51515	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1543	BORTR1A	UL	8958.00000	10.00000	.	8958.00000	8.08247
	1544	B1RTR1R	BS	526.94118	.	.	NONE	.
	1545	B2RTR1R	BS	526.94118	.	.	NONE	.
	1546	B3RTR1R	BS	526.94118	.	.	NONE	.
	1547	B4RTR1R	BS	526.94118	.	.	NONE	.
	1548	B5RTR1R	BS	526.94118	.	.	NONE	.
	1549	B6RTR1R	BS	263.47059	.	.	NONE	.
	1550	B7RTR1R	BS	1847.01031	.	.	NONE	.
	1551	BORTR2A	BS	16.38933	10.00000	.	3446.00000	.
	1552	B1RTR2R	BS	5.02740	.	.	NONE	.
	1553	B2RTR2R	BS	5.02740	.	.	NONE	.
	1554	B3RTR2R	BS	5.02740	.	.	NONE	.
	1555	B4RTR2R	BS	5.02740	.	.	NONE	.
	1556	B5RTR2R	BS	5.02740	.	.	NONE	.
	1557	B6RTR2R	BS	2.50985	.	.	NONE	.
	1558	B7RTR2R	BS	17.62293	.	.	NONE	.
	1559	BORTR3A	LL	.	10.00000	.	1378.00000	15.13513-
A	1560	B1RTR3R	LL	.	.	.	NONE	.
	1561	B2RTR3R	BS	.	.	.	NONE	.
	1562	B3RTR3R	BS	2899.09384	.	.	NONE	.
	1563	B4RTR3R	BS	4763.18025	.	.	NONE	.
	1564	B5RTR3R	BS	3219.28215	.	.	NONE	.
	1565	B6RTR3R	BS	823.75514	.	.	NONE	.
	1566	B7RTR3R	BS	.	.	.	NONE	.
	1567	BOSTR1A	BS	2675.35362	10.00000	.	79565.00000	.
	1568	B1FIS1R	BS	1798.78049	.00010-	.	NONE	.
	1569	B2FIS1R	BS	28266.13929	.00010-	.	NONE	.
	1570	B3FIS1R	BS	60.52836	.00010-	.	NONE	.
	1571	B4FIS1R	BS	60.52836	.00010-	.	NONE	.
	1572	B5FIS1R	BS	2402.28013	.00010-	.	NONE	.
	1573	B6FIS1R	BS	2402.28013	.00010-	.	NONE	.
	1574	B7FIS1R	BS	10845.58824	.00010-	.	NONE	.
	1575	BOKOK1A	UL	1475000.00000	10.00000	.	1475000.00000	7.72351
A	1576	B1DOM1R	EQ	190.00000	.	190.00000	190.00000	.
	1577	B1DWN1R	BS	5951.05322	.	.	NONE	.
A	1578	B2DOM1R	EQ	248.00000	.	248.00000	248.00000	.
	1579	B2DWN1R	BS	35117.92717	.	.	NONE	.
	1580	B3DOM1R	EQ	305.00000	.	305.00000	305.00000	220.99990-
	1581	B3DWN1R	BS	6969.31624	.	.	NONE	.
	1582	B4DOM1R	EQ	305.00000	.	305.00000	305.00000	220.99990-
	1583	B4DWN1R	BS	6969.31624	.	.	NONE	.
	1584	B5DOM1R	EQ	153.00000	.	153.00000	153.00000	220.99990-
	1585	B5DWN1R	BS	5196.79528	.	.	NONE	.
	1586	B6DOM1R	EQ	133.00000	.	133.00000	133.00000	220.99990-
	1587	B6DWN1R	BS	2535.28013	.	.	NONE	.
	1588	B7DOM1R	EQ	569.00000	.	569.00000	569.00000	211.69993-
	1589	B7DWN1R	BS	11414.58824	.	.	NONE	.
	1590	B1REL	BS	7078.50487	.	.	NONE	.
	1591	B1ROBW	BS	53333.03330	.	.	NONE	.
	1592	B2REL	BS	531.96858	.	.	NONE	.
	1593	B2ROBW	BS	34585.95860	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1594	B3REL	BS	3431.06242	.	.	NONE	.
	1595	B3ROBW	BS	3538.25383	.	.	NONE	.
	1596	B4REL	BS	5295.14882	.	.	NONE	.
	1597	B4ROBW	BS	1674.16742	.	.	NONE	.
	1598	B5REL	BS	3751.25073	.	.	NONE	.
	1599	B5ROBW	BS	1445.54455	.	.	NONE	.
	1600	B6REL	BS	1089.73558	.	.	NONE	.
	1601	B6ROBW	BS	1445.54455	.	.	NONE	.
	1602	B7REL	BS	1864.63324	.	.	NONE	.
	1603	B7ROBW	BS	9549.95500	.	.	NONE	.
A	1604	BOSTO	EQ	5857.00000	.	5857.00000	5857.00000	.
	1605	B1ROAW	BS	12090.90909	.	.	NONE	.
	1606	B1STO	BS	10869.40422	.	.	17981.00000	.
	1607	B2ROAW	BS	7643.56436	.	.	NONE	.
	1608	B2STO	UL	17981.00000	.	.	17981.00000	220.99990
	1609	B3ROAW	BS	645.36454	.	.	NONE	.
	1610	B3STO	BS	15195.30212	.	.	17981.00000	.
	1611	B4ROAW	BS	310.53105	.	.	NONE	.
	1612	B4STO	BS	10210.68435	.	.	17981.00000	.
	1613	B5ROAW	BS	279.02790	.	.	NONE	.
	1614	B5STO	BS	6738.46152	.	.	17981.00000	.
	1615	B6ROAW	BS	279.02790	.	.	NONE	.
	1616	B6STO	BS	5927.75385	.	.	17981.00000	.
	1617	B7ROAW	BS	1793.87939	.	.	NONE	.
	1618	B7STO	LL	5857.00000	.	5857.00000	NONE	220.99990-
	1619	BOACRD	BS	13206.25500	.	.	NONE	.
	1620	B1RETA	BS	1623.68805	.	.	NONE	.
	1621	B2RETA	BS	2047.27570	.	.	NONE	.
	1622	B3RETA	BS	2224.93825	.	.	NONE	.
	1623	B4RETA	BS	2092.87570	.	.	NONE	.
	1624	B5RETA	BS	1722.45060	.	.	NONE	.
	1625	B6RETA	BS	1308.26295	.	.	NONE	.
	1626	B7RETA	BS	3813.66375	.	.	NONE	.
	1627	B1REMA	BS	63522.53214	.	.	NONE	.
	1628	B2REMA	BS	32954.38070	.	.	NONE	.
	1629	B3REMA	BS	524.97454	.	.	NONE	.
	1630	B4REMA	BS	280.86095	.	.	NONE	.
	1631	B5REMA	BS	2593.73558	.	.	NONE	.
	1632	B6REMA	BS	2593.73558	.	.	NONE	.
	1633	B7REMA	BS	12104.93324	.	.	NONE	.
A	1634	B1ROA	EQ	13433.00000	.	13433.00000	13433.00000	.
A	1635	B2ROA	EQ	8492.00000	.	8492.00000	8492.00000	.
	1636	B3ROA	EQ	717.00000	.	717.00000	717.00000	198.91980
	1637	B4ROA	EQ	345.00000	.	345.00000	345.00000	198.91980
	1638	B5ROA	EQ	310.00000	.	310.00000	310.00000	198.91980
	1639	B6ROA	EQ	310.00000	.	310.00000	310.00000	198.91980
	1640	B7ROA	EQ	1993.00000	.	1993.00000	1993.00000	198.91980
A	1641	B1ROB	EQ	59253.00000	.	59253.00000	59253.00000	.
A	1642	B2ROB	EQ	38425.00000	.	38425.00000	38425.00000	.
	1643	B3ROB	EQ	3931.00000	.	3931.00000	3931.00000	198.91980
	1644	B4ROB	EQ	1860.00000	.	1860.00000	1860.00000	198.91980

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1645	B5ROB	EQ	1606.00000	.	1606.00000	1606.00000	198.91980
	1646	B6ROB	EQ	1606.00000	.	1606.00000	1606.00000	198.91980
	1647	B7ROB	EQ	10610.00000	.	10610.00000	10610.00000	190.54899
	1648	AOACR1A	UL	6150.00000	800.00000	.	6150.00000	771.72384
	1649	A1ACR1R	BS	2795.45455	.	.	NONE	.
	1650	A2ACR1R	BS	4659.09091	.	.	NONE	.
	1651	A3ACR1R	BS	4659.09091	.	.	NONE	.
	1652	A4ACR1R	BS	4659.09091	.	.	NONE	.
	1653	A5ACR1R	BS	1863.63636	.	.	NONE	.
	1654	AORTR1A	UL	3986.00000	10.00000	.	3986.00000	8.16901
	1655	A1RTR1R	BS	249.90596	.	.	NONE	.
	1656	A2RTR1R	BS	249.90596	.	.	NONE	.
	1657	A3RTR1R	BS	249.90596	.	.	NONE	.
	1658	A4RTR1R	BS	249.90596	.	.	NONE	.
	1659	A5RTR1R	BS	249.90596	.	.	NONE	.
	1660	A6RTR1R	BS	124.99216	.	.	NONE	.
	1661	A7RTR1R	BS	802.01207	.	.	NONE	.
	1662	AORTR2A	BS	277.19297	10.00000	.	1594.00000	.
	1663	A1RTR2R	BS	86.62280	.	.	NONE	.
	1664	A2RTR2R	BS	86.62280	.	.	NONE	.
	1665	A3RTR2R	BS	86.62280	.	.	NONE	.
	1666	A4RTR2R	BS	86.62280	.	.	NONE	.
	1667	A5RTR2R	BS	86.62280	.	.	NONE	.
	1668	A6RTR2R	BS	43.31140	.	.	NONE	.
	1669	A7RTR2R	BS	304.60766	.	.	NONE	.
	1670	AORTR3A	BS	.	10.00000	.	552.00000	.
A	1671	A1RTR3R	LL	.	.	.	NONE	.
A	1672	A2RTR3R	LL	.	.	.	NONE	.
A	1673	A3RTR3R	LL	.	.	.	NONE	.
A	1674	A4RTR3R	LL	.	.	.	NONE	.
A	1675	A5RTR3R	LL	.	.	.	NONE	.
A	1676	A6RTR3R	LL	.	.	.	NONE	.
	1677	A7RTR3R	LL	.	.	.	NONE	5.90000-
	1678	AOSTR1A	LL	.	10.00000	.	1000.00000	23.08955-
	1679	A1FIS1R	BS	193.50848	.00010-	.	NONE	.
	1680	A2FIS1R	BS	.	.00010-	.	NONE	.
	1681	A3FIS1R	BS	.	.00010-	.	NONE	.
	1682	A4FIS1R	LL	.	.00010-	.	NONE	15.55199-
	1683	A5FIS1R	BS	161.25707	.00010-	.	NONE	.
	1684	A6FIS1R	BS	290.26272	.00010-	.	NONE	.
	1685	A7FIS1R	BS	1161.05087	.00010-	.	NONE	.
	1686	AOKOK1A	BS	1451.31359	10.00000	.	2000.00000	.
A	1687	A1DOM1R	EQ	35.00000	.	35.00000	35.00000	.
	1688	A1DWN1R	BS	3023.96302	.	.	NONE	.
A	1689	A2DOM1R	EQ	39.00000	.	39.00000	39.00000	.
	1690	A2DWN1R	BS	4698.09091	.	.	NONE	.
	1691	A3DOM1R	EQ	35.00000	.	35.00000	35.00000	15.55189-
	1692	A3DWN1R	BS	4694.09091	.	.	NONE	.
	1693	A4DOM1R	EQ	35.00000	.	35.00000	35.00000	15.55189-
	1694	A4DWN1R	BS	4694.09091	.	.	NONE	.
	1695	A5DOM1R	EQ	39.00000	.	39.00000	39.00000	15.55189-

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1696	A5DWN1R	BS	2063.89343	.	.	NONE	.
	1697	A6DOM1R	EQ	35.00000	.	35.00000	35.00000	15.55189-
	1698	A6DWN1R	BS	325.26272	.	.	NONE	.
	1699	A7DOM1R	EQ	257.00000	.	257.00000	257.00000	6.45189-
	1700	A7DWN1R	BS	1418.05087	.	.	NONE	.
	1701	A1REL	BS	18288.85959	.	.	NONE	.
	1702	A1ROBW	BS	701.17012	.	.	NONE	.
	1703	A2REL	BS	13756.07561	.	.	NONE	.
	1704	A2ROBW	BS	349.23492	.	.	NONE	.
	1705	A3REL	BS	4579.77948	.	.	NONE	.
	1706	A3ROBW	BS	114.31143	.	.	NONE	.
	1707	A4REL	BS	4661.68767	.	.	NONE	.
	1708	A4ROBW	BS	32.40324	.	.	NONE	.
	1709	A5REL	BS	2031.49019	.	.	NONE	.
	1710	A5ROBW	BS	32.40324	.	.	NONE	.
	1711	A6REL	BS	292.85948	.	.	NONE	.
	1712	A6ROBW	BS	32.40324	.	.	NONE	.
	1713	A7REL	BS	1106.61973	.	.	NONE	.
	1714	A7ROBW	BS	311.43114	.	.	NONE	.
A	1715	A0STO	EQ	5000.00000	.	5000.00000	5000.00000	.
	1716	A1ROAW	BS	22595.85959	.	.	NONE	.
A	1717	A1STO	UL	9307.00000	.	.	9307.00000	.
	1718	A2ROAW	BS	13756.07561	.	.	NONE	.
	1719	A2STO	UL	9307.00000	.	.	9307.00000	15.55189
	1720	A3ROAW	BS	1648.06481	.	.	NONE	.
	1721	A3STO	BS	6375.28533	.	.	9307.00000	.
	1722	A4ROAW	BS	799.27993	.	.	NONE	.
	1723	A4STO	BS	2512.87759	.	.	9307.00000	.
	1724	A5ROAW	BS	679.56796	.	.	NONE	.
	1725	A5STO	BS	1160.95536	.	.	9307.00000	.
	1726	A6ROAW	BS	679.56796	.	.	NONE	.
	1727	A6STO	BS	1547.66383	.	.	9307.00000	.
	1728	A7ROAW	BS	4558.95590	.	.	NONE	.
	1729	A7STO	LL	5000.00000	.	5000.00000	NONE	15.55189-
	1730	A0ACRD	BS	9317.25000	.	.	NONE	.
	1731	A1RETA	BS	1056.39750	.	.	NONE	.
	1732	A2RETA	BS	1335.61500	.	.	NONE	.
	1733	A3RETA	BS	1425.58750	.	.	NONE	.
	1734	A4RETA	BS	1332.41500	.	.	NONE	.
	1735	A5RETA	BS	1153.17000	.	.	NONE	.
	1736	A6RETA	BS	870.05250	.	.	NONE	.
	1737	A7RETA	BS	2560.61250	.	.	NONE	.
	1738	A1REMA	BS	18747.80504	.	.	NONE	.
	1739	A2REMA	BS	10974.28470	.	.	NONE	.
	1740	A3REMA	BS	195.78857	.	.	NONE	.
	1741	A4REMA	BS	92.39676	.	.	NONE	.
	1742	A5REMA	BS	240.35383	.	.	NONE	.
	1743	A6REMA	BS	369.35948	.	.	NONE	.
	1744	A7REMA	BS	1702.11973	.	.	NONE	.
A	1745	A1ROA	EQ	25104.00000	.	25104.00000	25104.00000	.
A	1746	A2ROA	EQ	15283.00000	.	15283.00000	15283.00000	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	...INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1747	A3ROA	EQ	1831.00000	.	1831.00000	1831.00000	13.99810
	1748	A4ROA	EQ	888.00000	.	888.00000	888.00000	13.99810
	1749	A5ROA	EQ	755.00000	.	755.00000	755.00000	13.99810
	1750	A6ROA	EQ	755.00000	.	755.00000	755.00000	13.99810
	1751	A7ROA	EQ	5065.00000	.	5065.00000	5065.00000	13.99810
A	1752	A1ROB	EQ	779.00000	.	779.00000	779.00000	.
A	1753	A2ROB	EQ	388.00000	.	388.00000	388.00000	.
	1754	A3ROB	EQ	127.00000	.	127.00000	127.00000	13.99810
	1755	A4ROB	EQ	36.00000	.	36.00000	36.00000	13.99810
	1756	A5ROB	EQ	36.00000	.	36.00000	36.00000	13.99810
	1757	A6ROB	EQ	36.00000	.	36.00000	36.00000	13.99810
	1758	A7ROB	EQ	346.00000	.	346.00000	346.00000	5.80728
	1759	COACR1A	UL	459.00000	800.00000	.	459.00000	800.00008
	1760	C1ACR1R	BS	208.63636	.	.	NONE	.
	1761	C2ACR1R	BS	347.72727	.	.	NONE	.
	1762	C3ACR1R	BS	347.72727	.	.	NONE	.
	1763	C4ACR1R	BS	347.72727	.	.	NONE	.
	1764	C5ACR1R	BS	139.09091	.	.	NONE	.
	1765	CORTR1A	UL	610.00000	10.00000	.	610.00000	9.99999
	1766	C1RTR1R	BS	72.96651	.	.	NONE	.
	1767	C2RTR1R	BS	72.96651	.	.	NONE	.
	1768	C3RTR1R	BS	72.96651	.	.	NONE	.
	1769	C4RTR1R	BS	72.96651	.	.	NONE	.
	1770	C5RTR1R	BS	72.96651	.	.	NONE	.
	1771	C6RTR1R	BS	36.52695	.	.	NONE	.
	1772	C7RTR1R	BS	254.16667	.	.	NONE	.
	1773	CORTR2A	UL	235.00000	10.00000	.	235.00000	9.99994
	1774	C1RTR2R	BS	145.06173	.	.	NONE	.
	1775	C2RTR2R	BS	145.06173	.	.	NONE	.
	1776	C3RTR2R	BS	145.06173	.	.	NONE	.
	1777	C4RTR2R	BS	145.06173	.	.	NONE	.
	1778	C5RTR2R	BS	145.06173	.	.	NONE	.
	1779	C6RTR2R	BS	72.98137	.	.	NONE	.
	1780	C7RTR2R	BS	510.86957	.	.	NONE	.
	1781	CORTR3A	UL	94.00000	10.00000	.	94.00000	9.99985
	1782	C1RTR3R	BS	144.61538	.	.	NONE	.
	1783	C2RTR3R	BS	144.61538	.	.	NONE	.
	1784	C3RTR3R	BS	144.61538	.	.	NONE	.
	1785	C4RTR3R	BS	284.38041	.	.	NONE	.
	1786	C5RTR3R	BS	234.19566	.	.	NONE	.
	1787	C6RTR3R	BS	181.62468	.	.	NONE	.
	1788	C7RTR3R	BS	494.73684	.	.	NONE	.
	1789	COSTR1A	UL	2760.00000	10.00000	.	2760.00000	9.99998
	1790	C1FIS1R	BS	300.00000	.00010-	.	NONE	.
	1791	C2FIS1R	BS	2411.07656	.00010-	.	NONE	.
	1792	C3FIS1R	BS	150.00000	.00010-	.	NONE	.
	1793	C4FIS1R	BS	150.00000	.00010-	.	NONE	.
	1794	C5FIS1R	BS	270.25000	.00010-	.	NONE	.
	1795	C6FIS1R	BS	270.25000	.00010-	.	NONE	.
	1796	C7FIS1R	BS	900.83333	.00010-	.	NONE	.
	1797	COKOK1A	UL	21620.00000	10.00000	.	21620.00000	9.99999

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
A	1798	C1DOM1R	EQ	191.00000	.	191.00000	191.00000	.
	1799	C1DWN1R	BS	699.63636	.	.	NONE	.
A	1800	C2DOM1R	EQ	206.00000	.	206.00000	206.00000	.
	1801	C2DWN1R	BS	2964.80384	.	.	NONE	.
A	1802	C3DOM1R	EQ	191.00000	.	191.00000	191.00000	.
	1803	C3DWN1R	BS	688.72727	.	.	NONE	.
A	1804	C4DOM1R	EQ	191.00000	.	191.00000	191.00000	.
	1805	C4DWN1R	BS	688.72727	.	.	NONE	.
A	1806	C5DOM1R	EQ	213.00000	.	213.00000	213.00000	.
	1807	C5DWN1R	BS	622.34091	.	.	NONE	.
A	1808	C6DOM1R	EQ	191.00000	.	191.00000	191.00000	.
	1809	C6DWN1R	BS	461.25000	.	.	NONE	.
A	1810	C7DOM1R	EQ	1192.00000	.	1192.00000	1192.00000	.
	1811	C7DWN1R	BS	2092.83333	.	.	NONE	.
	1812	C1REL	BS	1081.50539	.	.	NONE	.
	1813	C1ROBW	BS	4772.27723	.	.	NONE	.
	1814	C2REL	BS	362.64362	.	.	NONE	.
	1815	C2ROBW	BS	2602.16022	.	.	NONE	.
	1816	C3REL	BS	362.64362	.	.	NONE	.
	1817	C3ROBW	BS	495.94959	.	.	NONE	.
	1818	C4REL	BS	502.40864	.	.	NONE	.
	1819	C4ROBW	BS	186.31863	.	.	NONE	.
	1820	C5REL	BS	452.22390	.	.	NONE	.
	1821	C5ROBW	BS	170.11701	.	.	NONE	.
	1822	C6REL	BS	291.13299	.	.	NONE	.
	1823	C6ROBW	BS	170.11701	.	.	NONE	.
	1824	C7REL	BS	1259.77307	.	.	NONE	.
	1825	C7ROBW	BS	1382.53825	.	.	NONE	.
A	1826	COSTO	EQ	4255.00000	.	4255.00000	4255.00000	.
	1827	C1ROAW	BS	2174.61746	.	.	NONE	.
	1828	C1STO	BS	5348.11207	.	.	9656.00000	.
	1829	C2ROAW	BS	1294.32943	.	.	NONE	.
	1830	C2STO	BS	6279.79788	.	.	9656.00000	.
	1831	C3ROAW	BS	164.71647	.	.	NONE	.
	1832	C3STO	BS	6081.87073	.	.	9656.00000	.
	1833	C4ROAW	BS	80.10801	.	.	NONE	.
	1834	C4STO	BS	5659.57010	.	.	9656.00000	.
	1835	C5ROAW	BS	68.40684	.	.	NONE	.
	1836	C5STO	BS	5275.75305	.	.	9656.00000	.
	1837	C6ROAW	BS	68.40684	.	.	NONE	.
	1838	C6STO	BS	5053.02690	.	.	9656.00000	.
	1839	C7ROAW	BS	461.74617	.	.	NONE	.
A	1840	C7STO	LL	4255.00000	.	4255.00000	NONE	.
	1841	COACRD	BS	695.38500	.	.	NONE	.
	1842	C1RETA	BS	248.39235	.	.	NONE	.
	1843	C2RETA	BS	262.15390	.	.	NONE	.
	1844	C3RETA	BS	257.10775	.	.	NONE	.
	1845	C4RETA	BS	250.15390	.	.	NONE	.
	1846	C5RETA	BS	275.14620	.	.	NONE	.
	1847	C6RETA	BS	234.48465	.	.	NONE	.
	1848	C7RETA	BS	1246.64625	.	.	NONE	.

	NUMBER	.COLUMN.	AT	...ACTIVITY...	..INPUT COST..	..LOWER LIMIT.	..UPPER LIMIT.	.REDUCED COST.
	1849	C1REMA	BS	6225.46903	.	.	NONE	.
	1850	C2REMA	BS	2843.71635	.	.	NONE	.
	1851	C3REMA	BS	393.21635	.	.	NONE	.
	1852	C4REMA	BS	179.58137	.	.	NONE	.
	1853	C5REMA	BS	296.73299	.	.	NONE	.
	1854	C6REMA	BS	296.73299	.	.	NONE	.
	1855	C7REMA	BS	1655.07307	.	.	NONE	.
A	1856	C1ROA	EQ	2416.00000	.	2416.00000	2416.00000	.
A	1857	C2ROA	EQ	1438.00000	.	1438.00000	1438.00000	.
A	1858	C3ROA	EQ	183.00000	.	183.00000	183.00000	.
A	1859	C4ROA	EQ	89.00000	.	89.00000	89.00000	.
A	1860	C5ROA	EQ	76.00000	.	76.00000	76.00000	.
A	1861	C6ROA	EQ	76.00000	.	76.00000	76.00000	.
A	1862	C7ROA	EQ	513.00000	.	513.00000	513.00000	.
A	1863	C1ROB	EQ	5302.00000	.	5302.00000	5302.00000	.
A	1864	C2ROB	EQ	2891.00000	.	2891.00000	2891.00000	.
A	1865	C3ROB	EQ	551.00000	.	551.00000	551.00000	.
A	1866	C4ROB	EQ	207.00000	.	207.00000	207.00000	.
A	1867	C5ROB	EQ	189.00000	.	189.00000	189.00000	.
A	1868	C6ROB	EQ	189.00000	.	189.00000	189.00000	.
A	1869	C7ROB	EQ	1536.00000	.	1536.00000	1536.00000	.

```
EXIT - TIME =   0.16
Execution phase succeeded.
   VSS CS: UNLOAD
Enter command:
Leaving the MPSX DRIVER.
Execution terminated   00:34:32  T=11.022  $10.18
T=11.146 DR=0  $10.25,  $14.53T


$sig
Logging on -LOG terminated.
```